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The Ecology of Early Childhood Risk: A Canonical Correlation Analysis of Children's Adjustment, Family, and Community Context in a High-Risk Sample

Corrie L. Vilsaint,

Department of Psychology, University of Virginia, 102 Gilmer Hall, PO BOX 400400,
Charlottesville, VA 22904, USA

Sophie M. Aiyer,

Curry School of Education, University of Virginia, Charlottesville, VA, USA

Melvin N. Wilson,

Department of Psychology, University of Virginia, 102 Gilmer Hall, PO BOX 400400,
Charlottesville, VA 22904, USA

Daniel S. Shaw, and

Department of Psychology, University of Pittsburgh, Pittsburgh, PA, USA

Thomas J. Dishion

Department of Psychology, University of Oregon, Eugene, OR, USA

Corrie L. Vilsaint: corrie@virginia.edu, clh4u@virginia.edu

Abstract

The ecology of the emergence of psycho-pathology in early childhood is often approached by the analysis of a limited number of contextual risk factors. In the present study, we provide a comprehensive analysis of ecological risk by conducting a canonical correlation analysis of 13 risk factors at child age 2 and seven narrow-band scales of internalizing and externalizing problem behaviors at child age 4, using a sample of 364 geographically and ethnically diverse, disadvantaged primary caregivers, alternative caregivers, and preschool-age children. Participants were recruited from Special Supplemental Nutrition Program for Women, Infants, and Children sites and were screened for family risk. Canonical correlation analysis revealed that (1) a first latent combination of family and individual risks of caregivers predicted combinations of child emotional and behavioral problems, and that (2) a second latent combination of contextual and structural risks predicted child somatic complaints. Specifically, (1) the combination of chaotic home, conflict with child, parental depression, and parenting hassles predicted a co-occurrence of internalizing and externalizing behaviors, and (2) the combination of father absence, perceived discrimination, neighborhood danger, and fewer children living in the home predicted child somatic complaints. The research findings are discussed in terms of the development of psychopathology, as well as the potential prevention needs of families in high-risk contexts.

Keywords

Risk factors; Internalizing; Externalizing; Psychopathology; Canonical correlation analysis

Introduction

By the preschool period, children show patterns of problem behavior that are prognostic of their future likelihood to use and abuse drugs (Dishion et al., 2008) and to engage in juvenile delinquency (Shaw & Gross, 2008). The concept of a risk factor is often used when linking ecology to the early emergence of maladaptive behaviors in children. At a macro level, it has been consistently found that disadvantaged children are likely to experience more risks and developmental problems than affluent children (Bradley & Corwyn, 2002). Children and families, however, rarely experience one risk factor in isolation. Although multiple risks are often experienced at once, little is known about the influences and trajectories of combined risks factors on early childhood behaviors. Cicchetti and Rogosch (1996) differentiated between two types of developmental paths of specific relevance to this study: multifinality and equifinality. First, the principle of multifinality is present when a range of behavioral outcomes occur from a set of social or structural processes. Multifinality implies that adverse conditions or characteristics should not be seen as leading to one type of emotional or behavioral outcome. Second, the principle of equifinality is present when multiple pathways lead to the same outcome.

The purpose of the present study was to explore the concepts of multifinality and equifinality using data from a 2-year prospective study of low-income families living in urban, rural, and suburban localities. Researchers advocate the use of an ecological framework to organize research on risk factors in disadvantaged families (McLoyd, 1998). This framework is useful for understanding risk processes at the individual, family, and community levels. Guided by the notion that children simultaneously experience a myriad of ecological systems that may influence numerous behavioral and emotional outcomes, we used canonical correlation analysis (CCA) as a multivariate approach to operationalize the theories of multifinality and equifinality. CCA can be used to model the combined influences of person and context on the development of behavior problems during early childhood.

Contextual and Individual Risk

Risk has been conceptualized as negative life circumstances that are known to be statistically associated with adjustment difficulties (Masten, 2001). In this study, we focused on contextual and individual risk factors that are associated with multiple types of maladaptive behaviors. Contextual risk factors are part of the larger constellation of risk factors that families encounter and include societal and demographic influences, whereas interpersonal risk factors include parent–child interactions. Individual risk factors including depression, substance use, and low educational attainment have been shown to predict both internalizing and externalizing behavioral outcomes (El-Sheikh & Flanagan, 2001). Furthermore, interpersonal and contextual risk factors including parent–child conflict, parenting hassles, discrimination, and residential crowding also increase a child's risk for

developing behavioral problems (Greenberg, Lengua, Coie, & Pinderhughes, 1999; Patterson, Forgatch, Yoerger, & Stoolmiller, 1998).

Contextual Risk Factors—Several researchers have reported that neighborhood problems and economic deprivation are cross-sectionally and longitudinally associated with the development of externalizing and internalizing behaviors in young children (Sampson, Morenoff, & Gannon-Rowley, 2002) over and above genetic influences (Caspi, Taylor, Moffitt, & Plomin, 2000). As described by other researchers (Pettit, Bates, Dodge, & Meece, 1999), certain kinds of neighborhoods may serve to facilitate behavioral development for children who are at risk for adjustment problems. The availability of positive role models in the neighborhood and shared community responsibility in overseeing its members serve to regulate child behavior. Thus, it may be that unsecure, dangerous neighborhood settings provide a context within which community cohesion is low and early seeds of negative behavior are less supervised by community members.

