FACULTY INTERACTION WITH HIGHER EDUCATION'S "OVERLOOKED MAJORITY": INVESTIGATING THE IMPACT OF NON-CLASSROOM INTERACTION ON COLLEGE OUTCOMES FOR COMMUTER STUDENTS

By

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CHAPTER I

INTRODUCTION

> Universities provide a myriad of resources to students in an effort to stimulate learning and discovery, and to enhance student satisfaction. One of the most obvious and important resources offered to students is faculty. Conventional wisdom suggests that faculty contribute to the college experience primarily via the classroom – through curriculum design, course content selection, course delivery method, and so forth. However, while the classroom may be a primary point of contact between faculty and students, the ability of faculty to contribute to the college experience of their students does not end when class is dismissed. Quite to the contrary, research has shown that interactions between students and faculty that take place outside of the classroom have a significant impact on students. (Cotten & Wilson, 2006, p. 487)

Background of Study

Within higher education, student engagement is recognized as "key to enhancing students' college success" (Kuh, Kinzie, Schuh, Whitt, & associates, 2010). High levels of learning, personal development, student satisfaction, and persistence are just some of the markers of student success attributed to their engagement. These markers accrue by virtue of the amount of time and effort students put into their studies and other activities that lead to student success, as well as by how the institution organizes learning opportunities and services to induce students

to participate in and benefit from such activities (Kuh et al, 2010). Student engagement is therefore the result of both student and institutional action.

On college and university campuses, out-of-class interaction between students and faculty members typifies both antecedents to student engagement. The interaction embodies both student effort and faculty commitment to student success. This dissertation investigated outcome-effects of this interaction for a specific subpopulation of students - first-year commuter students enrolled at four-year colleges and universities. Commuter students are those students who do not live in institutionally-owned or operated housing on-campus (Jacoby, 1989; Jacoby & Girrell, 1981). This is the definition adopted by the National Clearinghouse for Commuter Programs (NCCP) and the Council for the Advancement of Standards in Higher Education (CAS). These students therefore live either within walking distance or miles from the institution, and may commute to the institution by car, bus, train, bike, or by walking.

Commuter students account for over 80 percent of today's undergraduate and graduate students. The U.S. Census Bureau's 2009-2011 American Community Survey indicated that there were about 23.2 million college students pursuing undergraduate or graduate studies across the United States. Of this total, only about 12 percent lived in dormitories, correctional institutions, military quarters, and in other group quarters. The remaining 88 percent lived off-campus, with 63 percent living in family households with their parents or relatives, and 25 percent living in nonfamily households (Bishaw, 2013).

Unlike residential students, commuter students can be found at practically every institutional type in higher education; they "may represent a small percentage of students at a private, residential liberal arts college or the entire population of a community college or urban institution" (Jacoby, 2000, p. 5). In other words, commuter students may or may not attend

commuter institutions, this is, campuses with enrollments that consist primarily of non-residential students (Gianoutsos, 2011; Jacoby & Girrell, 1981).

Despite the fact that commuter students constitute the majority of students in higher education today, only a few studies examine the relationship between the college environment and the range of outcomes that could characterize success for these students. Empirical research on commuter students has mostly been confined to investigating potential associations between persistence and various constructs in Tinto's (1975) Theory of Student Departure. More recently however, Braxton, Doyle, Hartley, Hirschy, Jones, & McLendon (2014) proposed and empirically tested an alternative theory to Tinto's that accounts for student persistence in commuter colleges and universities. By presenting recommendations for institutional policy and practice to improve commuter student retention rates, the researchers make a contribution to the body of knowledge available to higher education administrators who are already challenged by their limited ability to apply traditional student engagement practices to this diverse group of students (Jacoby, 1989; National Clearinghouse for Commuter Programs, 2012; Rhatigan, 1986).

The diversity of commuter students encompasses differences in age, ethnicity, enrollment status, living arrangements, and non-academic obligations (such as family commitments, and employment). According to the NCCP (2012), commuter students include "full-time students between the ages of 18 and 22 years old living at home with parents, in an apartment (alone or with others), or in a house with other commuting students; older returning students; fully employed people pursuing a career-enhancing degree; graduate students; and retirees." Keeling (1999, p. 4) describes commuter students as "reinvented students," recognizing that being "a student is only one identity for people who are employees, wage workers, opinion leaders or followers, artists, friends, children…parents, partners, or spouses." For these students, therefore,

their social, emotional, and intellectual development may occur in different settings than the college or university, with the latter primarily providing a setting for intellectual development. Their "divided lifestyle" and "multiple identities" often imply little spare time as work and family obligations outside the college tend to reduce the amount of time these students have available to spend on campus outside of the classroom (Finkler & Leach, 1978; Harrington, 1972; Schuchman, 1974). According to Tinto (1997),

> …for students who commute to college, especially those who have multiple obligations outside the college, the classroom may be the only place where students and faculty meet, where education in the formal sense is experienced. (p. 599)

Relatively little is known about the interaction between faculty members and commuter students outside the classroom, and whether this interaction is associated with the various markers of student success. This is despite research findings that non-classroom interaction is associated with a range of student campus experiences and development outcomes. Pascarella (1980) and Pascarella & Terenzini (2005) summarize research that find positive correlations between non-classroom interaction and college outcomes such as learning and cognitive growth, academic achievement, persistence, social and personal competence, educational aspirations, satisfaction, and institutional commitment. Braxton, Eimers, & Bayer (1996, p. 607) recognize that faculty members who make themselves available to students, especially outside of scheduled class time, provide students with additional opportunities to develop academically and socially. These researchers state that interaction outside the classroom may afford students the opportunity to also develop their affective domain. Besides their cognitive development, interacting with

faculty may shape students' motivation, attitudes, perceptions and values. The development that accrues from interacting with faculty is consistent with Astin's (1985) finding that:

> …a large body of research suggests that the best way to involve students in learning and in college life is to maximize the amount of personal contact between faculty members and students. (p. 162)

Despite these findings that link non-classroom student-faculty interaction to both academic and non-academic benefits, such interaction involving commuter students remains a largely unexplored area of research. Baum (2005, p. 8) suggests that "until those attempting to enhance student success in higher education acknowledge the uniqueness of being a commuter," this group of students will remain "the overlooked majority."

Purpose of Study

The purpose of this study was twofold. First, it sought to investigate whether frequent and quality interaction between first-year commuter students and faculty outside the classroom were related to specific academic and non-academic outcomes – satisfaction with the college experience, grade-point average (GPA), and intellectual skills development – and whether these relationships varied by the Carnegie classification, selectivity, control, and enrollment size of institutions. With this intention, hierarchical linear modeling was applied to data drawn from a random sample of 9,000 first-year commuter students who completed the 2010 National Survey of Student Engagement (NSSE) survey at 465 four-year colleges and universities. NSSE data were used with permission from The Indiana University Center for Postsecondary Research.

Second, this study sought to address the problem of selection bias that may arise from the use of the potentially endogenous student-faculty interaction variable in empirical analysis. Endogeneity arises because students self-select or choose to interact with faculty. It is possible that those students who interact with faculty may differ from those who do not in unobservable ways, such as on their motivation levels. More motivated students are likely to seek out faculty members. Empirical analysis is affected because motivation may be correlated with both student-faculty interaction and student outcomes. In estimating outcome-effects, it becomes difficult to isolate the effect of student-faculty interaction from the effect of greater motivation on the part of those students who interact with faculty. This study addressed this problem by using the propensity score matching method which generated two *similar groups* of first-year commuter students – one group that interacted with faculty members outside the classroom, and another group that did not – prior to estimating their outcome-effects.

In this study, satisfaction with the college experience and grade-point average represented measures of the college experience, while intellectual skills development represented a developmental outcome. Grade-point average was considered a measure of the college experience because there is some debate over the reliability and validity of grades as an objective measure of learning. As Pascarella & Terenzini (2005, p. 66) summarize, grades may be influenced by factors extraneous to how much a person learns during college. Grades may be influenced by the type and selectivity of the institution the student attends, the type of course or coursework, situational constraints affecting the student such as stress and workload, the student's major, and a faculty member's cognitive style and his/her attitude towards teaching and learning. Given these factors, Pascarella & Terenzini do not consider grades as an outcome that represents how much is learned. Instead, they treat grades as an indicator of the extent to which a

student successfully complies with the academic norms or requirements of the institution, that is, as a dimension of the college experience.

Predicting the three outcomes - satisfaction with the college experience, grade-point average, and intellectual skills development – has implications for institutional practice. Identification of college experiences and outcomes correlated with student-faculty interaction will provide faculty members and college administrators with a deeper understanding of the role of the college environment in first-year commuter students' academic and social development.

Identification of these experiences and outcomes for first-year students provides administrators with information needed to engage students early in their college life. Timing is important for institutional action that would encourage student success. It was for this reason that this study focused specifically on first-year commuter students. Researchers (for example, Blanc, Debuhr, & Martin, 1983; Tinto, 1987) have found that approximately three-fourths of all dropouts leave at some time during the first year and that many of these individuals who drop out leave during the first six weeks of the fall term (Elkins, Braxton, & James, 2000). Tinto (1987) stated that the rate of student departures from the higher education system is highest during the first year of college (p. 21) and is particularly high during the first six weeks of the students' first semester (p. 49). Over the decade 2003-2013, the American College Test (ACT) found freshman-to-sophomore dropout rates have increased from: 31.8 percent to 35.1 percent in BA/BS-offering public institutions, 29.6 percent to 32.7 percent in BA/BS-offering private institutions, 30.2 percent to 31.1 percent in MA-offering public institutions, 25.7 percent to 30.5 percent in MA-offering private institutions, and 17.7 percent to 18.7 percent in PhD-offering private institutions. There was slight decline in the dropout rate in PhD-offering public institutions from 22.7 percent to 22.3 percent over the time period (ACT, 2014). The mostly

increasing trend in freshman-to-sophomore dropout rates suggests that first-year students represents a critical focal group from which an institution can acquire information on levers that contribute to positive college experiences and outcomes.

Research Questions

Two research questions drove this study:

1. Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?
2. Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?

Conceptual Framework

The conceptual guide for assessing these research questions was derived from Pascarella's (1980) conceptual model of the college impact on students. In this model, interaction with faculty members occurs within the institution's environment which is itself an integral component for student success.

Pascarella's (1980) conceptual model of the college impact on students

Pascarella (1980) sought to fit non-classroom student-faculty informal contact into a larger conceptual model of college impact on students. Drawing on the works of Astin (1970a, 1970b), Feldman (1971), Spady (1970), and Tinto (1975), his longitudinal model suggests that in

order to understand the influence of student-faculty non-classroom contact on educational outcomes and institutional persistence, it is necessary to take into account the background characteristics which students bring to college, the actual experiences of college in other areas, and salient institutional factors.

The model (see Figure 1.1) proposes that students' background characteristics (such as family characteristics/home environment, individual aptitudes, personality orientations, educational and career aspirations, and expectations of college, secondary school achievement and experiences) form a profile of individual differences which students bring to college. While these pre-enrollment characteristics have a direct influence on educational outcomes (e.g. academic performance, intellectual development, personal development, educational/career aspirations, and college satisfaction), they also influence: a) the extent and quality of students' contact with faculty outside of class, and b) students' experiences in the peer culture, the classroom and the extra-curriculum. Both of these factors - college experiences and student's informal contact with faculty - may both have reciprocal relationships with educational outcomes.

Pascarella (1980) also identified a reciprocal relationship between students' college experiences and student's informal contact with faculty. He stated that:

> A student's friendship groups, for example, may create a press within the group either supportive of or counter to faculty values, which significantly influences his or her subsequent behavior with respect to nonclassroom contact with faculty. On the other hand, the nature of a student's informal interactions with faculty may lead to the development of student friendships which are generally supportive of faculty values and perspectives. Similarly, students' nonclassroom interaction with faculty may have an

> influence on the types of extracurricular and leisure activities in which the student becomes involved. (p. 570)

The model also proposes that institutional factors (such as the kinds of students enrolled, faculty culture, institutional size, organizational substructure, administrative decisions, and policies bearing on curriculum, faculty reward structures, faculty advising and counseling programs, student orientation, and residence arrangements) influences informal contact with faculty, other college experiences, and educational outcomes (Pascarella, 1980).

Based on Pascarella's (1980) conceptual model of the college impact on students, this study posits that commuter students enter higher education institutions with a range of background characteristics such as age, race/ethnicity, and gender. These background characteristics influence college outcomes indirectly through their impact on students' frequent and quality interaction with faculty members outside the classroom.

The interplay between commuter students and faculty members occurs within the institutional environment where institutional characteristics (type, selectivity, control, and size) influence college outcomes indirectly by shaping the frequency and quality of student-faculty interaction. The other experiences that these students encounter within the college environment – having first-generation status, native or transfer status, full-time or part-time status, peer associations, an academic major, and the time required to prepare for classes – moderate the impact of student-faculty interaction on their college outcomes. The model therefore considers students' background characteristics, their experiences within the college environment, and institutional characteristics as conditioning factors in the relationship between non-classroom student-faculty interaction and outcomes for commuter students.

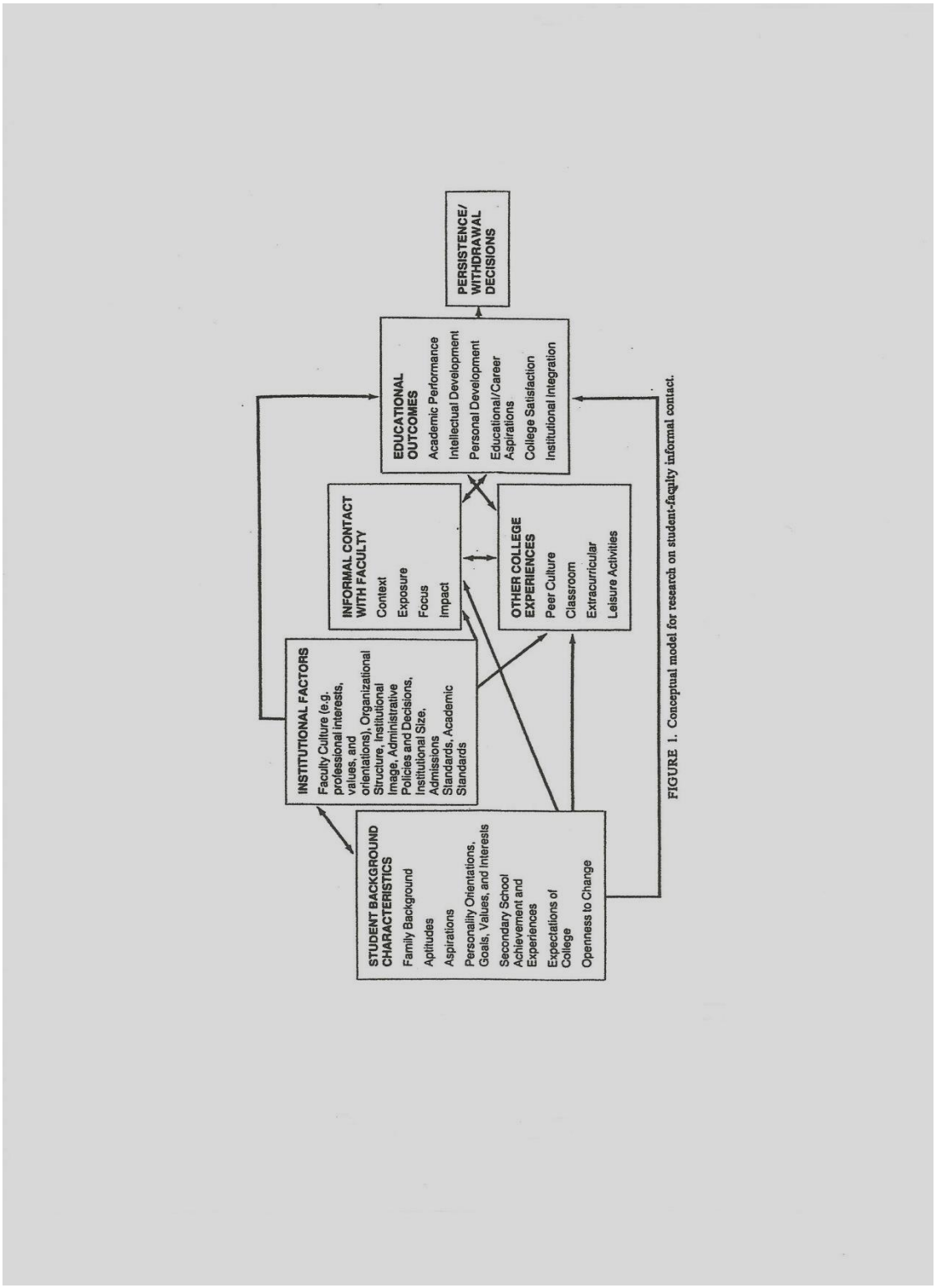


Figure 1.1. Pascarella's (1980) conceptual model of the college impact on students.

Significance and Contribution of Study

This study is significant because it both extends the body of knowledge on first-year commuter students and breaks new ground on the empirical investigation of this group of students.

First, this study extends the body of knowledge on first-year commuter students since, despite the significant number of studies that examine the impact of student-faculty interaction on student outcomes, there is a dearth of studies that explore this impact among commuter students. Commuter students are described within the extant literature as an "overlooked" and "neglected" majority (for example, Baum, 2005; Dugan et al., 2008; Jacoby, 1989; Slade & Jarmul, 1975). They constitute the majority of undergraduate students at 2- and 4-year institutions. Commuter students also constitute the majority of graduate students. During 2003-2004, commuter students accounted for 79.5 percent and 67.5 percent of students in 4-year non-doctorate-granting public institutions, and private not-for-profit institutions, respectively (Horn & Nevill, 2006). The U.S. Census Bureau's 2009-2011 American Community Survey estimated that 88 percent of all college students lived off-campus (Bishaw, 2013). However, despite their majority presence, commuter students represent a largely unexplored student population in studies that examine the role of student-faculty interaction on college outcomes.

Within the extant literature, studies examining non-classroom student-faculty interaction tend to find a positive association with measures of **learning and cognitive growth** (Anaya, 2001; Anaya & Cole, 2001; Astin, 1993; Cruce, Wolniak, Seifert, & Pascarella, 2006; Douzenis, 1996; Eimers, 2001; Endo & Harpel, 1982; Kim, 2002; Kim & Sax, 2011; Kuh & Hu, 2001; Lundberg, 2010; Lundberg & Schreiner, 2004; Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978; Sax, Bryant, & Harper, 2005; Terenzini, Springer, Pascarella, & Nora,

1995; Terenzini, Theophilides, & Lorang, 1984; Thompson, 2001; Volkwein & Carbone, 1994; and Volkwein, King, & Terenzini, 1986); **persistence** (Berger & Milem, 1999; Halpin, 1990; Johnson, 1997; Lundquist, Spalding, & Landrum, 2002/2003; Mallette & Cabrera, 1991; Nora, Cabrera, Hagedorn & Pascarella, 1996; and Pascarella & Terenzini, 1977; 1980); **social and personal competence** (Cokley, 2000; Endo & Harpel, 1982; Reason, Terenzini, & Domingo, 2007; and Pascarella & Terenzini, 1978); **educational aspirations** (Astin, 1993; Hearn, 1987; Iverson, Pascarella & Terenzini, 1984; and Sax, Bryant, & Harper, 2005); **satisfaction** (Astin, 1993; Cole, 2008; Endo & Harpel, 1982; Hearn, 1985; Kim & Sax, 2009; Kuh & Hu, 2001; Sax, Bryant, & Harper, 2005; Strayhorn, 2010; Volkwein & Carbone, 1994; Wilson, Gaff, Dienst, Wood, & Bavry, 1975); and **institutional commitment** (Strauss & Volkwein, 2004).

Of the studies listed above, only three analyzed data for commuter students at 4-year institutions. Terenzini, Springer, Pascarella, & Nora (1995) investigated students' interest in learning using data drawn from 210 freshman students enrolled for six or more academic credit hours in at a large, urban, Research 1 university in the Midwest that served an undergraduate population composed primarily of commuters. Iverson, Pascarella & Terenzini (1984) investigated educational aspirations using data on 213 students who had completed CIRP surveys at a large, urban, totally nonresidential, state-supported 4-year university, and Johnson (1997) investigated persistence using data on 171 undergraduate students from a four–year commuter university in the northeast.

Despite the significant number of studies that examine the impact of student-faculty interaction on college outcomes, there is therefore a dearth of studies that explore this impact among commuter students. Furthermore, while most of the studies identified above investigate effects on cognitive growth and satisfaction, these effects have not been investigated for

commuter students. This study extends the body of knowledge on first-year commuter students by simultaneously addressing these research gaps. In addition, by drawing on a data sample from multiple institutions that participated in the 2010 National Survey of Student Engagement (NSSE) survey, this study overcomes limits to generalizability that arise from the research work undertaken by Johnson (1997), Iverson, Pascarella & Terenzini (1984), and Terenzini, Springer, Pascarella, & Nora (1995). These three studies were all based on samples from single institutions; a feature that limits the generalizability of their conclusions since effects may be based on the particular features of the universities being studied. By using samples that are multi-institutional in scope, this study exploits a feature that enhances both the variability in the measurement of its theoretical constructs, and the generalizability of its findings on the impact of student-faculty interaction on outcomes for commuter students.

Second, this study breaks new ground in the ability to make stronger inferences when the endogenous student-faculty interaction variable is used in the estimation of college outcomes. More specifically, it breaks new ground by applying propensity score matching to deal with problems arising from the use of this endogenous variable. The use of student-faculty interaction to predict college outcomes raises an issue that affects the ability to determine a causal relationship, namely selection bias (or omitted variable bias). The key identifying assumption that I make in this study is that in the absence of student-faculty interaction, there are no difference in each of my three outcomes - satisfaction with the college experience, GPA, and intellectual skills development - between students who interact with faculty and those who do not. However, this assumption becomes problematic in the presence of selection bias or omitted variable bias which arises because participation in interaction with faculty is voluntary.

Students self-select or choose to interact with faculty. It is therefore possible that those who interact with faculty may differ systematically from those who do not. The two groups of students may differ in unobservable ways and these unobservable differences may ultimately influence my three student outcomes. As an example, students who interact with faculty and those who do not may differ on motivation. It is probable that the more motivated students will seek out faculty. It is also likely that more motivated students would be more satisfied with the college experience, and have higher GPA and intellectual skills development, even in the absence of interaction. Motivation therefore represents an omitted variable that is correlated with both student-faculty interaction and student outcomes. Given this, when comparing the differences in, say mean GPA, of students who do and those who do not interact with faculty, it will be difficult to isolate the impact of student-faculty interaction from the effect of greater motivation of the students who do interact. The estimator based on the difference in means between the two groups of students will be affected by the self-selection bias (Heinrich, Maffioli, & Vazquez, 2010).

To correctly estimate the effect of student-faculty interaction on the study's three outcomes of interest, the selection bias should equal zero. Propensity score matching is a non-experimental technique that adjusts for the bias that arises. Propensity score matching accounts and adjusts for differences between students who do and those who do not interact with faculty in order to estimate the impact of the interaction (Heinrich, Maffioli, & Vazquez, 2010). A review of peer-reviewed journals finds no evidence of the use of propensity score matching in any analysis of the impact of student-faculty interaction for commuter students. As an alternative to two-stage least-squares (2SLS), propensity score matching overcomes the difficulty of finding strong and valid instruments required for 2SLS, while also mitigating the endogeneity problem.

By applying propensity score matching to deal with this study's key independent variable of interest, the endogenous student-faculty interaction variable, this study contributes to the body of knowledge on the ability to make stronger inferences whenever student-faculty interaction is used in the estimation of college outcomes.

In the process of meeting its stated purposes, this study simultaneously extends the application of the National Survey of Student Engagement (NSSE) dataset to the study of faculty interaction on outcomes for commuter students. Little or no evidence was found among the body of peer-reviewed articles of the use of the NSSE dataset in a similar study. To date, studies on the interaction in general, utilize the large databases of the College Student Experiences Questionnaire (CSEQ), the Community College Student Experiences Questionnaire (CCSEQ), the Cooperative Institutional Research Program (CIRP), and the Higher Education Research Institute (HERI) at the University of California at Los Angeles (UCLA). Despite the fact that Student-Faculty Interaction is one of NSSE's five Benchmarks of Effective Educational Practice, data from NSSE are yet to be used in studies on commuter students' non-classroom interaction with faculty members.

CHAPTER II

LITERATURE REVIEW

This chapter provides a summary of what is currently known about commuter students and the interaction of students with faculty members outside the classroom. It highlights the nature and extent of research on student-faculty interaction among commuter students at 4-year institutions, and with regard to the student outcomes central to this study. In so doing, the review demonstrates how this study revises, extends, and breaks new ground regarding the body of knowledge on student-faculty interaction among commuter students.

Specifically, this literature review summarizes what is currently known about:

a) The profile of commuter students.
b) The nature of student-faculty interaction.
c) Research that examine student-faculty interaction among commuter students at 4-year institutions.
d) Research that examine the impact of student-faculty interaction on the three outcomes – satisfaction with the college experience, GPA, and intellectual skills development.
e) An additional issue that may arise in empirical analyses involving student-faculty interaction, namely simultaneity bias or reverse causality.

Profile of Commuter Students

Commuter students are those students who do not live in institutionally-owned or operated housing on-campus (Jacoby, 1989; Jacoby & Girrell, 1981). They account for over 80

percent of today's undergraduate and graduate students and constitute a diverse group. Their diversity encompasses differences in age, ethnicity, enrollment status, living arrangement, and non-academic obligations (Gianoutsos, 2011).

With regard to age, commuter students tend to occupy a broader age-range than residential students (Jacoby, 2000). According to the NCCP (2012), commuter students include "full-time students between the ages of 18 and 22 years old living at home with parents, in an apartment (alone or with others), or in a house with other commuting students; older returning students; fully employed people pursuing a career-enhancing degree; graduate students; and retirees." More descriptive were the examples given by Dr. Brian Keintz, Director of the Student Union at Florida Atlantic University, during a web conference entitled *Building Community with Off-Campus Students*. Dr Keintz stated that commuter students include 18 year-old first year students with or without part-time jobs who live with their parents 30 miles away from the campus; 22 year-old seniors who, after living in residence halls for three years, have moved with friends to an apartment complex within walking distance of campus; 35 year-old part-time students with children and full-time jobs who are taking evening or weekend classes after transferring from associate to baccalaureate institutions; 50 year old empty-nesters participating in special programs preparing displaced workers for new job opportunities; and even 80 year-old retirees taking classes for personal fulfillment, practical assistance, or the college degree they've always wanted but didn't have the time or money to pursue earlier in their lives (Alt & Palmer, 2011).

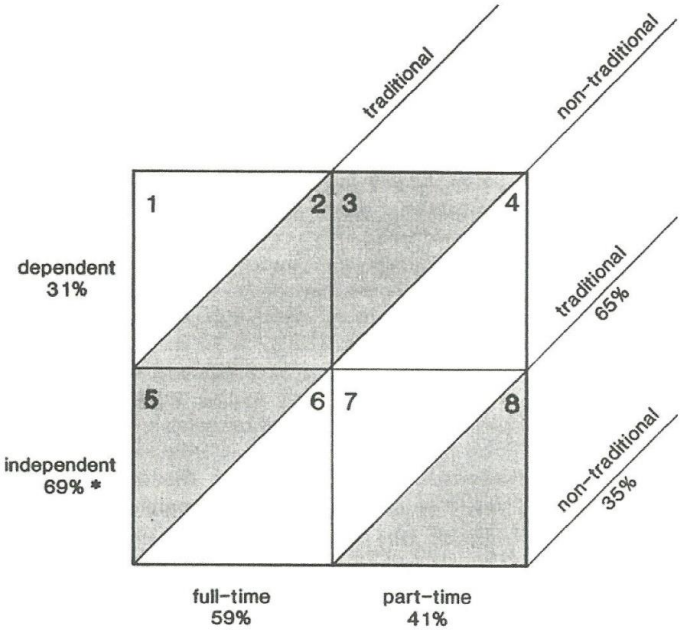
Kuh, Gonyea, & Palmer (2001) examined responses to the 2001 and 2002 NSSE surveys by more than 105,000 first-year and senior students at 470 different four-year colleges and universities. They found that compared to walking commuters, commuter students who drove to

campus were more likely to be female, African-American, Hispanic, part-time, first-generation, those who spend 6 or more hours per week caring for dependents, and who work more than 20 hours a week off campus. Current trends suggest that commuter students, like the U.S. student population, will "become more diverse as the numbers of part-time, adult, and minority students continue gaining access to higher education" (Jacoby, 2000, p. 5).

A useful taxonomy for distinguishing commuter students is provided by Stewart & Rue (1983) who recognize subgroups among these students. Not all subgroups are present on every campus. Stewart & Rue (1983) use three variables to distinguish undergraduate students: dependence/independence, traditional/nontraditional, and part-time/full-time. Dependent students live at home with parents or a close relative who assumes parental responsibilities. Independent students live on their own; they may share an apartment or house, have a place to themselves, or live in fraternity or sorority housing. Nontraditional students fall outside of the typical student-age group and tend to be 25 years or older. According to Stewart & Rue (1983), these students often have returned to school after a break in their education and may have a spouse or children. Part- and full-time students are identified by the number of credit hours taken.

The interactions between these three variables yield eight distinctly different types of undergraduate students (see Figure 2.1): (1) dependent, traditional, full-time; e.g. a new freshman who lives at home because of financial constraints, or because on-campus housing is limited; (2) dependent, nontraditional, full-time: e.g. a recently divorced woman with children who has returned to her parents' home while in school; (3) dependent, nontraditional, part-time:

Figure 1. Status of All Undergraduate Students in Higher Education by Three Variables



*Includes 21 percent in university-owned housing, 36 percent in own place of residence, and 12 percent in other off-campus arrangements.

Sources: Astin, 1980; Carnegie Council on Policy Studies in Higher Education, 1981; National Center for Education Statistics, 1981; U.S. Bureau of the Census, 1980.

4. A 19-year old who lives at home and works
5. An international student who attends school full-time supported by her government
6. An older student who has returned to school on a full-time basis after work
7. An adult student with a full-time job and family, who is taking one course a semester for personal development
8. A student living in her own apartment, who works to support herself and goes to school part-time.

Of course, individual students may switch from full-time to part-time and dependent to independent statuses at multiple points in their

Figure 2.1. Stewart & Rue's (1983) taxonomy for distinguishing commuter students. From Stewart & Rue (1983, p. 6).

e.g. a veteran who lives at home and works; (4) dependent, traditional, part-time: e.g. a 19-year old who lives at home and works; (5) independent, traditional, full-time: e.g. an international student who attends school full-time supported by her government; (6) independent, nontraditional, full-time: e.g. an older student who has returned to school on a full-time basis after work; (7) independent, nontraditional, part-time: e.g. an adult student with a full-time job and family, who is taking one course a semester for personal development; and (8) independent, traditional, part-time: e.g. a student living in her own apartment, who works to support herself and goes to school part-time (Stewart & Rue, 1983).

While almost all residential students tend to fall into the fifth category of independent, traditional, and full-time, commuter students may fit into all other categories (Stewart & Rue, 1983). This taxonomy helps to underscore the extent of the diversity that exists within the classification of commuter student, as well as the fact that not all commuter students are non-traditional students.

Commuter students tend to possess more identities and non-academic roles, than residential students (Gianoutsos, 2011). They often follow a "divided lifestyle", with some more closely identifying with the multiple (non-student) life roles than with being a college student (Andreas, 1983; Keeling, 1999). Keeling (1999, p. 4) describes commuter students as "reinvented students," recognizing that being "a student is only one identity for people who are employees, wage workers, opinion leaders or followers, artists, friends, children…parents, partners, or spouses." They are more likely to work while attending college than residential students. Jacoby & Garland (2004, p. 63) found that commuter students are "more likely to work, to work more hours, and to work off campus than residential students." For some students, their "divided lifestyle" and multiple life roles often imply little spare time as work and family

obligations outside the college tend to reduce the amount of time these students have available to spend on campus outside of the classroom (Finkler & Leach, 1978; Harrington, 1972; Schuchman, 1974).

Based on the foregoing profile of commuter students, my statistical analysis controlled for commuter students' background characteristics such as age, race/ethnicity, and gender. Other controls included students' entry status (native/transfer), first-generation status, enrollment status (full-/part-time), the time they spent preparing for class (their academic effort), academic major, the frequency of their peer interactions, and the quality of their relationships with peers. These characteristics were incorporated into the analyses for both hierarchical linear modeling and propensity score matching.

Despite being a diverse group, commuter students do share a common set of concerns or needs. According to the Educational Facilities Laboratories (1977, p. 6),

> Essentially what commuting students lack is a base from which to operate, a place to hang their hats. They need facilities to park their cars and their bicycles, to place their belongings and their children, to study, to grab a quick bite, or take a short nap; they need "hangouts" where they can meet friends or play a casual game of ping pong or pool- in short, places where they feel they belong and can spend time on campus productively.

The common concerns that commuter students have include transportation, systems of support, and developing a sense of belonging on campus. These concerns can potentially limit the frequency in which they interact with faculty members and student success. They therefore provide the basis for institutional practices that support these students. Transportation tends to be a key concern because commuter students associate college-going with issues such as parking

and parking costs, traffic, weather, transportation costs, and locating another means of transportation when their primary means fail (Jacoby & Garland, 2004). The convenience in scheduling of classes, services, and programs, has implications for their academic performance and availability to meet with faculty members, peers, and participate in on-campus activities (Jacoby & Garland, 2004; Wilmes & Quade, 1986).

Commuter students require integrated social networks, that is, campus programs that purposively set out to include those persons that provide these students with off-campus support and guidance. According to Jacoby & Garland (2004, p. 64), commuter students often lack the "supportive campus environment" that has been identified as one of the benchmarks of effective educational practice of the National Survey of Student Engagement (Kuh, Gonyea, & Palmer, 2001). Most institutions fail to provide venues for the integration of a support system (Wilmes & Quade, 1986). Support networks for commuter students usually exist off, rather than on, campus and include parents, partners, children, siblings, employers, coworkers, and friends in the community. Jacoby & Garland (2004) suggest that commuter students may find themselves in situations where they have to negotiate to establish priorities for responsibilities and time commitments with family, employers, and others who may not always understand the challenges and opportunities of higher education, as would campus-based advisors, counselors, and others who provide on-campus support to students. Useful campus programs that include commuter students' support networks include orientation programs for family members, online or in-person workshops for parents and partners, and training offered to these sources of support on how to access information and resources that address commuter students' concerns (Jacoby & Garland, 2004, p. 72).

Mattering is another concern of commuter students. Jacoby & Garland (2004, p. 65) state that "students who commute often lack a sense of belonging to or of feeling wanted by the institution." The feeling of physical connection with the institution may be impeded when colleges and universities fail to provide basic facilities, such as lockers, lounges, shower or overnight facilities, etc. Commuter students may feel that they do not matter when there are insufficient opportunities to develop relationships with faculty members, campus staff, and peers (Jacoby & Garland, 2004). Understanding commuter students' diversity and concerns is key to encouraging engagement and success among this population of college and university students.

The Nature of Student-Faculty Interaction

Forms of Student-Faculty Interaction

Faculty members assume a multiplicity of roles in their relationships with students. They serve as instructors, advisors, mentors, role models, employers, and sources of support and guidance (Chang, 2005). The relationship between students and faculty members may fall within three broad (and sometimes overlapping) categories - a formal or informal relationship, an academic or social relationship, and a professional, personal, or dual (both professional and personal) relationship.

Student-faculty interaction can take the form of formal or informal interaction, typically distinguished by the place and content of the interaction. Formal interaction embodies the faculty member's professional relationship with students and typically occurs within the classroom with academic and vocational advising topics being the focus of discussion (Endo & Harpel, 1982; Tinto, 1993). The discussion may center on course-related projects, and students' receipt of written or oral feedback on academic performance (Pascarella & Terenzini, 1979).

On the other hand, informal interaction involves contact between students and faculty members outside the classroom. It may include visiting with a faculty member informally after class to discuss course-related matters or career plans, having coffee with a faculty member, meeting with a faculty advisor, being a guest in a professor's home, working on a research project with a faculty member, and serving on committees with faculty (Kuh & Hu, 2001; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). Technology and the internet add other place-related features to non-classroom interaction, as faculty members also make contact with students through a variety of media such as e-mail, discussion boards, virtual office, wikis, blogs, and synchronous chat. Chickering & Ehrmann (1996) recognized that:

> Communication technologies that increase access to faculty members, help them share useful resources, and provide for joint problem solving and shared learning, can usefully augment face-to-face contact in and outside of class meetings. By putting in place a more "distant" source of information and guidance for students, such technologies can strengthen faculty interactions with all students, but especially with shy students who are reluctant to ask questions or challenge the teacher directly. It is often easier to discuss values and personal concerns in writing than orally, since inadvertent or ambiguous nonverbal signals are not so dominant. As the number of commuting part-time students and adult learners increases, technologies provide opportunities for interaction not possible when students come to class and leave soon afterward to meet work or family responsibilities. (p. 1)

Braxton, Eimers, & Bayer (1996, p. 607) recognize that faculty members who make themselves available to students, especially outside of scheduled class time, provide students

with additional opportunities to develop academically and socially. These researchers state that interaction outside the classroom may afford students the opportunity to also develop their affective domain. Besides their cognitive development, interacting with faculty may shape students' motivation, attitudes, perceptions and values.

Student-faculty interaction may also take the form of an academic or social relationship. In their academic relationships, students meet with faculty members to discuss matters related to academic advising, intellectual discussions, and career concerns. Their social relationships center around discussions of matters related to campus issues, socializing informally, and resolving personal problems.

The literature also indicates that student-faculty interaction can occur in the form of a professional relationship, a personal relationship, and a dual relationship (that is, both a professional and personal relationship). Rupert & Holmes (1997, p. 661) provide this elaboration on the dual relationship:

> As faculty extend their professional relationships with students outside the classroom, it is not unusual for them to find themselves increasingly involved in more personal relationships as well. For example, in more informal settings faculty may find themselves called upon to advise students about personal as well as academic issues. As faculty socialize with students at university-sponsored or private functions, they may also find themselves forming personal friendship or even intimate relationships with their students and their families. Similarly, as faculty become more involved in the private lives of their students, they may find themselves in financial or business relationships with students or their families that extend well beyond the traditional boundaries of academia (for example, hiring students as baby sitters or house sitters or involving a student in a private

business venture). While these types of personal relationships often provide opportunities to further the students' personal and professional development, they also carry very different expectations and obligations than the typical faculty professional roles and may thus give rise to greater and potentially more complex ethical issues (Kitchener, 1988).

Rupert & Holmes (1997) observe that the power differential between faculty and students may place at risk those students who enter into multiple types of relationships with faculty that extend outside the classroom. Students' educational experience may be adversely affected in some situations.

This study examined the impact on cognitive and affective outcomes of students' out-of-classroom interaction with faculty members. The frequency of student-faculty interaction was measured by five NSSE survey items that measured how often students discussed grades or assignments with an instructor, discussed ideas from readings or classes with faculty members outside of class, talked about career plans with a faculty member or advisor, used e-mail to communicate with an instructor, and worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.). Given the forms of student-faculty interaction outlined above, the focus of the study was on commuter students' informal, academic, social, and professional relationships with faculty members.

Types of Student-Faculty Interaction

Student-faculty interaction outside the classroom may fit into several types. In their 2007 study of informal student-faculty interaction, Cox & Orehovec developed a typology of non-classroom faculty-student interaction for residential students that also provides a relevant

framework for research on commuter students. Based on a multi-method qualitative study of students at a residential college in a large public research university, Cox & Orehovec (2007) were able to identify five types of informal student-faculty interaction that ranged, in increasing frequency of occurrence, from mentoring, personal interaction, functional interaction, incidental contact, to disengagement. Figure 2.2 indicates Cox & Orehovec's Typology of Faculty-Student Interaction. In the figure, the larger the area on the pyramid, the more frequent is its occurrence.

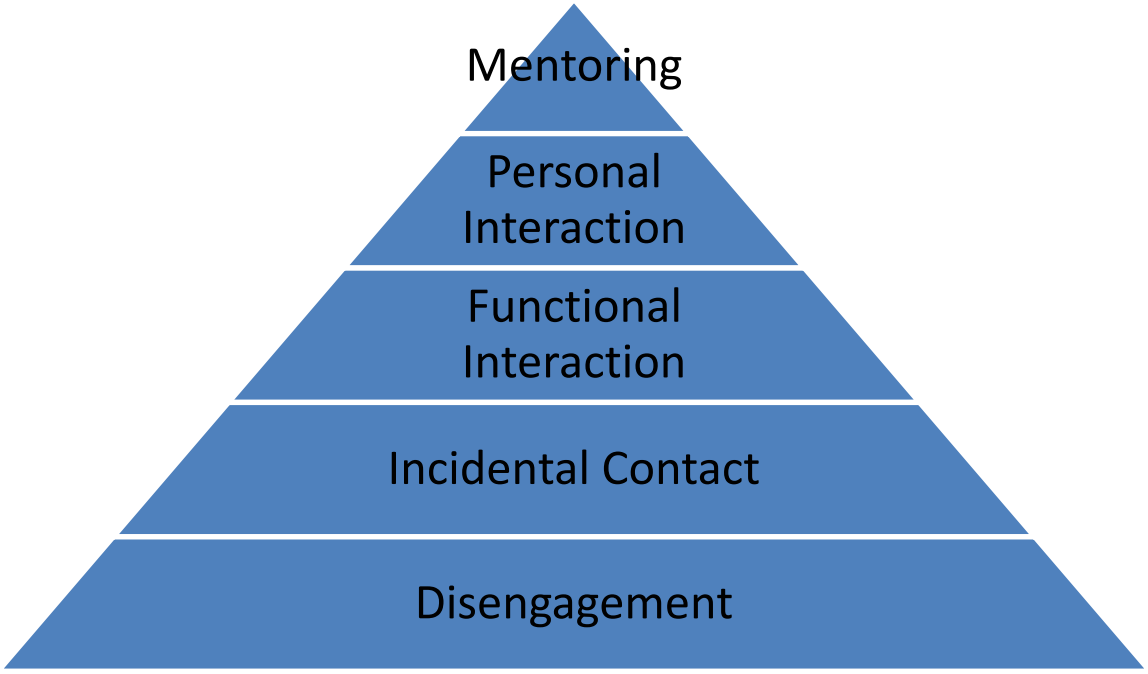


Figure 2.2. Cox & Orehovec's (2007) Typology of Faculty-Student Interaction.

