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Abstract: *Several scholars have employed the risk factor prevention paradigm in identifying risk factors and protective factors that increase and decrease the odds of offending. Farrington suggested that multiplicative interactions of such factors should be explored in an attempt to understand how they are linked to differential offending behaviors such as offending prevalence and early onset of offending. The authors examine Moffitt's interactional hypothesis that states that two specific risk factors, verbal IQ and family adversity, interact to increase the probability of particular types of criminal behavior. Using data from the Philadelphia portion of the Collaborative Perinatal Project of 987 African American youth, logistic regression analyses indicate that the combined effect of verbal IQ and family adversity did not significantly increase the odds of becoming an offender, whereas the combined effect of low verbal IQ scores at age 7 and family adversity significantly increased the odds of early onset of offending.*

Since the early 1990s, there has been a progressive effort to identify risk and protective factors that contribute to increasing and decreasing the odds of differential offending behavior (e.g., early onset of offending, violent offending, etc.). Farrington (2000) referred to this model as the *risk factor prevention paradigm*. Although recently introduced to the field of criminology by scholars such as Hawkins and Catalano (1992) and Farrington (2000), the risk factor prevention paradigm has been widely applied in the fields of public health and medicine to successfully address and prevent life-threatening illnesses such as cancer and heart conditions. As it pertains to criminology, this paradigm is simple in that its goal is to identify the important risk and protective factors of offending behaviors and then, based on the identification of such factors, implement prevention techniques designed to minimize the risk factors and maximize the protective factors. As noted by Farrington (2000), this relatively new and simple approach has been advocated and adopted in the United States (Loeber & Farrington, 1998) and expanded to several industrialized countries such as the United Kingdom (Nutall, Goldblatt, & Lewis, 1998) and the Netherlands (Junger-Tas, 1997).

NOTE: All correspondence regarding this article should be sent to Alex R. Piquero, University of Florida, Center for Studies in Criminology and Law, PO Box 115950, 201 Walker Hall, Gainesville, Florida 32611-5950; e-mail: apiquero@crim.ufl.edu.

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The risk factor prevention paradigm consists of both risk factors and protective factors. A risk factor by definition is a variable that predicts later involvement in offending (Farrington, 2000; Kazdin, Kraemer, Kessler, Kupfer, & Offord, 1997). Researchers have adopted several ways of assessing the effects of risk factors on later offending; thus, oftentimes a risk factor is referred to as an extreme category of an independent variable (Farrington, 2000). Such risk factors tend to co-occur, making it difficult to disentangle their effects on future offending behavior. Given the complex nature of how risk factors may contribute to the explanation of later offending, Farrington (2000) suggested that multiplicative interactions of such factors should be explored in an attempt to understand how they are linked to offending behaviors (e.g., prevalence, early onset, etc.). Protective factors are another component of the risk factor prevention paradigm. Although the definition and existence of protective factors are controversial, Rutter (1985) stated that one possible definition of a protective factor is a variable that mediates the likelihood that a risk factor will increase later offending behavior.

The majority of studies that have been conducted to assess risk factors for offending have used prospective longitudinal data (see Denno, 1990; Farrington & Loeber, 1999; Moffitt, 1993). Most of these studies have traditionally focused on individual, family, peer, school, and socioeconomic factors measured in childhood and/or adolescence that predict the later development of offending and violent offending (for a review, see Farrington, 1998). Two well-known longitudinal studies conducted in London and Pittsburgh have identified several comparative risk factors that predict subsequent delinquency and youth violence. These studies concluded that individual factors such as hyperactivity, poor concentration, and low achievement measured at ages 8 through 10 were significantly related to court referrals between ages 10 and 16 (Farrington & Loeber, 1999). Another important individual risk factor is low intelligence (Farrington, 1998; Moffitt, 1993), which was found to be a significant risk factor for court convictions and self-report offending in London. In addition, both studies also concluded that family adversity measures such as an antisocial father, large family size, low family income, a broken family, poor parental supervision, and parental disharmony measured at ages 8 to 10 were significant predictors of court referrals between ages 10 and 16 (Farrington & Loeber, 1999).