Despite a growing body of research indicating the harmful effects of discrimination on internalizing symptoms (Whitbeck, Hoyt, McMorris, Chen, & Stubben, 2001), psychological distress (Williams, Yan, Jackson, & Anderson, 1997), depression (Finch, Kolody, & Vega, 2000), and perceptions of general health (Ren, Amick, & Williams, 1999), few studies have found a direct link between discrimination experienced by parents and outcomes in children (Blank, Dabady, & Citro, 2004). Theories posit a number of avenues for this impact, e.g., segregated housing has implications on excessive exposure to environmental hazards such as cracked floors, inadequate heat, pests, unprotected stairwells, lead paint, and leaky ceilings (Bradley & Corwyn, 2002). Crowded and dilapidated housing has long been cited as one of the factors responsible for poorer child health outcomes (Marmot, 1999). Adverse housing conditions can lead to increased illnesses and injuries (U.S. Department of Health and Human Services, 2000), as well as lower intellectual and social well-being (Brooks-Gunn, Klebanov, & Liaw, 1995). Regoeczi (2002) demonstrated that household density had a nonlinear impact on withdrawn and aggressive behavior.

Family Interpersonal Risk Factors—Several family risk factors have been closely linked to child behavior problems. One such factor is chaos in the home, which is characterized by frequent foot traffic, phone calls, noise, disorganization (e.g., difficult to find items), and lack of routines (Matheney, Wachs, Ludwig, & Phillips, 1995). Chaotic homes often function as a centralized location for family and friends, and children raised in such chaotic environments tend to be viewed as being more difficult and more likely to engage in risky behaviors. For example, in a low-income sample, Supplee, Unikel, and Shaw (2007) reported a direct longitudinal association between chaos in the home at ages 2 and 3 and mother's (but not teacher's) reports of child behavior problems at age 5.5–6. Chaos or commotion in the home may serve to disrupt parenting practices or routines. Chaos can foster a level of environmental intensity that is reflected in the child's emotions through behavioral modeling or as a reaction to their surroundings.

Family conflict is defined as openly expressed anger, aggression, and disagreement among family members (Moos & Moos, 1994). Conflict has been found disproportionately in families under economic pressure (Wadsworth & Compas, 2002). Studies of disadvantaged

families with young children have reported that family conflict predicted externalizing behaviors (Koblinsky, Kuvalanka, & Randolph, 2006). Familial relationships and interactions can be shaped by short- and long-term economic hardship. Thus, children who grow up disadvantaged are at an elevated risk for a range of psychological problems (McLoyd, 1998). Youth who witness conflict in the home may begin to model family members' aggressive behavior in relationship with parents, peers, and others.

Parenting hassles are defined as irritating, frustrating, and distressing demands that characterize everyday transactions associated with caregiving (Kanner, Coyne, Schaefer, & Lazarus, 1981), and are associated with less sensitive caregiving. In a low-income sample, parental hassles during infancy were longitudinally related to the development of internalizing problems by age 3 (Shaw, Keenan, Vondra, Delliquadri, & Giovannelli, 1997). In a cross-sectional study, Kliewer and Kung (1998) found that high levels of cohesion and routines attenuated the relationship between parenting hassles and both internalizing and externalizing problems in older, inner-city children.

Individual Parental Risk Factors

Maternal depression has been consistently associated with poor child outcomes (Gross, Shaw, & Moilanen, 2008). Observational studies have shown that depressed mothers are less responsive to their children, communicate less effectively, and have fewer positive interactions with their children than mothers who are not depressed (Cohn, Campbell, Matias, & Hopkins, 1990). In addition to potential genetic influences, the strong association between maternal depression and depression in children may be partially the result of the quality of interpersonal interactions between parents and children. There is evidence that both the mother's and child's negative moods and behaviors can influence each other, leading to a long-term reciprocal process and exacerbation of both parent and child symptoms (Gross et al., 2008).

Children affected by parental alcohol or drug use may face considerable challenges to their psychosocial development. Parents with alcohol or drug problems may not effectively manage stressful events because of substance-induced physical and mental impairments, expending limited financial resources on purchases, frequent problems with the law (e.g., arrests, incarceration, and court dates), time spent seeking out or using drugs, and estrangement from positive support of family and friends. In addition, when a parental support network is composed of illicit drug users, children are further compromised because they have limited opportunities to develop the social skills and relationships that can help protect them against adversity (Knowlton, Buchanan, Wissow, Pilowsky, & Latkin, 2008) and facilitate social mobility. The relationship between parental alcoholism and childhood behavior problems, including externalizing, internalizing, and social problems, has been reported (El-Sheikh & Flanagan, 2001). However, the range of child outcomes varies, as many children of problem-drinking parents do not experience psychopathology.

Parental education may be related to the development of behavior problems in young children. Research indicates that less educated mothers are more likely to rate their children as displaying problem behaviors (Andersson & Sommerfelt, 2001; Runions, 2005). Maternal level of education may reflect socioeconomic status, availability of information,

communications, or discipline styles. In particular, parental expectations about parent–child interactions and socialization practices may vary as a function of educational exposure.