The five types of interaction are:

Disengagement. This describes a situation where there is a general lack of out-of-class interaction between professors and students. The absence of faculty members from college functions, and the lack of any interaction between faculty and students even where they are physically proximate, are indicators of this type of interaction. Cox & Orehovec give an example

of being invited to a dinner with faculty at which faculty members are mostly engaged in their own conversation, while the students are engaged separately in their own.

Incidental Contact. This occurs when the interaction is incidental or unintentional, such as interaction involving polite greetings and waves.

Functional Interaction. This type of interaction tends to be more specific and institutionally related. Typically academic-related, this type of interaction can involve students asking professors academic questions, students and faculty members working on a college project together, or faculty members asking students institution-related questions.

Personal Interaction. According to the authors (p. 354), "this is the type of interaction in which a personal - as distinguished from a purely professional - relationship can develop between a Professor." An example may be an invitation for coffee, lunch, or dinner on campus.

Mentoring. The authors (p. 356) state that:

> Specifically, we considered mentoring to be the "highest end on a continuum of helping relationships" (Jacobi, 1991, p. 511). To be labeled as a mentoring relationship in our study, the relationship must have met all three criteria set forth by Anderson et al. (1995), who summarized Jacobi's work: (a) direct assistance with career and professional development, (b) emotional and psychosocial support, and (c) role modeling. In essence, mentoring minimally required an extended relationship built on both functional and personal interactions.

Patterns of Student-Faculty Interaction

Several patterns distinguish the interaction between faculty members and students within higher education institutions. Student-faculty interaction can be distinguished:

By frequency of interaction: Several studies find that student-faculty interaction occurs relatively infrequently (e.g. Anaya & Cole, 2001; Chang, 2005; Cotten & Wilson, 2006; Cox & Orehovec, 2007; Cox, McIntosh, Terenzini, Reason, & Quaye, 2010; Hagerdon, et al., 2000). Obtaining the student perspective, Cotten & Wilson (2006) found that interaction was more likely when students were involved in some special group or activity that brought them into direct one-on-one contact with faculty outside the classroom. Students were often deterred from seeking contact with faculty by time constraints, insecurity, and a lack of awareness of the value of interaction with faculty. Faculty attitudes, presence, and personality also affected interactions. From a survey of 274 students at two medium-sized universities (one public and one private), Jaasma & Koper (1999) found that the average length of an office visit was 2.4 minutes while the average length of an informal contact was 1.4 minutes.

Exploring faculty perceptions of the personal, institutional, and pedagogical factors that influence out-of-class interaction, Cox, McIntosh, Terenzini, Reason, & Quaye (2010) also found that faculty members appeared to have relatively little contact with students outside of the classroom. Their finding that faculty behaviors were not the biggest predictors of their likelihood to engage students outside of class, led the researchers to suggest that the student side of the faculty-student interaction equation may be the driving force in student-faculty interaction and that the variability attributable to faculty members themselves may be relatively minor.

By faculty characteristics: studies find that faculty members who have a student-centered philosophy of education and believe that teaching is a critical part of their role as professors consistently display higher levels of out-of-class interaction with students (Cotten & Wilson, 2006; Einarson & Clarkberg, 2004; Golde & Pribbenow, 2000). So, too, do faculty members

with friendly personalities and strong interpersonal skills, and those with tenure or on the tenure track (Einarson & Clarkberg 2004; Wilson et al., 1974).

By institution: The lowest levels of interaction tend to occur at doctoral or research universities (Cox & Orehovec, 2007; Kuh & Hu, 2001). Students in liberal arts colleges, as a group, have significantly more informal contact with faculty around academic issues than do university or 4-year commuter college students (Chapman & Pascarella, 1983). Student-faculty contact around social issues is most likely to occur in liberal arts and 2-year colleges, and least likely to occur in universities and 4-year commuter institutions (Chapman & Pascarella, 1983). Students in private institutions report more out-of-class contact with faculty than students in public institutions (Kuh & Hu, 2001).

By major: Compared with students in professional/applied fields, students in the humanities and social sciences report more contact with faculty. Math and science majors have fewer contacts with faculty members related to writing improvement, perhaps because they write fewer papers overall than students in other majors (Kuh & Hu, 2001).

By students' race/ethnicity: Students of color experience student-faculty interaction differently than White students (Kim, 2010). In terms of "frequency" of interaction, Asian American students tend to engage in less out-of-class interaction with faculty than White students while African-American students engage in significantly more interactions (Chang, 2005; Einarson & Clarkberg, 2010; Kim & Sax, 2009; Kuh & Hu, 2001; Lundberg & Schreiner, 2004). In terms of the "nature" of the interaction, Asian American students engage more in research-related faculty interaction, and less in course-related interaction, and vice versa for African-American students (Einarson & Clarkberg, 2010; Kim & Sax, 2009). In addition, Kuh & Hu (2001) found that Latino students had more contact with a faculty member related to writing improvement.

By gender: For *research-related* faculty contact, male students are more likely than female students to assist faculty with research as a volunteer or for pay, whereas females are more likely than males to assist faculty with research for course credit. For *course-related* faculty contact, female students report more frequent communication with faculty by email or in person than males, while males interact more frequently with faculty during lecture class sessions than females (Kim & Sax, 2009). Sax, Bryant, & Harper (2005) found that women interact more frequently with faculty than men. The researchers noted that gender differences existed among the most frequently reported experiences, with women indicating more than men that faculty provide them with intellectual challenge, stimulation, and respect; and men reporting higher, rates of challenging a professor's ideas in class and feeling that faculty did not take their comments seriously.

By peer interaction: According to Pascarella & Terenzini (2005), the literature suggests that students who are actively involved with their peers in intellectual or academic pursuits outside the classroom are also more likely to have informal interactions with faculty members; students who regularly engage in peer activities that are primarily social in nature, on the other hand, may be less inclined to interact with faculty members outside the classroom. Pascarella (1980, pp. 562-563) reports on early studies of student culture (Becker, Geer, Hughes & Strauss, 1961; Bushnell, 1962; Katz, 1968; Wallace, 1966) that suggested that the student peer culture moderates faculty's attempts to socialize students to the intellectual goals of the institution, through its informal sanctions on group members' attitudes and behaviors. These researchers found that student-faculty interaction outside the classroom was likely if faculty's socialization efforts were supported by the norms of the dominant peer culture. However, if the norms of a

particular peer culture ran counter to those of the faculty culture, contact with faculty was likely to be confined to institutionally required situations (that is, the classroom and laboratory).

Astin (1993) found that peers' tutoring other students was positively associated with both the number of hours per week students spent talking to faculty outside of class and being a guest in a professor's home (p. 173). The researcher stated that the positive relationships suggested faculty members may serve as "brokers" between their best students and students who are experiencing academic difficulties.

By social class:

Kim & Sax (2009) found that students from upper-class families are more likely than students from lower- or middle-class families to assist faculty with research for course credit, communicate with faculty by email or in person, and interact with faculty during lecture class sessions. In contrast, students from lower-class families are more likely than their counterparts to assist faculty with research for pay.

By first-generation status:

Students whose parents attended college are more likely than students whose parents had not attended college to assist faculty with research for course credit, communicate with faculty by email or in person, and interact with faculty during lecture class sessions (Kim & Sax, 2009).

Measurement of Student-Faculty Interaction

The frequency and quality of non-classroom faculty-student interaction were the two independent variables of interest in this study. A review of the literature indicated that in empirical studies, student-faculty interaction tends to be conceptualized in terms of the "frequency and content/nature of the interaction," and the "quality or effectiveness of student-

faculty interaction." They tend to be operationalized using items contributed by Wilson, Gaff, Dienst, Wood, & Bavry (1975) and Pascarella & Terenzini (1977, 1979), and later by Astin (1993), Chapman & Pascarella (1983), Berger & Milem (1999), Kuh, Pace, & Vesper (1997), Milem & Berger (1997), among others.

The use of "frequency and content/nature of the interaction" is attributed to Wilson, Gaff, Dienst, Wood, & Bavry (1975). These researchers collected data from both faculty and students at eight institutions - two campuses of a state university, a state college, a sub-college of a state university, two denominational schools, a black college, and a selective liberal arts college - in order to identify the effects of college teachers on the lives of students. Student data were collected via a freshman questionnaire administered in fall 1966, and a senior questionnaire administered four years later in spring 1970. The senior questionnaire included questions about students' relationships with faculty members. The researchers used chi-square and Kruskal-Wallis tests to determine relationships among their variables, and a correlational approach to analyze the data.

Wilson, Gaff, Dienst, Wood, & Bavry (1975) asked students to provide information on the number of different discussions of 10 minutes or more with faculty members during a one-month period on six kinds of out-of-class discussion areas: "intellectual issues or course-related matters; educational plans or advice; informal conversations and socializing; career plans or advice; campus issues or sociopolitical discourse; and personal problems or counseling" (p. 152). It is interesting to note that the researchers found that students who had high-interaction with faculty members perceived that they made more progress in the development of a variety of specific academic skills (such as their ability to comprehend or interpret, to evaluate material and

methods, and to apply abstractions or principles to a particular situation) than other students; and expressed greater satisfaction with the total college experience.

Wilson, Gaff, Dienst, Wood, & Bavry's (1975) operationalization of the "frequency and content/nature of the interaction" received slight modification in Pascarella & Terenzini's (1977) "student-faculty contact," and significant modification in Chapman & Pascarella's (1983) "informal contact with faculty." Specifically, Chapman & Pascarella made a significant contribution to the measurement of the social contact between students and faculty by including a scale comprising three items (have dinner in faculty member's home, go out for refreshments with faculty, and have a meal on campus with faculty). These meal-related items have become prominent in later operationalizations of "frequency of student interaction with faculty" such as in Astin (1993), Berger & Milem (1999), Kuh, Pace, & Vesper (1997), and Milem & Berger (1997).

Studies that investigate student-faculty interaction most often utilize items in Pascarella & Terenzini's (1977) frequency of "student-faculty contact", that this, the number of times during each semester of the freshman year students met informally with a faculty member for 10-15 minutes or more for the six reasons: 1) get basic information and advice about my academic program; 2) discuss matters related to my future career; 3) help resolve a disturbing personal problem; 4) discuss intellectual or course-related matters; 5) discuss a campus issue or problem; and 6) socialize informally.

On the other hand, "the quality of student-faculty interaction" tends to be based on three measures derived from:

a) Pascarella & Terenzini (1979). In addition to splitting the six items in Pascarella & Terenzini's (1977) "student-faculty contact" into two concepts (academic integration and

social integration), Pascarella & Terenzini (1979) included a "faculty concern for teaching and student development" scale in their academic integration concept, and an "informal relations with faculty" scale in their social integration concept. Together these two scales constitute a measure of the quality of interaction between students and faculty members.

"Faculty concern for teaching and student development" consists of five items that assess students' perceptions of faculty's attitudes towards students and their quality as teachers. The "informal relations with faculty" scale consists of five items that assess students' perceptions of the extent to which they have developed close personal relationships with faculty and the extent to which those relationships have influenced their intellectual growth, personal growth, and career goals.

b) The CSEQ questionnaire which, in its "The College Environment" section, requests students' perceptions of the quality of their relationships with faculty. This individual item is scored on a seven-point scale, with 1 being remote, discouraging, unsympathetic, and 7 being approachable, helpful, understanding, and encouraging.

c) The NSSE questionnaire which requests students' perceptions of the quality of their relationships with faculty. This individual item is scored on a seven-point scale, with 1 being unavailable, unhelpful, and unsympathetic, and 7 being available, helpful, and sympathetic.

This study utilized the latter measure of "the quality of student-faculty interaction." The measure for "the frequency of student-faculty interaction" was based on the operationalizations attributed to Pascarella & Terenzini (1977) and Wilson, Gaff, Dienst, Wood, & Bavry (1975).

Relevant Conceptual and Theoretical Frameworks

The conceptual framework for this study derived from Pascarella's (1980) conceptual model of the college impact on students. Pascarella (1980) sought to fit non-classroom student-faculty informal contact into a larger conceptual model of college impact on students. His model suggests that in order to understand the influence of student-faculty non-classroom contact on educational outcomes and institutional persistence, it is necessary to take into account the background characteristics which students bring to college, the actual experiences of college in other areas, and salient institutional factors. Pascarella's model incorporates concepts derived from Astin's (1970a, 1970b, 1991) Input-Environment-Outcomes Model and his (1984, 1999) Theory of Involvement, into a more comprehensive model.

Astin's works represent "helper models" for the conceptual framework used in this study. Indeed, Astin's (1970a, 1970b, 1991) Input-Environment-Outcomes Model and his (1984, 1999) Theory of Involvement provide useful conceptual and theoretical guides for studies that seek to assess the relationship between student-faculty interaction and the three outcomes – satisfaction with the college experience, intellectual skills development, and grade-point average. In both works, interaction with faculty members occurs within the institution's environment which is itself an integral component for student success.

Astin's Input-Environment-Outcomes Model

Astin (1970a, 1970b, 1991) used his I-E-O Model as a conceptual guide for assessment activities in higher education and "to assess the impact of various environmental experiences by determining whether students grow or change differently under varying environmental conditions" (Astin, 1993, p. 7).

Astin viewed student success as depending on two factors: who students were before they entered college, and what happens to them after they enrolled. More specifically, student success develops through the interaction between inputs, the environment, and outcomes. The relationships between these three model components are shown in Figure 1.1. According to Astin (1970a, p. 225):

The principal concern of research on college impact is to assess relationship "B," the effects of the college environment on relevant student outputs. Relationship "C" refers to the fact that outputs also are affected by inputs, and relationship "A" to the fact that college environments are affected by the kinds of students who enroll.

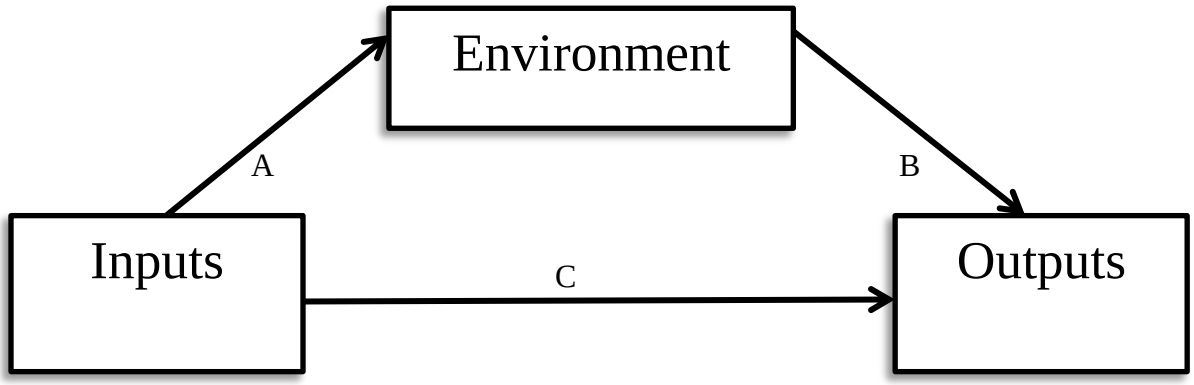


Figure 2.3. The Input-Environment-Outcomes Model. From Astin (1970a, p. 225).

In the I-E-O Model, student inputs include the demographic characteristics, family background, and academic and social experiences that students bring to the college or university. The environment, the second component of the I-E-O Model, is considered to be "the most neglected area of assessment activity" (Astin, 1970a, p. 235). The environment "encompasses everything that happens to a student during the course of an educational program that might

conceivably influence the outcomes under consideration" (Astin, 1991, p. 81). This component includes college programs, personnel (faculty and staff), administrative policies and practices, curriculum, physical plant and facilities, teaching practices, peer-associations, and other characteristics of the college environment.

The third component of the I-E-O Model is outcomes. Astin (1991, pp. 18, 233) described outcomes as the "talents" institutions seek to develop in their programs, and as the student characteristics the institution influences or attempts to influence. Student outcomes include measures of the student's achievements, knowledge, skills, values, attitudes, aspirations, interests, and daily activities.

Astin provided a taxonomy of outcomes. He suggested that college outcomes could be conceptualized along three dimensions – type of outcome, type of data, and time span. The first two dimensions can be conceived in terms of a 2 x 2 matrix where the type of outcome is either cognitive or affective and type of data is either psychological or behavioral. According to Astin (1991, pp. 42-44) cognitive outcomes "involve the use of higher-order mental processes such as reasoning and logic" while affective outcomes refer to "the student's feelings, attitudes, values, beliefs, self-concept, aspirations, and social and interpersonal relationships." Cognitive and affective outcomes can be measured by both psychological and behavioral data. Psychological data reflect "the internal states or traits of the student" while behavioral data reflect "student's observable activities."

Astin's 2 x 2 model of college outcomes presents four distinct type of outcomes: cognitive-psychological, cognitive-behavioral, affective-psychological, and affective-behavioral. Within these outcome types, Astin classified "satisfaction with college" as an affective-psychological outcome. Grade-point average (GPA) and specific skills – which includes basic

skills (mathematics and communication skills such as reading, writing, speaking, listening), and complex skills (verbal reasoning and critical thinking) - are cognitive outcomes in the psychological realm.

Astin (1970a, p. 224) recognized the development of cognitive skills as "the most common educational objective of both students and colleges," and specifically regarding the outcome "satisfaction with college", the author (1991, pp. 61-62) stated that:

> But perhaps the single most important affective-psychological area for outcomes assessment is student satisfaction. … This category of affective outcomes encompasses the student's subjective experience during the college years and perceptions of the value of the educational experience itself. Given the considerable investment of time and energy that most students make in attending college, their perception of the value of that experience should be given considerable weight. Indeed, it is difficult to argue that any other outcome category – cognitive or affective, behavioral or psychological – should be given greater priority than student satisfaction.

Astin conceptualized outcomes as dependent variables, and environment and input variables as both types of independent variables. He stated that input variables could also be referred to as control variables, while the environmental variables referred to as treatments, educational experiences, practices, programs, or interventions.

Astin's Theory of Involvement

Astin's (1984, 1999) Theory of Involvement, in which students' motivation and behavior play an integral role, is concerned with the behavioral mechanisms or processes that facilitate student development. Astin (1999) stated that:

> Student involvement refers to the quantity and quality of the physical and psychological energy that students invest in the college experience. (p. 518)

According to the Theory, student time and energy are institutional resources, with student time being the most important institutional resource. The time and effort students devote to institutional activities designed to produce developmental gains, determines the extent to which they achieve those goals. Involvement in institutional activities may take the form of absorption in academic work, participation in extracurricular activities, and interaction with faculty and other institutional personnel. Astin (1999, p. 518) stated that a highly involved student is one: "who devotes considerable energy to studying, spend a lot of time on campus, participates actively in student organizations, and interacts frequently with faculty members and other students." The greater is the student's involvement in college, the greater will be the amount of student learning and personal development (Astin, 1984, 1999).

Student-Faculty Interaction among Commuter Students at 4-year institutions

The outcomes to be examined in this dissertation - satisfaction with the college experience, GPA, and intellectual skills development – are yet to be explored within the peer-reviewed literature for commuter students attending 4-year colleges and universities. A review of the extant literature revealed that only three student outcomes have been investigated by the

empirical studies that examine student-faculty interaction among commuter students at 4-year institutions. Commuter students' interaction with faculty is associated with students' persistence, aspirations, and the value of learning. Specifically, these findings were presented in three studies (Iverson, Pascarella, & Terenzini, 1984; Johnson, 1997; and Terenzini, Springer, Pascarella, & Nora, 1995).

Frequent informal contact with faculty on academic topics predicts the educational aspirations of white commuter college freshmen. This was the finding of Iverson, Pascarella & Terenzini (1984) when they investigated the impact of student-faculty contact on the educational aspiration level. OLS regression analysis and two-stage least squares (2SLS) were applied to data on 213 students who had completed CIRP surveys at a large, urban, totally nonresidential, state-supported 4-year university. Educational aspirations were measured using "B.A. or less" and "M.A. or more". Student-faculty interaction was measured using three variables that reflected frequency of contact, interactions with faculty, and faculty concern for student development.

Student-faculty interaction discriminates between first-year year persisters and voluntary dropouts. This was the finding of Johnson (1997) when the researcher applied multivariate discriminant analysis to data on 171 undergraduate students from a four–year commuter university in the northeast. Johnson found that faculty-and staff-student interaction and connection was the most important characteristic distinguishing the retained from the dropout students. Retained students agreed more strongly than dropout students with the statements: "I got to know the faculty," "it was easy to get answers to questions I had about things related to my education at this institution," "this institution has a well-educated faculty," and "I had adequate opportunity to interact with faculty." In addition, students who reported being more

connected to the university were retained. Johnson (1997) concluded that students who have closer contact with faculty were the successful or retained ones.

Experiences with faculty positively predict the intrinsic value that students attach to learning. Terenzini, Springer, Pascarella, & Nora (1995) set out to assess whether students' interest in learning was shaped by both formal academic activities and by their out-of-class experiences. The researchers applied OLS regression analysis to data drawn from 210 freshman students enrolled for six or more academic credit hours at a large, urban, Research 1 university in the Midwest that served an undergraduate population composed primarily of commuters.

Terenzini et al's study included two dependent variables - "interest in academic learning" and "intrinsic value of learning" – and two measures of student-faculty interaction – "hours/week talking with teachers outside class" and "experiences with faculty". "Experiences with faculty" was developed from 10 items on the CSEQ "Experiences with Faculty" scale. While the researchers found that experiences with faculty positively predict the intrinsic value that students attach to learning, they found no evidence that frequent interaction with faculty predicted students' interest in academic learning.

Student-Faculty Interaction and the three outcomes: Satisfaction, GPA, and Intellectual Skills Development

Research on Satisfaction

In her 2009 study *Linking Student Satisfaction and Retention*, Schreiner (p. 1) states:

> Student satisfaction is of compelling interest to colleges and universities as they seek to continually improve the learning environment for students, meet the expectations of their constituent groups and legislative bodies, and demonstrate their institutional

effectiveness. Unlike service industries, which hold satisfaction as a goal in and of itself, colleges and universities typically perceive satisfaction as a means to an end. Higher education tends to care about student satisfaction because of its potential impact on student motivation, retention, recruitment efforts, and fundraising. But as Astin (1977) asserted more than three decades ago, "it is difficult to argue that student satisfaction can be legitimately subordinated to any other educational outcome" (p. 164).

While no evidence has been found of a peer-reviewed study that examines student-faculty interaction as a predictor of commuter students' satisfaction with the college experience, the research literature indicates that generally student-faculty interaction positively predicts academic satisfaction (such as Astin, 1993; Cole, 2008; Einarson & Clarkberg, 2010; Endo & Harpel, 1982; Hearn, 1985; Kim & Sax, 2009; Kuh & Hu, 2001; Sax, Bryant, & Harper, 2005; Strayhorn, 2010; Volkwein & Carbone, 1994; Wilson, Gaff, Dienst, Wood, & Bavry, 1975). However, some studies (for example, Endo & Harpel, 1982; Hearn, 1987) present exceptions.

According to Astin (1985):

> Frequent interaction with faculty members is more strongly related to satisfaction with college than any other type of involvement or, indeed, any other student or institutional characteristic. Students who have many contacts with the faculty are more likely than those who do not, to express satisfaction with all aspects of their institutional experience, including student friendships, the variety of courses, the intellectual environment, and even the administration of the institution. (p. 149)

As noted by Endo & Harpel (1982), several early studies found increased frequency of student-faculty interaction to be related to students' satisfaction with the academic and nonacademic aspects of college (for example, Astin, 1977; Wilson, et al., 1975; Heiss, 1967; Gregg, 1972; Pascarella and Terenzini, 1976; Spady, 1971; Newcomb, et al., 1970). The study of students' satisfaction was an offshoot of larger studies on persistence. Indeed, Hearn (1985, p. 414) reports that as far back as 1971, William Spady had suggested that academic satisfaction was a critical mediating factor in college persistence, and that this perspective was subsequently pursued by Tinto (1975), Pascarella & Terenzini (1977), Bean (1980), and Endo & Harpel (1982). Hearn further states that these analyses of persistence have often placed satisfaction in the broader context of the student's integration into, and commitment to, an institution.

As reported by Hearn (1985, p. 415), several researchers, such as Crawford & Bradshaw (1968), Keaveny & McGann (1978), and Neumann & Neumann (1981), have posited that students' academic satisfaction has distinct domains. These domains include: (1) social support factors, such as levels of faculty supportiveness and availability, and levels of student/student interaction; (2) teaching style factors, such as the liveliness and orderliness of course presentations; and (3) faculty competence factors, such as perceived faculty knowledgeability and commitment. Evident in each of these domains is the potential for a significant role by members of faculty.

Prior research has mostly found that a positive relationship exists between student-faculty interaction and satisfaction. Wilson, Gaff, Dienst, Wood, & Bavry (1975) found that the satisfaction received from getting to know faculty members is important for senior students who have significant interaction with faculty. These researchers examined on the effects of college teachers on the lives of students. Satisfaction was conceptualized in terms of "satisfaction

received from getting to know faculty members." The researchers applied correlational analysis to data for students at eight institutions and found that high-interacting seniors expressed greater satisfaction with the total college experience, with almost all specific aspects of it, and with getting to know faculty members in particular.

Frequent formal and informal interaction with faculty and the helpfulness of faculty predict satisfaction with education. In addition to examining the effect of student-faculty interaction on intellectual outcomes, Endo & Harpel (1982) also investigated its effect on students' satisfaction with education. Satisfaction was measured by a scale comprising seven items: satisfaction with the: overall quality of education; selection of courses for general education requirements; quality of program in major; variety of courses in major; challenge of courses in major; classroom equipment and facilities; and overall academic experiences.

Student-faculty interaction was defined in terms of the frequency of formal student-faculty interaction (faculty discuss traditional academic and vocational advising topics); the frequency of informal student-faculty interaction (where faculty members have a more friendly relationship with students, and exhibit a personal and broad concern with students' emotional and cognitive growth); the quality of faculty academic and vocational advising; and the helpfulness of faculty (which also provides some indication of the degree of faculty concern and willingness to interact with students) (pp. 119-120).

When the researchers applied general least squares regression analysis to data obtained from the University of Colorado's 1975 Freshman Questionnaire and a 1979 Graduating Students Survey, they found that frequent informal student-faculty interaction and the helpfulness of faculty positively predicted students' satisfaction with their educational

experience. However, frequent formal student-faculty interaction negatively predicted satisfaction. Endo & Harpel presented this explanation for the negative effect:

> This finding might be explained by the fact that frequency of informal interaction positively influenced satisfaction with education. In other words, the greater the informal interaction, the less likely the interaction will continue on a formal level, and if it does, satisfaction will decrease. Our findings might also be explained by the fact that many students who are dissatisfied with aspects of their academic work are likely to engage in interaction with faculty that is primarily formal. (p. 132)

Hearn (1985) investigated the determinants of college students' overall evaluation of their academic programs. Data was derived from a sample of 775 graduating seniors at two universities, one large and public and the other smaller and church-affiliated. Multiple regression analyses were utilized to assess the relationships between a global dependent variable indicator (overall satisfaction with major department experiences) and several independent variables. The independent variables examined student satisfaction with "professors' knowledge of their field," "professors' teaching ability," "availability of professors to students outside of class," "challenge and stimulation of course offerings," "professors' commitment to their field," and "opportunities for interaction with other students majoring in the field."

Hearn (1985) found that students' overall academic satisfaction was predicted by their satisfaction with the availability of professors outside of class. Hearn also found that satisfaction with faculty availability was more critical among women than men. While students enrolled in investigative (such as biology and physics), social (such as the social sciences), enterprising (such as business administration), and artistic (the arts and humanities) majors placed significant

weight on faculty availability in their overall evaluations, the difference in the weightings was not statistically significant.

According to Astin (1993, p. 273), student satisfaction is an area that "covers the student's subjective experience during the college years and perceptions of the value of the educational experience." The researcher measured satisfaction in two ways: by students' level of satisfaction with the overall undergraduate experience, and by their satisfaction with five specific aspects of that experience, namely relationships with faculty, curriculum and instruction, student life, individual support services, and facilities. Overall quality of instruction was an item included under "curriculum and instruction." Individual support services include career counseling and advising, personal counseling, academic advising, job placement services for students, and tutoring help or other academic assistance.

Astin utilized data derived from the 1989 follow-up Cooperative Institutional Research Program (CIRP) survey. Student-faculty interaction was operationalized through a composite measure "frequency of student interaction with faculty" derived from students' responses to questions regarding "hours per week spent talking with faculty outside of class," "assisted faculty in teaching a course," "worked on a professor's research project," and "was a guest in a professor's home." With regard to the effects of this composite measure, Astin (1993) found that frequent student interaction with faculty was positively correlated with student satisfaction, particularly with the quality of instruction, individual support services, and the overall college experience.

Astin's (1993) findings confirmed his previous 1977 finding of a correlation between the involvement factor - student-faculty interaction - and overall satisfaction using data from the

1969-1970 American Council of Education /Carnegie Commission on Higher Education (ACE-Carnegie) follow-up of the 1966 CIRP freshman survey.

Volkwein & Carbone (1994) found an association between faculty relations and academic satisfaction for students in their senior year. Volkwein & Carbone (1994) were interested in whether a strong research orientation by an academic department promoted or hindered student learning, and whether differences in departmental teaching and research climates were associated with differences in the academic integration and intellectual growth of the undergraduates who major in humanities, sciences, and social sciences. Their independent variables included departmental research climate, departmental teaching climate, academic integration, and social integration. As one of their outcomes, academic satisfaction was measured by three items that asked seniors to respond to statements about their satisfaction with their academic experience at the institution, their satisfaction with the extent of their intellectual development, and whether their academic experience had a positive influence on their intellectual growth.

Volkwein & Carbone include student-faculty interaction in their study in two ways - as faculty-student academic contact, and as part of academic integration. Faculty-student academic contact was used as a measure of departmental teaching climate and operationalized in terms of the frequency of out-of-class faculty contacts of at least ten minutes to discuss academic matters. In addition, the researchers included faculty relations, and faculty concern for student development in their measure of academic integration. The faculty relations scale was composed of four items that asked students to report on their personal relationships with faculty, and faculty influences on their intellectual, personal and career growth. The faculty concern scale asked students to report faculty interest in students and teaching.

Data was collected from the responses of 655 randomly selected graduating seniors in 27 academic departments at a Research II institution. From their regression analysis, Volkwein & Carbone (1994) found students' personal relationships with faculty, and faculty influences on their intellectual, personal and career growth (faculty relations) positively predicted academic satisfaction. No statistically significant relationship was found for faculty-student academic contact.

When Kuh & Hu (2001) examined the contribution of student-faculty interaction to student satisfaction during college, they measured satisfaction as the sum of student response to two items on the CSEQ questionnaire: "how well do you like college?" and "if you could start over again, would you go to the same college you are now attending?"

Student-faculty interaction was operationalized in two ways. First the researchers derived an overall student-faculty interaction index, "STUFAC" that measured the content and frequency of interactions and comprised 13 items that included: talked with a faculty member, visited informally after class, discussed career plans, had coffee with a faculty member, worked on a research project, met with a faculty advisor of a club, asked an instructor for advice to improve writing, and talked with an instructor who criticized your work. The second way in which Kuh & Hu (2001, p. 317) operationalized student-faculty interaction was to divide the overall STUFAC index into three student-faculty interaction factors: "Substantive Academic or Career-Related Interactions," "Out-of Class Personal or Social Contact," and "Writing Improvement."

Applying multiple regression analysis to data derived from the responses of 5,409 students in 126 colleges and universities to the third edition of the College Student Experiences Questionnaire (CSEQ), Kuh & Hu found that student-faculty interaction did not predict satisfaction directly, but indirectly through its effect on the total amount of effort students

devoted to other college activities. Out-of-class personal or social contact had positive gross effects on satisfaction but students' writing improvement-related contacts with faculty had negative net effects on satisfaction. The researchers suggested that it was possible that many students - especially in the first year - interpret faculty feedback on their writing as critical while faculty members may intend their critique as a challenge to achieve higher levels of performance. Such feedback may come as a shock to many new students who earned relatively high grades in high school (Kuh & Hu, 2001, p. 328).

Kuh & Hu (2001) also found that compared to White students, African-Americans, and Asian American students were less satisfied with college. Compared to students at comprehensive colleges and universities, students at research universities and doctoral universities were more satisfied with their college experience. The more selective the institution, the higher was the level of satisfaction.

Student-faculty interaction is positively associated with students' satisfaction with faculty contact, courses and instruction, and the campus community. Sax, Bryant, & Harper (2005) sought gender effects of both the quantity and quality of student-faculty interaction on a range of student outcomes. These outcomes included satisfaction with the community on campus (satisfaction with interaction with other students, the overall college experience, and the sense of community on campus); satisfaction with courses and instruction (satisfaction with the overall quality of instruction, relevance of coursework to everyday life, courses in major field, humanities courses, social science courses, and science and mathematics courses); and satisfaction with faculty contact (satisfaction with contact with faculty and administration, and the ability to find faculty and staff).

Sax, Bryant, & Harper (2005) found that, for both men and women, talking with faculty outside of class was related to satisfaction with faculty contact. For both men and women, feeling supported by faculty was related to greater satisfaction with faculty contact and with the campus community. For both men and women, feeling that their comments had been slighted by faculty predicted higher rates of feeling overwhelmed as well as lower levels of satisfaction with faculty contact, courses and instruction, and campus community (with the latter effect stronger among women). The effects of faculty support on satisfaction with courses and instruction was stronger among men. No effects on satisfaction was found for the other measures of student-faculty interaction utilized by Sax, Bryant, & Harper (2005) - challenging professors' ideas in class, having faculty provide opportunities for research, and feeling that faculty provided honest feedback about abilities. For their study, regression analysis was applied to data drawn from a national longitudinal sample of college students (N = 17,637) who were surveyed upon entry to college in 1994 and four years later in 1998 in a study conducted by UCLA's Higher Education Research Institute.

Cole (2008) redefined student-faculty interaction as "constructive criticism" based on the argument that student-faculty interactions constitute behavioral and psychological indicators of constructive criticism. His redefined category "constructive criticism" comprised three items: "negative feedback about academic work," "assistance with study skills," and "faculty support and encouragement." The latter was a 5-item factor scale that included: encouragement for graduate school, emotional support and encouragement, respect, opportunity to discuss coursework outside of class, and intellectual challenge and stimulation.

Cole examined the effect of student-faculty interactions on minority students' educational satisfaction. His focus was on African-American and Hispanic students. The researcher applied

regression analysis to data drawn from 1422 students who has completed the Cooperative Institutional Research Program (CIRP) surveys for 1999 and 2003. Educational satisfaction was measured on a 4-point scale with 1 = dissatisfied; 2 = neutral; 3 = satisfied; and 4 = very satisfied.

Cole (2008) found that faculty's support and encouragement positively predicted educational satisfaction for the sample of minority students. Negative feedback about academic work was negatively related to African-American students' educational satisfaction.

Kim & Sax (2009) examined whether the effects of student–faculty interaction on six outcome measures - college GPA, degree aspiration, integration, critical thinking and communication, cultural appreciation and social awareness, and satisfaction with college experience - varied by student gender, race, social class, and first-generation status. The study utilized data on 58,281 students who participated in the 2006 University of California Undergraduate Experience Survey (UCUES).

Kim & Sax operationalized student-faculty interaction in two ways. First, they used a scale to measure research-related student–faculty interaction that comprised three items concerning the frequency with which students assisted faculty with research as a volunteer, for course credit, or for pay. Second, the researchers used a scale to measure course-related student–faculty interaction that comprised three items: talking with faculty outside of class about course material, communicating with faculty by email or in person, and interacting with faculty during lecture class sessions.

Satisfaction with overall college experience was measured by two items: satisfaction with overall academic experience, and satisfaction with overall social experience. Students were asked to rate their satisfaction using a six-point scale, ranging from 1 = very dissatisfied to 6 =

very satisfied. Regression analysis was performed on the data. The analysis revealed that for both female and male students, course-related student–faculty interaction was associated with greater satisfaction with overall college experience. The effect of course-related student-faculty interaction on overall college satisfaction was significant and positive for all racial/ethnic groups except African-Americans. Course-related faculty interaction led students in all social class levels to be more satisfied with overall college experience. However, the positive impact of this contact on student overall satisfaction was significantly stronger for upper-class students than middle-class students. Course-related faculty interaction significantly and positively predicted students' overall college satisfaction regardless of students' first-generation status. No statistically significant results were obtained for the effect of research-related faculty interaction on satisfaction.

Einarson & Clarkberg (2010) investigated students' racial/ethnic identification as a moderator of the frequency and outcome impacts of their out-of-class interactions with faculty members. Hierarchical multiple regression analysis was applied to data on 37,401 students at 14 private, research-extensive universities. The students were from four racial/ethnic groups: White, Asian American, African-American, and Latino. Their model included three outcomes relating to the college experience – intellectual gains, self-development gains, and satisfaction. Student-faculty interaction was measured using a faculty contact scale that included six items: worked with faculty member on a research project, discussed your career plans with faculty, discussed your academic work with faculty, had intellectual discussions with faculty outside class, discussed course selection with faculty, and socialized with faculty member at a social event. Intellectual gains were based on a six-item factor reflecting students' estimated changes in general intellectual abilities (for example, think analytically and logically, synthesize and

integrate ideas and information). Satisfaction was a scale comprised of two survey items: students' evaluation of their entire educational experience and the extent of students' agreement that they would attend the same institution if they were starting over again.

Einarson & Clarkberg (2010) found that faculty contact was positively associated with satisfaction for all racial/ethnic groups except African-Americans. No form of faculty contact was a significant predictor of overall satisfaction for all four groups. For White students, having interactions with faculty at social events was the only form of faculty contact with a statistically significant relationship to overall satisfaction.

Strayhorn (2010) applied hierarchical linear regression analysis to data from the College Student Experiences Questionnaire (CSEQ) for a sample of 215 White undergraduates attending HBCUs. The researcher was interested in the impact of student-faculty relationships on overall satisfaction with college among White undergraduates at HBCUs. Student-faculty interaction was measured using the scale developed by Kuh, Pace, & Vesper (1997). A composite scale was calculated by summing the scores on 13 items: talked with a faculty member; asked your instructor for information related to a course you were taking (grades, makeup work, assignments, etc.); visited informally and briefly with an instructor after class; made an appointment to meet with a faculty member in his or her office; discussed ideas for a term paper or other class project with a faculty member; asked an instructor for advice and help to improve your writing; asked your instructor for comments and criticisms about your work; discussed your career plans and ambitions with a faculty member; made an appointment to talk with an instructor who had criticized a paper you had written; met with a faculty adviser or administrator to discuss the activities of a student organization; discussed personal problems or concerns with a

faculty member; had coffee, soda, or snacks with a faculty member; and worked with a faculty member on a research project.

Satisfaction was measured using a composite satisfaction index based on students' responses to two questions: "how well do you like college?" and "if you could start over again, would you go to the same institution you are now attending?" Strayhorn (2010) found that student-faculty interactions were positively related to White undergraduates' satisfaction at Black colleges, suggesting that White students at HBCUs who interacted frequently with faculty members were more satisfied than were their same-race peers.

Student-faculty interaction is not related to academic satisfaction. This was the finding of Hearn (1987) when he applied path analysis to freshmen data from the College Student Experiences Questionnaire (CSEQ). Hearn (1987) examined the impact of undergraduate experiences on aspirations and plans for graduate and professional schooling among 418 undergraduates at two universities, one large and public and the other smaller and church-affiliated. The researcher hypothesized that satisfaction with academic experiences was important in affecting educational aspirations and plans. The academic satisfaction variable measured students' overall satisfaction with "professors' knowledge of their field" in the major department. Student-faculty interaction was operationalized using three items, "chatted informally with a professor," "discussed career plans with a professor," and "discussed personal problems with a professor."

Summary: Research on Satisfaction

While no evidence has been found of a peer-reviewed study that examines student-faculty interaction as a predictor of commuter students' satisfaction with the college experience, the

research literature generally indicates that student-faculty interaction positively predicts academic satisfaction (such as Astin, 1993; Cole, 2008; Einarson & Clarkberg, 2010; Endo & Harpel, 1982; Hearn, 1985; Kim & Sax, 2009; Kuh & Hu, 2001; Sax, Bryant, & Harper, 2005; Strayhorn, 2010; Volkwein & Carbone, 1994; Wilson, Gaff, Dienst, Wood, & Bavry, 1975). However, some studies (for example, Endo & Harpel, 1982; Hearn, 1987) provide exceptions.

Specifically, frequent interaction with faculty predicts students' satisfaction with their educational experience (Astin, 1993; Endo & Harpel, 1982; Wilson, Gaff, Dienst, Wood, & Bavry, 1975); with the quality of instruction, and individual support services (Astin, 1993); and with faculty contact, courses and instruction, and campus community (Sax, Bryant, & Harper, 2005). The availability of professors, their teaching ability, and commitment to their fields predict academic satisfaction (Hearn, 1985).

Faculty contact is positively associated with satisfaction for all racial/ethnic groups except African-Americans (Einarson & Clarkberg, 2010), and for White undergraduates at Black colleges (Strayhorn, 2010). Faculty support and encouragement positively predict educational satisfaction for African-American and Hispanic students (Cole, 2008). Course-related student–faculty interaction relates to greater satisfaction with overall college experience for all racial/ethnic groups except African-Americans (Kim & Sax, 2009).

Sax, Bryant, & Harper (2005) find that for both men and women, talking with faculty outside of class and feeling supported by faculty, are related to satisfaction with faculty contact. For both female and male students, course-related student–faculty interaction predicts greater satisfaction with overall college experience (Kim & Sax, 2009).

There are studies that find negative or indirect relationships between student-faculty interaction and satisfaction. For example, Kuh & Hu (2001) find that student-faculty interaction

did not predict satisfaction directly, but indirectly through its effect on the total amount of effort students devoted to other college activities. Satisfaction is negatively predicted by frequent student-faculty interaction of a formal nature (Endo & Harpel, 1982), and students' writing improvement-related contacts with faculty (Kuh & Hu, 2001). On the other hand, Hearn (1987) finds that no relationship between student-faculty interaction and academic satisfaction.

Of the studies reviewed here, most applied multiple regression analysis to data for multiple institutions. In addition, most studies adopted items from Pascarella & Terenzini's (1977) "student-faculty contact" to operationalize student-faculty interaction.

Research on Intellectual Skills Development

While intellectual skills development is yet to be predicted empirically by student-faculty interaction specifically among commuter students, most studies have found a positive relationship between the two concepts (for example, Astin, 1993; Cruce, Wolniak, Seifert, & Pascarella, 2006; Endo & Harpel, 1982; Kim, 2002; Kim & Sax, 2011; Kuh & Hu, 2001; Lundberg, 2010; Lundberg & Schreiner, 2004; Pascarella & Terenzini, 1978; Sax, Bryant, & Harper, 2005; Terenzini, Springer, Pascarella, & Nora, 1995; Terenzini, Theophilides, & Lorang, 1984; Volkwein & Carbone, 1994; and Volkwein, King, & Terenzini, 1986).

