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ABSTRACT

The purpose of the present analyses was to assess the separate, relative, and combined associations of relatively enduring familial influences--parental cognitive abilities and personality traits and aspects of the home environment as reported by parents--with offspring cognitive abilities and personality traits. Data was obtained from the Hawaii Family Study of Cognition (see DeFries et al., 1979; Wilson et al., 1975), in which members of 1816 intact nuclear families (both biological parents and at least one offspring 13 years of age or older) (6581 individuals) completed a battery of cognitive tests yielding a four-factor structure of specific cognitive abilities, as well as a measure of general intelligence. Parents also provided data on certain aspects of the shared (between-family, common to all offspring) home environment, including parental occupation and education, visitors to and relatives in the home, print media and television usage, and the presence of offspring prenatal and developmental problems within the family. A large subset of these families (1554 families (3402 individuals)) also completed a quick personality measure, the Adjective Check List (Gough & Heilbrun, 1965), which was rescored to yield seven personality factors. Data analyses presented herein were confined to families of Caucasian and Japanese ancestries to allow for cross-ethnic group comparisons of the associations between the variables within and across generations.

Associations of cognitive abilities, personality factors, and home environment variables (parents only) were assessed within generations, since it could not be assumed that these variable domains were independent of each other or for parents, independent influences on offspring cognition and

personality. Significant and consistent (across ethnic groups, generations, and sexes) correlations between certain cognitive abilities and personality traits were obtained. Parental cognitive abilities and personality traits were also found to be significantly and consistently related to parental occupation, education, and media usage.

Across-generation correlations indicated that parental cognitive abilities, ACL intraception, occupation, education, and media usage were significantly related to offspring cognitive abilities, particularly verbal ability and general intelligence. Parental variables were found to be mostly inconsistently or not related to offspring ACL factors. The results of multiple regression analyses predicting offspring general intelligence from significantly related parental variables indicated that most of the variation in offspring intelligence was not accounted for by the combined influences of these shared familial (genetic and environmental) factors, while almost none of the variation in offspring personality was accounted for by these shared familial factors. These results were discussed in terms of the effects of measurement error, characteristics of the sample, non-inclusion of important home environment variables, and the influence of non-shared (within-family) familial factors on behavior development.

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INTRODUCTION

Familial influences have always been considered important in understanding the development of human behavior, and the relative contribution of heredity versus environment in such influences has been the topic of considerable debate. Of the major systems of human behavior (Royce, 1979)--sensory processing, motor processing, cognition, affect (personality traits), styles, and values--cognition and affect have received the lion's share of behavioral genetic research designed to evaluate the relative roles of heredity and environment (Powell & Royce, 1981). There are good theoretical and empirical grounds to believe that familial influences on the development of sensory and motor processing are mostly genetic in nature, since such development is closely associated with physiological maturation. Styles and values, if not conceptualized as merely surface manifestations of underlying cognitive abilities and personality traits, are probably mostly determined by a person's familial and larger cultural environment, as well as one's unique learning history and situational factors, although these behavioral systems have mostly been ignored in behavioral genetic research.

Cognition emcompasses the wide range of capacities and processes associated with the acquisition and use of knowledge, including "thinking, imagining, creating, generating plans and strategies, reasoning, making inferences, solving problems, classifying and relating, symbolizing and perhaps fantasizing and dreaming" (Flavell, 1977, p. 2). The concept of cognitive ability suggests that such capacities, whether as the result of genetic factors and/or learning, constitute relatively enduring characteristics of an individual. Unlike the cognitive research area, even today

there is no commonly agreed upon definition of personality among researchers in personality. Gordon Allport described and classified over fifty different definitions of personality, and his own final definition was that "personality is the dynamic organization within the individual of those psychophysical systems that determine his characteristic behavior and thought" (Allport, 1961). In functional terms, personality seems to be concerned with behaviors relating to an individual's unique emotional and social adjustment. Like the concept of cognitive ability, the concept of personality trait suggests that there are characteristic consistencies in an individual's behavior across time and across different situations. Given the broadness of the above definitions, there could be considerable conceptual overlap between cognition and personality theory and research, but for historical reasons the two domains have in general been kept separate in psychology. Whether one is speaking of cognitive abilities or personality traits, there is also considerable controversy in psychology as to the extent that behavior is consistent across situations.

