Academic Achievement and Statistical Knowledge: A Comparison of Criminal Justice and Noncriminal Justice Majors

Jon L. Proctor

This study examines the impact of college major (criminal justice versus noncriminal justice) on academic achievement as measured by several different dimensions of statistical knowledge. Students enrolled in two consecutive summer introductory statistics courses were used as the sample for this study. Analyses revealed that academic performance of criminal justice majors was less than that exhibited by noncriminal justice majors. Specifically, noncriminal justice majors scored higher on conceptual and computational knowledge and were more likely to earn an A/B grade than were criminal justice majors. Several methods for improving statistical knowledge for criminal justice majors are provided.

Introduction

A bachelor's degree in criminal justice continues to be a "hot" ticket major for many universities. Currently there are 393 criminal justice programs operating at universities throughout the United States, with another 38 universities offering undergraduate degrees in criminology (College Bluebook 2002). According to a recent survey of 300 two- and four-year college institutions conducted by Sallie Mae, 60% of the schools reported significant increases in the number of criminal justice majors (Clayton 2002). Although criminal justice continues to be one of the most popular majors, variations of criminal justice programs, in particular forensic science degrees, are growing at unprecedented rates. For example, the number of forensic science majors at West Virginia University increased 100% from 200 in January 2002 to 400 in the fall of 2002 and increased 1,000% at Baylor University from 39 majors in 1999 to 350 in 2002 (Clayton 2002).
Traditionally, criminal justice education was viewed as more of a vocational program with a training academy atmosphere derived from police science programs established in the early 1900s (Farnworth, Longmire, and West 1998). Within this model, criminal justice courses that focused on the development of work-specific skills such as report writing, defensive tactics, and firearm usage dominated the curriculum, while little effort was devoted to purely academic instruction (Krimmel and Tartaro 1999). The inclusion of vocational-type courses within the university seriously questioned the validity of criminal justice education as an academic discipline (Greene, Bynum, and Webb 1984). Changes in the criminal justice curriculum over the past few decades have witnessed not only tremendous growth in the number of programs and majors but also a shift in course emphasis from vocational to academic. Reasons for this shift included pressure exerted by the Law Enforcement Assistance Administration which mandated that criminal justice programs use an academic curriculum to educate students in the entire workings of the criminal justice system or risk losing federal funding for their programs (Newman 1993).

Another reason for the growing emphasis on criminal justice as an academic discipline grew out of the social unrest in the 1960s. Criminal justice administrators and educators realized that coursework in the social sciences that addressed criminal causation and organizational management of criminal justice agencies would better prepare police officers to deal with conflict, public interactions, and changing police practices (Carter and Sapp 1990; Farnworth et al. 1998; Krimmel and Tartaro 1999).

The development of national associations such as the American Society of Criminology (ASC) and the Academy of Criminal Justice Sciences (ACJS) provided further support for the legitimization of criminal justice as an academic discipline. Both organizations conduct annual conferences whereby academicians meet together to present research on a variety of criminological issues including curriculum standards and teaching methodology. One organization, ACJS, developed a set of minimum standards designed to provide criminal justice students with a comprehensive knowledge of the criminal justice field, as well as the ability to communicate in both oral and written form (Academy of Criminal Justice Sciences Minimum Standards 1998). The core curriculum developed by the ACJS Ad hoc Committee includes the following substantive areas:

- criminal justice and juvenile justice processes;
- criminology;
- law enforcement;
- law adjudication;
- corrections.

Furthermore, the construction of a core curriculum emphasizes general education and scholarly research rather than work-specific skills derived from vocational and/or technical training (Farmer 1996; Felkenses 1979). In fact, the committee stressed that academic credit should not be awarded for vocational
training courses that have little to do with conceptual learning and more to do with job-specific skills (Academy of Criminal Justice Sciences Minimum Standards 1998).

The growth in the number of programs offering degrees in criminal justice, the increased number of scholarly journals devoted wholly to the study of crime and criminal justice systems, the growing numbers of both scholars and practitioners affiliated with professional criminal justice associations, and the development of academic standards for criminal justice education, all give credence to criminal justice as a full-fledged academic discipline. The issue, however, is whether the discipline attracts students prepared for academic rather than vocational training. In general, high school students planning on a career in criminal justice may be more apt to take courses that are vocationally oriented rather than academically defined courses that prepare them for success in college. Thus, criminal justice students may not perform academically as well as students in other disciplines. This study addresses whether academic performance among criminal justice students is equal to that of students in other disciplines.