Risk Measurement Strategy

The accurate identification of individual risk factors, and combinations of risk factors, is central to delivering effective prevention efforts. Different statistical formulations of risk enable the comparison of vantage points into familial experiences. For example, a multivariate approach allows for a single established risk factor to be tested in a more complex matrix that serves to contextualize and mirror co-occurring experiences that families navigate at a given time. Most studies of disadvantaged children have examined only a single outcome (i.e., univariate) even when data on several outcomes were collected, with little attention given to whether children experience multiple adverse outcomes (Bradley & Corwyn, 2002; Masten, 2001).

CCA is an appropriate technique when there is a need to analyze the relationship between two meaningful sets of variables (Nimon, Henson, & Gates, 2010). Exploratory approaches can be useful when there is a need to consolidate large amounts of information and formulate a problem into a more precise clarified concept. Latent class analysis, whether exploratory or confirmatory, is an alternative statistical method that informs a similar question: Into how many homogeneous subgroups should the sample be divided (Laudy et al., 2005)? However, we selected CCA to conduct the present analysis because the latent groups are formulated based on their predictive association with each other and thus lend themselves to the “risk factor predicts child behavior outcome” model. Unlike confirmatory data analysis, strongly generalized inferences should not be derived from exploratory CCA because support for the hypotheses is determined descriptively by examining empirical patterns in the data. Because a null hypothesis is not compared in some exploratory research, the results may be interpreted as sample-specific findings to compare to previous findings or to inform future model development and testing in confirmatory frameworks. CCA considers all variables simultaneously with equal importance at the start of the analysis, thus honoring the ecological validity of much prevention science and eluding the inflation of Type I error (Nimon et al., 2010). It also provides a means to isolate and consolidate relationships between a battery of risk factors and internalizing and externalizing behaviors in this low-income sample of families.

A considerable amount of research has focused on broad-band factors of internalizing and externalizing problem domains (Garai et al., 2009). However, narrow-band measures of internalizing and externalizing problem domains can be employed to investigate specific dimensions of behavior that are more informative to intervention researchers because they provide detailed information on a child’s level of functioning (Eckert, Dunn, Coddington, & Guiney, 2000). We chose to focus on seven, specific narrow-band level, internalizing and externalizing emotional and behavioral problems (emotional reactivity, somatic symptoms, anxious depressed, aggression, sleep problems, attention problems, and withdrawn behaviors) for two reasons. First, there is some evidence suggesting that interventions may affect clusters of emotional and behavioral problems in young children (Chase & Eyberg, 2008). Utilizing narrow-band factors allows us to unpack specific combinations of behavior

problems that are predicted by combinations of individual and contextual risk factors. Second, although internalizing and externalizing problems are described as separate phenomena, evidence suggests they commonly co-occur (Pesenti-Gritti et al., 2008). In an effort to identify combinations of risk factors that show a persistent and prospective association with child behavior outcomes, we examined independent variables that were predictive over a 2-year period. Compared to studies of problem behavior among children 3 years of age and older, there is less empirical knowledge about the persisting longitudinal effects of earlier experiences on multiple outcomes, with few applicable datasets available (Mathiesen, Sanson, Stoolmiller, & Karevold, 2009). Thus, we intend to overcome current methodological limitations by examining adverse conditions when the children were age 2 and emotional and behavioral problems at age 4.

Theoretical Framework and Hypotheses

Proposed by Cicchetti and Rogosch (1996), the theory of multifinality posits that a range of developmental outcomes can emerge from a given set of social and structural processes. That is, any given risk factor(s) can result in multiple outcomes. The actual effect will depend on conditions set by values of additional elements with which the risk factor is linked. Originally a biological theory (Mayr, 1989) that was translated into the social sciences (Cicchetti & Rogosch, 1996), equifinality posits that multiple pathways can lead to the same outcome. Using an exploratory statistical technique and descriptive interpretation, we first hypothesized that multifinality will be evidenced through meaningful combinations of individual and interpersonal risk factors that predict multiple internalizing and externalizing problem behaviors. Second, we hypothesized that equifinality will be found in that a variety of contextual risk factors will lead to a single internalizing or externalizing problem behavior.

Multifinality and equifinality are organizational theories characterized by the premise that the meaning of any one attribute or process needs to be considered in light of a matrix of individual characteristics, experiences, and social-contextual influences. In the present study, we used CCA to operationalize the theories of multifinality and equifinality. CCA conceptualizes risk as dependent on the values of components with which it is structurally linked. CCA was first conducted on the sample halves followed by on the full sample. A commonality analysis and regression diagnostics are included.

Methods

Participants

Participants included 364 mother–child dyads recruited for a preventive randomized controlled trial aimed at risk reduction for developmental trajectories that lead to early-onset substance use and antisocial behaviors (Dishion et al., 2008). Briefly, families were recruited between 2002 and 2003 from Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) sites in the metropolitan areas of Pittsburgh, PA, and Eugene, OR, and within and outside the town of Charlottesville, VA. Families were approached at WIC sites and invited to participate if they had a 2-year-old child (i.e., age between 2 years 0 months and 2 years 11 months). Risk criteria for recruitment were defined at or above one

standard deviation (*SD*) above normative averages on several screening measures within the domains of child behavior (conduct problems, high-conflict relationships with adults), family problems (maternal depression, daily parenting challenges, substance-use problems, teen parent status), and sociodemographic risk (low education achievement and low family income, relevant to WIC criteria). Two or more of the three risk factors were required for inclusion in the sample.

