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Abstract

There is, perhaps, no more visible financial dilemma in the software industry today than that of software piracy. In this paper, we detail the development and empirical validation of a predictive model of software piracy behavior by computer-using professionals. The model was developed from the results of prior research in software piracy and the reference disciplines of the theory of planned behavior, expected utility theory and deterrence theory. The study utilized two methods to analyze the piracy decision. A survey was used to test the entire model and an experiment was undertaken to test several relationships between the included variables. The results indicate that the identified factors have a significant impact on the decision to pirate software and that the model is a useful tool in further understanding this behavior. The results add to a growing stream of MIS research into piracy behavior and have significant implications for organizations and industry groups aiming to reduce piracy behavior.

1. INTRODUCTION

Although legislation and enforcement mechanisms have been developed, software industry estimates indicate that the practice of software piracy is widespread and costs software manufacturers billions of dollars annually (Business Software Alliance 1994; Greenberger 1996). Reducing the problem of piracy is a goal of several industry groups and developing a valid model of piracy behavior is an important step in achieving this goal (Sims, Cheng and Teegen 1996). This study continues a recent stream of MIS research aimed at developing such a model.

2. THEORETICAL DEVELOPMENT

Much of the initial research into software piracy consisted of surveys measuring the attitudes and practices of students and professionals. Shim and Taylor surveyed both business faculty and managers in a pair of studies in 1988 and 1989. It was found that 90% of business faculty believed that their colleagues copied software illegally and over 50% of managers indicated that they had committed software piracy. The surveys also found that younger managers were more prone to practice software piracy than their older counterparts. This is a trend that runs throughout the literature and indicates that the practice may increase in frequency as these managers replace the older generation. Oz (1990), Paradice (1990), Solomon and O'Brien (1990) and Kievit (1991) all found similar results when studying student populations. Oz reached the disturbing conclusion that "young professionals have no scruples about copying software illegally" (1990, p.26). Paradice concluded that it was especially important for MIS managers to make their new employees specifically aware of the departments' ethical corporate policies. In more recent work, Sims, Cheng and Teegen found that males pirated software more frequently than females and younger students were more likely to pirate software than older students.

Perhaps the most comprehensive work toward developing a complete model of software piracy behavior has been done by Anne Christensen and Martha Eining (Eining and Christensen 1991; Christensen and Eining 1991, 1993). Their most recent model utilizes the theory of reasoned action, deterrence theory and equity theory to develop the model presented in Figure 1. The model was tested empirically, explained 36% of the variance in piracy behavior, and found that positive piracy attitudes are indicative of a propensity to copy software illegally. Also, those piracy attitudes are predicted by an individual's perceptions of authority figures' approval or disapproval of software piracy. Software prices were not found to be related to piracy attitudes, but individuals with positive attitudes toward computers were found to be more likely to have a positive attitude toward piracy (Christensen and Eining 1993). The initial model posited that the perception of peer norms would influence the individual's piracy attitudes. However, empirical evidence supported an assertion in the opposite direction, as indicated in Figure 1; the individual's attitude toward software piracy affected his or her perception of the peer group's norms. This result has been directly contradicted by the research of Watson and Pitt (1993) who studied possible determinants of behavior toward ethical issues in personal computing. Watson and Pitt found that the perception of management's beliefs influenced peers' behaviors which, in turn, influenced the behavior of the individual.

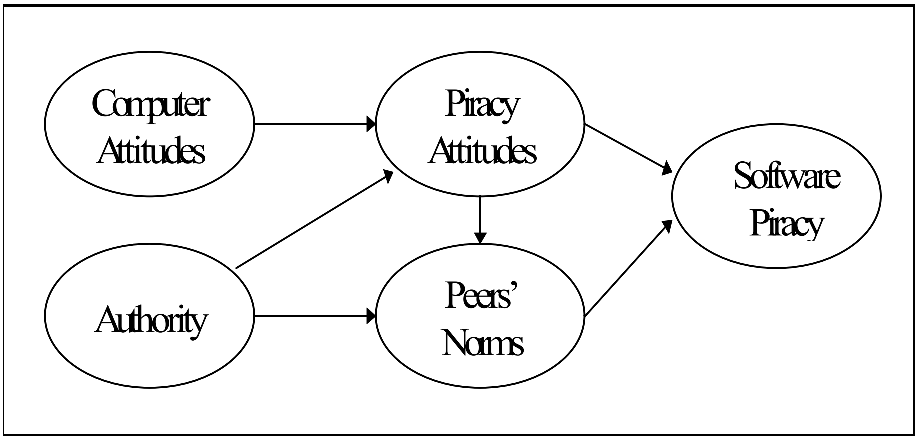

Figure 1. Software Piracy Model (Christensen and Eining 1993)

Gopal and Sanders (1992) theorized that deterrent measures could be used to increase software manufacturer profits by dissuading individuals from pirating software, and found empirical evidence to support their theory. They also determined that preventive measures such as anti-copying devices actually reduced profits.

