

# Known and Potential Processes Underlying Developmental Trajectories in Childhood and Adolescence

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Recent research on influences associated with variability in child and adolescent adjustment has highlighted the nature of the multiple processes underlying this variability. Variability in child and adolescent adjustment is viewed as a function of covarying influences from multiple domains, operating on specific developmental outcomes across a background of time and the availability of environmental niches for the individual.

With the increasing emphasis on systems approaches to science in general (Gleick, 1987; Salthe, 1985) and the study of human development in particular (Magnusson, 1993; Sameroff, 1989) has come an increasing emphasis on understanding the characteristics and nature of the processes underlying development (Rutter, 1989; see Magnusson, 1993, for a working definition of *process*). In this commentary, I elaborate on processes involving environmental influences and covariance among multiple influences. In addition, I present a third potential process that may serve as a common linkage point when multiple influences are involved.

## Environmental Influences

Previous theory has delineated three aspects of environmental action that are illustrated in the articles in this special issue. These are (a) the multilevel nature of the environment, (b) the concept of specificity, and (c) the distinction raised between shared and nonshared family environmental influences.

### *The Multilevel Nature of the Environment*

As elegantly delineated by Bronfenbrenner (1989, 1993), the environment is structured in a bidirectional, hierarchical fashion, ranging from lower order proximal input directly experienced by the individual in a specific microsystem (e.g., the home, the classroom) to higher order "overarching" cultural and social belief systems that cut across and impinge on multiple microsystems.<sup>1</sup> There are a number of hypotheses about the nature of environmental action that follow from such a hierarchical environmental structure. Two of these are of particular relevance to the findings reported in this special issue. First, there is the primary salience of proximal processes (Bronfenbrenner & Ceci, 1994). Second, there is the influence

of higher order environmental systems on caregiver beliefs and practices (Wachs, 1992).

In support of the greater salience of proximal processes, data reported by Greenberger and Chen (1996) and by R. D. Taylor (1996) demonstrate that distal influences like ethnicity or kin support become significantly less important for outcomes once family-level proximal processes are partialled out. In regard to the second hypothesis, evidence from articles in this special issue illustrate how ethnicity (Greenberger & Chen, 1996), income level (Brody, Stoneman, & Flor, 1996), and family support systems (R. D. Taylor, 1996) can act to influence patterns of parent-child relations. Besides providing further evidence on the validity of Bronfenbrenner's (1989, 1993) theory, the present set of articles also suggests possible extensions of this theory. For example, most of the research on Bronfenbrenner's concept of the exosystem (dual microsystems, one of which does not contain the child but can influence the nature of parent-child relations) has focused on parental exosystems (e.g., Cotterell, 1986). The pattern of results reported by Larson, Richards, Moneta, Holmbeck, and Duckett (1996) suggests the possibility of expanding the concept of the exosystem to include the impact on family processes of context characteristics that contain the adolescent but not the family, for example, relations between adolescent job stress and family relationships.

### *Specificity of Environmental Action*

Specificity of environmental action refers to the hypothesis that different aspects of the environment influence different aspects of development (Wachs, 1992). Results from three studies in this special issue suggest the potential operation of specificity, in terms of showing that different aspects of parental behavior are associated with different dimensions of adolescent adjust-

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<sup>1</sup> Bronfenbrenner's theory also postulates that the environment operates across time as well as in space, for example, the "chronosystem" (Bronfenbrenner, 1989). Although many of the studies in this special issue have a temporal component, the space limitations for commentaries preclude detailed discussion of temporal issues in the present article. Readers interested in exploring these questions in more detail are referred to recent volumes by Magnusson and Caser (1993) and by Moen, Elder, and Luscher (1995).

ment. For example, Ge, Best, Conger, and Simons (1996) reported that parental hostility is related to adolescent conduct problems but not to adolescent depression; results from this study further indicated that maternal warmth significantly differentiates adolescents with covarying depression and conduct disorders whereas maternal hostility and disciplinary techniques do not (also see Jacobvitz & Bush, 1996; Pike, McGuire, Hetherington, Reiss, & Plomin, 1996).