Of the 1,666 families who were approached at WIC sites across the three project sites and had children in the appropriate age range, 879 met the eligibility requirements of which 731 agreed to participate. Of these 731 families (49 % female children), 272 (37 %) were recruited in Pittsburgh, 271 (37 %) in Eugene, and 188 (26 %) in Charlottesville. Of the 731 families who initially participated, 619 (85 %) were available at the 2-year follow-up when the children were 4 years old (i.e., age between 4 years 0 months and 4 years 11 months). Of the 619 families, 364 were randomized to the control condition and thus free of intervention effects. Of the 364 families available at child age 4, 202 had an alternative caregiver (e.g., spouse, child's father, grandparent) who also participated in the study. Selective attrition analysis among families who completed assessments at child age 4 versus those who completed assessments only at child age 2 revealed no significant differences in project site or in children's race, ethnicity, or gender.

At child age 2, families had high levels of disadvantage. More than two-thirds had an annual income of less than \$20,000, and the average number of family members per household was 4.5 (*SD* = 1.63). Forty percent were single-parent families. Additionally, 42 % of mothers were above the clinical cutoff for depression [i.e., 16 on the Center for Epidemiological Studies on Depression Scale (CES-D; Radloff, 1977)]. In terms of race/ethnicity, 54 % of the full sample was European American, 29 % African American, 11 % Hispanic American, and 6 % other race/ethnicity.

Measures

All measures were selected based on their established validity and reliability in low-income and ethnically diverse populations. All measures were coded so that higher scores indicated greater risk.

Demographics Questionnaire—We assessed the following five sociodemographic variables as reported by the primary caregiver: (a) number of children living in the home, (b) residential density, (c) education, (d) income–need ratio, and (e) father absence. *Residential density* was equal to the number of rooms per person living in the home (i.e., rooms divided by number of people). For the CCA, scores were recoded so that higher values indicated fewer rooms per person. *Education* was the higher score of primary or alternative caregiver recoded so that higher scores indicated fewer years of education. *Income–need ratio* was calculated by dividing family income (ranges were coded 0 through 13) by the number of people living in the home. We then recoded scores so that higher scores indicated fewer financial resources per person. *Father absence* included a biological, step, adopted, or foster father who was parenting at child age 2 (0 = yes or 1 = no).

Parental Depression—Primary caregivers completed the CES-D (Radloff, 1977). The CES-D is a 20-item measure of depressive symptomatology. In the current sample, internal consistency was $\alpha = .76$ at the child age 2 assessment based on the total number of symptoms endorsed.

Alcohol and Drug Use—Primary caregivers completed the Parent Substance Use Questionnaire (Dishion & Kavanagh, 2001). This 23-item questionnaire focuses on basic patterns of substance use during the past year. Items were used concerning frequency of alcohol use and frequency of drug use (tobacco, marijuana, and illicit drugs). The drug items were summed to create a total score. Alcohol is the frequency of consuming any alcoholic beverage.

Parenting Daily Hassles—Primary caregivers completed the Parenting Daily Hassles Questionnaire (Crnic & Greenberg, 1990). This 20-item measure assesses the frequency of the hassles and the extent to which the caregiver perceived the hassles as a problem. Internal consistency for this 20-item measure was $\alpha = .90$ in the current sample.

Conflict with Child—The Student–Teacher Relationship Scale (STRS; Pianta & Steinberg, 1992) was originally designed to assess teachers' perceptions of their relationship with students. We adapted the STRS by changing the wording of items to reflect the parent–child relationship, and called it the Adult–Child Relationship Scale. This 15-item measure was reported by primary caregivers and taps the frequency and intensity of parent–child disagreements; it had an internal consistency of $\alpha = .75$ in the current sample.

Chaotic Home Environment—The Confusion, Hubbub, and Order Scale (Matheny et al., 1995) is a 15-item measure of the amount of disorder and chaos in the home as reported by the primary caregiver. Internal consistency for this 15-item measure was $\alpha = .84$ in the current sample.

Parental Discrimination—The Microaggression Scale (MIC; Chae & Walters, 2009) is an 18-item measure that assesses distressing experiences of discrimination related to ethnicity/race and income/education as reported by the primary caregiver. For the present study, the MIC was adapted from a measure used to assess experiences of discrimination among Native Americans. Internal consistency for this 18-item measure was $\alpha = .92$ in the current sample.

Neighborhood Danger—The 15-item subscale of the Me and My Neighborhood Questionnaire (Ingoldsby & Shaw, 2002), which assesses neighborhood dangerousness, was reported by primary caregivers. Internal consistency for this 15-item measure was $\alpha = .88$ in the current sample.

Child Internalizing and Externalizing Problem Behaviors—Primary or alternative caregivers completed the 99-item Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000) for ages 1.5–5 at the child age 4 assessment. The CBCL has seven narrow-band factors assessing the frequency of specific problem areas including emotional reactivity, anxious depressed, aggression, sleep problems, attention problems, somatic complaints, and

withdrawn behaviors in the past 2 months. In the current sample, internal consistency of the narrow-band factors ranged from $\alpha = .76$ to $\alpha = .92$, with a mean of $\alpha = .82$.