2.1 The Theory of Planned Behavior

A stream of research in social psychology suggests that a person's behavioral intention toward a specific behavior is a factor in whether or not that individual will carry out that behavior (Fishbein and Ajzen 1975; Ajzen and Fishbein 1977). Behavioral intention is, in turn, predicted by the individual's attitude toward the behavior and subjective norms. This is referred to as the theory of reasoned action (TRA). Much support has been found for the predictive ability of this theory (Sheppard, Hartwick and Warshaw 1988). The theory of planned behavior (TPB) was developed when the factor of perceived behavioral control (PBC) was added to TRA (Ajzen 1991). TPB posits that behavior is determined by the intention to perform the behavior, which is predicted by three factors: attitude toward the behavior, subjective norms, and PBC (Ajzen 1991; Beck and Ajzen 1991). PBC refers to the perception of the subject as to his or her ability and opportunity to commit the behavior. PBC is also theorized to have a direct effect on actual behavior.

Much research has been done to validate TPB empirically. Ajzen, alone, lists sixteen studies utilizing the construct, almost all of which found significant supportive evidence. While the original model of TPB posited interaction effects between the factors, research has only revealed the existence of main effects (Beck and Ajzen 1991).

The relative importance of attitude, subjective norms, and PBC can be expected to vary across situations (Ajzen 1991; Beck and Ajzen 1991). Consequently, it is useful to examine each specific behavior (such as software piracy) and the significance of each factor in predicting the behavior. For example, PBC was found to be a leading factor in the decision to cheat on an exam and shoplift (Beck and Ajzen 1991), whereas attitude was found to be more important in the decision to lose weight (Schifter and Ajzen 1985) and in the decision to use information technology (Taylor and Todd 1995). While attitude has been shown to be a factor in piracy behavior (Christensen and Eining 1993), the role of PBC has yet to be studied.

2.2 Expected Utility Theory

Economic issues such as costs and benefits are also commonly claimed to be factors in a person's decision-making process. For example, availability of financial resources has been cited as a reason for software piracy behavior (e.g. Solomon and O'Brien 1990). Expected utility theory (EUT) posits that, when faced with choices among risky prospects with outcome vectors x_i and with associated probabilities p_i such that $\sum p_i=1$, then a rational, self-interested individual will attempt to maximize $\sum F(p_i)U(x_i)$, where $F(p_i)$ is some function of the probability and $U(x_i)$ is the utility function of the possible outcomes. While different variants of this model exist, the underlying idea is that the individual will choose the course of action that maximizes his or her expected utility (Schoemaker 1982).

Computer-using professionals have three possible courses of action when faced with a situation in which software can be used: purchase the software, do without the software, or pirate the software. It is possible to describe these choices in terms of EUT. In order to do so, it is necessary to determine the costs and benefits involved.

It is assumed in this work that a benefit is gained from the use of software (i.e., a reduction in the amount of effort needed to complete the task at hand). Consequently, a rational, self-interested computer-user will always either purchase the software in question or pirate it.

A purchase cost is involved if the software is legally obtained. It is assumed in this study that the purchase cost is less than the benefit gained from the use of the software. The expected utility of purchasing the software is the expected benefit gained from the use of the software, less the expected cost of the software.

In the case of software piracy, costs result not from purchasing the software but from the punishment level and the probability that the punishment will be incurred. The expected utility of pirating is the expected benefit gained from pirating (the purchase cost) less the expected cost (calculated using the punishment probability and punishment level). The individual will pirate the software when the expected utility of pirating is greater than the expected utility of not pirating.

2.3 Deterrence Theory

The discussion of expected costs with respect to punishment levels and probability of punishment is closely linked to deterrence theory. Ehrlich (1973), for example, found that the rate of some felonies is positively related to estimated gains and negatively related to expected costs. The study also found that crime rates are related to income inequality. Straub (1990) found that deterrent measures are a useful primary strategy for reducing computer abuse. These findings have a direct bearing on the software piracy discussion.

The punishment probability factor and the punishment level factor described above are referred to in the deterrence theory literature as punishment certainty and punishment severity, respectively (e.g., Tittle 1980). As with EUT, deterrence theory proposes that, as these factors are increased, the level of illegal behavior should decrease. Ehrlich directly related this theory to economic factors and found that many crimes against property are related to the expected gains of the crime versus the expected costs at the margin, much as is proposed in the previous section.

Not only does deterrence theory relate to the punishment level and probability in the software piracy scenario, but also to the cost. Ehrlich's work indicates that a strong correlation exists between income inequality and crimes against property. This may be due to the fact that those with less income perceive more potential gain from illegally obtaining property than those for whom the cost of obtaining the property legally is relatively lower. In the case of software, the lower the cost of the software package, the less the gain if it is pirated.

A factor not taken into account by TPB or EUT but that may be relevant in cases of dishonest activity is that of moral obligation (Beck and Ajzen 1991). Developed from deterrence theory, moral obligation posits that people have personal feelings of a moral nature that influence their actions. These feelings of guilt are a form of control over a person's actions and inhibit unethical behavior (Grasmick and Scott 1982). The guilty feelings are a self-imposed punishment, inflicted when the behavior of actors contradicts their moral commitment (Grasmick and Scott 1982).