More critically, data from four other studies in this issue support an extension of the specificity concept first suggested by Bradley, Caldwell, and Rock (1988). Bradley et al. proposed that in addition to different aspects of the environment influencing different aspects of development, different environmental *processes* may also underlie different aspects of development. Supporting this argument, different underlying processes are found to be associated with different patterns of adolescent drinking behavior (Schulenberg, Wadsworth, O'Malley, Bachman, & Johnston, 1996), math versus reading achievement (Pungello, Kupersmidt, Burchinal, & Patterson, 1996), and violent versus nonviolent criminal offences in adolescence (Henry, Caspi, Moffitt, & Silva, 1996); different relational paths between family religiosity and family income and child academic or behavioral outcomes have also been shown (Brody et al., 1996).

The operation of environmental specificity, at either a variable or a process level, has at least one major methodological implication for the role of environment on developmental outcomes, involving the analysis of environmental influences. When specificity is operating, nonsignificant relations between environmental parameters and a specific outcome variable do not necessarily demonstrate that environment is irrelevant for development, but only that researchers may not have chosen the appropriate analytic strategy. I refer specifically to the situation when multiple environmental variables are collapsed into global composites or into latent variables, as in LISREL models. In this case, one faces the problem of infinite dilution (McCall & Appelbaum, 1991), namely that the significant impact of a small number of predictors specific for a given outcome will be *attenuated* when these predictors are combined with a greater number of predictors that are not specific to that outcome. In this situation, discrepancies between univariate results, when predictors are not combined, and results involving combined predictors may suggest the operation of specificity.

### *Shared Versus Nonshared Environments*

There has been an increasing emphasis in the developmental literature on the distinction between shared and nonshared environmental influences (Plomin & Daniels, 1987; Rowe, 1994; also see McGue, Sharma, & Benson, 1996; Pike et al., 1996), as well as a good deal of debate on the validity of this distinction (Hoffman, 1991). Both McGue et al. and Pike et al. are unanimous in emphasizing the importance of nonshared environmental influences for adolescent adjustment. What has not been clearly recognized in this debate over shared- versus nonshared influences is that there are, in fact, two forms in which this debate can be framed. The strong form (Harris, 1995; Rowe, 1994) is based on the proposition that even if siblings share common proximal family environments, these shared en-

vironments will be irrelevant for influencing variability in behavior and development. The weak form of the hypothesis follows the specificity concept, asserting that if siblings do not encounter the same environments, then one would expect exposure to different environments to produce different developmental outcomes (Hoffman, 1991; Wachs, 1992). A critical point to note is that few of the studies comparing shared and nonshared environmental influences are able to make a distinction between the strong and weak forms of this hypothesis, because these studies rarely directly measure the proximal environment of siblings to determine if they are in fact encountering the same environment. The overwhelming majority of studies use a social address approach and assume that siblings living under the same roof must of necessity be encountering the same proximal environments (e.g., McGue et al., 1996: this assumption "circumvents the need for direct assessment of the shared environment"). The multiple conceptual and empirical fallacies underlying this assumption have been repeatedly noted (Hoffman, 1991; Wachs, 1995a). For example, available evidence from both the adult (Kendler, Neale, Kessler, Heath, & Eaves, 1992; Rose, Kaprio, Williams, Viken, & O'Rourke, 1990; Rose, Koskenvuo, Kaprio, Sarna, & Langinvainio, 1988) and the child literature (Rowe & Waldman, 1993) clearly demonstrates that significant shared environmental influences appear primarily when direct rather than indirect measurements of the environment are used. The reason why may lie in the greater power associated with direct as opposed to indirect, residual measures of the environment (Kendler et al., 1992). Studies attempting to circumvent this problem by using family members' ratings of their environment must deal with problems such as varying effects depending on who is doing the rating (e.g., McGue et al., 1996; Molina & Chassin, 1996). There is serious question as to whether family rating scales are sufficiently precise to distinguish between the weak and strong forms of nonshared environmental action.

In this regard, the article in this special issue by Pike et al. (1996) is of special interest, in that it is one of the few studies dealing with the shared-nonshared question that actually uses direct, multiple environmental assessment procedures. Given their methodology, it is not surprising that Pike et al. are able to demonstrate the operation of shared environmental influences. Furthermore, the pattern of results reported by Pike et al. suggests that when nonshared influences are operating, it is the weak and not the strong form of nonshared influences that are occurring: "differential treatment affects adolescent adjustment. . . . if adolescents are the object of more parental negativity than is their sibling, they are also more likely to experience adjustment difficulties."

