AN EMPIRICAL FRAMEWORK FOR STUDYING DESISTANCE AS A PROCESS*

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Recent reviews of the desistance literature have advocated studying desistance as a process, yet current empirical methods continue to measure desistance as a discrete state. In this paper, we propose a framework for empirical research that recognizes desistance as a developmental process. This approach focuses on changes in the offending rate rather than on offending itself. We describe a statistical model to implement this approach and provide an empirical example. We conclude with several suggestions for future research endeavors that arise from our conceptualization of desistance.

Most criminologists define desistance as the state of having "terminated" offending. But recently, criminologists have begun to reexamine

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and expand the definition of desistance to include attention to the process by which people arrive at this state of nonoffending. Uggen and Kruttschnitt (1998), for example, use the term "behavioral desistance," suggesting that desistance has two implicit components: (1) a change from offending to nonoffending and (2) the arrival at a permanent state of nonoffending. We believe Fagan (1989) first recognized these two components when he defined desistance as the "process of reduction in the frequency and severity of (family) violence, leading to its eventual end when 'true desistance' or 'quitting' occurs" (p. 380; see also Loeber and LeBlanc, 1990). Laub and Sampson (2001) recently identified two similar components. They refer to the first as the causal process of desistance and the second as termination, the outcome of the desistance process. In their view, the desistance process is a gradual social transition that involves real change in individuals and how they interact with the world (Maruna, 2001; Shover, 1996). Termination or "true desistance" is a discrete state marking the permanent end of an offending career.

Theoretical accounts of desistance focus on explaining the relationship between age and offending and often confound these two distinct components (Laub and Sampson, 2001). There are two camps in this debate, the ontogenetic or maturational theorists, and the sociogenetic theorists.1 The first group claims that "aging is the only factor which emerges as significant in the (desistance) process" (Glueck and Glueck, 1940:105). Gottfredson and Hirschi (1990) represent the most current and prominent example of this "aging of the organism" argument. The second group, which includes social control, social learning, and strain theorists, claims that social processes that influence the likelihood of desistance occur as people age.

The identification of desistance as a process rather than as the state of termination has ramifications for this debate. Specifically, if desistance is a developmental process, then the idea that age can cause desistance is implausible. A developmental process is something that occurs as people age. From a developmental perspective, age is simply the dimension along which the behavior of interest changes. That is, age is incorporated into the dependent variable of interest (Wohlwill, 1971:51).2 As such, using age as an independent variable would be tautological in the sense that it implies that age predicts changes in behavior that occur as individuals age. Although true by definition, such an approach offers no insight into the

1. For a detailed review of this debate, see Maruna (2001).
2. Wohlwill (1971) lays out a very clear argument for the reconception of age as part of the dependent variable. He also argues that researchers should develop research methods that describe the form of the developmental process, an approach we also advocate in the empirical section of this paper.
causal mechanisms that generate these changes. The idea of desistance as a process is consistent, however, with how "sociogenic" theorists explain desistance. For example, differential association (Sutherland, 1947) and related social learning theories (Akers, 1973) suggest that as individuals age, exposure to delinquent peers diminishes while associations with nondelinquent individuals increase. According to these theories, such changes in one's affiliations impact how rewards and punishments associated with offending are interpreted. As exposure to more conforming individuals expands with age, definitions unfavorable to law violations increase, and the consequences of offending become magnified. Hence, it is not aging, but related changes in associations that influence age-graded changes in offending behavior. Because this and other sociogenic explanations reflect dynamic processes, it makes sense that the dependent variable (i.e., desistance) should also be thought of as a dynamic process.

Most empirical measures of desistance, however, emphasize the state of nonoffending rather than the process of desistance. Empirical researchers typically identify individuals who have not offended for a certain number of years after a particular cutoff age as desistors. This period of nonoffending can range from 1 year (Warr, 1998) to 11 years (Farrington and Hawkins, 1991). This approach essentially redefines desistance as temporary nonoffending because most data sets do not allow researchers to verify that offenders have never again offended (Baskin and Sommers, 1998; Elliott et al., 1989). More to the point, this focus on the final state of nonoffending ignores the nature of the process by which individuals reach the final state of nonoffending. Individuals with very different criminal careers in terms of length, timing, and frequency of offending are treated as if they reach this final state of nonoffending in the same manner. But these differences may convey important descriptive information about the circumstances surrounding desistance, including, but not limited to, the speed with which desistance occurs, and the probability that it occurs for different types of offenders (Fagan, 1989). Without information about when and for whom things change, it is hard to causally link explanatory factors to desistance. Causal study requires linking change in the independent variables with change in the dependent variable (Loeber and Leblanc, 1990).

For example, consider Warr's (1998) idea that marriage leads to desistance through a gradual disentanglement from delinquent peer networks.

