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Journal

Justice Quarterly, 21(4)

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Publication Date

2004

THE NONLINEAR EFFECTS OF PARENTAL AND TEACHER ATTACHMENT ON DELINQUENCY: DISENTANGLING STRAIN FROM SOCIAL CONTROL EXPLANATIONS

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Social control and general strain theory (GST) both predict that parental and teacher attachment will affect delinquency, but differ in their predictions about the form of this effect. Social control theory predicts that positively attached individuals will be much less delinquent than neutral and negatively attached individuals, with there being little difference in delinquency between the neutral and negatively attached individuals. GST predicts that negatively attached individuals will be much more delinquent than neutral and positively attached individuals, with there being little difference in delinquency between the neutral and positively attached individuals. These competing predictions are tested with data from a national sample of adolescent males. Results support the GST prediction, and thereby shed important light on the relationship between two of the central variables in the field and delinquency. This study also questions the tendency for criminologists to assume that effects are linear, and provides some guidance for investigating nonlinear effects.

Researchers seeking to test general strain theory (GST) confront a major problem: Many of the variables that index strain also index social control (see Agnew, 1993, 1995a, 1995b, Agnew,

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Rebellion, & Thaxton, 2000; Agnew & White, 1992). This is perhaps most true of parental and teacher attachment. Parental and teacher attachment are usually measured by asking juveniles such things as how much they like, respect, feel close to, and get along with their parents and teachers (such items are highly correlated and almost always load on the same factor). These measures frequently have a significant direct effect on delinquency. The effect of these measures, however, can be explained in terms of both GST and social control theory.¹

According to GST, strain involves negative relationships with others, defined as "relationships in which others are not treating the individual as he or she would like to be treated" (Agnew, 1992, p. 48). Such relationships may involve the blockage of goal-seeking behavior, the presentation of negative stimuli, and/or the removal of positive stimuli. From the perspective of GST, *low* attachment to parents and teachers is "both a symptom and a source of strain" (Agnew, 1995a, p. 120; also see Agnew, 1993, 1995b; Agnew et al., 2000). Juveniles are low in attachment because they believe they have been negatively treated by these others. Further, it is unpleasant to regularly interact with people you dislike (falling under that category of strain involving the presentation of negative stimuli). This strain creates negative feelings, such as anger, frustration, and depression. These negative feelings in turn create pressure for corrective action, and juveniles *may* engage in delinquent coping in an effort to reduce negative treatment by parents and teachers (e.g., assault parents and teachers to end abuse), escape from parents and teachers (e.g., running away, curfew violation, truancy, theft to reduce financial dependence on parents), seek revenge against parents, teachers, and related targets (e.g., aggression, vandalism), and/or alleviate their negative feelings (e.g., illicit drug use). Several tests of GST have included measures of attachment among their strain variables (e.g., Hay, 2003; Paternoster & Mazerolle, 1994), and Agnew et al. (2000) provide an extensive discussion of the role of attachment in GST.

¹ Social learning/differential association theories can also explain the effect of attachment on delinquency. Most notably, these theories would also argue that the absence of positive attachments increases delinquency by increasing the likelihood of association with delinquent peers. There is some support for this argument, although attachment often affects delinquency even after controls for delinquent peer association (see Agnew 1993, 1995b). These theories would also explain the effect of attachment in ways that mirror social control theory: Juveniles who are positively attached to parents are less delinquent because their parents have greater reward value for them, making it easier to control behavior directly and indirectly (e.g., juveniles are more responsive to parental sanctions, more fearful of jeopardizing parental ties, and more likely to model parental behavior and adopt parental beliefs).

Social control theory provides a rather different explanation for the relationship between attachment and delinquency. *High* attachment to parents and teachers is said to reduce the likelihood of delinquency because juveniles do not want to hurt these others or jeopardize their relationships with them. Attachment, then, does not positively motivate delinquency. Rather, it restrains individuals from delinquency by increasing the costs of delinquency. Most criminologists favor the social control interpretation, perhaps reflecting the fact that social control theorists like Nye (1958) and Hirschi (1969) introduced the variable of attachment into delinquency research.

It is important, however, to test the strain and social control explanations for the effect of parental and teacher attachment on delinquency. Doing so will deepen our understanding of why two of the core variables in the field impact delinquency (see the discussion of "depth" in Tittle, 1995, pp. 43–51). It will improve our ability to explain variation in delinquent offending (more below). And it will allow us to better control delinquency, because strain and control theory make somewhat different proposals for reducing delinquency. For example, while both theories would recommend increasing parental and teacher attachment, strain theorists would also recommend efforts to alleviate negative emotions like anger while control theorists would not (see Agnew, 1995c for a fuller discussion).

The most obvious way to test these explanations is to measure directly the intervening processes posited by strain and social control theories (see Agnew, 1993, 1995a, 1995b, 2001). Strain theory argues that the effect of attachment on delinquency is mediated by negative emotions such as anger, frustration, and depression. Social control theory argues that the effect of attachment is mediated by the perceived costs of delinquency, particularly the fear of hurting conventional others and jeopardizing relationships with them. A few studies have examined the intervening processes associated with strain theory, though none have examined whether the effect of attachment on delinquency is mediated by anger (but see Agnew, 1993, who reports that a general measure of social control including attachment affects delinquency partly through anger). No studies that we are aware of have examined the intervening mechanisms associated with social control theory.

Unfortunately, studies of intervening mechanisms are difficult to carry out. A proper test of the strain and social control explanations requires both trait and state measures for a range of negative emotions as well as measures of the perceived costs of

delinquency (for discussions of the difficulties of properly measuring emotions such as anger, see Furlong & Smith, 1994; Schieman, 2000; and Stone, 1995). It also requires longitudinal data, because it is important to verify that the intervening processes in question are both a consequence of attachment and a cause of delinquency. No existing data set allows for a full test of the strain and social control arguments, though several data sets allow for partial tests (e.g., they allow for the measurement of select intervening processes, such as trait anger—see Agnew, 1995b and Brezina, 1998).

There is, however, another way to examine the social control and strain explanations for the effect of attachment. While both theories predict that parental and teacher attachment affect delinquency, their predictions about the form of this effect are different. If we carefully examine the reasoning behind each theory, we find that each predicts that attachment has a particular type of nonlinear effect on delinquency. This paper describes the predictions that each theory makes in this area, then draws on data from a national sample of adolescent boys to test these predictions.

Nonlinear effects are estimated using polynomial regression, a fairly straightforward technique that is capable of modeling the types of nonlinear effects predicted by both strain and social control theories (see, e.g., Aiken & West, 1991). The results, however, are verified using three additional techniques for modeling nonlinear effects: (1) a “dummy regressor” model that relaxes the assumption of linearity (Fox, 1997); (2) a semi-log regression model (Gujarati, 1988); and (3) a scatterplot smoothing technique based on robust locally weighted regression (Cleveland, 1979).² Each of these techniques has certain advantages and disadvantages, which are described below, but together they allow for a thorough examination of nonlinear effects. This paper, then, not only performs a crucial test between two leading theories, but also provides some guidance for the investigation of nonlinear effects more generally. With a few notable exceptions (see conclusion), theorists and researchers generally assume that the key variables in the field have a linear effect on delinquency. This assumption, however, may be unjustified in certain cases and—as

² Other approaches to estimating nonlinear effects are also available: however, these techniques tend to be extremely problem specific and place rather strict assumptions on the data (see Bates & Watts, 1988; Ratkowsky, 1990). Moreover, these approaches often require an exact or nearly exact mathematical specification of the functional form—virtually an impossible task with existing criminological theory (Borowiak, 1989). Readers interested in these alternative approaches should consult the above-mentioned texts for a detailed treatment.

illustrated in this paper—may sometimes seriously impede our efforts to explain and control delinquency.