Procedures

Researchers approached mothers at the WIC sites and asked them if they would like to complete a packet of questionnaires for a study on “the terrible twos.” The mothers who agreed to participate were paid \$10 to fill out screening questionnaires focused specifically on child behavior, family problems, and sociodemo-graphic risk. The mothers who met eligibility requirements and agreed to participate in the study were scheduled for a 2.5-h home visit. Each assessment involved a battery of questionnaires and interactive tasks. The home visit protocol was repeated at the child age 4 assessment. Families received \$100 for participating in the child age 2 home visit and \$140 for participating in the child age 4 home visit. Additional details about the intervention and the randomized controlled trial are available elsewhere (Dishion et al., 2008). In the present study, primary caregiver reports of risk factors from the child age 2 assessment were used. Primary caregivers and, when available, alternative caregivers reported on child behavior problems at the child age 4 assessment.

Data Analysis Plan

Before describing the statistical analysis performed, there is certain terminology that needs to be defined. A *canonical variate* is a linear combination of variables that is extracted from a set of either independent variables or dependent variables. A pair of canonical variates, which is a pair of independent and dependent variables, has an overall linear relationship; the strength and practical significance of this linear relationship is measured by the *canonical correlation* (Hair, Anderson, Tatham, & Black, 1998). *Shared variance* measures how the strong variables in one set relate to their own canonical variate. *Redundancy* measures the variance extracted between one canonical variate and the variables in the other set (Tabachnick & Fidell, 2007).

Consistent with the first and second hypotheses, we used CCA to operationalize the theories of multifinality and equifinality. CCA operationalizes multifinality because it permits examination of a risk factor(s) that predicts multiple problem behaviors, and CCA operationalizes equifinality because it can show multiple pathways that predict the same problem behavior. CCA creates linear combinations of variables, or canonical variates, which represent mathematically viable combinations of latent variables. Canonical variates are then interpreted as a pair, with a variate derived from the independent set of variables interpreted relative to the variate from the dependent set of variables (Tabachnick & Fidell, 2007).

The criteria for variable selection were based on univariate procedures described by Thorndike (1977) and utilized by the research team in a previous cross-sectional report on the same sample (Wilson, Hurtt, Shaw, Dishion, & Gardner, 2009). There were 13 variables in the risk factor set at child age 2, and 14 variables in the child behavior set at child age 4 (i.e., primary caregiver and alternative caregiver reports of emotional reactivity, somatic symptoms, anxious depressed, aggression, sleep problems, attention problems, and

withdrawn behaviors), resulting in a total of 27 variables. Uncorrelatedness, instead of strict independence, is a conditional assumption for CCA. The correlations between primary caregiver and alternative caregiver reports of child behaviors ranged from .22 to .36, with an average of .26, which satisfies the assumption of uncorrelatedness. We used data from both sets of caregiver reports to make the outcome variables less correlated with each other and to minimize the influence of single reporter bias on the results. Although not all families had an alternative caregiver to report on the child behaviors, the pattern of the missing data is more important than the amount (Tabachnick & Fidell, 2007). In the current sample, the presence or absence of an alternative caregiver report was not related to the level of internalizing or externalizing child behaviors. To maximize replicability, CCA was performed on half the sample, attempted replication on the other half, and then on the full sample. A commonality analysis is presented to aid with interpretation (Nimon et al., 2010). To reduce the impact of outliers, regression diagnostics were performed on the canonical scores. A final model is presented that represents the full sample CCA that was validated between sample halves.

Results

CCA: Comparison Between Sample Halves

Descriptive statistics for the 13 risk factors are displayed in Table 1. The goal was to produce a final CCA model using the full sample that was validated between two groups (Hair et al., 1998). Thus, we randomly split the full sample in half using SPSS version 20 (IBM SPSS Statistics, Armonk, NY). The first half of the sample was referred to as group one ($n = 180$) and the second half as group two ($n = 184$). We computed an analysis of variance model and compared the means at baseline between the two groups at the $p < .01$ level. No mean level differences were found in any risk factor or child behavior outcome. Next, we examined the CCA results for substantial differences between groups. The model fit statistics remained remarkably stable between the two groups. The first two overall canonical correlations were relatively consistent between group one ($R_c = .75$ and $.78$) and group two ($R_c = .64$ and $.67$). The proportion of shared variance for the first two canonical functions in group one (.07 and .09) was similar to that in group two (.15 and .06). The redundancy index for the first two canonical functions in group one (.04 and .04) was similar to that in group two (.09 and .03).

Interpretation of the pairs of canonical variates involves examining the relative importance of each original variable in the derived canonical relationships. Most researchers interpret primary loadings $> .30$ because it represents more than 10 % shared variance between an item and the canonical variate (Tabachnick & Fidell, 2007). Canonical loadings were compared across the two groups thereby providing an indication of measure stability (Table 2). Inspection of the canonical loadings revealed a difference between the risk factor set of variables in the first canonical variates. Drug use in group one (.45) differed from drug use in group two ($-.15$). The child behavior set of variables showed two substantial discrepancies. Primary caregiver reports of group one withdrawn behaviors (.26) and anxious depressed (.24) differed from those of group two withdrawn behaviors (.58) and anxious depressed (.46). In the first canonical variate, drug use, withdrawn behaviors, and

anxious depressed were not reinforced by the model validation between groups, which was reflected in the final CCA model. In the second canonical variate, income–need ratio in group one (.11) did not load similarly to that in group two (.42).