Literature Review

The question of academic achievement for college-level students is not a new phenomenon. Much research has been devoted to the identification of factors that are predictive of academic success in higher education (Anaya and Cole 2001; Blimling 1999; Pinto, Parente, and Palmer 2001; Strage et al. 2002; Toth and Montagna 2002; Zheng et al. 2002). While the pursuit of causal factors of success continues to be a popular area of inquiry in educational research, most research has studied success in relation to GPA among the general population of college students. Many studies continue to study conventional factors believed to be related to success, including race, income level, age, high school GPA, SAT scores, and parental educational level (Anaya and Cole 2001; Hoffman 2002; Strage et al. 2002), while other studies have incorporated nontraditional factors such as co-curricular activities, class size, satisfaction with college, credit card usage, and student/teacher interactions and rapport (Hoffman 2002; Pinto et al. 2001; Strage et al. 2002) in an attempt to account for a greater proportion of variability in college achievement.

The research to date has shown some predictive validity for several variables. According to Wolfe and Johnson (1995), high school GPA and SAT usually account for 25% of the variability in college GPA. In their own study of 201 psychology majors at a public university in the northeast, the researchers found that high school GPA accounted for 19% of the variation in college GPA, a self-control measure accounted for 9% of the variation, and SAT explained 5% of the variability.

A similar finding was discovered by Hoffman (2002) in a study of academic achievement among a sample of 188 students from the general student population
at a private college in the west. Academic achievement was measured using both the fall and spring term GPA. Approximately 48.9% of the variability in achievement was explained by input measures and student involvement. The strongest input predictors included high school GPA (beta = .38*), SAT (beta = .28*), and class level (beta = .24*). It is interesting to note that although race and religion did not directly affect academic achievement, the predictive strength of high school GPA, SAT, and class were mediated by both race and religion. For example, the predictive strength of high school GPA was significantly stronger for nonwhites (beta = .56*) than for whites (beta = .39*), while the predictive power of SAT was statistically significant for whites (beta = .25*) but not for nonwhites. Class level was statistically significant for whites (beta = .24*) and Lutherans (beta = .26*) but not for nonwhites or non-Lutherans (Hoffman 2002).

Researchers have also looked at the impact of class size on student achievement and have found mixed results. For example, Toth and Montagna (2002) conducted a review of recent literature (1990-2000) studying the effects of class size on student achievement. In their assessment of eight studies using a variety of methodological approaches, they found that the results were mixed, with two studies showing no relationship between achievement level and class size, three studies showing a negative relationship, and one study showing a positive relationship. In a study of student achievement in a sophomore statistics course, Hancock (1996) found no differences in grade distributions between students enrolled in the large class (n = 118) versus students enrolled in the smaller classes (n = 39), even after controlling for potentially confounding variables including instructor, text, and test effects.

Several studies have analyzed the impact of living in residence halls on academic achievement. For example, Hoffman (2002) failed to find a significant relationship between living in a residence hall and academic achievement for the total sample; however, he did find that the effect of living on campus was significantly related to GPA for Lutheran students (beta = .23*). Using a meta-analytic approach involving studies from 1966 through 1987, Blimling (1999) concluded that when controlling for past academic performance the majority of research indicates that living on campus does not significantly increase academic performance compared to living at home.

Research has found a variety of other factors to be correlated with academic achievement, including personal background characteristics such as age, gender, and parental education level (Betts and Morell 1999; Strage et al. 2002; Zheng et al. 2002), economic factors such as hours worked, perceived need to work, and parental income level (Betts and Morell 1999; Pinto et al. 2001), and student attitudinal and behavioral factors (Anaya and Cole 2001; Strage et al. 2002; Zheng et al. 2002).

There are several shortcomings with the cited research. First, it has been standard practice for researchers to study academic achievement across the general population of students with little regard for discipline-specific achievement. That is, assumptions have been made that suggest that achievement has little to do with the type of major that one selects and more to do with external
factors unrelated to one’s course of study. There have been some recent studies that have addressed this shortcoming. For example, Zheng et al. (2002) found major to be a significant predictor of GPA for education and family and consumer science majors but not for engineering or business majors. In their study of college grades, Anaya and Cole (2001) found that business, education, and humanities majors were significantly more likely to achieve higher grades than were students majoring in sociology, physical and biological sciences, and health. In another study of academic achievement, Betts and Morell (1999) discovered that major field of study was predictive of university GPA for students pursuing degrees in engineering, science, and the arts but not for students majoring in humanities or social science.