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3. We suspect that Gottfredson and Hirschi in particular might not agree that desistance is a process. For example, they often refer to desistance as "spontaneous desistance," a description of an event rather than a process (Gottfredson and Hirschi, 1990:136).
In order to test this idea empirically, the researcher must first describe the desistance process: When did it start, how long did it last, how gradual was it, was it smooth or bumpy, and so on. After doing so, the researcher can attempt to discern whether the marriage event is associated with the beginning of the desistance process, and if changes in contact with delinquent peers can be linked with changes in offending. Based on these types of examples, Laub and Sampson (2001), Fagan (1989), and Loeber and LeBlanc (1990) argue forcefully that the key to future empirical progress in understanding desistance involves focusing on the process of desistance, not on the final state of nonoffending.

Identifying people who are in the process of desisting, however, is difficult. Maruna (1998) suggests, in fact, that identifying the transition is hopeless. In a colorful description of the issue, he asks:

When did the desistance process start? Is not the . . . desisting moment the very second after she stole the purse? If so, in the same moment that person becomes a criminal, she essentially also becomes a desistor (p. 11).

Maruna concludes that any analysis of desistance should be limited to factors that help sustain the steady state of desistance, which he refers to as “going straight.” However, his “person-based” theory attempts to explain how changes in the way in which people understand themselves and the outside world can lead to changes in behavior. As in the studies mentioned above, Maruna ends up linking changes in the explanatory variable(s) to desistance as a stable state (e.g., Maruna, 1998; Shover, 1996). But dynamic theories require dynamic dependent variables (Loeber and LeBlanc, 1990). A conceptually relevant empirical framework for describing desistance as a process that unfolds over time needs to be developed (Farrall and Bowling, 1999). We respond to that charge in this paper by presenting a framework for measuring desistance that emphasizes desistance as a process.

Although our goals are empirical, our enterprise requires dealing with some underlying theoretical concepts. In the next section, we argue that conceptualizing desistance as a process inevitably begs the question process of what? We conclude that it is the process by which criminality, defined as the propensity to offend, changes with age. We then discuss a statistical method that allows us to estimate criminality over time and illustrate its use with an example based on research by Laub et al. (1998). On the technical side, this approach does not solve the difficult problem of identifying permanent desistance, but it does allow for some informed decision making about how close a level of offending propensity may be to zero to say that someone has desisted.
DESISTANCE AS A PROCESS OF DECLINING CRIMINALITY

Having stated that change with age is implicit in the definition of desistance as a process, it is still not clear what exactly is changing with age. Fagan describes the desistance process as the decline in the frequency and severity of offending, where frequency is observed counts of offending behavior. Instead of viewing the transition to desistance as a qualitative change in states (offending to nonoffending), the transition can be considered a quantitative change in frequency, from higher levels to lower levels and finally to zero.

But not all change in offending behavior should be construed as "meaningful" change. Consider the case of official records. Because individuals are not arrested every time they offend, individuals with identical, stable levels of offending may have a different observed number of arrests. In the same way, an individual whose actual offending behavior has not changed can have several concurrent periods of observed nonoffending. Not appreciating the probabilistic nature of arrest may lead to the conclusion that someone has desisted when he or she has not, what Blumstein and Cohen (1987) call false desistance.

Although perhaps most obvious in the case of criminal records, Blumstein and Cohen's point is more general. Individuals with similar predisposition to commit crime may have different offending patterns, due to differential opportunity and random chance. If this is true, then our focus should not be on changes in crime, but on changes in criminality. This is a conceptual distinction, where the concept of crime is disaggregated into separate parts to be able to better explain or theorize about behavior. This conceptual distinction is not original to us—it is common to the work of the criminal career researchers led by Blumstein, and Gottfredson and Hirschi (e.g., Blumstein et al., 1986, 1988; Gottfredson and Hirschi, 1986, 1988). Both sets of researchers disaggregate crime into three parts: criminality, opportunity, and random chance. In addition, observed crime, whether it be self-report or official records, is seen as a function of criminality, opportunity, random chance, and measurement error.

Criminological theory identifies many potential explanatory factors that may affect criminality, such as poor self-control, temperament, weak social bonds, negative labels, exposure to delinquent peers, or strain. Taken together, these biological, psychological, and sociological explanatory factors shape the systematic component of behavior (Osgood and Rowe, 1994). We make no claim in this paper as to the factors that are most influential in shaping criminality—we leave that to future theory and
empirical research. We do, however, wish to focus attention on the general concept of criminality, the systematic component of criminal behavior.

Going one step further, we define criminality as an individual's propensity to offend.\(^4\) We believe criminality to be time varying. Criminality may in fact be invariant for some people, and there may be a time-stable component driving differences between individuals over most of the life course (Tittle, 1988). But because crime varies over time, it is likely that criminality also varies over time.\(^5\) As a result, it makes sense to describe desistance as a process in which criminality changes over time.

