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# Developmental Trajectories of Behavior Problems Among Children Who Have Experienced Maltreatment: Heterogeneity During Early Childhood and Ecological Predictors

Jiyoung K. Tabone[1], Neil B. Guterman[2], Alan J. Litrownik[3], Howard Dubowitz[4], Patricia Isbell[5], Diana J. English[6], Desmond K. Runyan[5], and Richard Thompson[7]

## Abstract

The current study is a longitudinal investigation of unobserved heterogeneity in the developmental trajectories of problem behaviors among children who have experienced maltreatment. The goal of this study is to inform effective intervention plans with respect to behavior problems of maltreated children by examining the different trajectories of behavior problems and by assessing ecological risk factors related to each trajectory. This study utilized data from the Longitudinal Study of Child Abuse and Neglect, in which 827 maltreated children have been followed from age 4 to age 10. This study identified five distinctive developmental trajectories of maltreated children. In most trajectory groups, a specific set of ecological risk factors distinctively predicted the probability of membership in a specific group. The results are discussed with respect to individualized early intervention efforts toward those most likely to benefit.

## Keywords

maltreatment, externalizing, trajectories, ecological factors

Decades of research have consistently demonstrated a strong association between the experience of abuse or neglect and later behavior problems (Alfaro, 1981; Jonson-Reid, 2002; Silver, Dublin, & Lourie, 1969; Smith & Thornberry, 1995; Widom, 1989). However, there is substantial variability in these outcomes. The extent to which maltreated children develop behavior problems may vary widely according to their ability to manage experiences of maltreatment and the extent to which support is available through family, community, and social services. Therefore, children who have experienced maltreatment may show different developmental trajectories in their lives. Identifying these developmental trajectories in early childhood, before they are entrenched in adolescence or adulthood, is crucial in the formulation of preventive interventions. The present study investigates unobserved heterogeneity in the behavior problem trajectories of maltreated children during early childhood and examines a number of ecological risk factors that may predict these different trajectories (see Note 1).

## Heterogeneity in the Behavior Problem Trajectories of Maltreated Children

Developmental psychopathologists argue that there are multiple contributors to developmental outcomes in any individual. The contributors' influence on individuals varies, and myriad pathways exist to any particular manifestation of adaptive or maladaptive behavior (Cicchetti & Cohen, 1995; Cicchetti & Rogosch, 1996). This idea of diversity in

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the developmental process suggests that there is heterogeneity among individuals who develop a specific maladaptive behavior with respect to the same adverse event as any one component may function differently depending on the context. For example, although two children may both undergo maltreatment, the effect of that maltreatment can vary in different systems, and children who have been abused or neglected may exhibit very different developmental trajectories. Development is not determined by previous experiences but continuously changes through a reorganization between person and environment over time, and maltreated children's behavior is either redirected or reinforced by their ecological environment. Thus, children's developmental trajectories of behavioral outcomes will follow very different patterns (e.g., desister, persister, escalator, etc.), depending on the child's environment.

Although developmental trajectories can vary widely within affected populations, little attention has been paid to investigating these individual differences. Some studies have attempted to identify different developmental trajectories of behavior problems, typically focusing on offending, bullying, or delinquent behaviors, and research in this area has defined four or five distinctive subgroup trajectories of such behavior problems: a high persistent and chronic group, a moderate to high escalator group, a moderate to high desister group, and a low or nonoffender group (Bongers, Koot, Ende, & Verhulst, 2004; Chung, Hawkins, Gilchrist, Hill, & Nagin, 2002; Nagin & Tremblay, 1999; Pepler, Jiang, Craig, & Connolly, 2008; White, Bates, & Buyske, 2001; Wiesner & Capaldi, 2003; Wiesner & Windle, 2004). All of these studies, however, focused on adolescents' developmental trajectories, and none of the studies utilized a sample of maltreated children. Thus, there may be groups of distinctive developmental trajectories among children who have experienced maltreatment, but it is not known whether there is heterogeneity in that population, nor which subgroups can be classified empirically.

## Ecological Factors Related to Behavior Problem Trajectories of Maltreated Children

Developmental psychopathologists also argue that research should be multileveled and concerned with person–environment integration (Cicchetti & Cohen, 1995). Because children who share the same experience of maltreatment (e.g., the same type, intensity, or duration of maltreatment) may follow different developmental trajectories depending on their environmental context, it is important to examine ecological factors related to these trajectories. As these risk factors accumulate across domains in the ecology of a maltreated child, behavioral problems tend to persist,

and the extent of individual differences can be explained by variation in these potential risk factors. The potential explanatory factors can be best conceptualized as occurring at multiple levels in the ecology of maltreated children (Stouthamer-Loeber, Loeber, Wei, Farrington, & Wikstrom, 2002). The range of factors related to developmental trajectories among maltreated children is broad; we focus on those proximate to maltreated children's development.

Prior research has identified a number of potentially important child level factors related to maltreatment outcomes. For example, studies have shown that developmental disability is linked to both maltreatment and behavior problems (Malmgren & Meisel, 2004; Sullivan & Knutson, 2000). In addition to developmental disability, there is considerable evidence that maltreated children are more likely to be insecure in their relationships to their caregivers, and this may result in negative developmental outcomes including behavior problems (Carlson, Cicchetti, Barnett, & Braunwald, 1989; Sroufe, 1988). Familial factors such as parental stress, poor parental supervision, poverty, and parental alcohol and mental health problems were generally reported to be related to the development of behavior problems in children (Loeber & Hay, 1997; Rutter, Giller, & Hagell, 1998). The few studies examining familial risk factors relevant to behavior problems among maltreated children have also identified these factors. For example, Fergusson and Lynskey (1997) have reported that a family history of alcohol problems is related to behavior problems among maltreated children, and Dubowitz, Papas, Black, and Starr (2002) have found an association between maternal depression and child behavior problems among high-risk neglected children. Community-level risk factors for maltreatment have also been explored; most commonly, rates of child maltreatment are elevated in many inner-city areas experiencing widespread poverty (Coulton, Korbin, & Su, 1999; Drake & Pandey, 1996), and impoverished inner-city communities also experience higher levels of delinquency (Jonson-Reid & Barth, 1998). Durant, Cadenhead, Pendergrast, Slavens, and Linder (1994) reported that exposure to community violence was the strongest predictor of youth violent behavior. Because many maltreated children live in impoverished communities, they are more likely to have been exposed to these problems. In particular, as children grow older and their environmental context extends beyond the immediate family, broad environmental factors such as community risk exert increasing influence on their development. A few studies have examined the effect of social services on the relationship between maltreatment and problem behaviors. Maltreated children often receive medical and mental health services, but their effects on behavior problems are largely unknown. Jonson-Reid (2002) reported that maltreated children—particularly ethnic minority children—who received child welfare services

