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Correlates of Internet Software Piracy

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Software piracy has become a significant problem for businesses and educational institutions, and as computer crime continues to proliferate in our Information Age, its causes and roots merit academic inquiry. This exploratory piece establishes the correlative and contributory factors in software pirating, specifically concerning types of Internet access and past experience with the unlawful duplication of computer CD-ROMs. An independent samples *t* test and a bivariate correlation matrix were used to empirically evaluate relationships between variables. The results of this study suggest policy aimed at combating the onset and perpetuation of unethical and illegal computing activity among students.

Software piracy among specific study populations such as business and computer science students has been the subject of previous studies, but these inquiries have been primarily descriptive in nature. Consequently, prior research has failed to satisfactorily establish possible situational or historical causes of the crime. One possible situational influence may be the broadband connectivity granted to students who reside in a university residential setting. A historical factor may be previous experience with pirating software on physical media—such as the duplication of program CD-ROMs.

The primary goal of the current study is to determine whether software piracy in a university setting is correlated with the availability and inherent rapidity of a high-speed link to the Internet. The influence of this variable has not previously been addressed but is deserving of investigation as network pipelines and consequently online data transfer speeds are continually upgraded and augmented to meet the usage requirements of a growing popu-

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lation of wired individuals. Piracy through traditional means—through the use of CD recording devices—is also analyzed as related to Internet piracy. Following a determination of the extant level of this crime, competent policy initiatives can be constructed and developed to curb the amount of illegitimate software that is being transferred and distributed by students over the university's network pipelines.

This study makes several useful contributions to the areas of criminal justice and computer crime research. Previous exploration into this area has not applied a criminological perspective to guide and steer the investigation. As such, it extends the research of criminal justice into an area little studied and works to fill the void of inquiry into deviance resulting from technological advances (in this case, the Internet). Furthermore, the work strives to engender useful policy solutions that universities can implement to curb high-tech crime on campuses. Finally, a latent objective is to spark additional interest in, and the future research of, all aspects of this illegality.

THE HISTORICAL EVOLUTION OF SOFTWARE PIRACY

In previous studies, software piracy has been defined and operationalized to include the sharing and duplication of program floppy disks and the misappropriation of application licenses for networks (Cheng, Sims, & Teegen, 1997; Im & Van Epps, 1992; Rahim, Seyal, & Rahman, 1999; Reid, Thompson, & Logsdon, 1992; Simpson, Banerjee, & Simpson, 1994; Wong, Kong, & Ngai, 1990). In the past 5 years, however, additional forms of piracy have emerged as the media on which programs and games are primarily stored and sold has switched—from floppy disks, which are capable of holding 1.44 megabytes (MB) of information, to CD-ROMs, which typically hold 650-700 MB of data. These higher density discs allow for easier installations of complex and powerful applications and games, as well as more advanced computing in general. When CD-ROMs first arrived on the market, they were extremely costly to copy, and one needed specialized duplication hardware not easily accessible through retail channels. As the information technology (IT) industry boomed and the cost of personal computers dropped, however, CD-recording devices, or "burners" as they are informally called, have become available for as little as $100, making it quite simple for end users to duplicate commercially created CD-ROMs, as well as generate their own compilation CDs consisting of various application and game files. Other types of software piracy continuing in prevalence include the purchase of a single workstation license to use a program and subsequently installing it on multiple machines and the loading of new hard drives with unauthorized software by computer dealers (SPA Antipiracy Division's Copyright Protection Campaign, 1998).

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As the definition of software piracy has changed, so too has the means by which piracy regularly occurs. High-speed connections to the Internet are now available at affordable prices for universities, corporations, small businesses, and other entities through the leasing of dedicated fiber optic or copper lines from a local or in-house telecommunications company. Furthermore, cable modems and digital subscriber lines (DSL) are currently being marketed to home computer users, offering high-speed links to the Internet at reasonable prices. According to a recent study by the Stanford Institute for the Quantitative Study of Society, 55% of individuals in the United States have Internet access either at home or at work, and that percentage continues to increase ("Study of the Social Consequences of the Internet," 2000). A growing proportion of individuals are using these dedicated connections—from 5 million in 1999 to 12 million in 2000 equipped with cable modem, DSL, or ISDN (integrated services digital network—a less prevalent and slower dedicated link) lines at home (Kelsey, 2001).