One of the reasons that criminality, defined as the propensity to offend, is somewhat difficult to talk about in this manner is that Gottfredson and Hirschi (1990), immediately after introducing the concept, place theoretical meaning on criminality. They split criminality into a time-varying and a time-stable component. They call the time-varying component "aging" and the time-stable component "criminality" or "propensity," which they argue is manifest as self-control. This redefinition of criminality as self-control is justified because they claim that aging (reflected by biological, social, and psychological factors), while clearly time variant, occurs in the same way for everyone. As a result, they claim that although criminality can change over time, stable differences in self-control strictly determine differences in criminality between individuals. Gottfredson and Hirschi's approach has become so accepted within criminological circles that some researchers refer to it as a "criminality" theory (Osgood and Rowe, 1994). The fact that the concept of criminality or propensity became wedded to Gottfredson and Hirschi's particular theory is in our view unfortunate. Criminality as a concept is distinct from any one theory that seeks to explain it.\(^6\)

In this section, we have argued that criminality as a concept is (1) the

\(^4\) Gottfredson and Hirschi (1990) use criminality and propensity to offend almost interchangeably. In general, however, criminality has more theoretical meaning, whereas propensity has more empirical meaning. We have decided for the sake of clarity to define criminality in terms of propensity.

\(^5\) The alternative is that changes in opportunity account for all of the changes in crime.

\(^6\) Ironically, Gottfredson and Hirschi (1990:137) claim that traditional "desistance theory asserts that crime declines with age because of factors associated with age that reduce or change the criminality of the actor." We agree wholeheartedly with this definition and believe that this is the starting point from which a productive measure of desistance can be created. However, we question whether traditional desistance theorists would necessarily agree, given that virtually all definitions of desistance focus on crime, rather than on criminality. The key from our perspective is accepting that we need to focus on criminality, rather than on crime, when we want to explain why crime declines over time.
systematic, causal component of crime; (2) driven by social, biological, and psychological factors; and (3) time varying. Furthermore, we claim that desistance is the study of change in criminality. By way of concluding this section, it might be helpful to point out that our focus on changes in criminality rather than on crime is implicit in how several qualitative scholars discuss desistance (Baskin and Sommers, 1998; Maruna, 1998). For example, Maruna (1998) classified individuals as desisting if they reported no criminal or violent behavior, arrests, or incarcerations over the last year. He concluded that “it became clear that if a serious, repeat offender manages to remain crime-free for a period of over one year while free in the community, this represents a significant and important change in behavior worthy of examination” (emphasis added, p. 48). In other words, Maruna believes that this large change cannot be a function of random chance or opportunity, but must reflect changes in criminality. As a result, it is worthy of study. These types of qualitative changes highlight the point that only changes in crime that represent changes in a person’s criminality can inform our understanding of desistance.

In the next section of this paper, we identify a statistical framework to facilitate the quantitative modeling and measurement of changes in criminality. Specifically, we will argue that the offending rate represents an empirical estimate of a given individual’s criminality at that point in time.

A STATISTICAL FRAMEWORK FOR STUDYING THE PROCESS OF DESISTANCE

The conceptual framework discussed in the above section, in which offending behavior is divided into parts, matches well with the basic statistical model of offending. Statistical models divide observed offending into two parts—a systematic component, usually referred to as the offending rate \( \lambda \), and a nonsystematic, or random, component (Osgood and Rowe, 1994). The rate, \( \lambda \), is an estimate of the systematic component of the behavior and is therefore a reflection of the individual’s propensity to offend. The nonsystematic component has three parts: random measurement error, random arrival of opportunity, and genuine random variation in behavior caused by the environment. Concerns about record validity fall under the rubric of measurement error.\(^7\) Random variation is related

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\(^7\) The problem of measurement error and the validity of official records has received considerable attention in criminology, and criminologists have grappled for years as to the “best” measurement of criminal behavior: official or self-reports (Hindelang et al., 1981; Lauritsen, 1998). Hindelang et al. (1979) report that the demographic and socioeconomic distributions of offenders designated by official sources is similar to the distributions in data gathered from self-reports. Moreover, Farrington (1989:418; see also Weis, 1986:44) has shown that self-reports and official sources of data produce
Different statistical frameworks handle this distinction in different ways. In an ordinary least-squares (OLS) framework, an error term is added to the model to capture the nonsystematic component of behavior. Probabilistic models, such as the Poisson models used by criminal career researchers, do not include an error term, but link the latent systematic dimension to observed behavior with a function that accounts for the random nature of behavior. The probabilistic approach is particularly suited to offending, in which the outcome is limited and discrete (Osgood and Rowe, 1994). Osgood and Rowe clearly describe the implications of linking the latent dimension with behavior through a probabilistic function:

[I]t is because of this probabilistic relationship (between propensity and behavior) that the causal dimension is unobservable, or latent. In other words, we assume that even individuals with identical “true” propensities to engage in crime differ in their observed offending due to innumerable random factors such as chance encounters of everyday life and error in detection or measurement (p. 528).