If one accepts the legitimacy of studying cognitive abilities and personality traits, then it seems reasonable to believe that the factors influencing their development are of a similar long-term nature. This brings us back to the issue of familial influences on human behavior development. Since each parent provides half of an offspring's genotype and, for intact natural families, also the home environment in which offspring develop, parent-offspring resemblances in cognitive abilities and personality traits reflect the influence of both genetic and environmental factors. Estimates of heritability based on resemblances within natural families do provide an upper limit for heritability, unless there are

negative environment-phenotype correlations (Plomin et al., 1980). Cross-correlations of parent personality with offspring cognition and parent cognition with offspring personality reflect the extent that the same genes and common home environment (which may in turn be the result of the parents' genotypes) influence both cognition and personality. Besides those aspects of the shared (common to all offspring) home environment directly resulting from variations in parents' measured cognitive abilities and personality, other measurable aspects of the shared home environment may be related to offspring cognition and personality. One cannot, of course, directly infer causality from such correlations, but it seems reasonable to believe that, to the extent that cognitive abilities and personality traits are relatively enduring characteristics of an individual, parents have more influence on offspring development than the reverse causal direction. The present paper reports the relationships between parental cognitive abilities, personality traits, and selected shared home environmental variables with offspring cognitive abilities and personality traits. These relationships are interesting in and of themselves, and when combined with the results from twin and adoption studies, help to provide insights into the nature and proportion of genetic and environmental influences on the development of cognition and personality. The data for these analyses come from the Hawaii Family Study of Cognition (HFSC), which will be briefly described below, since many of the references cited employed HFSC data, and more fully described in the Methodology section.

The Hawaii Family Study of Cognition was a large-scale study of familial factors in mental ability (see also DeFries et al., 1979, and Wilson et al., 1975, for descriptions of the HFSC). Members of 1816 intact

nuclear families (6581 individuals) living on the island of Oahu were administered a battery of fifteen cognitive tests and a questionnaire on various environmental indices (including parental occupation and education), as well as providing data on blood group and enzyme systems. Families consisted of both biological parents and one or more children 13 years of age or older. Data collection for the HFSC was conducted from 1973 through 1976, and for several of the later years, all subjects were administered a quick personality measure, the Adjective Check List (ACL) (Gough & Heilbrun, 1965) (1554 families (3402 individuals) completed this measure). Another subset of 118 families (456 individuals) was administered the Eysenck Personality Inventory (EPI) (Eysenck & Eysenck, 1968), the Comrey Personality Scales (CPS) (Comrey, 1970), and the Wechsler Adult Intelligence Scales (WAIS), with a subset of these subjects (105 families (393 individuals)) returning at a later date to complete the Cattel Sixteen Personality Factor Scales (16PF) (Cattell et al., 1970). The HFSC thus provides a rich body of data for researching the bases of cognition and personality.

Relationships among the variables within generations

Before considering the relationships of parental cognition and personality and shared home environment on offspring cognition and personality (i.e., the across-generation relationships), it is important to understand the relationships among these variables within generations. These within-generation associations are interesting in and of themselves, since they may suggest functional relationships, such as the extent to which performance on cognitive tests is mediated by personality factors or the extent to which parental cognitive abilities and personality determine aspects of the home environment. Associations between parental cognition,

personality, and home environment would also indicate that these variables do not act independently in influencing offspring behavior development (in fact, as will be discussed below, there is good evidence for believing that they are not independent influences), while associations between offspring cognition and personality might indicate that the same genetic and/or environmental factors are influencing both phenotypic domains.

Cognitive abilities and personality traits. A few theorists have suggested that some of the neurophysiological mechanisms underlying cognitive abilities may also be the basis for certain personality traits. Eysenck (1967), for example, proposes that higher levels of nervous system arousal are associated with introversion more than extraversion. Loo (1979) summarizes the few studies linking basic nervous system variations to questionnaire-measured personality traits, and his own research found that certain basic nervous system properties, as measured by motor reaction time tasks, are significantly associated with personality traits measured by the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975), although the relatioships may be more complex than hypothesized by Eysenck.

