Project Publications

Journal Articles, Books, and Chapters in Books

1. Plomin, R., DeFries, J. C., & Roberts, M. K. (1977). Assortative mating by unwed biological parents of adopted children. Science, 196, 449-450.

    Analyses of data obtained from 662 unwed couples whose children were relinquished for adoption reveal that biological parents of adopted children mate assortatively. For physical characteristics, assortative mating was similar to that of wed parents; for behavioral characteristics, however, there was less assortative mating by unwed parents.

2. Ho, H., Plomin, R., & DeFries, J. C. (1979). Selective placement in adoption. Social Biology, 26, 1-6.

    Using data from the adoption agency files for 206 "first" adoptions, we found little evidence for selective placement based on demographic characteristics of the parents or on infant characteristics such as gender, gestational maturity, APGAR scores, time in hospital, and time in foster care.

3. Hardy_Brown, K., Plomin, R., Greenhalgh, J., & Jax, K. (1980). Selective placement of adopted children: Prevalence and effects. Journal of Child Psychology and Psychiatry, 21, 143-152.

    We review what is known of the extent of selective placement from previous studies, examine data concerning the effects of selective placement, and explore some theoretical implications.

4. DeFries, J. C., Plomin, R., Vandenberg, S. G., & Kuse, A. R. (1981). Parent_offspring resemblance for cognitive abilities in the Colorado Adoption Project: Biological, adoptive, and control parents and one_year_old children. Intelligence, 5, 245_277.

    Cognitive data are presented for 359 biological (unwed) parents, 261 adoptive parents, 154 control parents, and 119 adopted and 79 control 1_year_old children. Analyses of adult data indicate that the biological, adoptive, and control parents are similar with regard to various demographic variables, test reliabilities, cognitive test score variances, factor structure, and mate correlations. As expected, parent_offspring correlations for height provided clear evidence of genetic influence at 12 months. There is significant resemblance between the general cognitive ability of parents and measures of mental development of their 1_year_old children for all three parent_child comparisons, suggesting that both heredity and common family environment contribute to familial resemblance for cognitive measures. The finding that Caldwell's HOME Responsivity measure correlated significantly with infant intelligence in both adoptive and control families suggests that the relationship between maternal responsiveness and infant mental development is primarily environmental in origin.

5. Hardy-Brown, K., Plomin, R., & DeFries, J. C. (1981). Genetic and environmental influences on the rate of communicative development in the first year of life. Developmental Psychology, 17, 704-717.

An extensive analysis of communicative development of the CAP 12_month_olds indicated a significant relationship with biological parents' general cognitive ability. This finding suggests that heredity influences infant communicative performance and that infant communicative performance is linked genetically to general cognitive ability.

6. Baker, L. A., DeFries, J. C., & Fulker, D. W. (1983). Longitudinal stability of cognitive ability in the Colorado Adoption Project. Child Development, 54, 290-297.

A path model for the analysis of longitudinal data in the CAP is presented. The maximum_likelihood application of the model to the CAP 12_ and 24_month_old data confirmed the previous conclusions concerning significant genetic influence on mental development in infancy. The analysis also indicated that short_term stability of mental ability between 12 and 24 months of age is relatively independent of between_family genetic and environmental influences as measured in the parent_offspring design.

7. Fulker, D. W., & DeFries, J. C. (1983). Genetic and environmental transmission in the Colorado Adoption Project: Path analysis. British Journal of Mathematical and Statistical Psychology, 36, 175-188.

A path model of genetic and environmental transmission was evaluated. In addition to providing tests of hereditary and environmental influences, the model includes parameters for passive genotype_environment correlation, parental influences on the child's environment, assortative mating, and selective placement. A maximum_ likelihood method was used to obtain parameter estimates from mental ability data on 1_ and 2_year_old adopted children, their biological and adoptive parents, and members of control families. There was a satisfactory fit of the model to the data, and highly significant estimates of genetic influence were obtained.

8. Plomin, R. (1983). Developmental behavioral genetics. Child Development, 54, 1-16.

Developmental behavioral genetics is the study of genetic and environmental influences on individual differences in behavioral development. The interdiscipline offers exciting possibilities for research in both child development and behavioral genetics. In this prelude to a special section on developmental behavioral genetics, the potentialities of the interdiscipline are discussed and an overview of the articles that follow is presented.

9. Plomin, R., & DeFries, J. C. (1983). The Colorado Adoption Project. Child Development, 54, 276-289.

This report provides an overview of the CAP. Examples of the types of analyses that can be conducted using this design are presented. The examples are based on general cognitive ability data for adoptive, biological, and control parents; assessments of the home environment; and Bayley MDI scores for 152 adopted and 120 matched control children tested at both 1 and 2 years of age. The illustrative analyses include examination of genetic and environmental sources of variance, identification of environmental influence devoid of genetic bias, assessment of genotype_environment interaction and correlation, and analyses of the etiology of change and continuity in development.

10. Daniels, D., Plomin, R., & Greenhalgh, J. (1984). Correlates of difficult temperament in infancy. Child Development, 55, 1184-1194.

> No systematic significant relationships were found between parental reports of difficult temperament in infants and other aspects of infant development, parental characteristics, or the home environment for the entire sample or for a subsample of the 10% most difficult infants. In addition, there was no evidence for significant interactions between parental personality and home environment as they affect difficult temperament. These data add to the doubts about the utility of the construct of difficult temperament and suggest the need to consider specific infant temperaments that parents find difficult.

11. Plomin, R., & Daniels, D. (1984). The interaction between temperament and environment: Methodological considerations. Merrill_Palmer Quarterly, 30, 149-162.

> The concept of temperament interactions is discussed in the context of statistical interaction. Also presented is a categorization of temperament interactions of three types, based on whether the interaction involves temperament as an independent variable, as a dependent variable, or as both an independent and a dependent variable. A general approach is described for the analysis of temperament interactions using hierarchical multiple regression. This report indicates that it is considerably easier to talk about temperament interactions in infancy than it is to find them.

12. Rice, T., Plomin, R., & DeFries, J. C. (1984). Development of hand preference in the Colorado Adoption Project. Perceptual and Motor Skills, 58, 683-689.

> A longitudinal study of the development of hand preference measured in natural situations at 12 and 24 months of age is reported. Significant developmental trends were observed for both increasing strength and direction of handedness. Less than 10% of the infants exhibited a clear preference at 12 months of age, whereas about 30% were lateralized at 24 months, with more boys than girls being left_handed.

13. Singer, S., Corley, R., Guiffrida, C., & Plomin, R. (1984). The development and validation of a test battery to measure differentiated cognitive abilities in three-year-old children. Educational and Psychological Measurement, 44, 703-713.

> A battery of eight tests to measure verbal skill, memory, perceptual speed, and spatial ability was constructed and administered to 98 preschool children, including 50 CAP participants. A factor analysis revealed four interpretable factors, each representing one of the targeted areas. Prior to this study, evidence for this particular organization of cognitive abilities in young children had not been reported in other factor analytic studies of preschool mental tests. Based on the results of factor analyses, a shorter version of the test battery, consisting of four tests, was devised.

14. Daniels, D., & Plomin, R. (1985a). Differential experience of siblings in the same family. Developmental Psychology, 21, 747-760.

> Although this article does not report on data collected in the CAP, it draws on a

similar source-adoptive families contacted through Lutheran Social Services of Colorado. The study was an investigation of dimensions of differential experience reported by siblings in the same family and an examination of the origins of these experiences. The Sibling Inventory of Differential Experience (SIDE) was completed by 396 adolescent and young adult siblings from adoptive and nonadoptive homes. The results indicate that, on the average, siblings experience quite different environments and that differential sibling experience as assessed by the SIDE shows little genetic influence.

15. Daniels, D., & Plomin, R. (1985b). Origins of individual differences in infant shyness. Developmental Psychology, 21, 118-121.

This article reveals that infant shyness is positively related to shyness and negatively related to sociability and extraversion in nonadoptive mothers who share both heredity and family environment with their infants. Genetic influence on infant shyness at 24 months of age was indicated by significant correlations of shyness and low sociability of biological mothers with shyness of their adopted_away infants. Infant shyness was also related to low sociability of adoptive mothers, suggesting family environmental influences.

16. Dunn, J. F., Plomin, R., & Nettles, M. (1985). Consistency of mothers' behavior toward infant siblings. Developmental Psychology, 21, 1188-1195.

Maternal behavior toward infant siblings was assessed by rating videotapes of 50 families in which mothers interacted with each of two siblings when each child was 12 months old. Factor analysis yielded three factors: affection, verbal attention, and control. The results indicate that mothers behaved very similarly toward their two children at the same age, suggesting that differential treatment of children is unlikely to be a major source of the individual differences that have been observed within pairs of siblings.

17. Hardy_Brown, K., & Plomin, R. (1985). Infant communicative development: Evidence from adoptive and biological families for genetic and environmental influences on rate differences. Developmental Psychology, 21, 378-385.

Measures of infant communicative competence, adult cognitive abilities, and aspects of the home environment were evaluated for both nonadoptive and adoptive families. Path analysis incorporating data on 100 infants confirmed that parental general intelligence is moderately predictive of infant communicative development and that this relationship is due to shared genetic influence. The data suggest that parental imitation of infant vocalizations may represent a direct environmental influence unconfounded by shared genetic variance.

18. Plomin, R., & DeFries, J. C. (1985a). Origins of individual differences in infancy: The Colorado Adoption Project. Orlando, FL: Academic Press.

"Nature and nurture in infancy are the dual themes of this first comprehensive report of results of the decade_long Colorado Adoption Project (CAP), a prospective, longitudinal adoption study. The results presented in this book derive from analyses of data on 182 adopted infants and 165 nonadopted infants who were tested at both 12 and 24 months of age and whose parents (biological as well as adoptive parents of the adopted infants) were also tested. The infants and their parents were assessed for diverse psychological characters such as general and specific cognitive abilities, language, temperament, and behavioral problems. Some of the most exciting results emerge from analyses based on measures of the adoptive and nonadoptive home environments. This multivariate approach should make the CAP findings of interest to any student of human development, including researchers, educators, and parents." (from the Preface)

19. Plomin, R., & DeFries, J. C. (1985b). A parent-offspring adoption study of cognitive abilities in early childhood. Intelligence, 9, 341-356.

Stanford_Binet IQ and scores for four specific cognitive abilities for 186 adopted and 151 nonadopted children at 3 years of age and 162 adopted and 138 nonadopted children at 4 years of age were correlated with corresponding measures for their parents (the biological and adoptive parents of the adoptees and the parents of the nonadopted children). Significant correlations were found between biological mothers' IQ and the IQ of their adopted_away children, but were not found for specific cognitive abilities scores. The findings suggest substantial genetic continuity for general, but not specific, cognitive ability from early childhood to adulthood.

20. Plomin, R., Loehlin, J. C., & DeFries, J. C. (1985). Genetic and environmental components of "environmental" influences. Developmental Psychology, 21, 391-402.

We suggest that correlations between environmental measures and child behavior often have both genetic and environmental components, and we propose a simple model to test this hypothesis. Data from classical adoption studies and new data from the CAP are used to illustrate the model and to provide quantitative estimates of the genetic and environmental components of environment_behavior correlations. The genetic components of these so_called environmental correlations are fully as large as the environmental components. Implications of the model for developmental research are discussed.

21. Thompson, L. A., Plomin, R., & DeFries, J. C. (1985). Parent-infant resemblance for general and specific cognitive abilities in the Colorado Adoption Project. Intelligence, 9, 1-13.

Parent_offspring correlations between 12_month Bayley MDI factors and parental cognitive abilities suggest only minimal relationships between infant mental ability and either parental IQ or specific abilities. At 24 months, more parent_offspring resemblance was present between biological parents and their adopted_away infants and between nonadoptive parents and their infants, suggesting some genetic continuity from infancy to adulthood.

22. Dunn, J., & Plomin, R. (1986). Determinants of maternal behaviour towards 3-year-old siblings. British Journal of Developmental Psychology, 4, 127-137.

The marked differences between siblings brought up together within the same family have been attributed to differential maternal treatment of the children. In a study of 44 sibling pairs from the Colorado Adoption Project, mothers' behavior towards each of two siblings was videotaped in their home when the children were 36 months of age. Mothers were found to be consistent in affectionate, verbal, and controlling behavior to the siblings, but there was no stability in mothers' verbal or controlling behavior to the same child between 24 and 36 months. The importance of a child's developmental stage as an influence on maternal behavior is discussed in relation to the development of differences between the siblings.

23. Dunn, J., Plomin, R., & Daniels, D. (1986). Consistency and change in mothers' behavior toward young siblings. Child Development, 57, 348-356.

The question of how consistently mothers treat their different children was examined in a study of 45 sibling pairs from the CAP in which each child was videotaped interacting at home with the mother at 12 and 24 months of age. The results showed mothers to be consistent in affection and verbal responsiveness but to differ in their controlling behavior. Comparison of the same mother's behavior toward each of the two siblings at 12 and at 24 months showed little stability in maternal behavior toward the same child at these two ages.

24. LaBuda, M. C., DeFries, J. C., Plomin, R., & Fulker, D. W. (1986). Longitudinal stability of cognitive ability from infancy to early childhood: Genetic and environmental etiologies. Child Development, 57, 1142-1150.

A path model of genetic and shared family environmental transmission was fitted to general cognitive ability data from 1_, 2_, 3_, and 4_ year_old adopted and nonadopted children and their parents in order to assess the etiology of longitudinal stability from infancy to early childhood. Stability across the years is moderate and is due mainly to influences not predicted by parental IQ.

25. Plomin, R. (1986a). Behavioral genetic methods. Journal of Personality, 54, 226-261.

Although traditional family, twin, and adoption methods have yielded important information about genetic influence on personality, newer methods are emphasized in this article. These include structural models and model_fitting, multivariate analysis, genetic change and continuity in development, shared and nonshared components of environmental variance, and genetic components of "environmental" variation.

26. Plomin, R. (1986b). Development, genetics, and psychology. Hillsdale, NJ: Lawrence Erlbaum Associates.

"This book is based on two simple ideas. The first is that genes are involved in change as well as continuity in development. The second is that the best way to study effects of environment on behavior is through the study of genetic influences, employing the theory and methods of quantitative genetics . . . Research in developmental behavioral genetics has just begun; nonetheless, significant advances have been made and these have important implications for developmental psychologists. The approach of behavioral genetics is highly empirical, an orientation that is reflected in this book. I do not attempt to argue or persuade as much as to present methods and data that I hope speak for themselves." (from the Introduction)

27. Plomin, R.(1986c). Multivariate analysis and developmental behavioral genetics: Developmental change as well as continuity. Behavior Genetics, 16, 25-43.

