ABSTRACT

Title of Thesis: CAN THE GENERAL THEORY OF CRIME ACCOUNT FOR COMPUTER OFFENDERS: TESTING LOW SELF-CONTROL AS A PREDICTOR OF COMPUTER CRIME OFFENDING

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Master of Arts, 2004

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Using self-report measures of attitudinal and behavioral self-control, this study tests the applicability of Gottfredson and Hirschi's theory of low self-control as it applies to self-reported computer crime offending among a college student sample. Computer crime was found to be relatively common, with more than ninety-five percent of the sample reported having engaged in some form of illegal computer activity. The results offer moderate support for Gottfredson and Hirschi's general theory of crime, finding direct and positive effects for self-control and opportunity on computer offending, but not for the interaction between self-control and opportunity. The prevalence of computer-

related offending is discussed in the context of the growing need to address the serious and widespread nature of computer crime. The study concludes by discussing the empirical and theoretical fit between the components of low self control, opportunity, and computer crime, as well as directions for future research.

CAN THE GENERAL THEORY OF CRIME ACCOUNT FOR COMPUTER OFFENDERS: TESTING LOW SELF-CONTROL AS A PREDICTOR OF COMPUTER CRIME OFFENDING

By

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Arts
2004

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Chapter One: Introduction

Computers have proven to be valuable assets to nearly every sector of society. The widespread use of computers has paved the way for significant gains in the efficiency and productivity of commerce, communication, record keeping, and research. Despite societies' substantial dependence upon computers and the networks they provide, computers and the information stored within are remarkably vulnerable to criminal manipulation. Given the presence of the networked computer in almost every aspect of modern life, the amount of sensitive information stored on computer networks, and the relative ease with which computer crimes may be committed, the study of computer crime demands the attention of researchers, law enforcement and legislators.

While the true costs of computer crime remain unmeasured, the potential costs of computer crime are staggering. Organizations from grocery stores to e-commerce sites that store financial information about their customers electronically have the potential to be victimized through the loss or abuse of confidential customer information. No matter the security measures taken to ensure the protection of the data from external threats, theft by an employee within the company can be just as damaging (FBI/CSI, 2002). While employee theft of trade secrets or confidential information was a problem long before the information age, the ease of the theft of such items and the massive scale of the number of potential victims makes computer crime a significant threat in the modern world. Both the music industry and software producers lose millions of dollars annually from the unauthorized distribution of their material (Furnell, 2002). Comparing total estimates of losses by different types of crime supports a greater legislative emphasis on curtailing non-traditional types of crime. The total property loss from conventional crime

in 1990 was $5 billion while the total loss from fraud and overpricing in industry and commerce was hundreds of times higher (Poveda, 1994). The true amount of loss from computer crime both in resources and in lost hours of productivity from employees is impossible to estimate, but companies affected by computer crime have reported staggering financial losses (American Bar Association, 1984). Additionally, acts of computer crime by terrorists who aim to disrupt or defraud American government or businesses will likely be a major security threat in the future.

Research on computer crime asks the same questions as research done on conventional forms of crime. Such questions include: who is the victim, what was the nature and extent of their loss, who was the perpetrator, how was the crime committed, why was the crime committed, and most importantly, how can crime be reduced or controlled. Prior research done on computer crime (Parker, 1976; Parker, 1983; Hollinger, 1993; Skinner & Fream, 1997; Furnell, 2002; FBI/CSI, 2002) has sought to answer many of these questions. Despite the best efforts of many organizations involved in the study of computer crime there is still very little known about its extent, its costs to society, and reasons underlying the behavior. This research aims to provide a clearer picture regarding:

1. The perpetrators of computer crime;
2. The kinds of activities in which they engage;
3. Whether computer crime can be explained by the General Theory of Crime.

There are several methodological challenges associated with research on computer crime. The lack of a clear definition of computer crime is problematic given that computer crime encompasses a broad and changing set of activities, many of which

have a legal status that is undecided, without precedent, lacking in legal penalties proportionate to their seriousness or vague in terms of the jurisdictions involved. Whether there is any worth in differentiating between computer crime, cybercrime (i.e. illegal network activity), and computer abuse (unethical but not illegal activities) is still undecided. An early, and broad, definition of computer abuse taken from Parker (1976, p. 17) is "any intentional act associated in any way with computers where a victim suffered, or could have suffered, a loss, and a perpetrator made, or could have made, a gain." This definition fails to address the lack of material gain associated with many computer crimes. Computer crimes are occasionally committed to prove that the perpetrator was capable of the act or for sheer thrill.

Further compounding definitional issues, computers, and the data and networks that they contain, can be the subject of a criminal act, or theycan be the instrument or tool through which criminal acts are facilitated. For example, computers are used to manufacture and print false identification cards, or to store and distribute copyrighted information or child pornography. A broader definition of computer crime is: "A crime in which the perpetrator uses special knowledge of computers" (Furnell, p. 21). Furnell's definition of cybercrime is "A crime in which the perpetrator uses special knowledge of cyberspace." For purposes of this research, computer crime encompasses cybercrime, given that cybercrime generally requires the use of and special knowledge about a computer.

By this definition, many computer crimes would fall into the category of white-collar crimes, the two categories being non-mutually exclusive. White-collar crimes are often defined as crimes committed in the course of one's occupation (Sutherland, 1949),

and given that many occupations rely on computers to store financial or personal information, the two forms of crime are closely intertwined. The FBI's computer crime survey (FBI/CSI, 2002) suggests that a substantial amount of computer crimes against businesses occur from within the victimized company, suggesting that many computer crimes are also occupational crimes. White-collar crimes and computer crimes thereby appear to share a number of theoretical underpinnings.

The growth of computer crime over the last few decades has afforded researchers with the unique opportunity to test older ideas about the causes of crime and deviance on computer crime. Perhaps owing to the lack of good data on computer crime only social learning theory has been tested using data on computer offenders (Skinner & Fream, 1997). The goal of this research is to further our criminological understanding of computer crime by testing the general theory of crime as a predictor of computer crime using original data drawn from a college-age sample.

Chapter Two illustrates past research on the general theory of crime, on computer crime and on a fundamentally related topic, white-collar crime as well as the hypotheses that guide this study. Chapter Three explains how this study was conducted and the sample used. The variables measured in this study, including self-control, opportunity and computer crime, as well as the control variables used are described. Chapter Four describes the statistical tests and their results, and whether these results are in line with the hypotheses, as well as how these results should be interpreted. This study concludes with a summary of the findings, the shortcomings of this research and directions for future research.

Chapter Two: Literature Review

The General Theory of Crime

Criminology has long been troubled by the lack of a general theory capable of explaining the full range of criminal and delinquent acts. Gottfredson and Hirschi (1990) sought to meet this challenge with their controversial general theory of crime, structured around the criminogenic effects of the interaction between low self-control and criminal opportunity. The introduction of their theory sparked lively debate as numerous theoretical and empirical attempts were made to evaluate the validity of Gottfredson and Hirschi's claim that self-control is the primary individual-level variable that determines criminal involvement (see Pratt & Cullen, 2000, for a meta-analysis of research on self-control). The generality of their theory has been a point of contention, particularly in it's ability to account for non-traditional offenses, such as white-collar crime. Gottfredson and Hirschi provided theoretical support in their 1990 book A General Theory of Crime as well as in previous and subsequent articles for the generality of their theory and its applicability to white-collar crime. An evaluation of the arguments in favor of and against the validity of the general theory's explanation of white-collar crime will facilitate my theoretical and empirical analysis of the General Theory of Crime's ability to account for computer crime.

Gottfredson and Hirschi's definition of crime as an "act of force or fraud undertaken in pursuit of one's self-interest" (Gottfredson and Hirschi, 1990: 15) is critical to understanding their general theory. According to Gottfredson and Hirschi most crimes are "mundane, simple, trivial, easy acts" (Gottfredson and Hirschi, 1990:xv) that require no special skills or abilities to commit. Offenders do not specialize in any one form or

type of crime, but instead commit many different types of crime as the opportunity presents itself. Opportunity is not clearly defined by Gottfredson and Hirschi; fitting with their conceptualization of crime however, opportunity can be seen as a situation in which an individual has the chance or choice to satisfy a short-term impulsive need through the commission of an illegal act.

This theory suggests that crime occurs when an individual with low self-control is presented with an opportunity to commit a crime. Criminal behavior is therefore not directly determined by self-control, but is mediated on an individual level by the presence of criminal opportunity. Despite the importance of opportunity in this theory, many empirical tests of self-control have not included formal tests of opportunity (Pratt & Cullen, 2000). The studies that have tested opportunity have done so in many different ways. Longshore (1998) as well as Grasmick and Tittle (1993) asked directly about the number of criminal opportunities which were present over a given time period for personal and property crimes, an opportunity being defined as the chance to engage in a crime in which no one would likely interfere or discover the commission of the crime quickly. These studies found support for their opportunity variables in relation to the General Theory.