2.4 The Predictive Model

Each of the theories discussed above provides valuable insight into the process behind the piracy behavior of the individual and the factors involved. Using TPB as a framework, this paper integrates these factors into a comprehensive predictive model of piracy behavior. TPB posits that belief outcomes feed into the predicting factors. In the case of *attitude*, Ajzen posits that behavioral beliefs lead to attitude toward a behavior. These beliefs link the behavior to a certain outcome. The more positive the outcome, as perceived by the individual, the more positive the individual's attitude toward that behavior. In the case of piracy, EUT and deterrence theory can be used to identify factors that affect the possible outcomes of the behavior of piracy. The probability of punishment (*punishment certainty*), the level of punishment (*punishment severity*), and the cost of the software (*s/w cost*) are all variables that directly relate to the expected outcome. Therefore, it is posited that each of these factors affects the attitude of the individual toward piracy behavior (*attitude*). The *moral obligation* factor is also associated with the costs and benefits of committing the action. As previously stated, guilt is a form of self-inflicted punishment incurred when an individual commits an action that he or she perceives as going against his or her moral obligations. Therefore, the model incorporates the factor of *moral obligation* as a predictor of *attitude*.

Christensen and Eining (1993) posited that *attitude toward computers* would have an inverse effect on the individual's attitude toward piracy (due to the respect that the individual would have for the work that goes into computer programming). However, those authors found the exact opposite result. Individuals with positive attitudes toward computers were found to have positive attitudes toward piracy. Due to this finding, *attitude toward computers* is included in the model as a predictor of *attitude*. However, it should be noted that this factor was not included in the final statistical analysis due to validity problems (detailed below) with the measuring instrument.

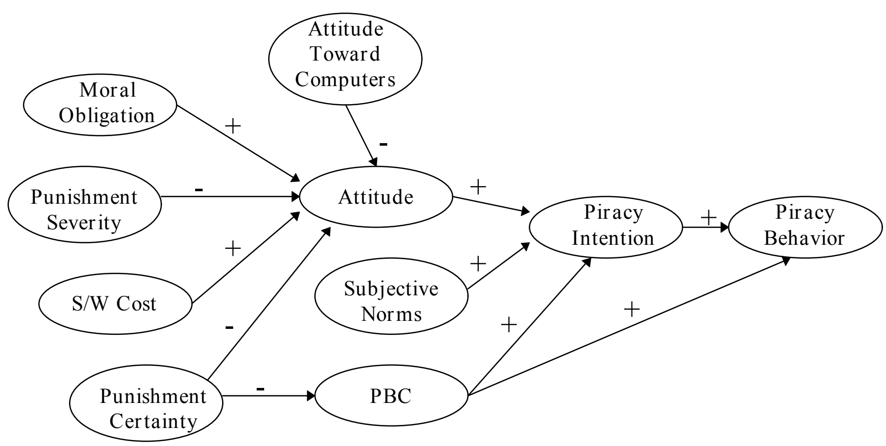

Figure 2. Predictive Model of Piracy Behavior

PBC is determined by control beliefs (Ajzen 1991). These control beliefs relate to the individual's perceptions of the resources and opportunities necessary to commit the act. In the case of piracy, a limiting factor on the ability to commit piracy successfully is the probability of detection. It is assumed that detection of the piracy will lead to the piracy action being halted. Therefore, perception of probability of detection (*punishment certainty*) is predicted to be a control belief affecting the individual's *PBC*.

3. RESEARCH METHOD

To enhance the validity of the results, the model and the relationships between the factors involved were tested using two methods: a survey and a quasi-experiment.

3.1 Questionnaire Development

The questionnaire was an important data gathering instrument in both the survey and the experiment. No previously tested questionnaire was available for gathering information on *attitude*, *subjective norms*, *PBC*, *moral obligation* and *piracy intention*. However, surveys have been carried out with the aim of gaining measures of some of these factors regarding similar dishonest behaviors. Beck and Ajzen utilized questionnaires to test the applicability of using TPB in predicting subjects' dishonest behavior in the areas of cheating on exams, lying and shoplifting. Using this instrument as a base, a similar set of questions was developed for this study. In each case, the original questions were adapted by replacing the dishonest behavior identified in the existing question with the term "software piracy."

The Attitudes Toward Computer Usage Scale (ATCUS) questionnaire (Popovich et al. 1987) was also used. This instrument utilizes twenty questions to measure a person's *attitude toward computers*. The scale, proving to be valid and useful in previous work (Brown, Brown and Baack 1988), has been employed several times successfully (Barrier and Margavio 1993). However, validity problems were found in the present study, leading to the exclusion of the ATCUS results from analysis.

No previously existing set of questions could be identified to measure the subject's perception of the *punishment certainty* for committing software piracy, *punishment severity* or *software cost*. Therefore, questions were developed to measure these factors. The questions did not ask the respondent to give specific figures for these items but, instead, attempted to gauge whether the subject felt the items were high or low. Specific figures are not important in this study, as one number may be perceived as high by one individual and/or low by another.