The relationship between multivariate and longitudinal analyses is discussed, the meaning of age_to_age genetic change is examined at the level of molecular genetics as well as quantitative genetics, and the implications of age_to_age genetic change for familial resemblance are considered in the context of parent_offspring data from the CAP. The point is made that the CAP can be viewed as an "instant" longitudinal study from infancy to adulthood.

28. Plomin, R., & Daniels, D. (1986). Developmental behavioral genetics and shyness. In W. H. Jones, J. M. Cheek, & S. R. Briggs (Eds.), Shyness: Perspectives on research and treatment (pp. 63-80). New York: Plenum.

Heredity plays a larger role in shyness than in other personality traits. The purpose of this chapter is to review evidence concerning the etiology of individual differences in shyness and to consider conceptual and clinical implications of findings that indicate genetic influence.

29. Rice, T., Corley, R., Fulker, D. W., & Plomin, R. (1986). The development and validation of a test battery measuring specific cognitive abilities in four-year-old children. Educational and Psychological Measurement, 46, 699-708.

A battery of nine tests to assess verbal, spatial, perceptual speed, and memory abilities in children at age 4 was constructed and administered to 267 children participating in the CAP. Exploratory and confirmatory factor analyses revealed four correlated factors that adequately describe the covariation among the tests. The reliable measurement of these specific cognitive abilities in preschool children facilitates analyses of familial resemblance and longitudinal comparisons.

30. Rice, T., Fulker, D. W., & DeFries, J. C. (1986). Multivariate path analysis of specific cognitive abilities in the Colorado Adoption Project. Behavior Genetics, 16, 107-125.

A multivariate path model of genetic and environmental transmission was fitted to specific cognitive abilities data and evaluated using a maximum_likelihood estimation procedure. Analyses of the structures of genetic and environmental correlation matrices indicated a strong genetic general factor and a similar but weaker environmental factor. Inspection of the genetic transmission parameters suggests that genetic continuity between early childhood and adulthood may be substantial for verbal ability, spatial ability, and perceptual speed.

31. Thompson, L. A., Fulker, D. W., DeFries, J. C., & Plomin, R. (1986). Multivariate genetic analysis of "environmental" influences on infant cognitive development. British Journal of Developmental Psychology, 4, 347-353.

A multivariate path model of the relationship between environmental measures and measures of infant cognitive development was tested. A maximum_likelihood estimation procedure produced a highly satisfactory fit of the model to the data. The results obtained from fitting a series of simplified models indicate that environmental variables have significant influences on Bayley MDI scores, language development, and a factor from the Bayley IBR termed task orientation. However, these relationships are mediated to a similar extent by hereditary influences.

32. DeFries, J. C., Plomin, R., & LaBuda, M. C. (1987). Genetic stability of cognitive development

from childhood to adulthood. Developmental Psychology, 23, 4-12.

> To assess genetic stability, a path model of genetic and family environmental transmission was fitted to general cognitive ability data from CAP families in which children were tested at 1, 2, 3, and 4 years of age, as well as to published twin correlations. In general, results of this study suggest significant and substantial genetic stability from 2, 3, and 4 years of age to adulthood.

33. Kent, J., & Plomin, R. (1987). Testing specific cognitive abilities by telephone and mail. Intelligence, 11, 391-400.

> The two goals of this research were to develop a brief battery of tests of specific cognitive abilities that can be administered via telephone to adolescents and to assess the psychometric properties of the battery. In a sample of 212 adolescents from 10 to 15 years of age, factor analyses supported the hypothesized structure of verbal, spatial, perceptual speed, and memory abilities. The median test_retest correlation was .77.

34. Plomin, R. (1987a). Developmental behavioral genetics and infancy. In J. Osofsky (Ed.), Handbook of infant development (2nd ed., pp. 363-417). New York: Wiley_Interscience.

> The research reviewed in this chapter serves to provide an inkling of the heuristic value of developmental behavioral genetics for understanding individual differences in infancy. Because the amount of developmental behavioral genetic research in infancy is minuscule most of this potential is as yet unrealized. Nonetheless, some exciting conclusions__or at least hypotheses for future research__are beginning to emerge.

35. Plomin, R. (1987b). The nature and nurture of cognitive abilities. In R. Sternberg (Ed.), Advances in the psychology of human intelligence (Vol. 4, pp. 1-33). Hillsdale, NJ: Lawrence Erlbaum Associates.

> During the past decade, recognition and acceptance of a role for genetics in complex human behavior, including intelligence, have increased dramatically. Indeed, we may be nearing the time when it will become important to prevent the pendulum of fashion from swinging too far in the direction of genetic influence. The purpose of this chapter is to review new findings from the field of behavioral genetics that demonstrate a critical point: Behavioral genetic research provides strong evidence for the importance of environmental influences as well as genetic influence on individual differences in cognitive abilities, and it suggests new ways to think about these environmental influences.

36. Plomin, R., & Daniels, D. (1987a). Why are children in the same family so different from one another? Behavioral and Brain Sciences, 10, 1-16.

> One of the most important findings that has emerged from human behavioral genetics involves the environment rather than heredity, providing the best available evidence for the importance of environmental influences on personality, psychopathology, and cognition. The research also converges on the remarkable conclusion that these environmental influences make two children in the same family as different from one another as are pairs of children selected randomly from the population. The article has three goals: (1) to describe

quantitative genetic methods and research that lead to the conclusion that nonshared environment is responsible for most environmental variation relevant to psychological development, (2) to discuss specific nonshared environmental influences that have been studied to date, and (3) to consider relationships between non_shared environmental influences and behavioral differences between children in the same family.

37. Plomin, R., & Daniels, D. (1987b). Children in the same family are very different, but why? Behavioral and Brain Sciences, 10, 44-54.

The above BBS target article elicited a record response; the purpose of the present article is to respond to 32 published commentaries. There is a consensus that children in the same family are very different from one another. There is also general agreement that most of the environmental variance is of the nonshared variety. So, the question now is, "Why?"

38. Plomin, R., & Fulker, D. W. (1987). Behavioral genetics and development in early adolescence. In R. M. Lerner & T. T. Foch (Eds.), Biological_psychosocial interactions in early adolescence: A life-span perspective (pp. 63-94). Hillsdale, NJ: Lawrence Erlbaum Associates.

Until recently, behavioral genetic research has not often been developmental in orientation, and early adolescence has received remarkably little attention. Although very few studies have focused on early adolescence, this review of behavioral genetic data from middle childhood, late adolescence, and early adulthood lead to the hypothesis that individual differences in early adolescence will show substantial and perhaps increasing genetic influence for cognition and personality as well as for other characters more specific to adolescence.

39. Plomin, R., & Thompson, L. A. (1987). Life-span developmental behavioral genetics. In P. B. Baltes, D. L. Featherman, & R. M. Lerner (Eds.), Life-span development and behavior (Vol. 8, pp. 1-31). Hillsdale, NJ: Lawrence Erlbaum Associates.

The exciting possiblities of combining developmental behavioral genetics and life_span developmental psychology are explored in this chapter. The first half of the chapter consists of a description of quantitative genetic theory and methods that underlie developmental behavioral genetics. In the second half of the chapter, mutual interests of developmental behavioral geneticists and life_span developmental psychologists are discussed, and relevant research is summarized in terms of broad principles of life_span developmental behavioral genetics.

40. Bergeman, C. S., & Plomin, R. (1988). Parental mediators of the genetic relationship between home environment and infant mental development. British Journal of Developmental Psychology, 6, 11-19.

The extensive CAP battery was searched for aspects of parental behavior that underlie genetic mediation of environment_development associations in nonadoptive families. Surprisingly, the results indicated that partialing out parental SES, education, IQ, specific cognitive abilities, and major dimensions of personality had little effect on the HOME_Bayley relationship in either nonadoptive or adoptive families. Criteria are offered to guide the search for parental factors that can explain genetic mediation of the HOME_ Bayley relationship.

41. Bergeman, C. S., Plomin, R., DeFries, J. C., & Fulker, D. W. (1988). Path analysis of general and specific cognitive abilities in the Colorado Adoption Project: Early childhood. Personality and Individual Differences, 9, 391-395.

> A path model was fitted to CAP parent_offspring data on general and specific cognitive abilities for adopted and nonadopted children at 3 and 4 years of age. Genetic influence is significant for general cognitive ability at both 3 and 4 years of age; moreover, genetic influence is also significant for spatial ability at both 3 and 4 years, for verbal ability at 3, and for perceptual speed at 4. Thus, there is at least some genetic continuity between early childhood and adulthood as well as some genetic differentiation for specific cognitive abilities.

42. Fulker, D. W. (1988). Genetic and cultural transmission in human behavior. In B. S. Weir, E. J. Eisen, M. M. Goodman, & G. Namkoong (Eds.), Proceedings of the second international conference on quantitative genetics (pp. 318-340). Sunderland, MA: Sinauer.

> A brief outline of the principles of path analysis is followed by a detailed account of models of multivariate assortative mating using the method of copaths. This approach is an improvement on earlier ones and permits a more flexible modeling of multivariate CAP data. Preliminary analyses of IQ data on CAP 7_year_olds are reported, and results are compared to those obtained at ages 1, 2, 3, and 4. The main finding is increasing heritability and decreasing impact of the home environment with age.

43. Fulker, D. W., DeFries, J. C., & Plomin, R. (1988). Genetic influence on general mental ability increases between infancy and middle childhood. Nature, 336, 767-769.

> Path analysis was employed to assess the genetic and environmental etiologies of individual differences in general cognitive ability during development from infancy to middle childhood. Observed covariance matrices were computed and then equated to their expectations using a maximum_likelihood estimation procedure. A simple linear model was assumed in which latent variables representing additive genetic values and environmental deviations cause variation in phenotypic values. The model was fitted to data from parents and children at each of five ages__1, 2, 3, and 4 years of age and during the summer after their first year in primary school (average age, 7.4 years). Analyses revealed increasing heritable variation of general cognitive ability from 1 to 7 years of age. In contrast to the pattern of increasing heritable influence, estimates of cultural transmission increased between 1 and 3 years of age, but then decreased at 7.4 years. These results provide the best evidence to date for the increasing importance of the genetic etiology of individual differences in cognitive ability between infancy and middle childhood. In contrast, the direct effects of parental intelligence upon the child's environment, especially after one year in primary school, appear to be relatively small.

44. Plomin, R., DeFries, J. C., & Fulker, D. W. (1988). Nature and nurture in infancy and early childhood. New York: Cambridge University Press.

> The goal of this second book emanating from the CAP is to consider the development of individual differences in behavioral development during infancy and early childhood as illuminated by the theory and methods of quantitative

genetics. Quantitative genetics provides a general theory of the development of individual differences that leads to novel concepts and research relevant to the study of change as well as continuity during development. It also provides powerful methods to address concepts of change and continuity, including model_fitting approaches that test the fit between a specific model of genetic and environmental influences and observed correlations among family members. Longitudinal quantitative genetic research is essential to study developmental change and continuity; the largest and longest longitudinal adoption study is the Colorado Adoption Project, in which data eventually will be collected on children from 1 through 16 years of age.

45. Rice, T., Fulker, D. W., DeFries, J. C., & Plomin, R. (1988). Path analysis of IQ during infancy and early childhood and an index of the home environment in the Colorado Adoption Project. Intelligence, 12, 27-45.

A parent_offspring adoption path model, which includes a measured index of the home environment, was formulated to assess the extent to which relationships between the environmental index and children's behavior are mediated by genetic and environmental influences of the parents. In addition to the direct effect of the home environment on children's behavior, three types of indirect effects mediated by parental phenotype are considered: a pure environmental effect, a pure genetic effect, and a combined environmental- genetic effect. The model was fitted to CAP parent_offspring IQ data and an environmental index based on the Caldwell HOME inventory. Four sets of data, including the HOME index and offspring IQ measured longitudinally at 1, 2, 3, and 4 years of age, were analyzed. The results suggest that in infancy (ages 1 and 2), the HOME reveals a direct environmental effect on children's IQ as well as indirect effects mediated by parental IQ. Surprisingly, during early childhood (ages 3 and 4), the relationship between the HOME and children's IQ is due only to indirect parental mediation. Moreover, other than at year 1, the mediation is purely genetic.

46. Thompson, L. A., Fulker, D. W., DeFries, J. C., & Plomin, R. (1988). Multivariate analysis of cognitive and temperament measures in 24-month-old adoptive and nonadoptive sibling pairs. Personality and Individual Differences, 9, 95-100.

The genetic and environmental etiologies of covariation among measures of temperament, cognition, and language development were assessed at 24 months of age in 66 adoptive and 70 nonadoptive sibling pairs. Genetic influences are important for the cognitive and language development measures, but not for the temperament measures. Little or no evidence was found for shared environmental influences for any of the measures.

47. Thompson, L. A., & Plomin, R. (1988). The Sequenced Inventory of Communication Development: An adoption study of 2 and 3-year-olds. International Journal of Behavioral Development, 11, 219-231.

The etiology of individual differences in communicative development is explored using data from 226 adoptive and 224 nonadoptive families in the Colorado Adoption Project. Sibling correlations for the SICD and cross_correlations for the SICD and IQ in related and unrelated pairs indicate that performance on the SICD is genetically influenced and that the relationship between the SICD and IQ at 2 and 3 years is, in part, genetically mediated. At 2 and 3 years of age, SICD scores are related to parental intelligence and verbal ability, and this relationship is partially determined by family environmental factors at both ages. At 3 years of age, the SICD scores of adopted children correlate significantly with their biological mothers' IQ.

48. Vogler, G. P., & Fulker, D. W. (1988). Human behavior genetics. In J. Nesselroade & R. B. Cattell (Eds.), *Handbook of multivariate experimental psychology* (pp. 475-503). New York: Plenum.

The multivariate extension of path analysis is described in detail, and its application to a number of behavioral genetic designs is illustrated with CAP and other data. This paper provides a definitive account of multivariate path analysis for psychologists as well as for behavioral geneticists.

49. Cyphers, L. H., Fulker, D. W., Plomin, R., & DeFries, J. C. (1989). Cognitive abilities in the early school years: No effects of shared environment between parents and offspring. Intelligence, 13, 369-386.

It was predicted that verbal and spatial abilities, but not perceptual speed and memory, would show significant genetic influence at 7 years of age. To test this hypothesis, specific cognitive abilities were compared for biological, adoptive, and nonadoptive parents and their 163 adopted and 142 nonadopted children tested at 7 years of age as part of the longitudinal Colorado Adoption Project. Model_fitting analyses supported the hypothesis of significant genetic influence on verbal and spatial abilities but not on perceptual speed and memory. These results imply the existence of some genetic continuity from the early school years to adulthood for verbal and spatial abilities. In addition, genetic influence of parents on their children appears to increase from early childhood to middle childhood, accounting for about 25% of the variance of verbal and spatial abilities at 7 years. In contrast, environmental resemblance between parents and offspring were found to be nonsignificant for all four specific cognitive abilities as well as for a composite score representing general cognitive ability. Such shared environmental influence between parent and child accounts for less than 1% of the variance at 7 years.

