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EXAMINING THREE-WAVE DETERRENCE MODELS: A QUESTION OF TEMPORAL ORDER AND SPECIFICATION*

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I. INTRODUCTION

Since its restatement as a perceptual process some fifteen years ago,[1] the deterrence doctrine has generated much research interest. There are now over twenty-five published studies in the criminological literature that test the deterrent effect of the perceived certainty of punishment.[2] The bulk of this literature consists of bivariate cross-sectional correlations between respondents' estimates of the certainty of punishment and self-reported involvement in minor forms of crime and delinquency. In general, these studies have found moderately large inverse correlations between the perceived certainty of punishment and various forms of self-reported deviance consistent with the deterrence doctrine.

As has often been noted,[3] however, such correlations may explain nothing about the deterrent effect of sanction threats. First,

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[1] Waldo & Chiricos, *Perceived Penal Sanction and Self-Reported Criminality: A Neglected Approach to Deterrence Research*, 9 SOC. PROBS. 522 (1972).

[2] *See, e.g.*, J. GIBBS, CRIME, PUNISHMENT, AND DETERRENCE (1975); Paternoster, *The Deterrent Effect of the Perceived Certainty and Severity of Punishment: A Review of the Evidence and Issues*, 4 JUST Q. 173 (1987).

[3] Paternoster, Saltzman, Waldo & Chiricos, *Estimating Perceptual Stability and Deterrent Effects: The Role of Perceived Legal Punishment in the Inhibition of Criminal Involvement*, 74 J. CRIM. L. & CRIMINOLOGY 270 (1983); Saltzman, Paternoster, Waldo & Chiricos, *Deterrent and Experiential Effects: The Problem of Causal Order in Perceptual Deterrence Research*, 19 J. RES.

even moderately large inverse bivariate correlations between perceived certainty and self-reported involvement in deviance may be spurious because they exclude explanatory factors which either generate deviance, such as peer involvement in crime, or inhibit deviance, such as moral beliefs condemning rule breaking. Second, the reported cross-sectional correlations usually measure the relationship between current perceptions of the certainty of punishment and self-reported criminal activity that occurred in the past. It is not clear from these inverse correlations whether the observed relationship measures the effect of perceptions on behavior, which is a deterrent effect, or the effect of prior behavior on current perceptions, which is an experiential effect.[4] The cross-sectional nature of the data, however, argues strongly for the second interpretation, which, in turn, suggests that those who commit offenses usually do so with impunity and subsequently lower their estimate of the risks involved.

More recently, those investigating the deterrence question have tried to overcome the methodological defects of previous studies by employing more fully specified causal models and longitudinal data collection designs.[5] In panel studies, respondents are queried about

CRIME & DELINQ. 172 (1982); Silberman, *Toward a Theory of Criminal Deterrence*, 41 AM. SOC. REV. 442 (1976).

[4] It is clear by now that inverse cross-sectional correlations between prior self-reported behavior and current estimates of sanction threats cannot be taken as evidence of a deterrent effect unless perceptions are relatively stable over time. This is particularly true if the sanction threat indicators refer to the risk to one's self rather than a generalized other. Recent panel research has suggested that perceptions are not particularly stable, even over short periods of time. In order to emulate longitudinal designs without multiple data collection efforts, some researchers have attempted to build the correct temporal order into the measurement process by asking respondents retrospective questions about perceptions or prospective questions about behavior. For a detailed discussion of these methodological issues in perceptual deterrence research, see C. TITTLE, SANCTIONS AND SOCIAL DEVIANCE: THE QUESTION OF DETERRENCE (1980); Bishop, *Deterrence: A Panel Analysis*, 1 JUST Q. 311 (1984); Grasmick & Green, *Legal Punishment, Social Disapproval and Internalization as Inhibitors of Illegal Behavior*, 71 J. CRIM. L. & CRIMINOLOGY 325 (1980); Greenberg, *Methodological Issues in Survey Research on the Inhibition of Crime*, 72 J. CRIM. L. & CRIMINOLOGY 1094 (1981); Lundman, *One-Wave Perceptual Deterrence Research: Some Grounds for the Renewed Examination of Cross-Sectional Methods*, 23 J. RES. CRIME & DELINQ. 370 (1986); Meier, Burkett & Hickman, *Sanctions, Peers and Deviance: Preliminary Models of A Social Control Process*, 25 SOC Q. 67 (1984); Minor & Harry, *Deterrent and Experiential Effects in Perceptual Deterrence Research: A Replication and Extension*, 19 J. RES. CRIME & DELINQ. 190 (1982); Paternoster, *supra* note 2; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3; Silberman, *supra* note 3; Teevan, *Subjective Perception of Deterrence (Continued)*, 13 J. RES. CRIME & DELINQ. 155 (1976).

[5] Bishop, *Legal and Extralegal Barriers to Delinquency*, 22 CRIMINOLOGY 403 (1984); Meier, Burkett & Hickman, *supra* note 4; Minor & Harry, *supra* note 4; Paternoster & Iovanni, *The Deterrent Effect of Perceived Severity: A Reexamination*, 64 SOC. FORCES 751 (1986); Paternoster, Saltzman, Waldo & Chiricos, *Perceived Risk and Social Control: Do Sanctions Really Deter?*, 17 LAW & SOC'Y REV. 457 (1983).

their perceptions of certain punishment at one time and their self-reported behavior during a later period. In this way, the temporal ordering for estimating a deterrent effect is less ambiguous than in cross-sectional studies because researchers can examine the relationship between current perceptions and subsequent behavior. In addition to collecting data on the perceptual properties of punishment, recent deterrence researchers have also gathered information on other relevant factors, such as the respondents' moral beliefs,[6] informal sanctions,[7] and peer involvement in or expressed verbal support for deviance.[8] With this more extensive data, researchers have estimated deterrence models that include inhibitory and generative factors in addition to perceptions of formal sanction threats. These models estimate the deterrent effect of sanction threats while simultaneously controlling for one or more other explanatory variables and make the estimated deterrent effect less susceptible to a spuriousness bias.

When researchers have employed these two methodological refinements, namely, panel data and more fully specified causal models, they generally have failed to find any significant deterrent effect for the perceived certainty of punishment. For example, in fourteen tests of the deterrence doctrine in which the effect of perceived certainty was estimated in a multivariate equation that included at least two other explanatory factors, the deterrent effect on various measures of self-reported subsequent deviance was negligible and was non-significant in twelve.[9] Only in the studies reported by Bishop[10] and Grasmick and Green[11] was the direct effect of perceived certainty both significant and in the theoretically expected direction.

Unfortunately, these latter two studies do not provide unequiv-

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6 Bishop, *supra* note 5; Minor, *A Deterrence-Control Theory of Crime*, in THEORY IN CRIMINOLOGY (R. Meier, ed. 1977); Paternoster & Iovanni, *supra* note 5; Silberman, *supra* note 3.

7 Grasmick & Green, *supra* note 4; Meier & Johnson, *Deterrence and Social Control: The Legal and Extralegal Production of Conformity*, 42 AM. SOC. REV. 292 (1977); Paternoster, Saltzman, Waldo & Chiricos, *supra* note 5.

8 R. JOHNSON, JUVENILE DELINQUENCY AND ITS ORIGINS (1979); Akers, Krohn, Lanza-Kaduce & Radosevich, *Social Learning and Deviant Behavior: A Specific Test of a General Theory*, 44 AM. SOC. REV. 636 (1979); Meier & Johnson, *supra* note 7; Paternoster & Iovanni, *supra* note 5; Silberman, *supra* note 3.

9 R. JOHNSON, *supra* note 8; Akers, Krohn, Lanza-Kaduce & Radosevich, *supra* note 8; Jacob, *Deterrent Effects of Formal and Informal Sanctions*, 2 LAW POLICY Q. 61 (1980); Meier & Johnson, *supra* note 7; Minor, *supra* note 6; Paternoster & Iovanni, *supra* note 5; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3; Piliavin, Gartner, Thornton & Matsueda, *Crime, Deterrence and Choice*, 51 AM. SOC. REV. 101 (1986); Silberman, *supra* note 3. For a more detailed review of these studies, see Paternoster, *supra* note 2.

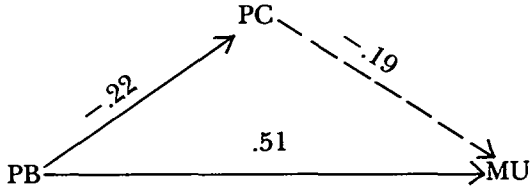
10 Bishop, *supra* note 5.

11 Grasmick & Green, *supra* note 4.

ocal evidence of a deterrent effect for perceived certainty. In both instances, the estimated equation contained only three independent variables: perceived legal sanctions, perceived informal sanctions, and a measure of moral beliefs. The estimated model, therefore, was likely to have been misspecified, and the estimated effects biased by the exclusion of other important explanatory variables. Perhaps most notable among the excluded variables was a measure of peer support for or involvement in deviance. Peer influence has consistently been found in the literature to be one of the best predictors of one's own involvement in deviance.[12] In addition, peer involvement and support are probably inversely related to one's own estimate of the certainty of formal legal sanctions, because one's peers have likely committed their offenses without apprehension and punishment. The positive effect that peer involvement in crime has on one's own participation and its inverse effect on one's estimate of the certainty of formal sanction could be part of the process producing the negative correlations between the latter two variables reported in the literature.[13] Therefore, the con-

[12] D. ELLIOTT, D. HUIZINGA & S. AGETON, EXPLAINING DELINQUENCY AND DRUG USE (1985); R. JOHNSON, *supra* note 8; Akers, Krohn, Lanza-Kaduce & Radosevich, *supra* note 8; Burkett & Jensen, *Conventional Ties, Peer Influence, and the Fear of Apprehension: A Study of Adolescent Marijuana Use*, 16 Soc. Q. 522 (1975); Jacob, *supra* note 9; Jensen, *Parents, Peers and Delinquent Action: A Test of the Differential Association Perspective*, 78 AM. J. SOC. 562 (1972); Meier, Burkett & Hickman, *supra* note 4; Meier & Johnson, *supra* note 7; Paternoster & Iovanni, *supra* note 5.

[13] This process describes a textbook example of spurious correlation. The following diagram shows the correlations among self-reported marijuana use (MU), the perceived certainty of punishment for marijuana use (PC), and peer behavior regarding marijuana use (PB). The correlations were calculated with survey data from approximately 1200 high school students for a study described in greater detail in Section II, *infra*. The indicators of peer use and perceived certainty were measured at one time, and respondents' self-reported marijuana use was measured one year later.



The zero-order correlations indicate that respondents with peers who are marijuana users and who have had considerable success in avoiding apprehension are less likely to believe that they will get caught if they use marijuana ($r = -.22$). Those with marijuana-using peers at one time are also more likely to use marijuana themselves in the subsequent year ($r = .51$). The inverse correlation between perceived certainty and self-reported marijuana use is consistent with the deterrence doctrine ($r = -.19$). The dashed line is drawn to suggest, however, that part of this correlation is not the result of an inherent causal link between the two variables, but reflects the causal effect on both

clusions of researchers such as Bishop and Grasmick and Green,[14] who interpret inverse correlations between perceived certainty and self-reported deviance as resulting from a causal deterrent effect should be viewed cautiously as long as any indicator of peer support is excluded from the estimated model.

Perhaps the most methodologically sophisticated attempt to assess the deterrent effect of perceived certainty was recently conducted by Meier, Burkett, and Hickman.[15] They estimated a model of marijuana use (MU) with three-wave panel data. Their model of social control included both a deviance generator (peer behavior regarding marijuana use, PB) and a deviance inhibitor (the perceived certainty of punishment for marijuana use, PC). With three waves of data, Meier, Burkett, and Hickman estimated at two different points in time both the lagged (PC1→MU2; PC2→MU3) and "instantaneous" (PC2→MU2; PC3→MU3) relationship between perceived certainty and marijuana use. In their conceptualization of the model, Meier, Burkett, and Hickman referred to these relationships as reflecting the causal deterrent effect of sanction threats on marijuana use. Estimating their model with data from a sample of 265 high school students, Meier and his colleagues found a significant inverse relationship between perceived certainty at wave three and self-reported marijuana use measured at the same time.[16] They found no evidence of a similar "instantaneous" relationship at the second wave or of a lagged deterrent (PCt→MUt+1) effect at any time. The significant negative relationship between perceived certainty and marijuana use at the third wave, with peer use of marijuana controlled, was interpreted as reflecting a deterrence process.[17]

The purpose of this Article is both to reexamine and reanalyze the Meier, Burkett, and Hickman data with a different model specification and to present and analyze additional data bearing on the relationship between perceived certainty and self-reported involvement over time in two types of common rule breaking. Rather than contradicting their findings, the present study confirms most of the

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of peer use of marijuana. This hypothesis is given some support by the partial correlation between perceived certainty and marijuana use. Although the zero-order correlation is $r = -.19$, the first-order partial, when controlling for peer use, reduces that figure to $-.10$. This example illustrates the necessity of including relevant explanatory factors, such as peer involvement in deviance, when making tests of the deterrence doctrine.

[14] Bishop, *supra* note 5; Grasmick & Green, *supra* note 4.

[15] Meier, Burkett & Hickman, *supra* note 4.

[16] *Id.* at 72.