Although several longitudinal investigations (Denno, 1990; Farrington & Loeber, 1999; Moffitt, 1994) have identified important risk factors that increase the odds of subsequent offending behavior, there have been limited empirical efforts to assess how such risk factors interact with one another to increase/decrease the odds of offending. This is especially true with regard to specific types of offending such as adolescent-limited versus life-course persistent offending (Moffitt, 1993). Furthermore, Farrington (2000) added that another key yet underresearched issue is whether the strength of the relationship between such risk factors and outcomes are similar or variable across distinct groups of offenders. Given that many longitudinal studies assessing risk and protective factors

have used samples of Caucasian youth, it makes it difficult to generalize such findings to other groups of individuals (e.g., African American, inner-city youth).

The present study builds on the risk factor prevention paradigm by investigating the interactive effect of verbal IQ and family adversity as they relate to the prevalence of offending as well as an early onset of offending in a sample of 987 African American, inner-city youth born and raised in Philadelphia. This investigation is important due to the limited empirical knowledge on how such risk factors interact with one another to predict different types of offending, especially among a sample of urban, inner-city, African American youth. Herein, we apply Moffitt's (1993) interactional hypothesis of antisocial behavior as a theoretical guide for investigating the joint contribution of both risk factors in explaining criminal behavior. First, we hypothesize that the Verbal IQ \times Family Adversity interaction will not be predictive of whether an individual is an offender by age 18 because Moffitt (1993) suggested that the interaction will only be a risk factor for a certain type of offending (i.e., life-course persistent offending). Second, we examine Moffitt's (1993) hypothesis that the Verbal IQ \times Family Adversity interaction will be important in weeding out specific types of offenders within the age-crime curve (i.e., the Verbal IQ \times Family Adversity interaction should be a risk factor for early onset of offending, which has been shown to be an important indicator of life-course persistent styles of offending).

The review of the literature is as follows. First, we discuss the importance of establishing known risk factors for early onset and how early onset is related to life-course persistent offending patterns. Second, we present Moffitt's (1993) theoretical framework, emphasizing her interactional hypothesis. Third, we discuss the extant empirical evidence of the relationship between verbal IQ and criminal behavior and the link between family adversity and criminal behavior.

CORRELATES OF EARLY ONSET AND PERSISTENT OFFENDING

Research has shown that adult persistent offending is rooted in early childhood behavioral problems. In concordance with the strong and positive association observed among past and future offending (Gottfredson & Hirschi, 1990; Nagin & Paternoster, 1991; Robins, 1966, 1978; Wilson & Herrnstein, 1985), the age at which a first offense occurs (i.e., onset) has similarly been found to be strongly correlated with future offending, especially serious, habitual, and violent offending (Blumstein, Cohen, Roth, & Visher, 1986; Dunford & Elliott, 1984; Farrington, 1986, 1998; Farrington et al., 1990; LeBlanc & Frechette, 1989; Loeber & LeBlanc, 1990; Patterson, Crosby, & Vuchinich, 1992; Reiss & Roth, 1993; Sampson & Laub, 1993; Tolan, 1987; Wolfgang, 1983). In addition, relationships have been observed between early onset, conduct disorder, and oppositional defiant disorder (Wasserman & Miller, 1998).

Although early onset is important to the understanding of homotypic and heterotypic continuity, the risk and protective factors that increase and/or decrease the odds of an early onset is an entirely different question. Acquiring knowledge of the risk and protective factors that increase and/or decrease the probability of an early onset would allow policy makers and researchers to more accurately identify individuals at risk for early onset and persistent offending styles, thus allowing for early implementation of prevention strategies (Farrington, 1998, 2000; Moffitt, 1993). Although few question this agenda and its profound policy implications, reviews of the literature pertaining to early onset suggest that there is limited evidence of risk factors associated with early onset (Farrington, 1998; Farrington et al., 1990).

Research has assessed the influence of several independent risk factors on the development of early offending behavior. Factors such as neuropsychological and psychosocial deficiencies (Gorenstein, 1990; Moffitt, 1990), poor psychomotor skills (Farrington & Hawkins, 1991), as well as family adversity and economic/social deprivation have been identified as predictors of an early onset (Farrington & Hawkins, 1991; Moffitt, 1990). A small number of studies has assessed biosocial interactions between some of the previously mentioned risk factors. Such studies have assessed psychological and environmental factors coupled with various biological and/or physiological traits (e.g., low birth weight, heart rate, and pre/perinatal complications) in predicting early onset of offending behavior (Moffitt, 1990; Raine, Brennan, & Mednick, 1994; Tibbetts & Piquero, 1999) as well as violent offending patterns (Brennan, Mednick, & Raine, 1997; Kandel & Mednick, 1991; Piquero & Tibbetts, 1999; Reiss & Roth, 1993). Although studies that have investigated interactions between individual differences (neuropsychological and personality traits) and environmental factors on offending outcomes are limited, Moffitt (1993) stated, "It is now widely acknowledged that personality and behavior are shaped in large measure by the interaction between the person and the environment" (p. 682).