Two questions were developed to measure the subject's actual piracy behavior. One question asked the respondent to self report the number of times per year (on average) the subject committed software piracy, while a second question asked the respondent to report the frequency of past piracy behavior (e.g., once per week, once per month, once per year). Each question utilized a five point Likert scale. In the final study, the answers to these questions were very highly correlated ($r=.80$, $p <.0005$). A measure of *piracy behavior* for the individual was found by taking the mean of these two items.

The questionnaire was extensively tested for validity. While the use of previously developed constructs and questionnaire items aids in creating a valid instrument, it does not, in itself, ensure validity (Straub 1989). As suggested by Cronbach (1971), an iterative review process was undertaken to maximize content validity. The questionnaire was also pilot tested using 38 subjects, resulting in minor changes.

Using the data gathered in the study, discriminant validity was tested by studying each item's correlation with other items in its factor and comparing these to correlations with items from other factors. A violation was considered to have occurred when a correlation with an item in another factor was higher than a correlation with an item in the factor. The results were acceptable for all factors with the exception of the ATCUS items, which had a violation rate of over 30%. In all factors, inter-item correlations were significant and large, indicating high convergent validity. However, the ATCUS items demonstrated only sporadic inter-item correlations of a high and significant nature. Internal consistency was tested using Cronbach's alpha. The calculated alphas were all above the generally accepted level of .8 with two exceptions: *attitude toward computers* (.70) and *PBC* (.73).

Due to the validity problems found with the ATCUS questionnaire, this factor was removed from the model for the purposes of statistical analysis.

3.2 The Experiment

A modified lab market was used in the experiment. Subjects were randomly assigned to sessions from a sample of part-time graduate students at three universities in a U.S. metropolitan area. Almost all of these individuals held full-time jobs that involved the use of computers. In each session, six subjects were asked to role-play as computer-using professionals in organizations that produced "widgets." The sessions were divided into twenty time periods. In each time period, the subject's organization produced one widget that was to be sold on the open market. The subject was allowed to set the price for his or her widget at any level he or she desired. However, only the five lowest-priced widgets were sold. The organization unable to sell its widget in that time period lost the widget and the cost of producing it. The five organizations that sold their widgets had the income (the sale price) added to their running balance. In effect, a quasi-widget market was created in which the experimental controller purchased widgets produced by the subjects. To reduce timing strategies, the subjects were not made aware of the actual number of time periods in the session.

To produce the widget, the subjects were given the option to purchase software in that time period, to not use any software, or to pirate the software. Purchasing the software involved a cost (the *software cost*). Pirating the software involved no cost, but did involve the probability of detection and the assessment of a financial fine if the piracy was caught. The subjects were made aware of both the *punishment certainty* and the *punishment severity*. In all cases involving the software, there was a benefit gained from the use of the software: the cost for producing the widget was reduced due to the increased productivity gained.

A running balance was kept for each subject. In each time period, the subject was charged a set amount for producing the widget. If the subject sold the widget, that income was added to his or her balance. If the subject purchased the software, the production costs were reduced by a set amount and the subject was charged for the software. The software cost was always less than the benefit gained. If the subject pirated the software, there was no software cost incurred, but the benefit from software usage reduced the cost of producing the widget.

At the end of the time period, a random number generator was used to determine if any subjects were audited by the authorities. If a subject was audited and had pirated the software, a financial fine was incurred and subtracted from the subject's running balance. At the end of the session, the subject with the highest total was financially rewarded, as were those subjects who finished with a profit.

By manipulating the variables (*s/w cost*, *punishment severity*, and *punishment certainty*) and monitoring the decision to pirate or not pirate, it was possible to test several of the relationships predicted by the model. Each variable was tested at two levels, making it necessary to create eight (2x2x2) experimental treatments to ensure that all combinations were tested. The values utilized in the experiment are shown in Table 1. These values were carefully chosen to ensure that perfectly rational behavior

Table 1. Experiment Variable Values

Variable	Value 1	Value 2
S/W Cost	\$10	\$30
Punishment Certainty	5%	50%
Punishment Severity	\$50	\$250

Variable	Value
Cost to Make One Widget	\$100
Reduction in Cost From Software Usage	\$40

would predict that software piracy would occur in four of the scenarios and purchasing would occur in the other four. It is important to note that the questionnaire used in the survey was also used in the experiment to gather data on the other relevant variables. The questionnaire was administered after the subjects had completed the experiment.

The experiment was run in a computer lab using software written by the first author. Using the designed interface, each subject entered the decisions (i.e. purchase software, pirate software, set widget price, etc.) at his or her own terminal. The software recorded the subjects' choices in each session. A central computer was used to display the running balance for each subject, visible to all subjects on a projection screen. The software also randomly selected subjects for audit in each time period (using the prespecified punishment probability for the session) and assessed fines automatically when pirates were caught. Audit and punishment data were displayed on the selected subjects' terminals when they were audited.