[17] Meier, Burkett, and Hickman noted that their findings provided "marginal support for a deterrence hypothesis." *Id.* at 74.

conclusions offered by Meier and his associates in their original study. Following their lead in constructing and estimating a general model of social control, this Article reports on a three-wave, six-variable model of marijuana use and petty theft.

II. METHODS

The data used by Meier, Burkett, and Hickman are fully described in their original publication.[18] Their well-detailed article describes the sample (265 high school students) and the measures they employed in their study. In addition, the authors report a full correlation matrix with standard deviations and means so that their LISREL models could be replicated and so that models different from theirs could be estimated and compared. Their correlation matrix (see Table 1) will be used in this Article to estimate a model of social control somewhat different from the one they originally estimated and on which they reported. The model used in this Article is theoretically identical to the one used by Meier and his associates, but the former is better justified methodologically. Furthermore, similar but more complete social control models will be estimated using a different data set which is described in the following sections of this Article.

A. SAMPLE

The new data that will be analyzed in this paper are similar to that of Meier and his associates. These data, as with the data used by Meier, Burkett, and Hickman, come from a three-wave panel study of high school students. The respondents included all tenth grade students who were in attendance at nine high schools in and around a mid-sized southeastern city. These schools represent a purposive sample that was selected to include urban, suburban, and rural schools in the study and to accurately reflect the race, gender, and social class characteristics of the city's high schools. Confidential questionnaires were administered in all tenth grade English classes during the fall of 1981. Follow-up questionnaires were given to the respondents in the fall semester of their junior year (second wave) and senior year (third wave). A total of 1244 respondents (49% male, 86% white) completed full questionnaires at all three time periods; this constituted approximately 46% of the respondents who completed a questionnaire during the first wave.

As in most panel studies, particularly those that extend beyond two waves, problems of sample attrition arose in this study. The

[18] *Id.* at 70-71.

original sample size was selected to be large enough so that even with considerable case attrition there would be a sufficiently large number of cases at the end of the third wave to conduct detailed and efficient analyses. More important than its size is the process by which the attrition is generated. A large case attrition will be of less concern to the analysis of theoretical relationships if the process is a random, rather than a systematic, one. Fortunately, a very large proportion of the case attrition in this study could not be attributed to two non-random sources of case attrition: an unwillingness of available respondents to cooperate in completing the questionnaire and the respondents dropping out of high school.

On the day of the questionnaire's administration, over 99% of those students who attended agreed to participate in the study, and approximately 95% of their responses were sufficiently complete to warrant analysis. In addition, in subsequent questionnaire administrations, approximately 99% of the attending students agreed to continue their participation. Therefore, the rate of participation in the study was very high for those who were in attendance. Furthermore, in none of the nine high schools did the dropout rate from the tenth to the twelfth grade exceed 5% of the original tenth grade class.

There were two major sources of case attrition in this study. One came from a change of research policy in one of the high schools. At the beginning of the second wave, an interim principal instituted a policy of requiring written parental approval for students to participate in research activities. This policy was not in effect in this school at either the first or third wave of the study but did result in a more than normal case attrition from the first to the second wave, as these students were less than diligent in returning parental permission slips from home. The second source of case attrition for these schools came from normal school processes, such as students missing English classes, failing to attend school on the day of follow-up administrations, moving out of the area, remaining behind in English, or electing a non-traditional English section, such as creative writing, journalism, or theatre. The most troubling of these reasons is non-attendance because it is plausible that the more delinquent students are also more likely to be irregular attenders.

There is, of course, no information available on those respondents who failed to attend school at any of the three times that the questionnaire was administered. It is possible, however, to compare the group of respondents analyzed here who completed useable questionnaires at all three waves (n=1244) with a second group that

completed a questionnaire at wave one but were lost for one or both of the subsequent waves (n=1449). To ensure that the sample of respondents about whom there is complete information did not differ in any important way from those lost due to attrition, these two groups of respondents were compared on each variable of interest. The data are presented in the appendix of this Article. With some exceptions, there were no substantial differences on these measured variables. A few points are important to keep in mind, however. Respondents who stayed in the sample across three waves were somewhat more "conventional" than those who were eventually lost. The former had somewhat lower means for the deviance generators, namely, peer behavior and peer attitude and for self-reported behavior and had higher means for each of the deviance inhibitors, namely, perceived certainty, moral beliefs, and parental supervision. These differences, though consistent for both offenses, are not large and are more characteristic of marijuana use than petty theft. It can be argued with some confidence, therefore, that the group of respondents examined here are reasonably representative of the students from the chosen schools. While both the non-random selection of schools and the case attrition from wave one to wave three limit the generalizability of the reported results, these data are valid for testing theoretical relationships among variables.

B. VARIABLES

Identical to the model reported by Meier and his associates, the first model to be estimated in this Article contains three variables measured at each of three time periods or waves: self-reported marijuana use, peer use of marijuana, and the percevied certainty of punishment for marijuana use. At each wave, respondents were asked to report how many times in the past year they had used marijuana. Because the distribution of this variable was somewhat skewed, a log transformation of the raw frequency was done. All analyses were conducted on this transformed variable. This measure of self-reported marijuana use was somewhat different than the measure used by Meier, Burkett, and Hickman.[19] They employed a similar time for the recall period, namely, the prior twelve months, but they had rank ordered response options that ranged on a five-point continuum from "never" to "once a week or more." The measure of peer use of marijuana and the measure of perceived certainty of punishment in the data set used in this Article are virtually identical to those used by Meier and his colleagues in their research.

[19] *Id.* at 71.

Peer use of marijuana was measured by asking respondents to report how many of their friends had used marijuana. Provided response options were "none," "some," "most," and "all." To measure the perceived certainty of punishment, respondents were asked to respond to the following question: "If you were to use marijuana, how likely is it that you will be caught by the police?" Response options for this question ranged on a five-point continuum from "very likely" to "very unlikely."

In order to expand the generality of the findings on adolescent marijuana use reported in this Article and by Meier and his associates, a second common delinquent offense, petty theft, was examined. Each respondent answered questions pertaining to self-reported petty theft, peer involvement in petty theft, and the perceived certainty of punishment for petty theft which were identical to the questions about marijuana use. All analyses conducted on the marijuana use measures were performed separately from the theft variables to determine whether the nature of the causal processes examined differed by offense.

III. FINDINGS

A. BIVARIATE RELATIONSHIPS

Table 1 reports the zero-order correlation coefficients among the marijuana use variables and their means and standard deviations at each of the three time periods for Meier's original study and the data collected for the present study.[20] Table 2 contains equivalent data on petty theft from the present study. The first task is to examine the zero-order correlations for marijuana use and petty theft from the data collected for the present study. For both sets of correlations, the relationships are consistent with theoretical expectations. Consistent with the deterrence doctrine, both the lagged and synchronous correlation between perceived certainty and self-reported marijuana use are significant and negative.[21] The three syn-

[20] The reader can compare the means and standard deviations for each marijuana use item from the present with those reported by Meier and his colleagues. This data is contained in Table 1, along with the correlation matrix from each study.

[21] In their original study, Meier, Burkett, and Hickman referred to the relationship between two variables measured at the same time as "instantaneous" and the relationship between two variables measured at different times as "lagged." By this terminology, the relationship between self-reported marijuana use and perceived certainty is "instantaneous" if both are measured at the same time even though the recall period for marijuana use occurs over the previous twelve-month period. Somewhat different terminology is adopted in the present paper. The relationship between perceived certainty and peer use of marijuana measured at the same wave is referred to as a synchronous relationship. The relationship between self-reported marijuana use and both perceived

TABLE 1

PEARSON CORRELATION COEFFICIENTS, MEANS AND STANDARD DEVIATIONS FOR SELF-REPORTED MARIJUANA USE, PEER MARIJUANA USE, AND PERCEIVED CERTAINTY, FOR MEIER'S STUDY* (ABOVE DIAGONAL, N=265) AND THE PRESENT STUDY (BELOW DIAGONAL, N=1148)

$\bar{X}$	2.16	1.72	2.46	2.05	1.61	2.52	1.85	1.41	2.62
SD	1.44	1.59	.86	1.41	1.60	.87	1.36	1.53	.91
	MU3	PB3	PC3	MU2	PB2	PC2	MU1	PB1	PC1
MU3**		.73	−.44	.63	.58	−.38	.50	.44	−.32
PB3	.56		−.43	.61	.71	−.41	.52	.54	−.38
PC3	−.23	−.25		−.26	−.31	.51	−.14	−.24	.31
MU2	.71	.45	−.19		.75	−.35	.65	.53	−.35
PB2	.50	.60	−.19	.56		−.41	.67	.67	−.39
PC2	−.19	−.21	.46	−.22	−.22		−.30	−.33	.47
MU1	.54	.41	−.15	.70	.43	−.20		.74	−.49
PB1	.42	.46	−.13	.47	.49	−.20	.59		−.54
PC1	−.18	−.20	.31	−.21	−.24	.36	−.22	−.22	
$\bar{X}$	.93	1.94	2.19	.66	1.78	2.41	.54	1.63	2.61
SD	1.59	.98	1.18	1.41	1.03	1.32	1.24	.89	1.37

* From Meier, Burkett, & Hickman, *Sanction, Peers and Deviance: Preliminary Models of a Social Control Process*, 25 Soc. Q. 67-82 (Winter 1984).

** MU is respondents' self-reported marijuana use, PB is peer use of marijuana, PC is the perceived certainty of punishment. Numbers refer to the wave during which measurement occurred.

chronous correlations (PC1MU1 = −.22, PC2MU2 = −.22, PC3MU3 = −.23) are not substantially different from the two one-year lagged correlations between perceived certainty and subsequent marijuana use (PC1MU2 = −.21, PC2MU3 = −.19). The correlations found between respondents' peers use of marijuana and their own use are stronger than those found for perceived certainty. Both the three synchronous (PB3MU3 = .56, PB2MU2 = .56, PB1MU1 = .59) and two lagged correlations (PB1MU2 = .47, PB2MU3 = .50) are moderately large and positive, as predicted by differential association and social learning theory.[22] Additionally, as was suggested earlier, peer involvement in marijuana use is in-

certainty and peer use, when all three are measured at the same wave, is referred to as a lagged effect, because respondents' own marijuana use had to have occurred before the measurement of the latter two variables. The relationship between two variables measured at different times is, of course, a lagged relationship if the lag interval is over one or two waves.

[22] *See, e.g.*, R. AKERS, DEVIANT BEHAVIOR: A SOCIAL LEARNING APPROACH (2d ed. 1980); Hirschi & Gottfredson, *The Sutherland Tradition in Criminology*, in UNDERSTANDING CRIME: CURRENT THEORY AND RESEARCH (T. Hirschi & M. Gottfredson eds. 1980); Kandel, *Drug and Drinking Behavior Among Youth*, 6 ANN. REV. SOC. 235 (1980).

versely related to respondents' estimate of their own risk of being caught by the police. The three synchronous (PB3PC3 = −.25, PB2PC2 = −.22, PB1PC1 = −.22) and two lagged correlations (PB1PC2 = −.20, PB2PC3 = −.19) are consistent with the suggestion that knowledge of one's friends' use of marijuana is related to a belief that one can do the same with relative impunity.[23]

The zero-order correlations for petty theft are reported in Table 2. With only minor variations, these results are identical to those for marijuana use, although the magnitude of the correlations is consistently weaker for petty theft. Both the synchronous and lagged correlations between perceived certainty and self-reported petty theft are negative, consistent with the deterrence doctrine. Similar to the case for marijuana use, the magnitudes of the two lagged effects are not substantially different (PC2PT3 = −.13, PC1PT2 =−.11). In addition, all correlations between respondents' peers involvement in petty theft and their own reported participation in theft, though positive, are much weaker than those found for marijuana use (PB3PT3 = .34, PB2PT2 = .31, PB1PT1 = .35, PB1PT2 = .19, PB2PT3 = .18). This finding is not too surprising in view of the important role attributed in the theoretical literature to social others in the etiology of marijuana use.[24] Finally, as for marijuana use, there is an inverse correlation between peer involvement in petty theft and respondents' estimates of their own likelihood of getting caught for the act. The magnitude of both synchronous (PB3PC3 = −.21, PB2PC2 = −.17, PB1PC1 = −.20) and lagged correlations (PB1PC2 = −.15, PB2PC3 = −.17) suggest that those respondents who have friends participating in petty theft are more likely to believe that they can get away with it than those respondents with fewer or no friends involved in theft.

Not only are these bivariate correlation coefficients for marijuana use and petty theft consistent with theoretical expectations, they are also similar to the substantive findings reported by Meier and his colleagues in their earlier three-wave study of marijuana use (see Table 1). They found both lagged and synchronous inverse correlations between the perceived certainty of punishment and self-reported marijuana use, larger positive correlations between self-reported marijuana use and peer use of marijuana, and inverse correlations between peer use and estimates of sanction threats for marijuana use. At least at the level of bivariate analysis and in terms

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[23] *See supra* note 13 and accompanying text.

[24] *See*, E. GOODE, THE MARIJUANA SMOKERS (1970); Becker, *Becoming A Marijuana User*, 59 AM. J. SOC. 235 (1953); Ginsberg & Greenley, *Competing Theories of Marijuana Use: A Longitudinal Study*, 19 J. HEALTH SOC. BEH. 22 (1978); Kandel, *supra* note 22.