CCA: Full Sample

Next, we performed a CCA on the full sample. CCA showed three statistically significant ($p < .01$) latent dimensions that predicted the child behavior set of variables from the risk factor set of variables. Table 3 displays two canonical functions, canonical correlations, variance shared, and redundancies, which indicate that the first two pairs of canonical variates were moderately related. The square of the canonical correlations (i.e., effect size) shows that there was 37 % overlapping variance in the first canonical function and 27 % in the second canonical function. The third pair of canonical variates was minimally related, so we will interpret only the first two pairs (Tabachnick & Fidell, 2007).

Inspection of the first canonical function shows that four risk factors were closely related and created a well-defined dimension that represents interpersonal and individual risk. This dimension predicted four co-occurring internalizing and externalizing behaviors. The first pair of canonical variates represents the highest possible correlation that can be extracted from the datasets, so the first canonical function is therefore the more important of the two canonical functions. The second canonical function showed that, on average, parents who reported higher levels of risk characterized by a structural and contextual dimension at baseline also reported similar internalizing and externalizing behaviors 2 years later. The commonality analysis included in Table 2 shows that alcohol use had a unique substantial contribution (34 %) when partitioning the child behaviors variate by risk factors. For correct interpretation, note that the unique, common, and total effects are not percentages of the canonical effect observed, but of the variance in the *other* variate scores. To reduce the impact of outliers, regression diagnostics were performed on the canonical scores. After deleting two potential outliers, we reran the CCA, and found that the R_c remained unchanged.

Final Validated CCA Model

For ease of interpretation, the full sample results that had primary loadings $> .30$ and were validated between the two groups are displayed in Figs. 1 and 2. Figure 1 displays the principle of multifinality using the first pair of canonical variates. As shown, the latent dimension of risk was characterized as individual and interpersonal, and it predicted a high degree of comorbidity between internalizing and externalizing child behaviors. Figure 2 displays the principle of equifinality with the second pair of canonical variates. As shown, the latent dimension of risk was characterized as structural and contextual, and it predicted somatic symptoms as reported by both sets of caregivers.

Discussion

Consistent with the first hypothesis, multifinality (Cicchetti & Rogosch, 1996) was empirically evidenced between individual and interpersonal risk factors and multiple internalizing and externalizing problems in early childhood. Like Marsh, McFarland, Allen,

McElhaney, and Land (2003), we found that high levels of chaos in the home environment, parental depression, parent–child conflict, and daily parenting hassles were prospectively predictive of multiple types of child emotional and behavioral problems. However, when interpreting these results, one should keep in mind that the principle of multifinality proposes that a particular adverse event or characteristic should not necessarily be seen as leading to one type of emotional or behavioral outcome. In fact, the influence of an event or characteristic is dependent on the conditions, or in this case the variables, with which it is structurally linked (Cicchetti & Rogosch, 1996). Consistent with the second hypothesis, equifinality was demonstrated in the relationship between father absence, high levels of discrimination, high neighborhood danger, and fewer children in the home and child somatic complaints. Thus, an assortment of risk etiologies can lead to the same behavioral problem in young children.

Although it appears that early internalizing and externalizing child behavior problems can be reached through many developmental paths, there is evidence that the number of risk influences is likely constrained. Multifinality and equifinality are useful heuristics that allow the consideration of additional information. The ability to effectively process large quantities of information is a known limitation of practitioners, both in terms of classification judgments such as diagnosis, and continuum estimates such as symptom severity. CCA creates combinations of risk factors and combinations of emotional and behavioral problems that are distinguished by likelihoods. The ability to distinguish between the likelihood of behavioral or emotional consequences from certain combinations of risk relative to other combinations of risk, offers researchers and practitioners an advantage in understanding the outcomes of early childhood risk.

Individual and Interpersonal Risk

Consistent with those of Dishion et al. (2008), our results support the notion that proximal family risk is at the core of many early childhood emotional and behavior problems. Chaos in the home, parental depression, conflict with children, and daily parenting hassles can be stressful events in family life. Parental depression has been consistently linked with poorer early childhood adjustment (Beardslee, Versage, & Gladstone, 1998). Depression reduces the energy a parent has available for managing stressful activities and likely compromises the efficacy of family management practices. Parental skills in managing stressful occasions are particularly salient during early childhood when mothers and children spend more time together than in later development. Like Shaw and Vondra (1995), we found that the combination of interpersonal family risk and depression forms a distinct dimension that prospectively and longitudinally predicts a range of internalizing and externalizing behavioral problems; that is, co-occurring internalizing and externalizing behavioral problems are affected by a combination of risk factors. Currently, most family interventions are designed to alleviate child emotional and behavioral problems by addressing parenting practices and strategies. Empirically, the results of this study support not only improving the quality of parent–child relationships (i.e., reducing parent–child conflict) as a point of entry to the solution, but also reducing depression, which may co-occur in highly stressed families.

In the same sample used in the present study, Trentacosta et al. (2008) used a mediational model to show that the longitudinal relationship between accumulated distal risk factors and broad-band internalizing and externalizing behaviors in early childhood was mediated through a proximal measure of maternal nurturance and involvement. Trentacosta et al.'s findings highlight the importance of parent-child relationships in the development of early broad-band internalizing and externalizing behaviors. Similarly, we found that when contextual and individual risk factors were given equal consideration, proximal interpersonal exchanges between the parent and child are among the most salient predictors of comorbidity. However, utilizing narrow-band factors revealed that child somatic complaints, which may be a proxy for general health status, may be more directly influenced by a combined effect of structural and contextual influences. Thus, the quality of parent-child relationships may be more influential (e.g., risk or protective) on emotional and behavioral problems other than somatic complaints or the general health status of the child.