The primary emphasis of the theory is on self-control, and this is where most of the empirical efforts to test the theory have focused, rather than on opportunity or the interaction between the two (Pratt & Cullen, 2000). Individuals low in self-control have a tendency to ignore the long-term consequences of their actions in their decision-making process as well as to be reckless and impulsive, which leads to a greater likelihood of engaging in crime when presented with the opportunity. On the other hand, individuals

with higher levels of self-control are better able to weigh the consequences of their actions and restrain their impulses when presented with a criminal opportunity.

Crime is not the only visible outcome of low self-control; Gottfredson and Hirschi suggest that individuals with low self-control will also engage in other risky or impulsive behaviors analogous to criminal behavior. Absent detailed information about criminal behavior, it is these analogous behaviors that allow for the determination of an individual's level of self-control. Observing an individual's past behaviors can be a time consuming process, one that could be eliminated if there were no measurement disparity between self-reports and actual behavior. In light of these self-report measurement problems, Gottfredson and Hirschi argue that self-control *should* be measured using behavioral measures rather than self-report measures, but that self-report measures are useable in the measurement of self-control. This preference for observed rather than self-reported behavior stems from the idea that self-control mediates the ability to accurately report on past behavior in a self-report survey. This effect has been demonstrated empirically by Piquero, MacIntosh and Hickman (2000) using a test of Grasmick and Tittle's (1993) self-control inventory. Despite this criticism, a substantial portion of the research done has used self-report methods as the primary means of determining self-control.

Given the relatively low level of non-trivial criminal offending in the general population, the measurement of more common analogous behaviors related to low self-control increases the testability of this theory by increasing the variance of behaviors. Generalizations drawn from rare events are more susceptible to error than generalizations drawn from more common events. The relationship between criminal and analogous

behaviors as accounted for by self-control has been challenged recently by Paternoster and Brame, (2000), who have found evidence to suggest that self-control does not account for the entirety of the relationship between crime and analogous behaviors. It is possible that other explanations exist for the relationship between crime and analogous behaviors besides self-control, however the relationship between self-control, crime and analogous behaviors is strong enough to support the general theory.

It should be noted that the study of self-control is not limited to the criminological domain. Psychiatric and psychological research on self-control has focused on the role that self-control plays in explaining a wide range of problem behaviors, including substance use (Wills, Duhamel & Vaccaro, 1995), academic dishonesty (Cochran, Wood, Sellers, Wilkerson & Chamlin, 1998) academic failure, poor adjustment and insecure emotional attachments (Tangney, Baumeister & Boone, 2004). Poor self-control appears to be a risk-factor for conduct disorder, as well as for higher rates of externalizing rather than internalizing disorders (Kreuger, Caspi, Moffitt & White, 1996). Although not explored systematically, the measurement of self-control in the psychiatric and psychological literature shares similarities to the work of Gottfredson and Hirschi.

Empirical Research

Research done by Grasmick and Tittle (1993) empirically describes and measures the six components of self-control suggested by Gottfredson and Hirschi. Derived from Gottfredson and Hirschi's theory, Grasmick and Tittle contend that low self-control can be determined by an individual's self-reporting of their tendency to be impulsive, prefer simple to complex tasks, prefer to take risks, prefer physical over mental activities, to be self-centered and to have difficulty controlling their temper. To measure these six traits,

Grasmick and Tittle adapted the California Psychology Inventory (self-control index), using a subset of the items to create a twenty-four item Likert type self-report survey of the six components of self-control. Grasmick and Tittle tested their instrument against self-reported involvement in acts of force and fraud and found that their survey was a valid measure of self-control, and that self-control predicted involvement in criminal behavior, despite the fact that only ten percent of the sample had been involved in acts of force or fraud. Grasmick and Tittle's measure of force and fraud was very weak, they asked the number of times in the past five years the respondent had "distorted the truth or falsely represented something to get something you couldn't otherwise obtain" (mean 1.44) for fraud and "used or threatened to use force against an adult to accomplish your goals" as force (mean .64) (Grasmick & Tittle, 1993, pg 15).

Empirical support for the general theory is mixed, but self-control does appear to be a valid predictor of future criminal behavior. Grasmick and Tittle's instrument has been used in many empirical tests of the general theory since its inception. Longshore, Turner, & Stein, (1996) found the scale to be a valid measure of self-control in an offending, rather than a general population. The predictive power of the scale was weaker than that found earlier in Grasmick and Tittle. Longshore's (1998) test of self-control and criminal opportunity found that self-control predicted only three to eleven percent of the variance in property and personal crimes.

Piquero and Rosay (1998) challenged the compatibility of a multidimensional model and a unidimensional model of self-control. They believed that the six component traits of self-control were not different types of self-control (multidimensionality), but that all were necessary in the measurement of the unidimensional self-control concept.

There has been discussion suggesting that if the six factor model does not fit cleanly into self-control, this would lead to multi-dimensionality, and that the effect of self-control might be in fact subsumed by one or more of the six components (see Arneklev, 1993 for details). Piquero and Rosay found support for the unidimensional model of self-control in their research. In a reply to Piquero and Rosey (1998), Longshore, Stein & Turner, (1998) addressed some earlier methodological concerns, and provided further support for the unidimensionality of self-control based on the six-component traits. It is important to determine whether self-control is a unidimensional or multidimensional trait. If there are empirically identifiable components of self-control, such as impulsivity, that predict offending beyond what is captured by self-control itself, then the theoretical nature of self-control as a single trait, as posited by Gottfredson and Hirschi, should be reevaluated.

While self-control seems to consistently explain criminal behavior, it only accounts for a small percentage of the total variance in crime. Combined with the opportunity factor, the variance explained remains disappointingly small, which is not unique for many criminological variables, but defies Gottfredson and Hirschi's claim that self-control is the primary explanatory cause of crime (Pratt & Cullen, 2000). Pratt and Cullen also found in their meta-analysis that social learning variables have additional predictive power when included with self-control in empirical tests. Research (Piquero & Rosay, 1998) has found disparate results for males and females, as well as for ethnic groups, and within different populations of offenders (Longshore et al, 1996) suggesting that this theory may not account for the offending behavior of different demographic groups. Despite these criticisms, empirical evidence suggests this theory is generally sound. A large portion of prior research on self-control has used attitudinal rather than

behavioral measures of self-control, which Gottfredson and Hirschi suggest may limit their findings. The theory has been strongly supported by studies that use behavioral measures of self-control, such as the study done by Keane, Maxim and Teevan (1993) that found a strong relation between behavioral measures of self-control and driving under the influence of alcohol.

Computer Crime

Computer crime has not received the same theoretical attention as has conventional crime. Computer crime, like conventional crime, can be measured through official data as well as self-reports of offenses and/or victimizations. While there are official law enforcement organizations and departments specifically devoted to computer crime, official data on computer crime from these sources is not based on a sampling technique, and offers little insight into the nature of the national problem. Surveys conducted by law enforcement organizations, research groups, and academics provide more focused appraisals of computer crime among specific populations. These surveys tend to focus on the victimization of individuals as well as large businesses and organizations. Offender surveys have been largely restricted to academia and the university populations that supply a ready pool of research subjects.

Of the victimization studies, the FBI's computer crime survey is particularly important. The only large-scale project to assess the costs of computer crime has been the combined effort of the FBI and the Computer Security Institute (FBI/CSI, 2002) in conducting their annual survey of computer crime and security-related issues. This study found that computer crimes are extremely costly to organizations, and are often not reported to the police.

Of the academia-based offender studies two are of particular relevance to this research. Hollinger's 1992 study of computer crime found that of 1,766 university students surveyed, 10% had given or received pirated software in the past semester (4 months). In terms of accessing another person's computer files without permission, 3.3% of respondents said this had occurred in the past semester. A study by Skinner and Fream (1997) expanded upon Hollinger's prior work by considering additional types of computer crime in a survey of 581 university students. Skinner and Fream found that over 40% of students surveyed had used or traded pirated software, and over 2% had used a virus or other malicious device to destroy or damage another's computer. This study was also the first formal test of a criminological theory on computer crime. They tested, and found modest support for Akers' Social Learning Theory as a predictor of computer crime among University students.