A second limitation of previous research is the use of college GPA as a sole criterion for academic achievement. While this is a valid measure of achievement, it does not take into account discipline-specific core courses that vary widely in their degree of complexity and workload. It is possible that achievement is discipline specific in that the more rigorous disciplines lead to lower GPAs when compared to less rigorous disciplines. For example, obtaining a bachelor’s degree in a hard science such as chemistry may be more difficult than obtaining a bachelor’s degree in a social science such as criminal justice.

A third limitation is that there have been very few studies on the effects of undergraduate criminal justice majors and college achievement. In one study, Kelley and Stack (1997) found that college GPA, gender, and transfer credits were significant predictors of student achievement, as measured by a standardized test for criminal justice students. Specifically, students who were male, had higher GPAs, and had fewer transfer credits scored higher on the standardized test; however, this study targeted only graduating seniors in criminal justice.

Comparing academic achievement of criminal justice majors with other majors is an important area of inquiry that needs to be addressed. There is a perception in some academic circles that criminal justice is an easy major—consisting of student athletes and others who are unable to achieve success in more traditional majors. And while there have been a variety of studies comparing criminal justice majors to nonmajors on such issues as learning styles (Wells and McKinney 1997), ethical orientations (Byers and Powers 1997), attitudes towards criminal justice sanctions (Farnworth et al. 1998), and test cheating intentions (Tibbets 1998), no research has made direct comparisons of academic achievement between criminal justice majors and nonmajors.

The present study attempts to control for the previously mentioned limitations by comparing academic achievement level between criminal justice and noncriminal justice majors in an upper level introductory statistics course. The advantage of this approach is that a direct comparison of students on several dependent measures related to academic achievement allows for a study of “major” effects. Furthermore, use of an upper level course taken primarily by juniors and seniors, controls for transitory effects that are more prevalent within introductory courses. Specifically, students in junior/senior-level courses
will have been readily acclimated to the college environment and thus have a
greater understanding of what is necessary to succeed in college-level course-
work. Using a statistics course for this study allows for direct comparisons
among different majors because statistics is a required course for most majors
at this university. There is no other class within the criminal justice curriculum,
with the exception of introduction to criminal justice, that has a near equal
split of criminal justice and noncriminal justice majors enrolled in the course.
Another advantage of using a statistics course is that the level of difficulty of
the course is relatively high, which allows for testing of multiple dimensions of
analytical reasoning. The use of multiple measures of achievement is far supe-
rior to studies that have typically used a one-dimensional measure such as
course grade or overall GPA (Toth and Montagna 2002).

**Methodology**

The sample for this study consisted of students drawn from two separate intro-
ductory statistics courses (k300 statistical techniques) taught during the
summer in two consecutive years. The first class was taught statistics in the
second summer session of the 2001 academic year while the second class was
taught during the first summer session of the 2002 academic year. Both classes
were nearly identical in regards to student majors. In the 2001 class, 46% of the
students were criminal justice majors compared to 52% of the 2002 class. The
other students comprised a variety of majors including, but not limited to,
biology, nursing, public affairs, and general studies. At this particular univer-
sity, students have the option of satisfying the quantitative course requirement
by electing to take a statistics class in one of several different departments
including public affairs, sociology, psychology, business, or math. The course is
taught from either a public affairs or criminal justice perspective, dependent
upon the instructor’s area of expertise. The fact that 50% of the students were
noncriminal justice majors is likely more a function of the course being offered
in the summer than perceptions of the course being less difficult than those
offered in other departments.

Similarities between the two classes included the instructor, lecture mate-
rial, assignments, and tests. There were some differences between the two
classes that are worth mentioning. First, a different textbook was used for the
two classes. The 2001 class used *Elementary Statistics in Criminal Justice
Research* (Fox, Levin, and Shively 1999) while the 2002 class used *Introductory
Statistics for Criminal Justice and Criminology* (Proctor and Badzinski 2002).
Second, the 2002 class had five quizzes during the course of the semester that
were taken directly from the text, whereas the 2001 class did not have any book
quizzes. Third, while both classes were taught statistical calculations using a
hand calculator and computer software, the 2001 class used SPSS and Excel. The
computing software used for the 2002 class consisted of Excel. Students were
required to use the computer to complete various homework assignments. The
last notable difference between the two classes was that the 2001 class had one test while the 2002 class had two tests. Despite the difference in the number of tests, the final exam for both classes was identical, consisting of both multiple-choice questions and statistical problems that required the use of a hand calculator. The use of computing software during the final exam was not allowed.