50. Phillips, K. (1989). Delta path methods for modeling the effects of multiple selective associations in adoption designs. Behavior Genetics, 19, 609-620.

In analyses of family data, multiple direct association processes can be modeled by use of delta path methods, especially the transitivity principle. The method is described for the case of an adoption study involving potential selective matching of adoptive parents to two sets of biological parents of adopted offspring in the presence of assortative mating for both wed and unwed couples. Second and third order delta paths may be derived by application of the transitivity principle, and these higher order paths are very convenient in formulating expectations that are due to direct and indirect association processes. Expectations are derived for resemblance among all adults in this three_couple adoption system; examples are given also for deriving parent_offspring expectations to illustrate the general use of higher order delta paths in structural models of familial resemblance. Matrix notation is employed in order to facilitate the application of the methods indevelopmental and/or multivariate models.

51. Phillips, K., & Fulker, D. W. (1989). Quantitative genetic analysis of longitudinal trends in adoption designs with application to IQ in the Colorado Adoption Project. Behavior Genetics, 19, 621-658.

A factor model is presented that provides for either multivariate or developmental specification of longitudinal genetic and environmental effects in the presence of assortative mating and cultural transmission. Delta path methods are employed for the treatment of assortative mating and selective placement effects. The proportions of genetic and environmental variance and covariance attributable to assortative mating and cultural transmission are modeled explicitly. The model was applied to cognitive ability data on 493 CAP families by means of maximum_likelihood pedigree analysis. A test of the assumption of multivariate normality of error provided an additional model criterion beyond the log_likelihood ratio statistic. No significant effects were found for cultural transmission, genetic_environmental covariance, or selective placement. The results suggest that the phenotypic stability of IQ during early childhood is largely, if not entirely, genetic in origin and that these longitudinal genetic effects can be represented most parsimoniously in the form of developmental transmission.

52. Plomin, R. (1989). Developmental behavioral genetics: Stability and instability. In M. H. Bornstein & N. A. Krasnegor (Eds.), Stability and continuity in mental development (pp.273-291). Hillsdale, NJ: Lawrence Erlbaum Associates.

The goal of this chapter is to introduce developmental behavioral genetics, a subdiscipline of behavioral genetics that applies its theory and methods to the study of development. Developmental behavioral genetics provides a perspective for understanding the genetic and environmental origins of stability and change in individual differences during development.

53. Plomin, R. (1989). Nature and nurture in the family. In K. Kreppner & R. M. Lerner (Eds.), Family systems and life_span development (pp.129-148). Hillsdale, NJ: Lawrence Erlbaum Associates.

Interesting and important implications follow from the fact that parents and their children share nature as well as nurture. This chapter explores some of the ways in which a behavioral genetic perspective stimulates fresh ways of thinking about and studying family systems.

54. Plomin, R., & Loehlin, J. C. (1989). Direct and indirect IQ heritability estimates: A puzzle. Behavior Genetics, 19, 331-342.

Direct estimates of IQ heritability based on a single family relationship such as adopted_apart relatives are often 50% greater than indirect estimates that rely on differences in correlations such as the classical twin method or nonadoptive_adoptive comparisons. Factors such as nonadditive genetic variance, assortative mating, selective placement, measurement error, age differences, and genotype_environment correlation and interaction do not obviously explain the difference between direct and indirect IQ heritability estimates. Because direct estimates are derived from separated individuals and indirect estimates are derived from individuals reared together in families, some aspect of the within_family environment seems a likely candidate but its exact nature remains to be understood.

55. Plomin, R., & Stocker, C. (1989). Behavioral genetics and emotionality. In J.S. Reznick (Ed.) Perspectives on behavioral inhibition (pp. 219-239). Chicago Press: Chicago, IL.

A review of behavioral genetic research relevant to behavioral inhibition, specifically research on the fearfulness component of emotionality. Behavioral genetic studies of emotionality/ fearfulness are likely to be relevant.

56. Rice, T., Carey, G., Fulker, D. W., & DeFries, J. C. (1989). Multivariate path analysis of specific cognitive abilities in the Colorado Adoption Project: Conditional path model of assortative mating. Behavior Genetics, 19, 195-207.

A multivariate path model of genetic and environmental transmission employing a conditional path representation of assortative mating was fitted to specific cognitive abilities data from the CAP and was evaluated using a maximum_likelihood estimation procedure. In agreement with results obtained from a previous analysis of a smaller data set, significant genetic covariation among the cognitive variables was indicated and evidence for a general genetic factor was found. However, cultural transmission parameters are nonsignificant and environmental correlations among the measures are relatively small.

57. Stocker, C., Dunn, J., & Plomin, R. (1989). Sibling relationships: Links with child temperament, maternal behavior, and family structure. Child Development, 60, 715-727.

The extent to which maternal behavior, children's temperament, age, and family structure variables__jointly and independently are associated with dimensions of sibling relationships was investigated in a sample of 96 families with younger siblings aged 3_6 years and older siblings aged 5_10 years. During home visits, mothers were interviewed and observed with their children in structured and unstructured settings. Together the four sets of predictor variables accounted for 22%_40% of the variance in measures of the sibling relationship. Maternal behavior (particularly differences in mothers' behavior toward their two children), child temperament, and younger siblings' age added independently to the prediction of sibling relationships. Family structure variables were less important in accounting for variance in sibling relationships than were the other groups of predictors. The implications of these findings for understanding differences in siblings' relationships in early and middle childhood are discussed.

58. Cardon, L. R., DiLalla, L. F., Plomin, R., DeFries, J. C., & Fulker, D. W. (1990). Genetic correlations between reading performance and IQ in the Colorado Adoption Project. Intelligence, 14, 245-257.

A multivariate conditional path model was fitted to general cognitive ability and reading performance data obtained from members of 199 adoptive families and 120 nonadoptive families. Measures include Wechsler-R Full-Scale, Verbal, and Performance IQ scores and Peabody Individual Achievement Test (PIAT) Reading Recognition scores for both parents and 7-year-old offspring. Results of model-fitting analyses provide evidence for moderate phenotypic correlations between the PIAT and IQ measures, substantial heritability for IQ and Reading Recognition, and large genetic correlations among the traits, particularly with respect to Verbal IQ and Reading Recognition. Thus, IQ-academic achievement relationships may be largely due to genetic influences.

59. Coon, H., Carey, G., & Fulker, D. W. (1990). A simple method of model fitting for adoption data. Behavior Genetics, 20, 385-404.

Traditional models used with adoption data often make strong assumptions concerning the nature of genetic transmission and assortive mating. A simple model is presented which avoids these assumptions. The model is linearized and, thus, has the further advantage that it can be used with standard statistical packages such as LISREL or EQS. The model allows tests of the internal consistency of the data, in addition to tests of the relative strength of genetic and environmental transmission parameters. To illustrate the model, measures of general cognitive ability in parents and their 7-year-old children from the Colorado Adoption Project (CAP) were fit to the model using the LISREL program. This relatively simple model may be expanded to incorporate more complex designs involving multiple measures or siblings. Although the model will not always allow constraints on the parameter estimates in more complex models, it offers a quick, flexible method for initial exploration of adoption data.

60. Coon, H., Fulker, D. W., DeFries, J. C., & Plomin, R. (1990). Home environment and cognitive ability in 7-year-old children in the Colorado Adoption Project: Genetic and environmental etiologies. Developmental Psychology, 26, 459-468.

Aspects of the family environment have been shown to affect childhood cognitive abilities, both directly through parent-offspring environmental transmission and indirectly through correlations with parental genotypes. The relative importance of such effects can be determined by means of model_fitting techniques. These relationships were investigated using measures of the home environment taken from infancy through 7 years of age as predictors of childhood cognitive ability at age 7. Specific aspects of the home environment, including activity_recreation orientation measured by Moos' FES scales and organized environment measured by the Caldwell HOME inventory, were found to have significant direct environmental effects on 7_year_old cognitive ability as measured by the WISC_R full_scale IQ score. However, indirect genetic mediation of most of the measures of the home environment investigated appeared to be of greater importance to cognitive ability.

61. Corley, R. P., & Fulker, D. W. (1990). What can adoption studies tell us about cognitive development? In M. Hahn, J. Hewitt, N. Henderson, & R. Benno (Eds.), Developmental behavioral genetics and evolution. (236-265). New York: Oxford University Press.

A review of adoption studies is provided from the point of view of cognitive development. The first attempt to develop a truly longitudinal model is described and is applied to parent_offspring analyses of IQ data on CAP children from 1 to 7 years of age. The analyses revealed that the increasing heritability with age found in earlier analyses of CAP data is largely the result of increasing genetic correlation with adult genotype as children approach 7 years of age. Data from other studies such as the Louisville Twin Study and the Hawaii Family Study of Cognition were combined with CAP data to estimate model parameters.

62. Dunn, J., Stocker, C., & Plomin, R. (1990 a). Assessing the relationship between young siblings. Journal of Child Psychology and Psychiatry, 31, 983-991.

> A report of an examination of sibling relationships as assessed by maternal interview, by videotaped observation in structured and semi-structured situations, and by naturalistic observation in unstructured settings. The different approaches to assessment were compared with data on 84 sibling pairs aged between 3 and 10 years. Test-retest reliabilities, assessed on 30 pairs studied on a second occasion, were good for maternal interview information, moderate for videotaped observations, and mixed for naturalistic observations. Independent positive and negative dimensions of the relationship were revealed by each method, and moderate agreement found between methods. Naturalistic observations of 30 minutes' duration were unsuitable for studying the negative aspects of the relationship.

63. Dunn, J., Stocker, C., & Plomin, R. (1990 b). Nonshared experiences within the family: Correlates of behavioral prolems in middle childhood. Development and Psychopathology, 2, 113-126.

> Sibling resemblance for psychopathology appears to be genetic rather than environmental in origin; environmental influences that affect the development of psychopathology must be nonshared and make children in the same family different rather than similar. Maternal interview and observations of differential maternal and sibling behavior were compared wthin 67 sibling dyads (younger and older siblings aged 4 and 7 years, respectively, on average), and differential experiences were related to the adjustment of the older sibling, as assessed by mother and teacher. Differential maternal behavior appeared to be particularly important as a predictor of adjustment problems. Older siblings showed internalizing problems in families in which mothers were less affectionate to the older than to the younger sibling. Greater maternal control toward the older than the younger sibling predicted both internalizing and externalizing problems.

64. Plomin, R. (1990). The role of inheritance in behavior. Science, 248, 183-188.

> Inheritance plays a major role in behavior as shown by selection and strain studies for animal behavior and by twin and adoption studies for human behavior. Unlike simple Mendelian characteristics, genetic variance for behavioral dimensions and disorders rarely accounts for more than half of the phenotypic variance, and multiple genes with small effects appear to be involved rather than one or two major genes. Genetic research on behavior will be transformed by techniques of molecular biology that can be used to identify DNA sequence responsible for behavioral variation. However, the importance of nongenetic factors and the multigenetic control of behavior require new strategies to detect DNA markers that account for small amounts of behavioral variation.

65. Plomin, R., Corley, R., DeFries, J. C., & Fulker, D. W. (1990). Individual differences in television viewing in early childhood: Nature as well as nurture. Psycological Science, 1, 371-377.

> We present results from the first parent-offspring and sibling adoption analyses of individual differences in time spent watching television in early childhood,

and we consider IQ and temperment as possible mechanisms of genetic influence. The sample consisted of over 220 adopted children studied at 3, 4, and 5 years of age; the complete sample of probands. Also assessed are the adoptees' biological and adoptive parents, matched nonadoptive families and younger adoptive and nonadoptive siblings. Both the parent-offspring and sibling adoption designs yielded evidence for significant genetic influence on individual differences in children's television viewing. Neither IQ nor temperament appear to be responsible for this genetic influence.

66. Plomin, R., & Nesselroade, J. R. (1990). Behavior genetics and personality change. Journal of Personality, 58, 191-220.

In this article, the authors review personality research on age differences in heritability and propose the counter-intuitive hypothesis that, when developmental changes in heritability are found, heritability tends to increase. Research to date suggests that genetic involvement in adult personality is slight whereas personality change in childhood is governed substantially by genetic factors.

67. Plomin, R., Nitz, K., & Rowe, D. C. (1990). Behavioral genetics and aggressive behavior in childhood. In M. Lewis & S. M. Miller (Eds.), Handbook of developmental psychopathology. New York; Plenum Press.

Behavioral genetics has contributed to the study of psychopathology, provided a theory of individual differences in behavioral pathology, devised methods that can disentangle the influence of nature and nurture, and produced data conclusive to hereditary influences in psychopathology. This chapter introduces developmental behavioral genetics, using aggressive behavior in childhood. Prior to reviewing relevant behavioral genetic research two prerequisite issues are discussed: the normal distribution of individual differences and quantitative genetics.

68. Cardon, L. R., Fulker, D. W., & Jöreskog, K. G. (1991). A LISREL 8 model with constrained parameters for twin and adoptive families. Behavior Genetics, 21, 327-350.

This methodological paper describes a LISREL model of parental transmission for use with twin and/or adoptive family data. The model incorporates genetic and environmental constraints due to assortative mating or cultural transmission.

69. Plomin, R., & Bergeman, C. S. (1991a). The nature of nurture: Genetic influence on "environmental" measures. Behavioral and Brain Sciences, 14, 373-414. (With open peer commentary)

Recent twin and adoption studies indicate substantial genetic influence when measures of the environment are treated as phenotypes in genetic analyses. Genetic influence has been documented for measures as diverse as videotaped observations of parental behavior toward their children, ratings by parents and children of their family environment, and ratings of peer groups, social support, and life events. The goal of this article is to document and discuss these findings and to elicit commentary that might help to shape the course of research on this topic.

70. Plomin, R., & Bergeman, C. S. (1991b). The nature of nurture: Genetic influence on "environmental" measures. Behavioral and Brain Sciences, 14, 414-424.

Response to commentaries to target article.

71. Plomin, R., Coon, H., Carey, G., DeFries, J. C., & Fulker, D. W. (1991). Parent-offspring and sibling adoption analyses of parental ratings of temperament in infancy and childhood. Journal of Personality, 59, 705-732.