Figure 1 demonstrates this probabilistic relationship graphically; it shows the distribution of the number of offenses expected using a Poisson distribution for a rate of three offenses per year. An individual with a rate of three crimes per year, which should reflect the systematic propensity to commit crimes, will only be observed offending with this frequency 22.40% of the time because of random variation in offending. He or she can be observed offending as many as six times, or as few as zero times, with nontrivial probabilities (Brame, 1997). As a result, we may see different frequencies of offending in contiguous time periods, even if the propensity to commit crimes, reflected in the rate of three crimes a year, does not change. To study meaningful change (i.e., change that can be explained), we need to explicitly shift our focus from observed behavior to the rate. We view the rate to be a sample estimate of an individual’s criminality.

"comparable and complementary results on such important topics as prevalence, continuity, versatility and specialization in different types of offenses." In an early summary conclusion of this literature, Hindelang et al. (1979) noted that any apparent discrepancy between results of official and self-reports was due to what each method measured: Self-reports tapped into more nontrivial offenses than did official records.

8. We do not believe that any causal model can fully predict human behavior, even in the absence of measurement error. If human behavior is probabilistic (i.e., not deterministic), then even the most fully specified, best-measured model will not completely explain behavior. Expressed another way, two observably identical humans may act in different ways, or the same individual may act inconsistently over multiple observations. Although we agree that measurement error contributes greatly to the unsystematic variation in data, we also believe that statistical models must treat human behavior as inherently probabilistic.
In an ideal setting, the rate ($\lambda$) is an unbiased sample estimate of an individual’s criminality. Of course, it is possible, indeed even probable, that opportunity and measurement error are not strictly random. If they are not random, then they too will be reflected in the estimate of the systematic component of the model, ($\lambda$). For example, if police tend to arrest African Americans more than whites, higher levels of arrests for African Americans will provide estimates of higher crime rates for this group compared with their white counterparts. Nonetheless, true criminality may be similar for whites and African Americans. Or, because incarcerated individuals have systematically fewer opportunities than do nonincarcerated individuals, they will have lower rates of offending than do nonincarcerated individuals, even if their underlying propensity to offend is exactly the same.

The extent to which the estimate of the rate captures the individual’s criminality depends on the quality of the data collection effort and the breadth of the behavior considered. Although both official records and self-reports have limitations, each provides important information about an individual’s criminal propensity (Farrington, 1989; Weis, 1986).

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9. For example, Nagin et al. (1995) found that individuals who were not represented in conviction records by age 32 nevertheless self-reported that they continued to drink heavily, use drugs, fight, and engage in other criminal acts. Nagin et al. (1995) suggest that this finding says something about their criminal propensity, specifically, that these individuals “seem to be careful to avoid committing crimes with a high risk of conviction” (p. 132). From our perspective, information from both sources provides a
problems can be accounted for directly in the estimation process. For example, researchers can and should take pains to identify periods of incarceration and include exposure time in estimates of offending rates (Piquero et al., 2001). It is, however, impossible to completely eliminate the possibility that systematic elements of opportunity and measurement error will enter into any estimate of the offending propensity. As a result, it is incumbent on the researcher to understand and identify the possible sources of bias, and for the readers to update their prior beliefs on the research question, conditional on the quality of the information available.10

Having identified a statistical framework that provides us with an opportunity to measure criminality, albeit imperfectly, we are ready to formally state our empirical definition of desistance. We define desistance as the process of reduction in the rate of offending (understood conceptually as an estimate of criminality) from a nonzero level to a stable rate empirically indistinguishable from zero. We will describe what we mean by “indistinguishable from zero” later in the paper, but we do believe that it is important to maintain the idea of desistance as the end of offending. We reach this position in part because of the long tradition in the field of viewing desistance in this manner. More substantively, we remain open to the possibility that the causal process by which someone arrives at zero may be different than is the causal process by which someone experiences a decline in offending to a nonzero level (Fagan, 1989). By maintaining the sense of zero in the definition, we allow that possibility to be tested,

more complete picture of an individual’s criminal propensity at any given point in time, which highlights that in either case, we are simply generating an estimate of an unknown population parameter.

10. We do not believe that any given estimate of criminality drawn from crime counts over time characterizes the true criminal propensity or criminality of an individual in the same way that a detailed psychological interview may describe the criminal intent of an individual. Rather, the rate reflects the individual’s criminal intent, in much the same way that someone’s GRE score reflects but does not fully characterize an individual’s academic potential and ability. To carry this analogy further, we propose that estimates of rates do for researchers what GRE scores do for graduate schools, provide an accurate prediction of behavior, on average. (We wish to thank Jonathan Caulkins for this analogy.) Individuals with lower rates of offending should commit fewer crimes in the future than should individuals with higher rates of crime—if this was not true, then we could not argue that the estimated rates reflect an individual’s true propensity. Evidence from the criminal career literature suggests that estimated rates indeed reflect relative willingness to commit crimes, on average (Barnett et al., 1987, 1989). Qualitative research by Sampson and Laub (1993) in which an individual’s behavior is explored in depth shows that characterizations about criminality made on the basis of official data are in large part verified by more detailed information about the individual.
rather than assumed. Our goal in the next section is to identify a statistical approach that allows us to identify trajectories of offending rates that meet our definition of desistance. In the big picture of desistance research, once we can identify how propensity to offend changes over time, we can simultaneously model causal factors that may explain the causal process (Wohlwill, 1971).