Only a handful of studies have reported the correlations between standardized paper-and-pencil measures of cognitive abilities and personality traits, and these studies have typically not suggested any strong theoretical basis for the significant relationships found. Two recent reports (Johnson et al., 1983a; Nagoshi et al., 1982), using data from the 118 HFSC families who provided Eysenck Personality Inventory, Comrey Personality Scale, Cattell Sixteen Personality Factor Scale, and Wechsler Adult Intelligence Scale data, comprehensively present significant within-generation cognition-personality correlations across three

standardized personality measures (EPI, CPS, and 16PF) and two standardized measures of cognitive abilities (the WAIS and the factors (verbal, spatial, perceptual speed, visual memory, and unrotated first principal component (a measure of "general intelligence") (see Methodology section)) derived from the HFSC cognition battery). These significant correlations are presented separately by generation (parents versus offspring) and sex.

Overall, Johnson et al. and Nagoshi et al. confirmed Turner and Horn's (1977) review of the literature and own data using the WAIS and the 16PF that personality traits are more closely associated with verbal ability than with other kinds of cognitive ability such as spatial ability and perceptual speed. Like Turner and Horn, Johnson et al. and Nagoshi et al. obtained significant positive correlations between Cattell's Dominance and Imaginative (Autia) factors and verbal ability. Dominance, on the other hand, was found to be negatively correlated with the HFSC perceptual speed factor, and unlike Turner and Horn's results, Cattell's Self-Sufficiency factor was found to be only moderately correlated with the cognitive abilities of HFSC subjects. The HFSC data also indicated that the Comrey Trust, Rebelliousness, and Masculinity factors are positively related to verbal ability. The finding for CPS Masculinity are in contrast to the pattern of results obtained in a study by Welsh and Baucom (1977), which found masculinity to be associated with non-verbal ability, while femininity was associated with verbal ability, but this may be a function of the particular masculinity-femininity scales used.

The two dimensions of personality that have received the most attention in terms of hypothesized causal linkages between personality and cognitive abilities are extraversion versus introversion and neuroticism

versus emotional stability. As noted above, Eysenck (1967) has proposed a linkage between extraversion-introversion and cognitive ability based on nervous system arousal. Studies by Jensen (1973), Turner et al. (1976), Turner and Horn (1977), Nagoshi et al. (1982), and Johnson et al. (1983a), however, have only found negligible to moderate correlations of standardized scales measuring extraversion-introversion with cognitive abilities. Analyses by Anthony (1983) of the correlations between extraversion-introversion and verbal ability at two different ages (10-11 years and 14-15 years) indicate that greater ability seems to be associated with the development of greater introversion at the later age rather than the converse direction of causality suggested by Eysenck. Going back to the work of Yerkes and Dodson (1908), level of arousal and hence, level of internal anxiety has been thought and often empirically found to be related to optimum performance on cognitive tasks of increasing complexity via an inverted U-shaped function. Mohan and Kumar (1979) and Samuel (1980) did obtain this inverted U relationship when correlating standardized measures of neuroticism with performance on IQ tests. Nagoshi et al. (1982) and Johnson et al. (1983a) found moderate negative correlations between neuroticism and cognitive abilities, but tests for curvilinear relationships produced non-significant results. Overall, the results reported above indicate that there are consistent significant relationships between certain dimensions of personality and cognitive abilities, although the theoretical bases for these relationships have not been adequately developed.

Parental cognitive abilities and shared home environment. Presumably variations in parental cognitive abilities are predictive of variations in parental childrearing behaviors, which in turn constitute a major part of

the shared home environment a family's offspring grow up in, but parental cognitive abilities may also be associated with other aspects of the home environment which act independently of measured parental ability in influencing offspring behavioral development. One of the simplest and widely used measures of home environment is family socioeconomic status (SES), typically indicated by parental education, parental occupation, family income, and/or the quality of the family's housing and area of residence. Family SES is often associated with such factors as size of family, educational aspirations, ethnicity, mobility, presence of reading materials in the home, amount of travel, and quality of schooling (White, 1982), although SES is by no means synonymous with the factors listed above. White's review and meta-analysis of the literature indicated that SES is significantly correlated with offspring academic achievement, although methodological differences across studies influenced the size of the correlations, and as will be seen in a subsequent section of this paper, SES has also been found to be highly correlated with offspring cognitive abilities.