Anecdotal evidence of computer crime offenders suggests that the typical computer offender is "almost always male, aged from mid-teens to mid-20s, lacking in social skills, is fascinated with technology, is an underachiever in other areas (e.g. education)-who sees the computer as a means of being important or powerful" (Furnell, p. 47). Computer crime perpetrators also tend to be "unusually bright, eager, highly motivated, courageous, adventuresome and qualified people willing to accept a technical challenge" (Parker, 1983, p. 45). These propositions have yet to be subjected to empirical testing. This conceptualization of the average computer crime offender does not fit well with Gottfredson and Hirschi's characterizations of the typical conventional criminal. While anecdotal evidence suggests the computer offenders prefer risky activities, there is little reason to believe that they use computer crime as a means to

immediately gratify themselves or pursue short terms needs and goals. Moreover, the characterization of computer offenders as "highly motivated", "unusually bright" and "qualified" is not consistent with the low self-control offender.

White Collar Crime

There has been no empirical research to date to determine whether self-control predicts involvement in computer crime. However, there has been extensive debate concerning the general theory's ability to explain white-collar crime. The debate over the definition and theoretical underpinnings of white-collar crime provides a useful starting point for the theoretical appropriateness of the general theory of crime to computer crime. Many of the problems faced in studying and understanding white-collar crime are similar to those faced when studying computer crime.

Studying white-collar crime is considerably more challenging than studying traditional crime, partly due to the unsettled definition of white-collar crime. White collar crime may be defined either by the characteristics of the offense (i.e. tax fraud or embezzlement) or by those of the offender (i.e. upper-class, corporate or management offenders). The nature and extent of white-collar crime depends largely on the definition that is chosen, as well as the offenses that may be included within the definition. Historically, white-collar crime was first defined by Sutherland in the 1930's as crimes unique to upper-class offenders and committed in the course of one's occupation. Further research has suggested that an offense-based definition may be more appropriate, given that a wide range of offenders have committed white-collar crimes (Gottfredson and Hirschi, 1989).

Contrary to popular perception, it should be noted that many white-collar crimes do not require an offender to have a unique set of skills or financial access (Gottfredson & Hirschi, 1989*)*. For example, altering financial statements, mail fraud or tax evasion are relatively simple examples that rely on the lack of diligence of auditors rather than the cleverness of the perpetrator to succeed. If it is empirically the case that white-collar offenses do not require specialized skills, then white-collar offenses seem to fit with Gottfredson and Hirschi's view of crime. Gottfredson and Hirschi posit that a theoretical explanation of white-collar crime as separate from traditional crime is fruitless, given the similarities between the types of crime and the individuals that engage in them. Evidence suggests that white-collar crime offenses are trivial, simple, and do not require specialized knowledge to commit (Gottfredson & Hirschi, 1990*)*. They believe that white-collar offenders are motivationally and demographically no different than regular offenders, and that they commit many traditional crimes as well as white-collar crimes (i.e. white-collar offenders do not exclusively specialize in white-collar crime). Gottfredson and Hirschi also believed that white-collar offenses would be relatively uncommon.

An argument against this claim that white-collar crime is relatively uncommon and committed by demographically similar groups to those that commit traditional crimes was made by Steffensmeier (1989). He found that white-collar offenders, either when viewed by offender or offense type, do tend to be demographically different in that offenders are more likely to be older when compared to traditional criminals. Female involvement was found to be higher as well. Steffensmeier illustrated how employee theft was a fairly common offense within businesses, and that given the total set of white-

collar workers in the country, white-collar crimes are actually fairly common, nearly as common as violent crime in the United States.

Benson & Moore (1992) continued the critique of Gottfredson and Hirschi's view that white-collar offenders are criminally versatile and as likely to engage in deviant behavior as regular offenders. Benson and Moore suggest that ignoring the motives of offenders when theoretically considering white-collar crime is problematic, and that the general theory falls short in assuming that white-collar crime is pursued out of short-sighted needs for immediate gratification.

Weisburd and Waring (2000) provide further evidence that self-control is a poor predictor of white-collar offending. They cite evidence suggesting that many white-collar offenders have stable employment histories. This runs counter to the idea that offenders with low self-control will have unstable employment throughout their life. However, Weisburd and Waring do point out that low frequency white-collar offenders did have more employment as well as marital stability than did high frequency offenders, lending some support to the general theory.

Many theorists disagree entirely with the general theory's view of white-collar crime. Rather than self-control explaining all types of white-collar crime, critics claim that some forms of white-collar crime, such as organizational crime, are better explained by differences in corporate or organizational norms and values. This theoretical explanation holds that some corporate cultures promote criminal activity as an acceptable practice. Yeager & Reed (1998) provide evidence that organizational crimes are based more on normative influences (culture) than impulsive ones (self-control). Herbert, Green, & Larragoite (1998) agree that norms of offending in corporate culture and

business practices encourage white-collar crime as a means to raise profits or increase competitiveness. Simpson & Leeper-Piquero, (2002) further the argument that the general theory of crime fails to explain organizational offending in that the role of corporate culture on criminality confounds the link between individual traits and white-collar offending. They found a high (66%) rate of willingness to engage in corporate crime, contrary to Gottffedson and Hirschi's belief that white-collar offending would be relatively rare. Analogous behaviors were found to have an insignificant correlation with offending intentions. The corporate offender appears to be more calculating and rational, as well as aware of potential risks, rather than being impulsive and shortsighted as Gottfredson and Hirschi assumed.

Wright and Cullen, (2000) used a juvenile sample to better understand occupational crime. They found that occupational crime and delinquency was related both to internal factors mediating criminal propensities as well as to external factors such as interaction with other delinquents. Self-control appears to fall short as an explanation of white-collar crime, but Gottfredson and Hirschi do not close the theoretical door to other potential causes of crime, "our theory does not claim that self-control (or self-control and opportunity) is the *only* cause of crime" (Gottfredson & Hirschi, 1993, p. 50).

The failure of the general theory of crime to adequately explain select forms of white-collar offending suggests that the same failure could occur with regards to explaining computer crime. Since very little is known about computer crimes, it is unknown whether they fit Gottfredson and Hirschi's conceptualization of crime. The distribution of computer crimes within our sample and the characteristics of attitudinal and behavioral correlates of computer crime offenders will help to determine whether

computer crimes can be seen as “mundane, simple, trivial, easy acts” that can be committed by anyone, and that are committed most frequently by individuals with low-self control and the appropriate opportunity.

Hypotheses

Hypothesis 1: The interaction between low self-control and opportunity will have a significant and positive effect on computer offending.

Hypothesis 1a: Opportunity and low self-control will have a direct and positive effect on computer offending.

Gottfredson and Hirschi state that the interaction between low self-control and opportunity is the primary variable that accounts for criminal offending. It is not the only variable that is relevant, and the explained variance of the interaction term will likely be low to moderate. Gottfredson and Hirschi also state that when self-control, opportunity and the interaction term between the two are included in the equation, the interaction term will be significant and the other two terms will be non-significant, having their explanatory power subsumed by the interaction (Gottfredson & Hischi, 1990).

Hypothesis 2: The same factors that predict conventional crime will predict computer offending.

Whether computer crimes are explained by the same variables as conventional crime is an important test in determining the applicability of the general theory to computer crimes. Gottfredson and Hirschi suggest that offenders with low self-control will tend to be impulsive, and have a preference for simple tasks and physical over mental activities. Despite the lack of empirical evidence, anecdotal evidence of computer offenders suggests they are more patient, more cerebral than physical, and prefer challenges to simple tasks. If the average computer offender does not fit the low self-

control proposition of Gottfredson and Hirschi, then there is little reason to believe that their theory will adequately account for computer offending. With regards to the demographic variables, computer offenders should be similar to regular offenders in their demographics.

Hypothesis 3. Behavioral measures of self-control will prove to be better at explaining computer crime than attitudinal measures.

Gottfredson and Hirschi state that behavioral measures of self-control are more reliable than attitudinal measures, since attitudinal measures are usually collected through problematic self-report methods. Self-report can be biased by one's self-control, those with low self-control are thought to be less likely to complete the survey accurately and completely. Behavioral measures such as the number of times engaging in a risk-seeking activity are usually measured with self-reports as well, but these survey questions are more objective since they measure specific behaviors and behavioral outcomes and not attitudes. Whether or not attitudinal self-report scales over or underestimate the actual level of self-control is beyond the scope of this paper.

The following chapter explains the methods used to test these hypotheses. The demographic make-up of the sample as well as the distribution of the independent and dependent variables are explored. The implications of these distributions are further described in the discussion section of Chapter 4.

Chapter 3: Methods

Sample

Data for this study were collected from anonymous self-report surveys administered to a convenience sample of undergraduates. The sampling frame for this study was all students enrolled in three large social science introductory classes (650 students total) offered in the spring semester at a major mid-Atlantic university. A substantial number of students were absent on the day the survey was administered. More than ninety percent of the students who were given the survey chose to complete it, resulting in 389 completed surveys. The primary sampling unit was the class and therefore these data are not fully representative of the university at large; however since the course used fulfilled a university CORE requirement and all colleges were represented among the students registered it is likely that the results of this paper can be generalized to the University undergraduate population. This methodology resulted in the over-sampling of freshman (53.5% were first-years), as the introductory classes tend to be taken by students in their first few years of study. University students belong to an age group that is highly likely to engage in conventional crime, and the benefit of purposively sampling individuals within this group is that it will likely maximize variation in the dependent variable, computer crime (Hollinger, 1993; Skinner and Fream, 1997). Although convenience samples of college students have been overused in academic research, this study is specifically directed at understanding college student offending. Descriptive statistics for all measured variables are included in Table 8 in Appendix One.