MOFFITT'S INTERACTION HYPOTHESIS

Moffitt (1993), among others (Wolfgang, Thornberry, & Figlio, 1987), suggested that a relatively small group of offenders (6% to 10%) exhibit criminal behavior early in life and are likely to be chronic in their offending patterns. Specifically, Moffitt claimed that the small group of individuals who incur an early onset are likely to possess two specific risk factors early in life, neuropsychological problems in early childhood and disadvantaged environments and/or family adversity. Moffitt stated that these risk factors interact to predict early onset of offending behavior, leading to a life-course persistent style of offending.

Moffitt, Lynam, and Silva (1994) claimed that problem behavior begins early in childhood because neuropsychological deficiencies disrupt normal develop-

ment, and it is these deficits that increase vulnerability to the criminogenic aspects of disadvantaged rearing environments. In agreement with studies on low verbal and communication skills (Tarter, Hegedus, Alterman, & Katz-Garris, 1983; Tarter, Hegedus, Winsten, & Alterman, 1984), Moffitt (1993) noted that children with varying degrees of neuropsychological deficiencies evoke a challenge to the most well-prepared parents. Specifically, these deficiencies may elicit increasingly more physical punishment from caregivers, especially if the family is living in a disadvantaged or distressed environment (Moffitt, 1997).

Preliminary findings from Moffitt's (1990) ongoing New Zealand study showed that young boys who scored low on neuropsychological tests and lived in adverse home environments had a mean aggression score more than four times greater than that of boys with either neuropsychological deficiencies or adverse home environments alone (also see Moffitt et al., 1994). More recently, Moffitt (1997) used data from the Pittsburgh Youth Study to assess the relationship between neuropsychological test scores and delinquency among two groups of African American youth living in "good" and "disadvantaged" urban neighborhoods. The interactive effect of neuropsychological test scores and environmental factors on boys' delinquent behaviors were assessed by categorizing the boys on their mean score, either below or above, on a measure of cognitive impulsivity. The boys were also categorized into good and disadvantaged neighborhoods based on census tract data. Results show that there was a marginally significant interaction effect on delinquency. Moffitt (1997) stated that the results indicate that neuropsychological deficit and delinquency coexist among individuals in disadvantaged inner-city environments. Furthermore, regardless of the type of neighborhood, boys with neuropsychological problems were more likely to be more delinquent.

Moffitt theorized that a variety of factors disrupt the central nervous system of the fetus/infant such as prenatal and perinatal complications. Importantly, these deficits manifest themselves in various ways such as temperament difficulties, lower executive functioning, and poor verbal test scores. Such cognitive deficiencies and temperamental deficits among children are found more pervasively in unsupportive or adverse environments (Moffitt, 1993). In agreement with empirical research (Alexander & Cornely, 1987; Caldwell, 1981; Greenberg, 1983), Moffitt (1997) suggested that neuropsychologically vulnerable children are found at higher rates in inner cities because prenatal care is scarce, premature births are more common, infant malnutrition is problematic, and the possibility for exposure to toxic and infectious agents is greater.

Moffitt (1993) suggested that the neuroenvironmental interactions should not be capable of distinguishing offenders from nonoffenders, but it should distinguish between types of offenders (i.e., early onset and late onset). In particular, the interaction between neuropsychological deficiencies and disadvantaged environments should predict early onset.