The correlation of global IQ with occupational level has been found to be approximately 0.50 (Herrnstein, 1973, p. 203; Jencks et al., 1972, p. 185 and Appendix B). In terms of specific cognitive abilities, Fozard and Nuttall (1971), who examined the relations of General Aptitude Test Battery scores to occupational level, found that SES was more strongly related to general intelligence and verbal and numerical ability than to spatial and perceptual ability and manual dexterity. A study by Johnson et al. (1983b), using data from the HFSC parents, also found occupational level to be more related to verbal ability (correlations ranging from 0.29 to 0.49) and the

first principal component (correlations ranging from 0.31 to 0.52) than to spatial, perceptual speed, or visual memory ability. The Johnson et al. study obtained similar results for parental educational attainment. (These results will be presented among the analyses in the Results section.)

In order to develop more precise measures of the home environment, a researcher must focus upon those few aspects out of the myriad elements that make up such an "environment" that he or she feels is most salient in influencing behavior development. Typically the factors selected for such scales are relatively enduring ones expected to thus be related to relatively enduring changes in offspring behavior. Only recently have standardized measures of home environment been developed that have also come to be widely used by researchers interested in environmental influences on behavior development, but each of these measures takes a somewhat different approach and emphasis in assessing the home environment. Marjoribanks' (1972a, 1972b) measure of the home environment used parental self-reports to measure the degree of environmental press in eight areas: press for achievement, press for activeness, press for intellectuality, press for independence, press for English language use, press for second language usage, mother dominance, and father dominance. These self-reports were obtained through interviews with parents. Moos' (1974) Family Environment Scale (FES) "focuses on the measurement and description of the interpersonal relationships among family members, on the directions of personal growth which are emphasized in the family, and on the basic organizational structure of the family" (p. 3). Responses to the 90 items of the FES may be obtained by having family members complete a paper-and-pencil questionnaire or through interviews. The FES has ten subscales: the "relationship" dimensions

labelled Cohesion, Expressiveness, and Conflict, the "personal growth" dimensions labelled Independence, Achievement Orientation, Intellectual-Cultural Orientation, Active-Recreational Orientation, and Moral-Religious Emphasis, and the "system maintenance" dimensions labelled Organization and Control. Caldwell and Bradley's (1978) Home Observation for Measurement of the Environment (HOME) Inventory was developed to assess early environmental influences salient to infant cognitive development. The HOME is a semi-structured interview consisting of 45 items, two-thirds of which are based on observations in the home and the remainder on parental reports. The six scales of the HOME include: emotional and verbal responsivity of the mother, avoidance of restriction and punishment, organization of the physical and temporal environment, provision of appropriate play materials, maternal involvement with the child, and opportunities for variety in daily stimulation.

As will be discussed in a subsequent section of this Introduction, it has only been recently that a number of researchers have expressed concern that reported relationships of home environment with offspring cognitive abilities may be mediated by parental cognitive ability. Earlier studies typically do not report the correlations between parental ability and the measure of home environment used. Longstreth et al. (1981), using Wolf's (1966) Home Environment Interview, obtained a correlation of 0.50 between the home environment score and mother's Raven's Standard Progressive Matrices score and a correlation of 0.25 between environment and mother's Peabody Picture Vocabulary Test score. Plomin and DeFries (1983) report a median correlation of 0.22 between total HOME score and parental IQ (first principal component score from a battery of tests similar to those in the

HFSC), while Yeates et al. (1983) report a median correlation of 0.46 between total HOME score and maternal WAIS IQ. It is clear that parental cognitive abilities are significantly related to home environment, whether one simply assess family SES or uses a more refined home environment measure.

Parental personality traits and shared home environment. As was the case with parental cognitive abilities, presumably variations in parental personality are also associated with variations in parental childrearing behaviors, which in turn are a major part of an offspring's shared home environment. Again parental personality may be associated with other aspects of the home environment which act independently of measured parental personality in influencing offspring behavioral development. When considering parental occupational level as a rough but useful indicator of the quality of the home environment, one finds that there are few studies which have correlated individuals' personality with their occupational attainment and even fewer that have also controlled for the influence of the individuals' cognitive abilities. Jencks et al. (1972) suggested that personality characteristics, such as self-confidence and self-control, account for much of the variation in individuals' occupational attainment not accounted for by their family background, cognitive abilities, or education. Jencks (1979) later presented empirical evidence in support of the influence of personality variables on occupational attainment, although non-standardized personality measures were used. Turner and Martinez (1977) found that for men with above-average education a Machiavellian personality facilitated occupational attainment over and above the influence of the subject's father's occupational attainment and the subject's own education,