Student-faculty interaction predicts intellectual growth (Astin, 1993; Endo & Harpel, 1982; Kim & Sax, 2011; Kuh & Hu, 2001; and Volkwein, King, & Terenzini, 1986). Astin (1993) found that every self-reported area of intellectual growth was positively correlated with frequent student interaction with faculty. This researcher examined "the comparative impact of different collegiate experiences" (p. 7) on the outcomes of a college education. The college

environment - faculty, peer group, and the curriculum - provided the bases for the comparative study.

Astin applied multiple regression analysis to longitudinal data drawn from the 1985 CIRP survey and follow-up surveys in the fall of 1989 and the winter of 1990 for a national sample of 24,847 freshmen at 217 four-year colleges. He predicted intellectual growth using a composite measure labeled "Frequency of Student Interaction with Faculty" which consisted of "the sum total of students' responses" to items that included: "hours per week spent talking with faculty outside of class," "assisted faculty in teaching a course," "worked on a professor's research project," and "was a guest in a professor's home" (p. 73).

For transfer students, the development of their intellectual skills and their acquisition of knowledge are positively related to the quantity and quality of student-faculty interaction. Using longitudinal data for 231 students at SUNY Albany a public research university, Volkwein, King, & Terenzini (1986) measured the effect of interacting with faculty on two measures of intellectual growth - intellectual skills development, and academic content acquisition. Student-faculty interaction was captured by two independent variables. One variable was the frequency of transfer student informal contact with faculty outside the classroom that lasted ten minutes or more. This variable measured the number of times students met informally with faculty members outside of class: (a) to get basic information and advice about their academic program; (b) to discuss intellectual and course-related matters; (c) to discuss matters related to their future career; (d) to help resolve a disturbing personal problem; (e) to discuss a campus issue or problem; and (f) to socialize informally.

Their second independent variable was the quality or effectiveness of informal contact with faculty based on two scales, "faculty relations" and "faculty concern for teaching and

student development." Students were asked to report the extent to which they had developed close personal relationships with faculty, the extent to which those relationships had influenced their intellectual growth, personal growth, and career goals, and their perceptions about their faculty as being superior teachers who were genuinely interested in teaching, who took the time to meet with students outside of class, and who were concerned about student growth both inside and outside the classroom.

After first conducting a principal components analysis, hierarchical, setwise, multiple regression was used to examine the relationships among the variables. Volkwein, King, & Terenzini (1986) found that the "faculty relations" and "faculty concern" scales were associated with gains in academic content (intellectual growth) among transfer students, whereas the frequency of faculty-student contact was consistently unrelated to such growth. The authors concluded that the mere frequency of faculty contact was not a contributor to transfer student intellectual growth. Instead, the quality or effectiveness of the faculty-student relationship was the key influence.

Frequent informal interaction with faculty predicts intellectual outcomes. Endo & Harpel (1982) examined the effects of four aspects of student-faculty interaction on a variety of student outcomes after four years at one institution. The four aspects were: the frequency of formal student-faculty interaction (faculty discuss traditional academic and vocational advising topics); the frequency of informal student-faculty interaction (where faculty members have a more friendly relationship with students, and exhibit a personal and broad concern with students' emotional and cognitive growth); the quality of faculty academic and vocational advising; and the helpfulness of faculty (which also provides some indication of the degree of faculty concern and willingness to interact with students).

The researchers examined the relationship between the four aspects of student-faculty interaction and four outcomes: personal/social outcomes (importance of self-directed learning, importance of developing independence, social self-confidence, formal involvement in extracurricular activities, and good social experiences); intellectual outcomes (adequacy of general knowledge, adequacy of math skills, development of problem-solving skills, and development of public speaking skills, progress toward intellectual goals, participation in cultural activities, and highest degree planned); academic achievement; and satisfaction with education. General least squares regression techniques were applied to data gathered from the University of Colorado's 1975 Freshman Questionnaire and a 1979 Graduating Students Survey.

The results provided support for the importance of student-faculty interaction on the intellectual outcomes of college. Endo & Harpel (1982) found that frequent informal interaction was positively related to six out of seven intellectual outcomes: adequacy of general knowledge, adequacy of math skills, development of problem solving skills, development of public speaking skills, participation in cultural activities, and progress towards intellectual goals. The helpfulness of faculty had a positive association with students' progress toward intellectual goals.

Substantive student-faculty interaction and writing improvement have positive net effects on intellectual development (Kuh & Hu, 2001). Kuh & Hu (2001) investigated the nature and impact of student-faculty interaction on student learning and personal development in the 1990s. In part, the researchers sought to find out the relative effects on student learning and satisfaction of informal social contacts between students and faculty and contact focused on academic performance (such as improving writing and discussing class readings outside the classroom). They applied multiple regression analysis to data derived from the responses of 5,409 students in

126 colleges and universities to the third edition of the College Student Experiences Questionnaire (CSEQ).

Student-faculty interaction was operationalized in two ways. First the researchers derived an overall student-faculty interaction index, "STUFAC" that measured the content and frequency of interactions and comprised 13 items that included: talked with a faculty member, visited informally after class, discussed career plans, had coffee with a faculty member, worked on a research project, met with a faculty advisor of a club, asked an instructor for advice to improve writing, and talked with an instructor who criticized your work. The second way in which Kuh & Hu (2001) operationalized student-faculty interaction was to divide the overall STUFAC index into three student-faculty interaction factors: "Substantive Academic or Career-Related Interactions," "Out-of Class Personal or Social Contact," and "Writing Improvement" (p. 317).

Kuh & Hu measured the effect of student-faculty interaction on gain factor scores that were based on five factors: general education, intellectual skills, personal/social development, science and technology, and vocational preparation. The researchers found the overall student-faculty interaction index (STUFAC) had negative effects on the general education factor gain scores. The three factors had differential effects on gains. Substantive student-faculty interaction had positive gross effects on GAINSUM (the sum of all gain items), general education, vocational preparation, and intellectual development, and positive net effects on vocational preparation and intellectual development.

Out-of-class contact had positive gross effects on the sum of gain items, general education, science and technology, and vocational preparation, but it had negative net effects on the sum of gain items, and intellectual development. Writing improvement had positive gross effects on the sum of gain items, general education, science and technology, and intellectual

development. It had positive net effects on intellectual development and negative net effects on vocational preparation. Kuh & Hu (2001) also found that the better academically-prepared a student was and the more time the student spent preparing for classes, the higher was the score on the overall student-faculty interaction index.

Both general faculty contact and research engagement with faculty are related to growth in students' cognitive skills (Kim & Sax, 2011). Kim & Sax (2011) used multilevel modeling to examine the relationship between student–faculty interaction and cognitive skills development across academic majors and departmental climate. Data was drawn from the responses of 43,014 students in 119 academic majors across nine campuses to the 2008 University of California Undergraduate Experience Survey (UCUES). The outcome variable, cognitive skills, was measured by students' self-assessment of their cognitive abilities in three areas: analytical and critical thinking skills, ability to be clear and effective when writing, and ability to read and comprehend academic material.

Students' frequency of interaction with faculty was measured by scales for general faculty contact and research engagement with faculty. General faculty contact was composed three items concerning how often a student was involved in talking with faculty outside of class about course material, communicating with faculty by email or in person, and interacting with faculty during lecture class sessions. Research engagement with faculty was based on three items concerning whether students assisted faculty with research as a volunteer, for course credit, or for pay.

Kim & Sax found that both general faculty contact and research engagement with faculty were related to growth in students' cognitive skills, and that the impact of students' interaction with faculty varied by academic major. The relationship between general faculty contact and

cognitive skill development tends to be greater in academic majors with higher levels of positive faculty support (i.e., where students have more open channels of communication with faculty, are treated more equitably and fairly by faculty, and obtain more prompt and useful feedback on student work by faculty). More specifically, the relationship between general faculty contact and cognitive skill development tends to be greater in academic majors with higher levels of positive faculty support and in fields such as Chinese Language/Literature, Microbiology, and Nutrition Sciences rather than in fields such Information Science/Studies, Cell/Cellular Biology, and minor areas of Social Sciences (Kim & Sax, 2011).

The relationship between research engagement with faculty and cognitive skill development tends to be greater in academic majors that more frequently require students in their classes to examine and consider other methods and conclusions, incorporate ideas from different courses, generate new ideas, and use facts and examples to support their view points. Specifically, students' cognitive skill development appear to benefit most from research engagement with faculty in the fields of Hispanic-American/Chicano Studies, Geography, and Microbiology and least within Mass Communication/Media Studies, Biotechnology, and minor areas of Social Sciences (Kim & Sax, 2011).

Student-faculty interaction is associated with the value students attribute to learning. Terenzini, Springer, Pascarella, & Nora (1995) sought to estimate the relative importance of three theoretically interrelated variables on changes on students' intellectual curiosity and interest in learning. The three variables were students' curricular experiences, their formal instructional experiences and classroom-related contacts with faculty members, and their out-of-classroom experiences with faculty, peers, and the formal curriculum. The researchers wanted to

assess whether students' interest in learning was shaped by both formal academic activities and by their out-of-class experiences.

OLS regression analysis was applied to data drawn from 210 freshman students enrolled for six or more academic credit hours at a large, urban, Research 1 university in the Midwest serving an undergraduate population composed primarily of commuters. The dependent variables "interest in academic learning" and "intrinsic value of learning" measured students' orientation towards learning. Interest in academic learning was developed from items dealing with students' enjoyment of their academic collegiate experiences, the willingness to work hard to master material, and their enjoyment in learning complicated material. Intrinsic value of learning was developed from items dealing with the importance of preparing for a career, the importance of getting the best grades, valuing learning in a course above the grade received, and the relatively greater value attached to learning about self, compared with preparing for a career.

The student-faculty interaction independent variable was operationalized differently for each model. The student-faculty interaction independent variable in the interest in academic learning model was operationalized as hours/week talking with teachers outside class. The corresponding variable in the intrinsic value of learning model was "experiences with faculty" consisting of the 10 items from the CSEQ "Experiences with Faculty" scale that included: talk with a faculty member, ask for course-related information, visit informally with a faculty member after class, discuss ideas for a term paper or class project with an instructor, ask an instructor for comments and criticisms of their work, meet a faculty member for coffee or a soft drink, or work with a faculty member on research project.

Terenzini, Springer, Pascarella, & Nora (1995) found that experiences with faculty predicted the intrinsic value students find in learning. Talking with faculty members outside class did not predict to interest in academic learning.

Student-faculty interaction predicts learning and intellectual growth (Lundberg, 2010; and Lundberg & Schreiner, 2004). Lundberg & Schreiner (2004) found that learning was predicted by the quality of relationships with faculty, and the frequency in which students worked harder due to instructor feedback, worked to meet faculty expectations, asked faculty for advice to improve writing, and talked with faculty about their personal concerns. The researchers investigated the extent to which students of seven different racial groups (African-American, Asian or Pacific Islander, Native American, Mexican American, Hispanic and Puerto Rican, multiethnic, and White) interacted with faculty members and how those interactions affected their learning. Hierarchical multiple linear regression analysis was applied to data drawn from a sample of 4,501 undergraduate students who completed College Student Experiences Questionnaires (CSEQ) between 1998 and 2001. Students were primarily from doctoral and master's level institutions, with fewer from baccalaureate colleges.

Lundberg & Schreiner (2004) measured faculty interaction using two variables: frequency of experiences with faculty, and quality of relationships with faculty. Frequency of experiences with faculty comprised of thirteen items: talked with instructor about course, discussed academic program or course selection with a faculty member, discussed ideas for a term paper or other class project with a faculty member, discussed career plans and ambitions with a faculty member, worked harder as a result of feedback from an instructor, socialized with faculty outside of class (had a snack or soft drink, etc.), participated with other students in a discussion with one or more faculty members outside of class, asked instructor for comments and

criticisms about academic performance, worked harder than you thought you could to meet an instructor's expectations and standards, worked with a faculty member on a research project, asked instructor or staff member for advice and help to improve writing, met with a faculty member or staff advisor to discuss the activities of a group or organization, talked with a faculty member, counselor or other staff member about personal concerns.

Quality of relationships with faculty was measured by students' rating of professors on a scale that ranged from 1 = remote, discouraging, unsympathetic; to 7 = approachable, helpful, with faculty understanding, encouraging. Learning, the dependent variable, was measured by students' rating of the extent to which they understand art, enjoy literature, broad general education, understand importance of history, knowledge about other parts of the world, aware of different philosophies, write clearly, present ideas through speaking, use computers, analyze quantitative problems, think analytically, put ideas together, understand science, understand new development in science, aware of consequences of new applications of science, ability to get along with different kinds of people, learning alone, adapting to change, function as a team member, good health habits, developing own values and ethics, and understanding self.

Lundberg & Schreiner (2004) found that learning was predicted by both the quality of relationships with faculty, and the frequency of experiences with faculty (in the form of "worked harder due to instructor feedback," "worked to meet faculty expectations," "asked faculty for advice to improve writing," and "talked with faculty about personal concern"). While the quality of relationships with faculty predicted learning for all the racial/ethnic groups, it was the strongest predictor in the model for Asian/Pacific Islander students. Among the racial/ethnic groups for which frequency of experiences with faculty predicted learning, "worked harder due to instructor feedback" was strongest for African-American students, "worked to meet faculty

expectations" was strongest for White students, "asked faculty for advice to improve writing" was strongest for Mexican-American students, and "talked with faculty about personal concern" was strongest for African-American students.

Students' perceptions of faculty rather than the frequency of interaction predict intellectual growth for students of color. This finding was endorsed by Lundberg (2010) when the researcher used multiple linear regression analysis to identify how student involvement in the college experience and an institution's emphasis on valuing diversity contribute to learning in three domains: general education, science and technology, and intellectual skills. Data was drawn from a national sample of 2659 students of color who had completed the College Student Experiences Questionnaire (CSEQ) of Indiana University's Center for Postsecondary Research during 1999-2001. One of the key independent variables was student involvement in the college experience which included frequency of interactions with faculty and student perceptions of quality of relationships with faculty. Ten items on the CSEQ questionnaire measured the frequency of interaction with faculty members outside the classroom around issues of coursework, career, or personal interest. The item on student perceptions of quality of relationships with faculty measured the extent to which faculty were viewed to demonstrate characteristics that ranged from being remote, discouraging, unsympathetic to being approachable, helpful, understanding, and encouraging.

Lundberg (2010) found that learning was predicted by positive perceptions about faculty. For students of color, their perception of faculty as approachable, helpful, understanding, and encouraging predicted learning in general education and the development of intellectual skills. However, while perceptions about faculty predicted learning outcomes, frequent interaction with faculty members outside of the classroom did not predict any of the learning outcomes.

Lundberg (2010) concluded that perceiving faculty to be approachable, helpful, encouraging, and understanding was more important than the frequency with which students of color engaged with faculty.

Einarson & Clarkberg (2010) investigated students' racial/ethnic identification as a moderator of the frequency and outcome impacts of their out-of-class interactions with faculty members. Hierarchical multiple regression analysis was applied to data on 37,401 students at 14 private, research-extensive universities. The students represented four racial/ethnic groups: White, Asian American, African-American, and Latino. Their model included three outcomes relating to the college experience – intellectual gains, self-development gains, and satisfaction.

Student-faculty interaction was measured using a faculty contact scale that included six items: worked with faculty member on a research project, discussed your career plans with faculty, discussed your academic work with faculty, had intellectual discussions with faculty outside class, discussed course selection with faculty, and socialized with faculty member at a social event. Intellectual gains were based on a six-item factor reflecting students' estimated changes in general intellectual abilities (for example, think analytically and logically, synthesize and integrate ideas and information).

Einarson & Clarkberg (2010) found that faculty contact was positively associated with intellectual gains for all four racial/ethnic groups. For White students, all types of faculty contact, except interacting at a social event, were statistically significant correlates of estimated intellectual gains with discussions of academic work being the strongest predictor. All six measures of faculty contact were significant predictors of intellectual gains for Asian American students. Discussion of academic work was also the strongest predictor of intellectual gains for Asian American, African-American, and Latino students. However, based on the unstandardized

beta coefficient, the discussions with Latino students appear to be of less importance than was the case for Asian American and African-American students.

Interaction with faculty is related to the development of critical thinking skills (Cruce, Wolniak, Seifert, & Pascarella, 2006; Kim, 2002; Sax, Bryant, & Harper, 2005). It is positively associated with changes in critical thinking skills. Sax, Bryant, & Harper (2005) find that talking with faculty outside of class predicts changes in critical thinking and knowledge similarly for men and women, while the predictive effect of general faculty support is stronger for men, and the effect of challenging professors' ideas in class is stronger for women.

Sax, Bryant, & Harper (2005) sought gender effects of both the quantity and quality of student-faculty interaction on a range of student outcomes. Their study included six student-faculty interaction variables as independent variables. These variables were general faculty support (a factor scale comprising eight items related to feeling respected, supported, and challenged by faculty), feeling that faculty did not take one's comments seriously in class, challenging professors' ideas in class, hours per week spent talking with faculty outside of class, having faculty provide opportunities for research, and feeling that faculty provided honest feedback about abilities. Regression analysis was applied to data drawn from a national longitudinal sample of college students (N = 17,637) who were surveyed upon entry to college in 1994 and four years later in 1998 in a study conducted by UCLA's Higher Education Research Institute.

Intellectual self-confidence, critical thinking ability, and analytical and problem-solving skills are associated with interactions with faculty (Kim, 2002). Kim (2002) investigated the effectiveness of 4-year women-only and coeducational colleges in cultivating women students' intellectual development. Hierarchical linear modeling was applied to data derived from 1,397

female students from 86 colleges who took the initial CIRP survey in 1987 and the follow-up survey in 1991.

The researcher focused on three criteria of intellectual development: (a) intellectual self-confidence, (b) critical thinking ability, and (c) analytical and problem-solving skills. "Intellectual self-confidence" was derived from a survey that required students to rate whether their intellectual self-confidence was highest 10 percent, above average, average, below average, and lowest 10 percent compared to the average person their age. "Critical thinking ability" and "analytical and problem-solving skills" were derived from items that asked seniors to describe whether their skills were stronger, weaker, or unchanged, as compared with when they entered college as freshmen. Student-faculty interaction was operationalized by two items: students' participation in a professor's research project, and "faculty took personal interest in my progress" which dealt with the quality of the overall student-faculty relationship.

Reading comprehension and critical thinking skills are also predicted by students' interaction with faculty (Cruce, Wolniak, Seifert, & Pascarella, 2006). Cruce, Wolniak, Seifert, & Pascarella (2006) used Chickering & Gamson's (1987) Seven Principles of Good Practices in Undergraduate Education as a basis for their 2006 study and confirmed that good practice principles, which include faculty student interaction, had significant positive impacts on student outcomes. The researchers estimated the effects of three dimensions of good practice on students' cognitive development, orientations to learning, and graduate degree plans during the first year of college. Specifically, the dependent variables for this study were three standardized measures of the students' cognitive development (i.e., reading comprehension, mathematics knowledge, and critical thinking skills), five measures of the students' orientations to learning (i.e., openness to diversity and challenge, learning for self-understanding, internal locus of

attribution for academic success, preference for higher-order cognitive tasks, and positive attitude toward literacy), and a measure of the students' educational aspirations (i.e., graduate degree plans - Master's degree or higher, or Bachelor's degree or lower).

The three dimensions of good practice were "Effective Teaching and Interaction with Faculty," Interactions with Peers," "Challenge/High Expectations." The dimension "Effective Teaching and Interaction with Faculty" measure comprised faculty interest in teaching and student development, quality of student–faculty non-classroom interactions, instructor use of high-order questioning techniques, instructor feedback to students, instructional skill/clarity, instructional organization and preparation, course challenge/effort, and college scholarly/intellectual emphasis.

Cruce, Wolniak, Seifert, & Pascarella (2006) applied ordinary least squares or logistic regression to analyze longitudinal data from a sample of 2,474 students at 18 four-year colleges (5 liberal arts colleges, 4 research I or research II universities, 7 regional (comprehensive) universities, and 2 historically Black) colleges and universities, and 5 two-year colleges that participated in the National Study of Student Learning (NSSL). The researchers found that Effective Teaching and Interaction with Faculty had a significant total and direct effect on reading comprehension, critical thinking skills, openness to diversity and challenge, and internal locus of attribution for academic success.

Pascarella & Terenzini (1978), Terenzini, Theophilides, & Lorang (1984), and Volkwein & Carbone (1994) found that the relationship between student-faculty interaction and intellectual growth and academic skills development depends on students' year of study. Pascarella & Terenzini (1978) found that student-faculty interaction influences intellectual development during the freshman year. The researchers investigated the relationship between student-faculty

informal relationships and three freshman year educational outcomes – academic performance (GPA), intellectual development, and personal growth.

Setwise multiple regression and partial correlational analyses were applied to data for 766 students attending Syracuse University, a large, private university in central New York. Student-faculty interaction was operationalized by three measures: student ranking of faculty members on the degree of positive influence on students' intellectual development, and on students' personal development, and a scale for the frequency in which students met informally with a faculty member outside of class "to get basic information and advice about my academic program," "to discuss matters related to my future career," "to help resolve a disturbing personal problem," "to discuss intellectual or course-related matters," "to discuss a campus issue or problem," and "to socialize informally." The intellectual development scale was developed from students' response to their progress in terms of their application of abstractions/principles in problem solving; critical evaluation of ideas; gain of factual knowledge; and learning of fundamental principles, generalizations, and theories.

Eight measures of the frequency and strength of student-faculty in formal relationships accounted for statistically significant increases in the variance in freshman year academic performance and self-perceived intellectual and personal development. Frequency of student-faculty informal interactions focusing on intellectual or course related matters had the strongest positive association with academic performance and intellectual development. Interactions for the purpose of discussing students' career concerns had the strongest association with self-perceived personal growth.

Terenzini, Theophilides, & Lorang (1984) found that academic skills development in the sophomore year was predicted by faculty concern for student development and teaching for

freshmen, and by faculty relations and frequency of non-academic contact for sophomores. Academic skills development in the junior year was predicted the frequency of academic contact for sophomores and the frequency of non-academic contact for juniors. The researchers investigated the relationship between students' college experiences and the development of academic skills (e.g., analytical thinking ability, critical evaluation skills). Three hierarchical, stepwise multiple regressions were performed with freshman-year progress, sophomore-year progress, and junior-year progress as the dependent variables. The data for their study was derived from the responses of 250 students at a large, northeastern, public university with a highly selective undergraduate division to the "1978 Student Information Form" developed by Astin and his colleagues for the Cooperative Institutional Research Program.

Similar to Pascarella & Terenzini (1979), Terenzini, Theophilides, & Lorang (1984) operationalized student-faculty interaction by splitting the six items in Pascarella & Terenzini's (1977) "student-faculty contact" measure into two in order to reflect social and academic integration. The measure for academic integration included academic issues, that is: 1) get basic information and advice about my academic program, 2) discuss matters related to my future career, and 3) discuss intellectual or course-related matters. The measure for social integration included non-academic issues: 1) help resolve a disturbing personal problem, 2) discuss a campus issue or problem, and 3) socialize informally. Similar to Pascarella & Terenzini (1979), Terenzini, Theophilides, & Lorang (1984) included a "faculty concern for teaching and student development" scale under academic integration, and an "informal relations with faculty" scale under social integration.

The scale for their outcome variable – academic development – was based on items that measured students' progress in terms of gaining factual knowledge (terminology, methods,

trends); developing the ability to critically evaluate ideas, materials, and methods; developing the ability to apply abstractions or principles to solving problems; learning fundamental principles, generalizations, or theories; learning how to learn; developing the ability to think analytically; developing the ability to learn on one's own ; and developing the ability to formulate creative and original ideas and solutions. Based on their findings, the researchers concluded that the quality of student-faculty contact appeared to be more influential than the frequency of that contact in the sophomore year, but in the junior year, frequency appears to exceed quality in importance.

Volkwein & Carbone (1994) found an association between faculty relations and intellectual growth for students in their senior year. Volkwein & Carbone (1994) were interested in whether a strong research orientation by an academic department promoted or hindered student learning, and whether differences in departmental teaching and research climates were associated with differences in the academic integration and intellectual growth of the undergraduates who major in humanities, sciences, and social sciences. Their independent variables included departmental research climate, departmental teaching climate, academic integration, and social integration. Their outcomes were senior year intellectual growth, fourth-year intellectual growth, senior year growth in disciplinary skills, fourth-year growth in disciplinary skills, and academic satisfaction.

The scale for senior year intellectual growth comprised 8 items measuring "academic skill development," "intellectual skill development," and "academic growth." The scale for fourth-year intellectual growth comprised of 12 items: gaining factual knowledge; developing ability to evaluate ideas critically; developing ability to apply abstractions in solving problems; learning fundamental principles and theories; learning how to learn; developing analytical

thinking; developing the ability to learn on my own; formulating creative ideas and solutions; gaining exposure to new intellectual areas; synthesizing information; recognizing general principles; and developing intellectual curiosity.

Student-faculty interaction was included in the study in two ways: as faculty-student academic contact, and as part of academic integration. Faculty-student academic contact was used as a measure of departmental teaching climate and operationalized in terms of the frequency of out-of-class faculty contacts of at least ten minutes to discuss academic matters. In addition, the researchers included faculty relations, and faculty concern for student development in their measure of academic integration. The faculty relations scale was composed of four items that asked students to report on their personal relationships with faculty, and faculty influences on their intellectual, personal and career growth. The faculty concern scale asked students to report faculty interest in students and teaching.

Data was collected from the responses of 655 randomly selected graduating seniors in 27 academic departments at a Research II institution. From their regression analysis, Volkwein & Carbone (1994) found that overall, departmental teaching climate was negatively associated with intellectual growth. The measure of faculty's personal relationships with students and their influence on students' intellectual, personal and career growth, was positively associated with intellectual growth for students in their senior year only. No impact on intellectual growth was predicted by faculty-student academic contact.

Summary: Research on Intellectual Skills Development

While commuter students' intellectual skills development is yet to be predicted empirically by student-faculty interaction, most studies have found a positive relationship

between the two concepts (for example, Astin, 1993; Cruce, Wolniak, Seifert, & Pascarella, 2006; Endo & Harpel, 1982; Kim, 2002; Kim & Sax, 2011; Kuh & Hu, 2001; Lundberg, 2010; Lundberg & Schreiner, 2004; Pascarella & Terenzini, 1978; Sax, Bryant, & Harper, 2005; Terenzini, Springer, Pascarella, & Nora, 1995; Terenzini, Theophilides, & Lorang, 1984; Volkwein & Carbone, 1994; and Volkwein, King, & Terenzini, 1986).

Frequent interaction with faculty predicts intellectual outcomes for students generally (Astin, 1993; Endo & Harpel, 1982; Kuh & Hu, 2001), and for transfer students in particular (Volkwein, King, & Terenzini, 1986). Both general faculty contact and research engagement with faculty are related to growth in students' cognitive skills (Kim & Sax, 2011). Student-faculty interaction predicts learning and the intrinsic value students attribute to learning (Lundberg, 2010; Lundberg & Schreiner, 2004; and Terenzini, Springer, Pascarella, & Nora, 1995).

While Einarson & Clarkberg (2010) found that faculty contact is positively associated with intellectual gains for all racial/ethnic groups, Lundberg (2010) and Lundberg & Schreiner (2004) find that it is the quality of relationships with faculty that predicted learning for these groups. Frequent experiences with faculty predicted learning for specific racial/ethnic groups. In particular, the strongest prediction by students' working harder as a result of instructor feedback and by talking with faculty about personal concerns was among African-American students; by students' working to meet faculty expectations was among White students; and by asking faculty for advice to improve writing was among Mexican-American students.

Interaction with faculty is related to the development of critical thinking skills (Cruce, Wolniak, Seifert, & Pascarella, 2006; Kim, 2002; Sax, Bryant, & Harper, 2005). Talking with faculty outside of class predicts changes in critical thinking and knowledge similarly for men and

women, general faculty support has a greater effect for men, while challenging professors' ideas in class has a greater effect for women (Sax, Bryant, & Harper, 2005). Intellectual self-confidence, critical thinking ability, and analytical and problem-solving skills are associated with interactions with faculty (Kim, 2002). Reading comprehension and critical thinking skills are also predicted (Cruce, Wolniak, Seifert, & Pascarella, 2006).

Pascarella & Terenzini (1978), Terenzini, Theophilides, & Lorang (1984), and Volkwein & Carbone (1994) find that the relationship between student-faculty interaction and intellectual growth and academic skills development depends on students' year of study. Student-faculty interaction influences intellectual development during the freshman year (Pascarella & Terenzini, 1978), sophomore and junior years (Terenzini, Theophilides, & Lorang, 1984), and senior year (Volkwein & Carbone, 1994).

Most of the studies that examined the relationship between student-faculty interaction and intellectual skills development utilized multi-institutional data, and in particular, data drawn from the College Student Experiences Questionnaire (CSEQ). Multiple regression analysis was the most frequently used method of analysis. Most studies operationalized student-faculty interaction using frequency of contact items derived from Pascarella & Terenzini's (1977) "student-faculty contact". None of the studies mentioned here were conducted primarily on data for commuter students.

Research on Grade-Point Average

While no evidence has been found of a peer-reviewed study that examines student-faculty interaction as a predictor of commuter students' grade-point average, the research literature generally indicates that generally student-faculty interaction positively predicts GPA (such as

Anaya & Cole, 2001; Astin, 1993; Cole, 2008; Cole, 2010; Kim, 2010; Kim & Sax, 2009; Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978). However, Cole (2008, 2010) found negative correlations with GPA.

Frequent student-faculty informal interaction to discuss intellectual or course related matters, and students' career concerns, predicts GPA (Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978). Pascarella & Terenzini (1978) found that student-faculty interaction predicted grade-point average during the freshman year. The researchers investigated the relationship between student-faculty informal relationships and three freshman year educational outcomes – academic performance (GPA), intellectual development, and personal growth. Setwise multiple regression and partial correlational analyses were applied to data for 766 students attending Syracuse University, a large, private university in central New York. Student-faculty interaction was operationalized by several measures: student ranking of faculty members on the degree of positive influence on students' intellectual development, and on students' personal development, and a scale for the frequency in which students met informally with a faculty member outside of class "to get basic information and advice about my academic program," "to discuss matters related to my future career," "to help resolve a disturbing personal problem," "to discuss intellectual or course-related matters," "to discuss a campus issue or problem," and "to socialize informally."

While all eight of Pascarella & Terenzini's measures of the frequency and strength of student-faculty formal relationships accounted for statistically significant proportions of the variance in freshman year academic performance, academic performance was positively associated with two measures - frequent student-faculty informal interactions that focused on discussing intellectual or course related matters, and students' career concerns.

Pascarella, Terenzini, & Hibel (1978) investigated the association between student-faculty informal interaction and academic achievement while controlling for the influence of student pre-enrollment characteristics. Multiple regression analysis was conducted on data for 498 freshmen at Syracuse University who responded to surveys on their expectations and the reality of their college experience. Academic achievement was assessed using freshman year cumulative grade-point average. The frequency of students' informal interaction with faculty was based on students' responses to questions regarding the number of times they had met informally with a faculty member outside of class: "to get basic information and advice about my academic program," "to discuss matters related to my future career," "to help resolve a disturbing personal problem," "to discuss intellectual or course-related matters," "to discuss a campus issue or problem," and "to socialize informally." Pascarella et al (1978) found that two categories of interactions: "to discuss intellectual or course related matters," and "to discuss matters related to my future career," made significant unique contributions to the explanation of residual achievement.

Astin (1993) found that college GPA is correlated with frequent student interaction with faculty. This researcher examined "the comparative impact of different collegiate experiences" (p. 7) on the outcomes of a college education. The college environment - faculty, peer group, and the curriculum - provided the bases for the comparative study. Astin applied multiple regression analysis to longitudinal data drawn from the 1985 CIRP survey and follow-up surveys in the fall of 1989 and the winter of 1990 for a national sample of 24,847 freshmen at 217 four-year colleges. He predicted GPA using a composite measure labeled "Frequency of Student Interaction with Faculty" which consisted of "the sum total of students' responses" to items that included: "hours per week spent talking with faculty outside of class," "assisted faculty in

teaching a course," "worked on a professor's research project," and "was a guest in a professor's home" (p. 73).

Talking with faculty and the quality of students' relationships with faculty predict the academic achievement of Latino students (Anaya & Cole, 2001). Anaya & Cole (2001) investigated the influence of student-faculty interaction on the academic achievement of Latina/o students. The researchers applied hierarchical blocked regression analysis to 1997 College Student Experiences Questionnaire (CSEQ) data for a sample 836 students at 30 research, comprehensive, and doctoral granting institutions. Academic achievement was measured by college grades.

Student-faculty interaction was operationalized by the quality of students' relationships with faculty, and the frequency and content of the interactions. The quality of relationships with faculty was measured by an item that asked students to rate the extent to which faculty demonstrated characteristics that ranged from being remote, discouraging, unsympathetic, to neutral, to being approachable, helpful, understanding, and encouraging. The frequency and content of the interactions were operationalized by items in three categories: "General," "Academic," and "Personal." The general category covered the number of times students talked with a professor, visited informally and briefly with an instructor after class, and made an appointment to meet with a professor in his or her office. The academic category covered the number of times students asked instructor for information related to the course, discussed ideas for a term paper or other class project with professor, asked instructor for comments and criticism about work, and worked with professor on a research project. The personal category covered the number of times students discussed career plans and ambitions with professor, had

coffee, cokes or snacks with professor, and discussed personal problems and concerns with professor.

Anaya & Cole (2001) found that for Latina/o students, the quality of their relationships with faculty, and talking with faculty, were positively associated with academic achievement while visiting faculty informally after class had a negative association with achievement. The researchers attributed the latter finding to the variable acting as "a suppressor variable," that is, the variable was reflecting variance associated with other independent variables rather than with the dependent variable.

Cole (2008) redefined student-faculty interaction as "constructive criticism" based on the argument that student-faculty interactions constitute behavioral and psychological indicators of constructive criticism. His redefined category "constructive criticism" comprised three items: "negative feedback about academic work," "assistance with study skills," and "faculty support and encouragement." The latter was a 5-item factor scale that included: encouragement for graduate school, emotional support and encouragement, respect, opportunity to discuss coursework outside of class, and intellectual challenge and stimulation.

Cole examined the effect of student-faculty interactions on minority students' GPA. His focus was on African-American and Hispanic students. The researcher applied regression analysis to data drawn from 1422 students who has completed the Cooperative Institutional Research Program (CIRP) surveys for 1999 and 2003. Educational satisfaction was measured on a 4-point scale with 1 = dissatisfied; 2 = neutral; 3 = satisfied; and 4 = very satisfied. Cole (2008) found that while faculty's support and encouragement positively predicted GPA for his sample of minority students, faculty assistance with study skills was a negative predictor of African-American and Hispanics students' academic performance (GPA).

Cole (2010) investigated the effects of student-faculty interactions on 2073 African-American, Asian American, and Latino/a students' college GPA. In particular the researchers sought to identify whether there were types of student-faculty contact specific to African-American, Asian American and Latino students; whether student-faculty interactions explained college GPA for African-American, Asian American and Latino students; and what college experiences explained college GPA for African-American, Asian American and Latino students.

Student-faculty interactions consisted of 12 items: Course-Related Faculty Contact (talked with a faculty member; asked for information related to a course; visited informally after class; made appointment to meet in office; discussed term paper/project; discussed career plans and ambitions; asked for comments/criticisms about work); Advice and Criticism from Faculty (asked instructor for advice on writing; made appointment to talk about criticism on paper); Establishing a Mentoring Relationships with Faculty (worked on a faculty research project; had coffee, cokes, snacks; and discussed personal problems).

Applying regression analysis to data from the 1997 College Student Experiences Questionnaire (CSEQ) at 10 predominantly White institutions, three distinctions in the nature of student-faculty interactions were identified across racial/ethnic groups. Each type of student-faculty contact was significantly correlated with students' GPA when the data was aggregated across race/ethnicity. "Course-related faculty contact" and "establishing a mentoring relationship with faculty" were positively correlated with GPA. However, the type "advice and criticism from faculty" was negatively related to GPA. According to Cole (p. 155), "the findings suggested that minority students‟ academic performance were negatively affected by their interactions with faculty regarding the adequacy or quality of their academic work." When the data was disaggregated by race/ethnicity, student-faculty interactions generally (all three types) were not

significantly related to Latino/a students' GPA, and course-related faculty contact was negatively correlated to African-American students' GPA.

Kim & Sax (2009) examined whether the effects of student–faculty interaction on six outcome measures - college GPA, degree aspiration, integration, critical thinking and communication, cultural appreciation and social awareness, and satisfaction with college experience - varied by student gender, race, social class, and first-generation status. The study utilized data on 58,281 students who participated in the 2006 University of California Undergraduate Experience Survey (UCUES).

Kim & Sax operationalized student-faculty interaction in two ways. First, they used a scale to measure research-related student–faculty interaction that comprised three items concerning the frequency with which students assisted faculty with research as a volunteer, for course credit, or for pay. Second, the researchers used a scale to measure course-related student–faculty interaction that comprised three items: talking with faculty outside of class about course material, communicating with faculty by email or in person, and interacting with faculty during lecture class sessions. College GPA was measured by students' transcript-based undergraduate GPA (that is, GPA reported in the University of California system student records).

Regression analysis of the data revealed that for both female and male students, research-related student–faculty interaction (students' experience of assisting faculty with research as a volunteer, for course credit, or for pay) positively predicted their higher college GPAs. Kim & Sax also found that while undergraduate research experience was positively associated with students' college GPA for all racial groups, the association was stronger among African-American students than for Latino and Asian American students. For all social class groups, students who assisted faculty with research were more likely to obtain higher college GPAs. The

positive impact of students' research experience with faculty on their college GPA was equally strong for both first-generation and non-first-generation college students.

For both female and male students, course-related student–faculty interaction related to higher college GPAs. The effect of course-related student-faculty interaction on college GPA was positive for all groups except African-Americans, for students in all social class levels, and non-first-generation students.

Kim (2010) investigated patterns of student-faculty interaction by racial group in terms of their levels, effects on student outcomes, and causal directions related to student outcomes. The researcher examined the effect of student-faculty interaction on student educational outcomes, as well as the effects of outcomes on student-faculty interaction, using a non-recursive causal model. 2SLS regression analysis was applied to data on 20,838 students from 267 universities and four-year colleges. The data was drawn from the 1994 Student Information Form (SIF) and the 1998 College Student Survey (CSS) of the Cooperative Institutional Research Program (CIRP).

Student-faculty interaction was operationalized as academic and personal interaction. . Academic student-faculty interaction was a composite measure of three items concerning the degree to which a student received the following from faculty: 1) honest feedback about students' skills and abilities, 2) advice and guidance about an educational program, and 3) assistance to improve study skills. Personal student-faculty interaction consisted of three items: 1) respect (treated students like a colleague peer), 2) emotional support and encouragement, and 3) personal interest in a student's progress. College GPA was alternatively an outcome and an independent variable.

Kim (2010) found that both academic and personal student-faculty contact increased the likelihood of obtaining higher college GPAs for all four racial groups - Whites, African-Americans, Asian Americans, and Latinos. The researcher also found that for all racial groups except Asian Americans, students' higher college GPAs increase the likelihood of their contact with faculty both academically and personally. Higher GPA predicted only academic interaction for Asian Americans.

Summary: Research on Grade-Point Average

While no evidence has been found of a peer-reviewed study that examines student-faculty interaction as a predictor of commuter students' grade-point average, the research literature generally indicates that generally student-faculty interaction positively predicts GPA (such as Anaya & Cole, 2001; Astin, 1993; Cole, 2008; Cole, 2010; Kim, 2010; Kim & Sax, 2009; Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978). However, Cole (2008; 2010) found negative correlations with GPA.

Frequent student interaction with faculty is corrected with college GPA (Astin, 1993). Higher GPAs are predicted when students interact frequently with faculty members to discuss intellectual or course related matters, and their career concerns (Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978).

The impact of student-faculty interaction on GPA varies by race/ethnicity, gender, social class, and first-generation status. Higher GPAs are associated with academic and personal student-faculty contact, faculty's support and encouragement for students, and students' undergraduate research experience for all four racial/ethnic groups - Whites, African-Americans, Asian Americans, and Latinos (Cole, 2008; Cole, 2010; Kim, 2010; Kim & Sax, 2009); and with

talking with faculty and the quality of students' relationships with faculty for Latino students (Anaya & Cole, 2001). While Kim & Sax (2009) find that course-related student-faculty interaction predicts GPA for all racial/ethnic groups except African-Americans, Cole (2010) finds that course-related student-faculty interaction predicts GPA for all racial/ethnic groups except Latinos.

For both female and male students, course-related student–faculty interaction (talking with faculty outside of class about course material, communicating with faculty by email or in person, and interacting with faculty during lecture class sessions), and research-related student–faculty interaction (students' experience of assisting faculty with research as a volunteer, for course credit, or for pay) positively predict their higher college GPAs (Kim & Sax, 2009).

For all social class groups, students who assist faculty with research, and engage faculty on course-related matters are more likely to obtain higher college GPAs (Kim & Sax, 2009). The positive impact of students' research experience with faculty on their college GPA is equally strong for both first-generation and non-first-generation college students. The impact of course-related student-faculty interaction on college GPA is positive only for non-first-generation students (Kim & Sax, 2009).

When Cole (2008; 2010) examined the effect of student-faculty interactions on minority students' GPA, results from his 2008 study indicated that African-American and Hispanics students' GPAs were predicted to be lower when these students' received faculty assistance with study skills. In his 2010 study, Cole found that course-related faculty contact was negatively correlated to African-American students' GPA. In addition, the researcher found that advice and criticism from faculty was negatively related to GPA for all minority students. According to Cole (p. 155), "the findings suggested that minority students' academic performance were negatively

affected by their interactions with faculty regarding the adequacy or quality of their academic work."

Most of the studies that examine the relationship between student-faculty interaction and GPA applied multiple regression analysis on multi-institutional data.

Reverse Causality and Student-Faculty Interaction

This study examined the issue of selection bias that may arise from the use of the potentially endogenous student-faculty interaction variable in empirical analysis. It is important to note that there is yet another issue that may arise in empirical analyses involving student-faculty interaction. This additional issue is simultaneity bias or reverse causality. This topic will be targeted in future research on student-faculty interaction.