VERBAL IQ AND CRIMINAL BEHAVIOR

Moffitt's (1993) theoretical framework suggests that verbal functioning is one of the two sorts of neuropsychological deficits that is most empirically associated with an early onset, which has been argued to be one manifestation of life-course persistent offending (see Gibson, Piquero, & Tibbetts, 2000). Moffitt (1993) suggested that "the verbal deficits of antisocial children are pervasive, affecting receptive listening and reading, problem solving, expressive speech and writing, and memory" (p. 680). Research has shown that cognitive deficits and criminal behavior share variation that is independent of the effects of social class, race, test motivation, and academic achievement (Lynam, Moffitt, & Stouthamer-Loeber, 1993; Moffitt, 1990). Moreover, existing empirical evidence supports the conclusion that the association between verbal deficiencies and offending behavior is one of the largest and most robust effects in the investigation of criminal behavior (see Hirschi & Hindelang, 1977; Moffitt, 1990; Moffitt & Henry, 1991; Moffitt & Silva, 1988). The consistency of these findings gives support to the notion that delinquents have a language manipulation deficit and that individuals with such neuropsychological deficiencies tend to be involved in offending at an early age. However, there is limited empirical evidence showing that childhood verbal IQ test scores interact with one's social environment to minimize and/or maximize their likelihood of early offending behavior (Moffitt, 1993, 1997).

FAMILY ADVERSITY AND CRIMINAL BEHAVIOR

Moffitt (1993) emphasized that children with cognitive and temporal deficiencies are often born into nonsupportive families that are oftentimes saturated with family adversity. For Moffitt (1993), vulnerable children "are disproportionately found in environments that will not be ameliorative because many sources of neural development co-occur with family disadvantage" (p. 681).

Although Moffitt (1993) used the term *criminogenic environment* throughout her theoretical argument, she implied that this is synonymous with family adversity. In defining family adversity, several empirical investigations have employed socioeconomic status (SES), single parenting, age of mother at birth, and multiple family transitions as risk factors that independently and collectively measure family adversity (Loeber & Farrington, 1998; Moffitt, 1990; Nagin, Pogarsky, & Farrington, 1997; Tibbetts & Piquero, 1999).

The aforementioned family adversity risk factors have all been shown to be independently related to several subsequent types of criminal offending. For example, empirical evidence has shown that maternal age at birth is a risk factor for offending behavior for mother's offspring (Nagin et al., 1997). To account for this linkage, scholars argue that young mothers are less likely to have well-developed parenting/role model skills, which oftentimes leads to neglect and poor supervision of offspring, particularly when other family adversity risk fac-

tors such as low SES and parental separation are involved (Nagin et al., 1997). Other empirical investigations have documented the adversities of being a young mother. Young mothers are more likely to engage in problem behavior (Elster, Ketterlinus, & Lamb, 1990), head a single-parent household, live in poverty (Grogger & Bronars, 1993), and fail to finish high school (Ahn, 1994), all of which have been used as indicators of family adversity and subsequently have been found to be related to offspring criminal behavior.

Many studies show that children from single-parent families are exposed to an increased risk for behavioral problems. Such studies have shown that broken homes and early separation of parents predict criminal offending (Farrington, 1992, 1993; McCord, 1982). In the New-Castle Thousand Family study, Kolvin and colleagues (Kolvin, Miller, Scott, Gatzanis, & Fleeting, 1990) found a significant association between parental divorce or separation before age 5 and later convictions up to age 33. The importance of the effects of single-parent homes is also shown in the English national longitudinal survey of more than 5,000 children born in 1946 (Wadsworth, 1979). Specifically, boys from broken homes due to divorce or separation were significantly more likely of being convicted or officially cautioned up to age 21. Furthermore, children from single-parent families have been found to have a variety of adverse problems such as conduct disorder and substance abuse (Blum, Boyle, & Offord, 1988; Boyle & Offord, 1986).

CURRENT EFFORT

In this article, we build on prior research in two ways. First, we examine two different outcome variables that are hypothesized to be related to various risk factors as implicated by Moffitt's theory and other empirical research (Farrington & Loeber, 1999). Second, we more directly measure the role of neuropsychological risk by explicating measures of verbal IQ and expand prior measurement of family adversity by integrating several other risk factors that have been related to offending. Toward this end, we examine two hypotheses from Moffitt's developmental taxonomy that center around the role of neuropsychological risk and family adversity. The following two outcome variables are employed: (a) whether the subject is an offender (no/yes) and (b) given that the subject is an offender, whether he or she exhibited an early onset of offending.