Thus, technological advances such as the development of media with larger data storage capacity and a network infrastructure that allows for greater speeds in data transmission have redefined and broadened the preexisting conception of software piracy. They have ushered in a revolutionary paperless form of communication and file archival and a burgeoning of productivity for society as a whole but have also increased the frequency and prevalence of the unlawful distribution of software. Apart from this determinant, many individuals are being exposed to the seedier corners of the information superhighway, where pirates make "warez" (pirated software) available through easily navigated Web sites offering "point-and-click, one-stop-shopping to even the most novice of users" ("Internet Software Piracy," 1998). A final impetus for the proliferation of piracy stems from the essential mechanics of the act—the transfer and distribution of software from a remote to local computer without personal communication, negotiation, or transaction, and with practically zero risk of detection.

Some general statistics are useful in portraying the nature of the problem and in underscoring the necessity for research in this area. For instance, a survey commissioned by two antipiracy organizations found that losses from piracy were estimated to exceed $12 billion worldwide in 1999, with the United States and Canada comprising 26% of that total (Beruk, 2000). Furthermore, it is reported that piracy in the United States cost 109,000 jobs in 1998, $4.5 billion in wages, and nearly $991 million in tax revenue ("Colorado Governor Issues Executive Order," 2000). It is argued that loss to the industry also occurs as piracy removes or decreases the incentive to research, develop, and produce innovative software of a high quality as perpetrators are able to misappropriate the fruits of another's labor at no cost to themselves.

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Concerning the study population, the university setting has been considered by many to be a breeding ground for software piracy, perhaps because of the necessity to use computers (Cheng et al., 1997; Eining & Christensen, 1991; Im & Van Epps, 1991). Recently, the exponential growth of the Internet has become an essential fixture in the lives of so many individuals, further increasing the potential for pirating. In addition, the student body is arguably more curious and prone to engage in questionable behavior—such as cheating and plagiarism (Agnew & Peters, 1986; Buckley, Wiese, & Harvey, 1998; Crown & Spiller, 1998)—compared to those in lower education or in the "working world." This particular group is targeted for analysis and subsequent policy development because it is important to speak to this penchant for dubious activities before students exit the sheltered collegiate environment. If a clear cognition of standards of ethical and lawful computing behavior is effectuated now, it is presumed that persons will be less likely to transgress following graduation and entrance into the professional arena.

PRESENT STUDY

In the current work, the first hypothesis is that high-speed online access in a university setting is positively correlated to Internet software piracy. This assumption is made because broadband connections greatly increase the delivery of data to and from one's computer. In addition, their dedicated presence allows for continual operability any hour of the day. Having a fast online link in the privacy of one's house, apartment, or dormitory room—coupled with the necessity of software use for research, papers, correspondence, projects for coursework, or other purposes—lends itself to a significant increase in computer and Internet usage. This increase consequently results in the amplified likelihood of encountering the occurrence of illegal activity on the Internet (such as software piracy) and the chance that an individual will become socialized or somewhat conditioned to condone and ultimately participate in this behavior. This conjecture will be validated or rejected through an independent samples *t* test and a bivariate correlation matrix to determine if those with high-speed connections pirate more than those who do not have such capabilities. The independent variable is whether the respondent used Ethernet (high-bandwidth local-area network), cable modem, or DSL connectivity to access the Internet.

The second hypothesis is that Internet piracy is significantly correlated with past CD-ROM piracy, and the interrelationship of these variables will be ascertained through the aforementioned matrix. Some reasons for this supposition are as follows. Those with previous experience with pirated software

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will be familiar with the attendant rewards. They may be likely to displace such a practice to the networked environment to increase the variety of programs and interested participants available to them. Furthermore, the duplication of software is made easier by removing the need for physical media such as CD-ROMs when entire games and applications can be transferred for use to one's computer in a simple and efficient manner. At the time of this writing, no previous research has addressed the validity of these relationships, despite their ostensible effect on the phenomenon.

DATA AND METHODS

A sampling frame was first constructed by selecting random disciplines in each of the colleges of a large Midwestern university. Then, classes were selected with the intent of obtaining a sample representative of the entire student body—freshmen, sophomores, juniors, and seniors. This was accomplished by purposively choosing courses of different levels (100, 200, 300, 400, etc.). The professors of 70 classes were initially contacted; however, only 30 responded positively and accommodated the request to survey their students. The classes were decidedly varied, ranging from Introduction to Political Science to College Algebra and from Money, Banking, and Financial Markets to Basic Biochemistry.