This paper presents parent-offspring comparisons for temperament (emotionality, activity, sociability, and impulsivity) for adopted and nonadopted children yearly from 1 to 7 years of age and their biological, adoptive, and nonadoptive parents. Also presented are correlations for adoptive and nonadoptive siblings when each child was 1, 2, 3, and 4 years of age. In contrast with twin results, little evidence is found for genetic influence. The average correlation between biological parents and their adopted-away children for data averaged over the 7 years is only .03. Similarly, the average parent-offspring correlation in nonadoptive families (.08) is no greater than in adoptive families (.12). Results for nonadoptive and adoptive siblings also indicate little genetic influence. The difference between the twin and adoption results may be due to environmental effects or to nonadditive genetic variance.

72. Plomin, R., & Rende. R. (1991). Human behavorial genetics. Annual Review of Psychology, 42, 161-190.

This article reviews human behavioral genetic research published or in press in 1988 or 1989. Focus is on three major domains of human behavioral genetic research--cognitive abilities and disabilities, personality, and psychopathology--as well as two themes considered in more detail--what behavioral genetics tells us about the environment, and what molecular genetics can tell us about behavior.

73. Plomin, R., Rende, R., & Rutter, M. (1991). Quantitative genetics and developmental psychopathology. In D. Cicchetti & S. Toth (Eds.), Rochester symposium on developmental psychopathology (Vol. 2): Internalizing and externalizing expressions of dysfunction (pp. 155-202). Hillsdale, NJ; Lawrence Erlbaum Associates.

The goal of this chapter is to show that the potential impact of quantitative genetics on developmental psychopathology is enormous. General themes relevant to the application of genetics to developmental psychopathology are discussed in order to guide the exploration of this largely uncharted territory.

74. Rende, R. D., & Plomin, R. (1991). Child and parent perceptions of the upsettingness of major life events. Journal of Child Psychology and Psychiatry, 32, 627-633.

An adaptation of the Coddington Social Readjustment Rating Scale for use with first-grade children was administered to 164 children and their parents. Parents indicated whether each event occurred and parents and their children rated the upsettingness to the child. Parent ratings of stress are significantly higher than child ratings for specific events and a composite stress measure. Parent and child composite scores correlated 0.21 when the number of events was controlled. Implications for research on life events and childhood stress are discussed.

75. Thompson, L. A., Fagan, J. F., & Fulker, D. W. (1991). Longitudinal prediction of specific cognitive abilites from infant novelty preference. Child Development, 62, 530-538.

> A test of visual novelty preference, the Fagan Test of Infant Intelligence, was administered to a group of 113 full-term infants at 5 and 7 months of age. The infants were followed longitudinally, at ages 1, 2, and 3. One novelty preference score was obtained for each infant by averaging across the 2 test ages. Novelty preference correlated significantly with 36-month Binet IQ, the first unrotated principle component from the cognitive battery, and the 24-month Bayley MDI score. Novelty preference was also compared to specific abilities at all 3 follow-up ages. Partial correlations suggest that novelty preference predicts language and memory independent of IQ. Overall, the results indicate that novelty preference during the first year of life not only predicts later IQ but may also reflect specific cognitive processes.

76. Braungart, J. M., Plomin, R., DeFries, J. C., & Fulker, D. W. (1992). Genetic influence on tester-rated infant temperament as assessed by Bayley's Infant Behavior Record: Nonadoptive and adoptive siblings and twins. Developmental Psychology, 28, 40-47.

> Results are reported for the 1st sibling adoption study of temperament in infancy, using tester ratings on the Infant Behavior Record (IBR) at 1 and 2 years for a sample of 95 pairs of nonadoptive siblings and 80 pairs of adoptive siblings. Twin data are reported by Matheny (1980) for 85 identical (MZ) and 50 fraternal (DZ) twin pairs on the same measure at the same ages were combined with the sibling adoption data for 3 IBR factors (affect-extraversion, activity, and task orientation). Both the sibling adoption and twin data yielded evidence or significant genetic influence for the 3 IBR factors at 12 and 24 months.

77. Braungart, J. M., Plomin, R., & Fulker, D. W. (1992). Genetic influence on the home environment during infancy: A sibling adoption study of the HOME. Developmental Psychology, 28, 1048-1055.

> The current investigation examined resemblance of 105 nonadoptive and 85 adoptive sibling pairs on an objective measure of the environment (HOME). Each sibling's home environment was separately assessed at 12 and 24 months of age. Nonadoptive sibling correlations were greater than those for adoptive sibling pairs at both ages, suggesting genetic influence in the HOME. Model-fitting analyses led to an estimate that about 40% of the variance of the HOME is genetic in origin.

78. Cardon, L. R., Corley, R. P., DeFries, J. C., Plomin, R., & Fulker, D. W. (1992). Factorial validation of a telephone test battery of specific cognitive abilities. Personality and Individual Differences, 13, 1047-1050.

> The factor structure of eight specific cognitive ability tests administered using a traditional paper-and-pencil protocol to 529 children at 7 years of age is compared to that of similar measures administered using the telephone to a subsample of these children at 9 and 10 years. Results of exploratory factor analyses suggest that both test batteries assess the same four ability dimensions: verbal, spatial, perceptual speed, and memory. Confirmatory factor analyses revealed that the factor loadings do not differ between the two test batteries, thus

indicating that telephone tests are factorially valid measures of specific cognitive abilities.

79. Cardon, L. R., Fulker, D. W., DeFries, J. C., & Plomin, R. (1992a). Continuity and change in general cognitive ability from 1 to 7 years of age. Developmental Psychology, 28, 64-73.

Observed and latent sources of individual differences in cognitive development were explored in data from adopted and nonadopted siblings measured from 12 months to 7 years and identical and nonidentical twins measured from 12 to 36 months. Longitudinal path models, designed to examine the structure of observed stability and assess the genetic and environmental sources of age-to-age change and continuity, suggest that observed continuity arises from age-specific effects that persist over time and from developmental influences that are static and unchanging. Genetic influences account for the age-specific yet persistent effects, shared sibling environment effects are constant from 1 to 7 years, and nonshared environmental factors are specific to each measurement age. Thus, genetic influences are a major source of both continuity and change in mental development, whereas shared and nonshared environmental effects contribute to continuity and change, respectively.

80. Cardon, L. R., Fulker, D. W., DeFries, J. C., & Plomin, R. (1992b). Multivariate genetic analysis of specific cognitive abilities in the Colorado Adoption Project at age 7. Intelligence, 16, 383-400.

A multivariate hierarchical model of specific cognitive abilities was fitted to data from 7-year-old adopted and nonadopted sibling pairs in order to assess differential genetic influence on specific mental abilities. Model fitting results and Schmid-Leiman (1957) transformations reveal significant heritable variation for verbal, spatial, and memory factors independent of general cognitive ability for the 8 ability tests examined. In contrast, environmental influences are primarily measure-specific. The results suggest genetic effects in middle childhood which differentially influence mental ability scores.

81. Chipuer, H. M., & Plomin, R. (1992). Using siblings to identify shared and non-shared HOME items. British Journal of Developmental Psychology, 10, 165-178.

Although shared environmental factors affect cognitive development during childhood, non-shared environmental factors experienced differently by children in the same family appear to be the major source of environmental influence on cognitive development after childhood. However, specific shared and non-shared aspects of environmental measures relevant to cognitive development have not been differentiated. Data for 92 sibling pairs, studied separately when each child was 12 and 24 months of age, were used to construct a non-shared scale and a shared scale from items of the Home Observation for Measurement of the Environment (HOME). Items that were not significantly correlated for siblings were selected as 'non-shared' items; the remaining items were selected as 'shared' items.

82. Coon, H., Carey, G., Corley, R., & Fulker, D. W. (1992). Identifying children in the Colorado Adoption Project at risk for conduct disorder. Journal of the American Academy of Child and

Adolscent Psychiatry, 31, 503-511.

Clustering techniques were used to identify a subsample of young adopted and nonadopted children at risk for conduct disorder. Although data from both boys and girls were analyzed, a cluster of girls large enough for subsequent statistical analysis could not be identified; therefore, results are reported for boys only. Identifying measures were selected based on the DSM-III-R diagnostic criteria. Cluster analyses confirmed the existence of a small group of boys who appeared to be significantly at risk. Subsequent parental and teacher ratings of these children verified the stability over time of the classification. The poor conduct group was significantly associated with difficult temperament in infancy, with poor conduct on the part of parents when they were youths, and with high achievement orientation in the home environment.

83. Coon, H., Carey, G., & Fulker, D. W. (1992). Community influences on cognitive ability. Intelligence, 16, 169-188.

Most "environmental" variables used in behavioral genetic research have proved to be strongly associated with parental genotype. This report discusses a second type of environmental variables called community based variables, which may have an independent effect on intellectual development in childhood. Employed was a developmental model in which many small effects of the community environment are aggregated to form a single environmental composite. Using census measures to test this model, evidence was found for a community influence above and beyond direct parental influence. The strongest association was found for characteristics of rural communinities, negatively associated with childhood IQ.

84. Corley, R.P. (1992). The Colorado Adoption Project: General Cognitive Ability and Height Data at Ages 1 to 4 Years. Behavior Genetics, 22, 225-228.

This is a brief report describing CAP data available to participants at the Human Developmental Behavior Genetics Workshop in June 1991.

85. Fulker, D. W. & Cardon, L. R. (1992) What can twins studies tell us about the structure and correlates of cognitive abilities? In T. Bouchard & P. Propping (Eds.), What are the mechanisms mediating the genetic and environmental determinants of behavior? Twins as a tool of behavioral genetics (pp 33-52). Chichester, England: John Wiley & Sons.

This paper discusses the strengths of the twin design in investigating the biological and social significance of cognitive abilities. An evolutionary perspective on IQ is also presented. How differences between individuals at the DNA level can be shown to be a cause of individual differences in IQ or any phenotype, by use of the twin design is discussed. Next, a discussion of multivariate twin analysis is presented, along with a brief history of the field with respect to specific cognitive abilities. The weaknesses of the older studies and the strengths of the current structural modelling approach are discussed. State of the art multivariate longitudinal analyses of our CAP and twin data are then presented. A longitudinal analysis of IQ yielded the conclusion that there is continuity of time-specific genetic influences from 1 through 7 years, with much new genetic variation appearing at year 7, after the child experiences the first year of schooling. There was also a small but constant influence of the family environment on continuity, while the unique environment only contributed to change across time. Next, a hierarchical analysis of specific cognitive abilities at year 7 indicated a strong unique environmental higher_order common factor, with unique environmental factors for spatial and memory abilities only. Shared environmental influences could not be detected. Genetic factors common to each of four specific cognitive abilities, in addition to genetic g factor of general intelligence were found necessary. Next, a model combining the hierarchical model of cognitive abilities at each age with the age_to_age transmission model is discussed. Finally, the integration of quantitative genetic analyses of this type with information on molecular RFLP markers to detect specific genes causing IQ is introduced.

86. Rende, R. D., & Plomin, R. (1992). Relations between first-grade stress, temperament, and behavior problems. Journal of Applied Developmental Psychology, 13, 435-446.

The goals of this study were (1) to examine relations between both child and parent reports of the child's stress in first grade and behavior problems in school, (2) to determine if school stress interacts with temperament in predicting behavior problems, and (3) to determine if gender differences were present in the pattern of relations between stress and behavior problems. Both child and parent reports of event upsettingness correlated significantly with externalizing behavior problems for boys, and with both internalizing and externalizing problems for girls. There was also evidence for interactions between first-grade stress and temperamental characteristics in predicting externalizing behavior problems. Implications for reseach on childhood stress resulting from developmentally relevant life transitions are discussed.

87. Rende, R., Slomkowski, C., Stocker, C., Fulker, D. W., & Plomin, R. (1992). Genetic and environmental influences on maternal and sibling interaction in middle childhood: A sibling adoption study. Developmental Psychology, 28, 484-490.

This study examines genetic and environmental influences on maternal and sibling interactions. Sixty-seven mother-child-child triads from nonadoptive families and 57 mother-child-child triads from adoptive families were videotaped in six play settings in their home. In addition, each sibling pair was observed in an unstructured setting in the home, and mothers completed an interview about the sibling relationship. Genetic influence was found for individual differences in sibling interactions and maternal interactions with siblings; shared environmental factors were also important. Results are discussed with respect to genetic influences on family interactions and relationships.

88. Slomkowski, C. L., Nelson, K., Dunn, J., and Plomin, R. (1992). Temperament and language: Relations from toddlerhood to middle childhood. Developmental Psychology, 28, 1090-1095.

This study examined contemporaneous and longitudinal relations between temperament and language in toddlerhood and middle childhood. Language was assessed using the Sequenced Inventory of Communicative Development in 229 children at age 2 and 212 of these children at age 3. Observers rated dimensions of the children's temperament at age 2 on the Infant Behavior Record. In addition, 164 of these children were administered a battery of language measures after completion of first grade. Affect-extraversion at age 2 made a unique contribution to individuals in both receptive and expressive language at age 3 and to receptive language skills at age 7.

89. Waldman, I. D., DeFries, J. C., & Fulker, D. W. (1992) Quantitative genetic analysis of IQ development in young children: Multivariate multiple regression with orthogonal polynomials. Behavior Genetics, 22, 229-238.

The study of psychological development has recently benefited from innovative methods for estimating and examining individual growth curves. These methods are consistent with conceptualizing development as an ongoing process rather than as discrete changes. Recent developmental behavior genetic models have focused on continuity and change in the genetic and environmental influences underlying phenotypes. In contrast, presented is a model for phenotypic development per se. The results suggested familial environmental influences on children's mean IQ for ages 1-4 but environmental influences specific to fathers' cognitive ability on children's IQ development.

90. Cardon, L. R., & Fulker, D. W. (1993). Genetics of specific cognitive abilities. In R. Plomin & G. E. McClearn (Eds.), Nature, nurture and psychology (pp.99-120). Washington, DC: American Psychological Association.

Results obtained from applications of heirarchical genetic models of intelligence provide some of the first evidence for gentic influences on specific cognitive abilities in childhood that are unrelated to those determining general cognition. Our results indicate that persistent infant genes are augmented by a novel genetic component that emerges at year 7 and continues to influence ability variation at year 9. The environmental outcomes indicate that although shared sibling environments do not exert a measurable effect in our sample, nonshared environmental factors play a large role in specific cognitive abilities.

91. Coon, H., Carey, G., Fulker, D. W., & DeFries, J. C. (1993). Influences of school environment on the academic achievement scores of adopted and nonadopted children. Intelligence, 17, 79-104.

Associations between academic achievement and characteristics of the school environment can result from direct environmental influences of the school, or from placement of children into particular school environments based on prior ability. In this study of first-grade children, measures of school environment included attending a private versus a public school, traditional versus non-traditional methods, type of discipline, fairness, and competitiveness. Several of these variables, in addition to measures of children's attitudes about school, showed direct environmental associations with reading and math achievement independent of the effects of parental IQ.

