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Modeling Specialization and Escalation in the Criminal Career

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Abstract

Although research on criminal offense specialization and escalation has presented a consistent set of findings, this body of research is flawed in its approach. Commonly used indices of specialization and escalation are based on an invalid model, have no clear meaning, and cannot be tested for statistical significance across groups. This paper applies a class of log-linear models developed for studying social mobility tables with matched categories for one or more groups to crime-type-switching tables. The benefit to using these models, in comparison with prior specialization and escalation research, is the parameter estimates can be interpreted directly as tests of specialization and escalation in a meaningful way. The application of these models is illustrated with arrest data on a sample of felony offenders from Michigan.

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1 INTRODUCTION

Specialization and escalation are key elements of the criminal career paradigm described by Blumstein et al. (1986, 1988). Specialization refers to the tendency among criminal offenders to repeat the same type of crime across their criminal careers, while escalation refers to the tendency of some criminal offenders to commit crimes of an increasingly serious nature over the span of their criminal careers. Although several papers have recently claimed to find significant levels of specialization and escalation, problems with the analytical approach used in this work raise questions about its accuracy. The main goal of this paper is to illustrate how an alternative approach to analyzing two-way crime-type tables provides a clearer picture of criminal offense sequencing than is currently available. To this end, I have organized this paper as follows. Following a brief summary of the main findings of prior specialization research, I note why prior methods provide at best an unclear picture of specialization and, at worst, an inaccurate portrayal of offense sequencing. I then explain how a log-linear model developed for studying social mobility in two-way and multi-way tables has an analogous application in the study of crime sequencing among criminal offenders. Data on black and white felony criminal offenders are analyzed with these models to illustrate their utility for studying specialization and escalation.

1.1 Prior Research

Research testing for offense specialization has generally concluded that the type of crime a person commits at say, time 1, appears to increase the likelihood of that crime being committed at time 2. What does vary across these studies is the strength of the relationship between successive crime types. The single most important factor influencing the likelihood of specialization appears to be the age

of the offender. The evidence for specialization is weakest among juvenile offenders (Bursik, 1980; Cohen, 1986; Nevares et al., 1990; Rojek and Erickson, 1982; Wolfgang et al., 1972, 1987), although several studies have concluded that juvenile offenders do specialize in limited criminal activities (Farrington et al., 1988; Kempf, 1987; Tracy et al., 1990). The strongest evidence for specialization, however, comes from studies of adult offenders (Blumstein et al., 1988; Brennan et al., 1989; Moitra, 1981), where relatively high degrees of specialization have been found for drug and fraud offenses (Blumstein et al., 1988) as well as violent offenses (Blumstein et al., 1988; Brennan et al., 1989).

The effects of race and gender on the likelihood of offense specialization have also received limited attention. The overall effect of race on specialization is unclear. Bursik (1980), for example, found significantly different crime sequences for white and black youth, while Blumstein et al. (1988) found the pattern of specialization to be approximately the same for their samples of black and white offenders. Farrington et al. (1988) represents the only study to have examined the effect of gender, and concluded that young males and young females had similar overall levels of specialization. However, when distinguished by specific crimes, males were more likely to specialize in violent and serious theft offenses (e.g., robbery, aggravated assault, burglary) while females were more likely to specialize in public order and status offenses (e.g., liquor, runaway, truancy).

The research on escalation is scant. In what little research has examined the issue of escalation, the demographic effects appear to be comparable to those for specialization. For instance, the evidence of escalation among juveniles is weak (Tracy et al., 1990; Wolfgang et al., 1972), but apparently stronger for adult offenders (Blumstein et al., 1988). Race does not appear to be related to patterns of escalation. Blumstein et al. (1988), Tracy et al. (1990), and Wolfgang et al. (1972, 1987) all failed to note large differences in the seriousness of offense

sequences by race over the criminal career.