Moffitt hypothesized that the Neuropsychological Risk \times Family Adversity interaction would not be predictive of who does/does not offend. For example, several research efforts have shown that there are important differences (in degree and kind) within the offending population such that offenders are not a homogenous population (D'Unger, Land, McCall, & Nagin, 1998; Nagin, Farrington, & Moffitt, 1995; Nagin & Land, 1993; Piquero et al., 2001). Furthermore, the Neuropsychological Risk \times Family Adversity interaction is not meant to distinguish between offenders and nonoffenders; instead, it best predicts a "special sort of delinquency" that is related to styles of life-course persistent offending

(Moffitt, 1997). For Moffitt's theory, the Neuropsychological Risk \times Family Adversity interaction should be predictive of an early but not late onset of offending because adolescence-limited offenders do not suffer from any individual-level deficits in neuropsychological risk or self-control (whereas the life-course persistent offenders do) (Moffitt, 1993; Moffitt et al., 1994; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996).

Two hypotheses are investigated herein. First, the Neuropsychological Risk \times Family Adversity interaction will not be a significant predictor of whether or not individuals offend. Second, the Neuropsychological Risk \times Family Adversity interaction will be able to distinguish among the offending population. In particular, the interaction will be a significant predictor of early but not late onset of offending. Because family adversity has independently been found to be related to whether individuals offend or refrain from offending, we expect it to be related to whether subjects offend or do not, but we do not expect it to be a significant discriminator between those who exhibit an early as opposed to late onset of offending. In sum, the key focus of the current analysis lies in understanding the ways in which neuropsychological risk interacts with social and environmental conditions to increase the probability that certain forms of offending will occur (Moffitt, 1997).

DATA

Data used to examine these hypotheses are drawn from the Philadelphia portion of the National Collaborative Perinatal Project (NCPP) (Denno, 1990). Designed as a health and development study, the NCPP followed prospectively the course of more than 56,000 pregnancies enrolled between 1959 and 1966 at several university-affiliated medical schools in the United States (Niswander & Gordon, 1972). Pregnancies for the Philadelphia site came from Pennsylvania Hospital.

A wide variety of variables were collected, including events of gestation, labor, and delivery as well as children's mental, motor, sensory, and physical development to 7 years of age. Major findings from the NCPP have been detailed elsewhere (Broman, Nichols, & Kennedy, 1975; Nichols & Chen, 1981), and specific criminological investigations have also been undertaken, primarily with the Philadelphia (Denno, 1990; Piquero, 2000a, 2000b, 2000c; Piquero & Tibbetts, 1999; Tibbetts & Piquero, 1999) and Providence (Lipsett, Buka, & Lipsitt, 1990; Piquero & Buka, 2001) cohorts.

Archived data from the Philadelphia cohort of the NCPP consisted of 987 subjects. All members of this subsample were African American, and the majority were of middle to lower class in socioeconomic status. Detailed criminal history information for this cohort was collected from the Philadelphia Police Department apart from the larger NCPP project by researchers at the University of Pennsylvania in the early 1980s when the cohort was 18 years of age. Several criteria

were established for inclusion in the Philadelphia subsample. All subjects were born and raised until young adulthood in Philadelphia, received very similar medical treatment early in life, attended Philadelphia public schools, and shared a predominantly lower to lower-middle socioeconomic status (Denno, 1990).

The Philadelphia NCPP data provide a unique opportunity to study the risk factors associated with the development of criminal offending. In fact, Moffitt (1997) regarded these data as among the best for the study of neuropsychological and cognitive risk factors and their relation to criminal offending.

VARIABLES

DEPENDENT VARIABLES

As stated earlier, we examine the following two distinct outcome variables: (a) whether the participant was/was not an offender by age 18 and (b) if the participant was an offender, the age at first police contact (i.e., early onset). The former variable was measured by the presence of a police contact with the Philadelphia Police Department by age 18. Of the 987 subjects, 220 incurred at least one police contact by age 18. This variable is coded as 0 (nonoffender) and 1 (offender). The latter variable was measured as the age at the first police contact among those individuals incurring at least one police contact by age 18. Following previous research (Patterson et al., 1992; Simons, Wu, Conger, & Lorenz, 1994; Tibbetts & Piquero, 1999), an early onset of offending is measured as onset prior to age 14 (coded 1, $n = 151$), whereas a late onset of offending is measured as onset at or after age 14 (coded 0, $n = 69$). In the Philadelphia data, age 14 marks the peak onset age and occupies the highest hazard, thus providing empirical support for selecting this cutoff.