TABLE 2
PEARSON CORRELATION COEFFICIENTS, MEANS AND STANDARD DEVIATIONS FOR SELF-REPORTED PETTY THEFT, PEER INVOLVEMENT IN PETTY THEFT, AND PERCEIVED CERTAINTY (N=1178)[a]

	PT3	PB3	PC3	PT2	PB2	PC2	PT1	PB1	PC1
PT3	1.00								
PB3	.34	1.00							
PC3	−.14	−.21	1.00						
PT2	.34	.27	−.21	1.00					
PB2	.18	.48	−.17	.31	1.00				
PC2	−.13	−.19	.38	−.16	−.17	1.00			
PT1	.25	.25	−.07	.36	.26	−.09	1.00		
PB1	.20	.43	−.08	.19	.35	−.15	.35	1.00	
PC1	−.12	−.21	.30	−.11	−.18	.30	−.10	−.20	1.00
X	.20	1.52	2.75	.20	1.45	2.8	.21	1.48	2.98
S.D.	.59	.77	1.16	.59	.80	1.27	.64	.79	1.17

[a] PT is the respondent's self-reported involvement in petty theft, PB is peer behavior for petty theft, PC is perceived certainty of punishment for petty theft. The subscript refers to the time of measurement (time 1, 2, or 3).

of the expected theoretical direction of the relationships, the findings reported here paralled those reported by Meier.

This Article will next analyze the causal model constructed by Meier and his associates to explain marijuana use over time. After examining their model, a different specification is suggested and tested both with their original data and the marijuana use and petty theft data collected as part of this study.

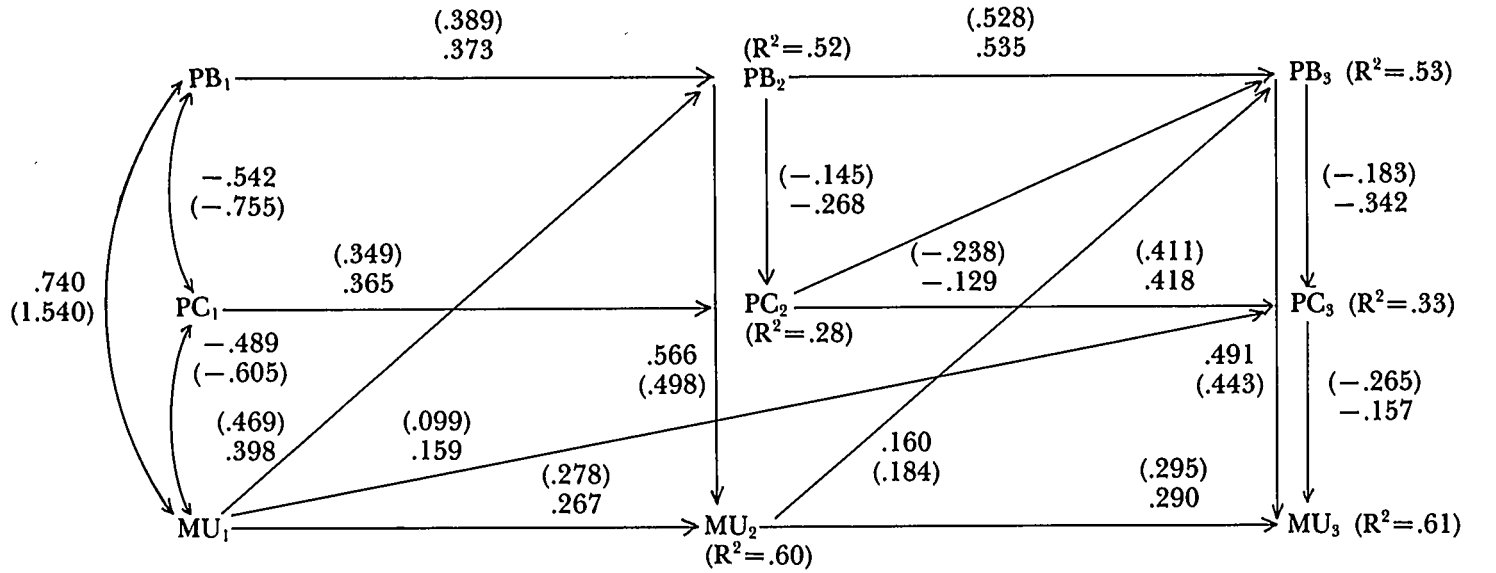
B. ESTIMATION OF PRELIMINARY MODELS: MEIER'S THREE-WAVE STUDY

In interpreting their data, Meier, Burkett, and Hickman specified and estimated a three-wave, three-variable model of marijuana use shown in Figure 1. Although it was not made explicit in their paper, Meier's estimated model is premised on a distinctive theoretical position which was translated into the model's specification.[25] This position can be clarified by a close examination of their model (see Figure 1). In an inspection of this model, two dimensions are particularly important. One such dimension is the nature and makeup of the social control process the model describes. This question addresses the theoretical constructs used to explain marijuana use over time. The second dimension has both a theoretical

[25] Meier, Burkett & Hickman, *supra* note 4, at 71-72.

FIGURE 1

ESTIMATED THREE-WAVE MODEL OF MARIJUANA USE BY MEIER, BURKETT AND HICKMAN*: STANDARDIZED SOLUTION (UNSTANDARDIZED ESTIMATES)**



(n = 265) X^2 = 24.43 18 d.f. p = .142

* From R.F. Meier, S.R. Burkett and C.A. Hickman (1984) "Sanctions, Peers and Deviance: Preliminary Models of a Social Control Process." The Sociological Quarterly 25 (Winter):67-82. PB is peer behavior for marijuana use, PC is the perceived certainty of punishment, MU is self-reported marijuana use.

** All estimates were obtained by analyzing the sample covariance matrix.

and methodological component and addresses the issue of how the theoretical constructs are related over time.

In constructing their model of marijuana use, Meier and his associates assumed that the process of social control is made up of two elements: deviance generators and deviance inhibitors.[26] The former is measured by an indicator of peer use of marijuana, and the latter is measured by respondents' estimates of the certainty of punishment for marijuana use (see Figure 1). As previously discussed, they obtained estimates on these two measures and respondents' self-reported use of marijuana during a previous twelve-month recall period. Their estimated model assumed that the causal effect of both peer behavior and perceived certainty on self-reported marijuana use occurs during the same measurement period. It means, for example, that the observed correlation found at wave three between peer behavior and self-reported marijuana use reflects the causal effect of peer use measured at wave three on self-reported marijuana use measured at the same time (PB3→MU3). This same causal process applies at wave two (PB2→MU2) and for perceived certainty (PC3→MU3, PC2→MU2). As understood by Meier, Burkett, and Hickman, the experiential effect of self-reported marijuana use on peer use is lagged, such that marijuana use that occurred during the preceeding year affects peer behavior measured one year later (MUl→PB2, MU2→PB3), and the effect of marijuana use on perceived certainty is lagged over a two-year measurement period (MUl→PC3). Also explicit in their model is that peer use of marijuana affects respondents' estimates of sanction threat at the same measurement period (PB3→PC3, PB2→PC2) and that perceived sanction threats, in turn, influence the deviance of peers with whom respondents associate at a later time (PC2→PB3).

The estimates derived from the Meier group's original model are reported in Figure 1. They found a mutual causal effect between peer use of marijuana and respondents' own drug use that was consistent with both social learning and differential association theory. Users of marijuana subsequently had more friends who also used marijuana, and these friends' use affected repondents' subsequent involvement. There was also a moderately large inverse effect of peer use of marijuana on respondents' estimate of their own risk of punishment for marijuana use. Both social control theory and differential association would predict that involvement with deviant others is likely to lead to a neutralization of the fear of legal

[26] *Id.* at 68-69.

threats.[27] Meier's data provided some confirmation of this and suggested that deviant peers both directly affect one's own involvement in crime and indirectly influence it by reducing the perceived threat posed by discovery and apprehension.

What the Meier data did not reveal, however, is a strong direct effect of one's own use of marijuana on estimates of sanction threat. Previous longitudinal studies have found evidence of such an "experiential" effect.[28] Meier reported no such relationship, except an effect from marijuana use that occurred in the year before wave one on wave three estimates of perceived certainty, and suggested that "those investigators who have reported larger effects . . . did so because their models were not completely specified."[29] It should be noted, however, that tracing the causal paths linking marijuana use to perceived certainty reveals a moderately strong indirect causal effect of wave one marijuana use on wave two (−.107) and wave three (−.134) estimates of sanction threats, and an inverse, but much weaker, effect of wave two marijuana use on wave three perceived certainty (−.053). Contrary to the conclusion of Meier and his associates, their data suggests that one's own experience with marijuana neutralizes the user's fear of the law by bringing him or her into contact with marijuana using peers.

Regarding the role of deviance inhibitors, Meier, Burkett, and Hickman reported a moderate inverse effect of perceived certainty on self-reported marijuana use, but only at the third wave ($p = -.157$). Although the effect of perceived certainty on self-reported marijuana use is weaker than that found for the deviance generator (peer use $p = .491$), their finding of a significant inverse relationship between a measure of perceived certainty and self-reported involvement in one common form of deviance is an important one. Most multivariate panel studies have failed to find a significant association between perceived risk and deviance once other explanatory factors were controlled. In addition, although Meier, Burkett, and Hickman reported no direct effect of perceived certainty on marijuana use at the second wave, had they traced the causal paths they would have found that the wave two measure of perceived certainty did have a non-trivial indirect effect on self-reported marijuana use

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27 T. HIRSCHI, CAUSES OF DELINQUENCY (1969); E. SUTHERLAND & D. CRESSEY, CRIMINOLOGY, (10th ed. 1978); Jensen, *supra* note 12; Kandel, *Homophily, Selection, and Socialization in Adolescent Friendships*, 84 AM. J. SOC. 427 (1978); Matsueda, *Testing Control Theory and Differential Association: A Causal Modeling Approach*, 47 AM. SOC. REV. 489 (1982).

28 Minor & Harry, *supra* note 4; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3; Saltzman, Paternoster, Waldo & Chiricos, *supra* note 3; Teevan, *supra* note 4. *See also* Paternoster, *supra* note 2 (review of perceptual deterrence literature).

29 Meier, Burkett & Hickman, *supra* note 4, at 76.

at wave three (−.136) both through its effect on wave three perceived risk and its effect in deterring respondents from associating with drug-using peers. The total causal effect is consistent in direction with the deterrence doctrine, and their model did suggest that perceptions of certain punishment are influential in explaining marijuana use.

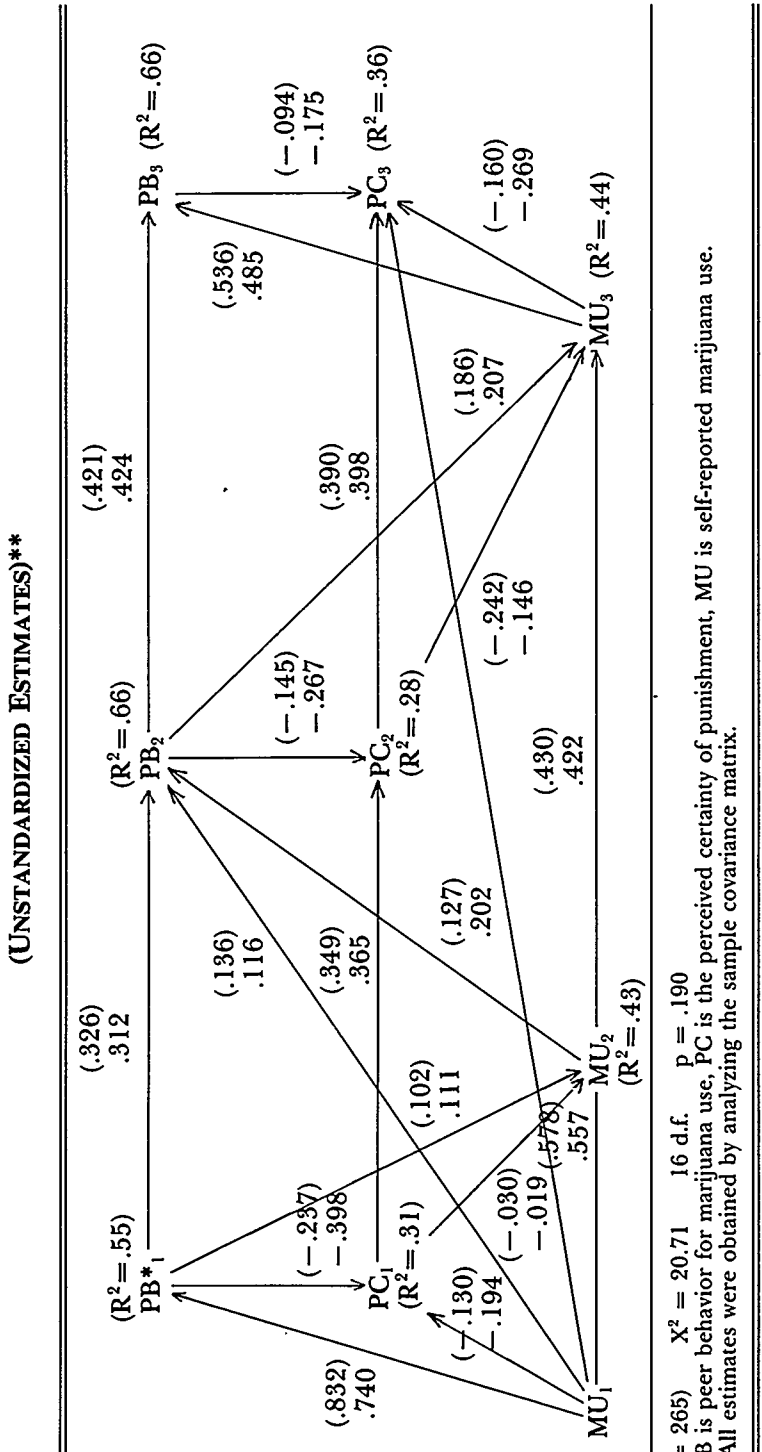
C. RESPECIFICATION AND ESTIMATION OF MEIER'S THREE-WAVE MODEL

In the analysis of their three-wave model of marijuana use, Meier, Burkett, and Hickman reported some support for an experiential effect of marijuana use on perceived certainty and a deterrent effect of perceived certainty on marijuana use. The evidence in support of these two effects becomes stronger when indirect effects are considered. This is particularly true for the deterrent effect specified by Meier's model. The total effect of wave three perceptions of risk on wave three marijuana use was −.157 (entirely direct), while for wave two perceptions it was −.137 (entirely indirect). Although much weaker than the direct and indirect effects for the role of peer use on self-reported marijuana use, these data do suggest a substantively important deterrent effect. Do these findings represent a true *deterrent* effect, or are they due to the particular specification of the causal model? In order to substantiate the latter interpretation, it must be shown not only that an alternative model can explain the data as well, but that such a model is more reasonable than the one originally specified and estimated by Meier and his associates in their paper.