4. SURVEY RESULTS

sample was taken from a population of part-time students taking evening classes in the MBA program of a mid-Atlantic U.S. university. The survey was anonymous and confidential (although the subjects were informed that group totals may be released). Of the 264 questionnaires distributed, 203 usable surveys were returned, yielding a usable response rate of 76.9%. For the questions involving actual piracy behavior, it was necessary to eliminate those individuals who had never had the opportunity to commit piracy. The subjects were asked to self-report whether or not they had ever had the opportunity to commit piracy. Those that claimed to have never had the opportunity were not included in any analysis involving *piracy behavior*. A total of 174 (65.9% of the total) usable questionnaires were returned from individuals claiming to have had the opportunity to copy software illegally.

Table 2. Survey Data Correlation Analyses

First Variable	Second Variable	r	r^2	N
Moral Obligation	*Attitude*	.7995*	.6392	203
Punishment Severity	*Attitude*	-.2907*	.0845	203
S/W Cost	*Attitude*	.2274*	.0517	203
Punishment Certainty	*Attitude*	-.3675*	.1351	203
Punishment Certainty	*PBC*	-.6407*	.4105	203
Attitude	*Piracy Intention*	.8029*	.6446	203
Subjective Norms	*Piracy Intention*	.6829*	.4664	203
PBC	*Piracy Intention*	.7113*	.5059	203
PBC	*Piracy Behavior*	.5997*	.3596	174
Piracy Intention	*Piracy Behavior*	.5850*	.3422	174

* p<.001

As an initial test, correlation analyses were undertaken for each of the pairs of variables connected in the research model (see Table 2). In all cases, the correlation coefficients were significant at the p<.001 level. Most of the calculated correlation coefficients were relatively large, indicating a strong relationship between the variables. The direction of all relationships was as expected.

The model was also tested using LISREL® 7 (SPSS 1993). The fit statistics indicate a good fit to the data ($\chi^2 = 573.6$, p<.0005; AGFI=.754; RMSR=.103). The model explained 86.7% of the variance in *attitude*, 78.6% of the variance in *PBC*, 84% of the variance in *piracy intention*, and 62.3% of the variance in *piracy behavior*. Table 3 summarizes the statistics. Figure 3 provides the calculated path coefficients for the model.

5. EXPERIMENT RESULTS

Subjects for the experiment were obtained from a sample of part-time graduate students. Almost all of the subjects worked full-time as computer-using professionals.

In each session, 120 (6 x 20) decisions to pirate or not pirate were made. Table 4 lists the number of pro-piracy decisions (out of 120) made in each treatment. In all, 298 (31% of total) decisions to pirate and 662 (69% of total) decisions to not pirate were made.

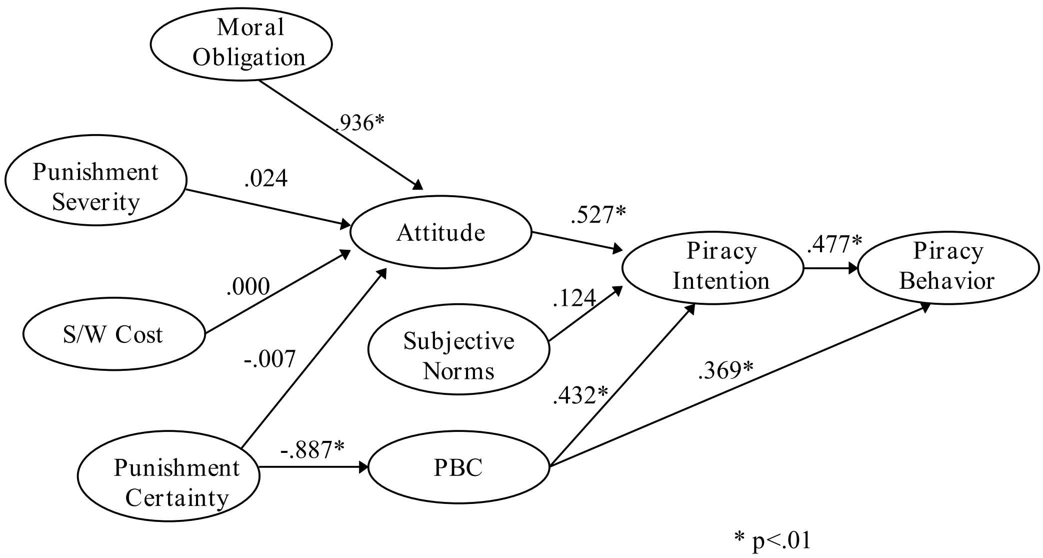

Figure 3. Path Coefficients For Piracy Behavior Model (Survey Data)

Table 3. Fit Statistics for Piracy Model

degrees of freedom	304
χ^2	573.6
goodness of fit	.802
adjusted goodness of fit	.754
root mean square residual	.103
attitude r^2	.867
PBC r^2	.786
piracy intention r^2	.840
piracy behavior r^2	.623

Table 4. Frequency of Decisions to Pirate in Each Scenario

Software Cost = $10

Punishment Certainty	Punishment Severity $50	Punishment Severity $250
.05	38 (31.7%)	26 (21.7%)
.50	39 (32.5%)	13 (10.8%)

Software Cost = $30

Punishment Certainty	Punishment Severity $50	Punishment Severity $250
.05	77 (64.2%)	39 (32.5%)
.50	58 (48.3%)	8 (6.7%)

Data were collected for each decision made in the experiment (i.e., the decision to pirate or not pirate by each subject in each time period). The variable *pirate* was set to 0 when a decision to not pirate was made and 1 when a decision to pirate was made. Data were then grouped by those decisions. A second variable, *piracy percentage*, was also used in the analysis. This variable represented the percentage of time periods in which the individual chose to pirate the software.