1.2 Methodological Issues

The typical test for specialization or escalation has the researcher test for independence in a two-way table of successive crime types. When the test reveals crime sequences are not independent, the researcher often concludes there is evidence of specialization or escalation. Although this research has consistently shown successive crime types to be related, there are several problems with concluding that non-independence implies the existence of specialization and/or escalation. Conclusions of this type represent a *non sequitur* – the lack of fit by the independence model simply implies that there is some degree of association in the table not captured by the different marginal distributions in a two-way table. The lack of fit by the independence model does not imply, as prior specialization and escalation research would have us believe, that the model of pure specialization (where all cases are expected to fall on the diagonal) or the model of pure escalation (where all cases are expected to fall below the diagonal) is then true. The concepts of specialization and escalation denote specific models – how individual cases should be arranged in a two-way table of offense types – which are not captured by a test for independence. Relatedly, Sobel (1983) criticized social mobility research on similar grounds, noting that it is nonsensical to make substantive inferences about the relationship between two variables on the basis of non-independence (see also Hauser, 1986; Sobel, 1985).

A problem related to the use of the independence model concerns the use of “specialization coefficients” and “escalation coefficients.” One of the more frequently used specialization indices is the “Forward Specialization Coefficient” (*FSC*) proposed by Farrington (1986; see also Farrington et al., 1988).¹ The *FSC*

¹The *FSC* is variably referred to as “Farrington’s Coefficient of Specialization” (Blumstein et

is computed as

$$FSC = \frac{n_{ii} - m_{ii}}{n_{i.} - m_{ii}}, \quad (1)$$

where n_{ii} is the observed frequency for diagonal cell ii , m_{ii} is the expected frequency for diagonal cell ii under independence, and $n_{i.}$ is the row total for row i . The FSC is restricted to the diagonal cells, since it has no meaning off the diagonal, where offenders have committed two different types of crime. The FSC can have a value ranging from -1 to $+1$. A value of -1 means that no one has repeated the same offense (i), a value of $+1$ means that everyone has repeated the same offense, and a value of 0 means that criminal offense type is completely random, or independent, from one arrest to the next arrest.

Although Farrington et al. (1988) present a reasonable case for the FSC , there are several problems with this measure that limit its usefulness. The main limitation to the FSC is that it is model dependent. The FSC has no meaning if the expected frequencies have been calculated under a model other than independence. Moreover, given that the independence model has rarely fit the joint distribution of two successive crime types, it could be argued that the FSC has no meaning anyway. Sobel (1983, 1985) makes such a case in rejecting the use of analogous indices in mobility research (e.g., Hope, 1982; Yasuda, 1964), where he notes

“When the independence model fails to hold, and in previous work this is the case, the parameters (parameter estimates) cannot be used to assess how closely a society approximates to or deviates from the equal opportunity standard. In fact, the independence model is no longer useful even as a null hypothesis, for both social theory and all available

al., 1988).

experience indicate that it is not a plausible representation of the mobility process" (1985:438).

In other words, indices computed on the basis of the independence model have no merit if the independence model does not provide a valid description of the data in the first place. Thus, with research on offense specialization and escalation, where the independence model has failed to describe the data in a two-way table of crime types, there are questions about the meaning of the *FSC*, since we are unable to use an index such as the *FSC* to assess how closely a group of offenders approximates to or deviates from pure specialization.

A second criticism of the *FSC* concerns its lack of any clear meaning. That the *FSC* has no meaningful interpretation is perhaps best illustrated by Farrington et al.'s (1988) interpretation of their results. For example, in discussing an *FSC* value of .107, they note that it can be interpreted as

"...roughly one-tenth of the distance between complete versatility and perfect specialization" (1988:475).

The reader is left wondering exactly what this comment means. Is "one-tenth of the distance to perfect specialization" a large value? Farrington et al.'s (1988) conclusion that juvenile offenders do specialize in criminal activities implies that it is; yet we might note that if this value represents one-tenth of the distance to perfect specialization, then it might conversely indicate approximately nine-tenths of the distance to complete versatility. The inability to attach a precise meaning to this index limits its generality and usefulness.