THE NONLINEAR EFFECTS OF ATTACHMENT ON DELINQUENCY: SOCIAL CONTROL AND STRAIN THEORY PREDICTIONS

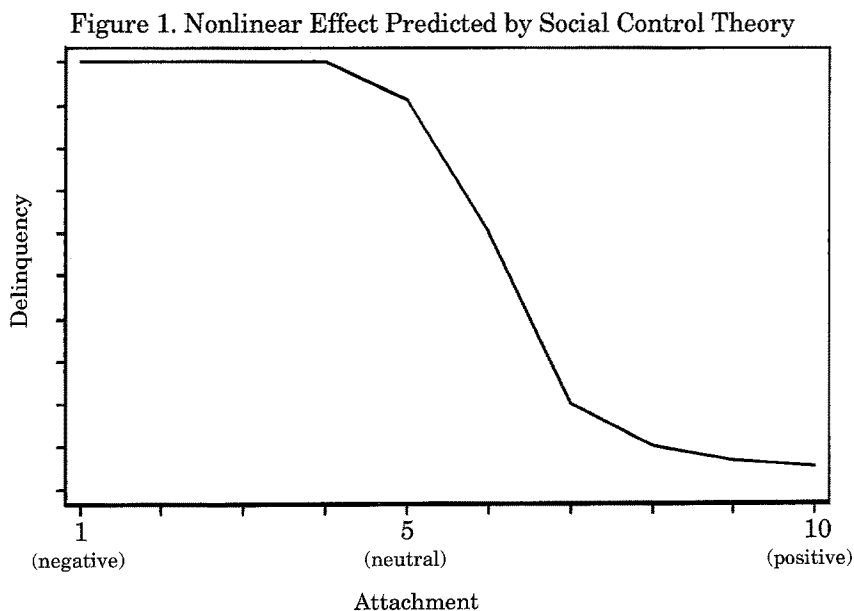
Attachment ranges along a continuum, from “positive” attachments (love or like others) to “neutral” attachment (neither like nor dislike others, do not care about others) to “negative” attachments (dislike or hate others).

Social Control Theory

Social control theory focuses on the presence or absence of *positive* attachments toward others. This is reflected in Hirschi's (1969) seminal version of social control theory, where the crucial distinction is between those who are attached to conventional others and those who lack such attachments. Positive attachments restrain delinquency through the costs they impose; that is, positively attached juveniles have much to lose through delinquency. Their delinquency may hurt others they care about and/or jeopardize their relationships with these others. The absence of positive attachments provides the freedom to engage in delinquency. In particular, juveniles are freer to satisfy their needs and desires in the most expedient way possible, including delinquency, since they do not have to worry about the impact of their delinquency on valued others.

If we follow the logic of control theory, juveniles who are positively attached to conventional others should be much less delinquent than those who are neutral toward or negatively attached to conventional others. Neutral and negatively attached juveniles, however, should have similar levels of delinquency. Juveniles who do not care about conventional others are as low in social control as juveniles who dislike or hate conventional others. Both have nothing to lose by engaging in delinquency, because “neither is concerned with incurring the disapproval of others or hurting others” (Agnew, 1995a, pp. 119–120). In the words of Hirschi (1969, p. 108), “if the child does not care or think about the reaction of his parents, their control over him is seriously reduced.” For these reasons, social control theory predicts a nonlinear effect of the type shown in Figure 1. Individuals who hate/dislike their parents (or teachers) are about as delinquent as individuals who hold neutral feelings toward their parents, while individuals who

like/love their parents are much less delinquent than the first two groups.



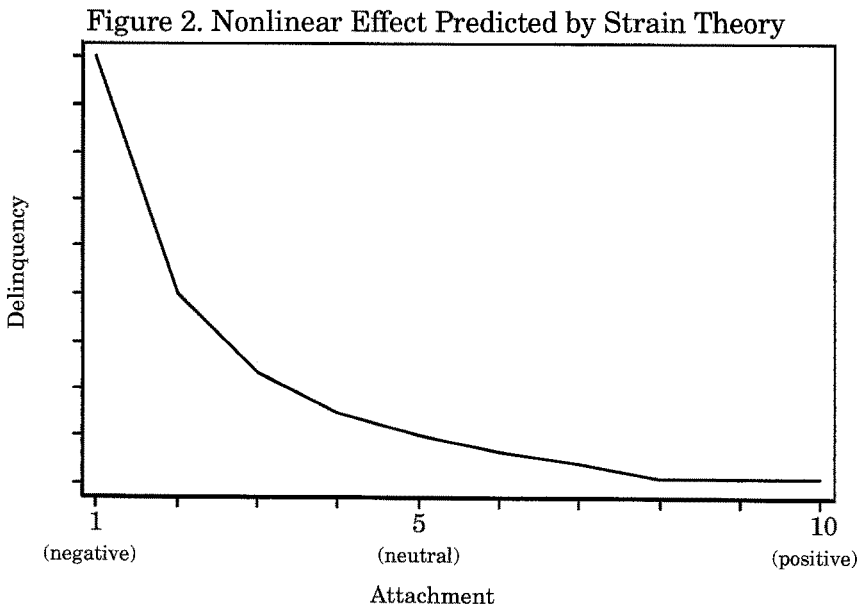
General Strain Theory

General strain theory (GST) focuses on the presence or absence of *negative attachments* to others (Agnew, 1992, 1993, 1995a). That is, does the juvenile hate/dislike others or not? Negative attachments positively motivate delinquency because of the strain associated with them. Juveniles hate or dislike parents and teachers because they believe that these others have mistreated them. Also, it is stressful to interact with people you hate or dislike. This strain generates a range of negative emotions and, as indicated above, these emotions motivate delinquency as adolescents seek to reduce or escape from their strain, obtain revenge against the source of their strain or related targets, and alleviate the negative emotions associated with their strain. The absence of negative attachments (i.e., neutral or positive attachments), however, is associated with little strain and so creates little motivation for delinquency.

If we follow the logic of GST, juveniles who are negatively attached to others should be much more delinquent than juveniles who are neutral toward or positively attached to others. The “neutral” and positively attached juveniles should have similar

levels of delinquency because both are low in what is perhaps the major type of strain: the presentation of negative stimuli (see Agnew, 1992; Agnew & White, 1992). One might argue that the "neutral" juveniles should be higher in delinquency than the positively attached juveniles because the neutral juveniles are more likely to experience a particular type of goal-blockage: the failure to achieve positive relations with parents. This type of goal-blockage, however, is unlikely to produce delinquency because the desire for positive parental relations is not easily achieved through illegitimate channels and it implies some level of social control (see Agnew, 2001, p. 340). For these reasons, GST predicts a nonlinear effect of the type shown in Figure 2. Individuals who hate/dislike their parents (or teachers) are much more delinquent than those who hold neutral feelings toward or like/love their parents (or teachers), with the "neutral" and positively attached juveniles having similar levels of delinquency.