It is important to note that the experimental design made it impossible to test the entire path model, as in the survey method above. For the purposes of the experiment, *PBC* was rendered irrelevant. All subjects were explicitly trained in how to pirate the software in the experiment setting. In effect, *PBC* was raised to a maximum as no controls were placed upon the individual's piracy behavior. Therefore, it was not appropriate to measure this factor. Also due to the fact that no controls were placed on the individual, *intent* was not explicitly measured. It was assumed that if an individual wished to pirate software in the experiment, they would pirate the software. There were no impediments to committing the piracy in the experiment setting. Finally, it should be noted that the measures of *attitude* and *subjective norms* represented the subject's attitude and subjective norms in his or her workplace and, therefore, would be affected by his or her perceptions of costs and benefits in that setting, not necessarily the costs and benefits utilized in the experiment. While these limitations made it impossible for the experiment to test the entire path model, some interesting analyses could be undertaken on the data to further study the relationships between the variables measured. The following paragraphs detail that statistical analysis.

As *pirate* is a dichotomous variable, a χ^2 analysis was used to test the relationship between *pirate* and the variables: *punishment severity*, *punishment certainty*, and *s/w cost*. As the sample size was greater than twenty, Yate's correction for continuity was applied (Norusis 1988). Each of the factors was found to have a significant relationship with *pirate* (see Table 5).

Table 5. χ^2 Analyses of Experiment Data
(*pirate*=0 vs *pirate*=1)

Groups	χ^2	**N**	**p**
punishment severity ($50, $250)	76.036	960	.000
punishment certainty (5%, 50%)	18.107	960	.000
s/w cost ($10, $30)	20.560	960	.000

Due to the nature of the data, a repeated measures analysis of variance (ANOVA) was carried out to study the effects of *punishment severity*, *punishment certainty*, and *s/w cost* on the individual's decision to pirate or not pirate in each time period. A summary of the results can be found in Table 6. As would be expected due to the nature of the data, the results were not as strong as those found in the χ^2 tests. However, *punishment severity* was found to have a significant impact on *pirate* ($p<.005$). While the results of the statistical tests involving *punishment certainty* and *s/w cost* were not significant, it appears that a larger sample size would be likely to provide the additional power necessary to achieve significance.

Table 6. Repeated Measures ANOVA Analysis of Experiment Data (*pirate*=0 vs *pirate*=1)

Variable	N	MS	F value	p
punishment severity ($50, $250)	48	16.54	9.42 (1,46)	.004
punishment certainty (5%, 50%)	48	4.00	2.28 (1,46)	.139
s/w cost ($10, $30)	48	4.54	2.49 (1,46)	.116

Finally, the data were analyzed using the variable *piracy percentage*. Correlation coefficients were calculated between *piracy percentage* and the measures of *attitude* and *subjective norms* gained from the questionnaire. As can be seen in Table 7, the results were highly significant in each case. A similar result was found between the variables *moral obligation* and *attitude*. Due to the dichotomous nature of the variables *punishment severity*, *punishment certainty*, and *s/w cost*, T-tests were used to analyze their relationships with the variable *piracy percentage*. As expected, the results mirrored those found in the multiple measures ANOVA analysis (see Table 8). Indications of a relationship were found in each case, but the only highly significant result was that found between *punishment severity* and *piracy percentage*.

Table 7. Experiment Data Correlation Analyses

First Variable	Second Variable	r	r^2	N
Moral Obligation	*Attitude*	.6081***	.3699	48
Attitude	*Piracy Percentage*	.3930**	.1544	48
Subjective Norms	*Piracy Percentage*	.4174**	.1742	48

*** p<.0001 ** p<.001

Table 8. Results of T-Test Analysis of Experimental Data

Variable	Mean	SD	Mean	SD	df	t-score	p
***s/w cost* =**	**$10**		**$30**				
piracy percentage	24.17	25.57	37.92	37.44	46	-1.49	.144
***punishment certainty* =**	**5%**		**50%**				
piracy percentage	37.50	35.02	24.58	29.00	46	1.39	.171
***punishment severity* =**	**$50**		**$250**				
piracy percentage	44.17	36.56	17.92	21.41	46	3.04	.004

6. DISCUSSION

The data indicate that the model is a useful tool in analyzing the piracy decision. In particular, the TPB structure appears to be a good fit to the data. Using the survey data, the path coefficients calculated between *piracy intention* and *behavior*, *attitude* and *piracy intention*, *PBC* and *piracy intention*, and *PBC* and *piracy behavior*, were all found to be significant ($p<.01$). Correlation coefficients between each of the pairs of variables were found to be strong and significant in all cases, indicating relationships between the factors. In the experiment, *attitude* and *subjective norms* were found to be significantly correlated with the subject's actual piracy behavior in the experimental setting.