had a lower risk of juvenile delinquency than those who did not receive services. This suggests that some child welfare services may have a mitigating effect on delinquency. However, Burns et al. (2004) found that maltreated youth exhibiting emotional and behavior problems were more likely to receive services, suggesting that mental health services were a marker for more behavior problems. Thus, the evidence on the effectiveness of social services is mixed (Thompson, 2009). Many studies have shown a variety of these potential risk factors at the child, family, neighborhood, and social levels that are generally related to the development of behavior problems, but ecological factors predicting different behavior problem trajectories of maltreated children are largely unknown.

The current study has two central aims. The first is to identify distinctive subgroup trajectories of behavioral problems among children who have experienced maltreatment, and the second is to examine ecological factors predictive of membership in each trajectory group. It is hypothesized that there is unobserved heterogeneity in the developmental trajectories of maltreated children and that these trajectories can be grouped into several distinctive subgroups. Furthermore, it is hypothesized that ecological risk factors related to the child, the primary caregiver, and community characteristics are more prevalent in trajectory groups with higher incidence of behavior problems (i.e., increasing and chronic trajectories) than in the lowest trajectory group.

## Method

### Sample and Design

This study utilized data from Longitudinal Study of Child Abuse and Neglect (LONGSCAN). LONGSCAN is a longitudinal study of 1,354 children and their primary caregivers at five sites across the United States. The national sample represents various levels of risk or exposure to maltreatment. One site includes children at high risk for maltreatment (East site); two sites include children reported for maltreatment (Northwest and Southwest sites); and two sites include both children at risk and children reported as maltreated (Southern and Midwest sites). The three sites in the East, Midwest, and Northwest are primarily urban; the Southwest site is primarily suburban, and the Southern site is a statewide site including urban, suburban, and rural communities. The LONGSCAN study investigates the long-term effects of maltreatment on children's growth and development. All five sites share measures, definitions, training of data collectors, data collection strategies, data entry, and data management and are linked through a governance agreement and coordinating center at the University of North Carolina at Chapel Hill. Participants at each site are followed through the age of 18, and extensive

evaluations occur at ages 4, 6, 8, 12, 14, 16, and 18. For the current analysis, data from the first four time points (ages 4, 6, 8 and 10) were used. At ages 4, 6, and 8, face-to-face interviews with the primary caregiver and the child are conducted, and at age 10, telephone interviews are conducted. For this study, the sample was reduced to 1,247 because of missing baseline (age 4) data. Because they had not been reported to child protective services for maltreatment, 420 individuals were then excluded. Therefore, data from 827 maltreated child–primary caregiver dyads, including both substantiated and unsubstantiated cases, were analyzed.

### Measurement

*Outcome variable for trajectories*. Externalizing behavior problems were analyzed as outcomes. Not only are primary caregivers more accurate and sensitive in reporting the externalizing behaviors of children (Bird, Gould, & Staghezza, 1992), but externalizing behaviors are also more observable than internalizing behaviors for children younger than age 10, when there are problems with child self-report (Reyes & Kazdin, 2005). Externalizing behavioral problems were measured by Achenbach's *Child Behavior Checklist* (CBCL; Achenbach, 1991). Achenbach's CBCL is completed by the child's primary caregiver. The CBCL is a 113-item behavior problems checklist divided into eight constructs: Social Withdrawal, Somatic Complaints, Anxiety/Depression, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, and Aggressive Behavior. Externalizing Behavior is the sum of the Aggressive Behavior scale and the Delinquent Behavior scale. Higher scores indicate more behavior problems. The raw scores of Externalizing Behavior Problems were used for the creation of trajectories. This measure is widely used with clinical and nonclinical populations and has extensive content, construct, and criterion-related validity and reliability (Achenbach, 1991). CBCL Externalizing scores were repeatedly measured at ages 4, 6, 8, and 10 to investigate the developmental trajectories of the children's behavior problems.

*Ecological predictors related to trajectories*. The ecological covariates to distinctive subgroup trajectories were all measured at baseline (age 4). The covariates included child developmental disability, child's separation from caregiver, caregiver depression, caregiver alcohol problems, community quality, and mental health services utilization.

*Child developmental disability*. Information on child developmental disability is coded as a dichotomous variable. Primary caregivers recorded if the child had a developmental disability.

*Child's separation from caregiver*. Information on child separation history was reported by primary caregivers and coded as the total number of separations from a primary maternal caregiver during the first years of life. The total number of separations in the first year of life was assessed without regard

for the reason for separation. Most separations resulted from child welfare removal (e.g., risky environment) or informal kin care arrangements (e.g., child stayed with grandmother while mother was in some treatment programs).