Structural and Contextual Risk and Somatic Symptoms

In our ethnically and geographically diverse sample, we found that father absence, perceived discrimination, neighborhood danger, and fewer children living in the home were predictive of somatic symptoms. Additionally, we extended the scope of previous research to address associations between parental reports of discrimination and children's somatic symptoms, an effect otherwise known as cumulative discrimination (Blank et al., 2004). Discrimination can have cumulative effects that function throughout the stages of life and even across generations to perpetuate inequality, and in this case, maladaptation. In this study, parent perceptions of child somatic complaints may represent an index of a child's general health status based on the item content covered (e.g., rashes without medical cause, nausea without medical cause, constipation without medical cause). The pervasive pathogenic effects of racial discrimination on physical and mental health have been thoroughly documented by Williams and Williams-Morris (2000) and Sanders-Phillips, Settles-Reaves, Walker, & Brownlow (2009). Moreover, comprehensive reviews of interpersonal and institutional discrimination due to low-income status have been conducted by Lott and Bullock (2006) and Williams (2009).

In our disadvantaged sample, social inequalities were expressed through structural and contextual channels such as father absence, perceived discrimination, neighborhood conditions that evoke fear, and fewer children in the home. A stress model has often been used to link social inequalities with health outcomes. Sanders-Phillips et al. (2009) fluently explained how inequalities result in chronic stress, which in turn creates a physiological reaction that increases the likelihood of disease in children and adults. When social environments challenge biological systems, the body's ability to meet the demands may diminish (i.e., allostatic load). Hence, the current findings underscore the importance of identifying a combined effect of father absence, perceived discrimination, neighborhood conditions that evoke fear, and the number of children in the home as a critical structural component of risk on somatic symptoms, and possibly the general health status of disadvantaged children.

Medically unexplained or functional somatic symptoms in children constitute a major child and familial problem and can eventually have a high social cost. According to Witthöft and Hiller (2010), compared with affective and anxiety disorders, somatoform disorders have received little research attention, despite being the most frequent mental health disorders in primary care settings. In the current study, somatic symptoms were prospectively predicted by a dimension with structural and contextual undertones, which indicates a need to widen the etiological lens through which we investigate connections to somatic symptoms. A common issue in the study of somatic symptoms is whether functional somatic symptoms are linked to other forms of psychopathology (Steinhausen & Winkler Metzke, 2007). Prevention scientists are well positioned to advance our scientific inquiry to include social conditions as fundamental causes of poor health and disease, which has been proposed in the past (Link & Phelan, 1995) and is reinforced by this study's findings.

Future Research

An important next step would be to inquire whether other promotive and protective factors diminished the associations found between assorted risk factors and child outcomes. In addition, it would be informative to know whether a protective factor would moderate the influence of a specific risk factor for one child outcome and not another child outcome. For instance, the risk of chaos in the home was found to be related to the co-occurrence of internalizing and externalizing behaviors. Would the presence of a supportive non-parental adult reduce the effect of chaos in the home on externalizing and not internalizing behaviors? Another interesting investigation would be to explore the contribution of multiple promotive and protective factors on various individual and clusters of child outcomes, as well as the notion of a specific protective and promotive factor on multiple outcomes.

Limitations

Several limitations should be considered when interpreting the present study's findings. First, there is potential rater bias, as we relied solely on maternal reports for assessing the vast majority of our independent variables, as well as primarily on one method for data collection (i.e., questionnaires). Although a few risk factors assessed domains for which more objective reports might be expected (e.g., number of people living in the home, number of rooms in the home), the potential for rater bias still exists. Second, the findings may not be generalizable to families from higher socioeconomic strata or those with fewer family risk factors.

Regarding the use of CCA, caution should be used when interpreting loadings, particularly with regard to the external validity of the findings. However, loadings when compared to weights have been shown to be largely free from the direct influence of multicollinearity (Laessig & Duckett, 1979). Strong inferences should not be drawn from exploratory and descriptive research. In addition, there were differences in how primary caregiver and alternative caregiver reports of internalizing and externalizing behaviors loaded (as shown in Fig. 1). However, we were unable to determine if these differences are due to true differences in caregivers' perceptions of child behaviors or to the smaller number of alternative caregiver reports compared with primary caregiver reports.

Conclusion

Despite these limitations, the current findings indicate that a combination of family interpersonal and individual risk factors has a 2-year prospective association with co-occurring internalizing and externalizing emotional and behavioral problems in early childhood. Moreover, they indicate that a combination of structural and contextual risk factors predicts somatic symptoms in ethnically and geographically diverse, disadvantaged preschool-age children.

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Fig. 1.

The principle of multifinality. Canonical function #1 shows the first pair of canonical variates that had primary loadings $>.30$ and were validated between the two groups. *PC* primary caregiver, *AC* alternative caregiver

Fig. 2.