**A STATISTICAL MODEL FOR STUDying THE PROCESS OF DESISTANCE**

Criminal career researchers have estimated rates of offending over time, but traditionally they have assumed that the rate is constant over the career, and it immediately declines to zero at the point of desistance. This apparently stark position has created some debate (see, for example, Blumstein et al., 1988). From our perspective, assuming that criminality is constant followed by a spontaneous drop to zero is inconsistent with the idea of desistance as a developmental process. At the very least, starting from this position would not allow us to determine if in fact desistance was gradual rather than spontaneous and immediate. We believe that this position was more practical than theoretical. As Hagan and Palloni (1988:97) observed at the time, "[t]he sociological conceptualizations and operationalizations based on longitudinal data that are required to test explanations of (the shape of the) age-crime curve are only beginning to become available."

Since that time, several techniques have been designed to measure changes in rates over time using panel data, including semiparametric models, hierarchical linear models, and various grouping methods. Our choice of model is driven by our particular goal, which is to identify and then study qualitatively different trajectories of offending, in particular, trajectories that match our definition of desistance (Raudenbush, 2001).

We believe the semiparametric trajectory model (SPM) introduced by

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11. To be clear, we do not mean to suggest that all studies of desistance must include attention to a final state of zero. A study focusing only on declines in offending rates, under the assumption that these people are in the process of desisting, seems to us to be a reasonable research strategy.

12. In hierarchical linear models (HLMs) and latent growth curve (LGC) models (see Hoffman and Cerbone, 1999; Horney et al., 1995), one growth curve is estimated for the entire sample, and individuals in effect get assigned a unique slope and intercept that reflects their unique trajectory's deviation from the main trajectory. Although useful for modeling changes in rates, this approach does not provide a systematic way to identify different patterns of offending across these dimensions, particularly patterns of desistance (i.e., a decline in criminality to a zero or near-zero rate). We thank Wayne Osgood for clarifying this point.
Nagin and Land (1993) and described further by Nagin (1999) is particularly well suited to this purpose. In this model, trajectories, usually quadratic functions of age, are estimated for a fixed number of groups and individuals are probabilistically assigned to the group that best represents their offending behavior. The group assignment probability and trajectory coefficients are chosen simultaneously to maximize the likelihood function. Individuals are assigned to the group for which they have the highest posterior probability. All group members receive the same slope and intercept, but the slope and intercept for the group are completely unconstrained.

Briefly, the offending trajectory for each group is assumed to be a quadratic function of age:

\[ \ln(\lambda_i^j) = \beta_0^j + \beta_1^j \text{Age}_i^t + \beta_2^j \text{Age}_i^t, \]

where superscript \( j \) denotes group \( j \), \( \text{Age}_i^t \) is individual \( i \)'s age in period \( t \), and \( \text{Age}_i^t \) is \( i \)'s age squared in period \( t \). Other polynomial functions are also possible. All of the parameters of the polynomial function are group specific, which allows groups to have distinctive offending trajectories in terms of both level and pattern of change. The intercept captures the group's base-level offending rate, and the slope parameters define the shape of the trajectory.\(^{13}\)

Once we have identified trajectories that meet our definition of desistance, we can then examine whether sociodemographic and other key characteristics of individuals and their environment can predict this group membership, as identified by the model. We can also search for factors that are correlated with changes in criminality within the group(s) of people identified as desistors. In other words, we can use this framework to test different theories of desistance as in the existing empirical work on desistance (Laub and Sampson, 2001).

\(^{13}\) The model can be estimated with "Proc Traj," which is a SAS-based procedure described in Jones et al. (2001) for estimating developmental trajectories. As described in Nagin (1999), suitably defined probability distributions are used to handle three data types: count, binary, and psychometric scale data. The method has four important capabilities: (1) the capability to identify rather than assume distinctive groups of trajectories, (2) the capability to estimate the proportion of the population following each such trajectory group, (3) the capability to relate group membership probability to individual characteristics and circumstances, and (4) the capability to use the group membership probabilities for various other purposes, such as creating profiles of group members. The procedure can be downloaded from http://lib.stat.cmu.edu/~bjones/ along with documentation, including illustrative examples and the Jones et al. paper. Muthen's M-Plus has also recently added the ability to estimate semiparametric models for some cases.
In this approach, the group assignments are probabilistic, and the group trajectory does not represent the behavior of all members of the group equally well. It is important to keep in mind that the act of grouping is instrumental rather than theoretical. It provides the researcher with the ability to estimate changes in rates over time. This advantage, which is the lynchpin to the study of desistance (change over time), comes at a cost of assuming that all members of the group are identical for the purposes of the analysis.