When analyzing the predicted antecedents of the *attitude* factor, the results are not as strong. While *moral obligation* was found to have a strong effect on *attitude* in all statistical tests, the calculated path coefficients between *attitude* and *punishment severity*, *punishment certainty*, and *s/w cost* were weak and non-significant, although the correlation analysis of the survey data did provide significant support for the predicted relationships. The analysis of the experiment data provided indications of a relationship between the three economic factors and the subjects' actual piracy behavior in the experimental setting. The repeated measures ANOVA provided particularly strong evidence of a relationship between the *punishment severity* and the subjects' decision to pirate. Although no significant effects were detected between piracy behavior and the two variables *punishment certainty* and *s/w cost*, it appears likely that an experiment with higher statistical power would be needed to support the assertion that these two variables have an impact on piracy. T-tests analyzing these factors and the percentage of decisions made by each individual to pirate gave results very similar to the ANOVA analysis. Chi-square analysis of the dichotomous economic variables and the individual decisions to pirate or not pirate yielded more significant results (see Table 5). Therefore, this study provides strong evidence that *punishment severity* is a factor in piracy decisions, and mixed evidence that *punishment certainty* and *s/w cost* are factors in piracy decisions.

The identification of *punishment certainty* as a control belief affecting *PBC* is strongly supported by the data. A strong and significant correlation coefficient was identified between these two factors using the survey data, and a strong and significant path coefficient was found in the LISREL analysis of the model.

7. IMPLICATIONS

This study has strong implications for both researchers studying piracy behavior and those groups attempting to stop it. TPB clearly is a useful tool in analyzing the decision to pirate and future research should focus on TPB as a framework. For practitioner groups, this implies that the factors identified by TPB, such as subjective norms, can be manipulated to yield the desirable effects. By creating an environment that promotes anti-piracy behavior among authority figures and peers, it may be possible to affect the individual computer-user's perceptions of subjective norms and, therefore, reduce the piracy behavior of the individual. To some extent, the Software Publishers Association (SPA) has attempted this course of action through their many advertisements, brochures and promotions.

While punishment factors did not contribute greatly to the tested model, there is evidence that punishment can be a tool in the fight against piracy. Increasing the punishment severity and punishment certainty may lead to a decrease in piracy behavior. However, it may be that, in reality, these factors are already significantly high. Computer-users may simply perceive them as being low. By publicizing the actual levels of severity and certainty more clearly, it may be possible to increase people's perceptions of these factors and, therefore, reduce the intention to commit piracy. Organizations that are intent on eliminating piracy within their ranks should consider instituting (and publicizing) significant punishments. Software that is available today (such as that available from the SPA) makes it very easy to perform audits of hard disks. This study indicates that creating and maintaining an audit strategy may be a deterrent to piracy behavior.

8. CONCLUSION

This study refines and builds on the previous attempts to develop a predictive model of piracy behavior. Previous research identified the usefulness of TRA as a model in this area (e.g. Christensen and Eining 1993). This study extends that model to include the factor of perceived behavioral control, as posited by TPB. The model also continues the process of decomposing the TPB factors and identifying the belief variables that determine the main TPB factors. While previous studies have begun this process, this study advances the model.

There is still much work to be done in this area. While the data establish a link between *punishment severity*, *punishment certainty*, *s/w cost* and the commitment of piracy, the model does not appear to adequately explain the contribution of these items. Future research must also focus on the belief factors that determine subjective norms. While *punishment certainty* was found to have a strong effect on *PBC*, there may be other control beliefs that could affect this construct. Finally, it was impossible to test any hypotheses involving attitudes toward computers in this study due to the validity concerns regarding the ATCUS questionnaire. Christensen and Eining's call for more research into the effect of this factor is still appropriate.

Despite the calls of such prominent researchers as Richard Mason (1986), research in the area of software piracy has long been conspicuous in its absence. However, recent years have seen the development of a small research stream in the MIS literature. A rich agenda lies ahead for investigators who wish to better understand the dynamics of piracy behavior and perhaps even reduce the significant losses that continue to occur on a daily basis.

9. REFERENCES

Ajzen, I. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes*, Volume 50, 1991, pp. 179-211.

Ajzen, I., and Fishbein, M. "Attitude-Behavior Relation: A Theoretical Analysis and Review of Empirical Research." *Psychological Bulletin*, Volume 84, September, 1977, pp. 888-918.

Barrier, T. B., and Margavio, T. M. "Pretest-Posttest Measure of Introductory Computer Students' Attitudes Toward Computers." *Journal of Information Systems Education*, Volume 5, Number 3, 1993, pp. 53-58.

Beck, L., and Ajzen, I. "Predicting Dishonest Actions Using the Theory of Planned Behavior." *Journal of Research in Personality*, Volume 25, 1991, pp. 285-301.

Brown, T. S.; Brown, J. T.; and Baack, S. A. "A Reexamination of the Attitudes Toward Computer Usage Scale." *Educational and Psychological Measurement*, Volume 48, 1988, pp. 835-842.