Simultaneity bias occurs when there is a feedback relationship between one or more independent variables and the dependent variable. In other words, it occurs when one or more of the independent variables are jointly determined with the dependent variable. Like selection bias, simultaneity bias causes the OLS coefficients and standard errors to be biased. According to Morone, Renna, & Testa (2013), the presence of reverse causality undermines the possibility to conduct sound empirical tests to disentangle the direction of causality between variables employing conventional parametric techniques. Its presence results in some ambiguity regarding the causal relationships between student-faculty interaction and the student outcomes it is used to predict.

Bean & Kuh (1984) examined the relationship between informal faculty contact and undergraduate grades. These researchers suggested that reverse causality may result when students self-select to be "active participants in their own socialization." While it is probable that

the more motivated students will seek out faculty, it is also likely that more motivated students would have higher GPAs, even in absence of interaction. Simultaneity bias arises because motivation may influence both GPA and contact with faculty. According to Bean & Kuh (1984):

> Motivation to succeed may lead not only to high GPAs, probably due to good study habits, but also to more contact with faculty because of a student's interest in doing well. It is difficult to determine whether these students are initially motivated to achieve high grades or are stimulated to work hard by contact with faculty. Some students may be both highly motivated and stimulated by faculty to attain good grades, and the effect of each stimulates the other. It is also probable that faculty gravitate toward students who appear bright, inquisitive, and having interests similar to those of the faculty member. In this situation, informal interaction may be initiated by the faculty member. Thus, the student's personality-particularly intellectual ability may lead to contact, rather than being derived from contact. (p. 463)

Only a few studies address simultaneity bias or reverse causality involving student-faculty interaction. Three studies (Bean & Kuh, 1984; Iverson, Pascarella & Terenzini, 1984; and Kim, 2010) discussed student-faculty interaction as an endogenous variable and endeavored to address this causality problem by applying the identification strategy of two-stage least squares (2SLS) to the data analysis of non-recursive causal models.

Bean & Kuh (1984) set out to assess the degree of reciprocity between informal faculty contact and undergraduate grades. They considered both faculty contact, defined as the total number of informal visits between students and faculty members for 10 minutes or more, and

GPA as endogenous variables. The researchers suggested that other factors (such as motivation) may influence a students' GPA, besides increased contact with faculty, or vice versa.

A non-recursive model was estimated using generalized two-stage least squares regression analysis applied to data on 1096 students enrolled at a mid-western research-oriented university. In their analysis, both GPA and faculty contact were estimated separately and their predicted values derived. However, estimating GPA using the predicted value of faculty contact, and estimating faculty contact using the predicted value of GPA, did not yield significant coefficients for the respective independent variable of interest. According to Bean & Kuh (1984, p. 461) "contrary to expectations, GPA and faculty contact did not strongly affect one another."

On the other hand, significant two-directional results were obtained by Iverson, Pascarella & Terenzini (1984), and Kim (2010). Iverson, Pascarella & Terenzini (1984) investigated the impact of student-faculty contact on the educational aspiration level of commuter college freshmen. Besides OLS regression analysis, the researchers applied two-stage least squares 2SLS to data on 213 students who had completed the 1978 and 1979 CIRP surveys at a large, urban, totally nonresidential, state-supported 4-year university.

The researchers (p. 125) noted that previous analyses had all assumed that student-faculty contact "causes" aspiration. However, Iverson, Pascarella & Terenzini suggested that causality may flow from aspiration to contact,

> …that is, students with initially high aspirations may seek out contact with faculty as a way of realizing their goals. To test which of these causal assumptions is more likely, a nonrecursive model was formulated with contact and aspiration as jointly dependent endogenous variables. (p. 125)

Student-faculty interaction was measured using three "Faculty Relations" variables, based on a combination of items in Pascarella & Terenzini (1977; 1979). The three variables measured the quality of interactions with faculty, faculty concern for student development and teaching, and the frequency of informal contact (social, academic, and total contact) with faculty. The results from the OLS regression analysis had indicated that frequency of informal faculty-student contact focusing on academic topics had a significant positive influence on the post-freshman year educational aspirations of white students. In the 2SLS model, the researchers adopted two approaches. They a) estimated the three forms of faculty-student contact (social, academic, and total contact) separately using predicted aspirations as an independent variable, and b) estimated aspirations using predicted values of the three forms of contact.

Iverson, Pascarella & Terenzini found no relationship in the second approach between aspirations and predicted contact. However, in the first approach, predicted aspirations had significant coefficients in the models for academic contact and total contact. For both whites and nonwhites, precollege degree aspirations and academic contacts were positively and significantly associated. For nonwhites, precollege aspirations were significantly and positively associated with total contact. Precollege aspirations were also positively associated with expected interactions with faculty for white students.

The researchers stated that their results suggested that increases in educational aspirations may lead to increased informal interaction with faculty for white students rather than vice versa, and that white students seek out contact to a greater extent than nonwhite students. Iverson, Pascarella & Terenzini concluded that:

> the test of the nonrecursive model with two-stage least squares regression procedures, however, calls into question the traditional recursive model assumption that informal interaction with faculty influences aspiration level. (p. 134)

Another researcher on reverse causality, Kim (2010) noted that:

> Measuring student college experiences and educational outcomes simultaneously, the majority of higher education surveys neglect to inform researchers of any time ordering between the variables. This, in turn, creates ambiguities of causal directions between student outcomes and college experiences in general, and student-faculty interaction in particular. Thus, to test all possible causal directions between a specific college experience and a student outcome, a nonrecursive causal model, which hypothesizes experience and outcome may affect one another, is more appropriate. (p. 163)

Kim (2010) investigated patterns of student-faculty interaction by racial group in terms of their levels, effects on student outcomes, and causal directions related to student outcomes. The researcher examined both the effect of student-faculty interaction on student educational outcomes, as well as the effects of outcomes on student-faculty interaction, using a non-recursive causal model. 2SLS regression analysis was applied to data on 20,838 students from 267 universities and four-year colleges. The data was drawn from the 1994 Student Information Form (SIF) and the 1998 College Student Survey (CSS) of the Cooperative Institutional Research Program (CIRP). Student-faculty interaction was operationalized as academic and personal interaction. College GPA, educational aspiration, and racial tolerance were alternatively outcomes and independent variables.

Kim found that student-faculty interaction predicted the three outcomes, and the three outcomes predicted student-faculty interaction. With GPA, aspirations, and racial tolerance as the dependent variables, Kim (2010) found that both predicted academic and personal student-faculty contact increased the likelihood of obtaining higher college GPAs for all four racial groups - Whites, African-Americans, Asian Americans, and Latinos; increased the likelihood of educational aspirations for white students; and the likelihood of racial tolerance for white and Asian American students.

With academic and personal student-faculty contact as the dependent variables, the researcher found that for all racial groups except Asian Americans, predicted students' higher college GPAs increase the likelihood of their contact with faculty both academically and personally. Higher GPA predicted only academic interaction for Asian Americans. Student educational aspiration predicted academic and personal student-faculty interaction for all racial groups while students' racial tolerance predicted both types of interaction for White students only.

Bean & Kuh (1984), Iverson, Pascarella & Terenzini (1984), and Kim (2010) addressed the problem of simultaneity bias or reverse causality by applying a two-stage least squares (2SLS) identification strategy in their data analysis. This method is not without its shortcomings. Morone, Renna, & Testa (2013) state that while the problem of endogeneity is typically solved using instrumental variable (IV) procedures, the use of the two-stage least squares (2SLS) method has shortcomings in terms of the difficulty of finding instruments that are both strong and valid. In addition, given that the 2SLS method only provides an estimate of the local average treatment effect, the results cannot be generalized to the entire population unless one is willing to make some strong behavioral assumptions (Morone, Renna, & Testa, 2013). It was because of

these shortcomings with two-stage least squares (2SLS) method that Morone, Renna, & Testa (2013) utilized an alternative method - propensity score matching - in their own analysis.

Chapter Summary

The foregoing literature review identified key findings related to commuter students, student-faculty interaction, and the effects of such interaction on student outcomes. Several of these findings guided this study. These findings were:

a) Commuter students are diverse in terms of their age, ethnicity, enrollment status, living arrangement, and non-academic obligations. This profile helped to determine the statistical controls used in the study's quantitative analyses.

b) Student-faculty interaction occurs in three broad (and sometimes overlapping) forms - a formal or informal relationship, an academic or social relationship, and/or a professional, personal, or dual relationship. Studies find that interaction varies by faculty characteristics, institution type, and students' gender, race/ethnicity, social class, first-generation status, major, and level of interactions with peer. These studies conceptualize student-faculty interaction in terms of the "frequency and content/nature of the interaction," and/or the "quality or effectiveness of student-faculty interaction."

   Both measures of student-faculty interaction were adopted in this study which focused on commuter students' informal, academic, social, and professional relationships with faculty members outside of classroom. The descriptive analysis in Chapter IV examines the extent to which the study's data demonstrated the student and institutional variations found within the literature.

c) The impact of out-of- class student-faculty interaction on satisfaction with the college experience, GPA, and intellectual skills development are yet to be explored within the peer-reviewed literature for commuter students attending 4-year colleges and universities. The literature review revealed that prior empirical studies (Iverson, Pascarella & Terenzini, 1984; Johnson, 1997; Terenzini, Springer, Pascarella, & Nora, 1995) investigated effects on three different outcomes - students' persistence, aspirations, and the value of learning. This study therefore extends the body of knowledge on student outcomes for first-year commuter students at 4-year institutions.

d) Positive impacts have generally been found between student-faculty interaction and the three outcomes – satisfaction with the college experience, GPA, and intellectual skills development. The foregoing literature review indicated that student-faculty interaction positively predicts **satisfaction** (such as Astin, 1993; Cole, 2008; Einarson & Clarkberg, 2010; Endo & Harpel, 1982; Hearn, 1985; Kim & Sax, 2009; Kuh & Hu, 2001; Sax, Bryant, & Harper, 2005; Strayhorn, 2010; Volkwein & Carbone, 1994; Wilson, Gaff, Dienst, Wood, & Bavry, 1975); **intellectual skills development** (for example, Astin, 1993; Cruce, Wolniak, Seifert, & Pascarella, 2006; Endo & Harpel, 1982; Kim, 2002; Kim & Sax, 2011; Kuh & Hu, 2001; Lundberg, 2010; Lundberg & Schreiner, 2004; Pascarella & Terenzini, 1978; Sax, Bryant, & Harper, 2005; Terenzini, Springer, Pascarella, & Nora, 1995; Terenzini, Theophilides, & Lorang, 1984; Volkwein & Carbone, 1994; and Volkwein, King, & Terenzini, 1986); and **grade-point average** (such as Anaya & Cole, 2001; Astin, 1993; Cole, 2008; Cole, 2010; Kim, 2010; Kim & Sax, 2009; Pascarella & Terenzini, 1978; Pascarella, Terenzini, & Hibel, 1978). Given that these studies did not examine the impact of student-

faculty interaction specifically for commuter students, this dissertation extends what is known about commuter students.

CHAPTER III

METHODOLOGY

This chapter describes the source of the data, the sample, and the variables used in the study. Data screening procedures and the study's analytical strategies are outlined.

Data Source: National Survey of Student Engagement (NSSE)

The overall design of this study was cross-sectional in nature. The data was collected from first-year commuter students at four-year institutions who completed the 2010 National Survey of Student Engagement (NSSE). This study sought to extend the body of knowledge on student-faculty interaction among commuter students. The aim was to obtain the most up-to-date information about these students. The 2010 NSSE dataset which examined student activity at four-year institutions was the most currently-available dataset that simultaneously provided measures of student-faculty interaction in line with the literature and for a variety of institutional types.

NSSE data were used with permission from The Indiana University Center for Postsecondary Research. NSSE's student survey, titled The College Student Report, collects information at four-year colleges and universities about student participation in programs and activities that institutions provide for their learning and personal development. Students randomly selected to complete The Report are first-year and senior students who were enrolled the previous term. According to the NSSE website, more than 1,500 different colleges and

universities in the U.S. and Canada have participated in the survey since it was first administered in 2000 (NSSE, 2014).

NSSE's data provide an estimate of how undergraduates spend their time and what they gain from attending college. Participating colleges and universities receive annual NSSE-generated reports that provide comparison data for individual survey questions and the five NSSE Benchmarks of Effective Educational Practice - Level of Academic Challenge, Active and Collaborative Learning, Student-Faculty Interaction, Enriching Educational Experiences, and Supportive Campus Environment. Student background data are also provided such as students' age, gender, race/ethnicity, living situation, educational status, and major field (NSSE, 2014).

Survey items on The College Student Report derive from other well-established college student research programs. According to Kuh, Hayek, Carini, Ouimet, Gonyea, & Kennedy (2001), items derive from UCLA's Cooperative Institutional Research Program (Astin, 1993; Sax et al., 1997), Indiana University's College Student Experiences Questionnaire Research Program (Kuh, Vesper, Connolly, & Pace, 1997; Pace, 1984, 1990), and student and alumni surveys administered by the University of North Carolina system. The survey items represent empirically confirmed "good practices" in undergraduate education and reflect behaviors by students and institutions that are associated with desired outcomes of college (NSSE, 2014).

Study Sample

The sample consisted of 9,000 randomly selected first year commuter students attending 465 different four-year US colleges and universities who had completed the National Survey of Student Engagement (NSSE) survey in 2010. The 2010 NSSE survey was completed by 165,946 first-year students. Commuter students comprised 42,069 and were so categorized because they

indicated that they lived off-campus within walking and driving distance of their institutions. The sample for this study comprised 9,000 students, or just over 20 percent of the total number of commuter students who completed the 2010 survey.

Table 3.1 indicates the number of commuter students in both the study sample and population by the Carnegie Classification of their institutions. The table also indicates that like the commuter student respondents to the 2010 survey, students at Master's colleges and universities in the study sample comprised the majority while students at Baccalaureate colleges had the lowest representation.

Table 3.1.

Number of Commuter Students Responding to the 2010 NSSE Survey, by Carnegie Classification of Participating Institutions, and Number of Students in Study Sample.

Carnegie Classification of Participating Institutions	**Students with Residence within Walking Distance of Institution**	**Students with Residence within Driving Distance of Institution**	**Commuter Population 2010 Survey (%)[a]**	**Study Sample (%)[b]**
Research universities (very high research activity)	1,634	1,875	3,509 (20%)	791 (23%)
Research universities (high research activity)	1,766	4,661	6,427 (32%)	1690 (26%)
Doctoral/research universities	546	2,221	2,767 (33%)	605 (22%)
Master's colleges and universities (larger programs)	2,665	11,169	13,834 (41%)	3326 (24%)
Master's colleges and universities (medium prgs)	937	3,593	4,530 (40%)	1042 (23%)
Master's colleges and universities (smaller prgs)	270	1,038	1,308 (28%)	372 (28%)
Baccalaureate colleges - arts & sciences	717	1,912	2,629 (21%)	653 (25%)
Baccalaureate colleges - diverse fields	447	2,349	2,796 (37%)	521 (19%)
"Other" Carnegie classifications	597	3672	4269	0
All colleges and universities, NSSE (2010)	9,579	32,490	42,069 (34%)	9000 (21%)

Note. [a] percentage of the total number of students (commuter and non-commuter) in the institutional type.
[b] percentage of total number of commuter students in the institutional type. (NSSE, 2014)

Variables

The variables used in the statistical analyses are identified below. A description of how each is measured is provided in Table 3.2. Scales were constructed for four variables: "satisfaction with the college experience," "intellectual skills development," "frequency of student-faculty interaction," and "frequency of peer interactions." Scales were computed by first summing the values of the responses for each item and then dividing that total by the number of items in the scale. The Cronbach alpha coefficients for these scales were all greater than .69 indicating a high correlation among the items in each scale. The alpha coefficients are indicated in Table 3.2.

It is important to note that the variables used in this study derive or are consistent with the conceptual framework for this study, namely Pascarella's (1980) conceptual model of the college impact on students. Pascarella's model suggests that in order to understand the influence of student-faculty non-classroom contact on educational outcomes and institutional persistence, it is necessary to take into account the background characteristics which students bring to college, the actual experiences of college in other areas, and salient institutional factors. The model specifically identifies "academic performance," "intellectual development," and "college satisfaction" as "educational outcomes."

Dependent Variables

Three student outcomes – satisfaction with the college experience, grade-point average (GPA), and intellectual skills development - were estimated in this study.

Satisfaction with the college experience. This variable was operationalized using two items on the NSSE survey. The first item asked: "How would you evaluate your entire

educational experience at this institution?" The second item asked: "If you could start over again, would you go to the same institution you are now attending?" A composite satisfaction index was created by the mean of the two items. Astin (1991) considered both items as measures of students' *overall* satisfaction with the college experience in his discussion of the I-E-O Model. The Cronbach alpha for this composite measure was 0.7465.

Intellectual skills development. Intellectual skills development was created as a composite variable from six NSSE items that measured learning: writing clearly and effectively; speaking clearly and effectively; thinking critically and analytically; analyzing quantitative problems; learning effectively on your own; and solving complex real-world problems. The items were consistent with those identified by Greenwood (1994) and Jones (1994, 1995, 1996) as key cognitive abilities and communication skills needed for college graduates. Lundberg (2010) and Volkwein, King, & Terenzini (1986) drew on similar items to measure learning and intellectual growth. The Cronbach alpha for this composite measure was 0.8648.

Grade-Point Average (GPA) This variable was measured by a self-reported item on the NSSE survey that required students to report their undergraduate grade point average on an eight-point scale ranging from A, A-, B+, B, B-, C+, C, and C- or lower. A new five-point scale (derived from Anaya & Cole, 2001; and Cole, 2010) was created with 1 = C, C- or lower, 2 = C+ or B-, 3 = B, 4 = B+ or A-, 5 = A.

Astin (1993, p. 385) found that student-faculty interaction had positively correlations with analytical and problem solving skills, critical thinking, and general knowledge, college GPA, satisfaction with faculty, satisfaction with student life and all other satisfaction outcomes except facilities.

Independent Variables of Primary Interest

The frequency and quality of non-classroom student-faculty interaction were the two independent variables of principal interest in this study. This conceptualization of student-faculty interaction was consistent with Astin's (1984, 1999) postulate that student involvement can be measured by both quantitative and qualitative features.

The frequency of student-faculty interaction outside the classroom. The frequency of student-faculty interaction was measured by five NSSE survey items that requested students to estimate how often they: (a) discussed grades or assignments with an instructor; (b) discussed ideas from your readings or classes with faculty members outside of class; (c) talked about career plans with a faculty member or advisor; (d) used e-mail to communicate with an instructor; and (e) worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.). The Cronbach alpha for this composite measure was 0.7373.

These items were consistent with those used in Wilson, Gaff, Dienst, Wood, & Bavry's (1975) "frequency of faculty-student interaction" and Pascarella & Terenzini's (1977) "student-faculty contact," and incorporated four of the six items that constitute the NSSE benchmark of Student-Faculty Interaction. The item "discussed grades or assignments with an instructor" was included although this discussion may occur both within and outside the classroom. The item "used e-mail to communicate with an instructor" captured the role of technology in today's non-classroom interaction with faculty, and recognized that faculty members engage students through a variety of media such as e-mail, discussion boards, etc.

The quality of students' relationships with faculty. The quality or effectiveness of the relationship between students and faculty was measured by students' rating of professors on a scale that ranged from 1 = unavailable, unhelpful, unsympathetic; to 7 = available, helpful,

sympathetic. Anaya & Cole (2001), Lundberg (2010), and Lundberg & Schreiner (2004) each used a similar measure derived from the item on quality faculty relationships in the "The College Environment" section of the CSEQ questionnaire.

Control Variables

Student-level Variables

Two groups of student-level variables – student background characteristics and other college experiences - served as controls in the analyses. It was necessary to statistically control for differences in individual background characteristics and the college experiences of first-year commuter students that might confound the relationship between student-faculty interaction and college outcomes. The student background characteristics were age, race/ethnicity, and gender. The other college experiences were entry status (native/transfer), first-generation status, enrollment status (full-/part-time), academic major, academic effort, the frequency of peer interactions, and the quality of peer relationships. These characteristics were consistent with the student inputs identified by Astin (1970a, 1970b, 1991, 1993) in his I-E-O Model and theory of involvement. The second group of variables was labelled "other" college experiences because they were additional to the dependent variables - satisfaction with the college experience and GPA - which are considered part of the college experience.

The control variables were also consistent with variables used in prior investigations of the study's outcomes. Prior research indicate that the impact of student-faculty interaction on satisfaction is moderated by gender (Kim & Sax, 2009; Sax, Bryant, & Harper, 2005), first-generation status (Kim & Sax, 2009), and race/ethnicity (Cole, 2010; Strayhorn, 2010). Race/ethnicity also has differential effects on intellectual gains (Einarson & Clarkberg, 2010;

Lundberg, 2010), and GPA (Anaya & Cole, 2001; Cole, 2008, 2010; Kim, 2010). Academic major has a differential effect on cognitive skill development (Kim & Sax, 2011) and for seniors, enrollment status has a moderating effect on gains in general education (Nelson Laird, 2009).

The control variables included:

Age. This variable was represented by a dummy variable coded as 0 = 23 and younger, and 1 = 24 and older. This particular coding was adopted from Strayhorn (2010), and was consistent with the NCCP's (2012) classification of commuter students as full-time traditional-aged students, and older returning students.

Entry Status. This variable was represented by a dummy variable coded as 0 = student native to the institution, and 1 = transfer student. The inclusion of this variable derived from Volkwein, King, & Terenzini's (1986) finding that faculty-student contact was positively related to the intellectual growth of transfer students.

Academic effort. Students' effort was operationalized using an item that measured the number of hours students spend in a typical 7-day week preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities). Astin (1993, p. 15) recognized this item as an environmental measure, and more specifically as a measure of student involvement. Astin (1993, pp. 375-376) found that hours per week spent studying or doing homework produced the largest and most numerous partial correlations with students outcomes such as satisfaction and increases in cognitive and affective skills, after controlling for the effects of student characteristics, environmental variables, and years of undergraduate education completed.

Quality of peer relationships. Students were asked to rate the quality of their relationships with other students. This variable was measured on a seven-point scale that ranged from 1 = unfriendly, unsupportive, sense of alienation; to 7 = friendly, supportive, sense of belonging..

Frequency of peer interactions. This variable was created as a composite variable using the mean of six items: how often students: (a) worked with other students on projects during class; (b) worked with classmates outside of class to prepare class assignments; (c) tutored or taught other students (paid or voluntary); (d) discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.); (e) had serious conversations with students of a different race or ethnicity than your own; and (f) had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values. The Cronbach alpha for this composite measure was 0.6988.

Astin (1993, p. 74) used similar items in his "frequency of interaction with student peers." Astin (1993, p. 398) recognized the role peers played in student development. He stated that "the student's peer group is the single most potent source of influence on growth and development during the undergraduate years" and that "student's values, beliefs, and aspirations tend to change in the direction of the dominant values, beliefs, and aspirations of the peer group." According to Astin (p. 403), students who interact with other students would tend to "place a higher priority than non-students on values and behaviors that are appropriate to the student role: studying, learning, intellectual development, and the pursuit of careers that require undergraduate and graduate degrees." Students who report higher levels of contact with peers and faculty also demonstrate higher levels of learning gain over the course of their stay in college (Endo & Harpel, 1982).

Institutional-level Variables

Four institutional characteristics were included in the analysis: type, control, selectivity, and enrollment size. The three variables - institutional type, control, and selectivity - were consistent with those used in Kuh & Hu (2001) who found that compared to students at comprehensive colleges and universities, students at research universities had lower overall student-faculty contact scores and reported fewer substantive interactions with faculty members while those at general liberal arts colleges reported the most out-of-class contact with faculty. Students in private institutions reported more out-of-class contact with faculty than students in public institutions. In addition, Kim (2002) and Cole (2010) found that enrollment size had differential effects on intellectual self-confidence and GPA, respectively.

Table 3.2.

Description of Variables

Variable	Definition
Dependent Variables	
Satisfaction with the College Experience ($\alpha = 0.7465$)	Composite variable using the mean of 2 items: students' evaluation of their entire educational experience (measured on a four-point scale from 1 = poor; 2 = fair; 3 = good; and 4 = excellent), and the extent of students' agreement that they would attend the same institution if they were starting over again (measured on a four-point scale 1 = definitely no; 2 = probably no; 3 = probably yes; and 4 = definitely yes). Composite scores will range from 1 = dissatisfied; 2 = neutral; 3 = satisfied; and 4 = very satisfied.
Intellectual Skills Development ($\alpha = 0.8648$)	Composite variable using the mean of 6 items: writing clearly and effectively; speaking clearly and effectively; thinking critically and analytically; analyzing quantitative problems; learning effectively on your own; and solving complex real-world problems. Each items is measured on a four-point scale, where 1 = very little, 2 = some, 3 = quite a bit, and 4 = very much.
Grade-Point Average	A five-point scale with 1 = C, C- or lower, 2 = C+ or B-, 3 = B, 4 = B+ or A-, 5 = A.
Independent Variables	
Frequency of student-faculty interaction ($\alpha = 0.7373$)	Composite variable using the mean of 5 items: how often students: (a) discussed grades or assignments with an instructor; (b) discussed ideas from your readings or classes with faculty members outside of class; (c) talked about career plans with a faculty member or advisor; (d) used e-mail to communicate with an instructor; (e) worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.). Composite scores range from 1 = never; 2 = sometimes; 3 = often; and 4 = very often.
The quality of students' relationships with faculty	A seven-point scale with 1 = unavailable, unhelpful, unsympathetic; to 7 = available, helpful, sympathetic.
Student Level Variables:	
Age	Dummy variable coded as 0 = 23 and younger, 1 = 24 and older.
Race/ethnicity	Dummy variables coded as 0 = no, 1 = yes for each of the following: African American/Black, Asian/Pacific Islander, Hispanic (Mexican or Mexican American, Puerto Rican, and Other Hispanic or Latino), and Other (American Indian or other Native American, Other, and "I prefer not to respond"). Students who "other" race are excluded from this analysis.

	Caucasian/White is treated as the reference group.
Gender	Dummy variable coded as 0 = male, 1 = female.
First-generation Status	Dummy variable coded as 0 = not first generation, 1 = first generation.
Entry Status	Dummy variable coded as 0 = native, 1 = transfer.
Enrollment Status	Dummy variable coded as 0 = part-time, 1 = full-time.
Academic Major	Major fields were assigned to four clusters and dummy variables coded as 0 = no, 1 = yes for each of the following clusters: arts and humanities, sciences (biological sciences and physical sciences), social sciences, and professional/applied majors (engineering, education, business, and professional other). Students who were undecided or who indicated some "other" major are excluded from this analysis. The arts and humanities major category is omitted as the reference group.
Academic Effort	Scale representing the number of hours student spent in a typical 7-day week preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities). An eight-point scale, with 1 = 0, 2 = 1-5, 3 = 6-10; 4 = 11-15, 5 = 16-20, 6 = 21-25, 7 = 26-30, and 8 = more than 30 hrs.
Frequency of Peer Interactions ($\alpha = 0.6988$)	Composite variable using the mean of 6 items: how often students: (a) worked with other students on projects during class; (b) worked with classmates outside of class to prepare class assignments; (c) tutored or taught other students (paid or voluntary); (d) discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.); (e) had serious conversations with students of a different race or ethnicity than your own; and (f) had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values. Composite scores range from 1 = never; 2 = sometimes; 3 = often; and 4 = very often.
Quality of Peer Relationships	A seven-point scale with 1 = unfriendly, unsupportive, sense of alienation; to 7 = friendly, supportive, sense of belonging.
Institutional Level Variables:	
Institutional type	Dummy variables coded as 0 = no, 1 = yes for each of the following: Research universities: institutions with "very high research activity", "high research activity", and "doctoral/research universities". Master's colleges and universities: institutions with "larger programs", "medium programs", and "smaller programs". Baccalaureate colleges - arts & sciences. Baccalaureate colleges - diverse fields is treated as the reference group.

Institutional selectivity	Based on Barron' Profile of American Colleges, 2013 selectivity criteria. A six-point scale with 1 = not competitive, 2 = less competitive, 3 = competitive, 4 = very competitive, 5 = highly competitive, and 6 = most competitive.
Institutional control	0 = public, 1 = private.
Enrollment size	A four-point scale with 1 = small (fewer than 2,500); 2 = medium (2,500-4,999); 3 = large (5,000-9,999); and 4 = very large (10,000 or more).

Analytical Procedures

Data Screening

Prior to data analysis, data screening was undertaken to identify inconsistencies or missing values. Inaccurate or incomplete data can lead to a biased analysis. First, following guidelines laid out in Tabachnick & Fidell (2007), the frequencies, means, standard deviations, minimum, and maximum values, and correlations of each NSSE survey item used in this study were inspected, and boxplots examined, in order to determine whether outliers, and atypical or implausible values were present. After examining the data, the values of all continuous variables were found to be within range. Furthermore, the means and standard deviations were all plausible. No outliers were detected and all item values were deemed reasonable.

Second, the quantity and pattern of missing data were analyzed. Non-randomly missing values could limit the generalizability of my results. The data for this study was based on 35 survey items on the 2010 NSSE survey. With regard to the quantity of missing data, the percentage of missing values was found to be less than 1 percent for 78 percent of the survey items. Twenty (20) percent of survey items missed between 1 and 2 percent of their values, and one item (college major) missed 3.2 percent of its values. The overall percentage of missing values for the entire dataset was 0.72 percent.

I also examined the patterns of missing data and the frequency with which those patterns occurred. The sample size for this study comprised 9,000 commuter students. Eighty-four percent (n=7535) of my sample provided answers to all survey items. College major was the item with the most dominant pattern of missing data. Two percent (n=205) of my sample did not indicate their major. The second most dominant pattern was displayed for the item father's education. Less than 1 percent (0.8%, n=78) of students did not indicate their father's education. While a small proportion of the study sample (0.5%, n=44) provided less than 20 percent of the data, the predominant pattern was that only a single student exhibited a particular pattern of missing values. Given the low rate of missing values, the low proportion of missingness for the college major item, and the dominant patterns of missingness, it was determined that listwise deletion would be used to deal with missing data in this dataset. This decision was guided by Tabachnick & Fidell (2007) who state:

> If only a few data points, say, 5% or less, are missing in a random pattern from a large data set, the problems are less serious and almost any procedure for handling missing values yields similar results. (p. 63)

As part of data screening I also checked for evidence of multicollinearity among my predictors. It was determined that the fit of the models would not be negatively affected by multicollinearity. This determination was based on the comparisons of the Pearson correlations, variance inflation factors, and tolerance values, with the rules of thumb provided by Cohen, Cohen, West, & Aiken (2003, pp. 423-424) and Tabachnick & Fidell (2007).

The variance inflation factor (VIF) provides an index of "the amount that the variance of each regression coefficient is increased relative to a situation in which all of the predictor

variables are uncorrelated" (Cohen et al., p. 423).Variance inflation factors for my predictors ranged in value from 1.02 to 1.38, with an average of 1.15 (greater than 10 is evidence of serious problems of multicollinearity). The tolerance is the reciprocal of the VIF and indicates how much of the variance of an independent variable is independent of other independent variables Cohen et al., p. 423). Tolerance levels ranged between .72 and 1 (less than .10 is evidence of serious problems of multicollinearity), and condition numbers were all below 30. My variables were therefore considered significantly unique.

Bivariate correlations were also examined. The highest values of Pearson's r were 0.631 observed between institutional control and enrolment size, and 0.54 between the frequency of student-faculty interaction and the frequency of peer interaction. Tabachnick & Fidell (2007, pp. 89-90) suggest that unless a researcher is doing analysis of structure or dealing with repeated measures of the same variable, one should "…think carefully before including two variables with a bivariate correlation of, say, .70 or more in the same analysis." Given the lower values of the Pearson r's, it was determined that multicollinearity was not a concern for this study. On the basis of the above findings, none of my variables were therefore excluded from the analysis. Each independent variable was considered to be potentially able to add to the prediction of my dependent variables of interest (Cohen et al., 2003, p. 419).

All continuous variables were checked for normality since statistical inference tends to be robust when variables have normal distributions (Tabachnick & Fidell, 2007, pp. 78-79). Histograms and summary statistics were examined instead of the results of the customary Shapiro-Wilk and Shapiro-Francia statistical tests for normality. These two tests are conducted with sample sizes up to 2,000 and 5,000 respectively whereas my sample comprised 9,000 students.

The existing values of my continuous variables were retained based on two considerations. First, the values of skewness and kurtosis for my variables were reasonably close to those for normal distributions. A normally distributed random variable should have values of skewness and kurtosis near zero and three, respectively. The values of skewness for my variables ranged from -0.8 to 0.6 while the values of kurtosis ranged from 2.5 to 3.4. Secondly, my variables were not transformed because of the limited impact of having distributions with skewness and non-normal kurtosis in the presence of large samples. According to Tabachnick & Fidell (2007, p. 80):

> In a large sample, a variable with statistically significant skewness often does not deviate enough from normality to make a substantive difference in the analysis. In other words, with large samples, the significance level of skewness is not as important as its actual size (worse the farther from zero) and the visual appearance of the distribution. In a large sample, the impact of departure from zero kurtosis also diminishes. For example, underestimates of variance associated with positive kurtosis (distributions with short, thick tails) disappear with samples of 100 or more cases; with negative kurtosis, underestimation of variance disappears with samples of 200 or more (Waternaux, 1976).

Analytical Methods

Method for Research Question #1: Hierarchical Linear Modeling

Hierarchical linear modeling (using IBM SPSS software) was applied to answer research question #1:

Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?

Hierarchical linear modeling (HLM) was considered best suited to answer this research question for several reasons. The first reason related to the structure of the data. Typically within higher education, the data tends to be organized hierarchically or nested at several levels such as at the student-, major-, department-, and institutional-levels. The most common hierarchical structure is students nested within higher education institutions (Cheslock & Rios-Aguilar, 2010). Since this 2-level structure was the adopted to answer the first research question, HLM was considered feasible.

Secondly, HLM was utilized to overcome data aggregation problems. When data are organized hierarchically, a decision has to be made regarding whether the student or the institution should be the unit of analysis. If the student is the unit of analysis, data would have to be disaggregated, that is, common institutional measures would have to be assigned to each student in a college (Ethington, 1997). This approach is problematic because it fails to account for the fact that since students are nested within an institution, it is likely that two students from one institution may have similar or common college experiences.

According to Cheslock & Rios-Aguilar (2010), if these experiences are important determinants of the dependent variables under study, and if one's regression model does not fully control for them, a portion of these experiences will be included in the error term. As a result, the error terms of the two students in the same institution will be correlated. Since it therefore cannot be assumed that students' observations are independent from one another, the fundamental

assumption in ordinary least squares (OLS) regression of independence of observations is violated (Raudenbush & Bryk, 2002). Failure to account for non-independence of observations can result in standard errors that are biased downward, misspecification of the degrees of freedom, and incorrect conclusions, that is, a Type I error may be committed (Goldstein, 2003; Kreft & De Leeuw, 1999; Raudenbush & Bryk, 2002).

On the other hand, if the institution is the unit of analysis, student-level data will have to be aggregated within institutions (Ethington, 1997). However, individual differences will be masked. According to Snijders & Bosker (1999), aggregation leads to shift of meaning, ecological fallacy, and the neglect of the original data structure. HLM was used in the analysis because it overcomes problems related to unit of analysis, and the aggregation and disaggregation of data, and allows for the examination of separate student and institutional effects. Kim & Sax (2011, p. 596) reports that "the majority of previous research on student-faculty interactions have used OLS techniques for their data analysis, which has generated analytical shortcomings such as aggregation bias, misestimated precision, and the unit of analysis problem (Raudenbush & Bryk 2002)."

Hierarchical linear modeling overcomes the aggregation problem by "decomposing any observed relationships between variables into separate student-level and institutional-level components" (Ethington, 1997, p. 169). By enabling the simultaneous estimation of the separate influence of the student-level variables and the institutional-level variables, we can identify what variance is attributed to the student and what variance is attributed to the institution and compare the between-institution and within-institutions effects.

Method for Research Question #2: Propensity Score Matching

Propensity score matching (using Stata software) was applied to answer research question #2: *Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?*

The use of student-faculty interaction to predict student outcomes raises an issue that affects the ability to determine a causal relationship, namely selection bias (or omitted variable bias). Selection bias arises because participation in interaction with faculty is voluntary. Students who interact with faculty may differ from those who do not in unobservable ways and these unobservable differences may influence the three dependent variables in this study: students' satisfaction with the college experience, GPA, and intellectual skills development. An estimator based on the difference in means between these two groups of students would therefore be affected by self-selection bias.

Propensity score matching is a non-experimental technique that adjusts for the bias that arises. It is an identification strategy that:

> … involves pairing treatment and comparison units that are similar in terms of their observable characteristics. When the relevant differences between any two units are captured in the observable (pretreatment) covariates, which occurs when outcomes are independent of assignment to treatment conditional on pretreatment covariates, matching methods can yield an unbiased estimate of the treatment impact. (Dehejia & Wahba, 2002, p. 151)

> … uses information from a pool of units that do not participate in the intervention to identify what would have happened to participating units in the absence of the intervention. By comparing how outcomes differ for participants relative to observationally similar nonparticipants, it is possible to estimate the effects of the intervention. (Heinrich, Maffioli, & Vazquez, 2010, p. 3)

Propensity score matching accounts and adjusts for differences between students who do and those who do not interact with faculty in order to estimate the impact of the interaction (Heinrich, Maffioli, & Vazquez, 2010). Propensity score matching rests on the assumption that the only source of omitted variables or selection bias is the set of observed covariates, x_i.

Propensity score matching allowed me to measure the effect of student-faculty interaction on my three outcomes for those students who actually interacted with faculty, that is, the average effect of the treatment on the treated (ATT) given by:

$$ATT = E(Y_1 - Y_0|x, z = 1) = E(Y_1|x, z = 1) - E(Y_0|x, z = 1)$$

The ATT is the difference in the expected values of the outcome resulting from the treatment (Y_1) among those who are actually treated, and the outcome that would have been observed if these same individuals were not treated (Y_o) (the counterfactual). Guo & Fraser (2010, p. 24) describe the counterfactual as a potential outcome, or "the state of affairs that would have happened in the absence of the cause." Information about the counterfactual outcome is not known. Propensity score matching adjusts for selection bias by creating a counterfactual

group of students similar to those students in the treatment group. According to Heckman, Ichimura, & Todd (1997):

> Matching methods pair program participants with members of a nonexperimental control group who have similar observed attributes and estimate treatment impacts by subtracting mean outcomes of matched comparison group members from the mean outcomes of matched participants. (p. 606).

Chapter Summary

This chapter provided an overview of the study's research design and analytical strategies. The chapter indicates that the study uses data collected from first-year commuter students randomly selected to complete the 2010 National Survey of Student Engagement (NSSE) survey. The sample consists of 9,000 first-year commuter students enrolled in 465 different four-year US colleges and universities. Hierarchical linear modeling and propensity score matching are utilized to estimate three commuter student outcomes - satisfaction with the college experience, grade-point average (GPA), and intellectual skills development. The primary independent variables of interest are the frequency of student-faculty interaction outside the classroom, and the quality of students' relationships with faculty. The analysis involves two groups of student-level controls – student background characteristics and other college experiences. Hierarchical linear modeling includes four institutional-level characteristics: institutional type, control, selectivity, and enrollment size. In preparation for data analysis, the data was screened for evidence of outliers, atypical or implausible values, missing data, skewness, kurtosis, and multicollinearity.

CHAPTER IV

DESCRIPTIVE ANALYSIS

This chapter describes the characteristics of the study's sample. Descriptive statistics are analyzed to provide a background picture of the commuter students for whom outcomes were estimated.

Sample Profile

The data for this study was collected from a random sample of 9,000 first-year commuter students who responded to the 2010 NSSE Survey at 465 four-year institutions. In this section I describe the characteristics of the student and institutional samples.

Student Sample

Table 4.1 displays summary statistics (frequency, mean, and standard deviation) of the study's variables related to the commuter students in the sample.

Satisfaction with the college experience. On average, the first-year commuter students in my sample were satisfied with the college experience. This variable was operationalized from two questions on the NSSE survey: "How would you evaluate your entire educational experience at this institution?" and "If you could start over again, would you go to the same institution you are now attending?" Eighty-four percent of students stated that they would attend the same institution if they could start over, and 86 percent rated their educational experience as either good or excellent.

Table 4.1.

Descriptive Statistics for Student Variables in Analysis

Variable	Label	Frequency	N	Mean	S.D.
Satisfaction with the College Experience	1 = dissatisfied 2 = neutral 3 = satisfied 4 = very satisfied	312 1466 4808 2391	8977	3.03	0.75
Intellectual Skills Development	1 = very little 2 = some 3 = quite a bit 4 = very much	501 3381 4159 922	8963	2.61	0.75
Grade Point Average	1 = C,C-or lower 2 = C+ or B- 3 = B 4 = B+ or A- 5 = A	568 1233 1816 3274 2077	8968	3.56	1.17
Frequency of Student-Faculty Interaction	1 = never 2 = sometimes 3 = often 4 = very often	2507 5023 1318 136	8984	1.89	0.61
Quality of Student-Faculty Interaction	1 = unavailable, unhelpful, unsympathetic; to 7 = available, helpful, sympathetic	1 = 84 2 = 228 3 = 508 4 = 1401 5 = 2207 6 = 2639 7 = 1888	8955	5.33	1.34
Age	0 = 23 & younger 1 = 24 & older	7881 1094	8975	0.12	0.33
Gender	0 = male 1 = female	3231 5745	8976	0.64	0.48
First-generation Status	0 = not first generation 1 = first generation	2485 6451	8936	0.72	0.45
Caucasian/White	0 = other races 1 = White	3781 5195	8976	0.58	0.49
African-American/Black	0 = other races 1 = African-American	8218 758	8976	0.08	0.28
Asian/Pacific Islander	0 = other races 1 = Asian/Pac. Island	8082 894	8976	0.10	0.30
Hispanic	0 = other races 1 = Hispanic	7762 1214	8976	0.14	0.34
Entry Status	0 = native 1 = transfer	8231 747	8978	0.08	0.28
Enrollment Status	0 = part-time 1 = full-time	614 8373	8987	0.93	0.25
Arts and Humanities Major	0 = other majors 1 = Arts/Humanities	7773 938	8711	0.11	0.31

Variable	Label	Frequency	N	Mean	S.D.
Professional/Applied Major	0 = other majors	4690	8711	0.46	0.50
	1 = Prof./Applied	4021			
Science Major	0 = other majors	7626	8711	0.13	0.33
	1 = Science	1085			
Social Sciences Major	0 = other majors	7744	8711	0.11	0.31
	1 = Social Science	967			
Frequency of Peer Interactions	1 = never	1993	8986	1.98	0.66
	2 = sometimes	5203			
	3 = often	1730			
	4 = very often	60			
The Quality of Peer Interactions	1 = unfriendly, unsupportive, sense of alienation; to 7 = friendly, supportive, sense of belonging	1 = 117 2 = 260 3 = 561 4 = 1290 5 = 2026 6 = 2595 7 = 2120	8969	5.35	1.40
Academic Effort - the number of hours student spent in a typical 7-day week preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities).	1 = 0 hrs.	40	8953	4.13	1.64
	2 = 1-5	1430			
	3 = 6-10	2271			
	4 = 11-15	1907			
	5 = 16-20	1517			
	6 = 21-25	906			
	7 = 26-30	468			
	8 = > 30 hrs.	414			
Research Universities	0 = other type	5906	8984	0.34	0.48
	1 = research	3078			
Masters Colleges and Universities	0 = other type	4252	8984	0.53	0.50
	1 = master's	4732			
Baccalaureate Colleges – Arts and Science	0 = other type	8331	8984	0.07	0.26
	1 = bacc. arts & sc.	653			
Baccalaureate Colleges – Diverse	0 = other type	8463	8984	0.06	0.23
	1 = bacc. diverse	521			
Institutional Selectivity	1 = not competitive	548	8984	3.04	0.95
	2 = less competitive	1549			
	3 = competitive	4490			
	4 = very competitive	1842			
	5 = highly competitive	491			
	6 = most competitive	64			
Institutional Control	0 = public	6115	8984	0.32	0.47
	1 = private	2869			
Enrolment Size	1 = small (< 2500)	1201	8984	3.04	1.06
	2 = med. (2500-4999)	1252			
	3 = large (5000-9999)	2518			
	4 = very large (>9999)	4013			

Intellectual skills development. Students evaluated items on a scale that ranged from "very little," "some," "quite a bit," to "very much." The study sample perceived that their intellectual skills had developed by "quite a bit." They considered their ability to think critically and analytically as the skill most developed (see Figure 4.1).