92. Fulker, D. W., Cherny, S. S., & Cardon, L. R. (1993). Continuity and change in cognitive development. In R. Plomin & G. E. McClearn (Eds.), Nature, nurture and psychology (pp. 77-98). Washington, DC: American Psychological Association.

The developmental analyses used clearly show that there is no single developmental process that determines relative intellectual ability from 1 through 9 years of age. Of the three sources of variation identified--shared environmental, unique environmental, and genetic influences--each appears to act in a rather different manner, with genetic influences showing the greatest complexity.

93. Rende, R. (1993). Longitudinal relations between temperament traits and behavioral syndromes in middle childhood. Journal of the American Academy of Child and Adolescent Psychiatry, 32, 2, 287-290.

This study tested links between temperament traits (emotionality, activity, and sociability) in infancy and early childhood with behavioral syndromes of depression, hyperactivity, and delinquency in early childhood. For boys, high emotionality in infancy and early childhood was associated with high scores on both anxiety/depression and attention problem scales. For girls, both high emotionality and low sociability predicted high scores on the anxiety/depression scale.

94. Stocker, C. (1993). Siblings' adjustment in middle childhood: Links with mother-child relationships. Journal of Applied Developmental Psychology, 14, 485-499.

Association between siblings' behavior problems and mother-child relationships were examined when older siblings were approximately 7 years old and 3 years later when younger siblings reached the same age. Children's behavior problems were positively associated with mothers' controlling behavior and negatively associated with mothers' affectionate behavior. Both "Different-age differential" maternal behavior--differences in mothers' behavior to siblings assessed at the same point in time when the siblings were different ages--and "Same-age differential" maternal behavior--differences in mothers' behavior to siblings assessed across a 3 year interval when siblings were the same age--were associated with children's adjustment. Children who received more maternal control and less maternal affection than their siblings had more behavior problems than other children. The magnitude of difference between siblings in behavior problems was correlated with the extent of maternal differential treatment but was not significantly associated with age or gender differences between siblings.

95. Wadsworth, S. J., DeFries, J. C., & Fulker, D. W. (1993). Cognitive abilities of children at 7 and 12 years of age in the Colorado Adoption Project. Journal of Learning Disabilities, 26, 611-615.

To test the hypothesis that adopted children are at an elevated risk for learning disabilities, the achievemnt scores of adopted and control children were compared at 7 and 12 years of age. Although the average Verbal IQ of the adopted children was significantly lower at both ages, these differences only accounted for about 2% to 4% of the variance. Scores on individual subtests were significantly lower only for Similarities at age 7 and Comprehension at age 12. Moreover, with regard to achievement tests, the proportion of adopted children who scored more than 1.5 standard deviations lower than expected was not significantly greater than that of controls. The results of this study provide little or no evidence for an increased risk of learning disabilities in "easily placed" adopted children.

96. Cardon, L. R., & Fulker, D. W. (1994). A model of developmental change in hierarchical phenotypes with application to specific cognitive abilities. Behavior Genetics, 24, 1-16.

This model combines multivariate and longitudinal methodologies for assessment of continuity and change in the relationships among characters over time. The model also permits assessment of shared and independent groups of measures. The procedure is illustrated by application to specific cognitive ability data from adopted and nonadopted siblings and monozygotic and dizygotic twin pairs. The results suggest that much of the observed continuity in general intelligence measures is due to genetic influences common to specific abilities and indicate different causes for specific abilities at different times in childhood.

97. DeFries, J. C., Plomin, R., & Fulker, D. W. (1994) Nature and nurture during middle childhood. Oxford: Blackwell Publishers.

Following two introductory chapters, the authors focus successively on general and specific cognitive abilities, school achievement, language disorders, personality, stress, body size and obesity, motoric development, sex differences, competence, and family relationships. Before summarizing and concluding, they then turn to issues like the meaning of "shared" environment, the correlations and interactions between the "nature" and "nurture," and the practical implications of the findings for adoption policy.

98. Dunn, J., & McGuire, S. (1994). Young children's nonshared experiences: A summary of studies in Cambridge and Colorado. In E. M. Hetherington, D. Reiss, & R. Plomin (Eds.), Separate social worlds of siblings: The impact of nonshared environment on development (111-128). Hillsdale, NJ: Lawrence Erlbaum Associates.

This chapter focuses on the extent to which siblings in the same family are treated differently. Results based on interview and observation data from the Colorado Sibling Study were reviewed. The authors discuss parent differential treatment, differential experiences within the sibling relationship, and sibling differences in friend and teacher relations. Finally, the links between siblings' nonshared experiences and individual differences in adjustment and sibling relationships were examined.

99. Plomin, R. (1994a). Genetics and experience: The interplay between nature and nurture (Individual Differences and Development Series, Vol. 6). Thousand Oaks: Sage Publications.

This book considers nurture and nature in terms of their interplay in the development of characteristics that differ among people. In relation to genetics, it considers DNA differences among individuals that are heritable in the Mendeleian sense of transmission from generation to generation rather than the vast majority of DNA that is the same for all members of our species. Similarly, the focus is placed on environmental differences in the language-learning environment that parents provide for their children, rather than the fact that nearly all children are exposed to language early in life. The core of the book is an important empirical phenomenon that has been discovered in the past decade: Genetic factors contribute to measures of the environment that are widely used in the behavioral sciences.

100. Plomin, R. (1994b). Nature, nurture, and social development. Social Development, 3, 37-53.

Initial research findings on three key domains of social development (attachment, empathy, and social competence) suggest that genetic factors contribute to individual differences in social development. Research on widely used measures of social environment implicates a genetic contribution. By the turn of the century, it is predicted that behavioral genetic research will be conducted using DNA markers that assess variation among individuals directly. This will revolutionize behavioral genetic research, making it more accessible and applicable to developmentalists.

101. Plomin, R. (1994c). Response to commentaries. Social Development, 3, 71-76.

Response to commentaries to target article.

102. Rende, R.D., & Plomin, R. (1994). Genetic influences on behavioural development. In M. Rutter and D.F. Hay (Eds.) Development Through Life: A Handbook for Clinicians (pp 26-48). London: Blackwell Scientific Publications.

The goal of this chapter is to provide a selective overview of some important topics for behavioral genetic approaches to development and psychopathology. Although there is accumulating evidence that diverse domains of psychopathology are influenced to some degree by genetics, many areas have only been the target of family studies or not studied at all in terms of genetics. Only for a few disorders have we sufficient information to gauge the strength of the genetic effect. A hope for the future is that the ever-growing array of molecular genetic techniques will help to pinpoint not only the molecular basis for genetic influence on psychopathology, but also the biological pathways involved in maladaptive development. Just as important is the need to refine further our study of the environmental processes involved in the development of psychopathology.

103. Braungart-Rieker, J., Rende, R.D., Plomin, R., DeFries, J.C., & Fulker, D.W. (1995). Genetic mediation of longitudinal associations between family environment and childhood behavior problems. Development and Psychopathology, 7, 233-245.

Previous studies have reported significant associations between measures of the family environment and behavior problems in children. However, because children in these studies were genetically related to their parents, such links may not be caused solely by the environmental influences. The goal of this study was to investigate genetic influence on associations between family environment and problem behavior using an adoption design. Patterns of correlations for nonadopted versus adopted boys indicated that associations between aspects of the family's relationship (conflict, cohesion, expressiveness) and behavior problems in home and school were mediated genetically. For girls, however, these links appeared to be influenced by direct shared environmental effects.

104. Cardon, L. R. (1995). Genetic influences on body mass index in early childhood. In J.R. Turner, L.R. Cardon, & J.K. Hewitt (Eds.), Behavior Genetic Approaches in Behavioral Medicine (pp.133-143). New York: Plenum Press.

Developmental trends in the causes of body fat are examined in a sample of 245 adoptive and nonadoptive families from birth to age 9. The childhood findings are related to adult body fat by examining relationships between the children and their biological, adoptive, and nonadoptive parents. Results indicate that genetic effects are responsible for observed continuity in body fat during childhood, and that the genetic influences in childhood relate strongly to those contributing to adult fatness.

105. Fulker, D. W., & Cherny, S. S. (1995). Genetic and environmental influences on cognition during childhood. Population Research and Policy Review, 14, 283-300.

The basic methodology of behavior genetics is described in the context of the twin and sibling/adoption design. Applying the models to cross-sectional data on general intelligence, genetic influences increase with age, while shared environmental influences decrease with age, a finding consistent with siblings leading increasingly separate lives. Upon examining language development in children during the first three years of life, shared environmental influences were, not surprisingly, found to be important for both expressive and receptive language development. For receptive language development, which is largely under the control of the parent, shared environmental influences were strong and genetic influences almost entirely absent, in contrast to the finding for expressive language. The models were also used to conduct longitudinal analyses of continuity and change in intelligence, as well as to examine genetic and environmental influences causing extremes of behavior, such as might be represented by psychopathology.

106. McGuire, S., Dunn, J., & Plomin, R. (1995). Maternal differential treatment of siblings and children's behavior problems: A longitudinal study. Development and Psychopathology, 7, 515-528.

The goal of this study was to examine the relationship between maternal differential treatment of the siblings, direct parenting of older siblings, and older siblings' behavior problems across middle childhood. Eighty-two families were interviewed twice in their homes when the siblings averaged 4.7 and 7.7 years of age and again when they averaged 7.9 and 10.5 years of age. Mothers completed questionnaires about parenting and both mothers and teachers completed questionnaires about the older siblings' adjustment. There was significnat stability in the mothers' reports of differential treatment and significant associations between mothers' reports of maternal differential discipline and differential attention and mothers' and teachers' reports of older siblings externalizing problems across time. Direct parenting measures were not correlated with differential treatment or older siblings' behavior problems across time.

107. Plomin, R. (1995a). Genetics and children’s experiences in the family. Journal of Child Psychology and Psychiatry, 36, 33-68.

Genetic research may have its greatest impact for clinicians and developmental researchers in terms of understanding the environment and how the environment relates to children’s development. This review focuses on one example at the interface between nature and nurture. Recent research using diverse genetic designs shows that family environment as it is currently assessed involves a substantial contribution from genetic factors. Genetic factors also contribute to correlations between measures of the family environment and developmental outcomes.

108. Plomin, R. (1995b). Genetics, environmental risks, and protective factors. In J.R. Turner, L.R. Cardon, & J.K. Hewitt (Eds.), Behavior genetic approaches in behavioral medicine (pp.217-235). New York: Plenum Press.

> Genetic differences among individuals contribute to most domains of behavior and to many common medical disorders. This chapter considers recent advances in quantitative genetics that can be used to take us far beyond the simplest "whether" and "how much" questions of heritability. While the emphasis of the chapter is on the contribution of quantitative genetic analysis to our understanding of environmental influences, it begins with other examples: multivariate analysis, developmental analysis, and quantitative trait loci.

109. Wadsworth, S. J., DeFries, J. C., Fulker, D. W., & Plomin, R. (1995a). Cognitive ability and academic achievement in the Colorado Adoption Project: A multivariate genetic analysis of parent-offspring and sibling data. Behavior Genetics, 25, 1-15.

> The purpose of this study was to assess sources of the relationships among measures of cognitive ability (verbal comprehension and perceptual organization) and school achievement (arithmetic and reading recognition) using both sibling and parent-offspring data. Although the strongest relationships were between verbal ability and the achievement measures, there was also a substantial genetic influence on the achievement measures independent of cognitive ability. In addition, nonshared environmental influences were also significant, but shared environmental influences were not.

110. Wadsworth, S. J., DeFries, J. C., Fulker, D. W., & Plomin, R. (1995b). Covariation among measures of cognitive ability and academic achievement in the Colorado Adoption Project: Sibling analysis. Personality and Individual Differences, 18, 63-73.

> This paper is similar to the previous paper, except that the emphasis is on sibling data. The authors suggest that one of the implications for their findings is that "If genetic factors are primarily responsible for the covariation between IQ and academic achievement, then perhaps environmental intervention would be most effective if focused on those aspects of achievement which are uncorrelated with IQ."

111. Plomin, R., Manke, B., & Pike, A. (1996). Siblings, behavioral genetics, and competence. In G.H. Brody (Ed.), Siblings relationships: Their causes and consequence, (pp. 75-104). Norwood, NJ: Ablex Publishing Corporation.

> The message of this chapter is that the inclusion of siblings in research makes it possible to address important and novel behavioral genetic questions concerning the etiology of individual differences. We used the topic of perceived competence to demonstrate the utility of five types of sibling analyses: 1) univariate sibling analyses which estimate the importance of shared familial influences; 2) nonshared sibling analysis which asks why siblings are so different from one another; 3) developmental sibling analyses which include comparisons of sibling correlations as a function of age; 4) multivariate sibling analyses which investigate the extent to which familial factors that influence a target trait overlap in their effects on other traits; and 5) DF sibling analysis which examines the familial links between the normal and abnormal.

112. Plomin, R., Petrill, S.A., & Cutting, A.L. (1996). What genetic research on intelligence tells us about the environment. Journal of Biosocial Science, 28, 587-606.

> Two of the most important discoveries about the role of nurture in the development of intelligence have emerged from genetic research during the past decade. The first is the importance of non-shared environment--environmental influences that make children growing up in the family different from one another. Often it has been assumed that the key environmental influences on children's development are shared by children growing up in the same family, yet to the extent that these influences are shared by siblings, they cannot account for the differences observed in siblings' IQ. There is a need to identify the environmental factors that make two children growing up in the same family so different from one another. A second significant discovery is that widely used measures of the environment show significant genetic influence.

113. Saudino, K.J., & Plomin, R. (1996). Personality and behavioral genetics: Where have we been and where are we going? Journal of Research in Personality, 30, 335-347.

> This paper describes some recent findings from behavioral genetics research in personality that go well beyond the rudimentary nature-nurture question. These findings include the importance of nonshared environmental influences on personality, genetic continuity and environmental change during development, personality as a mediator of genetic influence on environmental measures, links between personality and psychopathology, and harnessing the power of molecular genetics to identify specific genes responsible for genetic influence on personality.

131. Schmitz, S., Saudino, K. J., Plomin, R., Fulker, D. W., & DeFries, J. C. (1996). Genetic and environmental influences on temperament in middle childhood: Analyses of teacher and tester ratings. Child Development, 67, 409-422.