A third criticism of the *FSC* is the inability to test for significant differences across groups. The *FSC*'s sampling distribution is unknown, so it is impossible to test for subgroup differences. The inability to compare the *FSC* across groups thus

raises questions about how we know whether crime sequencing is the same for whites and non-whites? For males and females? For juveniles and adults? The "tests" performed in the published research noted above are simple eyeball tests, where the authors look for any "significant" differences in the *FSC* values across two or more groups (e.g., Blumstein et al., 1988; Farrington et al., 1988). Clearly, these are inadequate tests for group differences, and conclusions of significant (insignificant) group differences in prior research should be viewed cautiously.

Finally, it should be noted that Blumstein et al.'s (1988) conceptually equivalent "escalation coefficient" suffers the same limitations as the *FSC*. This coefficient is based on the independence model, has the same range of possible values ($-1, +1$) and interpretation, and does not permit a test of subgroup differences. Since it would be redundant to detail each criticism again, the reader is referred to Blumstein et al. (1988:332-336) for further details on their escalation coefficient.

1.3 Summary

In sum, the research on offense specialization and escalation in the criminal career has demonstrated the non-independence of two successive arrest-crime types. This may represent the limit of what has been established, however. The substantive conclusions of this work have questionable validity, since it is inappropriate to impute specialization or escalation – each implying a specific model form on the relationship between two variables – where the only test has been for independence.

Thus, to clarify the incomplete picture offered by prior specialization research, this paper specifies models for two-way and multi-way tables that include parameters directly interpretable as tests for specialization and escalation. This work borrows heavily from Hout et al. (1987), Sobel et al. (1985) and Sobel (1988). These models were developed to account for the one-to-one correspondence between

categories in two-way contingency tables of intergenerational mobility. The original work was aimed at measuring what Sobel et al. (1985) termed *exchange* and *structural* mobility. Structural mobility refers to the marginal heterogeneity that arises in a two-way table when the distributions of the origin and destination variables are not identical. In fact, the only time the distributions will be identical is when all cases fall on the diagonal, which will only occur by chance. An assumption made by Sobel et al. (1985) was that structural mobility would affect all origin categories uniformly (i.e., that the process was the same). Exchange mobility refers to the equal flow of cases between pairs of cells (i, j) and (j, i) in the two-way table. Thus, structural mobility is viewed as a factor that influences the odds of a particular destination category, relative to the origin category's share of the total distribution. Exchange mobility, meanwhile, is origin specific, and refers to combinations of origins and destinations in terms of the odds of moving between categories, relative to staying in the same category (Sobel et al., 1985:359-360).

These notions of exchange and structural mobility are analogous to specialization and escalation, respectively. Specialization can be thought of in terms of pairs of criminal offenses in a two-way table of crime types, where specialization refers to the odds of changing crime types, relative to staying with the same crime type. Similarly, escalation can be compared with structural mobility in the sense that it is a test for movement in the table, either upward or downward in offense seriousness, reflective of changes in each crime type's marginal distribution.

2 A MODEL OF OFFENSE SPECIALIZATION AND ESCALATION

2.1 Two-Way Tables

Sobel et al. (1985) reparameterized the quasi-symmetry (QS) model² in order to interpret its parameters in terms of exchange and structural mobility. The model is decomposed into symmetric marginal (β) and association (δ) parameters as well as asymmetric marginal (α) and association (γ) parameters. If F_{ij} is the expected cell frequency for cell ij in an $R \times R$ ($i = 1, \dots, R, j = 1, \dots, R$) contingency table, then the saturated multiplicative model is given by

$$F_{ij} = \beta_i \beta_j \alpha_j \delta_{ij} \gamma_{ij}, \quad (2)$$

where $\beta_i = \beta_j$ if $i = j$, $\prod_j \alpha_j = 1$, $\delta_{ij} = \delta_{ji}$ if $i \neq j$, $\delta_{ij} = 1$ if $i = j$, $\gamma_{ij} = 1$ if $i = j$, and at most $(R-2)(R-1)/2$ of the remaining γ_{ij} are identifiable (Sobel et al., 1985:361).