*Caregiver depressive symptoms*. Caregiver depressive symptoms were assessed with the *Center for Epidemiologic Studies Depression Scale* (CES-D; Radloff, 1977). The CES-D includes 20 items composing six scales reflecting major dimensions of depression such as depressed mood, worthlessness, and hopelessness. Primary caregivers recorded if they felt depression feelings in the preceding week. The response categories indicate the frequency of the occurrence of each item and are scored on a 4-point scale ranging from 0 (*rarely or none of the time*) to 3 (*most or all of the time*). Total scores can range from 0 to 60, and higher scores indicate more depressive symptoms.

*Caregiver alcohol problems*. Caregiver alcohol problems were assessed by the *CAGE Questionnaire* (Ewing, 1984). The scale involves four questions, and the responses to the four items were summed to derive a total score with values ranging from 0 to 4, where a higher score indicates a greater risk for alcoholism. In the LONGSCAN sample, the alpha coefficient for this measure is .78.

*Community quality*. Community quality was assessed with the *Neighborhood Short Form* (Hunter et al., 2003), which was developed to measure an individual's perception of neighborhood quality including safety and social support. This instrument comprises nine items, and a total neighborhood quality score is computed by summing scores across all nine items. The scores can range from 3 to 12, with higher scores indicating a higher degree of community quality being measured. In the LONGSCAN sample, the alpha coefficient for this measure is .87.

*Mental health services utilization*. Information on child mental health services was coded as a dichotomous variable. Primary caregivers reported whether or not the children had ever received mental health services.

*Control variables*. Additional control variables were measured at baseline (age 4) and included demographic questions about family income, caregiver education, welfare receipt, and child gender and ethnicity.

## Analytic Strategy

The primary goal of the present study was to investigate distinctive subgroup trajectories of behavioral problems among children who have experienced maltreatment and assess ecological factors predictive of membership in each trajectory group. This involved two steps, and all analyses were conducted using SAS Version 9.2.

*Identifying trajectory groups*. The group-based trajectory modeling approach was used to identify distinctive subgroup trajectories among maltreated children. This method,

developed by Nagin and colleagues (Jones, Nagin, & Roeder, 2001; Nagin, 2005; Nagin & Tremblay, 1999), is responsive to individual-level heterogeneity in developmental trajectories. The group-based trajectory modeling approach assumes that the population is composed of a mixture of distinct groups defined by developmental trajectories. Those distinctive developmental trajectories may in turn reflect distinctive etiologies (Nagin, 2005). By identifying clusters of individuals with similar developmental trajectories, differences that may explain individual-level heterogeneity can be expressed in terms of group difference. The censored normal distribution was used for modeling externalizing behavior problems to account for censoring at the minimum and maximum of externalizing scores, and a polynomial relationship was used to model the link between age and externalizing behavior problems. Final model selection was conducted based on the Bayesian information criterion (BIC) to determine the optimal number of groups in the data and the best explanatory shapes of trajectories (including liner, quadratic, and cubic functions) over time. The model with the maximum BIC identifies the best explanatory model. BIC rewards parsimony and is also known to be consistent (Bongers et al., 2004; Nagin & Tremblay, 1999). The difference in BIC values between the models can evidence how well the model with the highest BIC fits the data in comparison with other models.

*Assessing ecological factors*. Examining ecological factors related to each trajectory is a twofold process. The first step is the assessment of the individual effects of ecological factors on each trajectory group, and the second is the assessment of the cumulative effect of ecological factors on membership in different trajectory groups. For assessing individual effects, multinomial logit models were completed within a prospective design in which each ecological factor at baseline predicted later developmental trajectories of maltreated children from age 4 through age 10, holding other covariates consistent. For assessment of the cumulative effect, the trajectory group membership identified in the group-based trajectory modeling was extended, using different combinations of ecological factors. Using the multinomial logit coefficients for ecological factors, a propensity score for membership in each of the trajectory groups based on different combinations of ecological factors can be computed (Nagin, 2005). Specifically, let $S_{ij} = X_i \hat{\theta}_j$ denote individual *i*'s estimated propensity score for trajectory group *j*. When group 1 serves as the reference group ($S_{i1}$), the probability of membership in group 1 with no ecological risk factors can be calculated based on the intercept estimate of each trajectory because $X_i = 0$ and $S_{ij} = X_i \hat{\theta}_j$ equals the intercept estimate for each trajectory group (Nagin, 2005):

$$\pi_1 = \frac{e^0}{e^0 + e^{\text{INTercept}_{group2}} + e^{\text{INTercept}_{group3}} + ... + e^{\text{INTercept}_{groupj}}}$$

In addition, the multiple imputation method was conducted to accommodate missing data. Because missing data imputation methods can be valid under the assumption of missing at random (Allison, 2002), missing data patterns were examined to see if a set of missing variables followed a specific pattern or if there were important predictors on missingness of the outcome variable. Missingness did not significantly covary across variables, and none of predictors was associated with missingness of the outcome variable. Thus, the missing data multiple imputation technique was valid and was applied for multinomial logistic regression analyses because the group-based trajectory modeling already accommodates missing data when the methods identify trajectories of externalizing behavior problems from age 4 to age 10 (Jones et al., 2001).