Distinctions between the strong and weak forms of nonshared environmental action can be made when appropriate assessments involving direct, aggregated, multimethod approaches to measuring the environment are used. Unfortunately, almost all of the research on this question has been based on studies using environmental assessment procedures that sharply reduce the chances of finding existing shared environmental influences. Few of these studies are able to distinguish whether nonshared influences reflect a true lack of common rearing influences or are due to siblings encountering different environments and, through a process of environmental speci-

ficity, moving along different developmental pathways. These are two very distinct conclusions, with very different implications for conceptualizing the nature of environmental influences.

### Covariance Among Multiple Influences

Available evidence has increasingly documented that there are multiple influences on development. The articles in this special issue document a number of these, including proximal family and nonfamily environments, social support and social stressors, ethnicity, maturation and/or pubertal status, both physiological and psychological individual characteristics, gender, and genetics. Although substantial, this array in no way exhausts the list of other influences on developmental outcomes. Other demonstrated influences include individual differences in central nervous system integrity (Lyon & Gadisseaux, 1991) and function when integrity is not an issue (Fox, 1994); prenatal hormonal patterns (Berenbaum & Snyder, 1995); both severe (Grantham-McGregor, 1995; Pollitt, 1993) and chronic low-level (Gorman, 1995; Wachs, 1995b) protein-energy and micronutrient deficits; pre-, peri-, and postnatal biomedical risks (Friedman & Sigman, 1992; Rutter, 1988; Shonkoff, 1994); and exposure to environmental toxins (E. Taylor, 1991).

Not only are there multiple influences on development, but many of these influences also covary with each other; for example, environment covaries with genetics, nutrition, and biomedical risk (Wachs, 1992), and nutritional status covaries with illness, parasitic infection, and cultural factors such as feeding practices when children are ill (Engle & Ricciuti, in press; Pollitt, 1988). Covariance processes may be particularly important in certain populations favored by developmental researchers. As noted by both Brody et al. (1996) and Pungello et al. (1996), individuals living in poverty have a greater likelihood of encountering not only social but also biological hazards (e.g., undernutrition and illness). Ge, Conger, et al. (1996) also noted the multiple biomedical risks (e.g., prenatal trauma and maternal drug abuse) that are more likely to be found with adopted children whose mothers have a history of antisocial behavior. Adoptive samples containing substantial numbers of infants from less developed countries (e.g., McGue et al., 1996) also are more likely to include children at risk for multiple nutritional and biomedical problems (Miller, Kiernan, Mathers, & Klein-Gitelman, 1995).

Given the increasing knowledge on the various types of multiple influences affecting developmental variability and the potential covariances among these multiple influences, it becomes increasingly difficult to explain developmental continuity or variability as a function of the action of a single influence. Rather, as I document below, causality is best assigned to a complex of covarying multiple influences.

Three types of covariance processes have been described in the literature (Plomin, DeFries, & Loehlin, 1977). *Passive* covariance refers to probabilistic, naturally co-occurring relations among specific influences on development; for example, less adequate parental rearing is associated with young children's increased exposure to lead (Schroeder & Hawk, 1987). Covariance may also be *reactive* in nature such that children with certain individual characteristics have a higher probability of

eliciting certain types of reactions from others in their environment; for example, children with neuropsychological deficits predisposing to difficult temperament are more likely to elicit negative reactions from others in their environment (Moffitt, 1993). Finally, covariance may be *active* in nature such that children with certain characteristics have a higher probability of seeking out specific environmental contexts; for example, children with less tractable temperamental characteristics are more likely to put themselves in dangerous situations that result in a greater frequency of physical injuries (Matheny, 1986).

The critical issue is not the operation of these three forms of covariance as important developmental processes; of this there can be no doubt. Rather, what continues to be problematical are the conclusions that some researchers draw from the operation of these covariance processes. Specifically, all too often the operation of organism-environment covariance is used as an argument to assert that relations between family environment and development are spurious, given that parents may transmit both genes and environments to their children, or given that children with certain biologically influenced individual characteristics are more likely to elicit specific types of reactions from others in their environment or may be more likely to be found in certain types of contexts (Rowe, 1994; Scarr, 1992). Such thinking is seen in some of the articles in this special issue: for example, Pike et al. (1996) stated, "common genetic influences could account for associations between parenting practices and children's outcome" (also see McGue et al., 1996).