Control Variables

Demographic and educational data were collected and used to create the following control variables:gender, age, class year, race, college of study and socio - economic status (SES). Age could be related to being more likely to have ever engaged in an offense, since the older individual would have had more opportunity to do so. While the finding that criminal involvement declines with age is one of the most reliable in criminology, the age range measured in a college sample does not allow for enough variation to capture the age effect. Males are more likely to engage in conventional crime, and we would expect this to be true with computer crimes. High SES could be associated with more access to computers (and thus opportunity), and thus higher levels of offending. The specific college of the surveyed student may also be associated with computer crime since computer science or engineering departments that rely on computers and related technical knowledge could increase the opportunity for offending.

The gender breakdown in this sample was essentially equal, 49% of the sample were male, and 51% were female. Although age was measured in the survey, class year is a better measure since its categories are more descriptive, as the difference between class years is meaningful in terms of University experience, more so than a given age difference. Both variables were highly correlated, as expected ($r = .754$). 54% of the sample were first-years, 31% were sophomores, 12% juniors and 3% seniors. In terms of race, this sample was predominantly white (70%). The remainder were African-American (12%), Asian (9%), Latino (6%) or other (3%). The non-white categories were combined into one group, so that race was measured as being white or non-white. College of study was a variable of interest since prior research had found that computer

intensive majors such as computer science and engineering had higher levels of computer crime (Hollinger 1993, Skinner & Fream, 1997). College was measured as either having a computer science/engineering major or not. There was not much variation in this variable since this survey was given to students in the social sciences and only 13% of the sample were computer science or engineering majors. Socio-economic status could potentially have an effect on opportunity, since computers are expensive. This effect might be more noticeable outside of a college campus where computer are less commonplace. Parental education is believed to be a proxy for SES, and was measured as a combination of mother's education and father's education as suggested in McMullen (1997). SES was divided into two categories, low SES meaning no parent with a college education (41%) and high SES meaning having at least one parent with a college education (59 %).

Independent Variables

Self-Control. Self-control was measured using separate behavioral and attitudinal measures. Although not the preferred method of measurement by Gottfredson and Hirschi, attitudinal measures have been used to measure to self-control with some success (Grasmick & Tittle 1993). Given the abstract nature of the self-control construct, diverse measures of self-control are the best way to capture its effects. In this study self-control is measured using both attitudinal and behavioral scales of self-control.

Self Control: Attitudinal Measure. The self-report questionnaire designed by Grasmick and Tittle (1993) comprised the attitudinal measure of self-control. The reliability and validity of this instrument have been affirmed with thorough empirical and theoretical testing, in a wide variety of populations (Longshore et al, 1996). A scale-

reliability test was performed on the twenty four items in the scale, and one item related to risky behavior substantially reduced the reliability of the total scale as well as the risky behavior subscale. This item was dropped and the remaining twenty three items were combined additively to measure attitudinal self control. The alpha for this scale was .742, which was slightly lower than Grasmick and Tittle's alpha of .805. See Table 11 in Appendix Two for individual subscale factor loadings. This scale was normally-distributed.

In this study this questionnaire allows for the assessment of self-control as a unidimensional construct (by measuring self-control as the sum of the component scores), as well as to individually test the six components of self-control described by Gottfredson and Hirschi against the dependent variable.

An exploratory principal component factor analysis of the twenty three attitudinal self-control questions resulted in the identification of six factors (using the Kaiser rule) whose eigenvalues were greater than 1. The scree discontinuity test found that the greatest difference between eigenvalues was between factor 1 and 2, which supports a one-factor or uni-dimensional scale. Factor 1 (eigenvalue = 3.777), Factor 2 (eigenvalue = 2.370), Factor 3 (eigenvalue = 1.848), Factor 4 (eigenvalue = 1.638), Factor 5 (eigenvalue = 1.411), Factor 6 (eigenvalue = 1.231). Factor 1 clearly represented the unidimensional trait of self-control, and all of the included variables loaded positively, if not strongly, on to it. Factor 2 contained the physical activities items and Factor 3 contained the Simple Tasks items. Further confirming the empirical accuracy of the unidimensional model of self-control, every item was positively and significantly correlated with the self-control variable. It is important to note that while this research,

and many prior studies using Grasmick & Tittle's scale support the unidimensionality of the model (Grasmick, Tittle, Bursik & Arneklev, 1993), a recent paper by Delisi, Hoschstetler & Murphy (2003) using a statisitically sophisticated confirmatory factor analytic technique with structural equation modeling supports the multi-dimensionality of the scale. Following the model outlined by Delisi et al. is beyond the scope of this paper; however, it is important to note that the nature of the scale appears to be related to the methods and techniques used to analyze it. Variations in these findings across various studies suggests that results drawn from attitudinally measured self-control scales may not be entirely valid. Furthermore, the low scale reliability alphas for the self-control subscales, as reported in Appendix Three, Table 14, suggest that this scale may not be a good measure for this sample. The scale items are correlated with the behavioral measures of self-control, as well as with computer and conventional offending, suggesting that despite these shortcomings the scale is still valid.

Self-Control: Behavioral Measure–A complementary measure of self-control was based on self-reporting of participation in risky or thrill-seeking behaviors thought to be analogous to crime. Simpson & Leeper-Piquero (2002) preferred using an additive measure of analogous acts to an attitudinal self-report measure (drawing on criticism by Piquero et al, 2000). However, sole reliance on the list of items used by Simpson and Leeper-Piquero in this study would not be effective given the different age range of the two samples. A university sample from an introductory class would produce little variability on all of the prior analogous acts due to their young age. (e.g. a substantial portion of underclassmen live on campus and may not own a car, most are not employed in a substantial way, nor are many likely to be divorced.) See Table 1 for the list of

analogous behaviors measured by Simpson and Leeper-Piquero, and the analogous and criminal behaviors and their participation rates measured in this study. See Table 8b in Appendix 1 for the distribution of participation in these activities by gender, as well as commentary about the relevant findings.

Table 1: Analogous Behaviors

Analogous Behaviors measured by Simpson & Leeper-Piquero (2002)
Having been unemployed for more than three months
Being divorced
Having more than one sexual partner in the past year
Number of motor vehicle violations in past year
Number of automobile accidents in past year
Number of times drunk in past year

Analogous Behaviors measured in this study	Proportion of Sample (%)
Typically drinks more than 5 drinks in an average drinking session	46.8
Having ever smoked cigarettes	24.9
Having one or more body piercings	24.2
Having one or more tattoos	9.8
Having more than one sexual partner in the past year	35.7
Viewed pornographic materials in the past year	63.8
Having gone sky diving in past year	2.3
Having gone rock climbing in past year	22.4
Having left your car unlocked in urban environment in past year	22.1
Not wearing a helmet when riding motorcycle or bike, past year	31.4
Not wearing a seatbelt in a car in the past year	42.7
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Engaged in any of these activities	95.4

Criminal Behaviors measured in this study	Participation Rate (%)
Having received a speeding ticket in the past year	29.3
Having intentionally damaged the property of another in the past year	33.7
Physically hurt someone in the past year	28.0
Taken property from another person without permission	42.7
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Engaged in any of these activities	67.4

This study used a different number of analogous acts more appropriate to a University sample, drawn from the dissertation work of McMullen (1997). The analogous behaviors (all but the criminal acts) were combined into the primary measure

of behavioral self-control. The alpha of this scale was =.5074. Four of the behaviors measured by McMullen as analogous acts were separated into a variable measuring participation in conventional criminal acts (Alpha=.5196). By having a separate measure of conventional crime we could test Gottfredson and Hirschi's assertion that self-control predicts conventional crime as well as computer crime, and test for an association between conventional and computer offending. It is also theoretically beneficial to understand the relationship between computer and non-computer offending. Gottfredson and Hirschi believe that offenders do not specialize in one type of crime, and this study will test whether offenders who did engage in conventional crime also engaged in computer crime.