It is possible, then, to test between the social control and strain explanations by examining the type of effect attachment has



on delinquency.³ Doing so requires measures that distinguish between negative attachments, neutral attachment, and positive attachments. While self-report surveys of delinquency commonly measure parental and teacher attachment, most of the attachment measures they use do not distinguish negative from neutral attachments. Most commonly, researchers will present juveniles with statements like "I feel very close to my mother" or "my father and I do things together that we both enjoy." Respondents can then select among several response categories, typically ranging from "strongly agree" to "strongly disagree." Those who strongly disagree, however, may hate or dislike their parents or feel neutral toward them. The fact that most attachment measures fail to distinguish negative from neutral attachments may reflect the dominance of social control theory. As indicated, control theory simply focuses on the presence or absence of positive attachments—it does not accord much importance to the distinction between neutral and negative attachments.

Only two studies that we are aware of have employed measures that distinguish negative from neutral attachments.⁴ Hirschi (1969, p. 121) used a survey that asked students "do you like school?" with the students being presented with three response categories: "like," "neither like nor dislike," and "dislike." Hirschi then calculated the percentage of students in each response category who had committed zero, one, or two or more delinquent acts. He found that those who disliked school were much higher in delinquency than those who neither liked nor disliked school. Indifferent students, in turn, were more delinquent than those who liked school. So school attachment had a roughly linear relationship to delinquency, supporting both strain and social control theories. It is important to note that Hirschi himself viewed the data in this way. In particular, he stated that the higher delinquency of those who disliked school is consistent... with a frustration hypothesis, but he went on to note that the indifferent

³ This method, however, is less well suited for distinguishing between social control and social learning explanations for the effect of attachment. For reasons indicated in note 1, social learning theory would also predict that positively attached juveniles will be less delinquent than neutral and negatively attached juveniles. It is less clear whether social learning theory would predict that neutral individuals will be less delinquent than negatively attached individuals. Agnew (1993, 1995b) discusses methods for testing between strain, social control, and social learning explanations.

⁴ Agnew (1995a, p. 120) reports that Nye (1958, pp. 71–72) distinguishes between negative and neutral attachments toward parents, but an examination of the items in Nye's parental rejection scale suggests otherwise (Nye, 1985, pp. 76–78). For example, one item asks "Are you interested in what your (mother/father) thinks of you?" with response categories ranging from "very much" to "not at all." It is unclear whether those who respond "not at all" have neutral or negative attachments to parents. The same is true for the other items in this scale.

students were more numerous and that they were more delinquent than those who liked school. He therefore stated that the data "does not support the view that acute discontent or intense frustration are in any sense necessary conditions for crime" (Hirschi, 1969, p. 122).

Agnew et al. (2000, p. 130) employed a survey that asked students "how satisfied are you with how you get along with your parents," with response categories ranging from "completely dissatisfied" to "completely satisfied." Parental dissatisfaction was converted into a set of dummy variables: "satisfied" juveniles, "dissatisfied" juveniles, and "neutral" juveniles—who were treated as the reference category. Several measures of drug and alcohol use were regressed on these dummy variables, with controls for sex, race, and social class. Agnew et al. discovered that students who were dissatisfied with how they "got along" with parents were more likely to engage in alcohol and drug use than those who were neither satisfied nor dissatisfied. The neutral students, in turn, were more likely to use drugs/alcohol than the satisfied students; again suggesting a linear relationship.

More research is clearly needed in this area, however, particularly research that controls for a fuller range of third variables that may be related to attachment and delinquency, that examines the effect of parental attachment on types of delinquency other than drug/alcohol use, and that employs recent methods for estimating nonlinear relations.

DATA

This study uses data from the "High School Youth, Weapons, and Violence" survey conducted by Sheley and Wright (1998). The survey is based on a national sample of 734 male high school sophomores and juniors conducted in 1996 (see Sheley & Wright, 1998, 2000). A random sample of 132 schools was selected from a national listing of high schools, with 53 of these schools agreeing to participate in the survey. There do not appear to be any major differences between the participating and nonparticipating schools across a range of sociodemographic and other variables. Surveys were then mailed to the eligible high school students in the participating schools, with 45% of these students returning the surveys. Data suggest that these respondents are somewhat biased toward "good boys," though the bias "is not so radical as to render the sample free of delinquency and related problems" (Sheley & Wright, 1998, p. 2).

Measures

Parental and Teacher Attachment Measures. Parental and teacher relations are measured on a ten-point semantic differential scale ranging from "awful" to "great," making it possible to examine the strain and social control predictions described above. Respondents were asked "On a scale of 1 (awful) to 10 (great), how would you rate your relationship with your parents or the adult you live with?" and responded by placing a check mark on a line divided into 10 parts, with the line labeled "awful" at one end and "great" at the other. Teacher attachment was measured in an identical manner, except that respondents were asked to rate their relationship with "most of your teachers."

The distributions of the parental and teacher attachment variables are highly skewed. Only 3.7% (26) of the respondents score from "1" to "4" or report that they are negatively attached to parents and only 5.6% (40) report that they are negatively attached to teachers.⁵ Other studies produce somewhat higher estimates of the extent of negative attachment (e.g., Hirschi, 1969; Agnew et al., 2000), though data do suggest that most juveniles are positively attached to their parents and teachers. The "good boy" bias in this sample may have led us to underestimate the extent of negative attachment by a modest amount. The small percentage of negatively attached juveniles, however, should not be dismissed as unimportant. It is estimated that from 5% to 10% of all adolescents are high-rate offenders, accounting for an enormous amount of delinquency, including a majority of all serious delinquency (see Farrington, 1995). Identifying negatively attached juveniles would be quite important if such juveniles were especially likely to offend at high rates.

Delinquency Measure. Delinquency is measured by a 12-item scale with high scorers stating that they have frequently engaged in the following offenses during the last 12 months: steal something worth more than \$50 (14% at least once); use hard drugs (5% at least once); sell hard drugs (3%); threaten to shoot someone (2%); threaten someone with a knife or sharp object (7%); shot at someone (2%); stab someone (3%); use a weapon to stick up a store or person (2%); break into a home, store, or car to steal something (8%); hit or try to injure someone with an object like a bat (15%); carry a gun (5%); and carry a knife (15%) (Cronbach's $\alpha = .91$). Response categories for each item are "never," "just once," "a few

⁵ Due to the small number of cases in the first two categories (1 and 2) for both parental and teacher attachment, these categories were collapsed into one category resulting in nine total categories.

times,” and “many times,” coded from 0 (“never”) to 3 (“many times”). Respondents’ delinquency scores reflect their average response across the 12 items. This scale clearly focuses on serious acts of delinquency. Future research should examine less serious forms of delinquency, which may be more strongly related to the attachment measures (see Agnew, 1991). Future research should also employ delinquency measures that do not use truncated response categories, like “many times,” since these categories may cause us to underestimate the delinquency of chronic offenders.

Control Variables. Unless otherwise indicated, the analyses control for the sociodemographic characteristics of the respondents and several of the leading causes of delinquency, including grades and gang membership. In particular, the control variables include: age (in years); race (0 = white, 1 = nonwhite); the education in years of the head of the household; whether the family has received welfare benefits in the last year (0 = no, 1 = yes); intact home (0 = “broken home”; 1 = both natural mother and father present); the juvenile’s grades in school (1 = mostly Fs, 2 = mostly Ds, 3 = mostly Cs, 4 = mostly Bs, 5 = mostly As); gang membership (0 = no, 1 = yes); and church attendance (1 = never, 2 = less than once a year, 3 = once a year, 4 = several times a year, 5 = once a month, 6 = every week). (See Table 1 for descriptive statistics.) Subsequent research should attempt to control for additional variables, particularly level of self control (see Gottfredson & Hirschi, 1990).