> The present study used the sibling adoption design to investigate teacher and tester ratings of temperament in middle childhood. When each child was seven-years-old, ratings on the Colorado Childhood Temperament Inventory were obtained from a teacher and tester for more than 50 pairs each of adoptive and nonadoptive siblings. Significant genetic influence emerged for both teacher and tester ratings of Activity, for tester ratings of Sociability, and for teacher ratings of Emotionality. Results obtained from bivariate genetic analysis suggest that the modest covariance between teacher and tester ratings of Activity is entirely mediated genetically. Except for teacher ratings of Attention Span, evidence of shared family environment was nonsignificant, despite the power of the sibling adoption design to detect it.

115. Cherny, S. S., Fulker, D. W., & Hewitt, J. K. (1997). Cognitive development from infancy to middle childhood. In R. J. Sternberg & E. L. Grigorenko (Eds.), Intelligence: Heredity and environment (pp 463-482). New York: Cambridge University Press.

> Analyses using data from adoption and twin longitudinal studies tell an interesting story of the diversity of processes controlling the development of general cognitive ability from infancy through middle childhood. The nonshared environment, uniquely experienced by individuals, clearly does not drive the developmental process. Its influences are transitory and occasion-specific. The

environmental influences shared by siblings and twins were found to be of a global nature which could be the result of such monolithic factors as socioeconomic status and other relatively constant influences on the family. These influences appear not to drive the developmental process. It appears that genes are driving the developmental process. New genetic variation appears at each age, and that variation persists onto later ages. This is characteristic of a truly developmental process. The amount of variation appears to be decreasing through age 4, but rises substantially at age 7, after the child has completed the first year of schooling.

116. Felsenfeld, S., & Plomin, R. (1997). Epidemiological and offspring analyses of developmental speech disorders using data from the Colorado Adoption Project. Journal of Speech and Hearing Research, 40, 778-791.

The present study examined the speech outcomes of 156 adopted and nonadopted children at varying risk for speech disorder based upon self-reported parental speech history. The sample consisted of four groups: adopted children with an affected biological parent, adopted children with an affected adoptive parent, nonadopted children with an affected parent, and low-risk adopted and nonadopted children. Results revealed that 25% of the children with a genetic background of speech disorder displayed questionable speech, language or fluency skills at age 7 compared to 9% with no known genetic history. Neither IQ nor home environment (as measured by the HOME) were significantly associated with speech outcome.

117. Manke, B., & Plomin, R. (1997). Adolescent familial interactions: A genetic extension of the social relations model. Journal of Social and Personal Relationships, 14, 505-522.

The purpose of this paper was to investigate genetic and environmental contributions to significant child actor effects (the tendency to behave in a similar way to all family members), child partner effects (the tendency to elicit similar interactions from all family members), and sibling relationship effects (factors unique to the sibling dyadic relationship). Genetic influence was found for actor effects for conflict and self-disclosure about postive things. In contrast, dyadic relationship effects for warmth and self-disclosure about both positive and negative things showed no genetic influence. Moderate shared environmental influences were found for both actor and sibling relationship effects. However, most of the environmental influences for both actor and sibling relationship effects were of the nonshared variety, suggesting that unique environmental experiences are important for children's familial interactions.

118. Plomin, R., Fulker, D.W., Corley, R., & DeFries, J.C. (1997). Nature, nurture, and cognitive development from 1-16 years: A parent-offspring adoption study. Psychological Science, 8, 442-447.

Children increasingly resemble their parents in cognitive abilities from infancy through adolescence. Results obtained from this 20-year longitudinal study of adopted children and their biological and adoptive parents, as well as a matched sample of nonadoptive parents and offspring, show that this increasing resemblance is due to genetic factors. Adopted children resemble their adoptive parents slightly in early childhood but not at all in middle childhood or adolescence. In contrast, during childhood and adolesecence, adopted children become more like their biological parents and to the same degree as children and parents in nonadoptive families. These findings indicate that genes that stably affect cognitive abilities in adulthood do not all come into play until after adolescence and that environmental factors that contribute to cognitive development are not correlated with parents' cognitive ability.

119. Plomin, R., and Petrill, S.A. (1997). Genetics and intelligence: What's new? Intelligence, 24, 53-77.

Nature as well as nurture contributes to the development of individual differences in intelligence. Genetic research on intelligence has moved beyond this rudimentary nature-nurture question to make several exciting discoveries about intelligence by investigating developmental change and continuity, multivariate associations among cognitive abilities, and the developmental interface between nature and nurture. Advances in molecular genetics have led to a new era for genetic research that makes it possible to identify specific genes responsible for gentic influence on cognitive abilities and disabilities.

120. Saudino, K.J., & Plomin, R. (1997). Cognitive and temperamental mediators of genetic contributions to the home environment during infancy. Merrill-Palmer Quarterly, 43, 1-23.

Data from the CAP comparing adoptive and nonadoptive siblings suggest substantial genetic variance on Caldwell and Bradley's Home Observation for Measurement of the Environment (HOME). The Bayley Mental Development Index (MDI) can account for approximately one quarter of the genetic contribution to the HOME at 24 months of age. The additional genetic contribution of temperament, as assessed by tester ratings on Bayley's Infant Behavior Record (IBR) was examined. In a trivariate genetic analysis of the HOME, MDI, and IBR Task Orientation (TO), TO explained the remaining genetic variance on the HOME not explained by the MDI. Thus, during infancy, genetic contributions to the HOME appear to be mediated by cognitive factors, but even more strongly by temperament factors.

121. Wadsworth, S.J., Corley, R.P., DeFries, J.C., Fulker, D.W., Carey, G., & Plomin, R. (1997). Substance experimentation in the Colorado Adoption Project. Personality and Individual Differences, 23, 463-471.

It has been suggested that adopted children may be more susceptible to adjustment problems, including substance abuse. This study examined prevalence of substance use/experimentation (cigarettes, alcohol, marijuana, and other drugs) and age of first experimentation for adopted and nonadopted participants in the CAP based on telephone interview data. The only significant differences were in proportions of individuals drinking by grades 8 and 9, and smoking by grades 9 and 10, with adopted adolescents smoking and drinking more. However, even these differences accounted for less than 4% of the variance in experimentation. Therefore, adoptive status in this prospective, population-based sample does not appear to be an important predictor of substance use/experimentation in adolescence.

122. Alarcon, M., Plomin, R., Fulker, D.W., Corley, R., & DeFries, J.C. (1998). Multivariate path analysis of specific cognitive abilities data at 12 years of age in the Colorado Adoption Project. Behavior Genetics, 28, 255-264.

In this paper we report the results of the first multivariate genetic analysis of CAP specific cognitive abilities (verbal, spatial, perceptual speed, and visual memory) data when the children were 12 years of age. By fitting a parent-offspring multivariate conditional path model to these data, the etiologies of individual differences for each of the four measures and their covariation were assessed. Consistent with the results obtained when the offspring were 4-years-old, the effects of familial environmental transmission on individual differences in specific cognitive abilities were nonsignificant, and the covariation between specific cognitive abilities may be influenced by a single general cognitive ability factor. Results obtained from this study support the hypothesis that the heritabilties of specific cognitive abilities increase with age.

123. Eley, T.C., Deater-Deckard, K., Fombonne, E., Fulker, D.W., & Plomin, R.P. (1998). An adoption study of depressive symptoms in middle childhood. Journal of Child Psychology and Psychiatry, 39, 337-345.

In this study, mothers reported their own neuroticism, and children's depressive symptoms were reported by the parents and by the children themselves. Heritability was negligible, shared environment modest, and nonshared environment substantial, irrespective of child gender. These findings support the only previous adoption study of depressive symptoms, but contrast with the results of twin studies, suggesting possible developmental changes or design-specific effects.

124. Manke, B. (1998). Genetic and environmental contributions to children's interpersonal humor. In W. Ruch (Ed.), The sense of humor: Explorations of a personality characteristic (pp361-384). London: Mouton de Gruyter.

The purpose of this chapter was to explore children's use of humor in ongoing social relationships and the origins of individual differences in interpersonal humor. Results are presented from a recent investigation of the links between specific measures of the childhood family environment and adolescent interpersonal humor, and the genetic and environmental mediation of these links.

125. O'Connor, T.G., Deater-Deckard, K., Fulker, D., Rutter, M., & Plomin, R. (1998). Genotype-environment correlations in late childhood and early adolescence: Antisocial behavior problems and coercive parenting. Developmental Psychology, 34, 970-981.

A key question for understanding the interplay between nature and nurture in development is the direction of effects in socialization. As part of the CAP, adopted children were classified as being at genetic risk (n=38) or not at genetic risk (n=50) for antisocial behavior based on their mothers' self-report history of antisocial behavior. From age 7 through 12, adoptive parents reported on negative control, positive parenting, and inconsistent parenting they use in managing their children. In addition, adoptive parents completed a measure of their children's behavioral problems. Analysis of these data indicated that children at genetic risk were consistently more likely to receive negative parenting, indicating an evocative genotype-environment correlation. The results could not be explained by selective placement.

126. Plomin, R., Caspi, A., Corley, R., Fulker, D.W., & DeFries, J. (1998). Adoption results for self-reported personality: Evidence for nonadditive genetic effects? Journal of Personality and Social

Psychology, 75, 211-218.

In contrast to twin studies, we find little evidence for hereditary or shared environmental influences in parent-offspring and sibling analyses of self-report personality data. Although several factors might contribute to the discrepancy between twin and adoption results, we suggest that nonadditive genetic effects, which can be detected by twin studies but not adoption studies, are a likely culprit. This has important implications for attempts to identify specific genes responsible for genetic influence on personality.

127. Plomin, R., & DeFries, J.C. (1998). Genetics of cognitive abilities and disabilities. Scientific American, 278, 5, 62-69.

Recent twin and adoption studies add strength to decades of research showing substantial genetic influence on cognitive abilities such as verbal and spatial abilities and on cognitive disabilities such as reading disability. Now specific genes are also being identified.

128. Saudino, K., & McManus, I.C. (1998). Handedness, footedness, eyedness and earedness in the Colorado Adoption Project. British Journal of Developmental Psychology, 16, 167-174.

Despite a relatively large sample size and evidence that the measures of lateralization were typical of those found in other studies, no significant familial trends were found in any of the measures of direction of lateralization. Nevertheless, effects found for handedness were of a similar magnitude to that shown elsewhere and it was concluded that this adoption study alone did not have sufficient statistical power to partition variance into genetic and environmental components. Degree of lateralization was also examined and no evidence was found for familial trends.

129. Schmitz, S., Cherny, S.S., & Fulker, D.F. (1998). Increase in power through multivariate analyses. Behavior Genetics, 28, 357-363.

Power to detect genetic and environmental influences increases not only with sample size but also with the number of measurements through longitudinal and/or multivariate designs, if those measures correlate with each other. Power simulations are presented for uni- through quadrivariate cases, with differing genetic and environmental parameters. Even though subject attrition is a problem for most longitudinal studies, the gain in power available may more than make up for this shortcoming in many situations. In terms of planning studies to examine genetic and environmental influences, power calculations should not only consider sample size but number of measurements on particular phenotypes and their intercorrelations.

130. Alarcon, M., Plomin, R., Fulker, D.W., Corley, R., & DeFries, J.C. (1999). Molarity not modularity: Multivariate genetic analysis of specific cognitive abilities in parents and their 16-year-old children in the Colorado Adoption Project. Cognitive Development, 14, 175-193

Consistent with previous twin analyses, these results support the hypothesis of genetic molarity rather than modularity: (1) genetic effects on specific cognitive abilities largely overlap, supporting the hypothesis of a common factor of general cognitive ability; (2) genetic effects are largely responsible for the phenotypic

correlations with the other specific cognitive abilities, about half of which are due to genetic influences. Also consistent with the results of several previous studies, heritabilities of perceptual speed and memory were lower, although not significantly so, than verbal ability and spatial ability. In agreement with results from studies of twins reared apart and other adoption designs, environmental influences shared by parents and offspring were not significant, despite the power of the adoption design to detect such effects.

131. Deater-Deckard, K., Fulker, D.W., & Plomin, R. (1999). A genetic study of the family environment in the transition to early adolescence. Journal of Child Psychology and Psychiatry, 40, 769-775.

In this longitudinal sibling adoption study, assessments of family environment completed by parents and children when the children were 10-, 11-, and 12-years old were analyzed to estimate genetic and environmental components of variance in these measures. Genetic influences were found for parent-reported negativity and warmth, and child-reported achievement orientation, suggesting child effects on these aspects of the family environment. Shared environmental influences were found for parent-reported negativity, inconsistent discipline, warmth, and child-reported positivity. Nonshared environmental influence was substantial only for children's ratings. Genetic and environmental influences were similar for unselected individuals and selected extreme groups, suggesting similar etiologies for more extreme negative family environments.

132. Deater-Deckard, K., & Plomin, R. (1999). An adoption study of the etiology of teacher and parent reports of externalizing problems in middle childhood: Comparing individual differences in extreme groups. Child Development, 70, 144-154.

In this sibling adoption study, teacher's ratings of children's behaviors were averaged over five years from first to sixth grade and analyzed to explore aggression and delinquency separately and to compare genetic and environmental influences on normal variation in both an unselected sample and in a selected extreme group. Heritability was moderate and shared environment was negligible for individual differences and extreme group differences in externalizing and aggression. In contrast, delinquency showed no significant genetic influence, and there was some evidence for a modest shared environment influence.

133. Fulker, D.W., Cherny, S., Sham, P., & Hewitt, J.K. (1999). Combined linkage and association sib-pair analysis for quantitative traits. American Journal of Human Genetics, 64, 259-267.

This paper describes an extension of maximum-likelihood variance components procedures for mapping quantitative trait loci in sib pairs that allows a simultaneous test of allelic association. The method involves modeling the allelic means for a test of association, while simultaneously modeling the sib-pair covariance structure for a test of linkage. By partitioning the mean effect of a locus into a between- and within-sibship component, the method controls for spurious associations due to population stratification and admixture. The power and efficacy of the method are illustrated through simulation of various models of both real and spurious association.

134. Wadsworth, S.J., Fulker, D.W., & DeFries, J.C. (1999). Stability of genetic and environmental

influences on reading achievement at 7 and 12 years of age in the Colorado Adoption Project. International Journal of Behavioral Development, 23, 319-332.

> The etiology of longitudinal stability of reading performance between 7 and 12 years of age was assessed using data from children tested in the CAP. Results of bivariate analysis confirmed earlier findings of moderate genetic influence on individual differences in reading performance at both ages, and about 70% of the observed stability between the two ages was due to common genetic influences. Of special interest, no new heritable or shared environmental variation was manifested at age 12, suggesting that the same genetic and environmental influences were operating at both ages. In contrast, nonshared environmental influences (e.g., instructional methods, teachers, peers, etc.) were responsible for change between 7 and 12 years of age, indicating the salience of such factors for the development of reading performance between middle childhood and adolescence.