An anonymous and voluntary questionnaire, developed to specifically measure software pirating attitudes and beliefs, was designed to gather the data required to analyze the relationships in this study. Software piracy is a controversial topic, and self-reporting instruments usually produce an underreporting of such deviant activities. Accordingly, questions were asked in as neutral a manner as possible to facilitate open, candid communication from the participants, as well as to avoid the predisposition of responses and any subsequent bias. Surveys were conducted in 25 classes between May and June 2000—the summer semester of the school year. A sample size of 507 was derived prior to data cleaning, resulting from an average of 20 students in each class. On listwise removal of cases with missing variables, the final sample size totaled 433 cases.

As evidenced by Table 1, the majority of respondents in the sample were White (71.8%), female (53.5%), 21 years of age or older (70.6%), and either majoring in business (23.5%) or a discipline of the social sciences (34.3%). Annual income of the parents of respondents was expressed to be $50,000 or more by 69.8% of respondents. Despite the reasonably comfortable economic status of most families, though, three fourths (74%) of the students who participated in the study worked at least 10 hours a week.

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TABLE 1
Demographics of Sample of Midwestern College Students Regarding Measure of Software Pirating Attitudes and Beliefs (N = 507)

Demographic Variable	*Percentage*
Gender	
Male	46.5
Female	53.5
Race	
White	71.8
Asian	10.3
Other	17.9
Age	
17 to 20	28.5
21 and older	71.5
Educational level	
Freshman	1.8
Sophomore	4.7
Junior	30.6
Senior	59.8
Graduate	3.2
Discipline	
Social science	34.3
Business	23.5
Other	42.2
Parental annual income	
$0 to $19,999	4.6
$20,000 to $29,999	4.2
$30,000 to $39,999	7.3
$40,000 to $49,999	14.1
$50,000 or more	69.8
Employment (hours per week)	
40	14.4
30	17.4
20	28.8
10	13.4
0	26.0

Outcome Measure

The primary dependent variable in this study, "Overall Online Pirating Behavior," was a factor composed of five individual survey items (see Table 2). Varimax rotation was originally conducted on the following seven survey items:

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TABLE 2
Varimax Rotated Factor Pattern for Primary Dependent Variable of Sample of Midwestern College Students Regarding Measure of Software Pirating Attitudes and Beliefs (Loadings ≥ 0.65)

Construct and Item	*Factor Loading*
Overall online pirating behavior	
How frequently do you upload/download pirated software to/from others (on average)?	.674
Number of mediums used to pirate software	.784
Degree of Hardcore Pirate	.778
How often in the past month have you pirated software?	.740
How often in the past year have you pirated software?	.806

NOTE: Eigenvalue = 2.873, reliability coefficient = .76.

1. How frequently do you upload/download pirated software to/from others (on average)?
2. Number of mediums used to pirate software.
3. Degree of Hardcore Pirate.
4. How often in the last month have you pirated software?
5. How often in the last year have you pirated software?
6. The majority (50%) of software on my computer is legitimately licensed.
7. At least one piece of software on my computer is not legitimately licensed.

The response options for the first item ranged from 0 to 31 or more times per week. Concerning the second item, mediums for transferring software included a Web browser, to/from the Usenet newsgroups, using an instant messaging program, using a chat program, logging into a file server to upload/download to/from others, and setting up a file server to allow others to do the same. An additive score ranging from 0 to 8 was created for "Degree of Hardcore Pirate," which measured how deeply an individual was immersed in the pirating scene. This third item consisted of the following questions: "I know what warez is"; "I know what a .nfo file is"; "I know what 0-day means"; "I have set up a FTP server on my computer system to allow others to log in and upload/download pirated software to/from me"; "the majority of my file transferring takes place at night (11 p.m. to 7 a.m.)"; "I leave my computer on for extended periods of time (i.e., overnight) to transfer files"; "I have a personal account on one or more FTP sites"; and "I can find almost any piece of commercial software I might need on the Internet, either through friends or searching/browsing through file archives." The fourth and fifth items of the dependent construct both had answer values ranging from 0 to 36 or more times. Finally, the sixth and seventh items, subsequently removed because they did not load high on one factor, had possible responses of "true"

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or "false." Cronbach's alpha for the five remaining items was .76, indicating moderate to high reliability (Carmines & Zeller, 1979). In the independent samples *t* test, the original seven survey items, the constructed measure of "Overall Online Pirating Behavior," and a ninth dependent variable—"I have transferred at least one piece of pirated software to/from someone" (with possible values of "true" or "false")—were included.