An alternative formulation of equation 2 is given by the additive form

$$F_{ij}^* = \beta_i^* + \beta_j^* + \alpha_j^* + \delta_{ij}^* + \gamma_{ij}^*, \quad (3)$$

where $F_{ij}^* = \log(F_{ij})$, $\beta_i^* = \log(\beta_i)$, $\beta_j^* = \log(\beta_j)$, $\alpha_j^* = \log(\alpha_j)$, $\delta_{ij}^* = \log(\delta_{ij})$, and $\gamma_{ij}^* = \log(\gamma_{ij})$. Since it is often easier to estimate the additive model, the remaining discussion will emphasize this model form, but the reader should bear in mind that the multiplicative model is obtained simply by taking the exponent of each additive parameter estimate.

The α_j^* parameters represent the marginal shift in the distributions of the origin and destination variables, and account for all marginal heterogeneity in a two

²The reader is referred to Agresti (1990), Bishop et al. (1975), and Hagenaars (1990) for more thorough discussions of QS and related classes of models.

way table. Unless there is a perfect relationship between the origin and destination variables in a table, there will be different marginal distributions (i.e., marginal heterogeneity), since the category of origin will not be the same as the destination category for every case in a two-way table. For example, all the cases that fit in category 2 of the origin variable will tend not to fit into category 2 of the destination variable, and once this occurs, there are different marginal distributions (i.e., marginal heterogeneity) that need to be controlled to get a better measure of the symmetric association in the table. If $\alpha_j^* < 0$, the destination category (j) holds proportionally fewer cases than the origin category (j). Conversely, when $\alpha_j^* > 0$, the destination category (j) has increased its proportion of cases in the marginal distribution.

The δ_{ij}^* parameters directly measure the symmetric association in the table with respect to the diagonal cells. Sobel et al. (1985:364) note that

$$\delta_{ij} = \sqrt{\frac{F_{ij}F_{ji}}{F_{ii}F_{jj}}}, \quad (4)$$

which shows that the δ_{ij} are a function of the odds ratio of moving between cells i and j relative to staying in cell i or j . In terms of the additive parameters, $\delta_{ij}^* < 0$ means the chances (log-odds) of staying in the same category (i or j) are greater than the chances of changing categories. Conversely, for $\delta_{ij}^* > 0$, the chances (log-odds) of moving between cells i and j are greater than remaining in the same category.

The asymmetric γ_{ij}^* measure any unreciprocated movement between cells F_{ij} and F_{ji} . For $\gamma_{ij}^* > 0$, more cases are moving to cell F_{ij} from cell F_{ji} than are moving from cell F_{ij} to cell F_{ji} , accounting for marginal heterogeneity (α_j 's). If $\gamma_{ij}^* < 0$, then the opposite pattern would be observed.

The QS model arises if there is no asymmetric association in the table (i.e.,

$\gamma_{ij} = 1$ for all i and all j). The additive form of QS is therefore

$$F_{ij}^* = \beta_i^* + \beta_j^* + \alpha_j^* + \delta_{ij}^*, \quad (5)$$

where the parameters are as defined above, and there are $(R-2)(R-1)/2$ degrees of freedom.

The reader should note that the QS model allows the cases to cluster on the diagonal, and fits these cells exactly. In other words, this model assumes there will be some likelihood of diagonal clustering, simply due to two variables with matched categories being compared, and then attempts to measure the strength of the symmetric association within the table, accounting for diagonal clustering and all marginal heterogeneity.

2.1.1 QS and Tests for Offense Specialization and Escalation

The application of the QS model and the interpretation of its parameters in terms of offense specialization is then straightforward. Given a two-way table of R criminal offense types, the degree of specialization (i.e., tendency to repeat the same offense and cluster along the diagonal of a table) is indicated by the values of the δ_{ij}^* parameters. Specifically, for each pair of offense types (i, j) , offense specialization is equivalent to $\delta_{ij}^* < 0$, where the log-odds of repeating the same offense (i or j) are greater than switching between offenses. This interpretation of the δ_{ij}^* parameters leads to a testable hypothesis with respect to offense specialization.

Hypothesis 1. Specialization $\equiv \delta_{ij}^* < 0$.

(If the $\delta_{ij}^* \geq 0$, then there is evidence of a tendency not to specialize in some criminal offense.)