INDEPENDENT VARIABLES

Verbal IQ. Verbal IQ is measured by the verbal IQ score on the Wechsler Intelligence Scale for Children (WISC). According to Friedes (1972), the WISC is "the best available test purported to measure intelligence in children," and researchers have established a strong link between verbal IQ and delinquency (Hirschi & Hindelang, 1977; Moffitt, 1997; Wilson & Herrnstein, 1985). Moreover, Caspi and his colleagues (Caspi, Harkness, Moffitt, & Silva, 1996) argued that the WISC is the "most psychometrically trustworthy measure of intellectual performance." The verbal IQ score is a summary measure of verbal ability based on a composite of the following four subtests: (a) information, (b) comprehension, (c) digit span, and (d) vocabulary.

Family adversity. Using the data available in the Philadelphia portion of the NCPP, we measured family adversity in a similar manner to the Dunedin Multidisciplinary Health and Development Study (Pryor & Woodward, 1996; also see Rutter, 1978). All of the variables that comprise the family adversity scale have independently been related to criminal offending (see Loeber & Farrington, 1998; Nagin et al., 1997; Tibbetts & Piquero, 1999). The family adversity scale is composed of the summation of the following four dichotomous items: (a) low socioeconomic status (coded 1 for lowest 25th percentile, coded 0 otherwise), (b) single mother at child birth and at age 7 (coded 1 if single at both ages, 0 otherwise), (c) age of mother at birth of child (younger than 21 coded 1, older than 21 coded 0), and (d) the number of family transitions through age 7 (coded 0 for zero transitions, 1 for one or more transitions). Higher scores indicate more family adversity.

Birth weight. Birth weight was measured immediately on delivery by hospital staff members and ranged from 3 to 12 pounds. Following the literature on low birth weight (Paneth, 1995; World Health Organization, 1950), this variable was recoded to less than 6 pounds (1) and equal to/greater than 6 pounds (0). Research has shown birth weight to be an important correlate of a variety of negative sequelae, including criminal behavior (Tibbetts & Piquero, 1999).

Gender. This variable was coded as male (1) and female (2).

Interaction. Following Jaccard, Turrisi, and Wan (1990), we created an interaction between family adversity and verbal IQ that was based on the multiplicative of the mean-centered scores of these two items. Mean centering is undertaken to avoid problems associated with multicollinearity among the two variables comprising the interaction as well as the interaction itself (descriptive statistics for all variables may be found in Table 1).

HYPOTHESES

Two key hypotheses are investigated in this article. The first is that the Verbal IQ \times Family Adversity interaction will not predict whether an individual is/is not an offender by age 18. We employ logistic regression for this analysis where the outcome variable is nonoffender (0) and offender (1). The second is that the Verbal IQ \times Family Adversity interaction will be predictive of the age at first police contact. Specifically, the interaction should be predictive of an early but not late onset of offending. We employ logistic regression for this analysis where the outcome variable is late (0) and early onset (1).

TABLE 1
DESCRIPTIVE STATISTICS

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Gender	1.50	0.50	1	2
Low birth weight	0.34	0.47	0	1
Verbal IQ	91.92	11.38	57	133
Family adversity	1.17	1.01	0	4
Offender	0.22	0.42	0	1
Early onset	0.36	0.48	0	1

NOTE: Based on $n = 220$.

RESULTS

Prior to examining the logistic regression results, we first present some preliminary bivariate analyses to establish the baseline association among the key variables in our analysis. Three ANOVAs were conducted where the family adversity scale was examined with the following three outcome variables: (a) verbal IQ, (b) whether the subject was an offender, and (c) among offenders, whether the subject exhibited an early onset.

Results (not shown) suggest that those individuals scoring highest on the family adversity scale (i.e., more risk factors) scored the lowest on verbal IQ, whereas those individuals scoring lowest on the family adversity scale (i.e., zero risk factors) scored the highest on verbal IQ ($F = 4.85, p < .05$). In terms of predicting offending, results once again showed the expected effect; that is, those individuals scoring highest on the family adversity scale were the most likely to become offenders, whereas those individuals scoring lowest on the family adversity scale were the least likely to become offenders ($F = 3.28, p < .05$). The family adversity scale was not related to early onset ($F = .93, p > .05$).