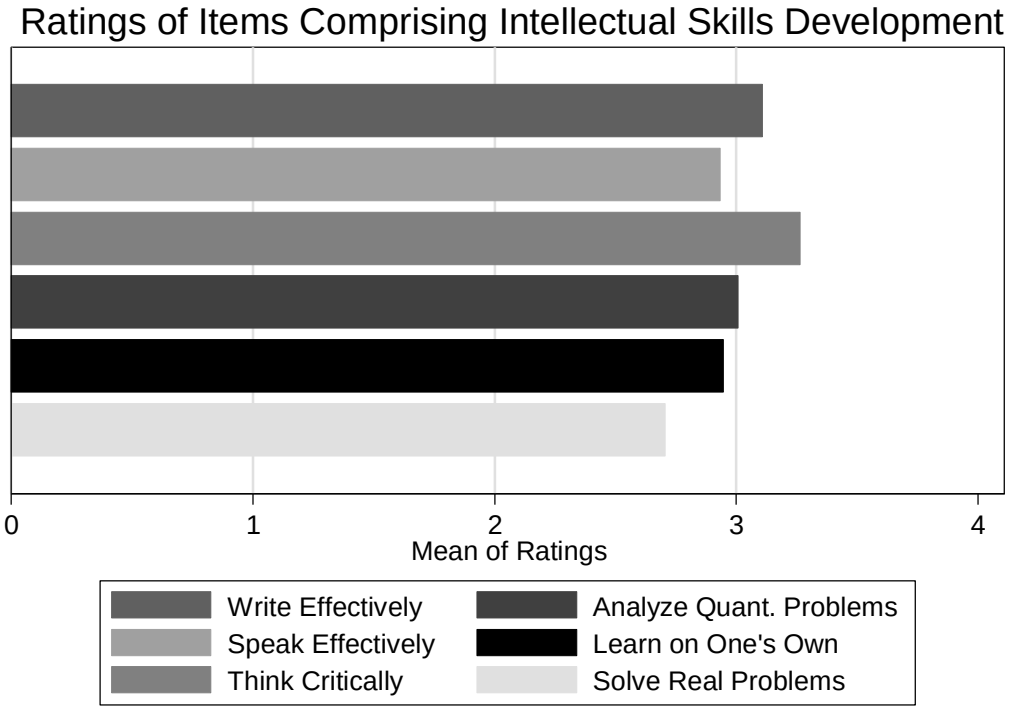


Figure 4.1. Items comprising the Intellectual Skills Development Variable.

Grade-Point Average. Students in the sample had average GPAs above a B (see Figure 4.2).

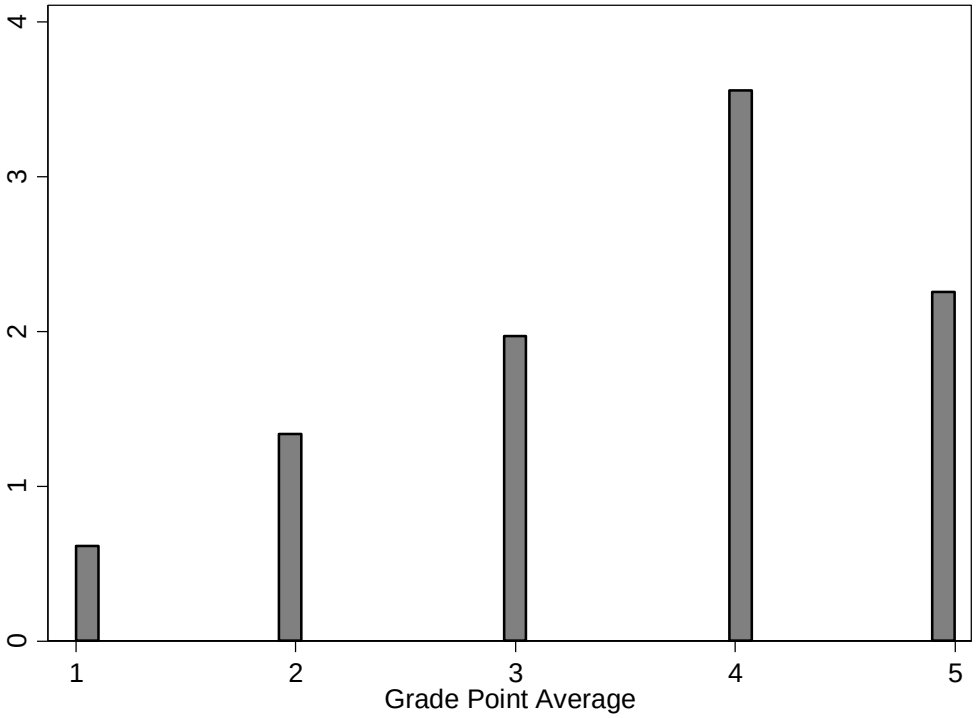


Figure 4.2. Distribution of Student's Grade-Point Averages.

Frequency and quality of interaction with faculty. Students in my sample evaluated items constituting frequency of student-faculty interaction on a scale that ranged from "never," "sometimes," "often," to "very often." On average students in the study sample sometimes interacted with faculty members outside the classroom during the school year. Email was the most common form of interaction; the least frequent forms were working with faculty members on activities other than coursework, and discussions about ideas from readings or classes. My sample of first-year commuter students sometimes held discussions with faculty members about grades, assignments and career plans (see Figure 4.3).

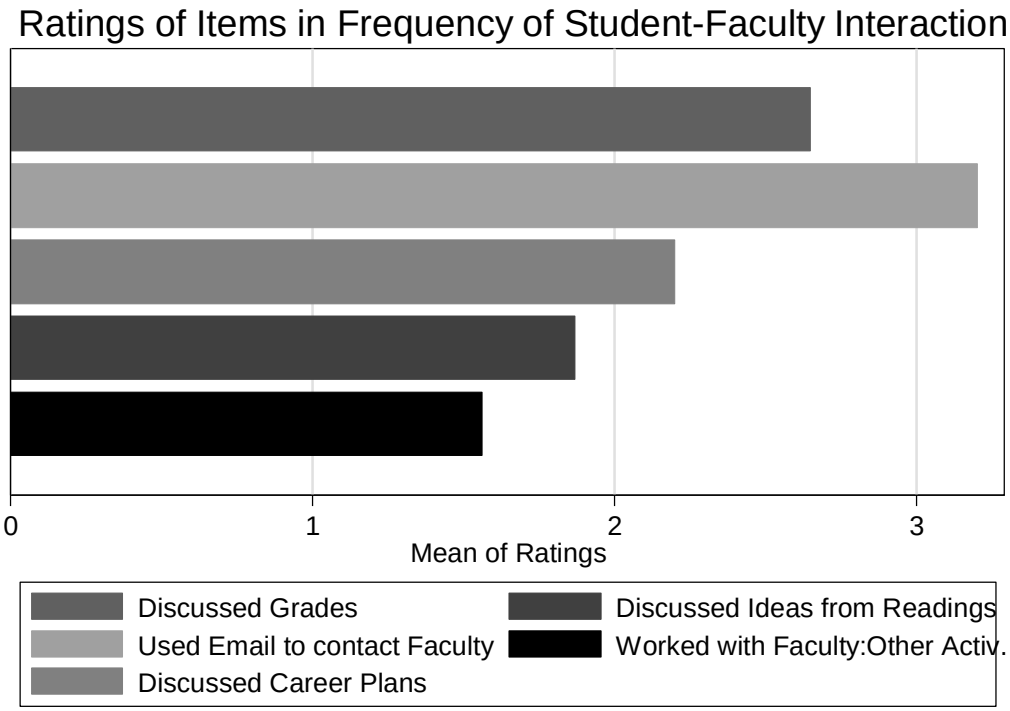


Figure 4.3. Items comprising the Frequency of Student-Faculty Interaction Variable.

My sample of first-year commuter students gave high ratings to the quality of their interaction with faculty members. Ratings tend to range from 5 to the maximum rating of 7 (see Figure 4.4).

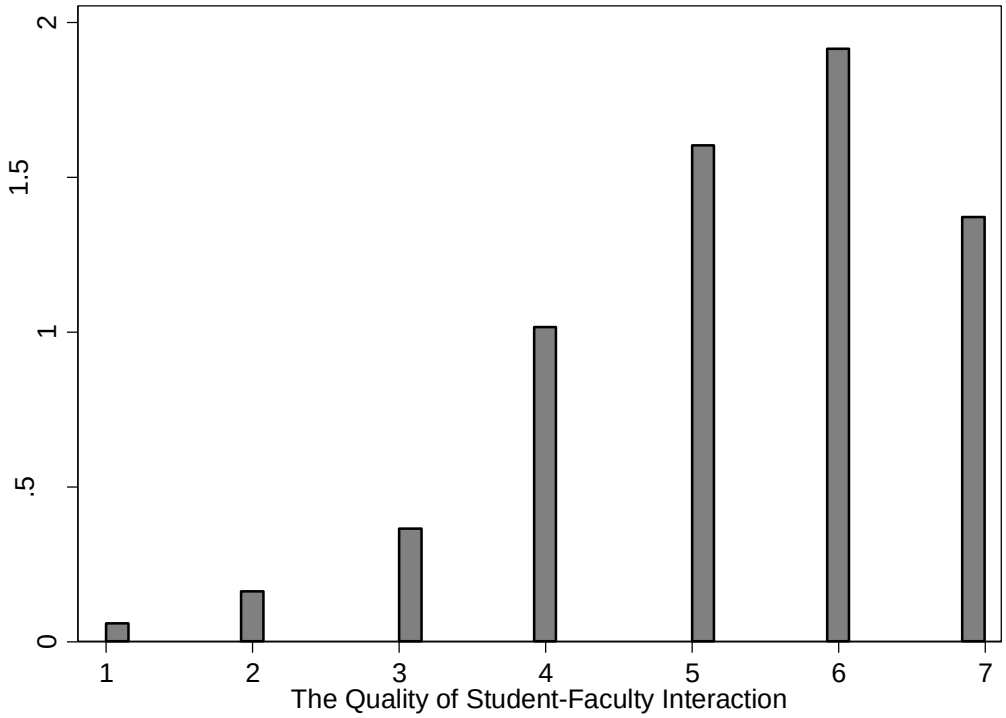


Figure 4.4. Students' Ratings of the Quality of Student-Faculty Interaction.

Frequency and quality of interaction with peers. Sample members sometimes interacted with their peers. While most discussed ideas from their readings and classes with others (students, family members, co-workers, etc.) outside of class, tutoring other students whether paid or voluntary was the least common activity (see Figure 4.5). They gave high ratings to the quality of their interaction with peers. Ratings tend to range from 5 to the maximum of 7.

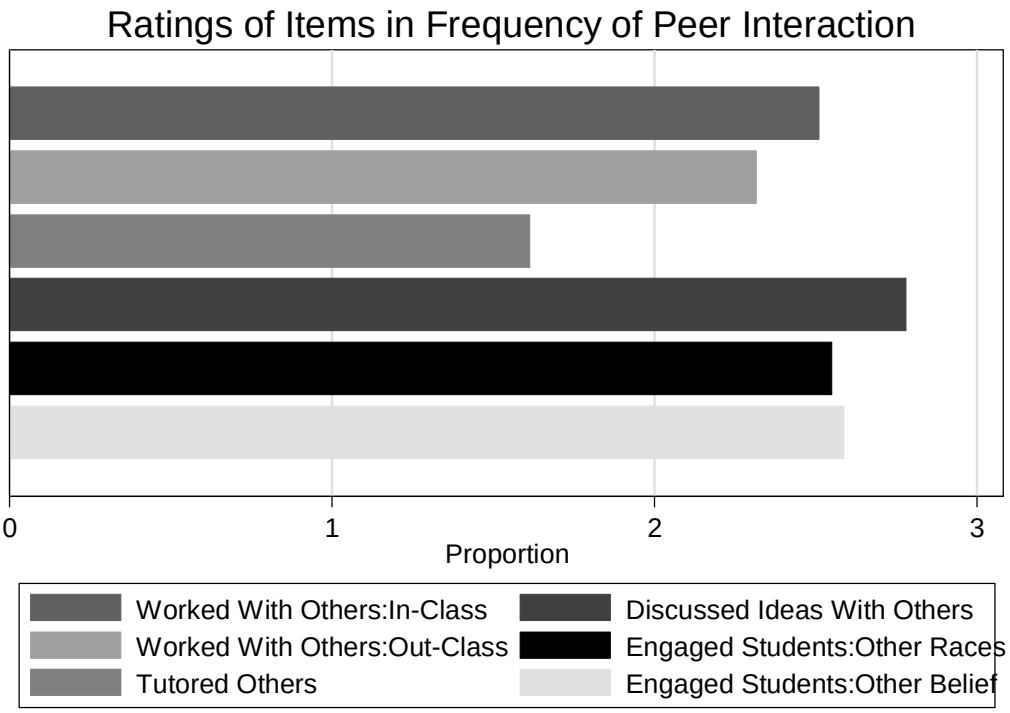


Figure 4.5. Items comprising the Frequency of Peer Interaction Variable.

Demographics. In terms of demographics, the sample was on average 23 years and younger (88 percent) and female (64 percent). White students constituted the majority within this sample of commuter students. The racial/ethnicity breakdown (see Figure 4.6) was White (58 percent), African-American (8 percent), Hispanic (14 percent), and Asian (10 percent) students, in addition to students that identified with other racial/ethnic groups (10 percent).

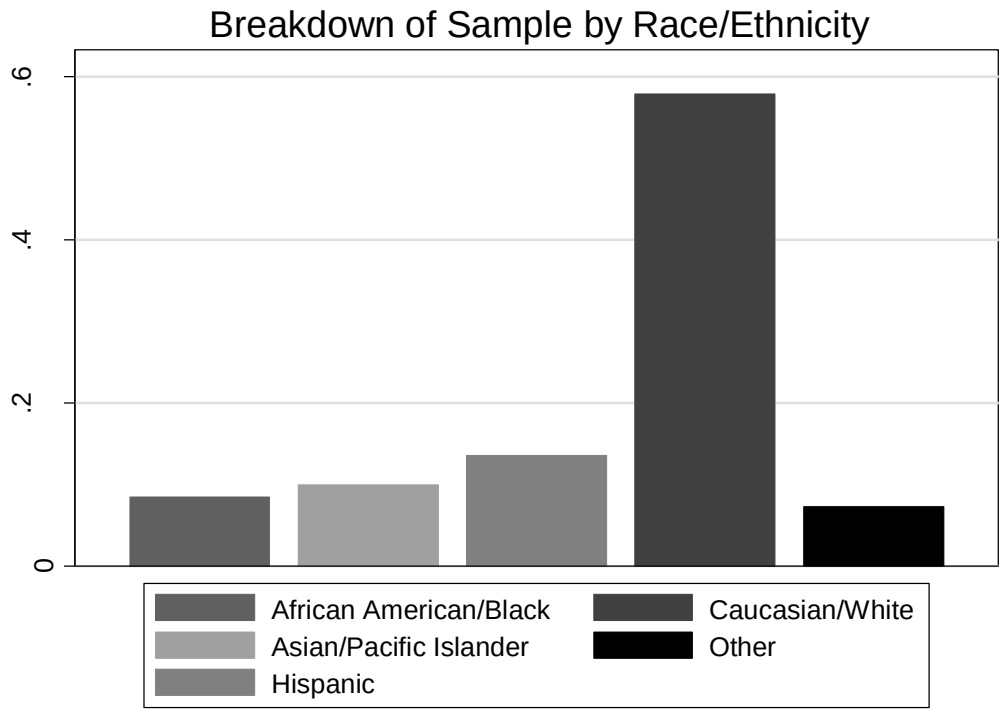


Figure 4.6. Breakdown of Sample by Race/Ethnicity.

Other campus experiences. The profile of students in the study sample revealed that they spent an average of 11-15 hours per week preparing for class. On average, they were full-time (93 percent), and native or non-transfer (92 percent) students. The average student fell within the first-generation (72 percent) category. Indeed, most students reported that the High School was the highest level of education completed by their parents.

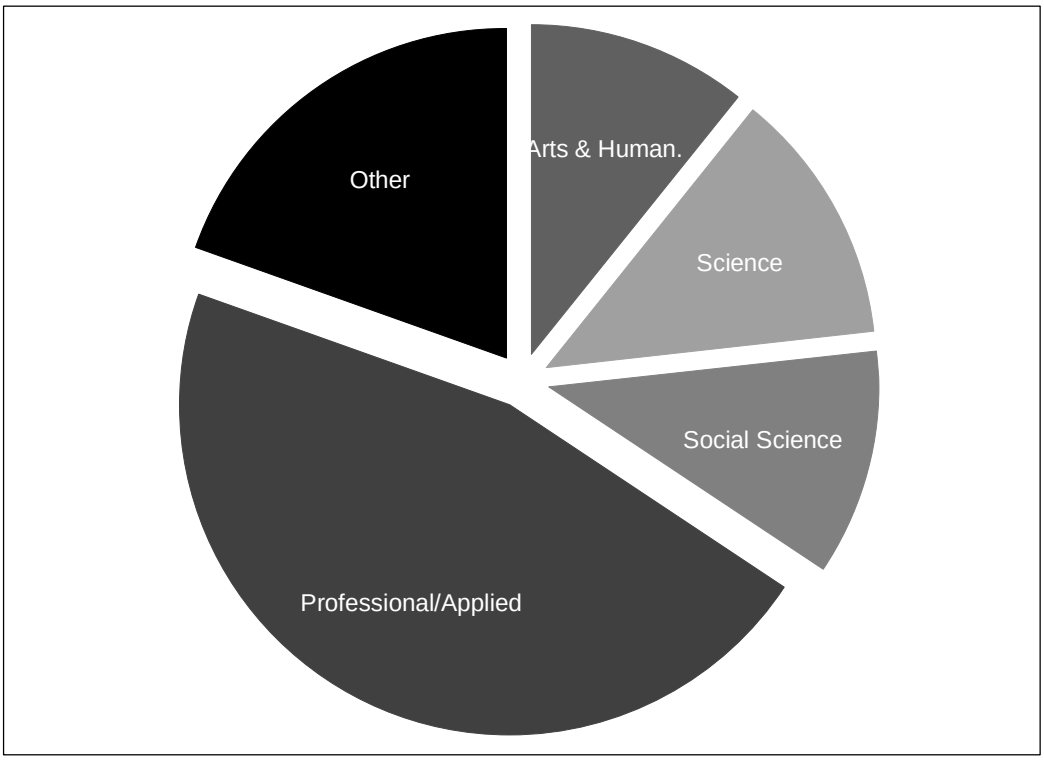


Figure 4.7. Breakdown of Sample by Academic Major.

On average, these first-year commuter students were enrolled in a professional or applied major (46 percent) (see Figure 4.7). The professional or applied major comprised the engineering, education, business, and professional (other) fields. The data indicated that overall, the majority of students in the sample were business majors, and those enrolled in professional fields. The business major included the areas of accounting, business administration, finance, management, and marketing. The professional (other) fields included architecture, urban

planning, health technology (e.g. medical, dental, and laboratory), law, library/archival science, medicine, dentistry, veterinary science, nursing, and pharmacy.

Institutional Profile. Most students were enrolled at Master's Colleges and Universities (53 percent). Thirty-four percent were enrolled in research universities, 7 percent in Arts and Sciences Baccalaureate Colleges, and 6 percent in Diverse Baccalaureate Colleges (see Figure 4.8). On average, the study sample were enrolled in institutions considered public, very large (enrollment of 10,000 and more students), and competitive based on Barron's (2013) selectivity criteria.

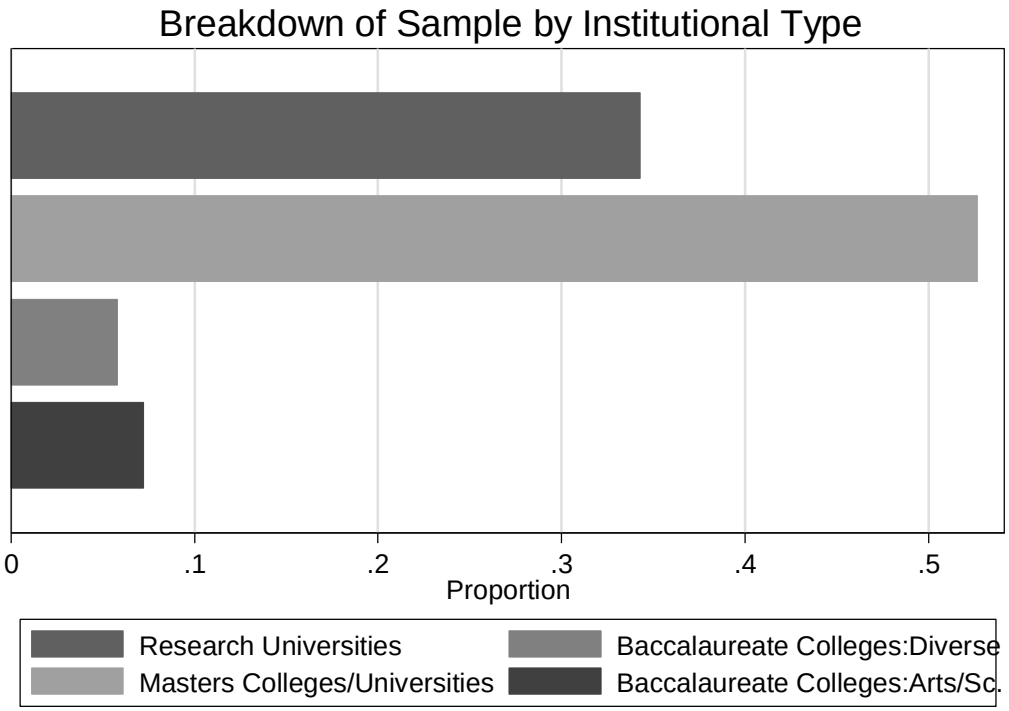


Figure 4.8. Breakdown of Sample by Institutional Type.

Institutional Sample

Table 4.2 displays summary statistics (numbers and percentages) for the 465 institutions at which the commuter students in my sample were enrolled. The table indicates that the set of institutions in my sample mostly comprised Master's Colleges and Universities (24 percent), and institutions that were categorized as private (63 percent), competitive (52 percent), and small (45 percent).

Table 4.2.

Descriptive Statistics for Institutional Variables in Analysis

Variable	Label	No. of institutions	Percentage (%)
Institutional Type	1 = Research universities - "very high research activity"	1 = 18	1 = 4
	2 = Research universities - "high research activity"	2 = 43	2 = 9
	3 = Doctoral/research universities	3 = 27	3 = 6
	4 = Master's colleges and universities - "larger programs"	4 = 113	4 = 24
	5 = Master's colleges and universities - "medium programs"	5 = 61	5 = 13
	6 = Master's colleges and universities - "smaller programs"	6 = 36	6 = 8
	7 = Baccalaureate colleges - arts & sciences	7 = 91	7 = 20
	8 = Baccalaureate colleges - diverse fields	8 = 76	8 = 16
Control	0 = public	1 = 172	1 = 37
	1 = private	2 = 293	2 = 63
Selectivity (Barron' Profile of American Colleges, 2013 selectivity criteria)	1 = not competitive	1 = 13	1 = 3
	2 = less competitive	2 = 57	2 = 12
	3 = competitive	3 = 243	3 = 52
	4 = very competitive	4 = 107	4 = 23
	5 = highly competitive	5 = 37	5 = 8
	6 = most competitive	6 = 8	6 = 2
Enrollment Size	1 = small (fewer than 2,500)	1 = 208	1 = 45
	2 = medium (2,500-4,999)	2 = 97	2 = 21
	3 = large (5,000-9,999)	3 = 87	3 = 19
	4 = very large (10,000 or more)	4 = 73	4 = 15

Sample's Interaction with Faculty Members

On the 2010 NSSE survey, the frequency of student-faculty interaction was evaluated by items on a scale that ranged from "never," "sometimes," "often," to "very often." Table 4.3 presents descriptive statistics for student and institutional characteristics among those students who indicated that they had interacted with faculty "sometimes," "often," and "very often."

Table 4.3.

Participation in Frequent Student-Faculty Interaction

Characteristic	Percentage of study sample who interacted with faculty	Characteristic	Percentage of study sample who interacted with faculty
Age:		Gender:	
23 & younger	72%	Female	73%
24 & older	72%	Male	71%
First-generation:		Entry Status:	
Non-first-generation	74%	Transfer	73%
First-generation	72%	Native	72%
Race/ethnicity:		Major:	
White	76%	Arts and Humanities	70%
African-American	78%	Professional/Applied	72%
Asian/Pacific Islander	72%	Science	72%
Hispanic	72%	Social Science	74%
Enrollment Status:		Institutional Control:	
Full-Time	72%	Public	69%
Part-Time	68%	Private	78%
Type of Institution:		Selectivity:	
Research University	70%	Not Competitive	68%
Master's College and Univ.	72%	Less Competitive	69%
Baccalaureate Colleges (Arts & Sc)	76%	Competitive	73%
		Very Competitive	72%
Baccalaureate Colleges (Diverse)	78%	Highly Competitive	75%
		Most Competitive	73%
Institutional Size:			
Small (< 2500)	81%		
Medium (2500-4999)	79%		
Large (5000-9999)	72%		
Very Large (>9999)	68%		

On average, over 70 percent of the entire study sample interacted with faculty members within these three categories. Interaction rates ranged from 68 percent to 81 percent. Slightly more female than male students (73 percent and 71 percent respectively) interacted with faculty outside the classroom. This is consistent with findings that, as compared to men, women report more frequent interaction with faculty outside of class (Sax, Bryant, & Harper, 2005), and more frequent communication with faculty by email or in person (Kim & Sax, 2009).

Older students (72 percent) were equally likely as younger students to interact with faculty. Full-time students (72 percent) were more likely than part-time students (68 percent) to interact with faculty.

Non-first generation students were more likely than first-generation students to interact with faculty. The latter tendency is consistent with Kim & Sax's (2009) finding that students whose parents attended college are more likely than students whose parents had not attended college to assist faculty with research for course credit, communicate with faculty by email or in person, and interact with faculty during lecture class sessions.

African-American students (78 percent) indicated that they interacted more with faculty than the other races/ethnicities. Asian and Hispanic students interacted the least with faculty members. This is consistent with findings in the literature that African-American students engage in significantly more interactions relative to other races, and Asian-American students tend to engage in less out-of-class interaction with faculty members (Chang, 2005; Einarson & Clarkberg, 2010; Kim & Sax, 2009; Kuh & Hu, 2001; Lundberg & Schreiner, 2004).

While students majoring in the social sciences (74 percent) had the highest rate of participation, the lowest rate was recorded among Arts and Humanities students (70 percent). Seventy-two percent of students in professional/applied fields interacted with faculty members

outside the classroom. Kuh & Hu (2001) found an opposite pattern using a sample of commuter and non-commuter students at 126 institutions. Compared with students in professional/applied fields, they found that students in the humanities and social sciences report more contact with faculty.

Comparing participation rates by institutional size, interaction with faculty members was most common in small-sized institutions (that is, those that enrolled less than 2,500 students), and was less common as institutional size increased. The participation rate at very large institutions was 68 percent. Between two-thirds and three-quarter of the commuter student population at institutions with varying levels of competitiveness indicated that they interacted with faculty "sometimes", "often", and "very often".

Interacting with faculty members outside the classroom was most prevalent at Baccalaureate Colleges offering Diverse Fields (78 percent) and Arts and Sciences Fields (76 percent), and least common at Research Universities (70 percent). This pattern was consistent with findings in the literature that the lowest levels of student-faculty interaction tend to occur at doctoral or research universities (Cox & Orehovec, 2007; Kuh & Hu, 2001).

The data also indicated that students enrolled at private institutions (78 percent) were more likely that those at public institutions (69 percent) to interact with faculty members outside the classroom. This was consistent with Kuh & Hu's (2001) finding that students in private institutions report more out-of-class contact with faculty than students in public institutions.

Chapter Summary

Descriptive statistics indicate that in terms of demographics, the first-year commuter students in my sample were on average 23 years and younger, female, White, full-time, native or

non-transfer, and first-generation students. On average, they were enrolled in a professional or applied major and at Master's Colleges and Universities, public, very large, and competitive institutions. On average, the first-year commuter students in my sample were satisfied with the college experience, had developed their intellectual skills, and had GPAs above B-averages.

Email was the most common form of interaction with faculty members. My sample of students gave high ratings to the quality of their interaction with faculty members outside the classroom. On average, over 70 percent of the entire study sample interacted with faculty members "sometimes," "often," and "very often." Students who were more likely to interact with faculty members within these three categories were female, full-time, non-first generation, African-American, and those majoring in the social sciences. Asian and Hispanic students interacted the least with faculty members. Examining interaction rates by institutional factors, the students in my sample who interacted more with faculty outside the classroom were those enrolled on small-sized institutions, Baccalaureate Colleges, and private institutions.

CHAPTER V

RESEARCH QUESTION #1: RESULTS

Hierarchical linear modeling was used to answer research question #1: *Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?*

A four-step data analysis was followed: First, the unconditional model for each dependent variable was estimated as part of the iterative hierarchical linear modeling strategy recommended by Raudenbush & Bryk (2002). Second, random effects were explored for my key independent variables. Third, my variables were centered, and finally, the full model for each dependent variable was estimated. Throughout the analysis, statistical significance was assessed against a significance level of 0.01. Given that my large sample size (n=9,000) increased the power of my statistical tests, the significance level was set at 0.01 to reduce the probability of making a Type 1 Error.

Step 1: The Unconditional Model

First, as part of an iterative hierarchical linear modeling strategy recommended by Raudenbush & Bryk (2002), the unconditional or null model was estimated and the intra-class correlation (ICC) calculated for each dependent variable. The following unconditional, random

analysis-of-variance (ANOVA) base model (i.e., a model with no level-1 or level-2 predictors) was estimated, for each of the three dependent variables.

Level-one model:

$Y_{ij} = \beta_{0j} + e_{ij} \quad e_{ij} \sim N(0, \sigma^2_e)$

Level-two model:

$\beta_{0j} = \gamma_{00} + \mu_{0j} \qquad \mu_{0j} \sim N(0, \tau_{00})$,

where i = 1, …, n_j students in institution j, and j = 1, …., J institutions. Y_{ij} was alternatively satisfaction with the college experience, GPA, and intellectual skills development for student i in institution j.

The level-1 sample comprised 9,000 first-year commuter students attending 4-year institutions, and the level-2 sample comprised the 465 institutions attended by these students.

This model, also known as the null model, provides substantial information for modeling. It provides an estimate of how much of the variance in the dependent variable is within-institution (at the student-level) and between-institution (at the institution-level). By partitioning the variance between the student-level variables and institution-level variables, cluster effects become apparent. This unconditional model also provides information on whether we can reject the null hypothesis of no variation in the average dependent variable between-institution, indicating that there is significant between-institution variance to be modeled. The null model is also significant in that it provides a benchmark against which all later model specifications can be compared.

With the null model's estimation results, I computed the intra-class correlation (ICC) to determine, for each dependent variable, whether the within- or between-variance constituted the

higher variance. The ICC gives the proportion of the total variance of each dependent variable that occur between-institutions or that is due to institutions being different from each other on average. It is computed as:

$$ICC = \tau_{00} / (\sigma^2_e + \tau_{00})$$

where τ_{00} is the between-institution variance and σ^2_e is the within-institution variance.

A positive ICC suggests that I can reject the null hypothesis of no between-institution variance for a particular dependent variable, and proceed to conduct hierarchical linear modeling. According to O'Connell & Reed (2012):

> Ignoring the existence of a positive ICC, even if close to zero, can have serious consequences for validity of hypothesis tests as well as for understanding and examining patterns of variability in the data. (p. 13)

Table 5.1 indicates the values of the between- and within-variances, and the intra-class correlations for my three dependent variables:

Table 5.1.

Results: Null Model

Dependent Variables	**Satisfaction with the College Experience**	**Intellectual Skills Development**	**Grade Point Average**
Between-institution Variance	0.015	0.006	0.046
Within-institution Variance	0.442	0.435	1.321
Computed Intra-Class Correlations (ICC)	0.03	0.01	0.03

Satisfaction with the College Experience. The estimates for the within- and between-institution variances were 0.442 and 0.015, respectively and both were statistically significant at the 1 percent level. The computed intra-class correlation of 0.03 meant that 3 percent of the observed variation was due to differences in satisfaction between institutions while 97 percent of the satisfaction scores were at the student level. Although most of the variance occurred at the student level or level-1, the null hypothesis of no variation in the average satisfaction levels between-institution was rejected. It was feasible to conduct hierarchical linear modeling using this dependent variable.

Intellectual Skills Development. The estimates of between- and within-institution variances of 0.006 and 0.435 were statistically significant at the 1 percent level. The intra-class correlation was 0.01. This meant that 1 percent of the observed variation was due to differences in intellectual skills development between institutions while 99 percent of the intellectual skills development scores were at the student level. It was feasible to conduct hierarchical linear modeling using this dependent variable.

Grade-Point Average. The estimates of the between- and within-institution variances of 0.046 and 1.321 were statistically significant at the 1 percent level. The intra-class correlation was 0.03. This meant that 3 percent of the observed variation was due to differences in grade point average between institutions while 97 percent of the GPA scores were at the student level. It was feasible to conduct hierarchical linear modeling using this dependent variable.

In summary, the percentage of observed variation due to differences between-institutions was 3 percent, 1 percent, and 3 percent for the dependent variables satisfaction with the college experience, intellectual skills development, and GPA, respectively. With positive ICC

established for each dependent variable, I rejected the null hypothesis of no between-institution variance and proceeded to conduct hierarchical linear modeling.

Step 2: Exploration of Random Effects (Random-Coefficients Models)

Second, random effects were explored for my key independent variables. For each of my dependent variables, I wished to determine whether the effect of my two independent variables of interest - frequency of student-faculty interaction (FSF) and the quality of relationships with faculty (QSF) - varied across institutions. The results of this exploration had implications for the design of the level-2 model in my final models.

Level-1 of the unconditional model for each dependent variable was expanded or built-up with student-level predictors, that is, with the two independent variables of interest - frequency of student-faculty interaction (FSF) and the quality of relationships with faculty (QSF) - and controls for age, race/ethnicity, gender, first-generation status, entry status (native/transfer), enrollment status (full-/part-time), academic major, academic effort, the frequency of peer interactions, and the quality of peer relationships.

In this random-coefficients model, the student-faculty interaction variables were interacted with gender, race, and full-time status to examine differential effects on the three outcomes. As mentioned previously, while research evidence indicates that gender and race condition the relationship between first-year student-faculty interaction and student outcomes, the available evidence on enrollment status relates to senior students. Little is known on the latter effect for first-year students.

For each of my dependent variables, I sought to determine whether the effect of my two independent variables of interest - frequency of student-faculty interaction (FSF) and the quality

of relationships with faculty (QSF) - varied across institutions. The slopes of these two variables were therefore allowed to vary across institutions at Level-2. A random intercept was included, and the slopes of the control variables were assumed to be fixed. The following model was estimated for each dependent variable:

Level-one model:

$Y_{ij} = \beta_{0j} + \beta_{1j}$ (frequency of student-faculty interaction FSF) + β_{2j} (quality of relationships with faculty QSF)
+ β_{3j} (age) + β_{4j} (female) + β_{5j} (firstgen)
+ β_{6j} (African-American) + β_{7j} (Asian) + β_{8j} (Hispanic)
+ β_{9j} (transfer) + β_{10j} (ftime) + β_{11j} (effort) + β_{12j} (peerf) + β_{13j} (peerq)
+ β_{14j} (major-sc) + β_{15j} (major-socsc) + β_{16j} (major-appl)
+ β_{17j} (FSF*female) + β_{18j} (QSF*female) + β_{19j} (FSF*ftime) + β_{20j} (QSF*ftime)
+ β_{21j} (FSF*African-American) + β_{22j} (QSF*African-American) + β_{23j} (FSF*Asian)
+ β_{24j} (QSF*Asian) + β_{25j} (FSF*Hispanic) + β_{26j} (QSF*Hispanic)
+ $\mu_{0j} + e_{ij}$ where $e_{ij} \sim N(0, \sigma^2_e)$, $\mu_{0j} \sim N(0, \tau_{00})$

Level-two model:

$\beta_{0j} = \gamma_{00} + u_{0j}$
$\beta_{1j} = \gamma_{10} + u_{1j}$
$\beta_{2j} = \gamma_{20} + u_{2j}$
$\beta_{3j} = \gamma_{30}$
. .
. .
$\beta_{16j} = \gamma_{16}$

Post-estimation, I examined the variances of the slopes of the two independent variables of interest - frequency of student-faculty interaction (FSF) and the quality of relationships with faculty (QSF). My decision-making rule was as follows:

a) If the variances of both slopes were found NOT to be statistically significant - indicating that the effect of my two independent variables of interest did not vary across institutions - the

Level-2 models would include fixed slopes for the independent variables of interest and the control variables. Only the intercept would be varied to allow the variance to be partitioned between the institution and the student. Additionally, if the between-institution or intercept variance was found to be statistically significant, this random intercept would be predicted by the institutional characteristics - type, control, selectivity, and enrollment size.

b) Alternatively, if the variances of either or both slopes WERE statistically significant, the Level-2 models would include a random intercept, and random slopes for the one or both independent variable of interest, with institutional predictors.

Table 5.2 indicates the results of Step 2: Exploring random effects.

Table 5.2.

Estimates of Covariance Parameters

Parameter	Estimate	Standard Error	Significance level (p-value)
Satisfaction			
Variance: Residual	0.319	0.005	0.000
Variance: Intercept	0.075	0.034	0.026
Variance: slope (frequency of student-faculty interactions)	0.003	0.003	0.284
Variance: slope (quality of relationships with faculty)	0.001	0.008	0.074
Intellectual Skills Development			
Variance: Residual	0.313	0.005	0.000
Variance: Intercept	0.001	0.001	0.073
Grade-Point Average			
Variance: Residual	1.180	0.019	0.000
Variance: Intercept	0.151	0.099	0.000
Variance: slope (frequency of student-faculty interactions)	0.013	0.011	0.218
Variance: slope (quality of relationships with faculty)	0.002	0.002	0.283

Note. Statistical significance is determined by $p<0.01$.

Random effects – Satisfaction with the College Experience

The estimate of the within-institution or residual variance in this random-coefficients model was statistically significant at the 1 percent level, indicating that students' level of satisfaction with the college experience deviated slightly from its mean value by 0.32 points, with a standard error of 0.005. A comparison of this residual value with the within-institution variance of the null model (0.442) indicated that the added variables explained 27 percent of the pooled within-institution variability of satisfaction with the college experience.

The between-institution variance of 0.075 was not statistically significant indicating that the mean level of satisfaction did not differ across institutions. This value was larger than the between-institution variance of the null model (0.015) because there were more equations defining the random-coefficients model and additional parameters to estimate.

For both variables "frequency of student-faculty interactions" and "quality of relationships with faculty", the variances of their slopes were not statistically significant at the 1 percent level. The effect of these variables did not vary across institutions.

Decision:

a) The Level-2 model in my final model for "Satisfaction with the College Experience" would include a random slope for the intercept only. Although the intercept variance was not statistically significant, the intercept was allowed to vary across institutions so that the variance could be partitioned between the institution and the student, and account for the limited clustering suggested by the positive intra-class correlation (ICC). No institutional predictors were included.
b) The model would include a fixed slope for the variables "frequency of student-faculty interactions" and "quality of relationships with faculty", and all controls.

To reflect these effects, the final model for "Satisfaction with the College Experience" became:

Level-one model:

$$\text{Satisfaction}_{ij} = \beta_{0j} + \beta_{1j}\,(\text{frequency of student-faculty interaction}) + \beta_{2j}\,(\text{quality of relationships with faculty}) + \beta_{3j}\,(\text{age}) + \beta_{4j}\,(\text{female}) + \beta_{5j}\,(\text{firstgen}) + \beta_{6j}\,(\text{African-American}) + \beta_{7j}\,(\text{Asian}) + \beta_{8j}\,(\text{Hispanic}) + \beta_{9j}\,(\text{transfer}) + \beta_{10j}\,(\text{ftime}) + \beta_{11j}\,(\text{effort}) + \beta_{12j}\,(\text{peerf}) + \beta_{13j}\,(\text{peerq}) + \beta_{14j}\,(\text{major-sc}) + \beta_{15j}\,(\text{major-socsc}) + \beta_{16j}\,(\text{major-appl}) + \beta_{17j}\,(\text{FSF*female}) + \beta_{18j}\,(\text{QSF*female}) + \beta_{19j}\,(\text{FSF*ftime}) + \beta_{20j}\,(\text{QSF*ftime}) + \beta_{21j}\,(\text{FSF*African-American}) + \beta_{22j}\,(\text{QSF*African-American}) + \beta_{23j}\,(\text{FSF*Asian}) + \beta_{24j}\,(\text{QSF*Asian}) + \beta_{25j}\,(\text{FSF*Hispanic}) + \beta_{26j}\,(\text{QSF*Hispanic}) + \mu_{0j} + e_{ij} \quad \text{where } e_{ij} \sim N(0, \sigma^2_e),\ \mu_{0j} \sim N(0, \tau_{00})$$

Level-two model:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30}$$
$$\vdots$$
$$\beta_{16j} = \gamma_{16}$$

Random effects – Intellectual Skills Development

Random effects could not be detected for this outcome. Convergence could not be achieved when the model included random slopes for the two variables "frequency of student-faculty interactions" and "quality of relationships with faculty." Convergence was attained when these random slopes were removed.