Table 1. Descriptive Statistics

	<i>N</i>
Delinquency (12-item scale)	720 Mean = .09; S.D. = .25 (Range: 0–3)
Age (years)	727 Mean = 16.87; S.D. = .81 (Range: 15–21)
Race	729 White = 69.8%; Nonwhite = 30.2%
Parent’s Education (years)	723 Mean = 13.41; S.D. = 3.51 (Range 1–18)
Receive Welfare	731 Yes = 13.6%; No = 86.4%
Intact Home	732 Yes = 62.4%; No = 37.6%
Grades in School	730 Mean = 3.81; S.D. = .85 (Range: 1–5)
Gang Membership	726 Yes = 7.5%; No = 92.5%
Church Attendance	731 Mean = 4.0; S.D. = 1.91 (Range: 1–6)
Attachment to Parents	730 Mean = 6.98; S.D. = 1.74 (Range: 1–9)
Attachment to Teachers	731 Mean = 6.41; S.D. = 1.81 (Range: 1–9)

METHODS

Linear models are more parsimonious than nonlinear ones (Borowiak, 1989; McDowall, 2002); therefore the standard practice in the literature is to compare alternative nonlinear models against a linear null model, favoring the nonlinear model *only* if it provides significantly better fit (Fox, 2000a, 2000b; Greene, 2000). Numerous analytical approaches allow researchers to empirically

examine the functional form of the relationship between variables, the most desirable being those which allow for a wide variety of possible nonlinear forms (see McDowall, 2002, p. 718). While several plausible models exist (e.g., polynomial regression models, robust locally weighted regression, semi-log regression models, and “dummy regressor” models), they differ in their underlying assumptions and computational complexity. We, therefore, elected to examine several different models, taking advantage of the unique properties of each. We rely primarily on polynomial regression (Aiken & West, 1991; Kromrey & Foster-Johnson, 1999) because it has certain advantages over the other approaches. In contrast to robust locally weighted regression (see Cleveland, 1979; Fox 2000a, 2000b; Hastie & Tibshirani, 1990), it can be used with virtually all statistical software packages,⁶ is a relatively straightforward extension of linear regression, can easily accommodate a range of control variables, and provides a simple equation describing the functional form. In contrast to semi-log regression models (see Greene 2000; Gujarati, 1988), it allows one easily to model a broad range of functional forms—including those shown in Figures 1 and 2. Finally, in contrast to dummy regressor models (see Fox, 1997; Greene 2000), it easily handles continuous variables and discrete variables with many categories without greatly sacrificing model parsimony.

A common type of polynomial regression involves including a quadratic (i.e., squared) term, X^2 , along with the first order term ($X^{(1)}$), in a linear (or generalized linear) model. The “main effect” of the explanatory variable, then, is a combination of the linear (first order) effect and the quadratic (second order) effect; therefore both the X and X^2 terms must be included in the model (Aiken & West, 1991, p. 63). Although additional higher-order terms, e.g., cubic or quartic, may also be used, researchers are unlikely to find these effects in social science research (Fox, 2000; Ratkowsky, 1990). Higher terms have been commonly used to test for nonlinear relationships in models that assume linearity in their parameters (see Borowiak, 1989; Ratkowsky, 1990). In fact, a quadratic term (or any other higher-order term) is a special case of an interaction: the effect of the independent variable on the dependent variable depends on the level of the same independent variable (see Friedrich, 1982, p. 829). The detection of a significant effect for a quadratic term indicates that the effect (i.e., slope) of the exogenous predictor is variable across its own range, i.e., evidence

⁶ We use *Stata 8* (StataCorp, 2003) to conduct all of the analyses in this study.

of nonlinearity.⁷ A common misconception is that the inclusion of a quadratic term necessarily implies that the functional form is U- or inverted U-shaped. While the quadratic term does imply that there is a maximum or minimum "effect" *and* that there is a single curve (bend) in the function, the maximum or minimum may occur outside the observed range of the explanatory variable (Aiken & West, 1991). The functional form, then, is more flexible than a U- or inverted U-shape because both the linear and quadratic components of the main effect must be jointly considered. For example, the form may be predominately positive or negative (i.e., a predominately increasing or decreasing function) and concave or convex (see Aiken & West, 1991, pp. 66–68; Ratkowsky, 1990, chapter 4). It is therefore incumbent on the researcher to plot the "main" effect of an explanatory variable in order to identify more clearly the functional form of the relationship.

It is important to note that using higher-order terms to test for nonlinearity is a rather conservative test of nonlinearity. As McClelland and Judd (1993) note, interaction effects are extremely difficult to detect in field research (e.g., survey research)—due to measurement error, extremely high collinearity between component variables, and differential residual variances—and field tests usually have less than 20% of the efficiency of optimal experimental tests. These problems tend to be compounded with polynomials because the constituent variables are identical, significantly increasing the probability that researchers will fail to detect significant interactions (Kromrey & Foster-Johnson, 1999, p. 395). In light of these limitations, detection of a significant effect provides rather strong support for nonlinearity (McClelland & Judd, 1993).

RESULTS

As noted above, nonlinear models are preferable to linear models only if they significantly improve model fit; therefore we first estimated the *linear* effects of parental and teacher attachment on delinquency using ordinary least squares (OLS)

⁷ Technically, the slope coefficient for a squared term describes the change in the effect of the variable for every one unit change of the same variable (Friedrich, 1982). However, failure to find the slope coefficient for the quadratic term statistically significant does not necessarily mean that there is no significant interaction effect. Nor does the presence of a statistically significant slope coefficient for an interaction term necessarily indicate that the effect of the variable is statistically significant throughout the entire range of the interaction. Conditional slopes and conditional standard errors must be calculated at various levels of the interaction in order to determine if and when the interaction is significant (see Friedrich, 1982; Jaccard, Turrisi, & Wan, 1990). We discuss the calculation of conditional slopes and conditional standard errors when presenting our results.

regression. Regression results are shown in Column 1 of Table 2. Both parental and teacher attachment have a significant negative effect on delinquency, although this effect is small in size—with the standardized regression coefficients for parental and teacher attachment being -0.16 and -0.12, respectively (such small effects are not uncommon in multivariate analyses; see the studies cited in Kempf, 1993).

Table 2. OLS Coefficients Predicting Delinquency: Linear and Nonlinear Models for Parental and Teacher Attachment^a

	Model 1		Model 2		Model 3	
	LRM		Parental PRM		Teacher PRM	
	Coefficient		Coefficient		Coefficient	
	(S.E.)		(S.E.)		(S.E.)	
Age (in years)	-.01	(.01)	-.01	(.01)	-.01	(.01)
	[-.04]		[-.04]		[-.04]	
Race (White)	-.02	(.02)	-.01	(.02)	-.01	(.02)
	[-.03]		[-.02]		[-.02]	
Parental Education	.00	(.00)	.00	(.00)	-.01	(.00)
	[.01]		[.01]		[-.01]	
Receive Welfare	.07	(.03)**	.08	(.03)**	.07	(.03)**
	[.10]		[.10]		[.10]	
Intact Home	-.03	(.02)	-.03	(.02)	-.03	(.02)
	[-.06]		[-.06]		[-.06]	
Grades in School	-.04	(.01)**	-.04	(.01)**	-.04	(.01)**
	[-.14]		[-.13]		[-.13]	
Gang Membership	.25	(.03)**	.24	(.03)**	.24	(.03)**
	[.26]		[.25]		[.25]	
Church Attendance	.00	(.00)	-.01	(.01)	.00	(.00)
	[-.03]		[-.04]		[-.03]	
Attachment to Teachers	-.02	(.01)**	-.02	(.01)**	-.01	(.01)
	[-.12]		[-.13]		[-.06]	
Attachment to Parents	-.02	(.01)**	.00	(.01)	-.02	(.01)**
	[-.16]		[-.03]		[-.16]	
Attachment to Parents (quadratic)			.01	(.00)**		
			[.23]			
Attachment to Teachers (quadratic)					.01	(.00)*
					[.09]	
Intercept	.10	(.02)**	.17	(.04)**	.08	(.02)**
AIC	-3.03		-3.08		-3.04	
N	690		690		690	
Adjusted R ²	0.23		0.27		0.24	