Figure 2 represents a different specification of Meier's three-wave, three-variable model of marijuana use. Employing their data, it reports alternative estimates of causal effects. This model is similar to Meier's in that the former presumes that social control is due to the effect of both a deviance generator (peer use of marijuana) and an inhibitor (perceived certainty). In addition, respondents' use of marijuana is related to peer use, and peer use is causally related to respondents' estimate of sanction threats. This model and the one estimated by Meier and his associates differ most critically in the temporal specification of effects. Most notably, Meier, Burkett, and Hickman assumed that there is a synchronous or "instantaneous" causal effect of peer use and perceived certainty on self-reported marijuana use at waves two and three. In the respecification of their model (see Figure 2), these relationships are instead expressed as the causal effect of self-reported marijuana use on peer use and perceived certainty. In the representation of this temporal ordering,

FIGURE 2

RE-ESTIMATION OF MEIER ET AL.'S THREE-WAVE MODEL OF MARIJUANA USE*: STANDARDIZED SOLUTION (UNSTANDARDIZED ESTIMATES)**



(n = 265) $X^2 = 20.71$ 16 d.f. p = .190

* PB is peer behavior for marijuana use, PC is the perceived certainty of punishment, MU is self-reported marijuana use.

** All estimates were obtained by analyzing the sample covariance matrix.

marijuana use is lagged behind the period at which all three are measured and before the measurement at the previous wave (see Figure 2). This alternative specification of the model was made because, even though all three variables are measured at the same time for each wave, the variables reflect logically different time periods. Peer use and perceived certainty reflect respondents' attitudinal states at the time they are measured, while self-reported marijuana use reflects behavior that occurred in the preceding twelve-month period.[30] Because of this, the measure of self-reported marijuana use should logically come before the measure of peer use and perceived certainty and should causally affect them.

In the model originally specified by Meier and his associates, the effect of perceived certainty on self-reported marijuana use, which they referred to as an "instantaneous" deterrent effect, reflected the relationship between perceived risk measured at one point in time and self-reported marijuana use that occurred in the previous year (see Figure 1). This, however, is precisely what has been identified in the literature as the experiential rather than the deterrent effect. The latter effect is defined by Gibbs as the association between perceptions of sanction threat and "*subsequent* criminal or delinquent acts."[31] Because reported experiential effects have consistently been greater than deterrent effects,[32] this may partially account for the significant and substantively non-trivial negative association reported by Meier, Burkett, and Hickman between perceived certainty and marijuana use ($p = -.157$).[33] Their estimate of the experiential effect was based on the effect of wave one marijuana use, which occurred sometime in the year before wave one and perceptions of sanction threats measured at wave three. Contrary to most of the published literature which finds moderately

30 Actually, even though these perceptions (certainty of punishment and reported peer use of marijuana) are measured at one point, they may reflect the respondents' attitudes over a previous time period. For example, estimates of perceived certainty at wave two (PC2), although measured at wave two, may have been formed immediately after wave one and gone unchanged over the intervening twelve month period. If this is true then the relationship between perceived certainty and self-reported marijuana use at any wave may reflect the causal effect of the former on the latter. Although conceptually reasonable and the premise behind the utilization of cross-sectional studies, empirical studies (and the stability coefficients from the models estimated here) have indicated that perceptions may be unstable over fairly short time periods, particularly for samples of adolescents. *See supra* notes 4 and 28 and accompanying text.

31 J. GIBBS, *supra* note 4, at 209 (emphasis added). *See* Silberman, *supra* note 3, at 444.

32 *See supra* note 2 and accompanying text.

33 Meier, Burkett & Hickman, *supra* note 4, at 72.

strong negative experiential effects,[34] Meier and his associates found a positive effect (p = .159).

Because the recall period for self-reported marijuana use is the previous twelve months, a lagged interval is built into the measurement process. For this reason, the model specification depicted in Figure 2 seems to be more logically defensible. In Figure 2, the measure of self-reported marijuana use is hypothesized to affect causally both perceived certainty and the deviance of peers when all three are measured at the same time. Perceived certainty and peer use of marijuana are assumed to affect respondents' own marijuana use occurring in the subsequent twelve months and measured at the next wave.

The correlation matrix reported in Meier's original paper was used to obtain estimates for the respecified model in Figure 2. The first thing to observe from this model is that it provides as good or slightly better an overall fit to the data as compared to Meier's model.[35] Although the two models are comparable in terms of overall fit, the amount of explained variance in the particular equations differs. While Meier and his associates reported R2 values of approximately .60 for self-reported marijuana use and .50 for peer use, the respecified model in Figure 2 shows the opposite pattern. This situation results because the synchronous correlation between peer and self-reported use of marijuana at each wave in the model in Figure 2 is expressed as the causal effect of self-reported use on peer use, while lagged correlations are expressed as the causal effect of peer use on self-reported use of marijuana. The correlation matrix indicates that the synchronous correlations between self-reported and peer use were larger than the lagged correlations between peer use and subsequent self-reported use of marijuana.

Taking full advantage of the panel nature of the data, then,

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[34] Minor & Harry, *supra* note 4; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3; Saltzman, Paternoster, Waldo & Chiricos, *supra* note 3.

[35] In both Meier's original model and the respecified one in Figure 2, causal effects were estimated with LISREL V. K. JORESKOG & D. SORBOM, LISREL: ANALYSIS OF LINEAR STRUCTURAL RELATIONSHIPS BY THE METHOD OF MAXIMUM LIKELIHOOD, (1981). In both Figures 1 and 2 the estimated effects are the standardized solution from analyzing the sample covariance matrix. The overall goodness of fit of the model can be determined from a number of measures. One of these is the estimated chi-square for that model. The magnitude of the chi-square reflects the difference between the observed covariance matrix and one generated by the model. A small discrepancy (low chi-square) indicates that the hypothesized model accurately reproduces the data. Unlike traditional uses of the chi-square statistic, small and non-significant values are desired for good fitting models. In the present case, the re-estimated model ($\times 2$ = 20.71, 16 df; p = .190) appears to provide at least as good a fit as Meier's original model ($\times 2$=24.43, 18 df; p = .142).

does not reduce the model's goodness of fit. In addition, the substantive conclusions suggested by the respecified model in Figure 2 are similar to those reported by Meier and his colleagues. There is a strong mutual causal relationship between peer use of marijuana and respondents' own use. At the first measurement wave, respondents who reported more marijuana use in the previous twelve month period were more likely to report having friends who also had used marijuana than those reporting less prior use of marijuana ($p = .740$). These deviant peers had a deviance generating effect on respondents' own subsequent use both directly ($p = .111$) and indirectly, though very weakly, by reducing their estimate of sanction certainty (.008). This process is repeated and is stronger at the second wave, where self-reported involvement affects peer use (.504) which, in turn, directly ($p = .207$) and indirectly through the neutralization of sanction fear (.039) leads to greater self-reported marijuana use.

There are two important differences, however, between the results originally reported by Meier, Burkett, and Hickman and those found here for the respecified causal model. First, while Meier found a positive experiential effect of self-reported marijuana use on perceived certainty lagged over three time periods ($p = .159$), the model in Figure 2 reports moderate (and stronger) inverse effects at wave one ($p = -.194$) and wave three ($p = -.269$) and a moderate positive experiential effect lagged over three waves ($p = .202$). The pattern of positive and negative experiential effects may reflect the different effect on perceived sanction threats of marijuana users (inverse effect) and desisters (positive) over the three-year period. Consistent with previous findings, these data do, however, show much stronger support for the effect of rule breaking on perceptions of the certainty of punishment than Meier's own analysis. Second, the deterrent effect estimated in this model ($p = -.146$) is weaker than that found by Meier and his associates in their original model ($p = -.157$). Nonetheless, contrary to much of the recent literature,[36] the direct effect of perceived certainty on subsequent self-reported marijuana use is both negative and significant, consistent with the deterrence doctrine. This deterrent effect was found at the third wave only, even after controlling for an important generator of marijuana use, namely, peer involvement, which had only a slightly stronger effect ($p = .207$). In addition, the indirect effect of perceived certainty, measured at wave one, on self-reported mari-

[36] *See supra* note 9 and accompanying text.

juana use at wave three is weak but non-trivial (−.064) and in the expected direction.

This respecified three-wave model was then used to estimate causal relationships for the marijuana use and petty theft data collected as part of this study. The correlation matrices reported in Tables 1 and 2 were employed to obtain the estimated causal models in Figures 3 (marijuana use) and 4 (petty theft). For clarity of presentation, the unstandardized estimates are omitted, and only the standardized solution is reported. In each model, the self-reported deviance variable is lagged in time before the wave at which it was measured to reflect the logic of the twelve-month recall period.

The model for marijuana use estimated from the present data (Figure 3) provides a good fit. Relative to degrees of freedom, the chi-square value for this model is comparable to that estimated from Meier's data in Figure 2.[37] The R2 values for individual equations are also comparable, though generally there is more explained vari-

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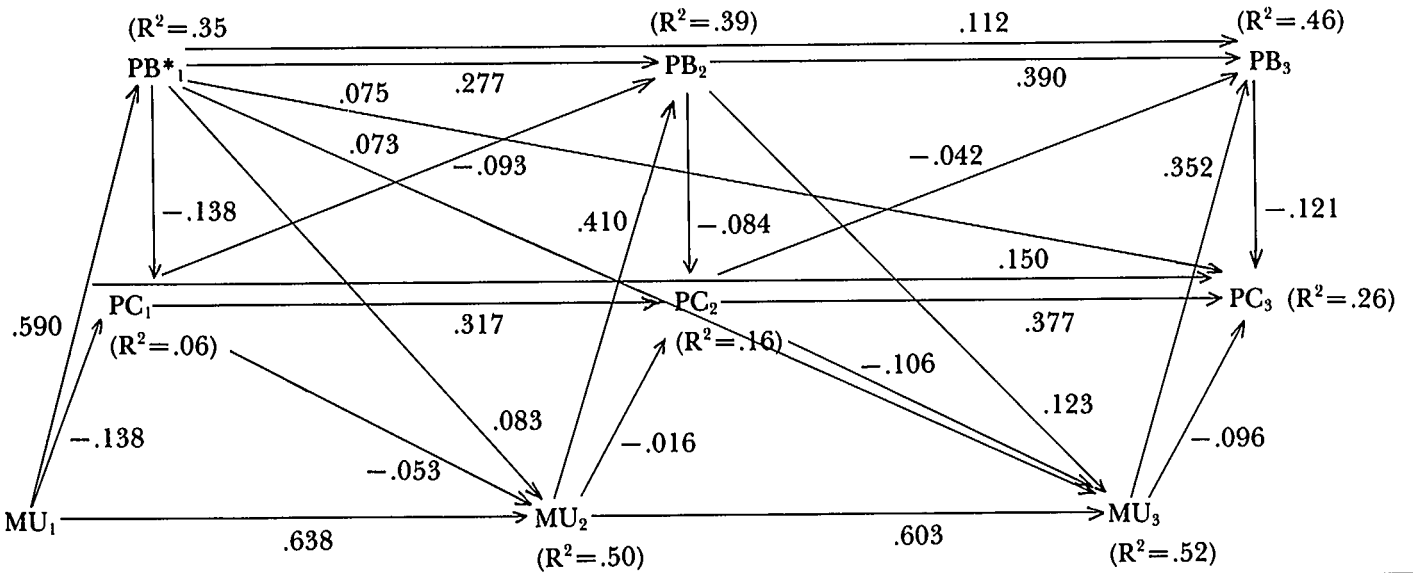
[37] In relatively large samples, as in this case, the chi-square statistic is not by itself an appropriate measure of a model's goodness of fit. This is because chi-square is very sensitive to sample size, and even trivial differences between observed and estimated covariance matrices may be statistically significant. With a large sample, the chi-square test may lead to the erroneous rejection of a good model. To correct for this, Joreskog has suggested that a model's goodness of fit be assessed by the ratio of chi-square to degrees of freedom. Joreskog, *A General Approach to Confirmatory Factor Analysis*, 34 PSYCHOMETRICA 183 (1969). Although intuitively reasonable, this adjusted chi-square is somewhat arbitrary, and there has been some debate as to the requisite value to indicate a good fit. Wheaton has suggested that a ratio of chi-square to degrees of freedom in the order of five or less is indicative of a good fit, while more recently Carmines and McIver recommended a more conservative ratio of two or three. Wheaton, Muthen, Alwin & Summers, *Assessing Reliability and Stability in Panel Models*, in SOCIOLOGICAL METHODOLOGY: 1977 (D. Heise ed. 1977). *See also* Carmines & McIver, *Analyzing Models With Unobserved Variables: Analysis of Covariance Structures*, in SOCIAL MEASUREMENT: CURRENT ISSUES (G. Borhnstedt & E. Borgatta eds. 1981). A more justifiable measure of goodness of fit in latent construct models has been offered by Hoelter. Hoelter, *The Analysis of Covariance Structures: Goodness of Fit Indices*, 11 SOC. METHODS & RES. 325 (1983). Hoelter's test statistic is called Critical N (CN), which is the largest sample size at which the hypothesis of a statistically acceptable fit (probability of .05) would not be rejected. The formula for the CN statistic is:

$$CN = \frac{\{z\ crit + (2\ df - 1)^{1/2}\}^2}{2X^2 / (N - G)} + G$$

where z crit is the critical value for the normal variable z at a given probability level (z crit at a .05 probability level is 1.65), N is the number of observations, and G is the number of groups. According to Hoelter, CN estimates "the size that a sample must reach in order to accept the fit of a given model on a statistical basis." *Id.* at 330. He suggested that CN values greater than 200 are indicative of a good fit between the observed and estimated variance-covariance matrix because Monte Carlo studies indicated that maximum likelihood estimates are robust with respect to departures from normality in samples exceeding 200 observations. The CN values for the model estimated in Fig-

FIGURE 3

ESTIMATION OF THREE-WAVE MODEL OF MARIJUANA USE*: STANDARDIZED SOLUTION



(n = 1148) X^2 = 16.37 10 d.f. p = .089 CN = 1266 (see note 28)

* PB is peer behavior for marijuana use, PC is the perceived certainty of punishment, MU is self-reported marijuana use.

ance in Meier's equations. More importantly, the substantive interpretation of the model for understanding marijuana use over time is similar for the two data sets. There is an ongoing relationship between the self-reported marijuana use of these respondents and their peers. Respondents' marijuana use prior to wave one has a strong direct effect on peer use measured at that time (p = .590). This effect is repeated but grows weaker at waves two (p = .410) and three (p =.352). It appears that the selection of marijuana-using peers was strongest when these students first entered high school and became progressively weaker once these friendships are formed. Marijuana-using peers also have a direct effect on respondents' own self-reported marijuana use, and this effect grows stronger over time (PB1→MU2 = .083; PB2→MU3 = .123). This trend is similar to what was found in the reanalysis of Meier's data (see Figure 2): an initially strong but declining social selection effect of one's own use on marijuana-using peers and a growing influence of peer use on self-reported use over the three-year period. This would suggest that upon entering high school marijuana users quickly seek out like-minded peers who, over time, come to have a stronger effect on their behavior.

These data also agree with Meier's by showing not only that peers have a direct influence on respondents' use of marijuana but that they also have an indirect effect by neutralizing the fear of detection.[38] At each wave, there is a significant direct inverse effect of peer use of marijuana on respondents' estimate of the certainty of punishment (PB1→PC1 = −.138, PB2→PC2 = −.084, PB3→PC3 = −.121). In terms of total causal effects, wave three peer use has a moderate inverse effect on wave three estimates of certainty (−.121), wave two peer use has an effect on perceived certainty at wave two (−.084) and wave three (−.097), and wave one peer use is negatively related to perceived certainty at waves one (−.138), two (−.081), and three (−.030). All of these effects suggest that association with deviant peers leads to a neutralization of sanction threats.

Not only does peer use of marijuana positively affect self-reported use through the neutralization of sanction threats, a moderate inverse experiential effect of one's own use of marijuana has the same effect. The experiential effects observed here for one's own behavior are both strong and consistent. Respondents' use of marijuana in the prior year has a direct (but diminishing) inverse causal

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ure 3 (CN = 1266) are substantially higher than the minimum value of 200 recommended by Hoelter as indicative of a good fit.

[38] *See* Meier, Burkett & Hickman, *supra* note 4, at 74-75; Figure 1.

effect on perceived certainty at waves one ($p = -.138$), two ($p = -.106$), and three ($p = -.096$). A strong indirect effect of respondents' use of marijuana is also felt on perceived certainty through its effect on peer behavior. The total causal effect of wave three self-reported marijuana use on perceived certainty at wave three is $-.139$. The total causal effect of wave two self-reported marijuana use on perceived certainty is $-.164$ at wave three and $-.141$ at wave two. Respondents' use of marijuana in the year prior to wave one had moderate inverse causal effects on perceptions of risk at wave one ($-.220$), two ($-.183$), and three ($-.162$). Contrary to Meier's original model, but consistent with the respecification of that model here (Figure 2), these data show a consistently strong negative experiential effect of self-reported marijuana use. Respondents' own involvement in using marijuana lowers their expectation of sanction risk directly and indirectly by moving them into closer affiliation with drug-using peers whose own experience neutralizes these threats.

Consistent with the previous reanalysis of Meier's model, this model for marijuana use shows a non-trivial, significant lagged deterrent effect for perceived certainty at only one measurement period. The direct effect of wave two perceived certainty on wave three marijuana use is in the expected direction, but it is negligible ($p = -.016$). The direct causal effect of wave one certainty on subsequent self-reported marijuana use measured at wave two is, however, more evident ($p = -.051$). The unstandardized coefficients for the deterrent effect estimated from Figure 3 are $-.019$ for PC2→MU3 and $-.054$ for PCl→MU2, while, for the reestimation of Meier's model, they were $-.242$ and $-.030$, respectively. The largest direct deterrent effect from the present data is considerably weaker than that found in the reanalysis of Meier's data. There are two factors which could account for this difference. First, the indicators of perceived certainty employed in the two studies are somewhat different. Meier, Burkett, and Hickman asked their respondents to estimate the likelihood that they would get *caught*, while in the present data set respondents were asked to estimate the likelihood that they would be *caught by the police*. The greater deterrent effect observed for the former measure may in part be due to the fact that, in answering the question, respondents were anticipating the probability that they would be discovered by others, such as parents, teachers, or disapproving peers, in addition to the police. Because the deterrence literature has consistently shown that infor-

mal sanctions are more important than formal ones,[39] part of the observed deterrent effect in Meier's data may be due to respondents' fear of the reaction of non-legal personnel.

Second, there is considerably more variation in marijuana use to explain over the three waves in Meier's original data set than in the data collected for this study. The unstandardized stability estimates for marijuana use in Meier's data are p = .578 for MU1→MU2 and p = .430 for MU2→MU3; in the present data, the corresponding stability coefficients were .726 and .680. The greater stability in marijuana use over time in this study may explain the generally weaker structural effects found not only for perceived certainty but for peer use as well. Consistent with this interpretation, the effects of perceived certainty and peer use in Meier's data were strongest during the period from wave two to wave three, when the stability of marijuana use was weakest. More generally, these data suggest that causal models may be misleading if the underlying processes are in a state of equilibrium.

Figure 4 presents the results of the model analysis for petty theft. The petty theft model shows a good fit to the data, although, in terms of the amount of variance explained in individual equations, it is not as good as the model for marijuana use. With minor exceptions, the substantive results for the petty theft model parallel those found for marijuana use. As suggested by the zero-order correlations, the relationship between self-reported involvement in petty theft and respondents' peers involvement is positive, though weaker than that found for marijuana use. Nonetheless, consistent with social learning and differential association theory, there is an on-going mutual effect between the two and moderately strong total causal effects. The petty theft data also reveal that both peer involvement and respondents' own participation in petty theft serve to reduce their fear of sanction threats. The most important difference between this model and the one for marijuana use is that for petty theft the direct inverse effect of perceived certainty on subsequent behavior is significant and non-trivial for both lagged effects (PC1→PT2 = −.065, PC2→PT3 = −.059). Both of these are consistent with the deterrence doctrine, as is the inverse but weak indirect effect of wave one perceived risk on wave three self-reported petty theft (−.037).

The respecification and reanalysis of Meier's three-wave model

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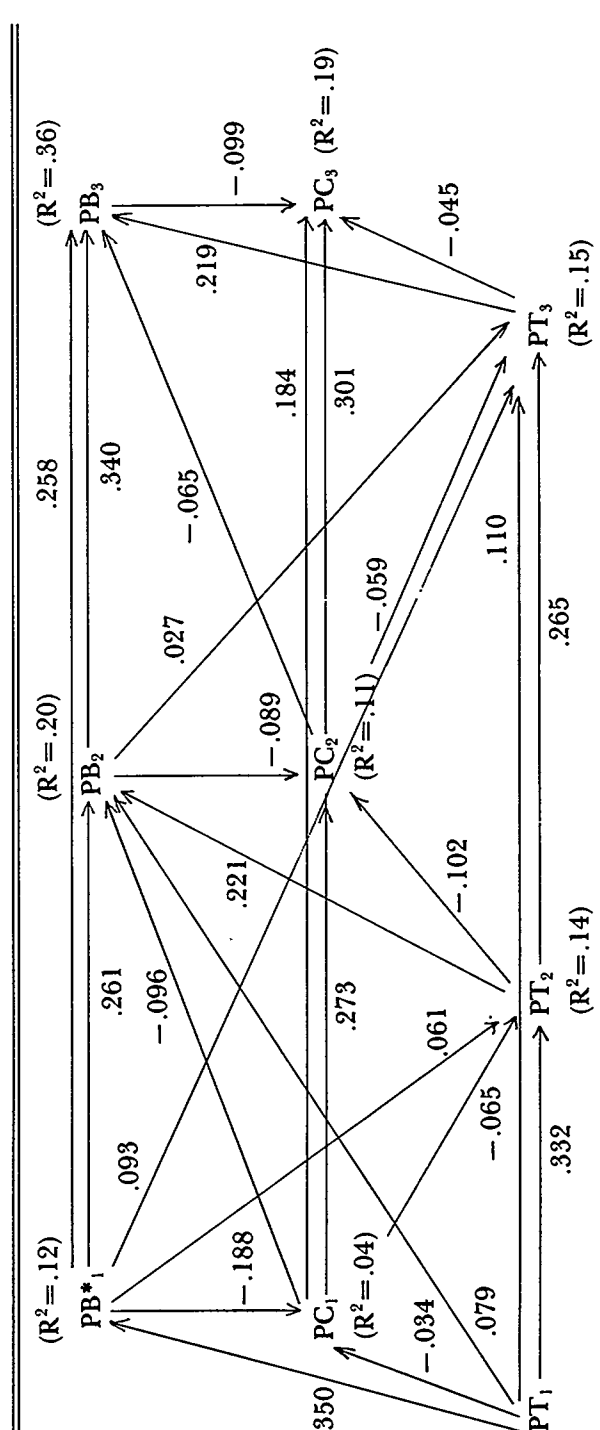
[39] *See, e.g.*, Anderson, Chiricos & Waldo, *Formal and Informal Sanctions: A Comparison of Deterrent Effects*, 25 SOC. PROBS. 103 (1977); Grasmick & Green, *supra* note 4; Jacob, *supra* note 9; Meier & Johnson, *supra* note 7; Minor, *supra* note 6; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3.

FIGURE 4

ESTIMATION OF THREE-WAVE MODEL OF PETTY THEFT*: STANDARDIZED SOLUTION



(n = 1178) X^2 = 21.75 10 d.f. p = .016 CN = 978

* PB is peer behavior for petty theft, PC is the perceived certainty of punishment, PT is self-reported petty theft.

of marijuana use presented here confirms their findings regarding both the mutual effect of peer behavior and respondents' own actions and the effect of these variables on respondents' estimates of the certainty of punishment. This reanalysis also reveals a significant and substantively non-trivial inverse effect consistent with the deterrence doctrine between perceived certainty and subsequent marijuana use. The hypothesized model was then estimated with a different data set for both marijuana use and petty theft. This analysis also reveals a mutual relationship between peer and self-reported behavior and a threat neutralization effect of both. Most importantly, these models suggest that, contrary to much of the recent literature, perceived certainty may have a significant and meaningful deterrent effect on at least two common forms of delinquency. This effect persisted even after controlling for the behavior of respondents' peers.

However persuasive, before these data may be taken as evidence of a deterrent effect for perceived certainty, one must ensure that the observed relationship is due to the inhibitory effect of sanction threats and not the effect of another deviance generator or inhibitor which was omitted from the model. Although Meier, Burkett, and Hickman argued for the necessity of complete models of the social control process, the one they estimated contained only one inhibitory and one generating mechanism.[40] The remainder of this Article will advance their work another step by constructing and estimating a more complete model of social control and deviance.