Business Software Alliance. *1994 Software Piracy Report*, http://www.bsa.org/bsa/docs/94prpt, 1994.

Christensen, A. L., and Eining, M. M. "Factors Influencing Software Piracy: Implications for Accountants." *Journal of Information Systems*, Spring, 1991, pp. 67-80.

Christensen, A. L., and Eining, M. M. "A Structural Model of Software Piracy." Unpublished manuscript, 1993.

Cronbach, L. J. "Test Validation." In R. L. Thorndike, Editor, *Educational Measurement*,, Second Edition. Washington, DC: American Council on Education, 1971, pp. 443-507.

Ehrlich, I. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation." *Journal of Political Economy*, Volume 81, 1973, pp. 521-565.

Eining, M. M., and Christensen, A. L. "A Psycho-Social Model of Software Piracy: The Development and Test of a Model." In R. Dejoie, G. Fowler, and D. Paradice, Editors, *Ethical Issues in Information Systems*. Boston: Boyd & Fraser Publishing Co., 1991, pp. 182-188.

Fishbein, M., and Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, Massachusetts: Addison-Wesley, 1975.

Gopal, R. D., and Sanders, G. L. "The Effect Of Preventive and Deterrent Software Piracy Strategies on Producer Profits." In J. I. DeGross, J. D. Becker, and J. J. Elam, Editors, *Proceedings of the Thirteenth International Conference on Information Systems*. Dallas, Texas, 1992, pp. 161-170.

Grasmick, H. G., and Scott, W. J. "Tax Evasion and Mechanisms of Social Control: A Comparison with Grand and Petty Theft." *Journal of Economic Psychology*, Volume 2, 1982, pp. 213-230.

Greenberger, R. "Software Theft Extends Well Beyond China." *Wall Street Journal*, Volume 72, May 20, 1996, p. A1.

Kievit, K. A. "Information Systems Majors/Non-Majors and Computer Ethics." *The Journal of Computer Information Systems*, Volume 32, Fall, 1991, pp. 43-49.

Mason, R. O. "Four Ethical Issues of the Information Age." *MIS Quarterly*, Volume 10, Number 1, March, 1986, pp. 5-12.

Norusis, M. *SPSS/PC+ V2.0 Base Manual*. Chicago, Illinois: SPSS Inc., 1988.

Oz, E. "The Attitude of Managers-To-Be Toward Software Piracy." *OR/MS Today*, Volume 17, August, 1990, pp. 24-26.

Paradice, D. J. "Ethical Attitudes of Entry-Level MIS Personnel." *Information & Management*, Volume 18, 1990, pp. 143-151.

Popovich, P. M.; Hyde, K. H.; Zakrajsek, T.; and Blumer, C. "The Development of the Attitudes Toward Computer Usage Scale." *Educational and Psychological Measurement*, Volume 47, 1987, pp. 261-269.

Schifter, D. B., and Ajzen, I. "Intention, Perceived Control and Weight Loss: An Application of the Theory of Planned Behavior." *Journal of Personality and Social Psychology*, Volume 49, 1985, pp.843-851.

Schoemaker, P. J. "The Expected Utility Model: Its Variants, Purposes, Evidence and Limitations." *Journal of Economic Literature*, Volume 20, June, 1982, pp. 529-563.

Sheppard, B. H; Hartwick, J.; and Warshaw, P. R. "The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research." *Journal of Consumer Research*, Volume 15, December, 1988, pp. 325-343.

Shim, J. P., and Taylor, G. S. "Business Faculty Members' Perceptions of Unauthorized Software Copying." *OR/MS Today*, Volume 15, October, 1988, pp. 30-31.

Shim, J. P., and Taylor, G. S. "Practicing Managers' Perception/Attitudes Toward Illegal Software Copying." *OR/MS Today*, Volume 16, August, 1989, pp. 30-33.

Sims, R. R.; Cheng, H. K.; and Teegen, H. "Toward a Profile of Student Software Piraters." *Journal of Business Ethics*, Volume 15, 1996, pp. 839-849.

Solomon, S. L., and O'Brien, J. A. "The Effect of Demographic Factors on Attitudes Toward Software Piracy." *The Journal of Computer Information Systems*, Volume 30, Spring, 1990, pp. 40-46.

SPSS, *SPSS® LISREL® 7 and PRELIS*. Chicago, Illinois: SPSS Inc., 1993.

Straub, D. W. "Effective IS Security: An Empirical Study." *Information Systems Research*, Volume 1, Number 3, 1990, pp. 255-276.

Straub, D. W. "Validating Instruments in MIS Research." *MIS Quarterly*, Volume 13, June, 1989, pp. 147-169.

Taylor, S., and Todd, P. A. "Understanding Information Technology Usage: A Test of Competing Models." *Information Systems Research*, Volume 6, Number 2, June, 1995, pp.144-176.

Tittle, C. R. *Sanctions and Social Deviance: The Question of Deterrence*. New York: Praeger Publishers, 1980.

Watson, R. T., and Pitt, L. F. "Determinants of Behavior Toward Ethical Issues in Personal Computing." *OMEGA*, Volume 21, Number 4, 1993, pp. 457-470.