This cost has two dimensions. First, researchers may believe that these groups are real reflections of different groups of people identified by typological theorists such as Moffitt (1993). It bears repeating that these methods will identify groups regardless of how discrete or continuous the individuals are in reality. Some people may believe this to be a major drawback to this approach; the alternatives, however, are to estimate rates as essentially stable over time (Blumstein et al., 1988) or to estimate change over time according to strict parametric assumptions (HLM). In light of these potential limitations, we believe that this grouping approach is both attractive and defensible.

The second dimension is more technical. Roeder et al. (1999) demonstrate that treating these groups as deterministic (i.e., real) can lead to errors in the causal analysis of factors that lead to group membership. They recommend modeling the causal factors and group trajectories jointly, a procedure we advocate. We also advocate examining the posterior probabilities of the groups as a measure of fit. Low average probabilities provide information about the reasonableness of the assumption that the discrete mixing distribution approximates a continuous distribution. In most cases in which this method has been used, the average probabilities of assignment have been high, usually above 90% (Nagin, personal communication).

The SPM approach has been used in at least one instance to study the question of desistance (Laub et al., 1998). This paper deserves special attention because it is the only quantitative analysis of longitudinal data of which we are aware that explicitly models desistance as a process. Although the authors do not link rates with criminality as we do in this paper, their definition of desistance as a gradual movement toward zero or a very low rate of offending is consistent with our definition. In the next section, we use the Laub et al. (1998) paper to highlight what we see as some of the advantages of modeling desistance as a process within the SPM framework.
In their paper, Laub et al. (1998:230) identify four groups of offenders. Their predicted trajectories are provided in Figure 1 in their text, replicated here as Figure 2. All four groups have about the same offending rate at age 15. This is to be expected, because the data are from the Glueck and Glueck sample of delinquent boys, all of whom were in a juvenile detention center at age 16. Despite this similarity in adolescence, all four groups have different offending trajectories in adulthood.

Figure 2 Predicted Offending Trajectories*

Group 1 includes 13 individuals who remain high-rate offenders throughout the adult observation period. They average nearly 3 arrests per year at age 25, and decline to 2 arrests per year by age 32. Group 2, made up of 93 individuals, essentially mirrors Group 1’s offending trajectory, but to a lesser degree. At age 32, those individuals in Group 2 average about 0.8 arrests per year. Groups 3 and 4 are the trajectories that the authors have identified as reflecting individuals in the process of desisting. The case for desistance for members of Group 4 is clearer than for members of Group 3. Group 4, containing 154 individuals, peaks at a rate of 0.65 arrests at age 16, and then drops dramatically to an average arrest
rate of 0.1 by age 19, and stays there or drops for the next 12 years. At age 32, the average arrest rate is essentially zero—0.02 arrests per year. This implies that there will be, on average, 50 years between arrests for these individuals. Group 3, with 220 members, peaks at 1.2 arrests at age 16, and then experiences a gradual decline over the next 12 years, arriving at a rate of 0.2 arrests per year at age 32, which implies an average of five years between arrests—low, but not that low.

One question left unanswered in the Laub et al. (1998) paper is whether this rate of offending is indistinguishable from zero, a point we believe has some importance for the study of desistance. In the Appendix, we propose a simple approach for answering that question objectively using information about the stability and magnitude of λ from the trajectories. This method identifies members of both groups 3 and 4 as participating in the process of desisting, and it allows objective statements about how close a particular group is to zero. As a result, the information available in the trajectories can distinguish between these groups in terms of how close they are to zero, or put another way, how indistinguishable they are from nonoffenders. We take this idea of "indistinguishable from zero" from Cohen and Canela-Cacho (1994:368; see also Lehoczky, 1986:385) who define termination as a "process by which the risk of future offenses drops to the same low trace levels that are found among non-offenders in the population. After termination, ex-offenders are no more likely to commit future offenses than are non-offenders."

For researchers comfortable with the traditional approach of defining desistance in terms of offending rather than criminality, regarding an individual with at least one offense as a nonoffender seems counterintuitive. Yet recall the earlier discussion of the probabilistic nature of offending. Individuals with very few offenses over their life course should not be considered an offender if this level is never distinguishable from zero in any formal sense. Very low levels of offending (one conviction over 20 years, for example) could have occurred by chance for an individual with only a trivial propensity to offend. And, it is impossible to distinguish between individuals with very low rates of offending and zero rates of offending, because propensity is measured with error (Lehoczky, 1986). In sum, it makes both statistical and intuitive sense to describe as a desistor any individual who previously offended at a higher rate but who now resembles the apparent nonoffender in terms of his or her rate of offending. More broadly, the study of offending rates allows the researcher to maintain the idea of a permanent end of offending in the definition of desistance (Elliott et al., 1989), but it does not force the researcher to follow all offenders until death in order to characterize their process of desistance. We believe that this ability to quantify the final stage of the offending trajectory is an important feature of the semiparametric method.
THE IMPORTANCE OF TIMING

Having distinguished between two different trajectories of desistance, we can begin to think carefully about the causal processes implicated in the declines in the offending rate. The decline of Group 3's trajectory is much more gradual than is that of Group 4, suggesting causal actions for Group 3 that are both more spread out in time and less event-like. The steep decline for Group 4 suggests an event or experience, occurring between age 16 and age 20, which leads to a sharp decline in the propensity to offend. These differences should be considered when causal factors are analyzed.