D. A GENERAL MODEL OF SOCIAL CONTROL

The models estimated in Figures 3 and 4 contain only two explanatory variables: peer behavior and perceived certainty. The delinquency literature has suggested the importance of other deviance generators and inhibitors in the social control process. Three of these generators and inhibitors will be added to the two models. Social learning and differential association theory suggest that, in addition to peer behavior, verbal support for deviance serves as an important generator of deviance.[41] Such verbal reinforcements

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[40] Meier, Burkett, and Hickman did recognize this, however, by referring to their model as a *preliminary* model of the social control process. Meier, Burkett & Hickman, *supra* note 4.

[41] *See, e.g.*, R. AKERS, *supra* note 22; D. MATZA, DELINQUENCY AND DRIFT (1964); R. JOHNSON, *supra* note 8; Akers, Krohn, Lanza-Kaduce & Radosevich, *supra* note 8; Britt & Campbell, *Assessing the Linkage of Norms, Environments, and Deviance*, 56 SOC. FORCES 532 (1977); Burkett & Jensen, *supra* note 12; Ginsberg & Greenley, *supra* note 24; Jacob, *supra* note 9; Kandel, *supra* note 27; Matsueda, *supra* note 27; Meier & Johnson, *supra* note 7.

from peers or definitions favorable to violating the law are understood to be a source of social control independent of one's behavior. Peers may actively encourage participation or neutralize any moral barriers against rule breaking even if they are not themselves active participants in the acts. In addition to this generative variable, the social control-deterrence literature has recognized two powerful inhibitors of delinquent involvement: the direct supervision provided by parents[42] and moral beliefs against the commission of offenses.[43] The inclusion of a measure of moral beliefs in a test of the deterrence doctrine is particularly critical because respondents who possess strong moral reservations against breaking particular rules are also likely both to refrain from committing such offenses and to have an understanding that these rules are regularly enforced. Consequently, inverse correlations between indicators of perceived risk and self-reported behavior may be spurious because both may be the effects of a common cause. Gibbs and others have suggested, and the empirical literature has shown, that when moral beliefs are controlled the effect of perceived certainty on self-reported behavior diminishes substantially.[44]

The social control model suggested here for both marijuana use (MU) and petty theft (PT) includes five explanatory variables measured at each of three waves: peer behavior (PB); perceived certainty (PC); moral beliefs (MB); parental supervision (PS); and peer attitudes (PA).[45] Figure 5 shows the relationship between the self-reported behavior measures and deviance generators and inhibitors. As before, since the recall period for the self-report indicators is the previous twelve months, these measures are lagged in relation to those measured at the same wave. Figure 5 also indicates that the model proposes mutual lagged effects between self-reported deviance and indicators of deviance generation and inhibition. It is as-

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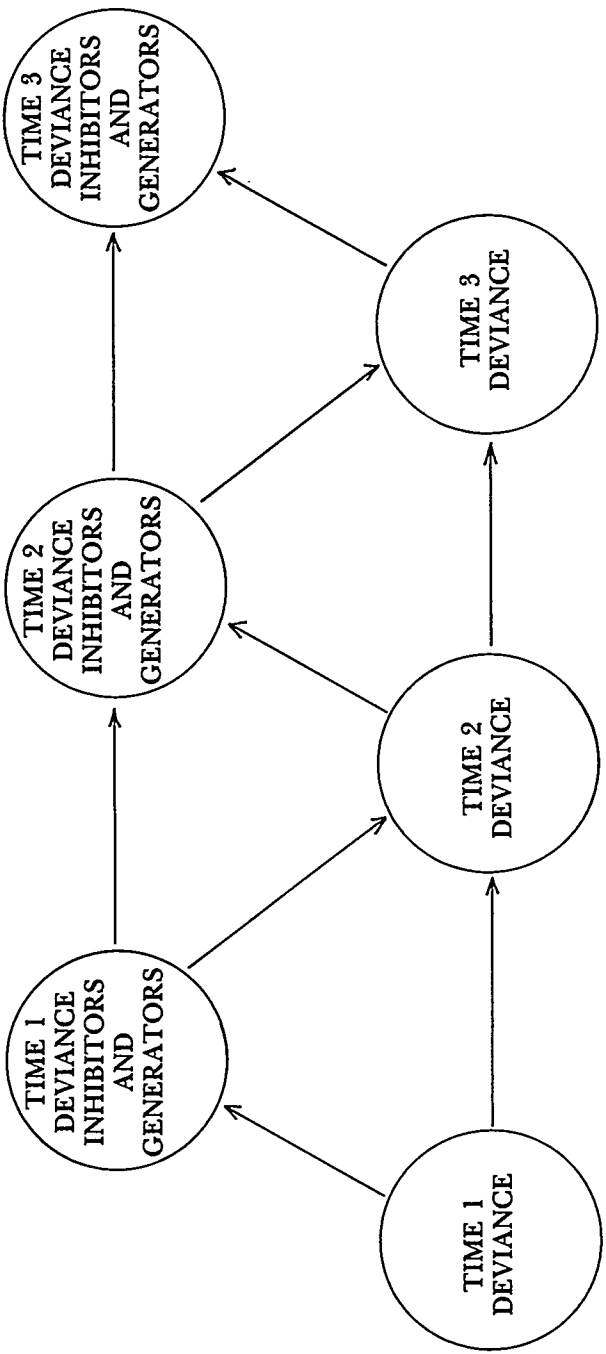
42 T. HIRSCHI, *supra* note 27; Jensen, *supra* note 12; Matsueda, *supra* note 27.

43 T. HIRSCHI, *supra* note 27; Akers, Krohn, Lanza-Kaduce & Radosevich, *supra* note 8; Bishop, *supra* note 5; Minor, *supra* note 6; Paternoster, Saltzman, Waldo & Chiricos, *supra* note 3; Silberman, *supra* note 3.

44 J. GIBBS, *supra* note 2; *see* Paternoster, *supra* note 2 (review of empirical studies).

45 Respondents' moral beliefs about marijuana use and petty theft were measured by asking them to indicate "how wrong" they thought it was to commit each act. The provided response options ranged on a five-point rank ordered scale from (1) "never wrong" to (5) "always wrong." Parental supervision was assessed by asking respondents to report if their parents knew where they were when they were away from home. Provided response options ranged on a four-point rank ordered continuum from (1) "never" to (4) "always." Peers' attitudes toward marijuana use and petty theft were measured by responses to the following question: "How wrong do your best friends think it is to smoke marijuana (steal something worth less than $10)?" To reflect peer approval of these two acts, the coded response options ranged on a five-point rank ordered continuum from (1) "always wrong" to (5) "never wrong."

FIGURE 5
GENERAL SCHEME OF THE THREE-WAVE CAUSAL MODEL FOR MARIJUANA USE AND PETTY THEFT



sumed that participation in illegal acts will have a positive effect on the indicators of peer deviance and attitudes and an inverse effect on perceived certainty, moral beliefs, and parental supervision. The latter two hypotheses are made because it is expected that, as respondents become more involved in deviance, they are likely to become more affiliated with peers who are themselves deviant and who have supportive attitudes for deviance and because respondents may justify their own increased participation in deviance by subsequently neutralizing their moral condemnation of such actions.[46] In addition, as a result of their further deviant behavior and that of their peers, respondents may discover that crime is not as risky as they once thought and may find themselves drifting away from parental influence and supervision. In this model, neutralization of moral condemnation, perceived sanction threats, and parental control are affected by one's own deviant involvement and that of peers and pave the way for additional participation.

In addition to these hypothesized causal effects, the proposed model of social control specifies additional causal relationships that, for clarity of presentation, are not portrayed in Figure 5. As part of the explanation of social control, this model seeks to explain not only the relationship between perceptions of certainty and deviant behavior but also the process by which perceptions of sanction threats are formed and change over time. Geerken and Gove and others have suggested that deterrence is a process wherein knowledge about the efficiency of law enforcement is learned from such sources as the media and interpersonal communication.[47] It has already been suggested that perceptions of the certainty of punishment are affected by one's own behavior and the behavior of peers. The proposed model also hypothesizes a causal effect of moral beliefs, peer attitudes, and parental supervision on respondents' estimates of certainty. The effect of moral beliefs against marijuana use and petty theft on the perceived certainty of punishment for such offenses is presumed to be a positive one, as is the effect of parental

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46 Having committed acts which they previously found to be morally wrong, respondents may try to reduce the dissonance by convincing themselves that such acts are not as repugnant as they once believed. *See, e.g.*, L. FESTINGER, A THEORY OF COGNITIVE DISSONANCE (1966).

47 Geerken & Gove, *Deterrence: Some Theoretical Considerations*, 9 LAW & SOC'Y REV. 497 (1975). *See also* Cohen, *Sanction Threats and Violation Behavior: An Inquiry Into Perceptual Variation*, in QUANTITATIVE STUDIES IN CRIMINOLOGY (C. Wellford ed. 1978); Parker & Grasmick, *Linking Actual and Perceived Certainty of Punishment: An Exploratory Study of an Untested Proposition in Deterrence Theory*, 17 CRIMINOLOGY 366 (1979); Mason, A Communication Model of Taxpayer Honesty (Unpublished manuscript) Survey Research Center, Oregon State University, Corvallis, Oregon (1986).

TABLE 3

ESTIMATED DIRECT CAUSAL EFFECTS (STANDARDIZED SOLUTION) FOR THREE-WAVE MODEL OF MARIJUANA USE[a] (N=1148)

	Time 3 Exogenous Variables[b]						Time 2 Exogenous Variables						Time 1 Exogenous Variables						
	PB3	PC3	MB3	PS3	PA3	MU3	PB2	PC2	MB2	PS2	PA2	MU2	PB1	PC1	MB1	PS1	PA1	MU1	R^2
Endogenous Variables[c]																			
Time 3:																			
PB3					.395	.137	.262	−.039					.112						.56[d]
PC3	−.024		.159	.025	−.060			.357						.135					.28
MB3	−.083			.063	−.272	−.283		.053	.078						.140				.47
PS3	−.072					−.137				.281						.181			.24
PA3				−.058		.382	.112		−.058		.224						.069		.48
MU3							.134	−.002	−.067	−.081		.526						.077	.53
Time 2:																			
PB2											.469	.201	.170	−.074					.53
PC2									.112	.077	−.075	−.045		.305					.17
MB2										.035	−.123	−.279		.048	.197				.27
PS2							−.056					−.115				.422			.24
PA2										−.033		.388	.094				.265		.40
MU2													.077	−.051		−.089		.617	.50
Time 1:																			
PB1																−.073		.570	.35
PC1													−.058		.175		−.076	−.032	.09
MB1													−.065			.047	−.341	−.383	.50
PS1																		−.255	.06
PA1													.423			−.091		.325	.49

[a] The estimates reported are based upon an analysis of the sample correlation matrix.

[b] Column variables affect row variables. PB is peer behavior for marijuana use, PC is the perceived certainty of punishment, MB is moral beliefs against marijuana use, PS is parental supervision, PA is peer attitude in support of marijuana use, and MU is self-reported marijuana use.

[c] The endogenous variables are grouped together according to the time period at which the measurement occurred, even though the recall period for the measure of self-reported marijuana use is lagged by one year (See Figure 5).

[d] These are R^2 values for individual equations. The overall fit of the model was $X^2 = 139.94$ with 80 df, CN = 834.

TABLE 4

ESTIMATED TOTAL CAUSAL EFFECTS FOR THREE-WAVE MODEL OF MARIJUANA USE[a] (N=1148)

		Time 3 Exogenous Variables[b]						Time 2 Exogenous Variables						Time 1 Exogenous Variables					
		PB3	PC3	MB3	PS3	PA3	MU3	PB2	PC2	MB2	PS2	PA2	MU2	PB1	PC1	MB1	PS1	PA1	MU1
Endogenous Variables[c]																			
Time 3:	PB3				−.023	.396	.291	.348	−.040	−.047	−.043	.261	.344	.271	−.058	−.019	−.083	.107	.455
	PC3	−.035		.159	.042	−.117	−.100	−.039	.367	.067	.053	−.080	−.133	−.081	.260	.081	.058	−.077	−.215
	MB3	−.056			.080	−.294	−.413	−.107	.057	.129	.069	−.136	−.338	−.127	.048	.173	.102	−.119	−.446
	PS3	−.072				−.029	−.158	−.060		.013	.296	−.036	−.147	−.040	.013	.005	.324	−.014	−.215
	PA3				−.058		.391	.169	−.001	−.084	−.061	.315	.392	.161	−.037	−.023	−.099	.163	.452
	MU3							.139	−.002	−.067	−.086	.072	.611	.094	−.045	−.021	−.101	.038	.553
Time 2:	PB2										−.015	.470	.385	.307	−.094	−.016	−.076	.137	.486
	PC2									.112	.084	−.091	−.122	−.073	.316	.077	.062	−.075	−.197
	MB2										.039	−.124	−.332	−.101	.065	.208	.073	−.109	−.398
	PS2							−.056				−.026	−.137	−.027	.011	.002	.438	−.008	−.215
	PA2										−.033		.392	.238	−.020	−.004	−.090	.267	.490
	MU2													.083	−.051	−.009	−.096	.007	.696
Time 3:	PB1																−.073		.589
	PC1													−.127		.175	.030	−.136	−.223
	MB1													−.209			.093	−.341	−.637
	PS1																		−.255
	PA1													.423			−.122		.597
	MU1																		

[a] Estimates of total causal effects are based upon traced paths from the estimated model in Table 3.