^a Standardized coefficients in brackets; standard errors in parentheses

* $p < .05$; ** $p < .01$ (two-tailed)

LRM = Linear Regression Model; PRM = Polynomial Regression Model

We next performed the polynomial regressions, adding a quadratic term involving parental attachment in one equation and a quadratic term involving teacher attachment in another. Columns 2 and 3 in Table 2 show these regression results, respectively. For the unstandardized regression coefficients, both

parental and teacher attachment were mean centered prior to squaring in order to reduce high collinearity between the variables (see Aiken & West, 1991; Cohen & Cohen, 1983).

The (standardized) parental attachment coefficient ($\beta = -.03$; $p > .10$), because of centering resulting from standardization, indicates the effect of parental attachment on delinquency when parental attachment is at its mean. Parental attachment does not have a significant effect on delinquency at its "average" value. The (standardized) coefficient of the squared parental attachment measure ($\beta = .23$; $p < .01$) is statistically significant. Incremental F -tests and information measure (i.e., Akaike's Information Criterion) comparisons also indicate that the inclusion of the squared term significantly improves the fit of the model.⁸ This suggests that the effect of parental attachment on delinquency does vary across levels of parental attachment; that is, the effect of parental attachment is *conditional* on its own value. The (standardized) coefficient indicates the change in the slope of parental attachment for a one standard deviation increase in parental attachment. Using this information, it is possible to calculate the effect of parental attachment on delinquency at different levels of parental attachment (Aiken & West, 1991, p. 64).⁹ The top half of Table 3 shows the effect of parental

⁸ Incremental F -tests and information measures are alternative approaches to assessing model fit, primarily differing in how less parsimonious models (i.e., models estimating additional parameters) are penalized. The incremental F -test can be used to compare models that are nested (in our case, models with and without a quadratic term). If the model with the quadratic term significantly improves model fit, there is support for a nonlinear relationship (see Ramsey 1969; Ramsey & Schmidt, 1976). The F -test is defined as: $F = [(RSS_0 - RSS_1)/(q)]/[RSS_1/(n - k - 1)]$; where RSS_0 is residual sum of squares from the null model, RSS_1 is the residual sum of squares from the model containing the quadratic term, q is the number of constrained parameters, n is the number of observations, and k is the number of parameters in the full model. The statistic has an F -distribution with q and $n - k - 1$ degrees of freedom (Fox, 1997, p. 124; Greene, 2000, p. 439).

Akaike's Information Criterion (AIC) can be used to compare the linear and nonlinear specifications examined in this article (see Akaike, 1987). The AIC allows the researcher to examine how well different models conform to the data, assessing a penalty to models that include more parameters. Unlike incremental F -tests, AIC can also be used to compare *both* nested and non-nested models. For least squares estimation, $AIC = [\log(RSS/N) + 2P]/N$; where RSS is the residual sum of squares, P is the number of parameters in the model, and N is the number of observations (Greene, 2000, p. 306). All else being equal, the model with the smaller AIC is considered the better fitting model. F -tests and AIC comparisons of the parental attachment models indicate that the nonlinear model provided superior fit: $F(1, 678) = 35.23$, $p < .001$. Similarly, the nonlinear teacher attachment model offered improved fit: $F(1, 678) = 6.63$, $p < .01$.

⁹ The derivative for calculating the conditional slope of a quadratic equation is defined as $b_1 + 2b_2X$; where b_1 is the slope coefficient of the linear term, b_2 is the slope coefficient for the quadratic term, and X is the value at which the slope is to be evaluated. It is important to note that the calculation of the conditional slope for a quadratic term is different from calculating the conditional slope of a regular interaction term (Aiken & West, 1991, p. 73). The conditional standard error is defined as: $s(b_1 \text{ at } X) = [\text{var}(b_1) + 4X^2\text{var}(b_2) + 4X\text{cov}(b_1, b_2)]^{1/2}$; where $\text{var}(b_1)$ is the

attachment on delinquency when parental attachment is at its minimum, at one standard deviation below its mean, at its midpoint, at its mean, at one standard deviation above its mean, and at its maximum. Parental attachment has a relatively large and statistically significant negative effect on delinquency when attachment is in the negative range, but this effect weakens and becomes insignificant as attachment increases.

Table 3. Conditional Slopes and Standard Errors^a

Effect of Parental Attachment at:	<i>Slope</i>	<i>S.E.</i>
minimum (1)	-.15 [-1.05]	(.07)*
midpoint (5)	-.05 [-.37]	(.02)*
1 std. dev. below mean (5.24)	-.05 [-.32]	(.02)*
mean (6.98)	-.00 [-.03]	(.01)
1 std. dev above mean (8.72)	.04 [.27]	(.02)
maximum (9)	.05 [.32]	(.03)
Effect of Teacher Attachment at:	<i>Slope</i>	<i>S.E.</i>
minimum (1)	-.06 [-.46]	(.03)*
1 std. dev. below mean (4.60)	-.03 [-.21]	(.01)*
midpoint (5)	-.03 [-.18]	(.01)*
mean (6.41)	-.01 [-.06]	(.01)
1 std. dev. above mean (8.21)	.01 [.05]	(.01)
maximum (9)	.01 [0.10]	(.01)

^a Standardized coefficients in brackets; standard errors in parentheses

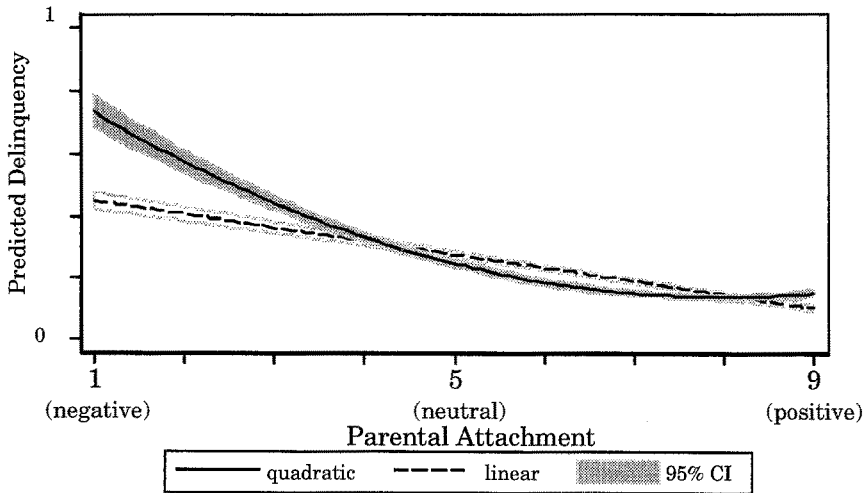
* $p < .05$; ** $p < .01$ (two-tailed)

It is also possible to plot the predicted value of delinquency when parental attachment is at various levels. This plot, shown in Figure 3, provides the most straightforward illustration of the type of nonlinear effect that parental attachment has on delinquency. This effect is quite similar to that predicted by strain theory.

variance of the slope coefficient for the first-order term, $var(b_2)$ is the variance of the slope coefficient for the quadratic term, and $cov(b_1, b_2)$ is the covariance of the slope coefficients for both terms.