Computer Crime Opportunity. As noted earlier, the general theory of crime states that crime can be explained through the interaction of low self-control and criminal opportunity. Given the wide range of computer crimes, and the varying levels of computer skills and knowledge required to commit different computer crimes, assessing the level of criminal opportunity is difficult to do directly. The following six items were used to measure opportunity: access to a computer, the amount of computer and Internet use as well as participation in a range of legal computer uses such as word processing and game-playing. While these proxies do not directly address the specific nature of what constitutes an opportunity to commit a computer crime, it is assumed that those who spend more time using their computers, and engaging in a diverse number of computer activities will have greater criminal opportunity. The final measure of computer opportunity was taken as the sum of the number of hours spent each day on a computer, the hours per day actively using the internet, and the frequency with which one uses word

processing, information searches, email, games, chat rooms, programming, downloading and uploading, viewing sexually explicit materials and other uses. It should be noted that, as expected, opportunity was positively correlated with having a computer science or engineering major, but the magnitude of the relationship was weak ($r=.118$,$p<.05$).

Dependent Variable: Computer Crime

The dependent variable in this study was participation in a range of eighteen different computer crimes. By summing participation in the eighteen offenses a total computer crime variable was created (Alpha=.7148.) This variable was slightly positively skewed, although not enough to affect analysis. The choice of these eighteen offenses, and the wording of the survey were chosen with advice from the University's computer crime office, as well as with the help of computer security/networking professionals knowledgeable about these types of offenses.

Conceptually it might make sense to break the total computer crime variable into three components based upon their seriousness: piracy, less serious computer crimes and more serious computer crimes. As could be logically expected, involvement in less serious offenses was much more common than involvement in serious offenses. The participation rate in all eighteen offenses, as well as within each category of computer crime are reported in Table 2. See Table 8c in Appendix One for the distribution of participation in these activities by gender as well as for commentary on the relevant differences. Factor analysis results did not lend clear direct support to the creation of the previously categories. Exploratory factor analysis resulted in six categories using the Kaiser rule. Factor 1 (eigenvalue 3.365) was clearly all the computer crimes measured. Factor 2, (eigenvalue 2.009) was the four software/media related piracy items. Factors 3-

6 were combinations of the other computer crime variables, but since they did not fit a clear conceptual category they will not be included in our analysis as separate variables. The software/media piracy variable will also not be included in this analysis.

Table 2: Computer Crime Prevalence

Computer Crimes Measured in this Study	Proportion of Sample (%)
Using Pirated Software	48.8
Trading Pirate Software	55.5
Traded music	89.7
Traded movies	69.7
Used a paper purchased online	9.8
Guessed another's password	34.4
Cracked another's password	7.2
Made false ID's with a computer	10.5
Harassed another online	22.6
Viewed documents illegally online	7.7
Purposely given a virus	1.3
Credit card fraud/theft	2.1
False purchases online	3.9
Changed documents illegally	4.4
Child pornography distribution	1.8
Auction fraud	1.3
Used a Trojan horse or 'bot' to attack a system	1.0
Hacked into a system	5.1
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Engaged in any of these activities	95.4

Note: Computer crimes were measured as participation in the past year and having ever done the activity.
Prevalence rates here reflect proportion of sample self-reporting past year participation.

The following chapter describes the ways in which these variables were used to test the previously stated hypotheses. The findings, their interpretation, as well as their implications are also discussed. Ways to improve future research on self-control and computer crime are described in the light of the findings and shortcomings of this study.

Chapter Four: Results and Discussion

Results

Hypothesis 1: The interaction between low self-control and opportunity will have a significant and positive effect on computer offending.

Hypothesis 1a: Opportunity and self-control will have a direct and positive effect on computer offending.

To test whether the interaction between opportunity and self-control explains variation in computer crime three ordinary least squares (OLS) regression models were developed. Due to the sufficient variation in the dependent variable, multivariate linear models were used rather than binary logistic models. As mentioned before, self-control is measured using two additive scales that capture (1) attitudinal and (2) behavioral indicators. A higher value on either scale indicates lower levels of self-control. The interaction term was created by multiplying self-control by opportunity. A positive and significant interaction term would indicate that the interaction between low self-control and high opportunity predicts offending- a result consistent with the theory. Model 1 measures the direct effects of self-control and opportunity on computer offending. Model 2 measures the interaction between self-control and opportunity, as well as their direct effects. Model 3 includes the interaction term without the direct effects of self-control and opportunity. Gender, class year, SES, race and major were included as control variables in both models. Table 3 presents the results of these models.

Table 3:
Results of OLS Regression Model of Self-Control, Opportunity and their Interaction on Computer Crime

	Model 1	Model 2	Model 3
Constant	-6.1 (1.0)	-11.2 (3.7)	-.406 (.50)
Gender	.209**	.207**	.230**
Year	.064	.061	.065
SES	.050	.051	.051
White	-.007	-.013	.006
Computer Major	.016	.014	-.024
Opportunity	.260**	.792*	
Self-Control	.337**	.601**	
Opportunity x Self-Control		.609	.386**
Adjusted R^2	.252	.254	.215

Dependent Variable: Computer Crime
Standardized Coefficients Reported
Constant reported unstandardized (standard error in parentheses)
** significant at the 0.01 level
* significant at the 0.05 level
N=389 for all models

Gender was the only significant control variable, males were more likely than females to be involved in computer crime. In Model 1, both opportunity and self-control had a significant and positive relationship with computer crime, with self-control having a greater direct impact (higher standardized Beta coefficient) than opportunity. In Model 2, contrary to our predictions the interaction term was not significant when included with the direct effects. Since the interaction term is a function of self-control and opportunity, it is very highly correlated with each term (with self-control, $r=.479$, $p<.01$ and with opportunity, $r=.895$, $p<.01$). Collinearity statistics were run for all the terms in Model 2 and the VIF statistics of the interaction term (VIF=93.7), opportunity (VIF=72.5) and self-control (VIF=18.7) were extremely high. Tolerance statistics also suggested that multicollinearity was a problem with the interaction term (Tolerance Statistics:

Opportunity=.014, Self-control=.054, Interaction=.011). VIF statistics greater than 2 and Tolerance statistics less than .5 indicate a problem with multicollinearity, as is clearly the case here. Unfortunately it would be theoretically improper to exclude one of the three variables to reduce multicollinearity, since all are important to the general theory's explanation of crime.[1] Model 3 found that the interaction term is positive and significant in the absence of the direct effects. The change in variance explained between these models is relatively small (e.g., suggesting that the addition of the interaction term does not add much to the model). Furthermore, the standardized coefficients of the interaction term is only slightly higher than each of the direct effect terms in Model 1, suggesting that the interaction term's significant coefficient is merely capturing the explanatory power of the direct effects. Despite the high multicollinearity, these three models suggest that self-control and opportunity predict variance in computer crime primarily through their direct effects, and not through their interaction. However, we cannot completely discount the role of multicollinearity in producing these results.

Hypothesis 2: The same factors that explain conventional crime will explain computer offending.

Table 4 shows the mean number of computer crimes and the mean number of conventional crimes committed by each category of the control variables. The only significant differences were for gender. For both conventional and computer crimes men committed more crimes than women on average.

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[1] Multicollinearity in an equation increases the likelihood of a Type II error, of not finding an effect where one exists. Although we can not conclude that the interaction term would be significant absent multicollinearity, it is a possibility. Grasmick, Tittle, Bursik & Arneklev (1993) as well as Longshore, Turner & Stein (1996) ran similar tests of self-control, except they used z-scores to zero their variables. Multicollinearity is not addressed in their work, but they both found the interaction term to be significant. After following their example, and converting measures of self-control and opportunity to z-scores as well, we did not find that this changed our finding of the interaction term being negative and non-significant.

Table 4: Control Variables and Mean Number of Computer and Conventional Crimes

	Sex		Race		Year				SES		Major	
	Male	Female	White	Non-white	1st	2nd	3rd	4th +	Low	High	Comp-related	Non-Comp
Computer Crimes	4.4	3.1** (33)	3.8	3.5	3.7	3.7	3.9	4.0	3.6	3.8	4.2	3.6
Conventional Crimes	1.6	1.0** (29)	1.4	1.1	1.3	1.3	1.2	1.1	1.3	1.3	1.3	1.3

Note: Computer-related majors were computer science or engineering. **=p<.01, (ANOVA F statistic)

Furthermore, computer crime and conventional crime were highly correlated (r=.448**), i.e., those individuals who engage in computer crime were more likely to have engaged in conventional crime.

To examine the relationships between conventional crime, computer crime, and self-control, both types of crime were correlated with the six attitudinal sub-scales of self-control. Computer crimes were correlated with four of the six self-control subscales and conventional crimes with five of the six subscales (see Table 5 below). The correlation coefficients were slightly larger for conventional crimes than for computer crimes, suggesting that these items are weaker predictors of computer offending.