[b] Column variables affect row variables. PB is peer behavior for marijuana use, PC is the perceived certainty of punishment, MB is moral beliefs against marijuana use, PS is parental supervision, PA is peer attitude in support of marijuana use, and MU is self-reported marijuana use.

[c] The endogenous variables are grouped together according to the time period at which the measurement occurred, even though the recall period for the measure of self-reported marijuana use is lagged by one year (See Figure 5).

supervision. There are good theoretical reasons to believe that the possession of strong moral sentiments against breaking a particular rule leads one to expect that such an important rule would be regularly enforced.[48] Strict parental supervision is an indicator of a strong affective attachment to conventional others through which lessons about law enforcement efficiency are imparted. In addition, parental supervision may be generalized by these high school students into a belief in general legal surveillance. The relationship between peer attitudes concerning marijuana use and petty theft and respondents' estimates of the certainty of punishment is presumed to be an inverse one. Fear of the law may be neutralized not only by respondents' knowledge of friends who actually commit deviant acts with impunity but also by their knowledge of peers' tolerance of such behavior.[49] With these a priori hypotheses stated, a series of three-wave, six-variable models of marijuana use and petty theft were estimated and the results are reported in Tables 3 through 6. Each model involves numerous causal connections which would be obscured in a path diagram, so the results are reported in tabular form only.

1. Marijuana Use Model

a. Self-Reported Marijuana Use

Tables 3 and 4 indicate the estimated structural effects for marijuana use. Table 3 reports the estimated direct effect for each causal relationship, and Table 4 provides a summary of total (direct and indirect) causal effects. It should be observed that the suggested model provides a very good fit to the data,[50] and, with few exceptions, the amount of variation explained in each equation is equal to or greater than that usually found in the delinquency literature. The substantive findings are particularly interesting.

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48 Durkheim observed that collectively held moral sentiments against rule breaking led to the expectation that such norms will be enforced.

> Crime brings together upright consciences and concentrates them. . . . In fact, the sentiments thus in question derive all their force from the fact that they are common to everybody. . . . Crime thus damages this unanimity which is their source of this authority. If, then, when it is committed, the consciences which it offends do not unite themselves to give mutual evidence of their communion, and recognize that the case is anomalous, they would be permanently unsettled. They must re-enforce themselves by mutual assurances that they are always agreed.

E. DURKHEIM, THE DIVISION OF LABOR IN SOCIETY 102-03 (1933).

49 *See supra* note 47 and accompanying text.

50 As in the other models estimated from this data set (Figures 3 and 4), the large sample size makes the chi-square statistic inappropriate. *See supra* note 37. The best goodness of fit measure is Hoelter's CN statistic, which is substantially greater than the minimum value of 200 which he recommends as indicating a good fit. Hoelter, *supra* note 37, at 330.

Looking first at the determinants of self-reported marijuana use, the data indicate that the perceived certainty of punishment at wave one has a weak but significant deterrent effect on subsequent marijuana use at wave two ($p = -.051$). This inhibitory effect for perceived certainty is somewhat weaker than that found for parental supervision ($p = -.089$) but it is stronger than that found for moral beliefs, the latter of which has no effect on subsequent marijuana use at this wave. Marijuana-using peers have a deviance generating effect on respondents' own use ($p = .077$), but peer attitudes have no direct effect on respondents' use once peer behavior and the other variables are controlled. In terms of total causal effects, the most important determinants of self-reported marijuana use from wave one to wave two (MU2) are parental supervision (−.096), peer behavior (.083), and perceived certainty (−.051). At this wave, the total causal effect of moral beliefs (−.009) and peer attitudes (.007) are negligible.

This picture changes somewhat once these students complete two years of high school and one tries to explain their self-reported marijuana use that occurred from their junior to senior years (MU3). By this time, peer use has a strong effect on respondents' own use ($p = .134$); parental supervision continues to have a moderate constraining effect ($p = -.081$) which is somewhat weaker than its effect in the previous wave; and moral beliefs now evidence a significant inhibitory effect ($p = -.067$) consistent with social control theory. As in previous waves, once these factors are considered, peer attitudes toward marijuana use have no direct effect on respondents' own use. However, peer attitudes do have a moderately strong indirect deviance-generating effect, mainly as a result of their positive effect on peer use ($p = .469$), moral beliefs ($p = -.123$), and perceived certainty ($p = -.075$) at wave two. The total causal effects on marijuana use reported at wave three are .139 for peer use, −.002 for perceived certainty, −.067 for moral beliefs, −.086 for parental supervision, and .074 for peer attitudes. In addition, there are lagged total causal effects of wave one deviance generators and inhibitors on wave three self-reported marijuana use (.094 for peer use, −.045 for perceived certainty, −.021 for moral beliefs, −.101 for parental supervision, and .030 for peer attitudes).

This estimated model of marijuana use over three high school years suggests that explanatory factors may vary in strength at different times in students' lives. When these respondents first entered high school, parental influence was strong; peer influence was present, but weaker than parental factors; moral beliefs were not related at all to marijuana use; and perceived certainty evidenced a

weak deterrent effect. These factors may suggest that when formal sanction threats "stand alone," that is, when moral influences are weak and peers have not yet established their influence, the threat of legal sanctions may effectively keep some from getting involved in marijuana use. In other words, when other sources of social control are weak, sanction threats may serve as an effective deterrent.[51]

In the subsequent year, the nature of these influences changed somewhat. Respondents who had used marijuana during their first year of high school had a greater number of friends who also used marijuana. These friendship networks became progressively homogeneous in regards to marijuana use, as did the attitude of peers toward such use. Both respondents' own use of marijuana and that of their friends had two major effects. First, the inverse causal effects of self and peer use on parental supervision and the positive effect of self use on later peer use and peer attitudes suggest that marijuana users became more immersed in a marijuana "subculture" while their ties with parents were eroded. Second, an inverse effect of peer use and peer attitude on moral beliefs and perceived certainty suggests a neutralization of both moral prohibitions and legal sanction threats against marijuana use. In fact, these data are compatible with an interpretation that suggests that initial drug users select friends at least in part on their behavioral and attitudinal similarity regarding marijuana use.[52] Respondents' own behavior and the behavior and attitudes of their friends, affect family relationships, the respondents' estimates of the likelihood of being caught by the police for marijuana use, and their own moral evalua-

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[51] In his text on deterrence and punishment, Andenaes has made a similar point. His suggestion, however, was that sanction threats may deter particular kinds of offenses that are *mala prohibita*, that is "illegal merely because they are prohibited by law." J. ANDENAES, PUNISHMENT AND DETERRENCE 45 (1974). For these offenses, he contended that "the law stands alone; conformity is essentially a matter of effective legal sanctions." *Id.* To Andenaes, the influence of moral restraints are an invariant property of the offense; *mala prohibita* offenses always receive less moral support than *mala in se* offenses, which are those offenses that are immoral in their own right. *Id.* The data presented here, however, suggest variation over time in both the magnitude of moral commitment and the effectiveness of moral restraints for some norms. These moral restraints may not be an inherent property of some offenses, but may be situational and episodically loosened. When these moral prohibitions are temporarily neutralized, other controls, which were previously dormant because of the restraint provided by moral feelings, may become prominent. This does not mean that moral commitments to all norms are so transient, but they may be so for minor, common offenses of adolescents such as marijuana use and petty theft.

[52] Findings very similar to these regarding adolescent marijuana use were reported by Kandel, *supra* note 27. She too found that friends were selected in part on the basis of their behavioral and attitudinal similarity and, in turn, influenced one another as a result of such association. Patterns of self-reported marijuana use reflect both process of selection (of friends) and socialization (by friends).

tion of that behavior. Users and non-users apparently split into two more or less different friendship networks which come to have a growing influence over their use or non-use of marijuana.[53] Fear of sanction threats, which once may have deterred some respondents from using marijuana, waned in importance by their junior year in high school.

b. Perceived Certainty for Marijuana Use

The estimates obtained from the model of marijuana use also help in understanding how perceptions of sanction threats are formed and change over time, which is a virtually neglected area of perceptual deterrence research. Previous deterrence research on the experiential effect has suggested that one's own behavior has a direct causal effect which is usually inverse, on one's estimate of the certainty of punishment.[54] The data in Table 3 aid in unraveling this direct effect by describing the intervening causal mechanisms. For marijuana use, the direct effect of self-reported marijuana use on perceived certainty is weak at both wave one ($p = -.032$) and wave two ($p = -.045$) and is non-existent at wave three. In terms of direct causal effects, the most important determinants of respondents' estimates of perceived certainty are the moral beliefs they hold and the attitudes held by close friends. Contrary to our earlier model (Figure 3), neither respondents' own behavior nor that of their friends has a direct effect on the perception of risk.

At first blush, this data would lead us to question the existence of an experiential effect of deviance participation on perceived sanction threats. However, when the causal paths are traced from self-reported marijuana use to other variables intervening in the model, its indirect effects on perceived certainty can be seen to be quite strong. Table 4 reports that the total causal effect on perceived certainty at wave three is $-.100$ for self-reported marijuana use in the immediately preceeding year (MU3), $-.133$ for marijuana use that occurred in between wave one and two (MU2), and $-.215$ for respondents' marijuana use in the year before wave one (MUl). Wave two estimates of certainty are affected by respondents use of marijuana both in the previous year ($-.122$, MU2) and in the year before that ($-.197$, MUl). Finally, even though its direct effect is weak ($p = -.032$), self-reported marijuana use that occurred in the year before wave one (MUl) has a moderate total causal effect on perceived certainty at the end of that year ($-.223$).

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[53] *See id.*

[54] *See supra* note 4 and accompanying text.

TABLE 5

ESTIMATED DIRECT CAUSAL EFFECTS (STANDARDIZED SOLUTION) FOR THREE-WAVE MODEL OF PETTY THEFT[a] (N=1178)

		Time 3 Exogenous Variables[b]						Time 2 Exogenous Variables						Time 1 Exogenous Variables						
		PB3	PC3	MB3	PS3	PA3	PT3	PB2	PC2	MB2	PS2	PA2	PT2	PB1	PC1	MB1	PS1	PA1	PT1	R^2
Endogenous Variables[c]																				
Time 3:	PB3				−.121	.303	.138	.269						.219						.44[d]
	PC3	−.041		.037	.053	−.109			.295						.179					.21
	MB3				.108	−.169	−.140			.193				−.072		.188				.24
	PS3						−.100				.278			−.066	.083		.160			.20
	PA3				−.037		.199	.119		−.062		.234						.149		.26
	PT3								−.058		−.078	.070	.252						.123	.15
Time 2:	PB2											.361	.152	.204	−.057					.30
	PC2							−.074		.059	.049		−.086	−.045	.253					.12
	MB2											−.144	−.066	−.040		.134	.107			.10
	PS2												−.079	−.066			.396			.19
	PA2										−.109		.190	.109		−.100		.263		.24
	PT2														−.037	−.076	−.123	.067	.296	.17
Time 1:	PB1																.110		.330	.13
	PC1													−.116		.120	.074	−.112		.08
	MB1																.066	−.276	−.143	.14
	PS1																		−.151	.02
	PA1													.305			−.164		.252	.26

[a] The estimates reported are based upon an analysis of the sample correlation matrix.
[b] Column variables affect row variables. PB is peer behavior for petty theft, PC is the perceived certainty of punishment, MB is moral beliefs against petty theft, PS is parental supervision, PA is peer attitude in support of petty theft, and PT is self-reported petty theft.
[c] The endogenous variables are grouped together according to the time period at which the measurement occurred, even though the recall period for the measure of self-reported petty theft is lagged by one year (See Figure 5).
[d] These are R^2 values for individual equations. The overall fit of the model was $X^2=132.95$ with 79 d.f., CN=891.

TABLE 6

ESTIMATED TOTAL CAUSAL EFFECTS FOR THREE-WAVE PANEL MODEL OF PETTY THEFT[a] (N=1178)

		Time 3 Exogenous Variables[b]						Time 2 Exogenous Variables						Time 1 Exogenous Variables					
		PB3	PC3	MB3	PS3	PA3	PT3	PB2	PC2	MB2	PS2	PA2	PT2	PB1	PC1	MB1	PS1	PA1	PT1
Endogenous Variables																			
Time 3:	PB3				−.132	.302	.210	.305	−.012	−.019	−.075	.198	.145	.357	−.037	−.038	−.135	.121	.243
	PC3	−.041		.037	.066	−.128	−.043	−.048	.297	.033	.042	−.055	−.059	−.105	.263	.053	.086	−.081	−.098
	MB3				.114	−.169	−.184	−.021	.011	.203	.056	−.089	−.085	−.144	.016	.232	.124	−.120	−.178
	PS3						−.100		.006		.287	−.007	−.050	−.101	.086	.015	.302	−.019	−.113
	PA3				−.037		.202	.120	−.012	−.062	−.059	.300	.136	.146	−.018	−.051	−.115	.253	.201
	PT3							.004	−.058	−.003	−.088	.072	.278	.035	−.025	−.032	−.085	.049	.247
Time 2:	PB2										−.039	.361	.223	.294	−.065	−.061	−.106	.134	.221
	PC2							−.074		.059	.053	−.035	−.112	−.119	.261	.051	.086	−.060	−.108
	MB2										.016	−.144	−.094	−.084	.004	.156	.158	−.088	−.124
	PS2												−.079	−.069	.003	.006	.415	−.007	−.111
	PA2										−.109		.198	.211	−.007	−.116	−.149	.309	.245
	PT2													.033	−.037	−.081	−.150	.094	.365
Time 1:	PB1																−.110		.346
	PC1													−.161		.120	.124	−.145	−.125
	MB1													−.084			.120	−.276	−.258
	PS1																		−.151
	PA1													.305			−.197		.382

[a] Estimates of total causal effects are based upon traced paths from the estimated model in Table 5.