Negatively attached individuals are much higher in delinquency than neutral and positively attached individuals, with there being little or no difference in delinquency between the neutral and positively attached individuals. What matters, then, is whether or not individuals are negatively attached to their parents.

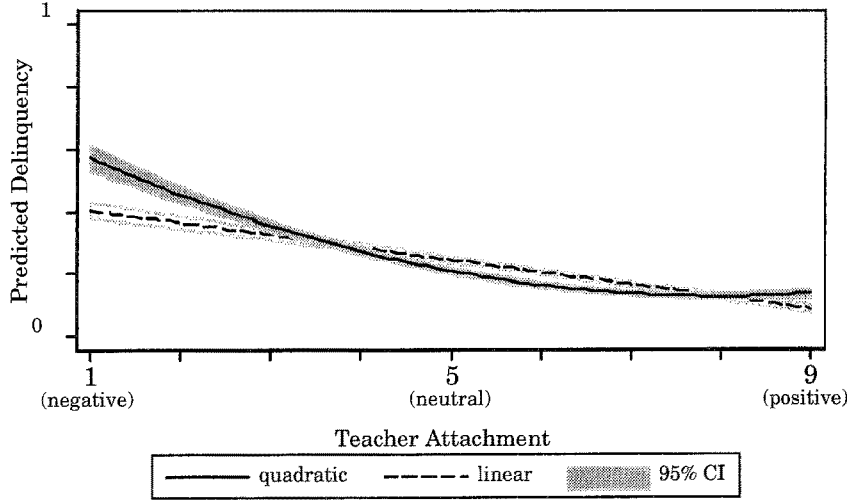
Figure 3. Curvilinear (and Linear) Effects of Parental Attachment on Delinquency



NOTE: Predictions calculated after controlling for covariates in the model.

The results for teacher attachment are very similar to those for parental attachment. As shown in column 3 of Table 2, the quadratic term for teacher attachment is statistically significant. Further, incremental F -tests and AIC comparisons indicate that the inclusion of this term significantly improves model fit. Teacher attachment, then, also has a nonlinear effect on delinquency. The bottom half of Table 3 shows the effect of teacher attachment on delinquency when teacher attachment is at various levels. Like parental attachment, teacher attachment has a statistically significant negative effect on delinquency when attachment is in the negative range, but this effect weakens and becomes insignificant as attachment increases. Figure 4 shows the predicted value of delinquency when teacher attachment is at various levels. As predicted by strain theory, negatively attached individuals are much higher in delinquency than neutral and positively attached individuals, though there is little or no difference in delinquency between neutral and negatively attached individuals.

Figure 4. Curvilinear (and Linear) Effects of Teacher Attachment on Delinquency



NOTE: Predictions calculated after controlling for covariates in the model.

In sum, these data indicate that both parental and teacher attachment have a nonlinear effect on delinquency and the effect assumes the form predicted by strain theory. Examining nonlinear effects, then, provides a way to test two major theories of delinquency. Further, taking account of nonlinear effects allows us better to explain delinquency. As an illustration, we can compare predicted delinquency scores from the linear and nonlinear regression equations (see King, Tomz, & Wittenberg, 2000; Roncek, 1991). Based on the linear model, individuals who have an awful relationship with their parents have delinquency scores that are, on average, 64.1% higher than individuals who have a neutral relationship with their parents, all else constant. Individuals who have an awful relationship with their teachers have delinquency scores that are, on average, 54.6% higher than individuals who have a neutral relationship with their teachers. These figures, however, underestimate the delinquency of the negatively attached individuals because the relationship between attachment and delinquency is, in fact, nonlinear. Based on the nonlinear specifications, we estimate that individuals who have awful relationships with their parents and teachers are, on average, 353.1% and 168.9% higher, respectively, in delinquency than those with neutral relationships. So analyses that assume that the effects of parental and teacher attachment are linear will substantially underestimate the effects of these variables.

Sensitivity Analyses

We estimated nonlinear effects using polynomial regression because of its advantages over alternative techniques, as discussed earlier. Polynomial regression, however, is not without its problems. It does make certain *weak* assumptions about the functional form of the relationship. In particular, a polynomial raised to the n th power assumes $n-1$ "bends" in the data (Aiken and West, 1991).¹⁰ Second, high-order polynomials tend to become increasingly unstable (as indicated by wide confidence intervals) at the extreme bounds of the variable of interest (i.e., at values at or near the minimum and maximum of the range). This instability can make detection of nonlinear effects extremely difficult, thus significantly increasing the risk of Type II error. Third, polynomials may abruptly change direction outside the observed data range, making extrapolation beyond the observed data range extremely risky. Finally, polynomial equations are much more sensitive to "noise" and outliers than first-order terms (i.e., linear regression), which can seriously undermine model fit. For these reasons, we verified the above results using several alternative techniques for estimating nonlinear effects. In particular, as noted earlier, we examined the robustness of our results using dummy regressor models (see Fox, 1997, pp. 318–320), semi-log regression models (Greene, 2000; Gujarati, 1987), and locally weighted regression (Cleveland, 1979; Cleveland & Devlin, 1988; Fox 2000a, 2000b; Hastie & Tibshirani, 1990).

Space considerations prevent us from describing these techniques in detail, although readers are referred to the above-cited references for thorough reviews. We used each of these techniques to estimate the nonlinear effects of parental and teacher attachment on delinquency, with the results shown in Appendix A (dummy regressor and semi-log regression models), and Appendices B-1 and B-2 (locally weighted regressions). In brief, each of these alternative techniques produces results very similar to those produced by polynomial regression. That is, these techniques also indicate that negatively attached individuals are

¹⁰ Although more "bends" can be examined by raising the power of the polynomial, a potential problem may arise if the variable of interest possesses a small number of points (i.e., different X_i values). In fact, it is recommended that the power a variable is raised to should not exceed more than one-third to one-half of the total number of points. The two attachment variables in the current study both have nine data points, therefore we are limited to examining a fourth-order polynomial (i.e., three bends). As discussed above, high-order terms of this degree are unlikely in social scientific research, thus this restriction does not present a problem in this particular study. (The inclusion of cubic and quartic terms in our models did not improve model fit.) Researchers electing to use high-order polynomials with variables that have a limited number of points, however, may be seriously limited by this restriction.

much higher in delinquency than neutral and positively attached individuals, there being little or no difference in delinquency between neutral and positively attached individuals. The dummy regressor models (see Appendix A, Models 4 and 5), for example, reveal no statistically significant difference in delinquency between individuals who indicate a “neutral” attachment to parents and teachers and those who indicate a positive attachment. Similarly, the semi-log regression models—used to capture the type of nonlinearity between parental and teacher attachment and delinquency hypothesized by GST—provide significantly better fit than the linear models, as indicated by nested *F*-tests and information measures (see Appendix A, Models 6 and 7).¹¹ Finally, the smoothed scatterplots produced by locally weighted regression (see Appendix B-1 and Appendix B-2) clearly show that the negative effect of parental and teacher attachment is strongest (i.e., the slope is steepest) in the negative to neutral attachment range and rapidly weakens (i.e., the slope flattens) in the neutral to positive range.