Independent Measures

A predictor variable measuring whether the respondent was equipped with broadband connectivity was "I use Ethernet, cable modem, or DSL connectivity in my dorm room, apartment, or house" ("true" or "false"). In the first analysis, those who answered affirmatively for this item were placed in the "High-Speed" group, and those who responded negatively were placed in the "Dialup" group. Variables measuring opportunity and access, previous piracy with CD-ROM duplication, and Internet pirating behavior were included in the second model to ascertain any correlative effects of one on another. Specifically, these items were as follows: "I use Ethernet, cable modem, or DSL connectivity in my dorm room, apartment, or house"; "I have bought/received/borrowed a copy of at least one software package on CDR" (recordable CD-ROMs); "I have burned/recorded at least one software package onto CDR"; "I have transferred at least one piece of pirated software to/from someone"; "The majority (50%-plus) of software on my computer is legitimately licensed"; "At least one program/game on my computer is not legitimately licensed"; and "Overall Online Pirating Behavior."

RESULTS

First, an independent samples *t* test was used to determine if the pirating activity of students who had high-speed Internet access differed from those who did not. Results are provided in Table 3. The sample means are higher for every piracy variable among those who have high-speed Internet access, indicating that respondents, so equipped, pirate software with greater incidence and frequency than those who are not. Assuming unequal variances, the *t* statistic for "At least one program/game on my computer is not legitimately licensed," "How frequently do you pirate per week," "Degree of Hardcore Pirate," "I have transferred at least one piece of pirated software to/from someone," "Number of mediums used to pirate software," and "Overall Online Pirating Behavior" all were significant at the .05 level. Thus, the findings show support for the hypothesis that broadband connectivity increases the likelihood of online software piracy.

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TABLE 3

Independent Samples T Test: Dialup (D/U) Versus High-Speed (H/S) Internet Access and Piracy Variables of Sample of Midwestern College Students Regarding Measure of Software Pirating Attitudes and Beliefs

	Mean			
Dependent Variable	*D/U*	*H/S*	*Mean Difference*	t
How often in the past month have you pirated software?	1.14	1.20	–.06	–.95
How often in the past year have you pirated software?	1.25	1.43	–.18	–1.94
The majority (50%) of software on my computer is legitimately licensed.	.70	.77	–.07	–1.76
At least one program/game on my computer is not legitimately licensed.	.41	.51	–.10	–2.03*
How frequently do you pirate per week?	1.37	1.59	–.22	–3.39**
Degree of hardcore pirate	1.15	1.76	–.61	–3.26**
I have transferred at least one piece of pirated software to/from someone.	.28	.46	–.18	–3.79**
Number of mediums used to pirate software	.78	1.39	.61	–4.01**
Overall online pirating behavior	–.14	.24	.10	–3.48**

* correlation is significant at the 0.05 level (two-tailed). ** correlation is significant at the 0.01 level (two-tailed).

A correlation matrix was next created with the predictor and outcome variables to discover which items were related and how strong of a relationship existed between those items. Use of broadband Internet access was included in the model and compared to the variables that measured piracy. As depicted in the matrix, high-speed connectivity was significantly related at the .01 level to illegally transferring at least one piece of pirated software and with the measure of "Overall Online Pirating Behavior." This provides evidence that Ethernet, cable modem, or DSL Internet users are more likely to have participated in piracy, perhaps because of the easy accessibility and rapidity of a dedicated file-transferring pipeline. Moreover, the finding lends additional support to the aforementioned *t*-test analysis.

As evidenced by Table 4, "I have burned/recorded at least one software package onto CDR"—a measure of traditional pirating activity—is significantly correlated to overall Internet piracy ($r = .38$). The coefficient of determination for that predictor is $(.38)^2$, or .14. As a proportionate reduction of error statistic, it can be concluded that 14% of the variation in overall Internet piracy can be explained by, or attributed to, previous experience with the creation of pirated CD-ROMs. Unarguably, these correlations remain relatively weak, perhaps because of the amount of variation that must be explained. In

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TABLE 4
Bivariate Correlation Matrix for High-speed Access and CD-ROM Piracy of Sample of Midwestern College Students Regarding Measure of Software Pirating Attitudes and Beliefs

	1	*2*	*3*	*4*	*5*	*6*	*7*
Opportunity variable							
1. I use high-speed Internet access.	1.00	.11*	.17**	.18**	.08	.10*	.18**
Past piracy through physical media (duplicated CD-ROMs) variables							
2. I have bought/received/borrowed a copy of at least one software package on CDR.		1.00	.44**	.38**	.06	.30**	.22**
3. I have burned/recorded at least one software package onto CDR.			1.00	.40	.03	.21	.38
Internet piracy variables							
4. I have transferred at least one piece of pirated software to/from someone.				1.00	.07	.31**	.49**
5. The majority (50%-plus) of software on my computer is legitimately licensed.					1.00	.18**	–.10*
6. At least one program/game on my computer is not legitimately licensed.						1.00	.25**
7. Overall online pirating behavior							1.00

* correlation is significant at the 0.05 level (two-tailed). ** correlation is significant at the 0.01 level (two-tailed).

fact, the trend throughout the bivariate correlation results is that in general, the independent and dependent variables are significantly related to each other; however, not much differentiation can be made.