## Results

### Identifying Trajectories of Externalizing Behavior Problems

*Model selection.* Model selection for the developmental trajectories of behavior problems required the estimation of models with varying numbers of groups and shapes of the trajectories. We tested one-, two-, three-, four-, five-, and six-group models in which the BIC scores were –10460.03, –10001.70, –9936.56, –9921.44, –9886.17, and –9889.76, respectively. The five-group solution had the largest BIC score and was most likely to have the most appropriate number of groups. Several five-group models were then tested to specify the best shape of the trajectories, and a model in which the first and fifth groups were constrained to be constant, the second and forth groups followed linear trajectories, and the third group followed a quadratic trajectory over age was selected as the final model. Posterior group-membership probabilities were then computed using the selected five-group model to check model fit. Because posterior probabilities measure the probability that an individual with a specific behavioral profile belongs to a specific trajectory group *j* in the selected model, they provide an objective basis for assessing the quality of the model's fit to the data (Nagin, 2005). The average posterior probabilities for the assigned groups were .9, .8, .8, .8, and .9 for the first, second, third, fourth, and fifth groups, respectively, surpassing the minimum threshold of .7 (Nagin, 2005). In addition, the estimated proportions for the first, second, third, fourth, and fifth groups were 32.6% (vs. actual 31.0%), 42.7% (vs. actual 46.1%), 12.5% (vs. actual 12.5%), 7.8% (vs. actual 6.2%), and 4.4% (vs. actual 4.2%), respectively, and both values were very similar, also suggesting that the final model had a good fit. The selected trajectory groups are plotted in Figure 1. The first, second, third, fourth, and fifth groups were labeled as the lowest,
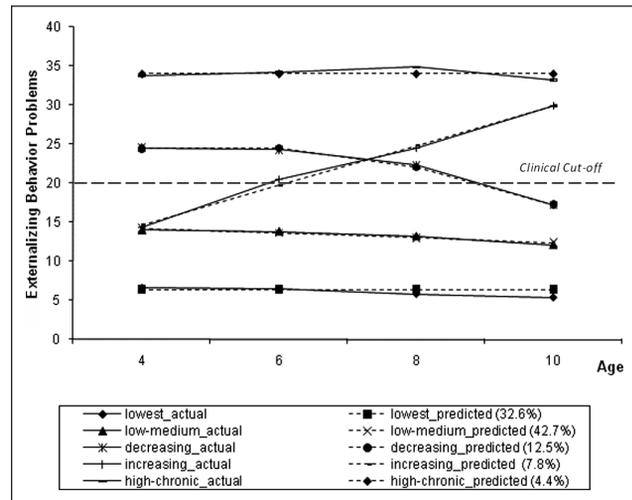


**Figure 1.** Developmental trajectories of externalizing behavior problems among maltreated children

low-medium, decreasing, increasing, and high-chronic groups, respectively.

Based on the final model selected above, the lowest group represented 33% of the sample and consistently displayed the lowest rate of externalizing behavior problems from ages 4 through 10. The low-medium group comprised 43% of the sample and showed a slightly higher rate of externalizing behavior problems than the lowest group at age 4; however, behavior problems stayed consistent over ages 4–10 in this group. The decreasing group represented 12% of the sample and showed high externalizing behavior problems at age 4, followed by a decreased rate of behavior problems from ages 6 to 10. Inversely, the increasing group showed a low incidence of externalizing behavior problems at age 4, but was found subsequently to show an increased incidence of behavior problems. The increasing group constituted 8% of the sample. Interestingly, the increasing group was nearly identical to the low-medium group in incidence of behavior problems at age 4, but showed a significant linear increase in behavior problems over time, whereas the low-medium group stayed consistent. Finally, maltreated children who showed consistently highest behavior problems from ages 4 to 10 were grouped into the high-chronic group, and this group represented 4% of the sample.

*Demographic characteristics by trajectory groups.* Descriptive statistics for trajectory groups depicted in Figure 1 are summarized in Table 1. Gender showed a statistically significant difference across groups. Male gender was more common in the decreasing, increasing, and high-chronic groups, whereas female gender was more common in the lowest and low-medium groups. There were few ethnic differences in membership in the different trajectory groups.

**Table 1.** Demographic Characteristics by Externalizing Behavior Problem Trajectory Groups

| Variable | Lowest (n = 256) | | Low-medium (n = 382) | | Decreasing (n = 103) | | Increasing (n = 51) | | High-chronic (n = 35) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| Gender | | | | | | | | | | |
| Male*** | 102 | 40.0 | 177 | 46.3 | 63 | 61.2 | 34 | 66.7 | 20 | 57.1 |
| Ethnicity | | | | | | | | | | |
| White | 68 | 26.6 | 130 | 34.0 | 31 | 30.0 | 17 | 33.3 | 13 | 37.1 |
| African American | 123 | 48.0 | 169 | 44.3 | 36 | 35.0 | 18 | 35.3 | 16 | 45.7 |
| Other | 65 | 25.4 | 83 | 21.7 | 36 | 35.0 | 16 | 31.4 | 6 | 17.2 |
| Years of caregiver education (*M, SD*) | 11.77 | 2.12 | 11.70 | 2.25 | 11.75 | 2.27 | 11.51 | 2.18 | 12.08 | 2.07 |
| Yearly family income (in $5K increments; *Mdn*, IQR[a]) | 3.0 | 3.0 | 3.0 | 3.0 | 3.5 | 5.0 | 3.0 | 3.0 | 4.0 | 4.0 |
| Welfare receipt | 203 | 79.6 | 322 | 84.9 | 89 | 87.3 | 45 | 88.2 | 27 | 77.1 |
| Site | | | | | | | | | | |
| East | 31 | 12.1 | 43 | 11.3 | 10 | 9.7 | 6 | 11.8 | 3 | 8.6 |
| Midwest | 40 | 15.6 | 36 | 9.4 | 6 | 5.8 | 1 | 1.9 | 1 | 2.9 |
| Northwest | 62 | 24.2 | 119 | 31.1 | 35 | 34.0 | 15 | 29.4 | 9 | 25.7 |
| Southern | 29 | 11.4 | 43 | 11.3 | 9 | 8.7 | 6 | 11.8 | 6 | 17.1 |
| Southwest | 94 | 36.7 | 141 | 36.9 | 43 | 41.8 | 23 | 45.1 | 16 | 45.7 |

Values are *n* and percentage, unless otherwise noted.
a. Interquartile range.
*** *p* < .001.

The average number of years of caregiver education was 12 years across all five trajectory groups, and median annual family income was between $15,000 and $20,000 (i.e., between 3 and 4 increments of $5,000). More than 77% of families with maltreated children across all trajectory groups had received welfare services. Because the LONG-SCAN data were collected from five different sites, a chi-square test was conducted to investigate whether there was an association between trajectory group membership and study site. The chi-square statistics showed there was no significant association ($\chi^2$ = 22.58, *p* = .125), suggesting that developmental trajectory group membership was independent from site.