To illustrate an approach to identifying dynamic processes that can account for these changes, Laub et al. analyze the groups' marriage patterns. Their approach is generalizable to other contemporaneous dynamic processes, such as employment and family formation. In their paper, factors measured at one point in time were first compared between groups. Members of both desistance groups have higher quality marriages at age 32 than do the persistors. Furthermore, members of Group 4 are more likely to be married, less likely to have a shotgun marriage, and more likely to have a higher quality marriage than are members of Group 3. This implies that marriage may have more of an impact for Group 4 than for Group 3. But, as noted by the authors, this type of analysis cannot be interpreted causally because it does not take timing into account.

The second method used in the Laub et al. (1998) paper deals with this problem directly by modeling temporally sequenced offending at the individual level on years of an *ex-post* good marriage, with group membership used as a control for differences between individuals. The number of years of an *ex-post* good marriage is strongly correlated with declines in offending rates for members of Group 3, but not for members of Group 4.

In fact, we know that these individuals have essentially desisted by age 20, and, according to the authors, most of the marriages in the sample occur after this point. It is therefore possible that the members of Group 4 are less likely than are members of Group 3 to get into "shotgun" marriages during their twenties and early thirties and more likely to be in higher quality marriages at age 32 because they experienced changes in propensity to offend early in the life course before they were married. Developmental theorists such as Thornberry (1987) and Sampson and Laub (1993) have suggested that the formation of adult social bonds and offending behavior interact in a complex, dynamic way. Marriage can affect offending, but offending can also affect marriage. Although this hypothesis must be explored further before definitive conclusions can be made, we believe that this example suggests that developing a method that
highlights the process of changes in rate over time can lead to unique insights.

CONCLUSION

The conceptualization of desistance as a process is an important recent development in criminological theory. We set out to identify an empirical approach that models the process of change over time explicitly, and we provide an example of how the richness of information available in this model can be used to both identify and explore the causal process(es) that may be partly responsible for desistance.

Using developmental trajectories avoids some of the problems associated with linking desistance to maturation via its correlation with age. Although developmental markers are often age-graded, the influence of development on behavior is not a function of age, but of the biological, psychological, and social changes that mark development (Gove, 1985; Riley, 1986). Our modeling strategy allows researchers to trace patterns of individual offending behavior across age and to explore the developmental dynamics that generate change or stability in such behavior. In this framework, age is incorporated into the dependent variable, which is defined as changes in offending behavior over time. Any causal factor by definition will be studied in the context of age, a point we demonstrated when we showed that marriage can have a different causal role, depending on the age at which the change in offending behavior took place. Development trajectories allow us to model stability and change in behavior across age, and are thus a useful tool for studying “the systematic change in an attribute over time” (Rogosa, 1988:172).

This is particularly true when, as in Laub et al. (1998), different groups of people experience change at different ages. In this context, it stands to reason that not all factors will play the same role in the desistance process for all individuals. We accept that there may be different paths to desistance, but this is ultimately an empirical question. Identifying these paths across different data sets, describing some of the more common paths, and searching for important causal factors should provide fruitful ground for further research.

In that spirit, we present several possible avenues for future research. First, because our conceptualization contrasts sharply with binary conceptualizations of desistance, it would be useful to compare and contrast information gleaned from empirical analyses that use one or the other conceptualization. By applying two different methodological strategies for defining desistance to the same set of data, researchers can evaluate empirical distinctions between a dynamic definition and a binary, static definition.
Second, research is needed to illuminate the specific nature of the desistance process. Specifically, we would like to know if there are changes in rates of offending that signify abrupt desistance, continuous desistance, or some combination of the two. Similarly, we would like to know if desistance is a process marked by a gradual reduction in all offending behavior over time (Laub and Sampson, 1993) or by a move from more to less serious crimes over time (LeBlanc and Loeber, 1998). We can think of many similar questions about the nature of desistance that can be addressed by this method.

Third, many unanswered questions remain about how the developmental conceptualization of desistance outlined in this paper explains the desistance phenomena across age, gender, and race. There is little research in this area, although extant findings point to gender, race, and age differences in the desistance process (Rand, 1987; Uggen and Kruttschnitt, 1998). These differences may be, in part, a function of gender differences in the meaning attributed to various transitional life events (Broidy and Agnew, 1997; Caspi and Moffitt, 1993), and it may be that the salience of specific events also differs by race and age.