Table 5: Computer Crimes, Conventional Crimes and Correlations with Attitudinal Self-Control

	Impulsivity	Preference for Simple Tasks	Preference for Risky Activities	Preference for Physical Activities	Self-Centered	Problem with Temper
Computer Crime	.274**	.041	.348**	.027	.182**	.221**
Conventional Crime	.323**	.073	.406**	.117**	.216**	.230**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Hypothesis 3. Behavioral measures of self-control will prove to be better at explaining computer crime than attitudinal measures.

Two sets of four OLS regression models were used to test this hypothesis. All models used computer crime as the dependent variable and gender, race, year, major and SES as control variables. Table 6a shows the results of four multivariate OLS regressions done to determine the direct effects of self-control and opportunity on computer offending. Model 1 contains attitudinal self-control, and opportunity. Model 2 contains behavioral self-control, and opportunity. Model 3 contains both attitudinal and behavioral self-control variables (separate from each other, but both included), and opportunity. Model 4 contains a combined measure of self-control constructed by adding the attitudinal and behavioral scales, as well as opportunity. Only gender was significant as a control variable, and the others will not be reported here. VIF and Tolerance statistics were calculated, and consistently suggest that multicollinearity was problematic across all of the models used. However, like the earlier results, the coefficient of the interaction term was fairly small, as was the explained variance ($\mathbf{R^2}$), suggesting that the interaction term did not add substantially to the model and was merely reflecting the explanatory power of the direct effects.

Table 6a: OLS Regression Models Comparing Attitudinal, Behavioral and a Combined Measure of Self-Control and Opportunity on Computer Crime

	Model 1	Model 2	Model 3	Model 4
Constant	-5.7 (1.0)	-.91 (.58)	-5.1 (1.0)	-6.1(1.0)
Gender	.232**	.207**	.202**	.216**
Self Control				
Attitudinal	.287**		.216**	
Behavioral		.286**	.213**	
Combined				.330**
Opportunity	.252**	.272**	.264**	.254**
Adjusted R^2	.227	.225	.264	.253

Dependent Variable: Computer Crime
Standardized Coefficients Reported
Constant reported unstandardized (standard error in parentheses)
** significant at the 0.01 level (2-tailed).
* significant at the 0.05 level (2-tailed).

The second set of OLS regressions (see Table 6b) are similar to the first four listed above, except that an interaction term was included.

Table 6b: OLS Regression Models Comparing Attitudinal, Behavioral and Combined Measures of Self-Control, Opportunity and their Interaction on Computer Crime

	Model 5	Model 6	Model 7	Model 8
Constant	-11.8 (4.0)	.1.4 (1.0)	-10.1 (4)	-11.2(3.7)
Gender	.224**	.225**	.195**	.212**
Self Control				
Attitudinal	.583**		.456*	
Behavioral		.401*	.210	
Combined				.603**
Opportunity	.883**	.331**	.773*	.803*
Interaction (Self-Control x Opp)				
Attitudinal x Opp	-.709		-.581	
Behavioral x Opp		-.136	-.002	
Combined x Opp				-.629
Adjusted R^2	.228	.222	.264	.255

Dependent Variable: Computer Crime
Standardized Coefficients Reported
Constant reported unstandardized (standard error in parentheses)
** significant at the 0.01 level (2-tailed).
* significant at the 0.05 level (2-tailed).

Opportunity was significant in all eight of the models and from this we can safely draw the conclusion that the higher the opportunity, the higher the likelihood of engaging in computer crime. Self-control was significant in all models, although Model 7 shows that the behavioral self-control measure was non-significant when attitudinal self-control and their interaction terms were included in the model. The interaction term between self-control and opportunity was not significant in any of the models, suggesting that self-control and opportunity both affect computer offending, but their affects operate independently of one another.

To further test the contributions of behavioral and attitudinal self control, two more OLS regressions compared the predictive power of attitudinal and behavioral

measures of self-control on conventional and computer offending. When the six subcomponents of self-control were regressed alongside behavioral self-control, for both types of offending, behavioral self-control was significant and liking risks and temper problems were the only two significant attitudinal variables (see Table 7 below).

Table 7: OLS Regressions for Attitudinal Sub-Scale Items Predicting Computer and Conventional Crime

Computer Crime	Beta	Conventional Crime	Beta
Behavioral Self-Control Beta	.193**	Behavioral Self-Control Beta	.299**
Risk Taking Subscale Beta	.205**	Risk Taking Subscale Beta	.196**
Temper Subscale Beta	.134**	Temper Subscale Beta	.119**
Self-Centered Subscale Beta	.054	Self-Centered Subscale Beta	.076
Physical Activity Subscale Beta	.060	Physical Activity Subscale Beta	.012
Simple Task Subscale Beta	-.016	Simple Task Subscale Beta	.014
Adjusted R^2 = .175		Adjusted R^2 = .265	
Standardized Coefficients are reported		** significant at the 0.01 level	

Discussion

Descriptive statistics from Table 2 show that while a range of computer crimes are commonly committed, the most common offenses are software and media copyright violations. Table 8c in Appendix One shows that while both genders engage in a variety of computer offenses, males are more likely to engage in certain offenses such as software trading and hacking to a greater degree than females. Participation in analogous and conventional criminal behaviors, as seen in Table 1 suggests that these behaviors are relatively common, and Table 8b in Appendix One shows that males are more likely to engage in certain analogous and criminal behaviors more often than females as well. A large portion of this sample reported having engaged in conventional criminal acts in the past year. Close to half of the males in this sample reported having engaged in assault, theft or the destruction of property in the past year. Females were more likely to engage in theft than in any of the other conventional crime types.

The primary finding of this research was that opportunity and self-control had positive and significant effects on computer offending, confirming hypothesis 1a, despite the non-significance of the interaction term. Grasmick et al. (1993) found that opportunity was significant beyond the effect it had through the interaction term, although unlike Grasmick's results, and contrary to Hypothesis 1, the interaction term was not significant when direct effects were included in the models. We can conclude from these findings that opportunity and self-control play a substantial and independent role in explaining computer crime.

The fact that computer offenders were more likely to have engaged in prior conventional criminal acts is another important finding of this research. Although we did not directly test for offense specialization in this sample (see Benson & Moore, 1992), these results suggest that individuals do not specialize in one type of offending alone. Computer offending was explained by the same variables that explained regular offending, confirming hypothesis 2. The average computer offender appears to have the same traits as the average conventional offender in that they are more likely to be male and to have low self-control, particularly a preference for risky activities, high impulsivity, self-centeredness and difficulty controlling their tempers. Although individuals in computer-related majors have more computer opportunity, this variable was not a significant predictor of computer offending.

Furthermore, the use of conventional crime as a secondary dependent variable allows us to analyze in greater detail the contributions of our independent variables (See Appendix 2). As can be seen in Table 5, conventional crimes were more highly correlated with the subscales of attitudinal self-control than were computer crimes,

suggesting that there is a difference between computer and conventional crimes in how they relate to the concepts measured by these subscales. The magnitude of these differences in the correlation coefficients were not particularly large (<.09) however. Since neither crime type correlated with the simple task item, this suggests that either the simple task item is measured poorly, or that a preference for simple tasks, contrary to Gottfredson and Hirschi's belief, is not part of self-control. A preference for physical activities was not correlated with computer crime either, and this makes logical sense since computer crimes are not physical tasks, unlike conventional crimes. Unfortunately determining which of the two prior explanations is correct is beyond the scope of this research. The substantial agreement between conventional and computer crimes in terms of their correlations to self-control related traits strongly suggests the unidimensionality of the self-control item, as well as the applicability of the self-control model to explaining computer crimes.

Attitudinal measures of self-control had higher standardized coefficients than did behavioral measures, and in Model 7 in Table 6b, when both were placed in the same equation with interaction terms, behavioral measures became non-significant. This contradicts Gottfredson and Hirschi's belief as well as hypothesis 3 that behavioral measures ought to provide a better predictor of self-control than attitudinal measures. Since both measures, when used simultaneously to predict self-control in the absence of an interaction term (see Model 4 in Table 6a), have a significant effect, this suggests that they predict computer crime independently of each other, and should both be included in the model. Theoretically they ought to measure the same underlying concept, but these findings suggest that they could be measuring something different. Attitudinal measures

are more subjective than the behavioral measures, since they do not measure discrete events and the differences found here could reflect measurement error due to the reduced reliability of self-report measures of attitudes. Whether they measure different concepts, or the same concept differently is beyond the scope of this research, but is an important theoretical and measurement-related issue that needs to be addressed if self-control is going to continue to be used in empirical research.

Table 7 shows that behavioral self-control is related to both types of offending in addition to certain subscales of attitudinal self-control. This suggests that having a preference for risky behaviors and having a problem controlling one's temper measure some form of self-control beyond what is captured by the behavioral measures, and that including both attitudinal and behavioral measures when measuring self-control is important. Behavioral measures had a stronger effect in the model for conventional crimes (Beta=.299), but risk taking was slightly larger in its effects for computer crime (Betas .205 vs. .193 respectively). Temper, while significant, was a less important predictor in both equations than risk taking and behavioral measures of self-control. The fact that there is agreement between the variables on two separate forms of crime further supports the idea that risk taking and temper variables capture somewhat different aspects of self-control than that captured by measuring analogous acts, and that both should be included as measures of self-control.