Tobit Analyses. The analyses in this article use extensions of OLS regression to examine the nonlinear relationship between parental and teacher attachment and delinquency. However, the highly skewed distribution of our delinquency measure may potentially lead to biased estimates, particularly considering that over two-thirds of the sample reported no involvement in delinquency. OLS regression fails to take into account the qualitative difference between limit (e.g., zero) and nonlimit observations (Greene, 2000). Although criminologists commonly overlook the problems associated with analyzing censored delinquency measures with OLS regression—usually resulting in estimates that are biased towards zero—we are particularly mindful of this problem because

¹¹ Unlike the other methods employed in this article, semi-log regression models require an *a priori* assumption concerning the functional form between variables. We elected to use the semi-log models only after the other approaches, which do not assume a specific functional form, provided strong support for the nonlinear form predicted by GST. If one has a strong theoretical reason to believe in a specific functional form, one can also explicitly model this relationship via nonlinear regression which assumes nonlinearity in the *parameters* of interest. In order to further examine the robustness of the results obtained from the previous models, which assume nonlinearity in the variables of interest but linearity in the parameters, we analyzed several additional nonlinear models that assume the specific functional form hypothesized by GST via nonlinear least squares using the Gauss-Newton iterative method (see Bates & Watts, 1988, pp. 40–60). Results from these nonlinear models (not shown, but available upon request) are very similar to those obtained from the semi-log models. All of the nonlinear models that were analyzed significantly improved model fit over the linear specification, as indicated by incremental *F*-tests and AIC comparisons. Collectively, these findings suggest that the nonlinear attachment models, whether explicitly nonlinear in their parameters or linear in their parameters but nonlinear in their variables (e.g., dummy regression, polynomial, and semi-log models), all fit the data much better than models which assume linearity in both their parameters and variables.

censored dependent variables can lead to the type of nonlinearity that we discovered (see Osgood, Finken, & McMorris, 2002, p. 337). To determine whether our findings are a methodological artifact of the censored dependent variable, we reanalyze *all* of our models (i.e., polynomial, dummy regressor, and semi-log) using Tobit regression models (Tobin, 1958), which allow for the analysis of dependent variables that cannot take on values beyond a certain point (e.g., zero).

Space restrictions do not permit a detailed discussion of the Tobit model, but thorough reviews are readily available (e.g., Long, 1997, pp. 187–214; Maddala, 1992, pp. 338–342; Sigelman & Zeng, 2000). For our purposes, it is important to note that the Tobit model takes into account the potential nonlinearity resulting from analyzing a censored dependent variable by estimating the compound effect of independent variables in the model on the probability that an observation is above the limit (i.e., uncensored), and the value of the dependent variable for observations with a nonlimit value (McDonald & Moffit, 1980, pp. 318–319). The total change in delinquency, then, can be disaggregated into two parts: (a) the change in delinquency of those above the limit, weighted by the probability of being above the limit; and (b) the change in the probability of being above the limit, weighted by the expectation of the dependent variable if above the limit.

The results from the Tobit analyses of the polynomial regression, dummy regressor models, and semi-log regression models for parental attachment are nearly identical to those obtained using OLS regression (results not shown, but available on request). That is, the nonlinearity that was discovered in the earlier analyses holds irrespective of the distributional assumption and, therefore, is not a methodological artifact of the censored dependent variable. Similarly, results for the teacher attachment models support the nonlinear specifications over the linear ones.

CONCLUSION

This study used polynomial regression and other methods to determine whether parental and teacher attachment have a nonlinear effect on delinquency. All analyses suggest that the effect of parental and teacher attachment on delinquency is nonlinear, with the form of this effect corresponding to that predicted by strain theory: Negatively attached individuals are much more delinquent than neutral and positively attached individuals, while neutral and positively attached individuals have similar levels of delinquency.

These findings call into question previous research on the effect of attachment on delinquency, which assumes that the effect is linear. This is not a trivial assumption; in fact, it may have caused previous researchers to seriously underestimate the effect of attachment on delinquency. As shown in this paper, the nonlinear effect of attachment on delinquency is much stronger than the linear effect. This fact may help explain the mixed results of previous research on attachment and delinquency. Some studies suggest that attachment has a relatively large direct effect on delinquency, while others studies suggest that it has a small or nonsignificant effect (see Agnew, 1991; Elliott, Huizinga, & Ageton, 1985; Kempf, 1993; Sampson & Laub, 1993). Though none of these studies estimate the nonlinear effect of attachment on delinquency, some—like that of Sampson and Laub—contain a high proportion of serious delinquents who may be negatively attached to parents and school. These studies may therefore be more likely to find that attachment has a strong effect on delinquency, because negatively attached individuals have much higher rates of delinquency than the neutral and positively attached individuals.

Related to the above, this study also suggests that it may be extremely important to distinguish negative attachment from neutral attachment, something that most studies now fail to do. Most studies employ measures of attachment that group negatively attached individuals with neutral individuals. For example, they present respondents with a statement like "I feel very close to my mother." Respondents are then provided with several response categories, ranging from "strongly agree" to "strongly disagree." Those who strongly disagree, however, include individuals who hate or dislike their parents (negatively attached) and those who neither like nor dislike their parents (neutral individuals). Grouping the negatively attached individuals with the neutral individuals may cause us to seriously underestimate the effect of attachment, because the neutral individuals are much lower in delinquency and much more numerous than are the negatively attached individuals.

The survey used in this study is one of the few to distinguish negative attachment from neutral attachment. This was done in the context of a single measure, where low scores indicated negative attachment, middle scores indicated neutral attachment, and high scores indicated positive attachment. Researchers may also want to experiment with *separate* measures that focus on the presence or absence of positive attachment and on the presence or absence of negative attachment. Certain research suggests that positive and negative feelings may be separate dimensions, rather

than different poles of a single affective dimension (see Schimmack, 2001). While such feelings are related, in that positive feelings toward an object may reduce negative feelings toward that object (and vice versa), it is possible to hold both positive and negative feelings at the same time. Some juveniles, for example, may both like and dislike their parents. The use of *separate* measures of positive and negative attachment would better reflect this fact. It would also allow us better to distinguish social control from strain theory explanations for the effect of attachment on delinquency. The measure of positive attachment would reflect social control arguments, while the measure of negative attachment would reflect strain arguments.

Further, the findings from this study suggest that the dominant explanation for the effect of attachment on delinquency may be mistaken. The effect of attachment on delinquency is typically explained in terms of social control theory: The absence of positive attachments reduces the juvenile's stake in conformity, thereby making it easier for the juvenile to engage in delinquency. In particular, juveniles who lack positive attachments to others do not have to worry that their delinquency will hurt these others or jeopardize their relationships with them. What is most important, then, is the presence or absence of positive attachments to others; there should be little difference in delinquency between neutral and negatively attached individuals. This contrasts with the strain theory explanation. Strain theory does not focus on the *presence or absence of positive attachments*, but rather on the *presence or absence of negative attachments*. Negative attachments are said to reflect the level of strain in a relationship (we hate others because they treat us in a negative manner) and to be a source of strain in and of themselves (it is stressful to interact with people you hate). The strain associated with negative attachments, then, motivates delinquency. The data from this study support the strain theory explanation: It is the presence or absence of negative attachments that is most consequential for delinquency. Individuals who are negatively attached to parents and teachers are much higher in delinquency than neutral and positively attached individuals. The difference in delinquency between neutral and positively attached individuals, however, is slight.