The principle of equifinality. Canonical function #2 shows the second pair of canonical variates that had primary loadings $>.30$ and were validated between the two groups. *PC* primary caregiver, *AC* alternative caregiver

Table 1

Descriptives for predictor variables at age 2

Risk factors	<i>M</i>	<i>SD</i>	Min–Max
Chaotic home	20.87	2.81	15–28
Conflict with child	28.33	7.43	11–49
Parenting hassles	93.94	20.47	52–167
Depression	16.75	10.66	0–55
Discrimination	3.03	1.20	2–8
Number of children	2.00	1.00	1–8
Neighborhood danger	2.93	2.61	0–13
Alcohol use	1.87	1.74	0–9
Income-need ratio	2.75	1.30	.7–11
Drug use	5.36	3.84	0–80
Residential density (rooms per person)	1.26	0.52	.25–3.33
Education (categorical)	High school grad/GED 42.7 % 7th grade or less—college grad		
Paternal absence (categorical)	Yes 45 %		

Table 2

Correlations and standardized canonical coefficients between risk factor and child problem behavior variables and the canonical variate. Commonality analysis

	Half of sample <i>n</i> = 180				Half of sample <i>n</i> = 184				Full sample <i>N</i> = 364			
	Canonical variate first pair		Canonical variate second pair		Canonical variate first pair		Canonical variate second pair		Canonical variate first pair		Canonical variate second pair	
	Correlation	Coefficient	Correlation	Coefficient	Correlation	Coefficient	Correlation	Coefficient	Correlation	Coefficient	Correlation	Coefficient
<i>Risk factors</i>												
Chaotic home	.70	.50	.04	-.03	.59	.23	.04	-.04	.66	.49	.07	.12
Conflict with child	.51	.39	.39	.38	.41	.07	.27	-.11	.54	.30	.00	.07
Parenting hassles	.61	.36	.11	-.03	.45	.02	.11	.00	.47	.18	.00	.10
Depression	.43	.22	-.09	-.33	.33	.10	-.04	-.03	.54	.32	.05	.35
Discrimination	.02	-.21	.46	.27	.00	-.26	.47	.53	.08	.03	.06	.14
Paternal absence	-.06	-.15	.80	.73	.11	-.03	.49	1.37	-.09	.39	.03	.14
Number of children	.10	-.03	-.30	-.10	.22	-.14	.39	.05	-.14	-.29	.00	.08
Neighborhood danger	-.01	-.26	.40	.22	-.20	-.11	.33	.12	-.14	-.16	.00	.09
Alcohol use	.22	.18	.03	-.05	.13	.05	.14	.03	-.14	.22	.00	.02
Education	-.20	-.18	.24	.01	.16	.05	.05	-.10	.21	.41	.00	.18
Income-need ratio	-.26	-.04	.11	.03	.05	-.09	.42	.34	-.17	-.26	.08	.21
Drug use	.45	.17	.15	.11	-.15	-.06	-.09	-.03	.19	.03	.19	.15
Residential density	.12	-.18	.12	.08	-.22	-.65	-.49	-.99	-.10	-.10	.01	.04
<i>Child problem behaviors</i>												
Aggression PC	.77	.71	.26	.17	.67	.35	-.12	-.81	.64	.51	.00	.06
Sleep problems PC	.68	.41	-.03	-.58	.56	.33	.07	.59	.51	.09	.06	.12
Emotionally reactive PC	.65	.15	.07	.19	.54	-.24	.12	.45	.59	-.10	.01	.07
Anxious depressed PC	.24	-.13	-.02	-.16	.46	.35	-.10	.00	.55	.32	.00	.01
Attention PC	.46	-.40	.09	.26	.37	-.44	.18	.04	.41	-.24	.01	.11
Aggression AC	.43	.20	.25	.16	.38	.29	.30	.19	.34	.21	.01	.15
Sleep AC	.43	.19	.36	.17	.39	-.13	-.16	-.71	.37	.27	.01	.20
Attention AC	.06	-.05	.41	-.34	.34	.56	.55	.52	.08	.09	.03	.21
Somatic AC	.05	-.20	.39	-.12	-.03	-.20	.41	-.17	-.21	-.37	.19	-.18
Somatic PC	.22	.13	.45	.19	.49	.26	.54	-.02	.20	.19	.00	.00
Anxious depressed AC	.03	.07	.51	-.21	.04	-.05	.10	-.17	.20	.13	.03	.21

Full sample <i>N</i> = 364											
Half of sample <i>n</i> = 180						Half of sample <i>n</i> = 184					
Canonical variate first pair			Canonical variate second pair			Canonical variate first pair			Canonical variate second pair		
Correlation	Coefficient		Correlation	Coefficient		Correlation	Coefficient		Correlation	Coefficient	
Emotionally reactive AC	.10	-.59	.85	.80		.42	.51		-.18	-.02	
Withdrawn AC	.12	.39	.52	.25		.30	.12		.24	.00	
Withdrawn PC	.26	.03	-.05	-.39		.58	-.33		.09	.05	

Primary loadings are in bold

PC primary caregiver, *AC* alternative caregiver. Unique refers to the sum of variable's unique effect. Common refers to the sum of variable's common effects. Total refers to the sum of Unique + Common

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Table 3

Measures of overall model fit for canonical correlation analysis

Canonical function	Canonical correlation	Probability	Risk factors		Child problem behaviors	
			Variance shared	Redundancy	Variance shared	Redundancy
1	.61	.001	.11	.04	.15	.06
2	.52	.001	.13	.04	.15	.04