A second testable hypothesis implied by this interpretation of the QS model addresses the issue of offense escalation. If the R crime types in a two-way are

ordered on the basis of seriousness, then a test for escalation is provided by the difference of the marginal shift parameters ($\alpha_j^* - \alpha_i^*$, $j < i$). Sobel et al. (1985) referred to this difference as an indicator of structural mobility, since it represents overall trends in the shape of the marginal distributions for the origin and destination variables. For $\alpha_j^* - \alpha_i^* > 0$, there is upward movement of cases from the less serious origin offense type i to the more serious destination offense type j . If, on the other hand, $\alpha_j^* - \alpha_i^* < 0$, there is downward movement from the more serious offense (j) to the less serious offense (i), or what Blumstein et al. (1988) call de-escalation.

Hypothesis 2. Escalation $\equiv \alpha_j^* - \alpha_i^* > 0$.

(If $\alpha_j^* - \alpha_i^* \leq 0$, then there is no evidence of escalation, and instead, support for no pattern (i.e., $\alpha_j^* - \alpha_i^* = 0$) or of offending becoming less serious over time (i.e., $\alpha_j^* - \alpha_i^* < 0$).)

2.2 Conditional Quasi-Symmetry

One of the difficulties associated with using specialization and escalation indices based on the independence model for a two-way table is the fact that tests of statistical significance cannot be performed across tables. A related problem in mobility research concerned the question of how to test whether mobility patterns in the United States were similar to the mobility patterns in other countries. With specialization and escalation, analogous questions concern whether patterns are the same for different racial and ethnic groups of offenders and/or male and female offenders.

The conditional quasi-symmetry (CQS) model (Bishop et al., 1975:299-300; Sobel, 1988:172-176) provides a means for extending the QS model, described in the preceding subsection, to the $R \times R$ table for K ($K > 1$) groups. The model of

CQS states that the QS model holds for each group for which there is an observed $R \times R$ table. In additive form, CQS may be written as

$$F_{ijk}^* = \mu_k^* + \beta_{ik}^* + \beta_{jk}^* + \alpha_{13(ik)}^* + \alpha_{23(jk)}^* + \delta_{ijk}^*, \quad (6)$$

where F_{ijk}^* is the frequency for the (ijk) th cell in a three-way table, μ_k^* represents a control for the different sizes of the K different groups, and the α^* , β^* , and δ^* parameters have the same meaning in the three-way table that they have in the two-way table, with the only difference being a unique set of parameter estimates for each group (denoted by the subscript k on each parameter).

The test for similarities and differences across the K groups is accomplished by imposing equality constraints on the α , β , and δ parameters. For example, if CQS holds and the δ_{ijk}^* are homogeneous across groups, the model is

$$F_{ijk}^* = \mu_k^* + \beta_{ik}^* + \beta_{jk}^* + \alpha_{13(ik)}^* + \alpha_{23(jk)}^* + \delta_{ij}^*, \quad \delta_{ij}^* = \delta_{ji}^*. \quad (7)$$

This model permits the α and β parameters to vary across groups, but states that the nature of association, with respect to the diagonal in each table, is the same for the different groups. Sobel (1988) suggested a simplified notation for this model as CQS + H_δ , which describes the model of CQS with homogeneity constraints on the δ parameters (H_δ).

By placing additional and alternative constraints on the marginal and association parameters, several other models can be derived to test for similarities and differences across groups. These models include, from most restrictive, CQS + $H_{\alpha\beta\delta}$, CQS + $H_{\alpha\beta}$, CQS + $H_{\alpha\delta}$, and CQS + H_α . Since these models are nested, tests of statistical significance are easily performed to assess whether a particular homogeneity constraint adequately describes the data in a three-way table.