The estimate of the within-institution variance was statistically significant at the 1 percent level, indicating that students' intellectual skills development deviated from its mean value by 0.31 points, with a standard error of 0.005. A comparison of this value with the within-institution

variance of the null model (0.435) indicated that the added variables explained 29 percent of the pooled within-institution variability of intellectual skills development. The between-institution variance was not statistically significant at the 1 percent level suggesting that the mean level of intellectual skills did not vary across institutions.

Decision:

a) The Level-2 model in my final model for "Intellectual Skills Development" would include a random slope for the intercept only. Although the intercept variance was not statistically significant, the intercept was allowed to vary across institutions so that the variance could be partitioned between the institution and the student, and account for the limited clustering suggested by the positive intra-class correlation (ICC). No institutional predictors were included.

b) The model would include a fixed slope for the variables "frequency of student-faculty interactions" and "quality of relationships with faculty", and all controls.

To reflect these effects, the final model for "Intellectual Skills Development" became:

Level-one model:

$$\begin{aligned}\text{Intellect}_{ij} = {} & \beta_{0j} + \beta_{1j}\,(\text{frequency of student-faculty interaction}) \\ & + \beta_{2j}\,(\text{quality of relationships with faculty}) \\ & + \beta_{3j}\,(\text{age}) + \beta_{4j}\,(\text{female}) + \beta_{5j}\,(\text{firstgen}) \\ & + \beta_{6j}\,(\text{African-American}) + \beta_{7j}\,(\text{Asian}) + \beta_{8j}\,(\text{Hispanic}) \\ & + \beta_{9j}\,(\text{transfer}) + \beta_{10j}\,(\text{ftime}) + \beta_{11j}\,(\text{effort}) + \beta_{12j}\,(\text{peerf}) + \beta_{13j}\,(\text{peerq}) \\ & + \beta_{14j}\,(\text{major-sc}) + \beta_{15j}\,(\text{major-socsc}) + \beta_{16j}\,(\text{major-appl}) \\ & + \beta_{17j}\,(\text{FSF*female}) + \beta_{18j}\,(\text{QSF*female}) + \beta_{19j}\,(\text{FSF*ftime}) + \beta_{20j}\,(\text{QSF*ftime}) \\ & + \beta_{21j}\,(\text{FSF*African-American}) + \beta_{22j}\,(\text{QSF*African-American}) + \beta_{23j}\,(\text{FSF*Asian}) \\ & + \beta_{24j}\,(\text{QSF*Asian}) + \beta_{25j}\,(\text{FSF*Hispanic}) + \beta_{26j}\,(\text{QSF*Hispanic}) \\ & + \mu_{0j} + e_{ij} \quad \text{where } e_{ij} \sim N(0, \sigma^2_e),\ \mu_{0j} \sim N(0, \tau_{00})\end{aligned}$$

Level-two model:
$\beta_{0j} = \gamma_{00} + u_{0j}$
$\beta_{1j} = \gamma_{10}$
$\beta_{2j} = \gamma_{20}$
$\beta_{3j} = \gamma_{30}$
. .
$\beta_{16j} = \gamma_{16}$

Random effects – Grade-Point Average

The estimate of the within-institution variance was statistically significant at the 1 percent level, indicating that students' GPA deviated from the mean value by 1.2 points, with a standard error of 0.02. A comparison of this value with the within-institution variance of the null model (1.32) indicated that the added variables explained 11 percent of the pooled within-institution variability of GPA.

The between-institution variance was statistically significant indicating that the mean GPA differed across institutions.

For both variables "frequency of student-faculty interactions" and "quality of relationships with faculty", the variances of their slopes were not statistically significant at the 1 percent level. The effect of these variables did not vary across institutions.

Decision:

a) The Level-2 model in my final model for "Grade-Point Average" would include a random slope for the intercept only. This random intercept would be predicted by the institutional characteristics: type, control, selectivity, and enrollment size.
b) The model would include a fixed slope for the variables "frequency of student-faculty interactions" and "quality of relationships with faculty", and all controls.

To reflect these effects, the final model for "Grade-Point Average" became:

Level-one model:

$GPA_{ij} = \beta_{0j} + \beta_{1j}$ (frequency of student-faculty interaction)
$+ \beta_{2j}$ (quality of relationships with faculty)
$+ \beta_{3j}$ (age) $+ \beta_{4j}$ (female) $+ \beta_{5j}$ (firstgen)
$+ \beta_{6j}$ (African-American) $+ \beta_{7j}$ (Asian) $+ \beta_{8j}$ (Hispanic)
$+ \beta_{9j}$ (transfer) $+ \beta_{10j}$ (ftime) $+ \beta_{11j}$ (effort) $+ \beta_{12j}$ (peerf) $+ \beta_{13j}$ (peerq)
$+ \beta_{14j}$ (major-sc) $+ \beta_{15j}$ (major-socsc) $+ \beta_{16j}$ (major-appl)
$+ \beta_{17j}$ (FSF*female) $+ \beta_{18j}$ (QSF*female) $+ \beta_{19j}$ (FSF*ftime) $+ \beta_{20j}$ (QSF*ftime)
$+ \beta_{21j}$ (FSF*African-American) $+ \beta_{22j}$ (QSF*African-American) $+ \beta_{23j}$ (FSF*Asian)
$+ \beta_{24j}$ (QSF*Asian) $+ \beta_{25j}$ (FSF*Hispanic) $+ \beta_{26j}$ (QSF*Hispanic)
$+ \mu_{0j} + e_{ij}$ where $e_{ij} \sim N(0, \sigma^2_e)$, $\mu_{0j} \sim N(0, \tau_{00})$

Level-two model:

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ (research) $+ \gamma_{02}$ (masters) $+ \gamma_{03}$ (baccart) $+ \gamma_{04}$ (selective)
$+ \gamma_{05}$ (control) $+ \gamma_{06}$ (size) $+ u_{0j}$
$\beta_{1j} = \gamma_{10}$
$\beta_{2j} = \gamma_{20}$
$\beta_{3j} = \gamma_{30}$
. .
$\beta_{16j} = \gamma_{16}$

In summary, the final models estimated for my three dependent variables were random-intercept models. The student-level or level-1 models included the variables "frequency of student-faculty interactions" and "quality of relationships with faculty", and all controls. Level-2 for the GPA model included random intercepts predicted by six institutional characteristic – research universities, masters colleges and universities, baccalaureate colleges – arts and sciences, control, selectivity, and size. The final model for GPA is alternatively known as random intercept ANCOVAs or "means as outcomes ANCOVAs" and took the form:

Level-one model:

$Y_{ij} = \beta_{0j} + \beta_{1j}$ (frequency of student-faculty interaction) + β_{2j} (quality of relationships with faculty)
+ β_{3j} (age) + β_{4j} (female) + β_{5j} (firstgen)
+ β_{6j} (African-American) + β_{7j} (Asian) + β_{8j} (Hispanic)
+ β_{9j} (transfer) + β_{10j} (ftime) + β_{11j} (effort) + β_{12j} (peerf) + β_{13j} (peerq)
+ β_{14j} (major-sc) + β_{15j} (major-socsc) + β_{16j} (major-appl)
+ β_{17j} (FSF*female) + β_{18j} (QSF*female) + β_{19j} (FSF*ftime) + β_{20j} (QSF*ftime)
+ β_{21j} (FSF*African-American) + β_{22j} (QSF*African-American)
+ β_{23j} (FSF*Asian) + β_{24j} (QSF*Asian) + β_{25j} (FSF*Hispanic)
+ β_{26j} (QSF*Hispanic)
+ $\mu_{0j} + e_{ij}$ where $e_{ij} \sim N(0, \sigma^2_e)$, $\mu_{0j} \sim N(0, \tau_{00})$

Level-two model:

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ (research) + γ_{02} (masters) + γ_{03} (baccart) + γ_{04} (selective)
+ γ_{05} (control) + γ_{06} (size) + u_{0j}

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

. .

$\beta_{16j} = \gamma_{16}$

where i = 1, …, nj students in institution j, and j = 1, …., J institutions. Y_{ij} was GPA for student i in institution j.

The above level-2 model distinguished this model from the models for satisfaction with the college experience and intellectual skills development. The level-2 model for satisfaction and intellectual skills development took the form:

Level-two model:

$\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

. .

$\beta_{16j} = \gamma_{16}$

Step 3: Centering

Given that hierarchical linear models use level-1 parameters as dependent variables in the level-2 analysis, it is important that the meaning and interpretation of these parameters are clear (Umbach & Porter, 2002). Having an intercept value equal to "the expected value of student satisfaction when student-faculty interaction is zero" may not be particularly meaningful. More meaningful is "the predicted value of satisfaction for a student with an average level of student-faculty interaction". Centering permits such an interpretation.

Grand mean centering was undertaken in this study. This choice of centering method was guided by:

a) The outcomes of my Step 2: Exploring Random Effects. More specifically, the effect of neither "frequency of student-faculty interaction" nor "quality of relationships with faculty" was found to vary by institution for my dependent variables. These two variables were therefore considered as fixed level-1 variables.
b) Umbach & Porter (2002, p. 223) who suggest that:

> A general convention used in multilevel modeling is to grand mean center all fixed level-1 variables, and group mean center all random level-1 variables. At level-2, in most cases, all independent variables are grand mean centered.

Grand mean centering involves the subtraction of the grand mean of the level-1 predictor from each level-1 case (that is, $X_{ij} - X_{..}$ where $X_{..}$ is the grand mean of X_{ij}). The grand mean is calculated across all observations. Grand mean centering yields an intercept equal to the expected value of the dependent variable Y_{ij} for a student with an "average" level of X_{ij} (that is, the expected value for Y_{ij} for a student with a score on X equal to the mean across all students in

the sample). The variance in the intercept term represents the between-group variance in the outcome variable adjusted for the level-1 variables (that is, after partialling out or controlling for the level-1 variables). Grand mean centering has the advantage of reducing the correlation between the intercept and slope estimates across groups. This reduction of the co-variation between the random intercepts and slopes can help to alleviate potential level-2 estimation problems due to multicollinearity (Hofmann & Gavin, 1998).

Effect Sizes

All HLM results are displayed as effect sizes to aid the interpretation of the estimated coefficients in my final models. My sample comprised 9,000 first-year commuter students attending 465 four-year institutions. Give that large sample sizes make it more likely that a difference – even a small one – will be statistically significant, examining the p-value alone is not sufficient. I focused on effect sizes in addition to p-values in order to account for both the practical and statistical significance of my estimates. According to Olejnik & Algina (2000),

> …statistical significance does not imply meaningfulness. … While statistical "significance"' helps to protect the researcher from interpreting an apparently large observed difference as meaning a true difference between populations when sample sizes are small, it does not protect the researcher from interpreting a trivially small observed difference as meaningful when sample sizes are large. (p. 241)

An effect size measures the size of the relationship between a dependent and independent variable. Consistent with Kinzie Thomas, Palmer, Umbach, & Kuh (2006), Umbach & Kuh (2006), and Umbach & Wawrzynski (2005), all continuous dependent and independent variables

were standardized so that the unstandardized coefficients represent effect sizes. I applied Rosenthal & Rosnow's (1991) categorization of effect sizes:

- r less than 0.10 - trivial effect
- r = 0.10 – small effect
- r = 0.30 – moderate effect
- r = 0.50 – large effect

In my Results section, I do not report variables with trivial effect sizes as differences below 0.10 standard deviations may be too small to be considered of practical importance. I report only coefficients that are both statistically significant ($p<.01$) and practically significant (that is, those coefficients with small, moderate, and large effect sizes).

Step 4: Estimation of Final Models

The full model for each dependent variable was estimated based on the results of the exploration of random effects in Step 2. Table 5.3 indicates the final results (in effect sizes) of utilizing hierarchical linear modeling to estimate the impact of student-faculty interaction on my three outcomes – satisfaction with the college experience, intellectual skills development, and grade-point average. I report only coefficients that are both statistically significant ($p<.01$) and practically significant (that is, those coefficients with small, moderate, and large effect sizes). The full set of estimates for the entire model (including coefficients that are trivial and not statistically significant at the 1 percent level) can be found in Appendix A.

The estimates in the Table 5.3 indicate that for the most part, "small" effects (ES>0.30) are detected. The exception is the "moderate" effect of the quality of student-faculty interaction on satisfaction.

Table 5.3.

Results - HLM Models (in effect sizes)

	Dependent Variables		
Variables	**Satisfaction with the College Experience**	**Intellectual Skills Development**	**Grade Point Average**
Key Independent Variables:			
Frequency of Student-Faculty Interaction	0.11**	0.28***	
The Quality of Student-Faculty Interaction	0.37***	0.26***	0.29***
Institutional Variables:			
Institutional Selectivity			-0.10**
Institutional Control			0.21***
Interactions:			
Frequent Interaction*African-American	0.15**		0.19**
Quality Interaction * Hispanic	0.13***		
Quality Interaction * Asian	0.10***		
Fit:			
Deviance	21292.15	21212.35	23034.91
Variance:			
Residual	.71***	.74***	.87***
Intercept	.02***	.00	.02***

Note. **p<0.01, ***p<0.001

Estimation results are as follows:

Satisfaction with the College Experience. My sample of first-year commuter students experience higher levels of satisfaction from their interactions with faculty members outside the classroom (ES=.11). The level of satisfaction is much higher among students who give high ratings to the quality of their relationship with faculty (ES=.37).

Moderation effects are detected. As faculty interaction increases for African-American students, their satisfaction also increases (ES=.15). The higher the quality of the relationship is between faculty and Hispanic (ES=.13) and Asian (ES=.10) students, the greater is their satisfaction with the college experience.

The between-institution variance of 0.02 is statistically significant suggesting that there are still differences in the average satisfaction levels across institutions to be explained. In pre-estimation analyses, the null model had indicated that 3 percent of the variance was explained by institutional differences while 97 percent was explained by differences in my sample of first-year commuter students. After including student characteristics in the level-1 model, 27 percent of the within-institution difference among students was explained by those variables. Since none of the between-institution variance is accounted for by the six institutional characteristics, differences in satisfaction with the college experience are primarily due to differences in student characteristics for this sample of commuter students.

Intellectual Skills Development. Intellectual skills development is higher for students who interact frequently with faculty members (ES=.28) and who give higher ratings to the quality of their relationship with faculty (ES=.26).

The between-institution variance in the final model for intellectual skills development is not statistically significant at the one percent level. This suggests that there are no additional

differences in average intellectual skills development levels across institutions to be explained by institutional variables.

In pre-estimation analyses, the null model had indicated that 1 percent of the variance was explained by institutional differences while 99 percent was explained by differences in commuter students. After including student characteristics in the level-1 model, 29 percent of the within-institution difference among students was explained by those variables. Since none of the between-institution variance is accounted for by the six institutional characteristics, for this sample of commuter students, differences in the development of intellectual skills are primarily due to differences in student characteristics.

Grade-Point Average. No evidence is found of an association between GPA and frequent interaction with faculty members. Rather, slightly higher GPA is associated with the quality of the relationship between faculty and students (ES=.29). As faculty interaction increases for African-American (ES=.19), their GPA also increases.

With regard to institutional averages, GPA is slightly higher for students enrolled in private (ES=.21) but less selective (ES=.10) institutions.

The between-institution variance was 0.03 in the random-coefficients GPA model (with standardized variables). Its value of 0.02 in this random-intercept model indicates that the six institutional variables predicting the intercept explain 33 percent of the variance in GPA across institutions. The fact that the between-variance is also statistically significant suggests that there are still differences in the average GPA across institutions not explained by the six institutional variables. Of these variables, being enrolled in a private institution has a positive statistically significant effect on average GPA across institutions, while institutional selectivity has a negative effect. These effects suggest that students enrolled in private institutions have higher

average GPAs than their peers in public institutions, controlling for the other five institutional variables. On the other hand, students enrolled in less selective institutions have higher GPAs when compared to their peers in more selective institutions.

In pre-estimation analyses, the null model indicated that 3 percent of the variance was explained by institutional differences while 97 percent was explained by differences in commuter students. After including student characteristics in the level-1 model, 11 percent of the within-institution difference among students was explained by those variables. Thirty-three percent of the between-institution variance is accounted for by the six institutional characteristic – research universities, masters colleges and universities, baccalaureate colleges – arts and sciences, control, selectivity, and size. For this sample of commuter students, the difference in GPA is comparatively less due to differences in student characteristics and more due to differences in the kinds of institution in which they were enrolled.

Deviance. The deviance of the final models was compared to those of the null models for each dependent variable. The deviance provides a measure of the lack of fit between one model and other models fitted to the same dataset (Cohen, Cohen, West, & Aiken, 2003, p. 501; Snijders & Bosker, 2012, p. 97; Tabachnick & Fidell, 2007, p. 830). The test determines whether each final model in my study predicts the dependent variable beyond what would be expected by chance, or in other words, whether each model does better than the null model (Tabachnick & Fidell, 2007, p. 830). As shown in Table 5.4, the large chi-square differences in deviances (between the null and final models) are all statistically significant at their respective degrees of freedom. This suggests that for each dependent variable, my full model leads to a prediction that is significantly better than chance.

Table 5.4.

Comparison of Deviance - Null and Full Models

Dependent Variables	Models	Deviance -2 Log Likelihood
Satisfaction with the College Experience	Null Model	25,360.62
	Final Model	21,292.15
	Difference χ^2	4,068.47
Intellectual Skills Development	Null Model	25,401.36
	Final Model	21,212.35
	Difference χ^2	4,189.01
Grade Point Average	Null Model	25,359.68
	Final Model	23,034.91
	Difference χ^2	2,324.77

Research Question #1: Summary of Findings

Hierarchical linear modeling was used to answer research question #1: *Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?*

This research question can be split into two parts. In response to the first part of the question: "*Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development,*" the results indicate that yes, first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, intellectual skills development, and GPA. My sample of first-year commuter students are more satisfied and develop their intellectual skills when they interact frequently with faculty and rate highly the quality of their relationships with faculty members. While the analysis

fails to detect a relationship between frequent interaction and GPA, higher GPAs are associated with higher ratings of the quality of relationships with faculty members.

A definitive response cannot be determined for the second part of my research question: "*and in what types of institutions are these tendencies more likely?*" It was not feasible to explore cross-level interactions or moderating effects of the institutional factors in analyses for the three dependent variables. An exploration of random effects for my key independent variables - frequency of student-faculty interaction and the quality of relationships with faculty - revealed that the effect of these two variables did not vary across institutions.

However, what was explored was the effect of institutional factors on the average levels of GPA. The results indicate that on average, the first-year commuter students in my sample with higher GPAs are those enrolled in private and less selective institutions.

Conditional effects of faculty-student interactions are key additional findings of this study. Table 5.5 summarizes the effects of frequency and quality of the interaction by race/ethnicity.

Table 5.5.

Conditional Effects of Student-Faculty Interaction

	Dependent Variables	
	Satisfaction	**GPA**
Frequent Interaction	+ African-American	+ African-American
Quality Relationship	+ Hispanic + Asian	

The positive interaction effects indicate that the association between frequent non-classroom interaction with faculty members and each of the two outcomes - satisfaction and

GPA - is higher for African-American students than for White students. The association between quality non-classroom relationships with faculty members (that is, the extent to which students feel connected to faculty members who are helpful, available, and sympathetic) and satisfaction with the college experience is higher for Hispanic and Asian/Pacific Islander students than for White students.

In summary, the findings for research question #1 suggest that satisfaction with the college experience, intellectual skills development, and GPA, are associated with student-faculty interaction. Being enrolled in a private institution is associated with higher GPAs. Students in less selective institutions expect higher GPAs. As compared to effects for White students, higher associations are found between frequent non-classroom interaction and satisfaction and GPA for African-American students, and between quality non-classroom relationships with faculty members and satisfaction for Hispanic and Asian/Pacific Islander students.

CHAPTER VI

RESEARCH QUESTION #2: RESULTS

Propensity score matching was used to answer research question #2:

Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?

A five-step data analysis process was followed: First, baseline models were estimated for each dependent variable. Second, propensity scores were estimated. Third, matching was undertaken, and the final model estimated for each dependent variable. Fourth, the two assumptions underlying propensity score matching were confirmed. As a final stage, sensitivity tests were conducted to test the robustness of my results. Throughout the analysis, statistical significance was assessed against a significance level of 0.01. Given that my large sample size (n=9,000) increased the power of my statistical tests, the significance level was set at 0.01 to reduce the probability of making a Type 1 Error.

Hierarchical linear modeling or an approach based on nested data was not incorporated into the propensity score matching analysis to answer my second research question. Such an approach was considered unlikely to be very informative for at least two reasons. The analysis related to my first research question reveals that the effects for my key independent variables – frequency of student-faculty interaction and the quality of relationships with faculty – are mostly small (effect sizes less than 0.3) and that these effects do not vary across institutions.

Step 1: Estimation of Baseline Models (or Naive Regression Analysis)

Baseline models for each dependent variable – students' satisfaction with the college experience, GPA, and intellectual skills development - were estimated using OLS regression. The aim was to examine the relationship between these variables and student-faculty interaction. In this analysis, student-faculty interaction was operationalized for simplicity using only one interaction measure - "the frequency of student-faculty interaction outside the classroom." This measure lent itself more readily to the construction of the binary treatment variable required for propensity score matching.

In this naïve regression analysis, the model estimated for each dependent variable was:

$$Y_i = \beta_{0j} + \beta_{1j}\,(\text{student-faculty interaction}) + \beta_{2j}\,(\text{age}) + \beta_{3j}\,(\text{female}) + \beta_{4j}\,(\text{firstgen}) + \beta_{5j}\,(\text{African-American}) + \beta_{6j}\,(\text{Asian}) + \beta_{7j}\,(\text{Hispanic}) + \beta_{8j}\,(\text{transfer}) + \beta_{9j}\,(\text{ftime}) + \beta_{10j}\,(\text{effort}) + \beta_{11j}\,(\text{peerf}) + \beta_{12j}\,(\text{peerq}) + \beta_{13j}\,(\text{major-sc}) + \beta_{14j}\,(\text{major-socsc}) + \beta_{15j}\,(\text{major-appl}) + e_i$$

where Y_i was alternatively the satisfaction with the college experience, intellectual skills development, and GPA for student i.

Controls included students' age, race/ethnicity, gender, first-generation status, entry status (native/transfer), enrollment status (full-/part-time), academic major, academic effort, the frequency of peer interactions, and the quality of peer relationships.

Table 6.1.

Results – Naïve Regression Analysis

Dependent Variable	β	Standard error	Confidence Interval
Satisfaction with the College Experience	0.13	0.01***	0.10 - 0.16
Intellectual Skills Development	0.28	0.01***	0.25 - 0.30
Grade Point Average	0.01	0.02	-0.04 - 0.05

Note. **p<0.01, ***p<0.001

Table 6.1 displays the results from the naïve regression analysis. Frequent student-faculty interaction is found to be positively associated with satisfaction (β=.13) and intellectual skills development (β=.28). No evidence is found of an association between student-faculty interaction and GPA. The effects for satisfaction and intellectual skills development are likely higher than they should be due to selection bias. Students self-select to interact with faculty members. For instance, while it is probable that the more motivated students will seek out faculty members, it is also likely that these students will be more satisfied with their college experience, and have more developed intellectual skills, even in the absence of interaction. Selection bias likely causes the estimates to be overstated.

Step 2: Estimation of Propensity Scores

Treatment (participation in student-faculty interaction) was regressed on student characteristics to determine the probability of participating in student-faculty interaction (or each student's propensity to be a member of the treatment group), given the control variables (or the factors associated with self-selection). The propensity score was given by:

$$E(x) = Pr\ (z = l|x),$$

where z represents the treatment variable and x represents the control variables.

A probit function was estimated because the treatment z was in binary form. The variable "frequency of student-faculty interaction outside the classroom" was expressed as a binary variable. More specifically, I identified as group y_1 those students who were "treated", that is, those students who indicated on the 2010 NSSE survey that they interacted with faculty "very often," "often," and "sometimes." Group y_0 referred to those students who indicated on the NSSE survey that they "never" interacted with faculty. Using the variable "the frequency of student-faculty interaction outside the classroom" the treatment z was created as a binary variable equal to 1 if a student interacted with faculty, and equal to 0 otherwise.

The majority of students (72 percent) in the study sample fell into the treated group (as shown in Table 6.2).

Table 6.2.

Number and proportion of students in treated and untreated groups

Treatment	Number of students	Percentage (%)
0	2,507	28
1	6,477	72
Total	8,984	100

Independent t-tests reveal that the characteristics of students in the treated and untreated groups are mostly similar. While those first-year commuter students in my sample who interact with faculty members differ from those who do not on several variables, Table 6.3 indicates that the two groups of students are not statistically different in terms of being female, their age, first-

generation status, White, Asian/Pacific Islander and Hispanic race/ethnicity, full-time status, entry status, academic major, and enrollment in Arts and Science baccalaureate colleges, and master's institutions. These characteristics (except the institutional characteristics) were among those used in the matching process.

Table 6.3.

T-tests Results for Interaction with Faculty Mean Comparisons

Variable Name	Mean Interacted with Faculty (n)	Mean Did not interact with Faculty (n)	Sample size N	T
Satisfaction with the College Experience	3.11 (n=6460)	2.85 (n=2502)	8962	-14.68***
Intellectual Skills Development	2.73 (n=6451)	2.30 (n=2502)	8953	-25.71***
Grade Point Average	3.60 (n=6454)	3.47 (n=2498)	8952	-4.64***
Frequency of Student-Faculty Interaction	2.24 (n=6477)	1.00 (n=2507)	8984	-130***
Quality of Student-Faculty Interaction	5.49 (n=6445)	4.93 (n=2497)	8942	-17.97***
Age	0.12 (n=6455)	0.12 (n=2504)	8959	-0.07
Female	0.65 (n=6457)	0.62 (n=2503)	8960	-2.11
First-generation Status	0.71 (n=6536)	0.74 (n=2485)	8921	2.47
Caucasian/White	0.57 (n=6459)	0.60 (n-2502)	8961	2.28
African American/Black	0.09 (n=6459)	0.07 (n=2502)	8961	-3.74***
Asian/Pacific Islander	0.10 (n=6459)	0.10 (n=2502)	8961	-0.38
Hispanic	0.14 (n=6459)	0.13 (n=2502)	8961	-0.34
Entry Status	0.08 (n=6459)	0.08 (n=2503)	8962	-1.01
Full-Time Status	0.94 (n=6469)	0.92 (n=2502)	8971	-2.34
Arts and Humanities Major	0.11 (n=6280)	0.10 (n=2418)	8968	1.64
Professional/Applied Major	0.46 (n=6280)	0.46 (n=2418)	8698	-0.17
Science Major	0.13 (n=6280)	0.12 (n=2418)	8698	-0.27
Social Sciences Major	0.11 (n=6280)	0.10 (n=2418)	8698	-1.56

Note. **p<0.01, ***p<0.001

Table Continued

Variable Name	Mean Interacted with Faculty (n)	Mean Did not interact with Faculty (n)	Sample size N	T
Frequency of Peer Interactions	2.12 (n=6476)	1.63 (n=2507)	8983	-33.33***
The Quality of Peer Interactions	5.50 (n=6456)	4.98 (n=2499)	8955	-15.95***
Academic Effort	4.27 (n=6439)	3.77 (n=2501)	8940	-12.83***
Research Universities	0.33 (n=6477)	0.37 (n=2507)	8984	2.73**
Masters Colleges and Universities	0.53 (n=6477)	0.53 (n=2507)	8984	0.26
Baccalaureate Colleges – Arts and Science	0.08 (n=6477)	0.06 (n=2507)	8984	-2.56
Baccalaureate Colleges – Diverse	0.06 (n=6477)	0.05 (n=2507)	8984	-3.26**
Institutional Selectivity	3.06 (n=6477)	3.00 (n=2507)	8984	-2.86**
Institutional Control	0.34 (n=6477)	0.26 (n=2507)	8984	-8.18***
Enrollment Size	2.97 (n=6477)	3.21 (n=2507)	8984	9.74***

Note. **p<0.01, ***p<0.001

Table 6.4 displays the results of the probit model used to estimate propensity scores. The probit estimation results suggest that African-American students are more likely to interact with faculty members outside the classroom. Higher likelihoods are also predicted for students who spend more time preparing for class, and those who interact frequently and have quality relationships with their peers. These results of the probit model are similar to those obtained from a confirmatory logit model that was estimated with the data.

Table 6.4.

Probit Results for Outcome: Participation in student-faculty interaction

Variable	β	SE	Variable	β	SE
Age	0.018	0.054	Full-Time Status	0.018	0.065
Female	0.068	0.032	Academic Effort	0.071	0.010***
African-American/Black	0.187	0.059**	Frequency of Peer Interactions	0.689	0.026***
Asian/Pacific Islander	0.023	0.053	The Quality of Peer Interactions	0.090	0.011***
Hispanic	0.002	0.046	Professional/Applied Major	-0.010	0.036
First-generation Status	-0.042	0.035	Science Major	-0.075	0.052
Entry Status	0.080	0.060	Social Sciences Major	0.037	0.054
Constant	-1.522	0.102***			
Log likelihood		-4467.59			
Chi2		114.96			
N		8528			

Note. **p<0.01, ***p<0.001

Step 3: Mahalanobis Metric Matching and Estimation of Final Models

Matching and the estimation of final models were carried out using Leuven & Sianesi's (2003) psmatch2 command developed for Stata. I first determined my matched samples. According to Rosenbaum & Rubin (1985):

> matched sampling is a method for selecting units from a large reservoir of potential controls to produce a control group of modest size that is similar to a treated group with respect to the distribution of observed covariates. (p.33)

I determined my matched samples using the hybrid matching algorithm of Mahalanobis metric (covariate) matching within a caliper of 0.058 standard deviations of the propensity score. Following Cochran & Rubin (1973), I calculated the caliper size using the equation:

$$c = a \sqrt{(\sigma_1{}^2 + \sigma_2{}^2)/2} = a * SIGMA$$

where $\sigma_1{}^2 and\ \sigma_2{}^2$ were the variances of probit-estimated propensity scores in the treatment and control groups.

The value of SIGMA was 0.2897. I also calculated the value of the ratio of treatment group sample variance to control group sample variance, $\sigma_1{}^2/\sigma_2{}^2$. The value of the ratio of variances was approximately equal to 1 (0.944). According to Cochran & Rubin (1973), when the ratio of variances has a value of 1, a caliper width of c = .2 * SIGMA would remove 99 percent of the bias in a normally distributed covariate. For my study, the value of the caliper width used was:

$$c = .2 * SIGMA = .2 * .2897 = .0579$$

This caliper size allowed for 'tight matching' which occurs when a <= 0.2 (Cochran & Rubin, 1973).

By using Mahalanobis metric (covariate) matching with a caliper, bias was minimized because the characteristics between both my treatment and control group students were similar. However, I recognized that using this technique might ignore a lot of information from my sample, since many control group students may not be used for estimation. I accepted the possible tradeoff - that the reduction in bias might be accompanied by an increase in the imprecision of the estimates caused by a higher variance (Heinrich, Maffioli, & Vazquez, 2010).

To apply this matching method, study participants were first randomly ordered. Behind the scenes, Stata did the following: the first treated student was selected and then a subset of potential control students who were close to this student on the propensity score (that is, within the .058 caliper) was defined. Thereafter, a control student was selected from this subset using the smallest Mahalanobis distance (Rosenbaum & Rubin, 1985). The treated and control students were then removed from the pool. Stata would have repeated this matching process until each treatment student was matched. If no available matches were found within this width, the unmatched control students would have been removed from my sample.

During estimation, the matched sample was used to compare the treatment group of students with the control group on each of my dependent variables. Stated differently, the effect of student-faculty interaction on the three student outcomes was estimated for the matched sample. The resulting coefficient for the treatment dummy variable indicates the estimated average effect of treatment for those who received the treatment (the ATT). Standard errors were bootstrapped using 500 replications each. The reported significance levels are based on t-statistics generated using bootstrapping.

Table 6.5 displays the estimated average effect of treatment for those who received the treatment (ATT), or estimates of the effects of interacting with faculty, vis-a-vis not interacting, on levels of satisfaction, GPA, and intellectual skills development, after minimizing selection bias and controlling for the effects of various student background variables.

Table 6.5.

Results: Mahalanobis Metric Matching with Caliper = 0.058sd

Dependent Variable	OLS β/SE	Matching β/SE	Treated Average	Controls Average
Satisfaction with the College Experience	0.13 (0.01)***	0.12 (0.05)***	3.09	2.97
Intellectual Skills Development	0.28 (0.01)***	0.24 (0.04)***	2.66	2.42
Grade-Point Average	0.01 (0.02)	0.03 (0.07)	3.55	3.54

Note. **p<0.01, ***p<0.001

The matching results indicate that compared to their counterparts who do not interact with faculty members outside the classroom, students who interact with faculty experience higher levels of satisfaction and intellectual skills development. No effect on GPA is detected. The results also indicate that, compared to the estimates from propensity score matching, the OLS estimates have overstated the average effects for satisfaction and intellectual skills development. The matched sample consists of 2,605 students.

Step 4: Confirmation of Assumptions.

Assumption of Conditional Independence

Two conditions must be met for propensity score matching to work - conditional independence, and common support must be assumed. Before my estimates for the average effect of treatment on the treated (ATT) could be accepted, it was necessary to confirm that these two assumptions of propensity score matching had been met. The first assumption - conditional independence or un-confoundedness – was confirmed using balancing tests.

The variables (x) on which the treatment and control groups differ must be observable to the researcher, that is, there must be selection on observables. Propensity score matching therefore assumes that the information contained in x is sufficient to make the counterfactual outcome y_0 independent of treatment z (Doyle, 2009; Smith & Todd, 2001):

$$y_0 \perp z|x$$

Stata's pstest command was utilized to confirm this assumption. The tests checked whether propensity score matching adequately balanced characteristics between treatment and control group students. This verified whether, after conditioning on p(X), there were no other variable that could be added to the conditioning set of the propensity score models that would improve the estimation, and after matching, there would be no statistically significant differences between the covariate means of the treatment and control groups (Heinrich, Maffioli, & Vazquez, 2010).

To verify the Conditional Independence Assumption, I ran t-tests of equality of means before and after matching to evaluate if the propensity score matching succeeded in balancing the characteristics between my treated and untreated groups. The before-matching t-tests examined the difference in means using the full sample. The after-matching t-tests used the matched sample. Table 6.6 displays the results of the balancing tests.

Table 6.6.

Differences in Means before and after Matching

Variable	Unmatched Matched	Mean Treated	Mean Untreated	Percentage Bias (%)
Age	Unmatched	0.123	0.120	0.7
	Matched	0.030	0.030	0.0
Female	Unmatched	0.649	0.621	5.7
	Matched	0.704	0.704	0.0
African-	Unmatched	0.089	0.067	8.4**
American/Black	Matched	0.021	0.021	0.0
Asian/Pacific	Unmatched	0.099	0.097	0.8
Islander	Matched	0.042	0.042	0.0
Hispanic	Unmatched	0.137	0.134	1.1
	Matched	0.098	0.098	0.0
First-generation	Unmatched	0.715	0.742	-6.0
Status	Matched	0.764	0.764	0.0
Entry Status	Unmatched	0.084	0.077	2.6
	Matched	0.014	0.014	0.0
Full-Time Status	Unmatched	0.937	0.923	5.3
	Matched	0.984	0.984	0.0
Academic Effort	Unmatched	4.271	3.798	29.3***
	Matched	3.836	3.386	0.0
Frequency of Peer	Unmatched	2.123	1.636	79.9***
Interactions	Matched	1.913	1.913	0.0
The Quality of Peer	Unmatched	5.522	4.986	38.1***
Interactions	Matched	5.540	5.540	0.0
Professional/Applied	Unmatched	0.461	0.458	0.7
Major	Matched	0.521	0.521	0.0
Science Major	Unmatched	0.126	0.122	1.2
	Matched	0.081	0.081	0.0
Social Sciences	Unmatched	0.114	0.104	3.4
Major	Matched	0.079	0.079	0.0

Note. **p<0.01, ***p<0.001

The assumption of Conditional Independence is confirmed. According to Heinrich, Maffioli, & Vazquez (2010), in examining the results of after-matching balancing tests, one looks to see if any differences in the covariate means between the two groups in the matched sample have been eliminated, which should increase the likelihood of unbiased treatment effects. If after matching, the differences are no longer statistically significant, this suggests that matching helped reduce the bias associated with observable characteristics. After matching, none of the differences in means for my variables are statistically significant (indicated in Table 6.6).

The absence of a statistical difference in the pre-matching means of some variables is observed for the variables – female, age, first-generation, White, Asian/Pacific Islander and Hispanic race/ethnicity, full-time status, entry status, and academic major. These are the same variables (indicated on Table 6.3) for which independent t-tests indicates an absence of a statistical difference between those students who interact with faculty and those who do not. However, bias is also reduced for this set of variables.

Assumption of Common Support

In order to accept the estimates for the average effect of treatment on the treated (ATT), it was also necessary to confirm a second assumption of propensity score matching. This assumption of common support required that there be sufficient overlap in the characteristics of treated and untreated students so that adequate matches or common support can be found. For each possible value of the covariates x, there must be a positive probability of finding both a treated and an untreated student. The common support or overlap condition is given by:

$$0 < p(z = 1|x) < 1 \text{ for all } x$$

I graphed density plots of the propensity score distributions of both the treatment and control groups. The Common Support Condition is verified if there is significant overlap of the density plots for the treatment and control groups. Figure 6.1 illustrates that common support is achieved.

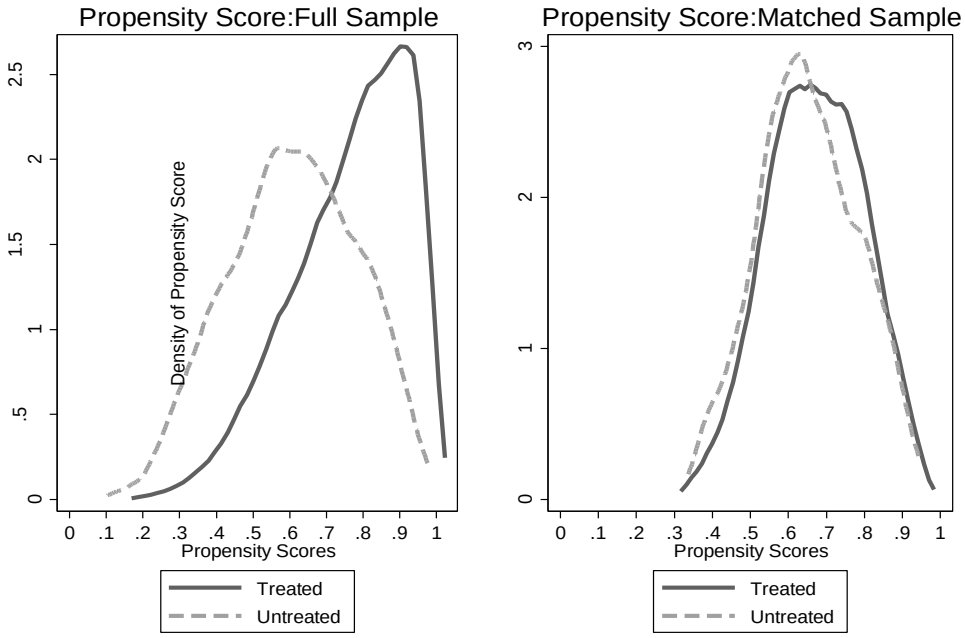


Figure 6.1. Density Plots of the Propensity Scores for the Full and Matched Samples.

To further demonstrate that the Common Support Condition was achieved, density plots were also graphed for three control variables - academic effort, frequency of peer interactions, and quality of peer relationships. Figure 6.2 displays the distributions of the propensity scores in the full and matched samples for these variables. The figure shows that the matched samples contain nearly identical distributions of these variables for those commuter students who interact/do not interact with faculty members outside the classroom. Since the control variables were previously continuous variables, bandwidths were adjusted to obtain smoother

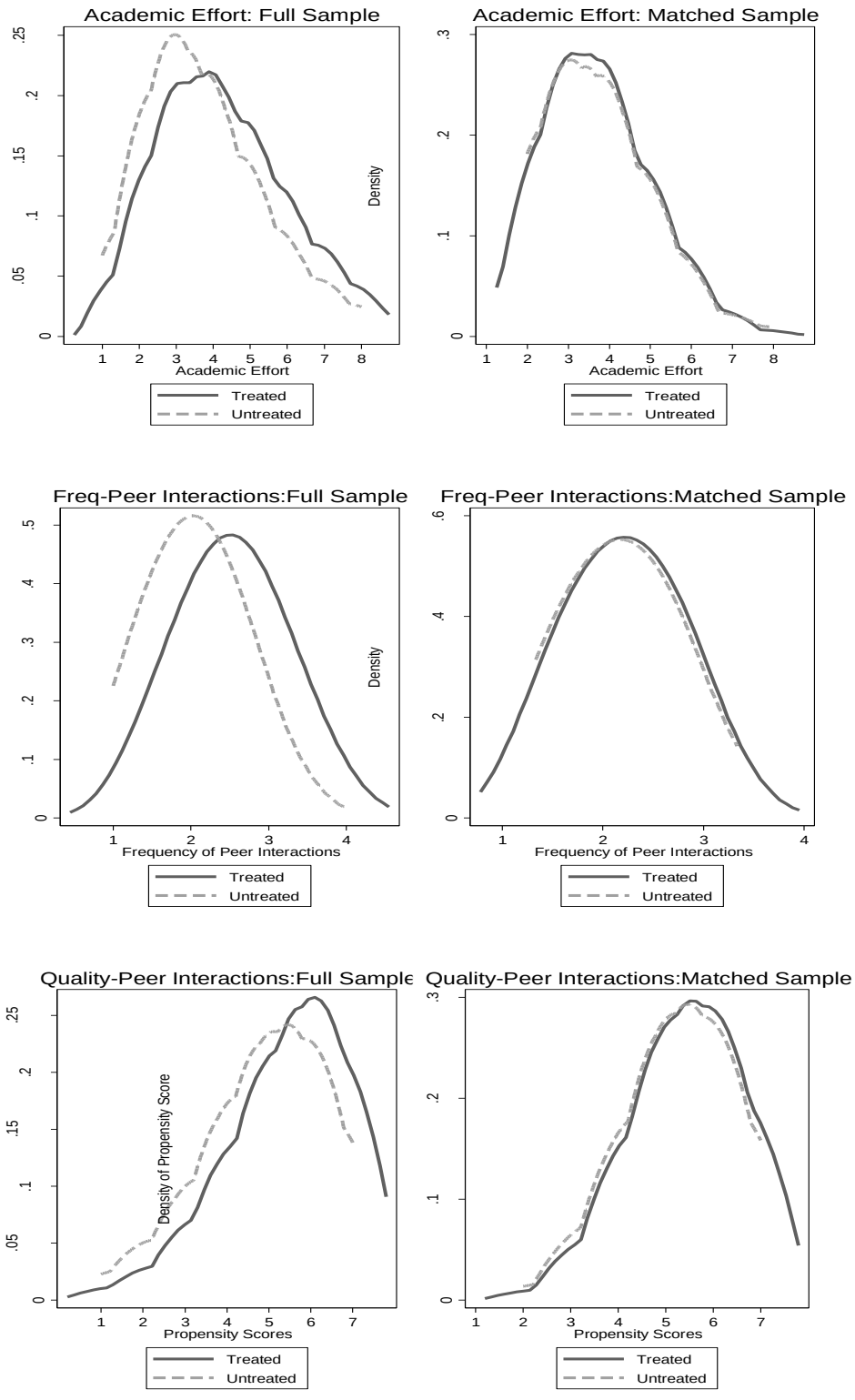


Figure 6.2. Density Plots of the Full and Matched Samples for Select Covariates.

distributions. The bandwidths for the distributions of academic effort, frequency of peer interactions, and quality of peer relationships were adjusted from 0.22 to 0.75, from 0.10 to 0.55, and from 0.11 to 0.8, respectively.