## Individual Effects of Ecological Factors

Given the polychotomous nature of trajectory group membership, multinomial logistic regression was used to examine the individual effects of ecological predictors on trajectory group membership. Child gender and ethnicity, caregiver education, family income, and welfare receipt were used as controls. We focused on four meaningful contrasts: increasing and high-chronic versus lowest, increasing versus low-medium, and increasing versus decreasing. In the first two contrasts, the high-chronic and increasing groups were in the range of clinically significant behavior problems, whereas lowest groups showed almost no problem behaviors. In the third contrast, the low-medium and increasing groups had similar starting points at the baseline.

However, although the low-medium groups stayed consistent over age 4 to age 10, the increasing group showed a linear increase in externalizing behavior problems. In the fourth contrast, children in the decreasing group showed high externalizing behavior problems at age 4 and then a decrease in behavior problems from age 6 to age 10. Inversely, children in the increasing group showed low externalizing behavior problems at age 4 and an increase in behavior problems subsequently. Examining ecological factors predicting the divergence of these pairs of trajectories is useful to formulate preventative intervention plans, and the results from three multinomial logit models follow.

*Increasing and high-chronic groups versus lowest group.* Multinomial logistic regression revealed several significant ecological predictors of trajectory group membership, after controlling for the demographics of child and caregiver. Developmental disability was more common in the increasing (odds ratio [OR] = 2.39, 95% confidence interval [CI] = 1.02–5.64, *p* = .04) and high-chronic (OR = 3.28, 95% CI = 1.27–8.16, *p* = .01) groups than in the lowest group. Caregiver alcohol problems were significantly related to membership in the increasing group (OR = 1.42, 95% CI = 1.11–1.80, *p* = .02), whereas caregiver depression was significantly related to high-chronic trajectory groups (OR = 1.10, 95% CI = 1.06–1.13, *p* = .001) compared to the lowest group. Low community quality was significantly related to the increasing trajectory group (OR = 0.95, 95% CI = 0.90–0.99, *p* = .04). The likelihood of being in the increasing group increased as community safety and support decreased.

Child mental health services were much more common in both increasing and high-chronic groups in comparison with the lowest group (OR = 2.72, 95% CI = 1.35–5.41, *p* = .01 and OR = 4.78, 95% CI = 2.05–10.91, *p* = .001, respectively). Separation from primary maternal caregiver during the first years of life did not significantly distinguish between any of the pairs of trajectory groups contrasted.

*Increasing group versus low-medium group*. After controlling for child and caregiver demographics, caregiver alcohol problems predicted the contrast between the low-medium group and the increasing group. The likelihood of being in the increasing group significantly rose 28% per each additional unit of caregiver alcohol problems in comparison with the low-medium group (OR = 1.28, 95% CI = 1.01–1.61, *p* = .04).

*Increasing group versus decreasing group*. There was a significant difference in caregiver depression between the decreasing group and the increasing group after controlling for child and caregiver demographics. The likelihood of being in the increasing group decreased as caregiver depression increased (OR = 0.94, 95% CI = 0.91–0.97, *p* = .001). The analysis focused on four pairs of these trajectories is presented in Table 2.

## Cumulative Effects of Ecological Factors

The results of the multinomial logit analysis have allowed a closer look at the unique effects of each ecological factor while holding other factors constant. Although isolating the individual effects of particular ecological factors is useful and informative, maltreated children often live in environments in which multiple risk factors are present; their behavior problems are collectively influenced by the accumulation of these risk factors. What must also be investigated is whether the probability of membership in a specific behavior problem group can be definitively identified with a specific set of risk factors. We have attempted to estimate group membership probabilities on cumulative risk factors using four ecological variables that were significant predictors in the previous analyses: child developmental disability, caregiver alcohol problems, caregiver depression, and low community quality. Mental health services can be considered both a risk and a protective factor as mentioned before. Mental health services can help children, while simultaneously mental health services utilization can be an indication of a child's mental health problems. For this reason, we have excluded mental health services from the list of risk factors. The results are summarized in Table 3.

As seen in Part 1, presented in the upper section of Table 3, in the lowest and high-chronic groups, group membership probability followed a linear trend as the number of risk factors increased from zero to one, two, three, and four. Although the probability of membership in the lowest group gradually decreased with each additional risk factor, the probability of high-chronic group membership increased linearly from 0 to .02, .07, .15, and .20. The probability of low-medium group membership was clustered around a smaller number of risk factors (zero, one, and two risk factors), and the probability of decreasing group membership was clustered around a larger number of risk factors (three and five risk factors). In the increasing group, group membership probability was widely spread over different numbers of risk factors.

In addition to the number of risk factors, different types and combinations of risk factors could be differentially related to behavior pattern trajectories within each risk factor level. Part 2, displayed in the lower section of Table 3, presents the predicted group membership probabilities on all possible combinations of ecological risk factors. In the hypothetical case of a child at no risk of any ecological factors, the probability of membership in the lowest group was highest, but any additional risk factors decreased the probability of being in the lowest group.

In the low-medium group, there was no distinct pattern regarding sets of risk factors. In general, one or two risk combinations were common, and a set of risk factors (including low community quality) was found to have a relatively high probability.

The probability of membership in the decreasing group was as low as .08 and .09, when factoring in child developmental disability alone and caregiver depression alone as singular risk factors, respectively. Yet when these risk factors were combined, the probability of membership in the decreasing group increased dramatically, to .33. Three risk combinations including these two risk factors together also showed high probabilities. These results suggest that the interaction of child developmental disability and caregiver depression could result in an immediately high risk of behavior problems, which become more attenuated over time.