2.2.1 CQS and Offense Specialization and Escalation

The CQS model and tests for homogeneity restrictions then provide a means of testing whether patterns of specialization and escalation are similar for different groups of offenders. Specifically, based on the discussion linking parameters of the QS and CQS models to specialization and escalation, similarities and differences across groups of offenders are tested for by placing equality constraints on the α and δ parameters. There would seem to be three cases of primary interest. First, a test for similar patterns of offense specialization would be given by the fit of the model $\text{CQS} + H_\delta$. If the δ_{ijk}^* are the same for different groups of offenders, their tendency to cluster on the diagonal (repeat the same offense) are the same. Second, a test for similar patterns of escalation is provided by the fit of the model $\text{CQS} + H_\alpha$. Recall that the α parameters measure marginal heterogeneity, and that differences in these parameters indicate shifts to (away) from specific offense types. Thus, if the α parameters are the same across groups, it states that there is the same kind of marginal shift occurring in each $R \times R$ table of crime types for the different groups. Third, a test for similarity in both specialization and escalation is provided by the fit of the model $\text{CQS} + H_{\alpha\delta}$. If this model provides the best fit to the data in a three-way table, then it means that the different groups of offenders have the same patterns of crime-switching (specialization and escalation) across their criminal careers.

3 DATA

The data to be used in the following analyses come from the Michigan Felony Offenders Study conducted by Alfred Blumstein and Jacqueline Cohen.³ For

³Readers are referred to Blumstein et al. (1988) for a detailed description of the sample and methods of data collection.

expository purposes, the following analyses are restricted to the first arrest transition for black and white offenders in the Detroit SMSA. For the following analyses, I use the same 10 offense classifications, and their assumed rank order seriousness, used by Blumstein et al. (1988).⁴ The two-way tables illustrating the transition from first to second adult arrest for black and white offenders are displayed in Tables I and II, respectively.

4 FINDINGS

4.1 *FSC* Analysis

In order to establish a baseline against which to compare the results obtained from the application of the QS model to the crime-type switching data, the *FSC* values for the diagonal cells in Tables I and II were calculated. The results from this analysis are presented in Table III.⁵

Turning first to the black offender subsample, we see that the three highest *FSC* values are for drug offenses (.258), auto theft (.246), fraud and robbery (both .210), suggesting there was a significant tendency for black offenders in Detroit to specialize in these crimes. The white offender subsample reveals a similar pattern, where the three highest *FSC* values are for drug offenses (.373), fraud (.263), and robbery (.258). The difference in the magnitudes of the *FSC* values for black and white offenders further suggests that each group of offenders has a greater (lesser) likelihood of specialization in some crime. For example, whites would be viewed as

⁴Some readers may object to the overly broad (narrow) offense descriptions used in this research. There may also be some debate over the relative seriousness of these 10 offenses. Although we should be wary of these concerns, they are beyond the immediate purpose of this paper, and will not alter the substance of the following discussion.

⁵The reader should note that these results vary from those published by Blumstein et al. (1988:322, Table VI). The primary reason is due to Blumstein et al. (1988) using summary transition matrices (i.e., all pairs of arrest sequences) for these offender subsamples, while the research reported here uses only the first offense transition.

more likely to specialize in drug, fraud and robbery offenses, since the *FSC* values appear to be considerably larger (.373 to .258, .263 to .210, and .258 to .210, respectively), while the sample of black offenders shows a greater likelihood of specializing in auto theft (.246 to .183).

Two additional aspects of Table III are worth noting. First, the *FSC* values for murder and rape for white offenders are negative. The reason for this is no one charged with murder or rape for their first offense repeated that crime, leaving the diagonal cell empty (see Table II). Second, recall that differences in the *FSC* cannot be tested across groups. Thus, while the differences in *FSC* values for murder (.139), drug (.115), larceny (.107), and rape (.097) offenses may appear to vary substantially across black and white offender subsamples, we really have no way of knowing whether these differences are meaningful.

4.2 Application of the QS Model

The QS model fit statistics and parameter estimates for the black and white offender subsamples are displayed in Tables IV and V, respectively. As indicated by the model fit statistics, the QS model offers a good fit to the crime-type data in Tables I and II ($L^2 = 42.426$, $df = 36$, $p = 0.214$, and $L^2 = 46.100$, $df = 36$, $p = 0.121$, respectively). The importance of the fit of this model is the ability to interpret the parameter estimates as tests for specialization and escalation.