Fourth, we do not believe the trajectory method is the only empirical research strategy consistent with the developmental definition of desistance outlined in this paper. Another approach that is consistent with our goal of tracking criminality over time is the person-based approach of Bergman and Magnusson. They recommend using cluster analysis at each time period, and then grouping individuals according to membership in each cluster in each time period (Bergman and Magnusson, 1997). From our perspective, the Nagin and Land approach is attractive because the groups are chosen within a maximum likelihood framework and the outcome is easy to interpret, but we do not think cluster analysis is inherently

14. This type of question raises an important issue about the scope of what we called criminality. In the bulk of this text, we referred to criminality as a general term, reflecting criminal intent defined broadly. This approach implies that measures of crime used to estimate criminality should also be broad. But it is possible to think about the propensity to commit certain types of crime, such as, for example, violent crime, or property crime. The usefulness of this disaggregation depends on our ability to observe the behavior in question. The less information available, the less able we are to distinguish between offenders and nonoffenders and, therefore, the less able we are to document and study change. Recall that the ability to study change defined as desistance requires that we can first identify individuals as distinct from nonoffenders, and then observe that they currently resemble nonoffenders. For some rare events, such as homicide, it might not be productive to think about desistance from homicide, not because we cannot think about homicidal propensity, but because the data cannot provide a reliable estimate of change. We would like to thank an anonymous referee for bringing this issue to our attention.
flawed. Applying both techniques to the same set of data will likely provide an interesting methodological comparison.

Fifth, the issue of intermittency—declines in criminality followed by increases in criminality—needs to be explored in more detail. Trajectories are generally modeled with quadratic trends, which do not allow offending levels to rise again after they have declined. Yet some members of the group may exhibit behavior that reflects an increase in the propensity to offend, which will be difficult to observe unless it is explicitly anticipated. The possibility that periods of increased activity will follow periods of inactivity is estimated explicitly in Laub et al. (1998), although the parameter is not discussed. It is important to examine behavior at the latter part of the trajectory to determine if individuals within the group are beginning to reoffend in any systematic way.

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We propose the following formal, but ad hoc, method for using the information from the trajectory model to characterize the permanence and closeness to zero of the final stage of a given trajectory. We use the trajectories in Laub et al. (1998) as examples.

The first step is to observe the period of stability at the end of a trajectory (if there is one). Unless people reach this period of stability, they cannot be considered desistors. To define stability, we use a rule of thumb of at least three years in which the rate of offending differs by no more than 0.1. For Group 3, we conclude that the group has a rate of offending of about 0.25 for five years, from age 28 to 32. Second, we find the highest predicted value of the rate for the five years before age 28, about 0.5 at age 23. If there were ten years of stability, we would select the highest predicted value for the ten years before the period of stability. Third, we use the Poisson distribution to calculate the probability of observing no offending for the number of years during which the trajectory appears stable.

In this case, we calculate the Poisson probability of observing non-offending for five years if the rate of offending is 0.25. Our goal is to determine whether the rate of offending is indistinguishable from zero if an individual with this rate was to have five years with no offending. Observing people for a number of years with no offending is the way that we traditionally would have identified individuals in desistance. Here, we use the information available from the rate and period of stability to determine how much we could learn, in this case, from observing five years of nonoffending. If the rate is fairly close to zero, the probability of observing five consecutive periods of no offending should be fairly high. Formally, this can be thought of as a hypothesis test for the null hypothesis that $\lambda = 0.25$.

This is a fairly easy test, because with only three years of stability, $\lambda$ as high as 0.75 can be indistinguishable from zero with an alpha of 0.1. Rather than insist on a large number of years of stability, in which the problem encountered by traditional desistance researchers resurfaces, we have added a final step that illustrates the idea of meaningful change. In the final step, the highest predicted rate of offending during the five years preceding the period of stability is tested to determine whether it is indistinguishable from zero. If it is also indistinguishable from zero, it is hard to argue that there has been meaningful change. If the final rate of offending is indistinguishable from zero, but the initial rate, calculated during the five preceding years, is distinguishable from zero, we can claim (with error) that real change has occurred and that the final rate of offending is indistinguishable from zero.
In this case, the probability of observing five years in a row with zero offenses when the rate is 0.25 is 28.7%, and the probability of observing five years in a row with zero offenses when the rate is 0.5 is 8.2%. This means we can reject the null hypothesis that the rate of offending is 0.5 with an alpha of 0.1. Although the decision is marginal, we can claim in this case that real change has occurred, and that it would not be possible to distinguish the final level of offending from zero.

In contrast, consider the case of Group 4. They have been at a rate of at least 0.05 for nine years. The highest predicted rate during the preceding nine years is about 0.4 at age 15. The probability of observing nine years of nonoffending at a rate of 0.4 is 2.7%. The probability of observing nine years of nonoffending at a rate of 0.05 is 57.1%. Individuals in this group have experienced a decline in offending and are now at a rate of offending that is indistinguishable from zero, despite nine years of observation.