Child developmental disability was the single risk factor most predictive of increasing group membership in externalizing behavior problems, when it was factored in both alone and in combination with other risk factors. A set of risks including caregiver alcohol problems and low community quality also resulted in a high probability of increasing group membership: In fact, child developmental disability, caregiver alcohol problems, and low community quality were found to be significant ecological factors differentiating the increasing group from other groups in the previous analysis of multinomial logistic regression.

The probability of membership in the high-chronic group was nearly 0 among those with no risk factors. However, the presence of all four risk factors resulted in a dramatic change to .20 in membership probability of high-chronic group. Moreover, the combination of three

**Table 2.** Multinomial Logistic Regressions for Individual Effect on Ecological Factors: Increasing and High-Chronic Versus Lowest, Increasing Versus Low-Medium, and Increasing Versus Decreasing

| Ecological predictor | Increasing vs. lowest | | High-chronic vs. lowest | | Increasing vs. low-medium | | Increasing vs. decreasing | |
|---|---|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | Odds ratio | 95% CI | Odds ratio | 95% CI | Odds ratio | 95% CI |
| Demographic | | | | | | | | |
| Female vs. male | 0.34 | 0.18–0.66** | 0.55 | 0.26–1.17 | 0.43 | 0.23–0.82** | 0.75 | 0.98–1.53 |
| African American vs. White | 0.57 | 0.26–1.25 | 0.87 | 0.36–2.10 | 0.88 | 0.42–1.84 | 0.94 | 0.39–2.24 |
| Other vs. White | 0.98 | 0.44–2.20 | 0.62 | 0.21–1.82 | 1.46 | 0.68–3.12 | 0.73 | 0.35–1.75 |
| Caregiver education | 0.95 | 0.83–1.12 | 1.05 | 0.86–9.21 | 0.95 | 0.83–1.09 | 0.96 | 0.82–1.12 |
| Family income | 1.11 | 0.96–1.28 | 1.13 | 0.94–1.32 | 1.04 | 0.91–1.19 | 0.90 | 0.77–1.06 |
| Welfare receipt | 2.77 | 0.98–7.68 | 0.99 | 0.36–2.74 | 1.75 | 0.65–4.74 | 1.02 | 0.32–3.15 |
| Individual | | | | | | | | |
| Developmental disability | 2.39 | 1.02–5.64* | 3.28 | 1.27–8.16** | 1.46 | 0.67–3.18 | 1.17 | 0.48–2.88 |
| Separation from caregiver | 1.02 | 0.97–1.07 | 0.95 | 0.81–1.09 | 1.04 | 0.98–1.09 | 1.09 | 0.96–1.24 |
| Family | | | | | | | | |
| Caregiver alcoholism | 1.42 | 1.11–1.80** | 1.11 | 0.81–1.52 | 1.28 | 1.01–1.61* | 1.27 | 0.94–1.69 |
| Caregiver depression | 1.02 | 0.98–1.06 | 1.10 | 1.06–1.13*** | 0.98 | 0.95–1.02 | 0.94 | 0.91–0.97*** |
| Community | | | | | | | | |
| Community quality | 0.95 | 0.90–0.99* | 0.97 | 0.91–1.04 | 0.97 | 0.93–1.02 | 0.99 | 0.94–1.05 |
| Social service | | | | | | | | |
| Child mental health service | 2.72 | 1.35–5.41** | 4.78 | 2.05–10.91*** | 1.79 | 0.93–3.42 | 0.87 | 0.42–1.81 |

CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

risk factors (i.e., child developmental disability, caregiver alcohol, and caregiver depression) resulted in a high probability of .26, but in general it was the number of risk factors that mattered rather than the particular types of risks in this group. Interestingly, although a set of combinations including low community quality was related to the increasing group membership, it was irrelevant to high-chronic group membership.

## Discussion

### Identifying Distinctive Subgroup Trajectories

This study has found that the trajectories of behavior problems among maltreated children can be individually differentiated. Five distinctive developmental trajectories of maltreated children were identified: lowest, low-medium, decreasing, increasing, and high-chronic trajectory groups. Not all maltreated children experienced externalizing behavior problems, and, surprisingly, most maltreated children showed resilience in the face of abuse or neglect. In terms of raw externalizing behavior scores for ages 4 through 10, 20 is generally considered a clinical cutoff point. As seen in Figure 1, approximately 16.9% of maltreated children (in the decreasing and high-chronic groups) scored higher than 20 in externalizing behavior scores from age 4 to age 6. However, as maltreated children in the decreasing group

showed a decrease in behavior problems to beneath the cut-off points after age 7, approximately 12.2% of maltreated children, including children in the high-chronic and increasing groups, exhibited clinically significant behavior problems from age 8 to age 10. Although the incidence of clinically significant behavior problems in maltreated children ranged from 12.2% to 16.9%, more than 80% of maltreated children were not in the clinical range at any given point in time, and only 4% showed high-chronic trajectories. Wiesner and Windle's (2004) study of adolescent delinquency trajectories in the general population found that 6% could be considered part of the high-chronic group. Chung et al.'s (2002) study of offending trajectories in poor adolescents found that 11% could be considered part of the high-chronic group. Although this study cannot be directly compared to these other two on account of the substantial difference in sample characteristics, it may suggest that the lower incidence of high-chronic trajectories in maltreated children was found compared with the general population and poor adolescents.