This study finds support for the general theory of crime's ability to predict computer crime offending. Low self-control, measured attitudinally, behaviorally, and as a combined measure of the two, was significantly related to computer offending. Contrary to the general theory, however, the interaction between self-control and

opportunity was not significantly related to computer crime. The effects of opportunity and self-control appear to operate independently of each other in predicting computer crime. The general theory of crime offers some insight into computer offending within a university-based sample, but the failure to uncover a significant interaction between self-control and opportunity suggests that other processes are at play.

Gottfredson and Hirschi may challenge this research on several grounds. The findings of this paper support their belief that self-control predicts all types of offending, not just conventional offending. However, this research relies entirely upon self-report data, data whose collection may be biased by a participant's level of self-control. In its' defense, this research uses both behavioral and attitudinal measures of self-control, as well as a measure of opportunity. Many tests of the general theory do not include opportunity or behavioral measures of self-control at all, and this research is stronger than many in this aspect. Gottfredson and Hirschi would question the finding that using both types of measures are essential, since they believe that self-control is a single concept best measured through behavioral indicators. Furthermore this research finds that two of the subscales of attitudinal self-control fail to predict computer offending (preference for simple tasks and preference for physical activities) and that one subscale, having a preference for simple tasks, does not explain conventional offending either. Gottfredson and Hirschi would argue that these findings are a result of measurement error and a poorly designed attitudinal survey. They would recommend using behavioral indicators of these items rather than the limited self-report survey designed by Grasmick and Tittle. The attitudinal self-control survey used in this research did not strongly support the separation of the subscales (The alphas of the subscale items were generally low, as seen

in Appendix Three). The survey instrument may in fact be poorly conceived, although more theoretical conceptualizing of what these subscale items are and how to measure them more carefully is needed if the instrument is to be improved. This exploratory research does not provide the final word on any aspects of the general theory, and this paper does not provide firm ground to either defend or refute the nature and role of self-control in explaining computer offending. One reason for this is the number of methodological shortcomings associated with this research.

Methodological Shortcomings

The under-theorizing of opportunity by Gottfredson and Hirschi is a significant oversight in their theory. The exact definition and meaning of an opportunity is not clearly explained, and while they explicitly explain the best ways to measure self-control, measuring opportunity is scarcely addressed. By failing to suggest how to operationalize or measure opportunity, past research on the theory has often used rudimentary measures of opportunity or failed to include it at all. This research measured opportunity very broadly, as the sum of having engaged in a wide variety of legal computer activities as well as the amount of time spent using a computer daily. Future research on opportunity, specifically computer crime opportunity, would be better served by developing a more valid measure. This could be accomplished by asking direct questions about computer crime opportunity, rather than just computer use. For example, rather than asking how many hours a day an individual uses a computer, a more specific measure of computer crime opportunity would be to ask “have you ever had the opportunity to browse through another’s computer files without their permission”, or “have you ever had the opportunity to use or install copyrighted software on your own computer that you did not legally

purchase". Overall, Gottfredson and Hirschi's failure to adequately describe the opportunity component of their theory is a major weakness.

Self-report surveys of illegal behavior have often been questioned on their reliability and validity due to the potential for falsification or under-reporting of offenses. The potential for falsification and under-reporting of offending behavior exists, but under-reporting generally tends to be minimized in confidential self-reports of non-violent (non-serious) offenses (Hindelang, Hirschi & Weis, 1981). The anonymity of the survey further reduces falsification of responses and it is unlikely that falsification is a substantial problem in this study.

Aside from the theoretical implications associated with measuring self-control through a self-report survey, this study is limited in its generalizability due to a non-random sampling technique and the use of a convenience sample. The results are not fully generalizable to the university or other subpopulations. This exploratory research is designed to better understand the nature and extent of computer crime offending among an important sub-population.

The use of a university-based sample of students is also potentially problematic. University students are likely to have higher self-control than the general population given that they have succeeded in education. Furthermore, the nature of criminal opportunity, both for conventional and computer crimes, is different for a University population. The presence and use of computers is virtually ubiquitous, and access to high speed internet connections and peer-based file sharing networks provides easy access to pirated software and media. University students are also more likely to be exposed, by virtue of their frequent computer access and use, to other computer offenders. Social

learning and subcultural theories of offending would prioritize the social learning mechanisms over individual traits as the main explanation for computer crime. For example, having peers who engage in computer crime could be a powerful predictor of computer offending and could possible account for the strong opportunity effects found in this study. The learning variables could be mediated by self-control however, but to test this would require including variables specific to peer influences and social learning. To determine the exact effects of other theoretical variables as well as their relation to self-control, both sets of variables could be included in the same model. Self-control predicts a certain amount of the variance in computer offending when measured alone, but its explanatory power could be substantially reduced when other competing explanations are included in the model. If the addition of other theoretical variables did not alter the effect size of self-control in a combined model, then self-control could be seen as having an independent effect on computer offending beyond the effects of the additional variables.

Another shortcoming of this study is its' low explained variance. The highest variance explained by the included variables in this study was .254 (Model 2 in Table 3). This is moderate, and is in line with prior research findings of the general theory's explanatory power, although gender was also significantly associated and accounts for a portion of this effect. Pratt and Cullen (2000) report in their meta-analysis of self-control research that the average explained variance for self-control variables was .193. To explain more of the variance in computer crime, and to improve our understanding of role of self-control, other theoretical variables should be included in future research on computer crime. Social learning and peer influence variables would likely explain

computer offending, although their explanatory power would likely operate more through opportunity than through individual propensities to offend.

As for the causal ordering of the variables, Gottfredson and Hirschi's theory states that self-control is a relatively stable trait that is established in early childhood. An individual's level of self-control is set early in their life, and remains relatively stable throughout. While our method does not address potentially problematic questions of causal ordering in the data, such as whether engaging in crime alters levels of self-control, there is no reason to believe that this issue will confound our data in any appreciable manner (Longshore et al, 1996). The nature of self-control as described above creates a problem for those who would attempt to reduce crime by treatment or counseling. Since self-control is essentially fixed, there is little that can be done policy-wise to alter self-control-related offending. Policies that reduce opportunity for crime may be more effective, although very little research has been done on this topic. Universities could potentially seek to reduce student access to illegal file-sharing networks as a way to reduce computer crime opportunity. More stringent punishment of computer offenders may also deter future offenders from computer crime, although this effect is also empirically unsupported for computer offenses.

Directions for Future Research

Given the wide participation in computer offending, as well as the diversity of different computer crimes that occur on a University campus, further research into the causes and correlates of computer offending is warranted. The high rate of computer crime participation in this sample clearly shows that computer crime is relatively common. The less serious computer crimes, especially media-related copyright

violations, were quite widespread within the sample. More serious computer crimes were less prevalent, although common enough to warrant further research. Since there is a high rate of offending, a generalized educational prevention approach may be effective in reducing computer offending. Rather than directly targeting known offenders with intervention efforts, the large number of students engaged in computer crime suggests that a more effective strategy would be the general education of the University population about the nature, seriousness and consequences of computer crime. It is unknown whether the high rates of computer offending in Universities may result in high rates of victimization among University students. Computer victimization in the form of identity theft, electronic harassment and virus or hacking attacks is a growing problem nationwide, and further research on computer victimization would be beneficial. These findings suggest that computer crime should be an immediate concern of policy makers and University officials.

Future studies on self-control using college samples should seek to improve their measurement of self-control. This study measured analogous behaviors in a rather rudimentary way. The behaviors that were used to construct the behavioral self-control scale were appropriate to a college sample, but measurement of behavioral self-control could be improved by including a wider range of behaviors related to self-control. Measuring college-related behaviors such as cutting class and procrastinating on homework could increase the accuracy of the behavioral measure. Measuring opportunity more directly would further improve a test of the general theory such as asking opportunity-related questions specific to computer offending. Questions could also be asked about age of onset, since it is likely that computer-related offending begins

before an individual enters a University. Future research would also benefit from the inclusion of more theory-related variables to better understand the role that social learning, peers and social control may have on computer crime. By combining social learning and peer influence variables into a model alongside self-control variables, the unique contribution of self-control on computer crime may be better understood.

Appendix One: Descriptive Statistics for Measured Variables and Gender Distributions for Analogous Behaviors, Conventional and Computer Crimes.