In summary, the assumptions of conditional independence and common support are both confirmed. The estimates of the effects of interacting with faculty, vis-a-vis not interacting, on levels of satisfaction, GPA, and intellectual skills development, are accepted. Compared to their counterparts who do not interact with faculty members outside the classroom, students who interact with faculty experience higher levels of satisfaction and intellectual skills development. No effect on GPA is detected.

Step 5:Sensitivity Tests

Robustness and sensitivity tests were performed to ascertain whether my propensity score matching results were robust to the matching method applied, the student sample used, and specific failures of the Conditional Independence Assumption.

Sensitivity to Matching Methods

First, I checked the robustness of my estimation using three alternative matching estimators - Radius Matching, Kernel Matching, and Nearest Neighbor Matching (with replacement and with 1, 3, and 5 nearest neighbors). This sensitivity test was performed because the bias and variance of the average effect of treatment on the treated (ATT) may vary across matching estimators, because each estimator assigns a different number of control students to treated students and a different weight to control students.

With Radius Matching, each treated student is matched to control students with propensity scores that fall within a predefined neighborhood or radius of the propensity score of the treated student. A radius of 0.058sd was used in this robustness test. Using a smaller radius increases the quality of the matches and reduces bias. However, with small radii it is possible that some treated students do not get matched because the neighborhood does not contain control students. Higher variance may result because less data is being used to construct the counterfactual (Becker & Ichino, 2002).

All treated students are matched with the weighted average for students in the control group with Kernel Matching. The weight is calculated by the propensity score distance between a treatment student and all control students. The closest control students are given the greatest weight. While the variance tends to be lower because more information is used, it is possible that observations used are bad matches (Heinrich, Maffioli, & Vazquez, 2010). The default kernel function (epanechnikov kernel) and bandwidth parameter (0.06) were used in this test.

Nearest Neighbor Matching takes each treated student and searches for the control student with the closest propensity score. When matching is undertaken with replacement, the control student is once again considered part of the sample in order to be potentially selected as a match to another treated student. Once each treated student is matched with a control student, the difference between the outcome of the treated students and the outcome of the matched control students is computed. The average treatment effect on the treated or ATT of interest is then obtained by averaging these differences (Becker & Ichino, 2002).

Zhao (2004, p. 99) suggests that matching with replacement may lead to less precision because of the use of a reduced sample size produced by using some control group members

more than once. However, the researcher acknowledges that when the control sample is not much larger than the treated sample, matching with replacement seems more sensible.

In this test, Nearest Neighbor Matching was undertaken with replacement, and with 1, 3, and 5 nearest neighbors. Using one neighbor guarantees that we are using the smallest propensity-score distance between treatment and control students. This minimizes the bias, since the characteristics between both students will be very similar. However, using this method ignores a lot of information from the sample because many control students are not used for the estimation. Therefore, the reduction in the bias is accompanied by a reduction in the precision of the estimates caused by a higher variance. By using more neighbors or comparison students, the estimator is more efficient since it exploits a larger quantity of information from the untreated pool. The precision of the estimates increases but this occurs at the cost of increased bias by using poorer matches (Becker & Ichino, 2002; Dehejia & Wahba, 2002).

Table 6.7 and Figure 6.3 indicate that my estimates are robust to changes in the matching method. Estimates for satisfaction are all within range of the baseline Mahalanobis estimate of 0.12. Radius Matching and Nearest Neighbor Matching (3 and 5 neighbors) produce exact estimates as baseline. The estimates for Kernel and Nearest Neighbor (1) Matching deviate from the Mahalanobis baseline by 2 and 3 percentage points respectively, and standard errors are lower in all comparison matches.

Comparison matching methods produce estimates within the range of the baseline Mahalanobis estimate for intellectual skills development (0.24). The Nearest Neighbor (1) Matching estimate is equivalent to the baseline estimate. All other estimates deviate slightly from baseline (by 2-4 percentage points).

Consistent with the results from Mahalanobis matching with 0.058sd caliper, all comparison matching methods produce estimates for GPA that are not statistically significant at the 1 percent level.

The estimate derived from Mahalanobis matching is the preferred estimate because comparison estimates all lie with its range of values indicated by the spikes on its range plot. In addition, as Rosenbaum & Rubin (1985, p. 38) observed, this method produces the best balance between the covariates in the treated and control groups and eliminates more bias, as compared to Nearest Neighbor Matching and Mahalanobis matching using propensity scores.

Table 6.7.

Comparison of the Average Treatment Effects on the Treated (ATT) among various Matching Methods

	Mahalanobis Matching Caliper 0.058sd	**Kernel Matching**	**Radius Matching Caliper 0.058sd**	**Nearest Neighbor (1)**	**Nearest Neighbor (3)**	**Nearest Neighbor (5)**
Satisfaction						
ATT	0.12	0.14	0.12	0.15	0.12	0.12
Std. Error	0.05***	0.03 ***	0.03***	0.04***	0.03***	0.03***
Intellectual Skills Development						
ATT	0.24	0.28	0.26	0.24	0.27	0.27
Std. Error	0.04***	0.02***	0.02***	0.04***	0.03***	0.03***
GPA						
ATT	0.03	0.03	0.02	0.06	0.01	-0.003
Std. Error	0.07	0.04	0.04	0.06	0.05	0.04

Note. **p<0.01, ***p<0.001

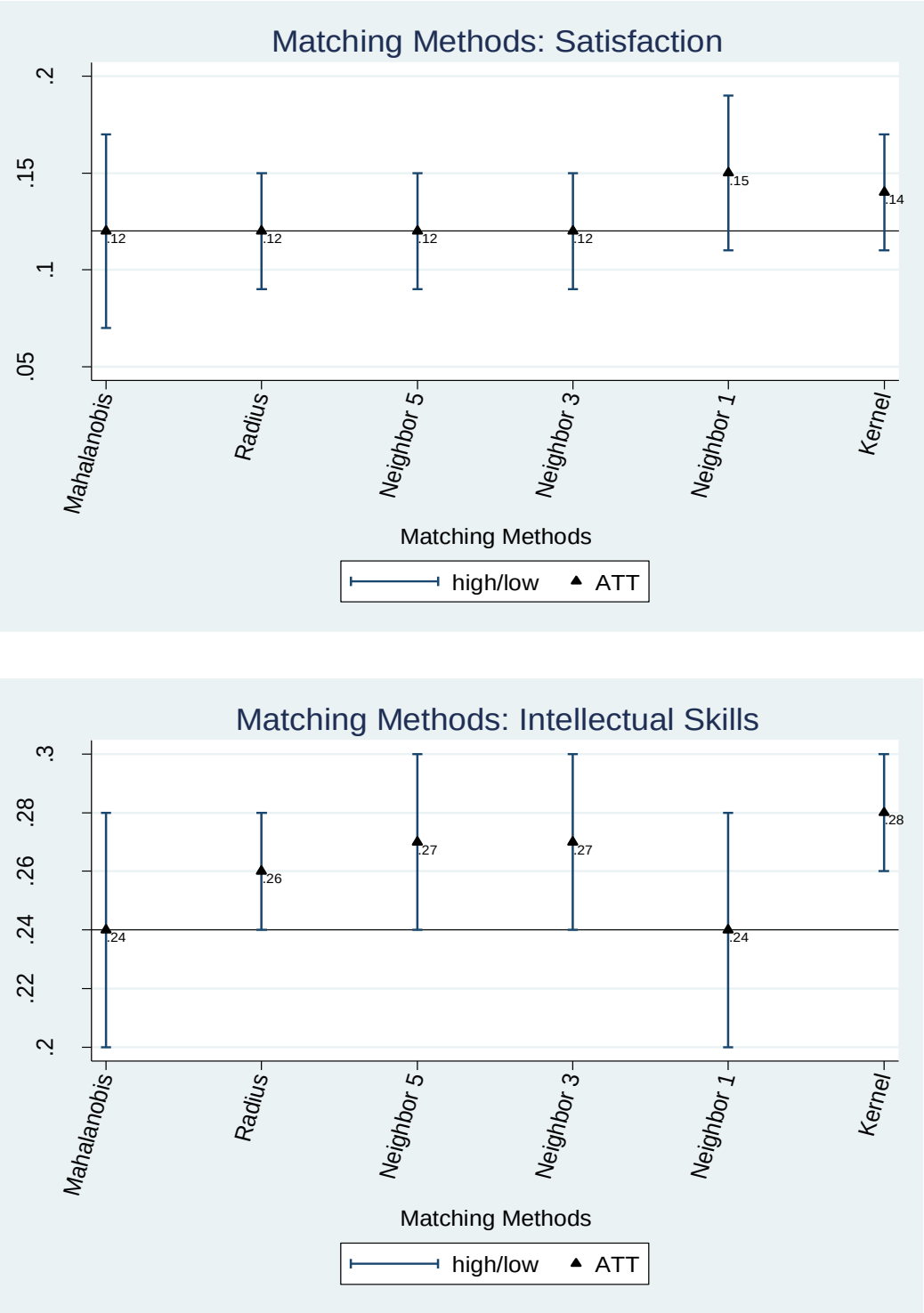


Figure 6.3. Comparison of Average Treatment Effects on the Treated, by Matching Method: Satisfaction and Intellectual Skills Development.

Sensitivity to Restricted Samples

I also checked the robustness of my estimates by performing Mahalanobis Matching with a caliper of 0.058sd on restricted samples of my data. I performed matching on samples of males only, females only, African-Americans only, etc. I recognize that while these restricted samples have less power, they represent cleaner samples and could provide an indication of the robustness of my estimates. Table 6.8 displays the results for each dependent variable.

Only one of my estimates – for intellectual skills development - is robust for most specific sub-samples of first-year commuter students. The estimate for intellectual skills development is robust for 63 percent of the sub-samples examined.

As compared to the result for intellectual skills development, my estimate for satisfaction for the college experience is not robust for the various sub-samples examined. Statistically significant results are obtained for less than 1 percent of the sub-samples at the 0.01 significance level.

Throughout the sensitivity analysis, no statistically significant effects are detected for GPA. However, an interesting finding is the single statistically significant effect for the part-time sub-sample. GPA is higher among part-time students who interact with faculty members outside the classroom. This finding suggests that interaction with faculty members makes a difference to the grades of these students. Part-time commuter students were a minority in the study sample, comprising a mere 7 percent of the sample. It could be that empirical analysis based on the aggregate of enrollment status might have masked effects for this sub-group. This finding is considered worthy of further exploration in future research.

Table 6.8.

Estimates of the Average Treatment Effects on the Treated (ATT) for different sub-samples

Sample of Students	Satisfaction	Intellectual Skills Development	Grade Point Average
FULL SAMPLE	0.12 (0.05)***	0.24 (0.04)***	0.03 (0.07)
Male	0.14 (0.06)**	0.24 (0.06)***	-0.03 (0.11)
Female	0.09 (0.06)	0.24 (0.05)***	-0.10 (0.09)
African-American	0.19 (0.18)	0.35 (0.14)**	0.15 (0.28)
White	0.08 (0.06)	0.29 (0.05)***	-0.06 (0.08)
Asian	0.08 (0.13)	0.15 (0.13)	0.21 (0.21)
Hispanic	0.02 (0.09)	0.10 (0.11)	0.02 (0.16)
First-generation	0.04 (0.05)	0.22 (0.05)***	-0.07 (0.09)
Non-first generation	0.01 (0.08)	0.16 (0.07)	-0.03 (0.11)
Full-time	0.10 (0.05)	0.27 (0.04)***	-0.03 (0.07)
Part-time	0.15 (0.16)	0.29 (0.19)	0.98 (0.29)***
Younger	0.06 (0.05)	0.23 (0.04)***	-0.03 (0.07)
Older	0.12 (0.12)	0.28 (0.13)	-0.36 (0.23)
Native	0.05 (0.05)	0.20 (0.04)***	-0.06 (0.07)
Transfer	0.10 (0.05)	0.22 (0.04)***	-0.06 (0.07)
Art and Humanities Major	0.03 (0.13)	0.19 (0.12)	-0.25 (0.16)
Science Major	-0.02 (0.11)	0.33 (0.10)**	0.16 (0.20)
Social Science Major	0.16 (0.14)	0.20 (0.13)	0.16 (0.20)
Professional/Applied Major	0.09 (0.07)	0.25 (0.06)***	-0.04 (0.11)
Private	0.01 (0.08)	0.23 (0.07)**	-0.15 (0.12)
Public	0.12 (0.05)**	0.24 (0.05)***	0.05 (0.08)
Baccalaureate Colleges - A&S	-0.20 (0.21)	0.32 (0.20)	0.24 (0.30)
Baccalaureate Colleges – Div.	0.28 (0.25)	0.03 (0.17)	-0.28 (0.40)
Masters Colleges and Univs.	0.11 (0.06)	0.15 (0.06)**	0.01 (0.09)
Research Universities	0.13 (0.07)	0.19 (0.06)**	-0.07 (0.11)

Note. **p<0.01, ***p<0.001

Sensitivity to Calibrated Confounders

Based on a method developed by Rosenbaum & Rubin (1983) and extended by Ichino, Mealli, & Nannicini (2006), I carried out two simulation-based sensitivity analyses to determine whether my results were robust to specific failures of the Conditional Independence Assumption. Specifically, I wanted to determine whether modest deviations from this assumption would substantially change, or even overturn, my baseline ATTs for satisfaction with the college experience, and intellectual skills development. Sensitivity tests were not performed for the GPA outcome because no statistically significant effect of student-faculty interaction could be determined for this dependent variable.

The first sensitivity analysis involved the use of 'calibrated confounders'; the second involved the use of 'killer confounders' (Ichino, Mealli, & Nannicini, 2006).

The Conditional Independence Assumption states that conditional on my observed covariates (x's), the potential outcomes (y_o, y_1) are independent of treatment status. Following Ichino, Mealli, & Nannicini (2006), I assumed that there existed an unobserved variable U that was correlated with both treatment (participation in student-faculty interaction) and my two outcomes. I assumed that the Conditional Independence Assumption failed, and that it would only hold if it was conditional on my observed covariates AND the unobserved variable U. According to Ichino et al. (p. 24), the outcome for control students cannot be used to consistently estimate the counterfactual outcome y_0 if U was not observed.

The sensitivity analyses therefore assumed that the Conditional Independence Assumption was conditional on my observed covariates and a binary unobserved variable, U. The counterfactual outcome y_0 became independent of z given x and U:

$$y_0 \perp z| (x, U)$$

where z was the binary treatment variable equal to 1 if a student interacted with faculty and equal to 0 otherwise, x represented my observed covariates, and U my unobserved variable.

Similarly, the propensity score had a new interpretation. It was the probability of participating in student-faculty interaction, given x and U, and was given by:

$$e(x) = Pr (z = l|x, U).$$

The unobserved confounding factor U had a distribution that was characterized by four parameters p_{ij} where:

$$p_{ij} = Pr (U = l| z = i, Y = j, x) = Pr (U = l| z = i, Y = j)$$

with i, j $\in$ {0,1}. The subscript i denotes the treatment status and the subscript j denotes the outcome status.

The first simulation exercise used 'calibrated confounders'. I sought to determine whether my estimates would still hold (remain robust) if I included such an unobserved variable U in the estimation of my propensity score, and as one of the variables that I match on.

According to Nannicini (2007, p. 341):

> Here the simulation exercise reveals the extent to which the baseline estimates are robust to deviations from the CIA induced by the impossibility of observing factors similar to the ones used to calibrate the distribution of U.

In this simulation, the p_{ij} were set so as to let U mimic the behavior of some of my covariates. I selected four variables - female, enrollment (full-time) status, first-generation status, and entry (transfer) status – which were already in binary form. Utilizing the sensatt command, Stata created variables with parameters identical to these four observed covariates. These newly created variables became my new confounders or U's. Stata then imputed a value for these new variables to each student, estimated the propensity score, performed matching, and then estimated my three models – satisfaction with the college experience, intellectual skills development, and GPA. On each occasion, the simulated U was treated as a regular covariate and included in the set of matching variables used to estimate the propensity score and compute the ATT. For each dependent variable, matching estimation was repeated 500 times and the simulated estimate of the ATT retrieved as an average of the ATTs over the distribution of U (Nannicini, 2007, pp. 338-339).

While Stata's sensatt command created the sensitivity ATTs using a Nearest Neighbor Matching estimator, I used as my baseline ATTs the estimates obtained from applying Mahalanbois matching with a 0.058sd caliper. I compared the simulated ATT estimates to my baseline estimates f or each of my models. Table 6.9 and Figure 6.4 indicate that my estimates for satisfaction and intellectual skills development are robust to these specific sources of failure of the conditional independence assumption.

All simulated estimates of the ATTs for satisfaction and intellectual skills development are positive, statistically significant, and close to the baseline estimate, implying that none of the calibrated confounders are able to wash out the main results. In the satisfaction model, the potential confounders - enrollment status, first-generation status, and entry status - "kill" only 8.3% of the baseline estimate ((.12-.11)/.12=.083). The potential confounder gender does not

"kill" any portion of the baseline estimate in this model or the model for intellectual skills development. The potential confounders - first-generation status and entry status - "kill" a smaller percentage (4.2%) of the baseline estimate in the intellectual skills development model.

Table 6.9.

Estimates of the Average Treatment Effects on the Treated (ATT) derived from using Calibrated Confounders (500 replications)

	Satisfaction with the College Experience		**Intellectual Skills Development**		**Grade Point Average**	
	ATT	SE	ATT	SE	ATT	SE
Mahalanobis with caliper of 0.058sd (baseline)	0.12	0.05	0.24	0.04	-0.03	0.07
Confounders:						
Full-time	0.11	0.03	0.23	0.03	-0.01	0.05
First-generation	0.12	0.04	0.25	0.03	-0.02	0.06
Female	0.11	0.04	0.25	0.03	-0.01	0.06
Transfer	0.11	0.03	0.24	0.03	-0.01	0.05

Note. Estimates for Satisfaction and Intellectual Skills Development are all statistically significant at the 0.01 level. Estimates for GPA are not statistically significant at the 0.05 or 0.01 levels.

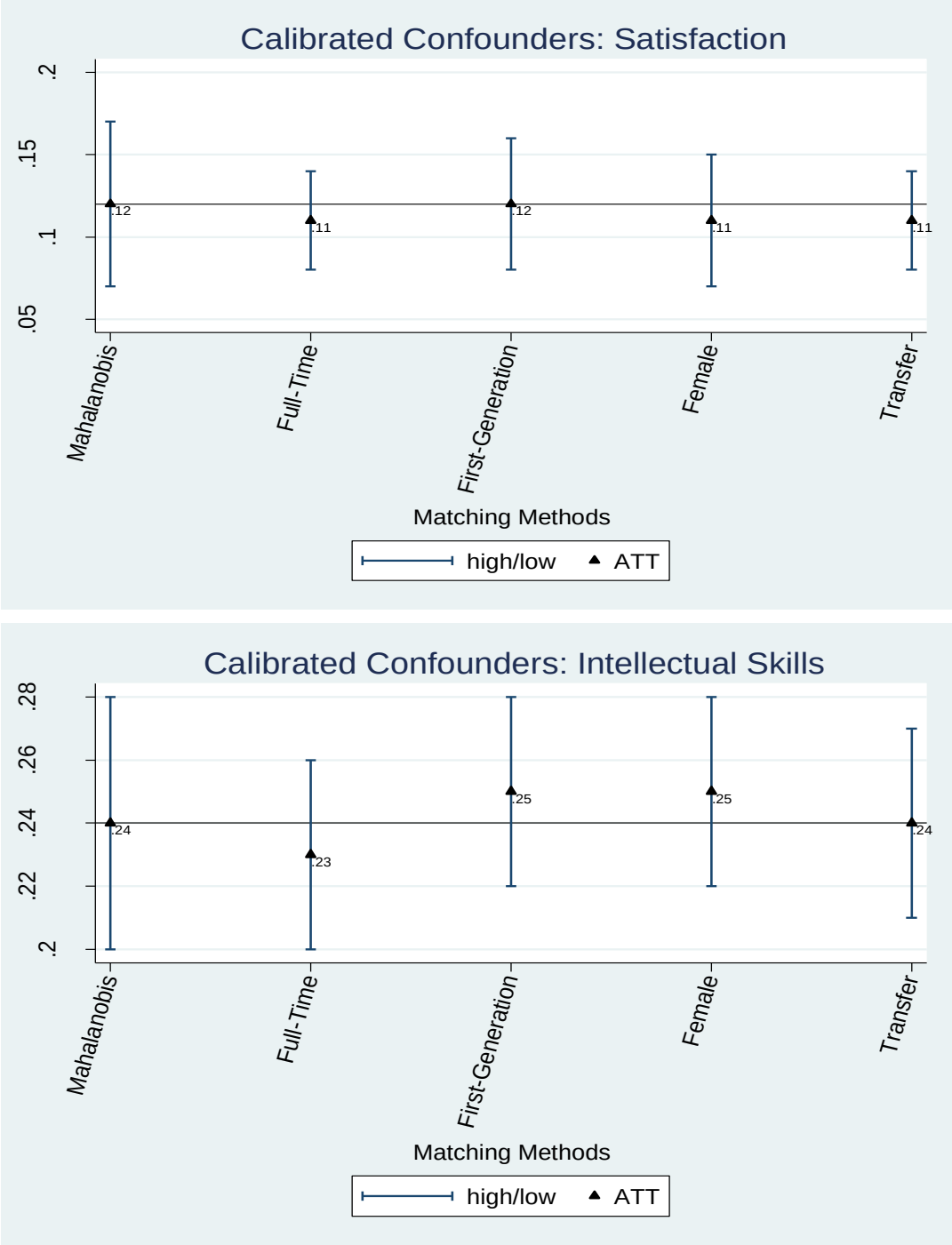


Figure 6.4. Comparison of Average Treatment Effects on the Treated, by Confounder: Satisfaction and Intellectual Skills Development

It is important to note that in addition to the estimates of the ATTs, Stata's sensatt command provides two sets of additional output. This output is relevant to the use of 'killer confounders' to assess the robustness of my estimates. The two additional sets of output are:

1. Probability values p_{ij} related to each calibrated confounder. Values are provided for:
    a. p_{11}: The probability of having U=1 if T=1 and Y=1
    b. p_{10}: The probability of having U=1 if T=1 and Y=0
    c. p_{01}: The probability of having U=1 if T=0 and Y=1
    d. p_{00}: The probability of having U=1 if T=0 and Y=0
    e. $p_{1.}$: The probability of having U=1 if T=1
    f. $p_{0.}$: The probability of having U=1 if T=0

In my analysis, z is equivalent to the treatment variable T used above. So, for example, when I used a confounder with a distribution similar to my gender variable, p_{11} indicated the fraction of female students who interacted with faculty members outside the classroom AND who either were satisfied with their college experiences, or had developed their intellectual skills. Values of these p_{ij} values were imposed during sensitivity tests using 'killer confounders.'

2. Average odds ratios of the "outcome effect" (Γ) and "selection effect" (Λ) of each simulated confounder, controlling for my observed covariates x. U's "outcome effect" (Γ) gives the effect of U on the relative probability of a positive outcome for students who do not interact with faculty. U's "selection effect" (Λ) gives the effect of U on the relative probability to be assigned to treatment (Ichino et al., p. 26).

By assuming that $p_{01} > p_{00}$, one can simulate a confounding factor that has a positive "outcome effect," conditioning on x, and by setting $p_{1.} > p_{0.}$, one can simulate a confounding factor that has a positive "selection effect, " conditioning on my x's. To conduct sensitivity tests involving 'killer confounders' I established d as $d = p_{01} - p_{00}$, and s as $s = p_{1.} - p_{0.}$, and assumed that both were positive.

Sensitivity to Killer Confounders

Sensitivity analysis using 'killer confounders' is advised to overcome any possibility of the estimates derived from the simulation exercise involving 'calibrated confounders' being "driven by the particular behavior of the chosen covariates" (Nannicini,2007, p. 342). In the analysis involving 'killer confounders,' a grid of different p_{ij} was created in order to identify the characteristics of a potential ("killer") confounder that would drive my ATT estimates to zero, or far away from the baseline results for satisfaction and intellectual skills development. I sought to create a variable that would be so important that it would take away the explanatory power of my treatment variable; a variable that once added to my model would render the effect of my treatment variable no longer significant. Stated differently, the aim of this simulation was to identify a set of parameters p_{ij} such that if U were observed, the estimated ATT becomes zero statistically. If all the configurations leading to such a result were considered unlikely, the simulation exercise would support the robustness of my estimates derived under the Conditional Independence Assumption (Nannicini, 2007, p. 342).

In this second sensitivity analysis, my confounder U had a similar distribution to my gender variable. To estimate the ATTs, I imposed values of the parameters that characterized the distribution of U. These parameter values were obtained using the Matlab code provided by

Tommaso Nannicini on his website: http://www.tommasonannicini.eu/ The code required 5 inputs: the values for three observed probabilities - Pr(Y=1|z=1), Pr(Y=1|z=0), Pr(z=1) - and 2 baseline parameters d`=p_{11}-p_{00} and Pr(U=1). Matlab provided a grid of different p_{ij} values for combinations of d and s values that ranged from 0.1 to 0.6. These p_{ij} values were entered into Stata's sensatt command.

In Table 6.10, estimates are presented for the ATT's for satisfaction and intellectual skills development that correspond to various combinations of d and s values. Along each row, the value of s increases from 0.1 to 0.5, while along each column the value of d increases from 0.1 to 0.5. Estimated values of Γ and Λ associated with each combination value of d and s are also included. The aim was to identify the characteristics of the potential ("killer") confounder (or combinations of d and s) that would drive my ATT estimates to zero. The baseline estimate from Mahalanobis matching within 0.058sd caliper represented the configuration (d = 0, s = 0). The simulations of U and the ATT estimations were replicated 100 times.

Table 6.10.

Effect of "Killer" Confounders: Satisfaction and Intellectual Skills Development

Satisfaction		**Selection Effects (s)**				
Outcome Effects (d)	0.0 [Γ, Λ]	0.1	0.2	0.3	0.4	0.5
0.0 [Γ, Λ]	**0.12 [1.1, 1.1]**					
0.1		0.11 [1.5, 1.8]	0.11 [1.5, 2.7]	0.10 [1.6, 4.1]	0.10 [1.6, 6.6]	0.10 [1.7, 11.0]
0.2		0.10 [2.3, 2.2]	0.10 [2.3, 3.3]	0.05 [2.4, 5.1]	0.01 [2.6, 8.5]	-0.04 [3.1, 15.1]
0.3		0.10 [3.5, 2.6]	0.02 [3.5, 4.1]	-0.02 [4.0, 6.6]	-0.08 [4.6. 11.4]	-0.22 [7.7, 22.5]
0.4		0.02 [5.4, 3.3]	-0.04 [5.9, 5.2]	-0.11 [7.2, 8.7]	-0.25 [12.0, 16.2]	-0.61 [456.7, 39.4]
0.5		-0.05 [9.4, 4.2]	-0.12 [11.2, 6.8]	-0.26 [17.2, 12.2]	-0.58 [752.2, 26.4]	n.d
Intellectual Skills		**Selection Effects (s)**				
Outcome Effects (d)	0.0 [Γ, Λ]	0.1	0.2	0.3	0.4	0.5
0.0 [Γ, Λ]	**0.24 [1.2, 1.1]**					
0.1		0.24 [1.5, 1.5]	0.23 [1.5, 2.3]	0.23 [1.5, 3.5]	0.22 [1.6, 5.5]	0.20 [1.6, 8.9]
0.2		0.23 [2.3. 1.5]	0.22 [2.3. 2.2]	0.20 [2.2, 3.4]	0.17 [2.4, 5.4]	0.14 [2.6, 8.8]
0.3		0.22 [3.9, 1.4]	0.20 [3.5, 2.2]	0.13 [3.8, 5.4]	0.17 [3.5, 3.4]	0.10 [4.3, 8.6]
0.4		0.21 [6.5, 1.4]	0.20 [5.7, 2.2]	0.14 [5.5, 3.3]	0.10 [6.0, 5.2]	0.03 [7.4, 8.4]
0.5		0.21 [12.8, 1.4]	0.16 [9.8, 2.1]	0.12 [9.3, 3.3]	0.06 10.2, 5.2]	-0.25 [13.8, 8.3]

Note. nd: This value could not be determined from Matlab-generated negative probability values.
Parentheses contain outcome (Γ), and selection (Λ) effects.
Emboldened are baseline estimates derived from Mahalanobis metric matching (0.058 caliper).
The shaded region indicates negative estimates of the average treatment effects on the treated.

Table 6.10 shows the impact of the unobserved confounding variable on the estimated impact of student-faculty interaction on satisfaction with the college experience, and intellectual skills development. The table provides evidence that both of my baseline estimates for satisfaction and intellectual skills development are robust to this specific source of failure of the Conditional Independence Assumption.

Satisfaction with the College Experience. Table 6.10 indicates that the 99% confidence interval crosses 0 in more than 50 percent of the cells. The ATT estimate approaches zero even when the outcome effect is relatively low, that is at d>0.1, s>0.4. In other words, the ATT estimate breaks down after a moderate violation of the Conditional Independence Assumption.

However, to determine whether my baseline estimate remains robust in the presence of a 'killer confounder', I have to assess whether this confounder is characterized by plausible outcome (Γ) and selection (Λ) effects. I set out to determine whether the introduction of such a confounder increases the probability to be treated (or the probability to be satisfied with the college experience) by such a large number that I have to conclude that the ATT goes to zero only for unrealistic confounders.

Table 6.10 indicates that, in order to have a negative estimate of the effect of student-faculty interaction on satisfaction for those students who actually interact with faculty (ATT), I would have to omit a variable that has a positive and very high effect on both the relative probability of being selected into treatment ($\Lambda = 15.1$) and the relative probability to have a positive outcome ($\Gamma = 3.1$). Given my NSSE dataset, it is highly unlikely that I omit a variable with such important effects, that is, one that is such a strong unobserved confounder. The baseline estimate for satisfaction derived from Mahalanobis metric matching with 0.058 caliper is therefore considered robust.

Intellectual Skills Development. Table 6.10 indicates that the ATT estimate remains positive and close to baseline for most values of d and s. In only one of the cells did the 99% confidence interval cross 0. This occurs when both d and s are relatively large (both greater than 0.4). The values of the outcome effect (Γ) observed in the data and the selection effect (Λ) would have to be implausibly large (Γ = 13.8, Λ = 15.1) to drive the treatment effect to zero. The baseline estimate for intellectual skills development derived from Mahalanobis metric matching with 0.058 caliper is therefore considered robust.

To summarize, I carried out two simulation-based sensitivity analyses to determine whether my results were robust to specific failures of the Conditional Independence Assumption. Specifically, I determined whether modest deviations from this assumption would substantially change, or even overturn, my baseline ATT estimates for satisfaction with the college experience, and intellectual skills development. After conducting sensitivity analyses involving 'calibrated confounders' and 'killer confounders,' I find that the results of my propensity score matching method are robust to reasonable failures of the Conditional Independence Assumption.

Research Question #2: Summary of Findings

Propensity score matching was used to answer research question #2:

Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?

The results indicate that compared to commuter students who do not interact with faculty, first-year commuter students who do interact with faculty outside the classroom have higher levels of satisfaction with the college experience, and higher levels of intellectual skills development. No comparative effect is detected on students' GPAs.

My estimates are robust to changes in the matching method. Estimation using radius, kernel, and nearest neighbor matching estimators with 1, 3 and 5 neighbors, yield exact or close estimates to the baseline estimate produced using Mahalanobis metric matching with a caliper of 0.058sd.

Only one of my estimates is robust for specific sub-samples of first-year commuter students. The estimate for intellectual skills development is robust for 63 percent of the sub-samples examined. My estimate for satisfaction for the college experience is not robust for the various sub-samples examined. Statistically significant results are obtained for less than 1 percent of the sub-samples at the 0.01 significance level. These findings suggest that of these two college outcomes, interacting with faculty members outside the classroom makes more of a difference to the development of the intellectual skills for a great number of student sub-samples.

However, my estimates for both satisfaction and intellectual skills development are robust to specific sources of failure of the Conditional Independence Assumption. The level of robustness is higher for the estimate for intellectual skills development.

Throughout the study, no statistically significant effects are found for GPA. However, I do have an interesting finding that is worthy of further research. I find one positive and statistically significant effect on GPA among part-time first-year commuter students. Part-time students who interact with faculty outside the classroom are predicted to have higher GPAs than their peers who do not interact with faculty.

In summary, the findings for research question #2 suggest that satisfaction with the college experience and intellectual skills development tend to be higher among first-year commuter students who interact with faculty members outside the classroom at four-year institutions, as compared to those who do not interact with faculty members. While there is a tentative prediction that part-time students who interact with faculty outside the classroom have higher GPAs than their peers, this finding warrants further investigation.

CHAPTER VII

CONCLUSIONS AND IMPLICATIONS FOR PRACTICE AND RESEARCH

Limitations of the Present Study

There are at least five limitations which may potentially temper my conclusions and recommendations for future research. The first limitation pertains to selection bias. At least three sources of self-selection bias may arise in this study since: a) institutions self-select to participate in the NSSE survey; b) students self-select to respond to the survey; and c) students self-select to interact with faculty. Of these three sources, only the third source was directly addressed by propensity score matching. The presence of the remaining two sources may in particular limit the generalization of findings to all 4-year institutions and their commuter student populations.

A second limitation arises from the fact that the study utilized cross-sectional data rather than longitudinal data. Student-faculty interaction, college experiences and outcomes were measured simultaneously in the 2010 NSSE survey. No information is therefore provided on any time sequencing between the variables. Given this design, the results from this study should be interpreted as correlational connections rather than causal connections between the key independent variable (student-faculty interaction) and the three outcome variables (students' satisfaction with the college experience, GPA, and intellectual skills development). This interpretation must be made despite the fact that traditional college impact models - such as Astin's (1970a, 1970b, 1991) Input-Environment-Outcomes Model - have shared the common assumption that college experience in general, and student–faculty interaction in particular,

affects student outcomes. Data collected at multiple time points would improve the ability to make causal inferences (Einarson & Clarkberg, 2004, 2010; Kim & Sax 2007, 2009).

Third, biased estimates remain possible if propensity score matching does not fully resolve the selection bias problem. According to Heckman, Ichimura, & Todd (1997, p. 606), "matching methods reduce the conventional measure of bias substantially for most groups but do not eliminate it entirely." Matching can only control for selection bias if selection occurs because of a variable that can be observed and used for matching. There could still be other factors, unobserved ones, involved, that make students who interact with faculty different from those who do not, and therefore influence the outcomes. Examples of unobserved factors are motivation, conscientiousness, goal-orientation, and confidence in one's ability to succeed. Measurement of these factors would require additional qualitative statements be added to the NSSE survey.

However, it must be noted that there were aspects of my study that reduced the possibility of bias. Heckman, Ichimura, & Todd (1997) identify four features essential to reducing bias in evaluation studies:

> (1) Participants and controls have the same distributions of unobserved attributes;
>
> (2) They have the same distributions of observed attributes;
>
> (3) The same questionnaire is administered to both groups, so outcomes and characteristics are measured in the same way for both groups; and
>
> (4) Participants and controls are placed in a common economic environment. (p. 606)

Features (2), (3), and (4) were met in this study: propensity score matching ensured identical distribution of observed characteristics; all students completed the 2010 NSSE survey,

and students were all present on a 4-year degree-offering institution, that is, a common social environment. The fact that this study met these three features is significant because Heckman et al (p. 606) state that: "matching methods substantially reduce bias when features (3) and (4) characterize the nonexperimental data." The researchers consider feature (1), or selection bias, "a relatively small part of bias as conventionally measured."

A fourth limitation relates to the fact that the measures used in the study were self-reported. NSSE survey relies on student self-reports. Self-reported data are open to challenges to their criterion and construct validity. Kuh et al. (2001) report that the validity and credibility of self-reports have been the subject of several studies (such as, Baird, 1976; Berdie, 1971; Pace, 1985; Pike, 1995; Pohlmann & Beggs, 1974; and Turner & Martin, 1984). Drawing on work by several researchers (Bradburn & Sudman, 1988; Brandt, 1958; Converse & Presser, 1989; DeNisi & Shaw, 1977; Hansford & Hattie, 1982; Laing, Swayer, & Noble, 1989; Lowman & Williams, 1987; Pace, 1985; Pike, 1995), Kuh et al identify five conditions under which self-reports are likely to be valid: (1) the information requested is known to the respondents; (2) the questions are phrased clearly and unambiguously; (3) the questions refer to recent activities; (4) the respondents think the questions merit a serious and thoughtful response; and (5) answering the questions does not threaten, embarrass, or violate the privacy of the respondent or encourage the respondent to respond in socially desirable ways. Since The College Student Report was intentionally designed to satisfy all five conditions, self-reported data are considered valid for this study (Kuh et al., 2001).

Fifth, biased estimates remain possible because the use of student-faculty interaction to predict student outcomes raises the issues of both selection bias and simultaneity bias that may affect the ability to determine a causal relationship. This study only addressed the issue of

selection bias. It did not address the issue of simultaneity bias. Simultaneity bias occurs when there is a feedback relationship between one or more independent variables and the dependent variable. In other words, it occurs when one or more of the independent variables are jointly determined with the dependent variable. Simultaneity bias causes the OLS coefficients and standard errors to be biased. According to Morone, Renna, & Testa (2013), the presence of reverse causality undermines the possibility to conduct sound empirical tests to disentangle the direction of causality between variables employing conventional parametric techniques. Its presence results in some ambiguity regarding the causal relationships between student-faculty interaction and the student outcomes it is used to predict. Exploration of this type of bias was proposed for future research.

The Study, its Findings and Discussion

The Study

This dissertation examined the impact of student-faculty interaction on cognitive and affective outcomes for first-year commuter students enrolled in four-year institutions. The study focused on commuter students who are defined as those students who do not live in institutionally-owned or operated housing on-campus (Jacoby, 1989; Jacoby & Girrell, 1981). Across US colleges and universities as a whole, commuter students account for the majority of undergraduate and graduate students. The Census Bureau's American Community Survey for 2009-2011 indicates that as much as 88% of the 23.2 million college students fall into the category of commuter students. However, while in terms of numbers these students represent the majority of students on college campuses today, research-wise commuter students represent an overlooked majority.

Empirical research on commuter students has mostly been confined to investigating potential associations between persistence and various constructs in Tinto's (1975) Theory of Student Departure. For instance, just over 30 peer-reviewed journal articles have examined the relationship between persistence and such constructs as academic integration, social integration, and institutional commitment for these students. Little is known about impacts on other markers of student success besides persistence. Little is known about the role of the college environment on these markers for *commuter student* success. Faculty members are a key part of a college's environment. They represent an important agent of socialization. They help students' bond with their environment; they help them to become socialized to the normative values and attitudes of the institution. There has been quite of bit of research that find that interaction between faculty and students outside the classroom positively impacts a wide range of student campus experiences and development outcomes, academic and non-academic. Pascarella (1980) and Pascarella & Terenzini (2005) summarized research that found positive correlations between non-classroom interaction and college outcomes such as learning and cognitive growth, academic achievement, persistence, social and personal competence, educational aspirations, satisfaction, and institutional commitment. But to reiterate the current situation, little is known about how this interaction impacts these college outcomes for commuter students.

This was the research gap that I set out to address with my dissertation. Specifically, my study sought answers to two research questions, which were:

1. Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?

2. Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?

The conceptual guide for assessing these research questions was derived from Pascarella's (1980) conceptual model of the college impact on students. My sample comprised 9,000 first-year commuter students who completed the 2010 NSSE survey at 465 four-year institutions.

The study is significant because it extends the body of knowledge on first-year commuter students and breaks new ground in terms of empirical investigation on the effects of student-faculty interaction. It extends the body of knowledge on first-year commuter students because, despite the significant number of studies that examine the impact of student-faculty interaction on student outcomes, there is a dearth of studies that explore this impact among commuter students. It breaks new ground in the ability to make stronger inferences when the endogenous *student-faculty interaction* variable is used in the estimation of college outcomes. The use of *student-faculty interaction* to predict college outcomes raises the issue of selection bias because students self-selected to interact with faculty. I used propensity score matching to reduce the selection bias. A search of peer-reviewed higher education journals failed to indicate evidence of the use of propensity score matching in any analysis of the impact of student-faculty interaction for commuter students.

Findings and Discussion

Research Question #1

Hierarchical linear modeling was used to answer research question #1:

Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development, and in what types of institutions are these tendencies more likely?

This research question can be split into two parts. In response to the first part of the question: "*Do first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, GPA, and intellectual skills development,*" the results indicate that yes, first-year commuter students with higher non-classroom interaction with faculty tend to achieve higher levels of satisfaction with the college experience, intellectual skills development, and GPA. My sample of first-year commuter students are more satisfied and develop their intellectual skills when they interact frequently with faculty and rate highly the quality of their relationships with faculty members. While the analysis fails to detect a relationship between frequent interaction and GPA, higher GPAs are associated with higher ratings of the quality of relationships with faculty members.