It is clear that this line of argument falls into what Mackenzie (1984) called the "hereditarian fallacy," namely that refutation of a purely environmental process automatically confirms the validity of a purely genetic process. The fact that genes and environments are passively correlated does not mean that family environmental influences reduce down to genetic influences. Rather, what this correlation means is that any discussion of process must shift from a main effects environmental or genetic framework to a multi-influence correlational framework. In this multi-influence framework, it is the *correlation* between genetic and environmental factors that serves to drive development and not their separate influences taken in isolation: "the correlation . . . is the causation" (Wachs, 1992, p. 112). In a multi-influence correlational framework, the specific environmental parameters found to be associated with genotype represent the environmental *contribution* to the covariance process. A critical question, to which all too little attention has been paid, is what are the specific genetic contributions to the passive covariance process.

In the case of reactive covariance, while having certain biologically influenced individual characteristics may increase the probability of receiving certain types of reactions from the environment, these reactions are not guaranteed. For example, the probabilistic nature of relations between child temperament and caregiver behaviors, and the kinds of moderators that make these relations probabilistic, have been noted elsewhere (Wachs, 1995a; see later for a similar point in regard to active covariance). More critically, using the example of reactive organism-environment covariance to argue against the salience of environmental influences ignores the existence of transactional or "causal chain" processes, wherein individual characteristics serve to influence the nature of the individual's subse-

quent environment, but the subsequent environment in turn influences the further development and impact of individual characteristics (Caspi, Elder, & Bem, 1987; Moffitt, 1993; Rutter, Quinton, & Hill, 1990; Sameroff & Chandler, 1975).

An excellent example of the distinction between these two approaches is seen in the article by Ge, Conger, et al. (1996), with specific regard to their distinction between the *simple-evocative model*, which focuses only on child effects, versus a *mutual influence model* that integrates both child and caregiver effects operating across time. As results from this article so elegantly demonstrate, a mutual influence model provides a far more complete picture of the nature of genetic and environmental influences on development than does a simple evocative model.

Given the operation of organism–environment covariance, what is the best way to take account of covariance processes without falling into a reductionist trap? One analytic approach that allows us not only to take account of covariance among predictors but also to identify what groupings of covarying predictors are particularly relevant to developmental outcomes is the use of *pattern analysis*, as described in the article by Schulenberg et al. (1996). Pattern analysis is based on the use of clustering techniques to group individuals with similar characteristics into specific, relatively homogeneous clusters. Although Schulenberg et al. used this approach to group participants on the basis of outcomes, its usage to group individuals on the basis of potentially covarying multiple predictor combinations has been extensively discussed by Magnusson (Magnusson, 1988; Magnusson & Bergman, 1990). Magnusson has used pattern approaches to group individuals with different environmental and biologically influenced individual risk characteristics into clusters; cluster membership was then used as the basis for predicting developmental outcomes. The advantage of this procedure is not only that naturally occurring covariances are highlighted—individuals who covary on specific characteristics will be put into a different cluster than individuals who covary on a different set of characteristics—but also that by looking at cluster characteristics, one can specify combinations of covarying individual and environmental characteristics that are most relevant for different developmental outcomes. In this regard, the advantages of pattern analysis procedures over multivariate decomposition techniques (e.g., Pike et al., 1996) seem obvious whenever researchers interested in influences on development are dealing with potentially covarying multiple sets of predictors, and when they wish to map existing reality rather than imposing their own order on reality.

### Niche Potential and Niche Valence

The idea of developmental niches defined by the culture within which the individual functions (Super & Harkness, 1986) and the idea of individual niches that the person self-selects into—active covariance (Scarr & McCartney, 1983)—have been emphasized as a developmental process that can act to maintain continuity in individual development over time.<sup>2</sup> As traditionally used in developmental theory, two aspects of niches selection and active covariance deserve comment. First, there appears to be an assumption that niches are easily available and that it is just a matter of the individual self-selecting which niche he or she chooses to enter (Scarr & McCartney,

1983; also see Schulenberg et al., 1996, regarding individuals seeking and constructing social contexts that are congruent with their personality style). Second, although niche selection is seen as a force for continuity over time, there is little discussion of the *valence* of niches—whether the niches selected are those that serve to inhibit or enhance individual adaptation.