Measures

Although the main independent variable of interest in this study was college major, a variety of other independent variables were included for use in a multivariate model of statistical knowledge. The variables included the following: (a) college major—operationalized as either criminal justice or noncriminal justice, (b) CGPA—the students' college grade point average prior to the start of the statistics course, (c) age—the students' age prior to the start of the course, (d) credit hours—the total number of credit hours earned prior to the start of the class, (e) positive attitudes towards statistics—measured on a 10-point agreement scale that asked respondents to indicate their level of agreement with the following three statements: "I would like to take another statistics course," "I enjoy solving statistical problems," and "I would like to use statistics in my job." The items were combined into a positive attitude index resulting in a Cronbach's alpha of .90. The final independent variable was negative attitudes towards statistics (f)—measured using a 10-point agreement scale that asked respondents to indicate their level of agreement with the following three items: "Statistics has no relevance in my desired profession," "Statistics should not be required for my major," and "I never want to take another statistics course as long as I live." The items were combined into a negative attitude index with a resulting Cronbach's alpha of .75.

Five dependent variables were used in this study for comparisons between criminal justice and noncriminal justice majors. The first dependent measure was conceptual knowledge defined as the understanding of terms, languages, and symbols associated with statistics and was measured using a 70-point objective test consisting of 35 multiple-choice and true/false questions. This part of the test was closed book. Two measures of computational knowledge, the ability to calculate and interpret statistical results, were used in this study. The first computational measure was the average numerical score (25 possible points) for the homework assignments. This score comprised six assignments for the 2001 class and nine assignments for the 2002 class. The second computational measure used three research scenarios on the final exam that required students to perform a statistical test using a hand calculator on a set of hypothetical data. Each student was required to calculate and interpret a dependent samples t-test, correlation, and single-factor ANOVA. This part of the exam was open book. The fourth dependent variable consisted of students' perceptions of their understanding of statistics. Although not a direct measure of achievement, this variable does attempt to measure a dimension of understanding that is
difficult to measure with a performance indicator. Understanding was measured using a 10-item survey that asked respondents to indicate, on a scale of 1 to 10, how well they understood such things as “the step-by-step procedures for calculating statistical tests,” “how to begin a statistics problem,” and “application of statistics.” The 10 items were combined into an understanding index, and reliability analysis revealed a Cronbach’s alpha of .95, suggesting a high degree of consistency among the items comprising the index. The final dependent variable was overall course grade measured as a dichotomous variable of A/B or C/D. There were no grades lower than a D for either class.

Results

Four of the five dependent variables used in this study represented numerical variables measured at either the interval or ratio level. The standard method of statistical analysis using such variables with a dichotomous independent variable (e.g., major) is the independent-samples t-test. While the t-test has several assumptions, one of the key assumptions associated with its correct usage is that the dependent variable is normally distributed. Owing to the small sample sizes in each class of 22 and 27, respectively, with an approximately equal number of criminal justice and noncriminal justice majors in each class, this assumption is likely to be violated, although not necessarily so. Researchers generally agree that a nonparametric alternative to the t-test, specifically the Mann-Whitney U test, is often recommended in cases where t-test assumptions may be violated (Bachman and Paternoster 1998; Fox et al. 1999; Miller and Whitehead 1995). This statistical technique was used to test the hypothesis of equal medians between the two majors within each class for four of the dependent variables. As shown in Table 1, two comparisons were statistically significant, with both occurring for the 2001 class. Noncriminal justice majors had a significantly higher median (63.00) on conceptual knowledge than criminal justice majors (56.00). Additionally, noncriminal justice majors had a significantly higher median score on the homework (23.62) compared to criminal justice majors (21.29). No other differences were statistically significant.

In order to conduct further analyses using more powerful parametric statistics, it was necessary to combine the two classes into a single sample. It is important to recognize, however, that, as previously mentioned, there were some differences between the two courses relating to instructional materials and course requirements. Therefore, it was necessary to determine whether there were any statistically significant differences between the two classes on the independent and dependent variables. To test for differences, independent-samples t-tests were used for all interval- and ratio-level variables, whereas Chi-square was used to test for all other differences. The results of the analyses revealed two statistically significant differences between the two classes. The first difference occurred on negative attitudes towards statistics ($t = 4.44$, $df = 41$, $p < .000$) with the 2001 class having a significantly higher average score on
Table 1  Mann-Whitney U test for 2001 and 2002 classes