There is a dearth of evidence on impacts of student-faculty interaction for the specific student subpopulation – commuter students. During a review of the literature, no evidence was found of a peer-reviewed study that examined student-faculty interaction as a predictor of satisfaction with the college experience, GPA, or intellectual skills development, specifically for commuter students attending 4-year colleges and universities. Despite this, my findings for first-year *commuter* students are consistent with what is known about first-year students in general.

My findings are consistent with what is known regarding first-year students' satisfaction with the college experience. Frequent interaction was established as a positive predictor of first-year satisfaction by Astin (1993), Einarson & Clarkberg (2010), Endo & Harpel (1982), Kim &

Sax (2009), Kuh & Hu (2001), Sax, Bryant, & Harper (2005), and Strayhorn (2010). Similarly, researchers (such as Endo & Harpel, 1982; Hearn, 1985; Sax, Bryant, & Harper, 2005; and Volkwein & Carbone, 1994) have found that perceptions that faculty members are helpful, available, and sympathetic (quality relationships with faculty members) are associated with first-year satisfaction.

My finding of a positive relationship between intellectual skills development and student-faculty interaction has also been established within prior research. Researchers (such as Astin, 1993; Einarson & Clarkberg, 2010; Endo & Harpel, 1982; Kim & Sax, 2011; Kuh & Hu, 2001; Lundberg & Schreiner, 2004; Pascarella & Terenzini,1978; and Sax, Bryant, & Harper, 2005) found that frequent interaction with faculty predicts the development of first-year students' intellectual skills while others (notably Cruce, Wolniak, Seifert, & Pascarella, 2006; Kim, 2002; Lundberg, 2010; Lundberg & Schreiner, 2004; Pascarella & Terenzini, 1978; Sax, Bryant, & Harper, 2005; and Volkwein, King, & Terenzini, 1986) established quality relationships with faculty as a predictor of their development intellectually.

Prior studies have also found that an association exists between GPA and the quality of the relationship with faculty members (for example, Anaya & Cole, 2001; and Kim, 2010). However, my failure to find a relationship between GPA and frequent interaction with faculty members is unexpected since the majority of prior studies have found a positive association (for example, Anaya & Cole, 2001; Astin, 1993; Cole, 2010; Kim & Sax, 2009; Pascarella & Terenzini, 1978; and Pascarella, Terenzini, & Hibel, 1978).

My finding that generally higher student-faculty interaction is positively associated with student outcomes such as higher levels of satisfaction with the college experience, intellectual skills development, and GPA, is also consistent with the view that the influence of faculty

members as agents of socialization in college is accentuated when that contact takes place with students in unstructured, informal settings (Jacob, 1957; Heath, 1968; and Chickering, 1969). Kim (2010) posits that since students and faculty are the main agents of socialization in colleges and universities, positive and close interactions between the two groups will accelerate students' active participation or engagement in college experiences. According to the Kim (p. 161), "this, in turn, contributes to greater student learning and development."

A definitive response cannot be determined for the second part of my research question: "*and in what types of institutions are these tendencies more likely?*" It was not feasible to explore cross-level interactions or moderating effects of the institutional factors in analyses for the three dependent variables. An exploration of random effects for my key independent variables - frequency of student-faculty interaction and the quality of relationships with faculty - revealed that the effect of these two variables did not vary across institutions.

However, what was explored was the effect of institutional factors on the average levels of GPA. The results indicate that on average, the first-year commuter students in my sample with higher GPAs are those enrolled in private and less selective institutions. It should be noted that the coefficient for the selectivity variable arises from a model that controls for private/public status.

That students with higher average GPAs are those enrolled at private institutions is not surprising. Additional analysis of baseline data reveals that in the private colleges and universities in my sample 40 percent and 26 percent of students indicated that most of their grades were B+ or A-, and A, respectively. On the other hand, lower percentages of their peers in

public institutions received comparable grades. Thirty-five (35) percent of students in public institutions received B+ or A-, while 22 percent received A's.

Higher GPAs in private institutions may also be attributed to the relatively greater emphasis on teaching at private schools where students pay higher tuition bills. It may be attributed to the tendency for lower student-faculty ratios, or even grade inflation practices at these institutions. In their study *Grading in American Colleges and Universities*, Rojstaczer & Healy (2010) observed that undergraduate grades had risen substantially in the last few decades, and grade inflation had become particularly pronounced at selective and private colleges. Rojstaczer & Healy examined historical data dating back at least 15 years at more than 80 4-year colleges and universities, and contemporary data from more than 160 institutions. They found that on a 4.0 scale, GPAs at private colleges and universities were 0.1 point higher than at public institutions admitting students with identical combined math and verbal SAT scores. Among institutions with equal selectivity, students at private institution had GPAs that were 0.2 higher than their peers at public institutions (Rojstaczer & Healy, 2010).

The finding that first-year commuter students with higher GPAs are those enrolled in less selective institutions is expected. Not only did descriptive statistics indicate that as many as 73 percent of students in the study sample were enrolled in institutions at the lower range of competitiveness (those categorized as "not competitive," "less competitive," and "competitive" institutions), but for each of these three categories, the majority of students indicated that their grades were at the higher rank (that is, B+, A-, and A).

Conditional effects of faculty-student interactions are key additional findings of this study. The positive interaction effects indicate that the association between frequent non-

classroom interaction with faculty members and each of the two outcomes - satisfaction and GPA - is higher for African-American students than for White students. The association between quality non-classroom relationships with faculty members (that is, the extent to which students feel connected to faculty members who are helpful, available, and sympathetic) and satisfaction with the college experience is higher for Hispanic and Asian/Pacific Islander students than for White students.

The extant literature has established that the impact of student-faculty interaction on satisfaction and GPA varies by race/ethnicity. Higher satisfaction levels are associated with faculty support and encouragement for African-American and Hispanic students (Cole, 2008). Kim & Sax (2009) find that course-related student-faculty interaction predicts satisfaction for Hispanic and Asian-American students. Higher GPAs are associated with academic and personal student-faculty contact, faculty's support and encouragement for students, and students' undergraduate research experience for African-Americans (Cole, 2008; Cole, 2010; Kim, 2010; Kim & Sax, 2009).

In summary, the findings for research question #1 suggest that satisfaction with the college experience, intellectual skills development, and GPA, are affected by student-faculty interaction. Being enrolled in a private institution is associated with higher GPAs. Students in less selective institutions expect higher GPAs. As compared to effects for White students, higher associations are found between frequent non-classroom interaction and satisfaction and GPA for African-American students, and between quality non-classroom relationships with faculty members and satisfaction for Hispanic and Asian/Pacific Islander students.

Research Question #2

Propensity score matching was used to answer research question #2:

Do first-year commuter students who interact with faculty outside the classroom have higher levels of satisfaction with the college experience, have higher GPAs, and higher levels of intellectual skills development than commuter students who do not interact with faculty?

The results indicate that compared to commuter students who do not interact with faculty, first-year commuter students who do interact with faculty outside the classroom have higher levels of satisfaction with the college experience, and higher levels of intellectual skills development. No comparative effect is detected on students' GPAs.

My estimates are robust to changes in the matching method. Estimation using radius, kernel, and nearest neighbor matching estimators with 1, 3 and 5 neighbors, yield exact or close estimates to the baseline estimate produced using Mahalanobis metric matching with a caliper of 0.058sd.

Only one of my estimates is robust for specific sub-samples of first-year commuter students. The estimate for intellectual skills development is robust for 63 percent of the sub-samples examined. My estimate for satisfaction for the college experience is not robust for the various sub-samples examined. Statistically significant results are obtained for less than 1 percent of the sub-samples at the 0.01 significance level. These findings suggest that of these two college outcomes, interacting with faculty members outside the classroom makes more of a difference to the development of the intellectual skills for a great number of student sub-samples.

However, my estimates for both satisfaction and intellectual skills development are robust to specific sources of failure of the Conditional Independence Assumption. The level of robustness is higher for the estimate for intellectual skills development.

Throughout the study, no statistically significant effects are found for GPA. However, I do have an interesting finding that is worthy of further research. I find one positive and statistically significant effect on GPA among part-time first-year commuter students. Part-time students who interact with faculty outside the classroom are predicted to have higher GPAs than their peers who do not interact with faculty.

In general, my results of propensity score matching suggest that interacting with faculty members outside the classroom matters for first-year commuter students enrolled in four-year institutions. It matters to their feeling a sense of satisfaction with their experience, to the development of their intellectual skills, and, for part-time students, potentially to their grade-point averages.

No prior research studies were found with which to compare my findings. A review of peer-reviewed journals found no evidence of the use of propensity score matching in any analysis of the impact of student-faculty interaction for commuter students or for students in general. My findings are however consistent with theoretical explanations of the effects of student involvement in institutional activities, and of interactions with socializing agents in college.

In his Theory of Involvement, Astin (1984, 1999) considered students' motivation and behavior as integral to their development. He theorized that the time and effort students devote to institutional activities (such as interacting with faculty members) designed to produce developmental gains, determined the extent to which they achieve those goals. Astin classified

the student who interacted "frequently" with faculty as a highly involved student. According to his theory, the greater is the student's involvement in college, the greater would be the amount of student learning and personal development (Astin, 1984, 1999). Compared to students who do not interact with faculty members outside the classroom, the behavior of those who do interact is consistent with Astin's highly involved students. My finding that the interaction makes a difference to their feeling a sense of satisfaction with their college experience and their development of the intellectual skills corresponds to the developmental gains conceived by Astin.

In line with Astin's Theory, Kuh, Kinzie, Buckley, Bridges, & Hayek (2006) suggest that:

> Perhaps meeting and talking with faculty members empowers students to do more than they think they can and helps validate them as full members of the campus community, which in turn legitimates their presence and makes them more comfortable to reach out and become engaged in a variety of activities. (p. 42)

Another explanation for my propensity score matching findings is linked to the role of college and university faculty members as institutional agents of socialization. Differential developmental outcomes may obtain for students who interact with faculty as the latter perform their socialization function. The value of the interaction is supported by theories originating from sociology and social psychology, and in the concept of colleges as socializing organizations (posited by early writers such as Clark & Trow, 1966; Newcomb, 1943, 1962, 1966; Wallace, 1964, 1965, 1967; Wheeler, 1966, etc.). As outlined in Bean & Kuh (1984, p. 462), "socialization is the process through which students acquire the values, norms, knowledge, and

skills needed to perform successfully in the college environment (Bragg, 1976; Merton, Reader, and Kendall, 1957).” College and university faculty members are part of students’ “interpersonal environment” which Rossi (1996, p. 200) defines as “the set of stimuli presented to the individual by those persons with whom he is in contact on a direct and unmediated basis.” Students become socialized to the normative values and attitudes of the institution when this environment presents them with:

> …a climate of opinion, values, attitudes, behaviors, and performances which are held or practiced by the socializing agents with whom he or she is in direct contact. … Thus, other factors being equal, we might anticipate that as faculty members occupy an increasing proportion of a particular student's interpersonal environment, primarily through informal nonclassroom contact, the greater the likelihood of the student's being significantly influenced by faculty attitudes and intellectual values. (Pascarella, 1980, p. 546)

These theoretical connections may explain why the first-year commuter students in my sample who self-selected to interact with faculty members outside the classroom experience stronger differential benefits. Through their socialization role and encouragement, faculty members’ interaction with students has the capacity to enrich students’ campus experiences, develop their affective and cognitive skills (Braxton, Eimers, & Bayer, 1996, p. 607), and help them achieve congruency with both the institution’s intellectual environment and its social system in line with Tinto’s (1975, pp. 106-107) conceptualization of normative and social integration.

In summary, the findings for research question #2 suggest that satisfaction with the college experience and intellectual skills development tend to be higher among first-year commuter students who interact with faculty members outside the classroom at four-year institutions, as compared to those who do not interact with faculty members. While there is a tentative prediction that part-time students who interact with faculty outside the classroom have higher GPAs than their peers, this finding warrants further investigation.

Further Considerations: Student-Faculty Interaction as a Treatment

The results from propensity score matching suggest positive outcome-effects for those students who interact frequently with faculty members outside the classroom. While the Limitations section notes the possibility of having unobserved factors that may make students who interact with faculty different from those who do not and therefore influence students' satisfaction with the college experience and their intellectual skills development, student-faculty interaction has the potential to be considered as a treatment in the natural environment for its implementation – the college or university.

A quasi-experimental design is preferable to a pure experiment in a college or university setting where the random assignment of students to interact with faculty may increase the threat of contamination. For example, control students may feel left out of the study and seek to over compensate (the John Henry Effect). The 2008 Discovery Project undertaken at Queen's University in Canada to assess the impact of student-faculty interaction using NSSE data was one of 10 studies that utilized quasi-experimental designs to identify effective engagement-related interventions (Conway, 2010). Similar to that study, a quasi-experimental study could be organized as follows:

The target group could be the set of first-year commuter students enrolled at a 4-year Research I university in the ECON 1010 (Principles of Microeconomics) course that typically has 200-plus enrollment sizes and is offered each semester to multiple course sections. In year-2, students from this course would be invited to participate (through self-selection) in the study. These treatment students would participate in six small group sessions across fall and spring semesters of year-2 that include involvement in economics-related projects with faculty members, and faculty-led seminars on topics related to economics research, the practice as an economist, and current economic issues. Students in the control group would receive regular courses.

The design would involve a pre-test and several post-tests. The NSSE survey would be administered to all students at the end of year-1 (prior to the treatment), and at the end of year-2 to both treatment and control students. An additional survey that specifically addresses issues related to student-faculty contact would also be administered at the end of the fall and spring semesters of year-2. Propensity score matching would be used to reduce selection bias and match the treatment group to both year-1 pre-treatment students, and to year-2 control students. Since students may attrit across the two year-2 semesters, I would compare the characteristics of students who leave the study with those who remain each semester to be assured that the effects I obtain are due to the treatment and not to the characteristics of those who left. Outcomes measured will be students' satisfaction with the college experience, GPA, and intellectual skills development. All sensitivity tests conducted in the present study would also be performed for this experimental study.

It is recognized that such a study would likely be stronger in terms of internal validity than in external validity. My results would be informative of the impact of student-faculty

interaction at the Research I institution. They would not be generalizable to other institutional types, whose baseline characteristics on students may differ significantly from those of my treatment group. A quasi-experiment like the one described which utilizes student-faculty interaction as a treatment establishes the interaction as a field practice and enables faculty and staff at the particular institution to identify a student engagement practice that is effective for student success (Conway, 2010).

Further Considerations: Fit with Pascarella's (1980) Model

The conceptual framework for this study derived from Pascarella's (1980) conceptual model of the college impact on students which suggests that in order to understand the influence of student-faculty non-classroom contact on educational outcomes, it is necessary to take into account the background characteristics which students bring to college, the actual experiences of college in other areas, and salient institutional factors. The model (shown in Figure 7.1) specifically identifies "academic performance," "intellectual development," and "college satisfaction" as "educational outcomes."

Pascarella's model proposes that students' background characteristics influence the extent and quality of students' contact with faculty outside of class. In my study, I find that as compared to White students, positive associations between frequent non-classroom interaction with faculty members and both college satisfaction and academic performance are higher for African-American students. Positive associations between quality non-classroom interaction with students and college satisfaction are higher for Hispanic and Asian/Pacific Islander students.

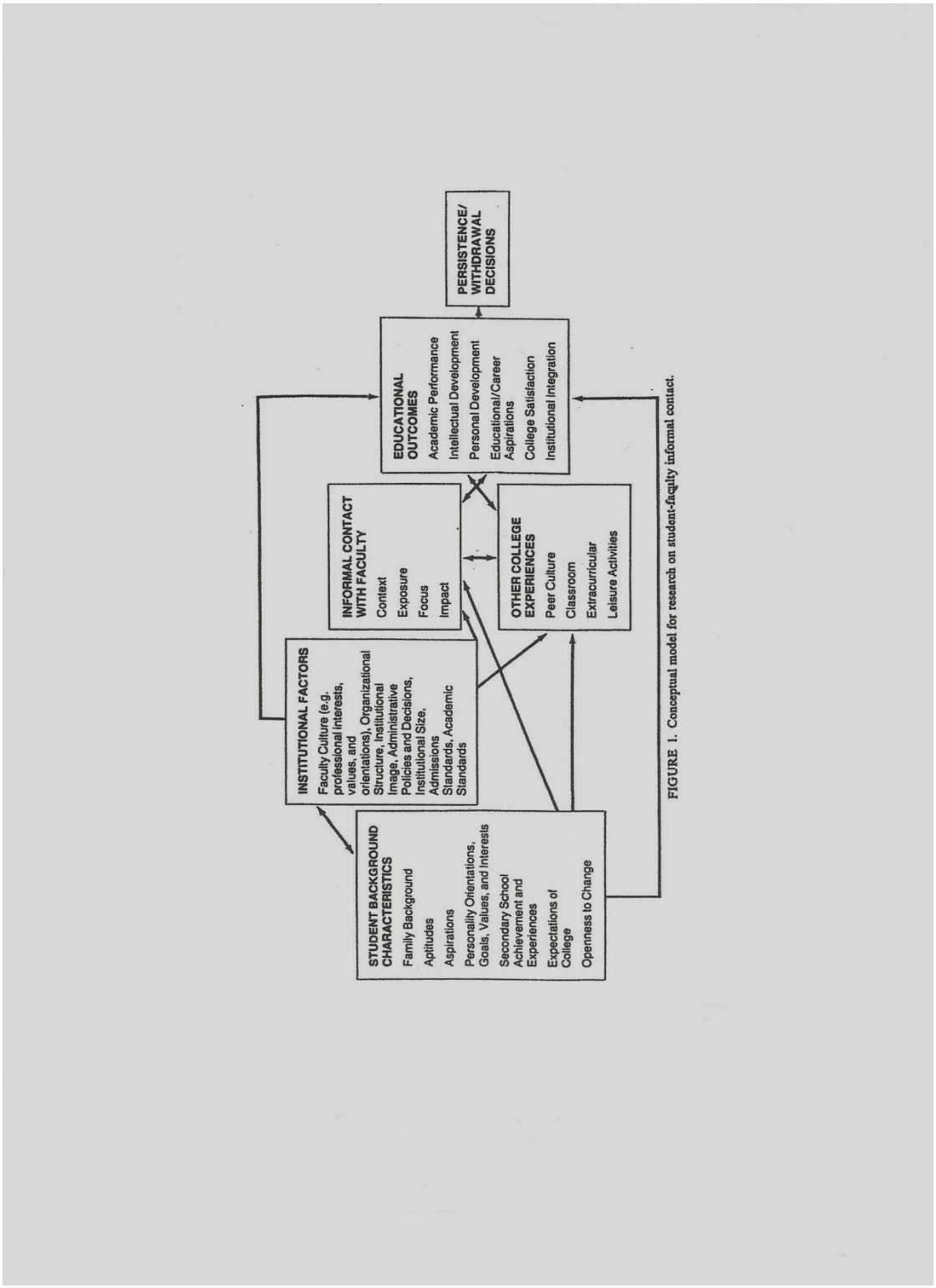


Figure 7.1. Pascarella's (1980) conceptual model of college impact on students.

Pascarella (1980) identifies a reciprocal relationship between student's informal contact with faculty and students' education outcomes. I find positive direct associations between:

a. Frequent non-classroom interaction with faculty member and two of Pascarella's educational outcomes – college satisfaction and intellectual development.
b. Quality non-classroom interaction with students and three of Pascarella's educational outcomes - college satisfaction, intellectual development, and academic performance.

Pascarella's model also proposes that institutional factors influences informal contact with faculty, other college experiences, and educational outcomes. My analyses did not detect institutional effects. Based on the variables and models I used in my study, Figure 7.2 illustrates how Pascarella's model is revised when my findings for first-year commuter students are taken into account.

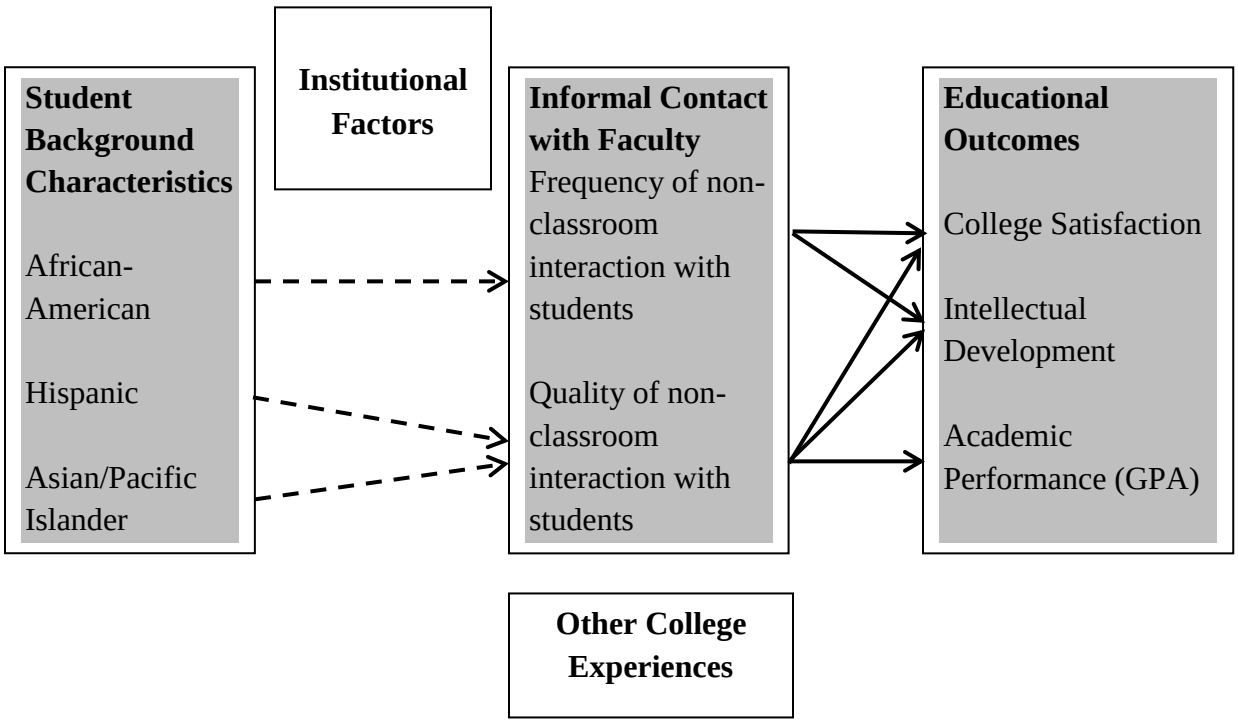


Figure 7.2. Pascarella's Model revised based on study findings.

Implications for Practice and Future Research

My findings have implications for higher education practice and future research. It is too early to prescribe policy action based on my results. Not only does my study represent an initial investigation but further in-depth research is warranted before policy levers can be identified. My study is relatively new in at least two regards. Only three prior peer-reviewed studies (Iverson, Pascarella, & Terenzini, 1984; Johnson, 1997; and Terenzini, Springer, Pascarella, & Nora, 1995) have investigated student-faculty interaction among commuter students at 4-year institutions. They examined effects on commuter students' persistence, aspirations, and the value of learning. My study contributes to what is known about the impact of student-faculty interaction on three un-researched (in the peer-reviewed literature) outcomes for commuter students at 4-year institutions – satisfaction with the college experience, intellectual skills development, and grade-point average. My study is also new because it breaks new ground in the ability to make stronger inferences when the endogenous student-faculty interaction variable is used in the estimation of college outcomes. No evidence was found in peer-reviewed journals of the use of propensity score matching in an analysis of the impact of student-faculty interaction for commuter students. Given that my study represents an initial study in both of the above respects I have to be cautious in drawing strong conclusions regarding the implications of my findings for educational policy.

However, predicting the three outcomes - satisfaction with the college experience, grade-point average, and intellectual skills development – has implications for institutional practice. Identification of college experiences and outcomes correlated with student-faculty interaction

provides faculty members and college administrators with a deeper understanding of the role of the college environment in first-year commuter students' academic and social development.

Implications for Practice

I find that frequent and quality interaction with faculty members outside the classroom matters to first-year commuter students. My findings suggest institutional action that enables and encourages increased contact between students and faculty members. Academic departments may apply the concept of proxemics in this regard. One practical option would be for departments to **provide physical spaces for engagement** to occur. The availability of chairs or student lounges in proximity to faculty offices can facilitate frequent student-faculty interaction. According to Strange & Banning (2001, p. 12), "the actual features of the physical environment can encourage or discourage the processes of learning and development." Kinzie & Mulholland (2007, p. 105) state that "the physical environment of the campus, whether natural or constructed, shapes behavior by permitting certain kinds of activities while limiting – or making impossible – others." Visible evidence that departments are making the effort to initiate contacts could encourage commuter students to view the design and layout as "socially catalytic" (Strange & Banning, 2001).

Particularly informative is the finding that the majority of student-faculty contact occurs via email. Faculty may set **electronic office hour** times when they will either be available live through chat or will respond to e-mails. To enhance the interaction-student outcomes link, it is imperative that faculty members understand the meaning and requirements of **online accessibility** to students using this medium of communication, that is, in the digital age. They must be cognizant of the need to "translate" through their choice of words and response rates the

same levels of encouragement and support they would otherwise communicate in a face-to-face encounter during office hours. As An & Frick (2006, p. 486) report, in comparison with face-to-face communication, text-based computer-mediated communication lacks visual and auditory cues. Faculty members must be careful with their choice of words to compensate for the absence of body language, gestures and other contextual cues that convey important meanings.

An & Frick recognize that while text-based asynchronous computer-mediated communication can be overwhelming to faculty members who have to respond to large numbers of messages, it has advantages over face-to-face instructional settings in terms of being place and time independent and enabling students to work in convenient places with highly flexible schedules. In addition, An & Frick (2006) note that computer-mediated communication:

> …can provide a more comfortable environment and discussion opportunities for students who do not perform well in spontaneous face-to-face discussion because they are shy or because their native language is not English (Berge & Collins, 1993; Harasim, 1990; Leasure, Davis, & Thievon, 2000). (p. 487)

Commuter students are diverse in terms of age, ethnicity, enrollment status, and non-academic obligations. Faculty members need to develop online communication skills so that they connect to students of traditional college-age in a similar manner as they would to older students who have additional responsibilities. Furthermore since students contact faculty on a wide range of college issues – academic, social, personal, etc. - it would be worthwhile for faculty members to be aware of, or have at-hand links to, online sources of assistance or student services to which students can be directed. My findings therefore also have implications for college and university administrators who may have to provide faculty members with the necessary training and

support for them to interact effectively with students online. There are implications in terms of the need for effective partnerships between faculty and student affairs personnel. Faculty members must be made aware of the needs of this particular demographic in the student population. Jacoby (1989, p. 5) suggests that "faculty and staff at all levels should be encouraged to learn more about the theoretical frameworks and models that lead to a fuller understanding of the student-as-commuter."

I find differential outcomes between students who interact with faculty and those who do not. Students differ in levels of self-efficacy and motivation to interact with faculty and staff. Institutions must create environments and opportunities that make faculty members more approachable and accessible. Although frequent interaction with students is not a typical criterion in a faculty reward system, my findings that satisfied students and those who develop intellectually are those who have contact with faculty may suggest that opportunities to encourage contact be explored. Opportunities may present themselves through **more intrusive advising sessions and learning communities, and during orientation and other student programming activities** in which faculty could have a role.

Advising, for example, provides an excellent opportunity to strengthen contacts with students who may not otherwise seek out interaction with a faculty member. Crockett (1978, pp. 29-30) suggest that advising facilitates student persistence by helping students develop mature educational/career goals; strengthening the relationship between academic preparation and the world of work; helping students achieve grade-point averages consistent with their abilities; and making them feel positive about the institution. One particular form of high-contact advising is intrusive or proactive advising. Under this system of advising, the advisor anticipates advisees' needs, initiates contact, and connects them to appropriate resources and support from the

beginning of their academic careers (Varney, 2012). Advisors do not wait for students to come forward to ask for help but insist that students make frequent appointments throughout the year to check on their progress, identify crisis situations, offer options, make referrals, and motivate students toward academic success. This form of advising can be an effective tool to increase student-faculty contact at least between students and advisers.

An alternative opportunity may arise during orientation when faculty advisers can arrange to meet personally with their advisees to begin building a relationship and set the stage for fulfilling the three expectations that most advisees desire from their advisers: accessibility, specific and accurate information, and a personal and caring relationship (Garing, 1993). To enhance the interaction-student outcomes link I find in this study, the responsibility for contact should not be left solely to the more motivated students to initiate. Promoting contact requires faculty, departmental, and college/university-wide effort.

While building successful student-faculty interaction should not be viewed as an individual initiative, this does not preclude college and university campuses from also seeking to **foster agency among their commuter students**. By communicating high expectations during admissions and orientation, and taking on hands-off facilitating roles, administrators can encourage their commuter students to be committed, accountable, and responsible for their self-development and learning. In their book *One Size Does Not Fit All: Traditional and Innovative Models of Student Affairs Practices,* Manning, Kinzie, & Schuh (2013) outline the student agency model, one of their student-centered innovative models of student affairs practice developed from the authors' research on the Documenting Effective Educational Practices (DEEP) project, site visits to institutions and consultations with student affairs units, the student affairs literature, and their own experiences and observations. According to the model, "rather

than planning and implementing activities based on individual student needs …, the student agency model requires student affairs professionals to empower students as a whole to take initiative." (pp. 147-148)

Manning, Kinzie, & Schuh (2013) describe one example at a DEEP institution that is particularly relevant to my discussion of institutional practice. It provides an example of how college and university administration and student affairs personnel can encourage student-faculty interaction while developing students' sense of responsibility for the quality of their educational experience. The authors describe the situation at a DEEP school where students were required to charge of their own learning by contributing to course development:

> Faculty list course proposals in the specialized bulletin boards in the library building; students add their ideas and comments on those suggested by faculty. As such, the shape of the final course is a collaborative effort of student and faculty who are all considered "co-learners" in the educational process. (pp. 148-149)

Creating environments adapted for contact, assuring online faculty accessibility, facilitating faculty participation in more intrusive advising sessions, learning communities, orientation and other student programming activities, and supporting the development of student agency, represent some of the institutional practices that, by enabling student-faculty interaction, may also stimulate commuter students' satisfaction with their college experience, intellectual skills development, grade-point average, and other student experiences and developmental areas.

Implications for Future Research

In his 1980 paper *Student-Faculty Informal Contact and College Outcomes,* Pascarella concluded:

> The evidence suggests that what transpires between students and faculty outside of class may have a measurable, and possibly unique, positive impact on various facets of individual development during college. Clearly, such evidence underscores the potential importance of individual faculty members as informal agents of socialization during the student's college experience. It also suggests that an increased understanding of college impact might be gained from inquiry focusing on the nature of student-faculty interaction beyond the classroom as well as in it. (p. 571)

With findings that suggest a positive impact of student-faculty interaction, my study proposes that the following research areas have potential to advance what is known about student-faculty interaction among first-year commuter students:

Effects for Part-time Students. I obtain an interesting finding regarding part-time first-year commuter students. The analysis from propensity score matching tentatively suggests that part-time students who interact with faculty outside the classroom have higher GPAs than their peers who do not interact with faculty. This finding warrants further investigation because the small number of part-time students in my sample reduced statistical power and in addition, little is known about effects of student-faculty interaction for part-time commuter students. Further research using NSSE data with oversampling of part-time students will confirm whether differential effects of interaction in general, and of frequent and quality interactions on student outcomes exist for this sub-sample of commuter students.

Predictors of Student-Faculty Interaction: Perspectives of Commuter Students. We know that commuter students account for over 80 percent of the student population today. I found that interacting with faculty members outside the classroom, and frequent and quality interaction mattered to first-year commuter students in four-year institutions. Descriptive statistics revealed that over 70 percent of my sample interacted with faculty "sometimes," "often," and "very often." African-American students interacted more with faculty while Asian and Hispanic students interacted the least. More female than male students, more full-time than part-time students, and more non-first generation than first-generation students, interacted with faculty. However, little is known about *why* they interact (or not interact), the *nature,* or the context – *for what purpose* – of their interaction. Qualitative research would add depth to an understanding of the reasons for and content of interaction which can, in turn, inform strategies that faculty and administration can use to improve the contact. Such research can shed light on what motivates students of different races/ethnicities, first-generation, gender, age ranges, social class, enrollment status, employment status, etc., to interact with faculty and how they perceive the interaction. It would also reveal the extent to which contact takes on personal, professional, or dual dimensions, and the content and context of the most prevalent form of interaction - email contact with faculty members.

Predictors of Student-Faculty Interaction: Perspectives of Faculty Members. A qualitative approach can also help discern faculty members' perspective on interactions with commuter students. Such a study would expand current research studies (for example Cox & Orehovec, 2007; Cox, McIntosh, Terenzini, Reason, & Quaye, 2010; and Frankel & Swanson, 2002) that provide insight on the viewpoint of faculty. For example, using a qualitative method we may want to detect, similar to Cox et al. (2010) in their quantitative study, whether the

frequency and type of out-of-class interactions result from faculty members' in-class behaviors that signal their "psychosocial approachability" to commuter students. Obtaining the faculty perspective would provide a window into the quantity and quality of the interaction across institutional types, academic disciplines, faculty ranks, and faculty tenure statuses.

Variation by Institution and Academic Major. The answer to the question as to whether the strength of the relationship between student-faculty interaction and student outcomes varies at the institutional level remains unresolved. My failure to detect institutional variation using hierarchical linear modeling was unexpected. Cluster sampling of NSSE data at the institutional and student levels is proposed to further investigate *whether* and then *why* the strength of association between student–faculty interaction and my outcomes varies across institutions. In addition, Kim & Sax's (2011) study of variation by major can be extended using NSSE data. Kim & Sax (2011) found that the impact of students' interaction with faculty varied by academic major when they used multilevel modeling on University of California Undergraduate Experience Survey (UCUES) data to examine the relationship between student–faculty interaction and student cognitive skills development. It would be interesting to discover whether a similar finding can be discerned among NSSE-reporting institutions.

Effects for Community College Students. Two-year institutions tend to enroll the majority of commuter students. A mixed methods study would provide useful information on the nature and effects of student-faculty interaction within more teaching-oriented contexts. Such information can inform institutional practice related to these students. Data derived from the Community College Student Experience Questionnaire (CCSEQ) administered by the Center for the Study of Higher Education at the University of Memphis can provide the basis for the quantitative portion of such a study.

Reverse Causality. When first-year commuter students interact with faculty members outside the classroom, does their interaction lead them to be more satisfied with their college experience, and develop their intellectual skills? Or is it that being more satisfied and intellectually developed lead these students to interact with faculty members? Which variable is the "cause" and which is the "effect?" Like faculty members, students are also agents of socialization on a college campus, and can impact the values, attitudes, and behaviors of others in the campus environment. An analysis involving 2SLS non-recursive models is proposed to determine whether the link between student-faculty interaction and outcomes for first-year commuter students is bidirectional (each variable affects the other significantly and equally), unidirectional (the bivariate association is entirely attributable to the effect of one of the variables upon the other), predominant (each variable affects the other significantly but the effect of one is greater than the effect of the other), or countervailing (the effect of one variable on the other is positive while the effect of the second variable on the first is negative) (Rosenberg, Schooler, & Schoenbach, 1989, p. 1005).

Effects for additional Student Outcomes. Pascarella's (1980) model includes educational outcomes - personal development, educational/career aspirations, and institutional integration - that were not examined in this study. Future research can investigate the effect of student-faculty interaction on these outcomes, in addition to related institutional effects, and interaction effects with commuter student background characteristics. Beyond the model's outcomes, additional outcomes may include those for which previous research studies have found positive associations with student-faculty interaction for non-commuter student populations. These additional outcomes are persistence, social and personal competence, and institutional commitment. Effects for political engagement, political orientation, confidence and self-perceptions, and physical and

psychological well-being – outcomes examined by Sax, Bryant, & Harper (2005) – are additional possibilities.

Ultimately, the knowledge provided by answering these questions and addressing these research gaps has relevance to institutional efforts aimed at promoting and supporting student retention and success. It was for this reason that my study focused specifically on first-year commuter students. Researchers (Blanc, Debuhr, & Martin, 1983; Tinto, 1987) have found that approximately three-fourths of all dropouts leave at some time during the first year and that many of these individuals who drop out leave during the first six weeks of the fall term (Elkins, Braxton, & James, 2000). Tinto (1987) stated that the rate of student departures from the higher education system is highest during the first year of college (p. 21) and is particularly high during the first six weeks of the students' first semester (p. 49). Research that identifies the nuances related to first-year commuter students' interaction with faculty members provides college and university administration with information with which to shape their engagement practices for the retention and success of this diverse group of students from their first year at the institution.

Conclusions

A popular perception of the college experience of commuter students is that it "consists primarily of the parking lot, a faculty member in the classroom, a classroom building and its hallways, the registrar's and bursar's offices, and possibly the library and food-service facilities" (Andreas, 1983, p. 10). This study takes exception to that claim. Using 2010 NSSE data, it asserts that the college experience of commuter students also consists of interactions with faculty members outside of the classroom. It goes further to assert that this essential aspect of the college environment – student-faculty interaction - has important associations with cognitive and

affective outcomes that characterize success for these students. In particular, my findings suggest the following for first-year commuter students:

- The more frequent the out-of class interaction with faculty members, the greater is the students' level of satisfaction with the college experience, and intellectual skills development.
- The higher the rating students give to the quality of their relationship with faculty members (that is, the more students consider faculty members to be helpful, available, and sympathetic), the greater is the level of satisfaction with the college experience, grade-point average, and the development of intellectual skills.
- Compared to students who do not interact with faculty, those who do interact with faculty outside the classroom experience higher levels of satisfaction, and higher levels of intellectual skills development.

This pattern of findings suggests the conclusion that interacting with faculty members outside the classroom matters for first-year commuter students enrolled in four-year institutions. Technology plays a key role in the interaction. This second conclusion derives from the additional finding that email is the most common form of interaction. It suggests the development of new online behavioral protocols to enable faculty members to effectively harness this mode of contact. According to Chickering & Ehrmann (1996, p. 1), "communication technologies that increase access to faculty members, help them share useful resources, and provide for joint problem solving and shared learning, can usefully augment face-to-face contact in and outside of class meetings."

My study represents an initial discovery into the impact of interactions between faculty members and first-year commuter students. The conclusion that frequent and quality interaction with faculty members outside the classroom matters to their satisfaction with the college environment, intellectual skills development, and grade-point average emphasizes the importance for colleges and universities to promote contact between these two critical participants in higher education. As Ernest Pascarella (1980) noted 35 years ago:

> One of the more persistent assumptions in American higher education has been that of the educational impact of close student-faculty interactions beyond the classroom. Indeed, so strongly and widely held is this assumption that frequent informal contact between faculty and students has often been viewed as a desirable educational end in and of itself (p. 545).

However, beyond promoting contact between faculty members and commuter students, colleges and universities are urged to understand who commuter students are on today's campuses. Based on findings related to race/ethnicity, an additional conclusion must be that the outcome-effects for commuter students are multidimensional. There is no "typical" commuter student. Commuter students are a diverse group; their diversity encompasses virtually every student demographic. This heterogeneity presents challenges for higher education institutions in their efforts to engage and encourage success among this increasing group of students. Furthermore, commuter students account for almost 90 percent of today's college students. They enroll at virtually every institutional type. However, despite their majority presence within higher education, the body of knowledge about this student population remains limited. Commuter students represent a relatively under-researched student population within higher education. As a

result, as Jacoby & Garland (2004, p. 62) state: “the unique needs of commuter students have been neither adequately understood nor appropriately incorporated into policies, programs, and practices.”

Attaining a comprehensive, detailed understanding of commuter students is critical. Only with further research, and particularly focused research that probe the specific characteristics of sub-groups of commuter students, their environment and associated outcomes, will college and university administrators be able to effectively service this client group. It is timely that this “overlooked majority” receive the full benefits of student engagement activities, programs, and services that are vital to their success.

APPENDIX A: FULL RESULTS – HLM MODELS (IN EFFECT SIZES)

Variables	Dependent Variables		
	Satisfaction with the College Experience	Intellectual Skills Development	Grade Point Average
Key Independent Variables:			
Frequency of Student-Faculty Interaction	0.11**	0.28***	0.01
The Quality of Student-Faculty Interaction	0.37***	0.26***	0.29***
Institutional Variables:			
Research Universities			0.08
Masters Colleges and Universities			0.06
Baccalaureate Colleges – Arts and Science			0.02
Institutional Selectivity			-0.10**
Institutional Control			0.21***
Enrolment Size			0.03
Student-level Variables:			
Age	0.24***	-0.12***	0.33***
Gender	0.10	0.09***	0.42***
First-generation Status	0.05*	0.10	-0.19***
African-American/Black	0.24	0.56***	-0.76***
Asian/Pacific Islander	0.10	0.05**	0.03
Hispanic	0.62***	0.64	-0.37*
Entry Status	-0.03	-0.01***	-0.03
Enrollment Status	0.23	0.46	0.34
Professional/Applied Major	0.03	0.06***	0.02
Science Major	-0.04	0.01**	0.08*
Social Sciences Major	-0.02	0.12	-0.03
Frequency of Peer Interactions	0.06***	0.19*	0.06***
The Quality of Peer Interactions	0.19***	0.13***	-0.03*
Academic Effort	0.02*	0.07***	0.12***

Note. *p<0.05, **p<0.01, ***p<0.001

Table Continued

Variables	Dependent Variables		
	Satisfaction with the College Experience	Intellectual Skills Development	Grade Point Average
Interactions:			
Frequent Interaction* Female	-0.04*	-0.01	-0.03
Quality Interaction * Female	0.01	0.00	-0.05*
Frequent Interaction*African-American	0.15***	0.02	0.19**
Quality Interaction * African-American	-0.04*	-0.06**	-0.03
Frequent Interaction*Asian	0.05	0.05	0.16*
Quality Interaction * Asian	0.10***	-0.03	-0.06*
Frequent Interaction*Hispanic	0.04	-0.04	0.14*
Quality Interaction * Hispanic	0.13***	-0.04**	-0.03
Frequent Interaction *Full-Time	-0.07	-0.10*	0.08
Quality Interaction *Full-Time	0.00	-0.01	-0.11*
Fit:			
Deviance	21292.15	21212.35	23034.91
Variance:			
Residual	.71***	.74***	.87***
Intercept	.02***	.00	.02***

Note. *p<0.05, **p<0.01, ***p<0.001

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