race, and age, while an inverse relationship was found for men with below-average education. Facilitative effects for Machiavellianism were found for women regardless of educational level attained. The study by Johnson et al. (1983b), using data from the HFSC, found that personality factors associated with verbal ability (CPS Trust, CPS Rebelliousness, 16PF Imaginative, 16PF Trusting, ACL ego organization, and ACL intraception (see Methodology section for descriptions of the ACL scales)) were significantly related to the educational attainments of HFSC parents, even after their family background and own cognitive abilities had been controlled. A few personality factors (CPS Egocentrism, 16PF Shrewd, ACL ego organization) were also found to be predictive of occupational attainment over and above the influence of the subject's family background and own cognitive abilities and education. In terms of more refined measures of home environment, unfortunately no recent studies have reported the correlations between standardized measures of the home environment and standardized measures of parental personality, although one would expect to find significant relationships.

Relationships of parental variables with offspring variables

In considering the influence of parental cognition and personality and the shared home environment on offspring cognition and personality, one should keep in mind that offspring cognition and personality are often substantially related with each other and parental influences on the two behavioral domains may be shared.

Parent offspring resemblance in cognitive abilities. Since the 1920's, there have been a number of investigations of familial resemblances in global IQ (see Dixon & Johnson, 1980, and Plomin et al., 1980, for brief

reviews). Overall the correlation between parents and offspring in intelligence test scores has been found to be about 0.50, the same overall correlation found between siblings. On those few studies where parent-offspring correlations are reported separately by sex of the parent, mother-offspring and father-offspring correlations have been found to be approximately equal with regard to general intelligence. As noted earlier, these familial resemblances may be the result of genetic similarities and/or similarities in the shared (between-family) family environment. If all of the 0.50 correlation in general IQ reported above was due to genetic effects, then the above correlation would indicate a heritability of 1.0 for IQ, since siblings and parents and offspring (in the absence of assortative mating) share half of their genetic variance. If the above correlation was due solely to environmental effects, it would indicate that half of the variation in IQ was due to shared (between-family, factors that make siblings alike) family environment, while the other half was due to non-shared (within-family differences) family environment. The results of twin and adoption studies indicate that the heritability of general intelligence is about 0.50 (Plomin et al., 1980).

Data from the HFSC provided a strong basis fro testing issues regarding familial resemblances in cognitive abilities, since a large sample of families was obtained, several standardized measures of cognitive ability were used, and correlations could be compared across different ethnic groups (results reported below from DeFries et al., 1979; Dixon & Johnson, 1980; and Plomin et al., 1980). Although the HFSC cognitive test battery was meant to assess separate cognitive abilities, it included a shortened version of Raven's Progressive Matrices, and the unrotated first principal

component across the 15 tests was found to be correlated 0.73 with full-scale WAIS IQ (Kuse, 1977), thus allowing for assessments of familial resemblances in general intelligence. Parent-offspring correlations from Caucasian (Americans of European Ancestry (AEA)) families in the HFSC were considerably lower on these measures of general intelligence than the 0.50 correlation reported above (0.26 for Progressive Matrices, upper limit to heritability based on mid-parent-offspring regression = 0.52; 0.35 for first principal component, upper limit to heritability = 0.60). Parent-offspring correlations were even lower in HFSC families of Japanese (Americans of Japanese Ancestry (AJA)) ancestry (upper limit to heritability for Progressive Matrices = 0.24; upper limit to heritability for first principal component = 0.42), although sibling correlations were similar in the two groups, indicating that genetic and environmental influences shared by siblings were about the same for the two groups, even though the familial influence shared by parents and offspring may have been greater in Caucasian than in Japanese families (Plomin et al., 1980).