135. Beer, J.M., & Horn, J.M. (2000). The influence of rearing order on personality development within two adoption cohorts. Journal of Personality, 68, 789-819.

> Data is reported from two adoption studies in which subjects were biological first-borns reared in various ordinal positions. Between- and within-family analyses indicated that rearing order's influence on personality was very weak. The only clear difference was for conscientiousness, on which first-reared siblings scored higher. A prenatal biological process that may produce birth order differences is discussed.

136. Deater-Deckard, K., & O'Connor, T.G. (2000). Parent-child mutuality in early childhood: Two behavioral genetic studies. Developmental Psychology, 36, 561-570.

> Parent-child mutuality (shared positive affect, responsiveness, and cooperation) is an important component of family socialization process. We extended previous research on mutuality by examining sibling differences and gene-environment processes using a quantitative genetic design applied to observations of mutuality and parents' and observers' rating of family environment and child behavior. The first study included 125 pairs of identical and same-sex fraternal three-year-old twins. Greater mutuality was associated with higher socioeconomic status. Moderate sibling similarity in parent-child mutuality was accounted for by child genetic similarity, suggesting evocative gene-environment correlation and nonshared environmental processes. These findings were replicated in a second study of 102 pairs of adoptive and biological siblings.

137. McGuire, S., & Clifford, J. (2000). Genetic and environmental contributions to loneliness in children. Psychological Science, 11, 487-491.

> Data were collected using both an adoption design and a twin-sibling design in which children participating in the Colorado Adoption Project completed a general loneliness scale at ages 9, 10, 11, and 12 years and in the San Diego Sibling Study completed a scale assessing loneliness at school between the ages of 8 and 14. Both studies showed significant heritability and nonshared environmental influences for children's loneliness.

138. McGuire, S., Manke, B., Eftekhari, A., & Dunn, J. (2000). Children's perceptions of sibling conflict during middle childhood: Issues and sibling (dis)similarity. Social Development, 9, 173-190.

> This study focused on the content of sibling conflict, conflict initiation, and conflict resolution during middle childhood. School-age sibling pairs from the Colorado Adoption Project were interviewed using a semi-structured format. Results shoed that descriptions of disagreements revolved around issues between the siblings, such as sharing personal possessions and physical aggression, rather than parental favoritism. Children in the same family rarely mentioned the same issues and fewer than half of the topics showed a pattern suggesting heritability.

139. O'Connor, T.G., Caspi, A., DeFries, J.C., & Plomin, R.P. (2000). Are associations between parental divorce and children's adjustment genetically mediated? Developmental Psychology, 36, 429-437.

> The hypothesis that the association between parental divorce and children's adjustment was mediated partly by genetic factors was examined. Children in biological families who experienced their parents' divorce or separation by age 12 years exhibited higher rates of behavioral/emotional problems and substance use, and lower levels of achievement and social adjustment difficulties compared with children whose parents' marriage remained intact. For adopted children, this finding was replicated for behavioral/emotional problems and substance abuse but not for achievement and social adjustment, suggesting an environmentally mediated explanation for the association between parent divorce and children's adjustment but a partly genetically mediated explanation for the achievement and social development outcomes.

140. Sham, P.C., Cherny, S.S., Purcell, S. & Hewitt, J.K. (2000). Power of linkage versus association analysis of quantitative traits, by use of variance-components, for sibship data. American Journal of Human Genetics, 66, 1616-1630.

> Optimal design of quantitative-trait loci (QTL) mapping studies requires a precise understanding of the power of QTL linkage versus QTL association analysis, under a range of different conditions. In this article we investigate the power of each for random sibship samples.

141. Sham, P.C., Zhao, J.H., Cherny, S., & Hewitt, J.K. (2000). Variance components QTL linkage analysis of selected and non-normal samples: Conditioning on trait values. Genetic Epidemiology, 19, S22-S28.

> Standard variance-components QTL linkage analysis can produce an elevated rate of type 1 errors when applied to selected samples and non-normal data. Here we describe an adjustment that leads to a test that is valid in these samples.

142. Von Klitzing, K., Kelsay, K., Emde, R.N., Robinson, R., & Schmitz S. (2000). Gender specific characterizations of five-year-olds play narrative and associations wth behavior ratings. Journal of the American Academy of Child and Adolescent Psychiatry, 39, 1017-1023.

This study examines the content and structure of children's play narratives. Girls told more coherent narratives with less aggression than boys. Agressive themes correlated with behavior problems in girls, but not in boys. Children who told repeated aggressive/incoherent narratives had more behavioral problems than those who did not show this pattern.

143. Gilger, J.G., Ho, H.-Z., Whipple, A.D., & Spitz, R. (2001). Genotype-environment correlations for language-related abilities: Implications for typical and atypical learners. Journal of Learning Disabilities, 34, 492-502.

This study, using longitudinal adoption data, provides evidence for the genetic mediation of the association between family environmental variables, such as provision of toys and games in the home, the degree of maternal involvement, the number of people in the home, or the degree of intellectual/cultural orientation in the home, with children's language-related abilities.

144. Manke, B., & Pike, A. (2001). Combining the Social Relations Model and behavioral genetics to explore the etiology of familial interactions. Marriage and Family Review, 33, 179-204.

The Social Relations Model (SRM) and its ability to explain family interaction in terms of actor, partner and dyadic relationship effects is described followed by findings from 3 studies. Results indicate that much of familial interaction is relationship specific and not due to individual-level effects.

145. O'Connor, T.G., Jenkins, J.M., Hewitt, J., DeFries, J.C., Plomin, R. (2001). Longitudinal Connections Between Parenting and Peer Relationships in Adoptive and Biological Families. Marriage and Family Review, 33, 251-271.

We examined whether or not change in peer relationship quality in early adolescence was predicted form qualities of the family environment. We found that short-term change in peer relationship quality was predicted from family factors with warm, positive relationships predicting a positive change in popularity and parental negative control predicting an increase over time in peer problems. However, the effect was not entirely from parent to child, as prior peer problems also predicted an increase in parental negative control. The findings indicated that there was genetic influence on teacher-rated popularity, but the change in peer relationship quality from parenting was equally strong in adoptive and biological families, suggesting no genetic mediation of this link.

146. Wadsworth, S.J., Corley, R.P., Hewitt, J.K., & DeFries, J.C. (2001). Stability of Genetic and Environmental Influences on Reading Performance at 7.12. And 16 years of age in the Colorado Adoption Project. Behavior Genetics, 31, 353-359.

The etiology of the longitudinal stability of reading performance was assessed by analyzing data from adoptive and nonadoptive siblings pairs tested in the CAP. These results confirmed previous finding of moderate genetic influence on individual differences in reading performance at 7 and 12 years of age with somewhat higher heritability at age 16. Corresponding shared environmental influences were negligible. No new heritable variation was detected at either 12 or 16 years of age, suggesting that genetic influences at 7 years of age are amplified at later ages. In contrast, new nonshared environmental influences were manifested at each age, suggested the possible importance of nonshared environmental factors such as instructional methods, teachers, and peers, for the development of individual differences in reading performance between 7 and 16 years of age.

147. Abrahamson, A.C., Baker, L.A., & Caspi, A. (2002). Rebellious teens? Familial influences on the social attitudes of adolescents. Journal of Personality and Social Psychology, 83, 1392-1408.

This study investigated genetic and environmental variation and covariation in social attitude measures obtained from members of the CAP at ages 12 to 15 for the children and by the parents when their children were age 12. Results indicate that variations in both conservatism and religious attitudes are strongly influenced by shared-family environmental factors throughout adolescence. In contrast to previous findings from twin studies, which suggest that genetic influence on social attitudes does not emerge until adulthood, the present study detected significant genetic influence on variations in the conservatism measure as early as age 12. However, there was no evidence of gentic influence on religious attitudes during adolescence.

148. Bishop, E.G., Cherny, S.S., Corley, R., Plomin, R., DeFries, J.C., & Hewitt, J.K. (2002). Developmental genetic analysis of general cognitive ability from 1 to 12 years in a sample of adoptees, biological siblings, and twins. Intelligence, 31, 31-49.

Research in childhood suggests that heritability increases and shared environmental influence decreases, that genetic factors contribute to change as well as continuity, and that nonshared environmental influence contributes entirely to change. Longitudinal model fitting using data from the CAP and LTS supported these hypotheses with two exceptions. Nonshared environmental inflluences contribute to continuity as well as change in middle childhood. The most striking exception is that during the transition to adolescence, genetic factors no longer contribute to change, just to continuity.

149. Gregory, A.M., & O'Connor, T. G. (2002). Sleep problems in childhood: A longitudinal study of developmental change and association with behavioral problems. Journal of the American Academy of Child and Adolescent Psychiatry, 41, 964-971.

Maternal ratings of sleep and behavioral problems recorded on the CBCL at ages 4-15 years for CAP participants were evaluated. Sleep problems decreased from age 4 years to mid-adolescence, but there was modest stability of individual differences across this age range. Sleep problems at age 4 predicted behavioral/emotional problems in mid-adolescence. The overlap between sleep problems and depression/anxiety increased significantly during this age period.

150. Iervolino, A.C., Pike, A., Manke, B., Reiss, D., Hetherington, E.M., & Plomin, R. (2002). Genetic and environmental influences in adolescent peer socialization: Evidence from two genetically sensitive designs. Child Development, 73, 162-174.

This study examined genetic and environmental contribution to self-reported peer-group characteristics in two samples of adolescent siblings: 180 adoptive and nonadoptive sibling pairs from the CAP and 386 pairs from the Nonshared Environmental and Adolescent Development Study. Substantial genetic influence emerged for college-orientation, with the remaining variance accounted for by nonshared environment. For delinquency, the majority of the variance was explained by non-shared environment. Although genetic influence was implicated for peer popularity in twin analyses, it was not important in explaining differences in non-twin siblings. These results suggest that although some dimensions of peers are mediated by genetic factors, nonshared environmental influence is substantial.

151. Wadsworth, S.J., Corley, R.P., Hewitt, J.K. Plomin, R. & DeFries, J.C. (2002). Parent-offspring resemblance for reading performance at 7, 12, and 16 years of age in the Colorado Adoption Project. Journal of Child Psychology and Psychiatry, 43, 769-774.

Parent-offspring correlations in adoptive families were not significant at any age, but correlations between scores of nonadoptive parents and their offspring were significant at all three ages. Results from model-fitting for age 16 indicate that individual differences in reading performance are due substantially to genetic influences. In contrast, environmental transmission from parents to offspring was negligible, suggesting that environmental influences on individual differences in reading performance of children are largely independent of parental reading performance.

152. Young, S.E., Corley, R.P., Stallings, M.C., Rhee, S.H., Crowley, T.J., & Hewitt, J.K. (2002). Substance use, abuse and dependence in adolescence: Prevalence, symptom profiles, and correlates. Drug and Alcohol Dependence, 68, 309-322.

In this sibling/twin/adoption sample, adolescent experimentation seemed to be general rather than specialized, as most users have tried multiple substances. A majority of adolescents had tried at least one substance more than 5 times by age 17, and substance use disorders were not rare in this sample. Gender differences in rates of use, abuse, and dependence were not dramatic, but more often showed higher rates in males than females. Differences in the ages of onset of substance experimentation and diagnostic symptom profiles for males and females suggest that some characteristics of substance use disorders may be gender-specific in adolescence.

153. Young, S.E., Smolen, A., Corley, R.P., Krauter, K., DeFries, J.C., Crowley, T.J., & Hewitt, J.K. (2002). Dopamine transporter polymorphism associated with externalizing behavior problems in children. American Journal of Human Genetics, 114, 144-149.

We examined the relationship between parent reported externalizing behavior assessed at ages 4, 7, and 9 years and the VNTR polymorphism of the 3' untranslated region of SLC6A3 (DAT1) in a community sample of 790 children ascertained as part of our longitudinal twin and adoption studies. We have demonstrated that the 9-repeat variant of the DAT1 is a significant risk allele for externalizing behavior at ages 4 and 7 years.

154. O'Connor, T.G., Caspi, A., DeFries, J.C., & Plomin, R. (2003). Genotype-environment interaction in children's adjustment to parental separation. Journal of Child Psychology and Psychiatry, 44, 849-856.

By age 12 years, 23 of the 171 adoptees on whom this analyses was based had experienced a separation in the adoptive home. Correlation and regression analyses indicated that the association between genetic risk and child adjustment was moderated by parental separation. In the absence of parental separation, genetic risk was uncorrelated with adoptee adjustment; however, there were substantial and significant associations between individual differences in genetic influence and poor adjustment among the adoptees who experienced parental separation. Genetic vulnerability is accentuated by major psychosocial stresses, and this may partly explain the wide individual differences in children's adjustment to family transitions.

155. Petrill, S., Plomin, R., DeFries, J.C., & Hewitt, J.K. (Eds.) (2003). Nature, nurture, and the transition to adolescence. New York: Oxford University Press.

This is the fourth book to report data from the CAP. In this edition the role of genes and environments on early adolescent cognitive, social, emotional, and physical development is investigated. The book examines the extent to which genes and environments affect social interactions associated with these developing competencies.

156. Rhee, S.H., Hewitt, J.K., Young, S.E., Corley, R.P., Crowley, T.J., & Stallings, M.C. (2003). Genetic and environmental influences on substance initiation, use, and problem use in adolescents. Archives of General Psychiatry, 60, 1256-1264.

This sibling/twin/adoption study of substance initiation, use, and problem use replicated findings from twin studies of adult substance use: there is moderate to substantial heritability for substance use and substance use disorders in this sample. Problem use is more heritable than initiation. The significance of environmental influences shared only by twin pairs on tobacco initiation, alcohol use, and any drug use suggests the influences of peers, accessibility of substances, and sibling interaction.

157. Young, S.E., Smolen, A. Stallings, M.C., Corley, R.P., & Hewitt, J.K. (2003). Sibling-based association analyses of the serotonin transporter polymorphism and internalizing behavior problems in children. Journal of Child Psychology and Psychiatry, 44, 961-967.

158. Becker-Blease K.A., Deater-Deckard K., Eley T., Freyd J.J., Stevenson J. & Plomin R. (2004) A genetic analysis of individual differences in dissociative behaviors in childhood and adolescence. J Child Psychol Psychiatry, 45(3), 522-32.

159. Petrill, S.A., Lipton, P.A., Hewitt, J.K., Plomin, R., Cherny, S.S., Corley, R., & DeFries, J.C. (2004). Genetic and environmental contributions to general cognitive ability through the first 16 years of life. Developmental Psychology, 40, 805-812.