[b] Column variables affect row variables. PB is peer behavior for petty theft, PC is the perceived certainty of punishment, MB is moral beliefs against petty theft, PS is parental supervision, PA is peer attitude in support of petty theft, and PT is self-reported petty theft.

[c] The endogenous variables are grouped together according to the time period at which the measurement occurred, even though the recall period for the measure of self-reported petty theft is lagged by one year (See Figure 5).

One's own marijuana use does result in an adjustment in estimates of the certainty of punishment for self as predicted by the experiential effect. The effect, however, is mediated by several variables. What the causal model implicit in Tables 3 and 4 reveals is the process through which the experiential effect of one's own behavior is felt. Respondents' use of marijuana eventually neutralizes their fear of sanction threats through two channels. One such channel is the negative effect marijuana use has on both moral beliefs against marijuana use and the extent of parental supervision. Both of these factors are positively related to perceived certainty. The second way marijuana use reduces the certainty of punishment is through its positive effect on peers' behavior and attitudes, both of which weaken beliefs in the certainty of punishment. At least for marijuana use, then, these data suggest that the process of shaping perceptions of legal threats is a process of communication that occurs from parents to respondents' moral beliefs, from peers through their behavior and moral position, and through one's own experience.

2. Petty Theft Model

a. Self-Reported Petty Theft

Table 5 reports the estimated causal effects for the model pertaining to petty theft. In terms of the general utility of the model, the goodness of fit measures suggest that it reproduces the data quite well. Substantively, although the original three-variable model revealed that both lagged effects of perceived certainty on self-reported petty theft were significant, non-trivial, and in the direction predicted by the deterrence doctrine (see Figure 4), the picture changes somewhat when additional deviance generators and inhibitors are added to the model. In explaining self-reported petty theft that occurred during the year between waves one and two (PT2), the deterrent effect for perceived certainty declines almost 50%, from $-.065$ to $-.037$. One deviance generator, peer attitudes ($p = .067$), and two deviance inhibitors, moral beliefs ($p = -.076$) and parental supervision ($p = -.120$), had stronger effects on petty theft at this wave. Contrary to the case for marijuana use, peer attitude rather than behavior has the greater effect on petty theft. In terms of total causal effects on petty theft reported at wave two, the strongest influences were found for parental supervision ($-.150$), peer attitudes (.094), and moral beliefs ($-.081$). Perceived certainty had only a direct effect, and the indirect effect for peer behavior was positive but minor (.033).

In examining the determinants of self-reported petty theft that occurred in the year before wave three (PT3), these data are consistent with the marijuana use model in showing that etiological factors vary in strength at different times. In understanding petty theft over this one-year period, moral beliefs become an inconsequential inhibitor, while the direct role of parental supervision declines from p = −.123 to −.078. The direct effect of peer influence is again felt through peer attitudes in support of petty theft (p = .070), rather than through their behavior. Contrary to the previous wave, however, the deterrent effect of perceived certainty on self-reported petty theft is not substantially reduced if the effects of additional explanatory variables are considered. In the original three-wave, three-variable model (Figure 4), the direct inverse causal effect of perceived certainty at wave two on subsequent petty theft was −.059. This effect is virtually unaffected by the addition of other explanatory variables; the direct effect in the six-variable model is −.058. At this wave, perceived certainty has the third strongest total causal effect on self-reported petty theft in the subsequent year, behind parental supervision (−.088) and peer attitude (.072) in importance. The indirect effect of peer behavior (.004) and moral beliefs (−.003) are not substantively different from zero.

An interesting parallel exists between these data and that found for marijuana use. In both causal models, when an inhibitory effect for moral beliefs is present, the deterrent effect for perceived certainty is nil. When, however, these moral beliefs are neutralized and sanction threats "stand alone," perceived certainty serves as an effective, but by no means strong, deterrent.[55]

b. Perceived Certainty for Petty Theft

The implicit causal model hypothesized in Tables 5 and 6 can again assist the researcher in untangling the factors that influence the formation and modification of perceptions of the certainty of legal punishment. Direct determinants of perceived risk at wave one include moral beliefs (p = .120), peer behavior (p = −.116), peer attitudes (p = −.112), and parental supervision (p = .074). Similar to the case for marijuana use, knowledge about the efficiency of law enforcement comes from two primary sources: one which imparts information that discovery and apprehension for rule breaking is certain, namely, respondents' own moral position and parents, and one which neutralizes that belief, namely, the behavior and attitude of close friends.

[55] *See supra* note 49 and accompanying text.

As was the case for marijuana use, there is no direct experiential effect of respondents' own prior behavior on perceptions of certainty at wave one. However, there is a strong indirect influence on perceptions. Petty theft committed in the year before wave one has a direct positive effect on both peer behavior ($p = .330$) and peer attitude ($p = .252$) and has an inverse effect on respondents' moral beliefs ($p = -.143$) and the extent of their parental supervision ($p = -.151$). The total indirect experiential effect of participation in petty theft on perceptions of the certainty of punishment for petty theft at this wave is $-.125$ (see Table 6). As was found for marijuana use, this data suggest that respondents who commit acts of petty theft are then likely to revise their estimates of certain punishment downward because it puts them into closer affiliation with deviant peers whose actions and attitudes serve to neutralize sanction threats; it leads them to question their moral position regarding the unacceptability of petty theft; and it separates them from their parents whose own beliefs support the perception of certain punishment. The effect of peer behavior on perceptions of certainty is much the same as for respondents' own behavior, though the former effects are weaker. Respondents with friends who commit petty theft are more likely to find petty theft morally acceptable and less likely to be supervised closely by their parents. The ultimate effect of both is to reduce respondents' perception of the certainty of punishment. In terms of both direct and indirect effects, this pattern is repeated at each wave. Peer behavior, peer attitudes, and respondents' own behavior are inversely related to estimates of certain punishment, while moral beliefs and parental supervision contribute to the perception that petty theft is likely to result in apprehension.

IV. Summary and Conclusions

The focus of this Article is the problem of model specification and the temporal ordering of variables in models of social control and deterrence. A review of the literature suggests that research employing a panel design would provide the best opportunity to estimate a true deterrent effect, namely, the effect of perceptions of sanction threats on subsequent behavior. The utilization of panel designs is not, however, a panacea for perceptual deterrence research, for several reasons. First, the appropriate lag interval to capture the process of deterrence is not known. Also, deterrence and social control processes may at times be in relative equilibrium, and even panel data may fail to record on-going causal events. A third reason, and the only one examined in detail in the present Article, is that even with panel designs researchers may ignore the

implied temporal ordering of their variables in estimating causal effects.

A recent three-wave, three-variable model of marijuana use was presented and estimated by Meier and his colleagues.[56] In this model, the deterrent effect was estimated as the effect of perceived certainty on self-reported marijuana use both measured at the same wave, even though the measurement recall period was the past year for self-reported marijuana use and respondents' current assessment of punishment certainty. In spite of possessing longitudinal data, Meier and his associates virtually ignored the logical order implied by the measurement of the deterrence variables and actually employed a series of cross-sectional data to estimate the deterrent effect. Unfortunately, this effect is probably not a deterrent effect, at least not without severe restrictions unaddressed by these data,[57] but, rather, is the experiential effect of respondents' prior behavior on current estimates of sanction threat.

Using Meier's own data, a different specification of the three-wave, three-variable model was tested. This model estimated a deterrent effect as the lagged influence of perceived certainty at one wave on self-reported marijuana use that occurred in the subsequent twelve-month period and measured at the next wave. This respecified model was also estimated with three-wave panel data on self-reported marijuana use and petty theft collected from another sample of high school respondents. All three models produced comparable results. The perceived certainty of punishment had a significant and non-trivial deterrent effect on self-reported deviance. This inverse effect is consistent with the deterrence doctrine, though it is generally weaker than the lagged causal effect of peer behavior. For marijuana use, the deterrent effect was present for

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56 Meier, Burkett & Hickman, *supra* note 4.

57 It was first suggested many years ago that cross-sectional correlations between current perceptions of sanction threats and self-reported criminal behavior that occurred in the past could only be interpreted as reflecting a deterrence process if those perceptions remained stable over time. Silberman, *supra* note 3. If this condition is met then perceptions measured at point t could be used as an accurate indicator of perceptions at an earlier point (t − 1) *before* the commission of the self-reported acts. In this event, a cross-sectional relationship serves as a valid proxy for the deterrent effect. The empirical literature suggests, however, that this critical condition of perceptual stability often may not be met. In samples of youth, they have been shown to change even over as short an interval as three or six months. Furthermore, the data presented herein indicate that one's perceptions are influenced not only by one's own behavior but also by the behavior of others, an effect which is felt over a year interval and longer. *See* Minor & Harry, *supra* note 4; Paternoster, *supra* note 2; *see also*, *supra* note 30 and accompanying text. For a contrary position on the utility of cross-sectional data in perceptual deterrence research, see Lundman, *supra* note 4.

one lagged relationship but not the other. In addition, and contrary to Meier's original analysis, respondents' own behavior had an inverse effect on their estimate of sanction threats.

Subsequent to these analyses, an expanded three-wave, six-variable model was estimated with the marijuana use and petty theft data collected for the present study. This more general model of social control revealed two interesting features of the deterrence process. First, the influences of particular explanatory variables on the generation and inhibition of deviance were not consistent but, instead, varied in their effect at different times. It was found that parents' influence tended to wane over the three-year high school period, while friends' influence became slightly stronger. Most importantly, perceived sanction certainty had a significant and nontrivial effect on respondents' behavior only when the effect of moral beliefs were weakened. Contrary to the findings of some deterrence theorists, these findings suggest that moral condemnation may not be a stable attribute of particular offenses, such as *mala in se* or *mala prohibita* offenses, but are more variable changing over time.[58] At least for these two forms of relatively minor (but common) delinquent acts, moral commitments may be episodically neutralized. The latter interpretation is consistent with social control theory. When moral barriers are temporarily loosened, sanction threats "stand alone" and may prove to be effective deterrents.

Second, these data suggest some of the mechanisms by which perceptions of sanction threats are formed and change over time. Respondents' own involvement in common delinquent acts was inversely related to their estimate of sanction threats because it brought them into closer affiliation with deviant peers and their supportive attitudes, neutralized their own moral condemnation of the acts, and distanced them from parents whose information tended to support a belief in the certainty of punishment.

In sum, these data suggest that perceptions of certain punishment may have a deterrent effect on some forms of common, nonserious delinquency. This effect is not a particularly strong one, however, and may depend upon the temporary loosening of other controls that more effectively regulate conduct. They also confirm some of the notions about deterrence being foremost a process of knowledge acquisition by one's self and communication from others. Most importantly, these data clearly reveal the difficulties in examining the process of deterrence. In addition to the problems of appropriate lag intervals and model equilibrium, there is the issue

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[58] J. ANDENAES, *supra* note 51, at 45-46.

of model specification. This research suggests that relevant explanatory factors may vary over time and thereby necessitate the estimation of fully specified causal models. Indeed, as with other models of social control, there is the possibility that the deterrent effect observed here may be spurious, due to exclusion of an important factor. The findings of this Article are in complete agreement with Meier's call for hard thinking about deterrence and social control processes and for the construction of complete causal models. Panel designs alone cannot provide the solution for the problem of estimating a deterrent effect which literally may be "here today, gone tomorrow."

APPENDIX

COMPARISON OF MEANS FOR MEASURED VARIABLES AT WAVE ONE BETWEEN RESPONDENTS COMPLETING ALL THREE QUESTIONNAIRES (SAMPLE 1) AND THOSE EVENTUALLY LOST TO CASE ATTRITION (SAMPLE 2)

Marijuana Use

	Sample 1			Sample 2			Arithmetic X_1-X_2
	X	sd	(n)	X	sd	(n)	Difference
Peer Behavior	1.67	.85	(1229)	2.05	1.04	(1415)	−.38
Perceived Certainty	2.68	1.24	(1211)	2.43	1.20	(1372)	.25
Moral Beliefs	4.53	.95	(1226)	4.12	1.28	(1391)	.41
Parental Supervision	3.16	.76	(1236)	2.95	.81	(1433)	.21
Peer Attitude	1.94	1.33	(1229)	2.44	1.56	(1417)	−.50
Marijuana Use	.55	1.26	(1197)	1.29	2.03	(1343)	−.74

Petty Theft

	Sample 1			Sample 2			Arithmetic X_1-X_2
	X	sd	(n)	X	sd	(n)	Difference
Peer Behavior	1.51	.75	(1233)	1.67	.82	(1415)	−.16
Perceived Certainty	3.01	1.06	(1220)	2.87	1.09	(1390)	.14
Moral Beliefs	4.71	.62	(1225)	4.56	.76	(1396)	.15
Parental Supervision	3.16	.76	(1236)	2.95	.81	(1433)	.21
Peer Attitude	1.70	.99	(1229)	1.94	1.14	(1419)	−.24
Petty Theft	.21	.64	(1206)	.38	.89	(1357)	−.17