### Ecological Factors Related to Each Trajectory

This study has attempted to assess ecological factors predicting the divergence of developmental trajectories of externalizing behavior problems among maltreated children. Child developmental disability was significantly related to the

**Table 3.** Predicted Group Membership Probabilities on Cumulative Ecological Risk Factors

| Part 1: Number of risk factors | | Group membership probability | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | Lowest | Low–medium | Decreasing | Increasing | High–chronic |
| 0 risk | No risk | .47 | .41 | .01 | .11 | .00 |
| 1 risk | Any 1 risk factor | .29 | .49 | .05 | .15 | .02 |
| 2 risks | Any 2 combinations of risk factors | .14 | .48 | .15 | .16 | .07 |
| 3 risks | Any 3 combinations of risk factors | .05 | .33 | .35 | .11 | .15 |
| 4 risks | All risk factors | .01 | .20 | .51 | .08 | .20 |

| Part 2: Combinations of risk factors | | Group membership probability | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | Lowest | Low–medium | Decreasing | Increasing | High–chronic |
| 0 risk | No risk | .47 | .41 | .01 | .11 | .00 |
| 1 risk | Child developmental disability only | .17 | .50 | .08 | .21 | .04 |
| | Caregiver alcohol problem only | .39 | .46 | .03 | .11 | .02 |
| | Caregiver depression only | .32 | .46 | .09 | .10 | .03 |
| | Low community quality only | .27 | .53 | .02 | .17 | .01 |
| 2 risks | Child developmental disability + caregiver alcohol | .11 | .47 | .14 | .17 | .11 |
| | Child developmental disability + caregiver depression | .07 | .34 | .33 | .12 | .15 |
| | Child developmental disability + low community quality | .08 | .52 | .10 | .26 | .04 |
| | Caregiver alcohol + caregiver depression | .22 | .44 | .16 | .09 | .08 |
| | Caregiver alcohol + low community quality | .22 | .56 | .04 | .16 | .02 |
| | Caregiver depression + low community quality | .16 | .53 | .13 | .15 | .03 |
| 3 risks | Child developmental disability + caregiver alcohol + caregiver depression | .03 | .22 | .42 | .07 | .26 |
| | Child developmental disability + caregiver alcohol + low community | .05 | .46 | .18 | .21 | .09 |
| | Child developmental disability + caregiver depression + low community | .03 | .31 | .41 | .13 | .11 |
| | Caregiver alcohol + caregiver depression + Low community | .11 | .47 | .23 | .12 | .07 |
| 4 risks | All risks | .01 | .20 | .51 | .08 | .20 |
| Population base rate | | .33 | .43 | .12 | .08 | .04 |

Child developmental disability: 0 = *no*, 1 = *yes*; caregiver depression: using clinical cutoff point (16), 0 = *less than 16*; 1 = *more than 16*; caregiver alcoholism: 0 = *no*, 1 = *yes*; low community quality: using 1 standard deviation below the mean, 0 = *less than 18*, 1 = *more than 18*.

increasing and high-chronic groups, and caregiver alcohol problems and low community quality were significantly related to membership in the increasing group compared with the lowest group. These findings are consistent with prior research suggesting that there is a strong relationship among child developmental disability, parental alcoholism, and poor community quality and behavior problems (Fergusson & Lynskey, 1997; Jonson-Reid & Barth, 1998; Malmgren &

Meisel, 2004). Chung et al. (2002) in particular have reported that neighborhood risk factors are associated with the escalating trajectory group in poor adolescents; this study upholds the same finding in maltreated children. As mentioned previously, it is possible that as maltreated children get older, their primary influences are more likely to be school or community rather than family based. Low community quality significantly predicted increasing group membership. Although

maltreated children in these communities showed a lower incidence of externalizing behavior problems than the decreasing group at age 4, these children showed a gradual increase in behavior problems after age 7 and are likely to continue to show increasing behavior problems as community-level factors influence development.

Using the lowest group as a point of comparison, caregiver depression was found to be related to the high-chronic group, but was not related to the increasing group. Because caregiver depression was measured at the baseline by asking about caregivers' own feelings about themselves in the past week, the depression scores may have been skewed by concerns more immediate to the time of the interview. Therefore, caregiver depression, measured in this way, may not predict the later change in the increasing group and fail to predict a divergence between the increasing group and the lowest group. This study also found that child mental health services were utilized more by the increasing and high-chronic groups than by the lowest group. This finding is consistent with previous research, which has also found that the high externalizing trajectory group was characterized by very high rates of service use, and mental health service use and mental health needs frequently co-occur (Burns et al., 2004; Thompson, 2009).

The analysis of the low-medium versus the increasing groups revealed that caregiver alcohol problems significantly predicted the divergence of those trajectories. Caregiver alcohol problems significantly contribute to membership in the increasing group compared with the low-medium group. Moreover, the analysis of the decreasing versus the increasing groups reported that caregiver depression significantly predicted the divergence of those trajectories. Caregiver depression was related to decreasing group membership, and this result might suggest that there was a high incidence of caregiver depression in the decreasing group and that this was closely related to children's elevated behavior problems at the baseline, though it became ameliorated over time.

Separation from caregiver was not significantly related to trajectory group; this may be because all participants in this study are children who have experienced maltreatment, and separation from primary caregivers may not have additional effects on divergent group membership among maltreated children. Also, because the current study emphasizes early ecology predicting different trajectories throughout childhood and the predictors were assessed at baseline, more proximal instances of the predictors might be more powerful, and the influence of separation that happened in the first year of a child's life may have been overwhelmed by more proximal factors.

In addition to the unique effect of each ecological factor, the cumulative effect of ecological risk factors on group membership was investigated. Although children with the

least risk factors are predominant in the lowest group, children with the most cumulative factors are the most common in the high-chronic groups. In particular, although the probability of membership in the decreasing group was .09 on caregiver depression only, when child developmental disability and caregiver depression were combined, the probability of membership in the decreasing group dramatically increased to .33. This suggests that caregiver depression alone cannot account for children showing a high incidence of behavior problems at age 4 and then a decreased slope. However, when caregiver depression is combined with child developmental disability, it is significantly related to a decreasing trajectory pattern with a high starting point. It is possible that child developmental disability could trigger or deepen the depression of a caregiver. With the passage of time, a caregiver's depressive symptoms could decrease and children's behavior problems could become stable, as shown in the decreasing group.