Table 8: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Control Variables				
Gender (Male = 1)	0	1	.4936	.500
Race (White = 1)	0	1	.6992	.459
Year	1	4	1.647	.810
Major (Comp/Engr = 1)	0	1	.1337	.340
SES (High SES = 1)	0	1	.5938	.491
Self-Control Subscales				
Impulsivity	4	14	8.676	1.81
Liking Risks	3	12	7.665	1.48
Liking Simple Tasks	4	14	9.128	1.70
Liking Physical Tasks	4	14	10.98	1.83
Self-Centered	4	14	7.840	1.68
Temper Problems	4	14	8.912	2.10
Self-Control Scales				
Attitudinal Measure	34	79	53.21	5.95
Behavioral Measure	0	10	3.509	1.91
Combined Measure	35	85	56.71	6.85
Opportunity	0	77	41.03	9.82
Computer Crime	0	16	3.766	2.30
Conventional Crime	0	4	1.336	1.20

N of cases for all variables was 389

Table 8b: Gender Differences in Behaviors

% Participating in Analogous Behaviors		
	Male	Female
Typically drinks more than 5 drinks in an average drinking session	59	35**
Having ever smoked cigarettes	23	27
Having one or more body piercings	6	42**
Having one or more tattoos	7	12
Having more than one sexual partner in the past year	34	37
Viewed pornographic materials in the past year	84	44**
Having gone sky diving in past year	4	1
Having gone rock climbing in past year	27	18*
Having left your car unlocked in urban environment in past year	23	21
Not wearing a helmet when riding motorcycle or bike, past year	45	18**
Not wearing a seatbelt in a car in the past year	67	68
% Participating in Criminal Acts		
	Male	Female
Damaged another's property	43	14**
Fought with/assaulted another person	46	22**
Been pulled over for speeding	31	27
Taken property without permission	46	39

Percent of each gender reporting engaging in the activity
Starred results indicate that a Chi-Square test found a significant difference between males and females,
* significant at the 0.05 level (2-tailed) ** significant at the 0.01 level (2-tailed).

Significant findings: Males engaged in more heavy drinking than females. They were also more likely to have viewed pornographic material, to not wear a helmet when riding a bicycle or motorcycle and to have gone rock climbing in the past year. Females were more likely to have one or more body piercings. For the criminal acts, males were more likely to engage in violent or destructive acts than females. None of these gender differences were surprising since they reflect the common view of males as engaging in certain types of behaviors, such as viewing pornographic materials, more often than females.

Table 8c: Gender Differences in Computer Crime Offending

% Participating in Computer Crimes		
	Male	Female
Use Pirated Software	63	35**
Traded Pirate Software	72	39**
Traded music online	91	89
Traded movies online	81	58**
Used a paper purchased online	9	11
Guessed another's password	35	34
Cracked another's password	9	6
Viewed documents illegally online	9	7
Changed documents illegally	6	2
Purposely given a virus	2	.5
Created False IDs	15	6**
Credit Card fraud/theft	2	2
False purchases online	4	4
Child pornography distribution	4	0**
Auction Fraud	2	.5
Harassed another online	27	17**
Used a Trojan Horse or 'bot' to attack a system	2	0
Ever hacked into a system	9	1**

Percent of each gender reporting engaging in the activity
Starred results indicate that a Chi-Square test found a significant difference between males and females
* significant at the 0.05 level (2-tailed). ** significant at the 0.01 level (2-tailed).

Males were more likely to engage in software and movie trading, as well as the creation of false IDs and the distribution of child pornography. They were also more likely to harass another online, and to report ever hacking a computer or network. Despite the differences in software and movie trading between males and females, both reported similar levels of trading music online. Also, a substantial number of males and females engaged in using purchased papers, guessing and cracking passwords and viewing documents illegally online. Computer crime is not a predominantly male phenomenon, and females engage in a wide range of illegal computer activities as well.

Appendix Two: Validating Self-Control Measures with Conventional Crime

If the general theory of Gottfredson and Hirschi is correct, then attitudinal measures of self-control as well as measures of participation in analogous acts will predict participation in regular crime, specifically property destruction, theft, assault and being caught for speeding. As expected, Table 9 below shows that behavioral and attitudinal measures of self-control were correlated with criminal offending as well as with each other.

Table 9: Correlations Between Self-Control Measures and Conventional Crime

Behavioral Self-Control with Conventional Crime	r=.434***
Attitudinal Self-Control with Conventional Crime	r=.400***
Behavioral Self-Control with Attitudinal Self-Control	r=.345***

***=P<.001

This provides support for Gottfredson and Hirschi's theory, as well as for the validity of the self-control measures, since both are positively correlated with criminal offending. To better understand the attitudinal measure of self-control, each of the subcomponents were checked in their correlation to criminal offending (Table 10). Five of the six self-control scales were significantly and positively correlated with conventional offending.

Table 10:
Correlations Between Attitudinal Self-Control Sub-Scales and Conventional Crime

	Impulsivity	Preference for Simple Tasks	Preference for Risky Behaviors	Preference for Physical Activities	Self-Centered	Problem with Temper
Conventional Crime	.323**	.073	.406**	.117**	.216**	.230**

** significant at the 0.01 level (2-tailed).
* significant at the 0.05 level (2-tailed).

OLS regression (see Table 11) was used to further confirm the relationship between criminal offending and self-control. Gender was included as a control since gender is a well-known correlate with criminal offending. Other control variables such as race, class year and SES were non-significant when added to the regression equation to predict criminal offending and are not reported here.

Table 11: OLS Regression of Self-Control on Conventional Crime

	Beta
Gender	.193***
Behavioral Self-Control	.308***
Attitudinal Self-Control	.276***

Dependent Variable: Conventional Crime. *** significant at the 0.001 level (2-tailed).
Standardized coefficients reported here Adjusted R^2 =.290

This equation shows that both attitudinal and behavioral self-control measures predict engaging in criminal behavior, even when they are both included in the equation. This suggests that each measures a unique dimension of self-control, and that both are useful in measuring self-control, as was previously noted in the discussion section of this paper. To better understand this finding, the six subscales of attitudinal self-control were

substituted in place of the attitudinal self-control scale. When theOLS regression was run (see Table 12) behavioral measures and gender remained significant, but only two attitudinal measures were significant, liking risks and having difficulty controlling one's temper.

Table 12:
OLS Regression of Self-Control (with Attitudinal Sub-Scales) on Conventional Crime

	Beta	p
Sex	.183***	.001
Behavioral Self-Control	.279***	.001
Impulsivity	.072	.169
Simple Tasks	.026	.563
Prefer Risks	.174***	.001
Prefer Physical Acts	.014	.755
Self -Centered	.057	.228
Temper Problem	.130**	.005

Dependent Variable: Conventional Crime. *** significant at the 0.001 level (2-tailed).
Adjusted R^2 = .295 ** significant at the 0.01 level (2-tailed).

When gender and behavioral self-control measures are dropped from the equation and just the attitudinal subscales are used to predict conventional offending (see Table 13), three of the six measures (impulsivity, liking risks and temper) significantly predict criminal behavior. The self-centered item approaches significance in this model as well. Preference for simple tasks is not significant, and this may be due, as previously stated, to the construct validity of the question in that it is a poor measure of a true preference for simple activities. The same may hold true for the measure of preference for physical activities, which is also not significant.

Table 13: OLS Regression of Attitudinal Sub-Scales on Conventional Crime

	Beta	p
Impulsivity	.137	.012
Simple Tasks	-.001	.985
Prefer Risks	.292**	.000
Prefer Physical Acts	.025	.599
Self-Centered	.093	.060
Temper Problem	.105*	.033

Dependent Variable: Conventional Crime.

** significant at the 0.01 level (2-tailed).

* significant at the 0.05 level (2-tailed).

Appendix Three: Item Loadings of Attitudinal Self-Control Scale

Table 14: Item Loadings on Attitudinal Self-Control Scale

The following shows the factor loadings of each of the twenty-four attitudinal self-control survey items on their respective six subscales. Sub-Scale reliabilities listed in italics. The final Attitudinal Self-Control Scale was constructed as the additive total of the twenty three included items (alpha=.7462).

Impulsivity *(Alpha=.5962)*	
Item 1	.541
Item 2	.451
Item 3	.553
Item 4	.402
Simple Tasks *(Alpha=.6219)*	
Item 1	.249
Item 2	.303
Item 3	.278
Item 4	.330
Risk Seeking *(Alpha=.6281)*	
Item 1	dropped
Item 2	.459
Item 3	.474
Item 4	.608
Physical Activity *(Alpha=.6416)*	
Item 1	.207
Item 2	.165
Item 3	.213
Item 4	.188
Self-Centered *(Alpha=.6311)*	
Item 1	.346
Item 2	.236
Item 3	.482
Item 4	.574
Temper *(Alpha=.6553)*	
Item 1	.303
Item 2	.529
Item 3	.482
Item 4	.420

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