The results of this study, however, should be viewed as tentative given such things as the use of a male sample, the bias toward "good boys" in this sample, the small number of negatively attached boys, the use of single-item indicators of parental and teacher attachment, the use of delinquency measures with truncated response categories, and the cross-sectional nature of the

data. Future studies, of course, should correct for these problems *and* distinguish between negative and neutral attachment, as just indicated. Future studies should also attempt to improve measures of the intervening mechanisms associated with strain and social control theories, which will allow for a more direct examination of the strain and social control explanations for the effect of attachment on delinquency. And, finally, although we were unable to control for respondents' level of self-control (see Gottfredson & Hirschi, 1990) in our analyses because the data did not contain any adequate measures, future research examining the relationship between attachment and delinquency should do so. Low self-control may be a potentially confounding variable because it may lead to both low attachment to parents and teachers *and* delinquency. But despite all these concerns, the results of this study are quite intriguing and, at a minimum, they seriously call into question the pervasive assumption that attachment has a linear effect on delinquency.

Finally, this study has more general implications for research on the causes of crime and delinquency. With certain notable exceptions, criminologists have shown little interest in nonlinear effects. As Tittle (1995, pp. 35–43) notes, for example, the major crime theories implicitly assume that their central causal variables have linear effects on crime. Tittle then argues that there are good reasons for assuming that many of these variables have nonlinear effects (also see Agnew, 1992 on strain theory; Walters, 1999 on crime and chaos). This study supports Tittle and suggests that criminology might benefit from a greater consideration of nonlinear effects. Certain additional studies also suggest that the consideration of nonlinear effects can substantially improve our efforts to explain and control crime. For example, some data from the deterrence literature suggest that the certainty of punishment must reach a certain threshold or “tipping” point before increases in certainty have a negative effect on crime. There is also some evidence for a “ceiling” effect, beyond which further increases in certainty have little effect on crime (for an overview, see Yu & Liska, 1993). Data on direct control by parents suggest that parental strictness has a negative effect on delinquency up to a certain point, beyond which it has a positive effect—perhaps for reasons related to strain theory (Rankin & Wells, 1990; Rollins & Thomas, 1979; Wells & Rankin, 1988; also see Sherman, 1993 on defiance theory). And there is evidence that socioeconomic deprivation often does not increase crime until high levels of deprivation are reached (e.g., Bennett, 1991a, 1991b; Blau &

Golden, 1986; Elliott & Ageton, 1980; Krivo & Peterson, 1996; Neapolitan, 1997; Williams, 1984).

These examples are not meant to suggest that all effects are nonlinear; certain research has found that some causes are related to crime and delinquency in a linear manner (e.g., Paternoster & Mazerolle, 1994; Wells & Rankin, 1988). These examples and the data in this study, however, suggest that nonlinear effects are not uncommon. The neglect of such effects in theory and research, then, may be a serious shortcoming in criminology. This study not only illustrates that point, but also provides some guidance for the investigation of nonlinear effects. One particularly promising technique for investigating nonlinear effects was illustrated in detail, with several alternative techniques being briefly discussed. The investigation of nonlinear effects should open up a new area of research in criminology, with the possibility of substantially improving our explanations of crime.

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**Appendix A. (Unstandardized) OLS Coefficients Predicting
Delinquency: Dummy Regressor Models for
Teacher and Parental Attachment^a**

	Model 4 Teacher DRM <i>Coefficient</i> (<i>S.E.</i>)	Model 5 Parental DRM <i>Coefficient</i> (<i>S.E.</i>)	Model 6 Parental SLRM <i>Coefficient</i> (<i>S.E.</i>)	Model 7 Teacher SLRM <i>Coefficient</i> (<i>S.E.</i>)
Attachment to Parents	-.02 (.01)**			
Attachment to Teachers		-.02 (.00)**		
<i>"Dummy Regressors"</i>				
Att. to Teachers (1)	.26 (.07)**			
Att. to Teachers (2)	.28 (.06)**			
Att. to Teachers (3)	-.01 (.06)			
Att. to Teachers (4)	.06 (.03)			
Att. to Teachers (5)	.04 (.03)			
Att. to Teachers (6)	.03 (.03)			
Att. to Teachers (7)	.03 (.03)			
Att. to Teachers (8)	.04 (.03)			
<i>"Dummy Regressors"</i>				
Att. to Parents (1)		.87 (.10)**		
Att. to Parents (2)		.30 (.08)**		
Att. to Parents (3)		-.03 (.06)		
Att. to Parents (4)		.03 (.04)		
Att. to Parents (5)		.01 (.04)		
Att. to Parents (6)		.01 (.03)		
Att. to Parents (7)		.00 (.02)		
Att. to Parents (8)		.01 (.02)		
Att. to Parents (<i>ln</i>)			-.18 (.03)**	
Att. to Teachers (<i>ln</i>)				-.10 (.03)**
Intercept	.06 (.03)*	.09 (.02)**	.44 (.05)**	.27 (.05)**
AIC	-3.04	-3.13	-3.07	-3.04
N	690	690	690	690
Adjusted R ²	0.25	0.31	0.26	0.24

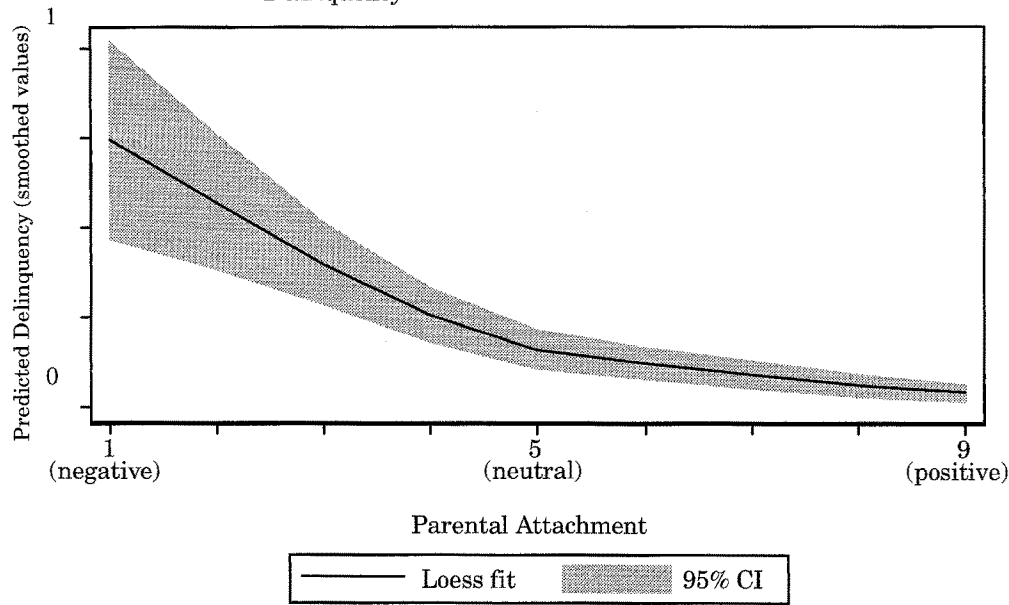
^a Models include controls for age, race, parental education, received welfare, intact home, grades in school, and church attendance.

Standard errors in parentheses

* $p < .05$; ** $p < .01$ (two-tailed)

DRM = Dummy Regressor Model; SLRM = Semi-log Regression Model

Appendix B-1. LOESS Scatterplot Smoother of Parental Attachment on Delinquency



Appendix B-2. LOESS Scatterplot Smoother of the Effect of Teacher Attachment on Delinquency