The HFSC test battery, of course, was based on the now more commonly accepted idea that "intelligence" is really the composite of several different cognitive abilities. Parent-offspring resemblances on specific cognitive abilities in the HFSC (DeFries et al., 1979; Dixon & Johnson, 1980; Plomin et al., 1980) varied considerably across the different tests, with higher correlations being obtained on tests of verbal and spatial ability than on tests of perceptual speed and accuracy and visual memory. Parent-offspring correlations were again lower in AJA than in AEA families, particularly on the spatial ability and visual memory factors. The few previous studies on family resemblances in specific cognitive abilities

(reviewed in DeFries et al., 1979) had also found greater parent-offspring resemblances for verbal than for non-verbal abilities, but more recent studies (Horn et al., 1979; Loehlin et al., 1978) have not found large differences in resemblance across these two domains of cognitive abilities. Recent family studies (reviewed in DeFries et al., 1979, and Plomin et al., 1980, who also present analyses using HFSC data) have also disconfirmed earlier studies indicating the presence of sex-linked genetic influences in spatial abilities. Although the results have been published elsewhere, as a convenience to the reader the present paper will present HFSC parent-offspring correlations on the HFSC cognition factors and first principal component.

Parent-offspring resemblance in personality traits. Studies using a global approach and standardized measures to assess familial influences in personality development have not been nearly as numerous as those assessing familial influences in cognition. One reason may be the difficulty of measuring personality. One can see how the problem of even defining "personality" has led to such major conceptual issues regarding the uniqueness of behavior, the stability of characteristic behavior, and the number of distinct dimensions that make up an individual's personality. Loehlin et al. (1975, p. 258) note that "the personality domain is much more complex, contingent, and multi-dimensional in character, with no massive central axis like 'general intelligence'," when compared to the cognitive domain. Measures of personality vary considerably in their emphases, approach, complexity, level of analysis, and time frame.

Twin and adoption studies on the genetic and environmental bases of personality are reviewed by Dixon and Johnson (1980), Goldsmith (1983), and

Powell and Royce (1981). Overall these reviews indicated that there was sufficient empirical evidence to believe that there are genetic bases for personality, although heritability estimates are typically much lower than for cognitive abilities (ranging from 0.00 to 0.50), that while heritabilities are only low to moderate, the influence of shared family environment is almost negligible in family resemblances in personality (Loehlin et al., 1981; Rowe & Plomin, 1981), that as with studies of cognitive abilities, twin studies tend to obtain higher heritability estimates than adoption studies, that heritabilities are typically lower when estimated on very young children and for personality dimensions more related to social attitudes and specific situations, and that the evidence for differential heritabilities across different personality traits is at best weak and often dependent upon the particular measures used.

As is the case for cognitive abilities discussed in the previous section, family resemblances in personality traits for intact biological families reflect both genetic and shared environmental influences, but may be used to estimate the upper limits of heritability for those traits. Ahern et al. (1982) and H. E. P. Cattell (1982) noted that until recently studies looking at associations of parental and offspring personality have been seriously flawed by using small and/or abnormal samples, by using unstandardized, unreliable, and/or situation-specific measures of personality, and by typically considering only a single dimension of personality. Recent family studies of personality by Ahern et al. (1982; also reported in Dixon & Johnson, 1980), using data from HFSC subjects who took the Eysenck, Comrey, and Cattell scales and those who took the Adjective Check List (scored using Gough and Heilbrun's (1965) original 24 scales),

H. E. P. Cattell (1982), using age-appropriate Cattell scales, Loehlin et al. (1981), using age-appropriate Cattell scales, and Scarr et al. (1981), using various Eysenck scales of personality, have all obtained similar results. These studies found generally low (average r of about 0.15) parent-offspring and sibling correlations for the same personality trait measured. There was considerable variability across traits in the magnitude of the correlations (and hence, the heritability estimates), but these variabilities were not consistent across the different family member dyadic combinations and thus provided no support for differential heritabilities across different personality traits. The great variability in the correlations across the four sex of parent/sex of offspring combinations, in fact, suggests that gender socialization is an important aspect of personality development. Ahern et al. (1982) had a sufficient number of HFSC subjects who took the ACL to be able to run separate family resemblance analyses for families of Caucasian versus those of Japanese ancestry. As with the results for cognitive abilities, parent-offspring correlations were lower in AJA than in AEA families, but sibling correlations were similar. Since historical generational changes in social status have been greater for AJA's than for AEA's living in Hawaii (see Johnson et al., 1983b), these latter findings do lend support for the influence of shared environmental influences on personality development (Dixon & Johnson, 1980).