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mean rank</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2001 class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conceptual knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>8.15</td>
<td>.03</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>14.29</td>
<td></td>
</tr>
<tr>
<td>Computational knowledge (exam)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>8.95</td>
<td>.09</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>13.63</td>
<td></td>
</tr>
<tr>
<td>Computational knowledge (homework)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>8.00</td>
<td>.02</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>14.42</td>
<td></td>
</tr>
<tr>
<td>Understanding index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>13.50</td>
<td>.20</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>9.83</td>
<td></td>
</tr>
<tr>
<td><strong>2002 class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conceptual knowledge</td>
<td>12.82</td>
<td>.43</td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>15.27</td>
<td></td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computational knowledge (exam)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>12.50</td>
<td>.33</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>15.62</td>
<td></td>
</tr>
<tr>
<td>Computational knowledge (homework)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>11.93</td>
<td>.17</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>16.23</td>
<td></td>
</tr>
<tr>
<td>Understanding index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal justice majors</td>
<td>11.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Noncriminal justice majors</td>
<td>11.50</td>
<td></td>
</tr>
</tbody>
</table>

the negative attitude index (6.83) than the 2002 class (4.00). Possible reasons for this difference may include the additional work required in the 2002 class (incorporation of quizzes and an additional test) or differences in the textbook. A second statistically significant difference was found for the average homework score ($t = 2.03, df = 47, p < .05$), with the 2001 class having a higher average score (22.43) than the 2002 class (21.22). The primary reason for this difference was the result of more variation in the scores for the 2002 class. Specifically, this class had several low scores which inflated the standard error resulting in a biased $t$-test. To correct for this problem, three outliers were re-coded to the next lowest score. The resulting $t$-test based on the re-coded values showed no statistically significant difference between the two classes on the average homework score. None of the other tests revealed statistically significant differences between the two classes.

Table 2 provides the descriptive statistics for the combined sample. The sample was comprised of nearly an equal number of criminal justice and
noncriminal justice majors, which makes for an effective comparison of the impact of major on statistical knowledge. In looking at Table 2, there are a couple of points worth mentioning. First, while age is an interval-level variable, an examination of the mean (25.98) and standard deviation (6.66) suggested a degree of positive skewness since the lowest value for the variable was 19 years. The frequency distribution revealed two high values for age, however, 10% of the values were 35 years and older. To correct this problem, age was re-coded into an ordinal-level variable having four different categories. A similar problem occurred for credit hours. An examination of the frequency distribution showed two extremely low scores of 6 and 16, and three extremely high scores of 134, 148, and 157. The low scores were re-coded to the next lowest value of 35 and the high scores were re-coded to the next highest value of 125. Other than these examples, none of the other variables exhibited distributional problems.

Multivariate regression analysis was used to test the effects of the independent variables on the dependent variables. This type of analysis is useful for assessing overall effects of each independent variable on the joint distribution of the dependent variables, with the exception of course grade since this variable was nonlinear. Major was the only independent variable to emerge as a significant predictor for the set of dependent variables (Wilks’s Lambda = .64, \( p < .01 \)).

Table 3 provides the regression analysis for each dependent variable separately. The conceptual knowledge model was statistically significant (\( F = 2.32, df = 6, p = .05 \)) with both major and GPA emerging as significant predictors. The
Table 3  Multiple regression analysis of independent variables on statistical knowledge

<table>
<thead>
<tr>
<th>Variables</th>
<th>Conceptual (exam)</th>
<th>Computational (exam)</th>
<th>Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>5.80*</td>
<td>10.13**</td>
<td>2.19**</td>
</tr>
<tr>
<td></td>
<td>(2.36)</td>
<td>(3.69)</td>
<td>(.64)</td>
</tr>
<tr>
<td>Age</td>
<td>-.51</td>
<td>-1.92</td>
<td>-.34</td>
</tr>
<tr>
<td></td>
<td>(1.30)</td>
<td>(2.04)</td>
<td>(.36)</td>
</tr>
<tr>
<td>GPA</td>
<td>5.34*</td>
<td>5.95</td>
<td>1.36*</td>
</tr>
<tr>
<td></td>
<td>(2.15)</td>
<td>(3.37)</td>
<td>(.57)</td>
</tr>
<tr>
<td>Credit hours</td>
<td>-.03</td>
<td>-.02</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>(.05)</td>
<td>(.08)</td>
<td>(.01)</td>
</tr>
<tr>
<td>Positive attitudes</td>
<td>.14</td>
<td>-.55</td>
<td>-.02</td>
</tr>
<tr>
<td></td>
<td>(.47)</td>
<td>(.73)</td>
<td>(.13)</td>
</tr>
<tr>
<td>Negative attitudes</td>
<td>.30</td>
<td>-.65</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>(.48)</td>
<td>(.75)</td>
<td>(.13)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.30</td>
<td>.27</td>
<td>.33</td>
</tr>
</tbody>
</table>

Note: The values for each variable represent the unstandardized regression coefficient and standard error.