For the black offender subsample, we see that all the δ_{ij}^* parameters are less than zero (statistically significant with $p \leq .05$, one-tail test), except for δ_{12}^* , which means the likelihood of switching between murder and rape is the same as the likelihood of repeating the same offense. The strongest relationship is indicated by δ_{38}^* (-3.016), the association between robbery and auto theft, which can be interpreted as meaning the odds of switching between robbery and auto theft relative to repeating the same crime are .002 ($\exp(-3.016)^2$). In other words,

offenders charged with robbery or auto theft for their first crime are much more likely to repeat the same offense, rather than switch between these two offenses.

The α_j^* parameters, as noted above, account for marginal heterogeneity. The values of the α_j^* parameters in Table IV show that regardless of the first offense, offenders are more likely to commit a homicide ($\alpha_1^* = .624$), weapons ($\alpha_1^* = .214$) and fraud ($\alpha_1^* = .070$) offenses. Offenders are then less likely to commit rape ($\alpha_2 = -.537$), burglary ($\alpha_6 = -.323$), and auto theft ($\alpha_8 = -.538$) for their second crime.

Table VI presents the test for escalation – the difference of the marginal shift parameters ($\alpha_j^* - \alpha_i^*$). These results provide mixed evidence for a pattern of escalation. There is clear upward movement from rape to homicide, from burglary to homicide, robbery, aggravated assault, and drug offenses, and from auto theft to homicide, robbery, aggravated assault, drug and larceny offenses. At the same time, however, there are significant downward trends from rape to robbery, aggravated assault, drug, larceny and weapons offenses, from burglary to larceny weapons and fraud offenses, and from auto theft to weapons and fraud offenses. In sum, of the 20 statistically significant differences, 10 show evidence of escalation, while 10 show evidence of de-escalation.

For the white offender subsample, the picture appears to be different. There are many more δ_{ij}^* parameters that are not statistically different from zero, suggesting there is not as great a tendency for cases to cluster along the diagonal, thus indicating a weaker tendency among white offenders to specialize their criminal activities. Recall that $\delta_{ij}^* = 0$ means that the odds of switching crime types relative to committing the same crime type are the same. Thus, the evidence of specialization among the white offender subsample would appear to be much weaker than in the black offender subsample. This finding varies with the results from the *FSC* analysis displayed in Table III. Recall that the pattern of *FSC*

values in Table III implied specialization was more prevalent in the white subsample. The QS model reveals a different pattern: specialization is more prevalent among the black offender subsample.

Turning to the issue of escalation, we see from Table V that, regardless of first offense type, offenders are less likely to commit larceny ($\alpha_7^* = -.20$) and auto theft ($\alpha_8^* = -.33$) offenses for their second crime. The results from a specific test for escalation appear in Table VII. In contrast to the results for the black offender subsample, there is only limited evidence of escalation. The only evidence of escalation shows that white offenders charged with larceny on the first arrest were significantly more likely to move up to robbery, while offenders charged with auto theft, similar to the black offender subsample, are more likely to move to robbery, aggravated assault, and drug offenses.

To summarize the results thus far, they demonstrate that the parameters of the QS model provide a much more detailed description of the nature of association between first and second crime type. They also point to some limits to the validity of the *FSC*, where, based on this coefficient, we would have concluded, as have prior studies, that there were significant levels of specialization and escalation among both the black and white offender subsamples. The problem with this conclusion, as the results in Tables IV through VII show, is that it misses some important aspects of the association between successive crime types, such as the level of specialization and escalation being much more pronounced in the black offender subsample, while there is only scant evidence of either specialization or escalation for the white offender subsample.

4.3 Application of the CQS Model

As I noted above, one of the main benefits to the use of the CQS model and its derivatives is the ability to test for equality in marginal and association parameters

across groups. The model fit statistics for the CQS model, in addition to the five alternative models that impose equality constraints on the α , β and δ parameters, are shown in Table VIII. Based on difference of chi-square tests, the overall, best-fitting model is CQS + H_δ , since the imposition of additional constraints deteriorates the model fit, while relaxing the equality constraint on the δ parameters, resulting in the general CQS model, does not significantly improve the fit of the model to the data ($L^2 = 40.450$, $df = 45$, $p = .35$).