On the basis of the concept of multiple influences, I would argue that the potential niches that exist in the individual's environment do not equal the niches that are actually available to the individual. Rather, a variety of biological (e.g., malnutrition, chronic illness), environmental (e.g., nonresponsive parenting, encouragement of independence), cultural (e.g., racism), or individual characteristics (e.g., secure attachment, cognitive abilities, and inhibited temperament) can act either to enhance or to restrict the individual's exposure to varying niches and the individual's capacity to discover and enter existing niches. Furthermore, it is important to note that niches that are open to individuals may not be developmentally neutral in terms of their characteristics. Niches with positive valence are those that contain characteristics, skill demands, or persons that are viewed as valuable by the individual's particular culture; negative valence niches contain characteristics, skills, or persons that are viewed as undesirable by the individual's particular culture.

In regard to developmental implications of the process of niche selection and active covariance, I would hypothesize that fewer available niches and a higher proportion of negative valence niches should act to maintain poorer behavioral adjustment over time. There are a number of reasons for this prediction: (a) the fewer niches available to the developing individual, the more the individual is likely to be locked in to a restricted number of behavioral–developmental patterns, so that he or she will be less flexible when encountering new situations that demand new skills or different application of existing skills (Caspi, et al., 1987; Moffitt, 1993); (b) with fewer niches available, the individual may be under greater pressure to try to adapt themselves to those niches that are open, which may be an additional source of stress for the individual; if these niches are negative in valence, societal pressure may be directed at breaking up negative valence niches, for example, pressure by school officials against aggressive peer networks (Cairns, Cairns, Neckerman, Gest, & Garipey, 1988); (c) children whose behavioral styles elicit hostility and rejection may find themselves restricted to family niches that not only serve to maintain these behavioral patterns (Caspi et al., 1987) but also do not provide the child with needed social support (Sroufe & Egeland, 1991); and (d) by their very nature, negative valence niches can serve to close off the possibility of entering positive valence niches later in life, either directly as when educational opportunities are closed off (Caspi et al., 1987) or indirectly through individual expecta-

<sup>2</sup> Unfortunately, formal definitions of exactly what is meant by an individual's niches are generally lacking. As a working definition, I would propose adapting Bronfenbrenner's (1989) concept of the microsystem to also emphasize stability of the roles, activities, and so forth that characterize the microsystem, as well as adding cognitive abilities and skills to the characteristics of persons found in the microsystem niche.

tions about the possibility of failure if they attempt to shift niches (Moffitt, 1993).

Although post hoc interpretation is always problematical, a number of the studies in this special issue do present results that are congruent with the processes associated with the concepts of niche potential and niche valence. Family practices, such as a history of father-daughter cross-generational alliance (Jacobvitz & Bush, 1996), could serve to restrict a daughter's sense of independence and thus close off future potential relationship niches, increasing the probability of later interpersonal problems. In contrast, the family practices documented by R. D. Taylor (1996) as increasing the adolescents' sense of self-reliance and involvement in school could well open up potential niches for these adolescents, resulting in a greater probability of enhanced functioning over time. Angry, defiant child behavior patterns, as described by Ge, Best, et al. (1996), Ge, Conger, et al. (1996), and Henry et al. (1996), could result in restricting the child's family niches to those that are negative valence (parental hostility and rejection) with the multiple potentials for negative consequences described earlier. In contrast, individual physiological characteristics, such as a greater ability to develop classically conditioned emotional responses (Raine, Venables, & Williams, 1996), or individual personality traits, such as an internal locus of control or a sense of self-efficacy (Schulenberg et al., 1996), could allow the individual either to avoid negative valence niches or to feel they still had the ability to choose niches other than those they were currently occupying. Culturally driven parental beliefs about appropriate levels of independence for late adolescent girls may be viewed by the adolescents as restricting their choice of appropriate niches (Molina & Chassin, 1996), resulting in increased stress and an increased probability of adjustment problems (Greenberger & Chen, 1996). On the other hand, cultural factors resulting in greater parental involvement in formal religious organizations may serve to open up a greater variety of positive valence niches for their children, thus mediating the positive behavioral outcomes reported by Brody et al. (1996).

Given that the individual's niche potential is the result of multiple influences, and that niche valence is a function of higher order contextual influences, this hypothesized expansion of the construct of active covariance fits well within the overall framework of developmental influences outlined earlier. In contrast to biological, environmental, or cultural influences that serve to set the child on specific developmental pathways earlier in life, the availability of niches and the valence of available niches are viewed as being of greater salience for later developmental outcomes. The operation of niche potential and niche valence are viewed as potential cumulative processes that serve to maintain the effect of prior multiple covarying influences on different developmental pathways across time.

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