* $p \leq .05$; ** $p \leq .01$.

effect of major on conceptual knowledge was positive, indicating an increase of conceptual knowledge of 5.80 points when moving from a criminal justice major to a noncriminal justice major. A similar positive effect was found for GPA. Eta-squared statistics indicated that both GPA (.16) and major (.16) accounted for an identical amount of the explained variance in conceptual knowledge.

Model 2 (computational exam) did not achieve statistical significance ($F = 1.99$, $df = 6$, $p = .09$). Major was the only variable to be statistically associated with computational exam knowledge. Once again the effect was positive, indicating that noncriminal justice majors scored, on average, 10.13 points higher in computational knowledge than criminal justice majors. Approximately 19% of the variation of computational exam knowledge was accounted for by major.

Computational knowledge, as measured by homework, was statistically significant ($F = 2.71$, $df = 6$, $p = .03$). Similar to model 1, both major and GPA emerged as significant predictors in model 3. The effect of major was once again positive, indicating that noncriminal justice majors scored, on average, 2.19 points higher on computational homework than criminal justice majors. GPA was also positive, indicating an increase of 1.36 points on homework scores for each unit increase in GPA. Eta-squared statistics indicated that major accounted for a higher proportion of the explained variance (.26) than GPA (.14) for homework knowledge.

Understanding of statistics, as measured by students’ own perceptions, did not emerge as a statistically significant model ($F = 1.65$, $df = 6$, $p = .16$). Positive attitudes towards statistics was the only variable to achieve statistical significance. The positive coefficient indicates an increase of .21 in perception
of understanding per one unit increase in positive attitudes. That is, as students’ attitudes towards statistics become more favorable their perceived level of understanding of statistics also increases.

Logistic regression was used to analyze the final dependent variable, the results of which are presented in Table 4. Overall, the model was statistically significant, as evidenced by the model Chi-square value of 15.26. Put simply, this means that the incorporation of the independent variables into the model resulted in a greater percentage of cases correctly predicted (80%) compared to the model that included only the intercept (62.5%). Both major and GPA emerged as significant predictors for the probability of getting an A/B course grade. Noncriminal justice majors were 11 times more likely to obtain an A or B grade than were criminal justice majors. Additionally, as GPA increased so did the odds of earning an A or B grade in the course. Figure 1 illustrates the impact of major and GPA modeled as a probability of earning an A or B in the course.

Discussion

The results of this study indicate that the level of statistical knowledge among criminal justice majors is significantly less than that exhibited by noncriminal justice majors. According to the multivariate analysis using the combined sample, major was a statistically significant predictor for four of the five dependent variables measured in this study. Given the lower level of achievement of criminal justice majors, it is interesting to note that criminal justice majors rated their level of statistical understanding higher than that of noncriminal

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE</th>
<th>Odds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>2.40*</td>
<td>1.18</td>
<td>11.07</td>
</tr>
<tr>
<td>GPA</td>
<td>2.01*</td>
<td>.98</td>
<td>7.45</td>
</tr>
<tr>
<td>Credits</td>
<td>.04</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>Positive attitude</td>
<td>-.03</td>
<td>.18</td>
<td>.97</td>
</tr>
<tr>
<td>Negative attitude</td>
<td>.21</td>
<td>.19</td>
<td>1.23</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 and under</td>
<td>3.57</td>
<td>1.94</td>
<td>35.59</td>
</tr>
<tr>
<td>22-25</td>
<td>1.08</td>
<td>1.25</td>
<td>2.93</td>
</tr>
<tr>
<td>26-30</td>
<td>.16</td>
<td>1.28</td>
<td>1.18</td>
</tr>
</tbody>
</table>

–2 Loglikelihood = 37.66
Model Chi-square = 15.37*
Nagelkerke $R^2 = .43$

Note: Age category 4 (31 and over) is the reference group.
n = 40; *$p \leq .05$. 
justice majors, although not statistically significantly higher. This suggests that criminal justice majors believe that they understand the underlying concepts of statistics; however, their level of performance as measured by different dimensions of knowledge does not coincide with their perceptions.