There are two important implications of the model CQS + H_δ . First, it states that the nature of association in each table, with respect to the diagonal, is the same for black and white offender subsamples. In short, the pattern of specialization, to the degree it exists, is the same for both groups of offenders. Second, this model states that patterns of marginal heterogeneity are different for the two groups of offenders, since the equality constraint on the α parameters provided a significantly worse fit to the data. Thus, there are significant differences in the patterns of escalation for the two groups of offenders.

The parameter estimates for the CQS + H_δ model are displayed in Table IX. Note that the δ_{ij}^* are all significantly less than zero, with the exception of δ_{12}^* - the association parameter for murder and rape. Simply put, there is a uniformly strong tendency for offenders to repeat the same crime, rather than switch to an alternative crime type, for all pairs of crime types. Interestingly, this relationship has about the same magnitude regardless of the distance from the diagonal. In other words, the likelihood that an offender will switch crime types relative to staying with the same crime type is approximately the same whether there is little or great difference in the seriousness of the acts. For example, the likelihood of switching (relative to staying) between rape and a weapons offense ($\delta_{29}^* = -1.707$) is close to the likelihood of switching (relative to staying) between aggravated assault and a drug offense ($\delta_{45}^* = -1.642$).

The discussion on patterns of escalation noted above for the two groups of offenders still applies to the results presented in Table IX, since the α_j^* were allowed to vary across group. The results of testing for escalation across the two groups of offenders are displayed in Panels A and B of Table X for black and white offenders, respectively. Although the absolute values of the differences ($\alpha_j^* - \alpha_i^*$) vary at the second or third decimal point, the pattern of escalation for black and white offenders found under the CQS + H_δ model is identical to that found under QS and displayed in Tables VI and VII.

To summarize, the results presented in this analysis show the pattern of specialization among black and white felony offenders to be statistically indistinguishable, while the two groups of offenders appear to have different tendencies to increase or decrease the seriousness of their criminal offenses across their criminal careers. This set of results then conflicts with the conclusion of Blumstein et al. (1988) that the pattern of escalation was similar between black and white offenders.

5 CONCLUSIONS

The goal of this paper has been to propose and to apply a substantively meaningful and testable model of specialization and escalation in criminal offending. The QS model used in this paper is based on the work of Sobel et al. (1985) and Hout et al. (1987), and contains parameters that are directly interpretable as indicators of either specialization or escalation. This model was then extended to allow for subgroup comparisons, which resulted in the CQS model. These models were applied to data previously tested for specialization and revealed significant differences in the pattern and level of specialization when compared to the pattern found with traditional indices of specialization. Although the analyses here have

been limited to the first arrest transition for the black and white offender subsamples, they would seem to raise doubts about the validity of Blumstein et al.'s conclusions regarding specialization among criminal offenders in the same sample.

In regard to tests for escalation, the model tested here provides clear evidence of a small group of offenders increasing the severity of the crimes they commit across their criminal careers, but, at the same time, there is evidence of many offenders decreasing the severity of their criminal offending. The overall pattern, then, is mixed. Clearly, additional tests will be necessary to document what, if any, pattern in offense sequence seriousness exists.

For the first time in research on specialization and escalation, statistical tests for significant differences across subgroups were performed. The results of the subgroup comparison show that black and white offender subsamples have statistically identical patterns of specialization, but different patterns of escalation. Thus, black offenders are just as likely as white offenders to repeat or switch crime types, regardless of which pair of the ten crime types is being investigated. Further, trends in escalation are much more pronounced for the black offender subsample, while there is very little evidence of escalation among the subsample of white offenders. Although the test here was limited to race, and depending upon data availability, contrasts by age, gender, offense transition (e.g., second to third arrest), or some other relevant category could be performed.

Continued reliance on indices of specialization and escalation will do little to advance knowledge of the processes underlying the likelihood of individual criminal offenders to specialize and/or to increase the seriousness of their crimes across the life course. The models used in this paper offer a means of improving the overall quality of research on criminal specialization and escalation. In addition to the ability to attach a precise meaning to the parameter estimates, these models also offer a means of performing multivariate analyses of the determinants of

specialization and escalation.

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