PREDICTING OFFENDING

In Table 2, the estimates for predicting offending are presented. As can be observed, two variables are statistically significant, gender and family adversity. Specifically, compared to males, females ($B = -1.10$) are significantly less likely to become offenders. In terms of family adversity, these results suggest a positive relationship; that is, the higher the score on family adversity ($B = .24$), the higher the probability of the subject becoming an offender. Birth weight was not a significant predictor of offending. Most importantly, and in accord with Moffitt's hypothesis, neither the additive effect of verbal IQ nor the interaction between verbal IQ and family adversity were significant predictors of whether a subject was an offender. These results are consistent with Moffitt's hypothesis because

TABLE 2
LOGISTIC REGRESSION PREDICTING OFFENDING

<i>Variable</i>	<i>B</i>	<i>SE(B)</i>	<i>Wald</i>	<i>Exp(B)</i>
Gender	-1.100	.171	41.253*	0.332
Low birth weight	0.046	.174	0.071	1.047
Verbal IQ	-0.003	.007	0.243	0.996
Family adversity	0.245	.080	9.400*	1.278
Interaction	0.003	.007	0.235	1.003
Constant	0.281	.245	1.309	
Chi-square/ <i>df</i>	55.19/5			

* $p < .05$.

the outcome variable speaks only to the prevalence of offending and not to the different types of offenders categorized by their age of onset.

PREDICTING EARLY ONSET

Since Moffitt anticipated that the Verbal IQ \times Family Adversity interaction will be important in differentiating distinct offenders within the age-crime curve, we examine whether such an interaction is present for the prediction of the age at first police contact. Recall that Moffitt's theory hypothesizes that life-course persisters are more likely than adolescent-limited offenders to exhibit an early age of onset (Moffitt et al., 1994, 1996).

As can be observed from Table 3, two of the five coefficients in this model are predictive of early onset. Specifically, individuals incurring a low birth weight ($B = .72$) are significantly more likely to incur an early age of onset. As expected by Moffitt, the interaction between verbal IQ and family adversity is a significant predictor of early onset ($B = -.039$). The sign of this interaction requires some discussion.

The interaction sign is negative, implying that higher verbal IQ scores serve to inhibit the deleterious consequences of family adversity; thus, individuals who are at most risk for an early onset of offending are those individuals who have the lowest verbal IQ scores and who have the highest family adversity scores. Although there are a number of ways to probe and interpret this interaction, we present one method outlined by Neter, Wasserman, and Kutner (1989). Specifically, to obtain the effect of family adversity at the minimum and maximum levels of verbal IQ, we perform the following calculation:

$$B_1 + B_3X_2$$

where B_1 is the unstandardized coefficient for family adversity, B_3 is the product term between verbal IQ and family adversity and X_2 is the minimum and maxi-

TABLE 3
LOGISTIC REGRESSION PREDICTING EARLY ONSET

<i>Variable</i>	<i>B</i>	<i>SE(B)</i>	<i>Wald</i>	<i>Exp(B)</i>
Gender	-.109	.335	0.106	0.896
Low birth weight	.724	.316	5.249*	2.062
Verbal IQ	-.003	.015	0.054	0.996
Family adversity	.010	.158	0.004	1.010
Interaction	-.039	.015	6.284*	0.961
Constant	-.843	.471	3.207	
Chi-square/df	12.72/5			

* $p < .05$.

mum value of verbal IQ (found in Table 1). Thus, when verbal IQ is at its lowest level (57), the effect of family adversity on early onset is -2.213 . When verbal IQ is at its highest level (133), the effect of family adversity is at its lowest level (-5.177). This result suggests that subjects who are proficient in verbal abilities are able to ward off the detrimental consequences of family adversity. These results are consistent with those obtained by other research in that exceptionally strong verbal skills can be an asset for resisting the effects of adverse familial environments (Kandel et al., 1988; White, Moffitt, & Silva, 1989). Furthermore, this finding is in concordance with Rutter's (1985) definition of a protective factor in that individuals who have high verbal IQ scores are able to minimize the detrimental effects of family adversity on early onset.

DISCUSSION

This study provides one of the few attempts to assess the prospective link between the interactive effect of two known risk factors, verbal IQ deficiencies and family adversity, on two different forms of criminal offending among a longitudinal sample of urban, inner-city, African American youth. Given the understudied nature of such interactions (Brennan et al., 1997; Raine, 1993; Tibbetts & Piquero, 1999), this assessment should be seen as an important contributor to the risk factor prevention paradigm. At the same time, our findings should be regarded as an empirical contribution to Moffitt's theoretical model as it pertains to the risk factors for differential types of criminal behavior. Not only do our results lend support to Moffitt's interactional hypothesis concerning the correlates of early onset of offending, but our results show that the negative effect of biosocial interactions on early offending are underway or rooted in early childhood.