LIMITATIONS

A few methodological issues merit attention. For one, although anonymity and confidentiality were guaranteed to research subjects, the veracity of the feedback received could not be ensured—an inherent negative characteristic of self-report studies. Nonrespondent bias may have occurred in that those who did respond might have been less likely to misapropriate software than those who did not respond (Seale, Polakowski, & Schneider, 1998). In addition, several variables (e.g., race, age, and year of studies) were highly skewed. The vast majority of the sample was White, of junior or senior class status, 21 years of age or older, and had parents who made more than $50,000

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annually. Although the disproportionate distribution of race and parental income in the sample mirrors the overall student population at this university, age and year of studies might have been more varied had the research occurred during the fall or spring semester of a school year. Fortunately, these logistic problems can be corrected quite easily in a future wave of study. A final note—this particular crime has been predominantly studied among college-aged individuals in a university setting. As such, additional research examining other populations might retrieve different results and would provide interesting material for comparative analyses.

POLICY IMPLICATIONS

This empirical examination substantiated the two previously specified hypotheses concerning the influence of high-speed online access and CD-ROM piracy participation on software theft over the Internet. These results suggest policy recommendations that could ultimately aid in reducing, if not eliminating, the illegal duplication of software applications and games by university students. How can students be reminded of the illegal nature of many computer crimes they might be inclined to commit? Perhaps a proviso in text can be called up on their computer screens the first time they register to use the dedicated Internet access in their residential halls. This would delineate the honorable behavior required while using the school's resources and access to the Internet and remind users of the negative sanctions that will result from illegal behavior. A small, automatically executable file can even be written and installed on every user's computer displaying a similar warning message at log-on concerning proper computer usage. Periodic mass e-mails sent to the student body may help to remind individuals that unethical and unlawful actions online will not be tolerated.

Another idea would be to require the personal signature of all potential users of the university network and bandwidth—perhaps incorporated into the university application for enrollment form—to officially indicate an agreement to abide by virtuous computing standards. These strategies should reduce, to some degree, the erosion of accountability for unethical computing practices. The Software & Information Industry Association (SIIA) provides a sample policy statement for organizations to use and recommends that all users (faculty, staff, students) read and sign such a document to indicate agreement to adhere to the rules in place (Sample Corporate Policy Statement, 1999).

Solomon and O'Brien (1990) found that nearly half of the students they surveyed had never heard a faculty member or administrator speak out against software piracy and that 25% had heard university personnel condone the unauthorized duplication of a program. Although the generalizability of

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these findings is as yet unproven, certainly faculty members have the ability to influence, consciously or unconsciously, the moral practices of their students to some degree. Perhaps it is necessary to require instructors and professors in all courses in which the use of a computer is expected to include in their syllabus a warning against the use of illegal software, as many have found it necessary to provide a similar warning against plagiarism. At the very least, professors of certain majors in which the use of computing resources is extremely high (engineering, computer science, graphics design, journalism) should emphasize the importance of complying with the school's directives in this area. What punitive measures can be instituted to discipline transgressors and dissuade others from the same deviant path? As mentioned earlier, perhaps those who transgress codes of ethics in a university setting should be denied future use of Internet access on campus for a specified period of time. Although this would be difficult to monitor and enforce, the presence of such a sanction might deter potential offenders.

DISCUSSION

Advancements in information technology have allowed for improvements in the speed of communications, the accessibility of information and data files, and the increase in overall computing power to run processes previously unfeasible. Such technological progress has also opened the door to a multitude of antisocial behaviors. Specifically, the file-sharing capabilities of the Internet, attendant with high-speed access provided to university students, have greatly augmented the prevalence of the unauthorized distribution and downloading of copyrighted programs from various Web and archive sites. The current work has empirically identified two important contributive factors to piracy and suggests policy that university personnel can implement. It also provides further evidence of how proactive steps must be taken to curtail high-tech crime and serves as a basis for future study of the phenomenon.

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