There are several possible explanations for these findings. First, it is possible that students who are drawn to the criminal justice major are weaker in quantitative reasoning skills. Bushway and Flower (2002) suggest that criminal justice students often have a detrimental combination of poor math skills along with math anxiety. To fully understand the relationship between quantitative ability and statistical knowledge would require a comparison between criminal justice majors and nonmajors on some type of quantitative pre-test. The quantitative part of the SAT (e.g., math) provides an opportunity to make such a comparison. Unfortunately, the SAT is not a required component of college admissions at the university from which these data were collected, and the number of scores available to make such a comparison is small (n = 19).

However, in looking at the data that are available, SATmath scores were not statistically correlated with any of the dependent variables. In fact, the correlations between SATmath and four of the five measures of statistical knowledge were negative, with the strongest correlation occurring for computational homework knowledge ($r = -.19, p < .43$). In addition, there was no statistically significant difference in median SATmath scores between criminal justice majors and nonmajors.
Although previous research has demonstrated some support for the predictive validity of SAT scores on college achievement (Hoffman 2002; Wolfe and Johnson 1995), those findings were not replicated in this study. This may simply be the result of the large number of missing data points for SATmath scores and the resulting small sample size encountered in this study. Thus, the lack of significance of SATmath scores on statistical knowledge must be viewed cautiously. The differences in the findings from this study compared to previous studies may also be the result of differing operationalizations of achievement. Previous research has measured achievement as overall GPA, whereas the present study measured achievement as statistical knowledge obtained in a single course. Another plausible explanation may be that SATmath attenuates over time and becomes less influential as students progress further into their college career. That is, SATmath may exert strong influence on academic achievement in quantitative courses early in college—first- and second-year students—but then gets displaced by achievement in those college courses. Thus, college GPA then becomes a significantly influential factor of academic achievement for students who are in their junior and senior years. This seems logical given that most students in this study were classified as junior/senior-level standing (76%) and that GPA emerged as a significant factor for three of the five dependent measures.

Figure 1 is illustrative of the effects of both major and GPA on the probabilities of obtaining an A/B course grade. A visual examination of the chart shows that the differences in the probabilities for criminal justice and noncriminal justice majors are more pronounced at the lower and middle GPA ranges. However, as GPA converges between the two majors, the probability of earning an A/B grade similarly converges such that students with high GPAs (e.g., 3.8 and above) are nearly as likely to get an A/B grade. Thus, GPA is an important indicator of statistical knowledge, and students with high GPAs should be equally as likely to achieve academic success in statistics regardless of their major.

Another possibility is that criminal justice students, generally speaking, are not achieving at an academic level that is commensurate with other majors. Many students may be drawn to the criminal justice degree because of its perceived low level of difficulty, and many of these students may simply be academically weak. To test this assumption, researchers commonly use GPA to make comparisons among different majors. A problem with using this approach is that GPA may be inflated or deflated as a result of specific courses tied to one’s major. Core courses within a hard science major probably require more quantitative reasoning skills than do core courses within a social science major. Additionally, the number of courses requiring quantitative aptitude is greater in some majors than in others. In this study, criminal justice students’ GPA was slightly higher (3.03) than noncriminal justice students (2.81) but the difference was not statistically significant. On the surface, it would appear that criminal justice students are performing at a commensurate level compared to noncriminal justice students. Once again, caution is warranted simply because such
comparisons do not control for level of difficulty associated with different majors.

The question for criminal justice educators is: how do we increase criminal justice students’ level of statistical understanding given the fact that many students may not be adequately prepared to succeed in statistics? I believe that a multi-dimensional approach is warranted.

According to a study by Strage et al. (2002), students were more likely to work harder and achieve a good grade in courses that were in the students’ major, the students found interesting, and where the students connected with the instructor. Thus, criminal justice instructors should incorporate different methodological approaches to enhance the above-mentioned points.

In regards to the first point, all criminal justice students at the university where this study was conducted are required to take the introductory statistics course. And while the courses used for this study had a near even split of criminal justice and noncriminal justice majors, the textbook, as well as all other course materials (e.g., assignments, lecture material, labs, and tests) had criminal-justice-specific content as a result of the instructor being a criminal justice professor. Thus, criminal justice students had a distinct advantage in the application of statistics being applied to their major.