The genetic and environmental contributions to the development of general cognitive ability throughout the first 16 years of life were examined using sibling data from CAP. Correlations were analyzed along with structural equation models to characterize the genetic and environmental influences on longitudinal stability and instability. Intra-class correlations reflect both considerable genetic influence at each age and modest shared environmental influence within and across ages. Modeling results suggested that genetic factors mediated phenotypic stability throughout this entire period, while most age-to-age instability appeared to be due to nonshared environmental influences.

160. Slomkowski, C., & Manke, B. (2004). Sibling relations during childhood: Multiple perceptions from multiple perspectives. In R. Conger (Ed.) Continuity and change in family relations: Theory, methods, empirical findings. Hillsdale, N.J.: Erlbaum. pp 293-318.

161. Gelhorn, H.L., Stallings, M.C., Young, S.E., Corley, R.P., Rhee, S.H., & Hewitt, J.K. (2005). Genetic and environmental influences on conduct disorder: Symptom, domain and full-scale analyses. Journal of Child Psychology and Psychiatry, 46, 580-91.

162. Stallings, M.C., Corley, R.P., Dennehey, B., Hewitt, J.K., Krauter, K.S., Lessem, J.M., Mikulich-Gilbertson, S.K., Rhee, S.H., Smolen, A., Young, S.E., & Crowley, T.J. (2005). A genome-wide search for quantitative trait loci influencing antisocial drug dependence in adolescence. Archives of General Psychiatry, 62, 1042-1051.

163. Bricker, J.B., Stallings, M.C., Corley, R.P., Wadsworth, S.J., Bryan, A., Timberlake, D.S., Hewitt, J.K., Caspi, A., Hofer, S.M., Rhea, S.A., DeFries, J.C. (2006). Genetic and environmental influences on age at sexual initiation in the Colorado adoption project. Behavior Genetics, 36, 820-832.

164. Haberstick, B.C., Smolen, A., Hewitt, J.K. (2006). Family-based association test of the 5HTTLPR and aggressive behavior in a general population sample of children. Biol Psychiatry, 59(9), 836-843.

165. Hopfer, C.J., Lessem, J.M., Hartman, C.A., Stallings, M.C., Cherny, S.S., Corley, R.P., Hewitt, J.K., Krauter, K.S., Mikulich-Gilbertson, S.K., Rhee, S.H., Smolen, A., Young, S.E., Crowley, T.J. (2006 epub ahead of print). A genome-wide scan for loci influencing adolescent cannabis dependence symptoms: Evidence for linkage on chromosomes 3 and 9. Drug and Alcohol Dependence

166. Hopfer, C.J., Young, S.E., Purcell, S., Crowley, T.J., Stallings, M.C., Corley, R.P., Rhee, S.H., Smolen, A., Krauter, K., Hewitt, J.K., Ehringer, M.A. (2006). Cannabis receptor haplotype associated with fewer cannabis dependence symptoms in adolescents. American Journal of Medical Genetics Neuropsychiatric Genetics, 141(8), 895-901.

167. Wadsworth, S.J., Corley, R.P., Plomin, R., Hewitt, J.K. & DeFries, J.C. (2006). Genetic and environmental influences on continuity and change in reading achievement in the Colorado Adoption Project. In A. Huston & M. Ripke (Eds.) Middle Childhood: Contexts of Development, pp 87 - 106.

168. Young S.E., Rhee S.H., Stallings M.C., Corley R.P. & Hewitt J. K. (2006) Genetic and environmental vulnerabilities underlying adolescent substance use and problem use: general or specific? Behav Genet, 36(4), 603-15.

170. Schlaepfer, I., Clegg, H.V., Corley, R.P., Crowley, T., Hewitt, J.K., Hopfer, C.J., Krauter, K., Lessem, J., Rhee, S.H., Stallings, M.C., Wehner, J.M., Young, S.E., Ehringer, M.A. (2007). The human protein kinase C-gamma gene (PRKCG) as a susceptibility locus for hyperactive/impulsive behaviors. Addiction Biology, 12, 200-209.

171. Hopfer, C.J., Lessem, J.M., Hartman, C.A., Stallings, M.C., Cherny, S.S., Corley, R.P., Hewitt, J.K., Krauter, K.S., Mikulich-Gilbertson, S.K., Rhee, S.H., Smolen, A., Young, S.E., Crowley, T.J. (2007). A genome-wide scan for loci influencing adolescent cannabis dependence symptoms: Evidence for linkage on chromosomes 3 and 9. Drug and Alcohol Dependence, 89, 34-41. PMCID: PMC1892279

172. Ehringer, M.A., Clegg, H.V., Collins, A.C., Corley, R.P., Crowley, T.J., Hewitt, J.K, Hopfer, C.J., Krauter, K, Lessem, J., Rhee, S.H., Schlaepfer, I., Smolen, A., Stallings, M.C., Young, S.E., Zeiger, J.S. (2007). Association of the neuronal nicotinic receptor b2 subunit gene (CHRNB2) with subjective responses to alcohol and nicotine. American Journal of Medical Genetics – Neuropsychiatric Genetics, 144B, 596-604.

173. Corley, R.P., Zeiger, J.S., Crowley, T.J., Ehringer, M.A., Hewitt, J.K., Hopfer, C.J., Lessem , J., McQueen, M.B., Rhee, S.H., Smolen, A., Stallings, M.C., Young, S.E., Krauter, K. (2008). Association of candidate genes with antisocial drug dependence in adolescents. *Drug and Alcohol Dependence, 96*, 90-98. PMCID: PMC2574676

170. Gelhorn, H., Hartman, C., Sakai, J., Stallings, M., Young, S., Rhee, S., Corley, R., Hewitt, J., Hopfer, C., Crowley, T. (2008). Toward DSM-V: An Item Response Theory analysis of DSM-IV alcohol abuse and dependence criteria in adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 47,* 1329-1339. PMCID: PMC2800944

171. Hartman, C.A., Gelhorn, H., Crowley, T.J., Sakai, J., Stallings, M.C., Young, S.E., Corley, R., Hewitt, J.K., Hopfer, C.J. (2008). An Item Response Theory analysis of DSM-IV marijuana abuse and dependence criteria in adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*, 165-173. PMCID: PMC2443687

172. Schlaepfer, I.R., Hoft, N.R., Collins, A.C., Corley, R.P., Hewitt, J.K., Hopfer, C.J., Lessem, J.M., McQueen, M.B., Rhee, S.H., Ehringer, M.A. (2008). The CHRNA5/A3/B4 gene cluster variability as an important determinant of early alcohol and tobacco initiation in young adults. *Biological Psychiatry*, *63*, 1039-1046. PMCID: PMC2526976

173. Subbarao, A., Rhee, S.H., Young, S.E., Ehringer, M.A., Corley, R.P. (2008). Common genetic and environmental influences on major depressive disorder and conduct disorder. *Journal of Abnormal Child Psychology, 36,* 433-444. PMCID: PMC2435091

174. Zeiger, J.S., Haberstick, B.C., Schlaepfer, I., Collins, A.C., Corley, R.P., Crowley, T.J., Hewitt, J.K, Hopfer, C.J., Lessem, J., McQueen, M.B., Rhee, S.H., Ehringer, M.A. (2008). The neuronal nicotinic receptor subunit genes (CHRNA6 and CHRNB3) are associated with subjective responses to tobacco. *Human Molecular Genetics, 17*, 724-734.

175. Brant, A.M., Haberstick, B.C., Corley, R.P., Wadsworth, S.J., DeFries, J.C., Hewitt, J.K. (2009). The developmental etiology of high IQ. *Behavior Genetics, 39(4),* 393-405. PMCID: PMC3086674.

176. Button, T.M.M., Stallings, M.C., Rhee, S.H., Corley, R.P., Boardman, J.D., Hewitt, J.K. (2009). Perceived peer delinquency and the genetic predisposition for substance dependence vulnerability. *Drug and Alcohol Dependence, 100,* 1-8. PMCID: PMC2663024

177. Gelhorn, H., Hartman, C., Sakai, J., Mikulich-Gilbertson, S., Stallings, M., Young, S., Rhee, S.H., Corley, R., Hewitt, J., Hopfer, C., Crowley, T. (2009). An Item Response Theory analysis of DSM-IV Conduct Disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 48,* 42-50, 2009. PMCID: PMC2773289

178. Palmer, R.H., Young, S.E., Hopfer, C.J., Corley, R.P., Stallings, M.C., Crowley, T.J., Hewitt, J.K. (2009). Developmental epidemiology of drug use and abuse in adolescence and young adulthood: Evidence of generalized risk. *Drug Alcohol Dependence, 102,* 78-87. PMCID: PMC2746112

179. Young, S.E., Friedman, N.P., Miyake, A., Willcutt, E.G., Corley, R.P., Haberstick, B.C., Hewitt, J.K. (2009). Behavioral disinhibition: Liability for externalizing spectrum disorders and its genetic and environmental relation to response inhibition across adolescence. *Journal of Abnormal Psychology, 118,* 117-130. PMCID: PMC2775710

180. Button, T.M.M., Hewitt, J.K., Rhee, S.H., Corley, R.P., & Stallings, M.C. (2010). The Moderating Effect of Religiosity on the Genetic Variance of Problem Alcohol Use. Alcoholism*: Clinical and Experimental Research, 34, 9,* 1619-24. PMCID: PMC2929317

181. Haworth, CMA, Wright, MJ, Luciano, M, Martin, NG, de Geus, EJC, van Beijsterveldt, CEM, Bartels, M, Posthuma, D, Boomsma, DI, Davis, OSP, Kovas, Y, Corley, RP, DeFries, JC, Hewitt, JK, Olson, RK, Rhea, S-A, Wadsworth, SJ, Iacono, WG, McGue, M, Thompson, LA, Hart, SA, Petrill, SA, Lubinski, D & Plomin, R. (2010). The heritability of general cognitive ability increases linearly from childhood to young adulthood. *Molecular Psychiatry,* 1112–1120. PMCID: PMC2889158

182. Munn M.A., Stallings M.C., Rhee S.H., Sobik L.E., Corley R.P., Rhea S.A., & Hewitt .JK. (2010). Bivariate analysis of disordered eating characteristics in adolescence and young adulthood*. International Journal of Eating Disorders, 43,* 751-761. PMCID: PMC2980580

183. Zeiger, J. S., Haberstick, B. C., Corley, R. P., Ehringer, M. A., Crowley, T. J., Hewitt, J. K., Hopfer, C. J., Stallings, M. C., Young, S. E., Rhee, S. H. (2010). Subjective effects to marijuana associated with marijuana use in community and clinical subjects. *Drug and Alcohol Dependence, 109* 161–166. PMCID: PMC3000695

184. Button, T. M., Stallings, M. C., Rhee, S. H., Corley, R. P., Hewitt, J. K. (2011). The etiology of stability and change in religious values and religious attendance. *Behavior Genetics, 41(2),* 201-1. PMCID: PMC3045647

185. Cosgrove, V. E., Rhee, S. H., Gelhorn, H. L., Boeldt, D., Corley, R. C., Ehringer, M. A., Young, S. E., Hewitt, J. K. (2011). Structure and etiology of co-occurring internalizing and externalizing disorders in adolescents. *Journal of Abnormal Child Psychology,* 39(1):109-23. PMCID: PMC20683651

186. Haberstick, B. C., Zeiger, J. S., Corley, R. P., Hopfer, C. J., Stallings, M. C., Rhee, S. H., Hewitt, J. K. (2011). Common and drug-specific genetic influences on subjective effects to alcohol, tobacco and marijuana use. *Addiction*, 1*06(1)*, 215–224. PMCID: PMC3006038

187. Nilsson, R., Rhee, S.H., Corley, R.P., Rhea, S.A., Wadsworth, S.J. & DeFries, J.C. (2011). Conduct problems in adopted and non-adopted adolescents and adoption satisfaction as a protective factor. *Adoption Quarterly,14(3),* 181-198. MNCID pending.

188. Smith, A. K., Stasi, S. M., Rhee, S. H., Corley, R. P., Young, S. E., & Hewitt, J. K. (2011). The role of attention-deficit/hyperactivity disorder in the covariation between conduct disorder and verbal ability. *Frontiers in Psychiatry*, 2, 3. PMCID: PMC3089995

189. Brooker, R.J., Berenbaum, S.A., Bricker, J.B., Corley, R.P., Wadsworth, S.A. (2012). Pubertal timing as a potential mediator of adoption effects on problem behaviors. *Journal of Research on Adolescence*, *22(4),*739-745. PMCID:PMC3547396

190. Stephens, S. H., Hoft, N.R., Schlaepfer, I. R., Young, S. E., Corley, R. C., McQueen, M. B., Hopfer, C., Crowley, T., Stallings, M., Hewitt, J., Ehringer, M. A. (2012). Externalizing behaviors are associated with SNPs in the CHRNA5/CHRNA3/CHRNB4 gene cluster. *Behavior Genetics, 42,* 402-414. PMCID: PMC3506120

191. Zeiger, J. S., Haberstick, B. C., Corley, R. P., Ehringer, M. A., Crowley, T. J., Hewitt, J. K., Hopfer, C. J., Stallings, M. C., Young, S. E., Rhee, S. H. (2012). Subjective effects for alcohol, tobacco and marijuana associated with cross-drug outcomes*. Drug and Alcohol Dependence, 123,* Suppl 1:S52-8 PMCID:PMC3729264

192. Brant A.M., Munakata Y., Boomsma D.I., Defries J.C., Haworth C.M., Keller M.C., Martin N.G., McGue M., Petrill S.A., Plomin R., Wadsworth S.J., Wright M.J., Hewitt J.K. (2013). The nature and nurture of high IQ: an extended sensitive period for intellectual development. *Psychological Science,24(8),* 1487-95.

193. McClelland MM, Acock AC, Piccinin A, Rhea SA, Stallings MC. (2013) Relations between Preschool Attention Span-Persistence and Age 25 Educational Outcomes. *Early Childhood Research Quarterly, 28(2),* 314-324. PMCID: PMC3610761

194. Muchimba M, Haberstick BC, Corley RP, McQueen MB. (2013) Frequency of alcohol use in adolescence as a marker for subsequent sexual risk behavior in adulthood. *Journal of Adolescent Health, 53(2),* 215-21.PMCID: PMC3725214

195. Rhea, S.A., Bricker, J.B., Wadsworth, S.J., Corley, R.P. (2013). The Colorado Adoption Project. Twin Research and Human Genetics, *Twin Research and Human Genetics, 16(1),* 358-365. PMCID: PMC3817005

196. Rhea SA, Bricker JB, Corley RP, Defries JC & Wadsworth SJ (2013). Design, Utility, and History of the Colorado Adoption Project: Examples Involving Adjustment Interactions. *Adoption Quarterly, 16(1),* 17-39. PMCID:PMC3700549

Last update 3/1/14