As seen in Table 2, individual ecological factors have a significant but relatively small effect on membership in different groups, after controlling for effects of other factors. However, when these individual significant effects are combined, the cumulative effects predicted divergence of several group memberships with large probabilities. For example, community quality and caregiver alcohol problems have little individual contribution to the increasing group membership in the multinomial logistic regression, but a set of risks including caregiver alcohol problems and low community quality resulted in a high probability of increasing group membership. Also, caregiver depression has a significant but little effect on the decreasing membership controlling for other factors. However, when caregiver depression and child developmental disability were present as a combination, the probability of membership in the decreasing group was dramatically increased. In fact, the highest probability of group membership in the decreasing, increasing, and high-chronic groups in cumulative analyses resulted from the combination of individual ecological factors that were shown significance in the multinomial logistic regression.

## Limitations and Future Directions

There are some limitations that must be noted in this study. A primary limitation is that this study restricted ecological factors to be measured at baseline. Because the analyses used a prospective framework in which ecological factors at baseline predicted later developmental trajectories of maltreated children from age 4 through age 10, it did not address changes in maltreated children's developmental ecology. For example, as children grow older, their environmental context broadens. In addition to caregiver or family factors, factors related to peer relationships and school- or

after-school-related activities may influence children's developmental trajectories. As well, there were some limitations in the assessment of the family environment itself; for example, the assessment included caregiver alcohol use but not other substance use. Moreover, information about maltreatment experiences over time (e.g., maltreatment chronicity, different types, and different time points that maltreatment happened) may also be important predictors of different trajectory groups. Future research examining the effects of these time-varying covariates on children's trajectories and linking childhood trajectories to adolescent behavior outcomes is needed to fully understand continuing development of maltreated children.

A second limitation is that these analyses did not examine potential protective factors that may be related to the decreasing group, as the main focus was on assessing early risk factors related maltreated children's ecology. The research of these potential protective factors could become another promising area for future investigation. A third limitation is that we excluded mental health service utilization from the cumulative analysis because of the bidirectional nature of the relationship between services and behavioral problems. A fourth limitation is that potential unknown errors could be involved in multinomial logit models. Although the group-based trajectory model approach has some uncertainty in class membership, multinomial logit process treats group membership as known and could not take into account the uncertainty in the analyses. An additional possible limitation related to analyses was that we deleted cases that are missing at baseline. Baseline data played an important role not only to create different trajectory groups, especially different intercepts of subgroups, but also to serve as predictors related to divergence of group membership within a prospective framework. Although it was necessary to eliminate the missing baseline data and they were a small portion (8%), we should be aware that doing so may have introduced some bias into the analyses.

Finally, the result of heterogeneity in this study should be interpreted cautiously. The subgroups identified in this study may not be generalizable to other samples of maltreated children. Since the group-based trajectory modeling approach identified distinctive subgroups existing in this specific sample, more replicating studies using maltreatment samples are needed.

## Implications for Intervention and Prevention

This study has significant implications for effective preventative intervention plans, and different intervention goals should be formulated to more effectively take stock of the different factors related to increasing and high-chronic trajectories and to prevent further diversions into juvenile delinquency and adult crime. This study found that the combination of caregiver depression and child developmental disability was highly related to decreasing group membership—that is, a developmental trajectory in which the incidence of a child's behavior problems were found to have been initially high, with a gradual decrease over time. This suggests that short-term intervention plans structured in a timely manner would be effective if depressed caregivers with developmentally disabled children were offered help in a way that the most damaging, later effects of a caregiver's depression on his or her child could be avoided.

Also, this study found that child developmental disability was highly related to increasing and high-chronic trajectory group membership. Part C of the Individuals with Disabilities Education Act (IDEA) was designed as an interagency program to address the needs of infants and toddlers with developmental delays. Maltreated infants or toddlers with developmental disabilities could qualify for special education services, with the possibility of enhancing their positive educational development. Developmental disabilities can influence not only school performance but also adjustment to further self-sufficiency later life. The academic failure of maltreated children with disabilities may interfere with successful transition into adolescence or adulthood. As maltreated children are eligible for early intervention services under the IDEA, a partnership among child welfare, health care, and special education services may enable the provision of early intervention services to preclude ongoing developmental damage for maltreated children with developmental disabilities.

Finally, this study found that most maltreated children showed a low incidence of behavior problems or a pattern of decreasing behavior problems, in spite of their experience of maltreatment; only a few children showed increasing or high-chronic patterns in the incidence of their behavior problems. Thus, it would be a mistake to consider maltreated children a monolithic group that is universally prone to high behavior problems. There is a growing amount of research on resilience among children who have experienced maltreatment (McGloin & Widom, 2001; Perkins & Jones, 2004). This study provides significant empirical evidence for heterogeneity among maltreated children and for potential importance of resilience research in child maltreatment.

Department of Health and Human Services Administration on Children, Youth, and Families to the LONGSCAN consortium.

## Note

1. This article defines "children who have been maltreated" as children who have been reported to child protective services, which includes both substantiated and unsubstantiated reports. Maltreatment includes physical abuse, sexual abuse, neglect, and other maltreatment. Physical abuse includes hitting, burning, and choking. Sexual abuse includes fondling and penetration. Neglect includes abandonment, insufficient food and shelter, and medical neglect. Other maltreatment includes emotional abuse and various types of exploitation. Also, in this article, we use "behavior problems" to refer to externalizing behavior problems, including aggression and delinquent behavior. Information regarding the behavior problems of young children was reported by primary caregivers, and consequently it is more valid to use externalizing behavior problems rather than internalizing behavior problems as a focus: Not only are primary caregivers more accurate and sensitive in assessing the externalizing behaviors of children (Bird, Gould, & Staghezza, 1992), but also externalizing behaviors are more observable (Reyes & Kazdin, 2005). In other words, it is easier to detect externalizing behaviors (e.g., aggression) than internalizing behaviors (e.g., anxiety) for young children younger than age 10.

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