Do students find statistics interesting? The answer to that probably depends on which students you ask. Most students, at least in criminal justice, tend to have some fear of statistics. In fact, Chermak and Weiss (1999) suggest that statistics are a source of major anxiety for criminal justice students because numbers are intimidating, statistical concepts are difficult to comprehend, and students have difficulty making a connection between statistics and a career in criminal justice. Perhaps one of the best methods for increasing student interest in a course such as statistics is to incorporate computing software into the course. Not only does this aid in teaching statistics but also teaches students valuable computing skills that may be more applicable to their future career goals than statistics alone. There were two statements on the student survey used in this study that were designed to measure students’ perceived value of computing software. The first statement, “I learned a valuable computer skill,” had an overall mean of 8.84 on a 10-point agreement scale. Further analysis of this item showed that criminal justice students had a mean agreement rating of 9.25 compared to 8.44 for noncriminal justice students ($t = 1.25$, $df = 30$, $p < .22$). The second item, “The computer software I learned will be useful in my profession,” had an overall mean agreement rating of 7.72, with criminal justice students having a slightly higher, although not statistically higher, rating (8.06) than noncriminal justice students (7.38). The above comparisons were made only for those students who used Excel in the two courses and not SPSS. Similarly, Chermak and Weiss (1999) found that students in their introductory statistics course reported that using the computer (SPSS) was valuable, especially when combined with an interesting data set.

The high value of computing software as found in this study and others is an indication that students can learn other valuable skills within a statistics
course that not only enhance statistical understanding but also provide an impetus for increasing the interest level of the course. Criminal justice educators would be well advised to incorporate a computer component within their statistics courses to enhance understanding and increase the interest level of statistics.

The final point mentioned by Strage et al. (2002) suggested that students who connected with their instructor were more likely to work harder and perform at a higher level of academic achievement. Because statistics is often an anxiety-producing course, criminal justice instructors can alleviate some of this anxiety by increasing their connection level with students. This calls for establishing and developing significant rapport with each student in such a manner that students feel comfortable with the instructor in regards to asking questions in class and seeking unsolicited assistance outside of normal class hours, especially for those statistical concepts that are difficult to learn. Students must view instructors as approachable and a valuable resource to use in the learning process. Methods for providing students with this perception might include encouraging students to ask questions in class, offering encouraging comments on assignments, assigned office hours for student availability, increasing the number of criminal justice examples used in class, and varying instructional techniques to tap into differential learning styles.

Varying the instructional techniques may include the incorporation of group work, quizzes, lab instruction, and recitation sections, all designed to improve student understanding of statistics and increase academic achievement. Chermak and Weiss (1999) for example, suggest that cooperative learning, having students work in groups, is an effective method for students to learn difficult concepts. Bushway and Flower (2002) found that incorporating quizzes and supplemental instruction into a statistics course significantly decreased failure rates.

Criminal justice educators must be willing to incorporate various methodological approaches into their teaching of statistics to undergraduate criminal justice students. These approaches must also be evaluated in regards to their effect on statistical knowledge and academic achievement. Practices that improve performance and increase knowledge should be adapted so that our students are able to perform at a comparable level to other academic majors.

In addition, educators should strive to make a stronger connection between statistics education and criminal justice careers. Explaining "how" research and statistics is important in the criminal justice field is a significant task for educators and can be accomplished by using real-world examples such as crime analysis in policing to assessment instruments in correctional decision making. Research and statistics plays an integral part of the criminal justice system and must be conveyed to students in a way that sparks interest and increases understanding.

Future research should compare academic achievement between criminal justice majors and nonmajors using GPA from those courses that are commonly taken by most university students. General education courses fit this criterion.
The comparison would exclude major specific courses, and count only those courses that comprise the general university education requirement. General education requirements commonly include English, Communication, Math, Science, and Social Science courses. An analysis of academic achievement across general education courses would undoubtedly shed some light on the academic ability of criminal justice majors in general and whether their level of achievement is similar to that of other majors while controlling for level of course difficulty.

Research should also look into methods for identifying weak students who may need additional help in statistics courses. These students could be identified as "at risk" for failing and be given additional resources that would enable them to succeed in statistics. Comparisons of students at various levels of "risk" of failing would be useful for determining whether different methods of instruction and/or differing levels of workload (e.g., quizzes, homework, tests) influence statistical knowledge and increase performance.

An additional area of research that would be useful for evaluating criminal justice students' success in statistics would be to compare the effects of different types of computing software on statistical knowledge. A previous study by Proctor (2002) found that students taught statistics using Excel performed better on two measures of statistical knowledge than students taught statistics using SPSS. Studies using larger samples and controlling for academic major (e.g., hard sciences versus social sciences) would be useful not only for enhancing our understanding of statistics education but also improving statistics education for criminal justice majors.

Finally, it would be useful to use pre-test/post-test designs to ascertain the impact of statistics education on academic ability. Comparing academic ability of criminal justice majors before and after a statistics course would enable us to determine whether the criminal justice student is less academically prepared going into such a course and whether a course designed specifically for the criminal justice major lessens the achievement gap.

References