Our results reveal that the two risk factors under investigation had differential effects on two types of offending behavior (offending prevalence and early onset

of offending). First, regarding the model predicting the prevalence of offending, our results are consistent with Moffitt's theory. The interaction of Verbal IQ \times Family Adversity did not distinguish between whether or not a youth had committed an offense before age 18, thus lending further support to Moffitt's claim that the interaction cannot distinguish between offenders and nonoffenders. Second as predicted by Moffitt, our findings show that low verbal IQ scores at age 7 interact with family adversity to predict early onset of offending. Specifically, the odds of incurring an early onset were increased when there was a co-occurrence of both low verbal IQ scores and high family adversity. Further analysis of the interaction term revealed that high verbal IQ scores act as a protective factor because high verbal IQ scores were shown to minimize the deleterious effect that family adversity had on early onset. Neither verbal IQ nor family adversity exerted an independent effect on early onset of offending. In sum, our findings suggest that there may be different risk factors across different types of offending measures.

Although we feel that our findings have made an important contribution, the data used for this investigation suffer from some limitations. First, this study used only WISC verbal IQ scores as an indicator of neuropsychological risk. Although Moffitt (1993) clearly stated that verbal deficiencies are the best risk indicators of neuropsychological problems, future studies should attempt to examine other proxies (e.g., minor physical anomalies, maternal drug use during pregnancy, birth/delivery complications, etc.) or more direct measures (e.g., positron emission tomography scans and magnetic resonance imaging) of neuropsychological risk (Raine, 1993) in concert with criminogenic or disadvantaged environments in predicting early onset. Second, our analysis focused only on one manifestation of life-course persistent offending. Other dimensions such as chronicity, seriousness, and violence were not examined. Future efforts may wish to examine the extent to which the interactions studied herein apply to related life-course persistent offending dimensions. Third, Moffitt's (1993) strategy for research, along with others (Farrington, 1998), suggests that "reports of antisocial behavior should be gathered from multiple sources to tap pervasiveness across circumstances" (p. 694). Due to the original data collection protocol, we were only able to employ official data records. Although many researchers have used official measures for identifying early onset (Moffitt et al., 1994; Simons et al., 1994), such indices would probably best be used in conjunction with multiple measures such as self-reports, teacher reports, and parental reports of early adverse behavioral problems. Different operationalizations of early onset may possibly increase the validity and confidence of the results in this study. Fourth, due to the fact that the sample consisted of only inner-city, African American youth, the generalizability of our findings may be limited. Therefore, the significant effect of the interaction of risk factors in our study may be diminished (or enhanced) in other populations (e.g., rural Caucasian youth). Finally, future efforts may wish to explore how Moffitt's interactional hypothesis relates to sociopathy. This would be a fruitful research agenda because estimates suggest that sociopaths comprise a small portion of the male population (between 3% and 4%) yet account for 33% to

80% of the chronic offender population (Cohen & Vila, 1996). Information is needed on the extent to which this group of offenders resembles the most extreme end of the life-course persistent continuum.

Given that the present study's results suggest that predictors of life-course persistent types of offending patterns may be underway in early childhood, it would be fruitful to initiate prevention and intervention strategies early in the life course. Programs should place an emphasis on the development of social skills and cognitive tasks when training children to generate multiple alternative solutions to problems, whereas preschool enrichment programs may wish to target the social/cognitive and behavioral correlates of early antisocial behaviors. Continued research into the etiology of life-course persistent styles of offending is likely to provide much more needed information on prevention tactics across various settings and sample compositions.

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Chris L. Gibson, M.A.

Graduate Research Assistant
University of Nebraska, Omaha
Department of Criminal Justice
Omaha, Nebraska 68182
USA

Alex R. Piquero, Ph.D.

Associate Professor
University of Florida
Center for Studies in Criminology and Law
PO Box 115950
201 Walker Hall
Gainesville, Florida 32611-5950
USA

Stephen G. Tibbetts, Ph.D.

Assistant Professor
California State University, San Bernardino
Department of Criminal Justice
San Bernardino, California 92407
USA