Unlike previous studies of parent-offspring resemblances in personality, H. E. P. Cattell (1982) argued for the usefulness of looking at cross-trait parent-offspring correlations, since different traits may share the same genetic and/or environmental bases. Among her findings was that son's neuroticism was influenced by a number of different parental traits, while

daughter's extraversion was influenced by several different parental traits. There was again considerable variation in the pattern of significant correlations across the four parent/offspring combinations.

Associations of parental personality and offspring cognition and of parental cognition and offspring personality. As with cross-personality trait parent-offspring correlations, significant associations of parental personality and offspring cognition and parental cognition and offspring personality would suggest that these two behavioral domains may share some of the same genetic and/or environmental bases. To my knowledge, the only studies that used standardized measures of cognitive abilities and personality traits to assess such parent-offspring cross-correlations were the reports by Nagoshi et al. (1982) and Johnson et al. (1983a) which reported data from the subset of approximately 100 HFSC families who were administered the HFSC cognition battery, the WAIS, the Eysenck Personality Inventory, the Comrey Personality Scales, and the Sixteen Personality Factor Inventory. Overall more significant correlations were obtained than would be expected by chance, but the pattern of correlations varied considerably across different measures and even moreso across the four parent-offspring combinations. When considering the association of parental personality and offspring cognition, there was a sufficient pattern of consistency indicating that emotionally stable mothers but neurotic fathers were associated with offspring with higher cognitive test scores and that egocentrism (CPS) in fathers was strongly associated with more able daughters. Results were even less consistent for the associations of parental cognition and offspring personality, but seemed to indicate that more able mothers had offspring who lacked compulsion (CPS), while more able fathers had daughters who were

more tough-minded (16PF). As with the recent research on parent-offspring resemblances in personality, the above findings suggest the importance of considering differential influences in the different sex of parent versus sex of offspring dyads.

Associations of shared home environment with offspring cognitive abilities and personality traits. Over the years numerous studies have sought to assess the influence of various aspects of family "environment" on offspring cognitive development, but many of these studies have used unstandardized and/or situation-specific measures of the environment and cognitive abilities. As noted earlier, the vast number of potential variables that could be important in the home environment (physical resources, intellectual and communications media resources, other family members, specific patterns of behavior of those members, the larger social context, etc.), the need to differentiate long-term and short-term influences, and the need to consider interactional effects between maturational processes and individual differences with environmental influences make any "comprehensive" measure of home environment controversial. Nevertheless, until recently the consistent findings across many studies using diverse measures had led many to accept as a given that home environment had a substantial influence on offspring cognitive abilities. The typical correlation between family socioeconomic status (SES) and offspring IQ has been between 0.30 and 0.40, and Vernon's (1979) review of the literature described the typical conclusion that "(i)t is usually taken for granted by most American psychologists that the superior IQs of upper- and middle-class children are completely explained by the superior environment in which they are reared and that, conversely, the more deprived or disadvantaged conditions of

lower SES homes account for the poorer average IQ of their children" (p. 115-116). When more comprehensive measures of home environment are used, the correlation with offspring IQ has been found to be even higher. Wolf (1966) reported a correlation of 0.69 between his home interview schedule and child IQ and a correlation of 0.80 with achievement test scores. Marjoribanks (1972a, 1972b, 1978; Walberg & Marjoribanks, 1973) has consistently obtained high correlations between his home environment measure and offspring IQ and achievement, while Bradley, Caldwell, and Elardo (1977) reported a correlation of 0.74 between the HOME measure and the IQ of 3-year-olds. The frequently cited Youth in transition studies (Bachman, 1970; Bachman et al., 1978) concluded that family SES was the major predictor of offspring performance on cognitive tests, as well as offspring educational and occupational attainment.

Longstreth et al. (1981), however, pointed out that "(a) parental IQ is correlated with parental SES, $r = .60 \pm .10$, and (b) narrow heritability for IQ is in the range of .40 - .70. It follows from (a) and (b) that the correlation between home environment and child IQ may be accounted for by inheritance rather than by environmental effects. The only way to unscramble the two influences, if in fact there are two influences, is to measure each one separately and to determine its relationship to child IQ while holding the other one constant" (p. 532). Longstreth et al.'s own data analyses found that the significant correlations between Wolf's home environment measure and offspring IQ were reduced to non-significance when maternal IQ was partialed out, but maternal IQ continued to be a significant predictor or offspring IQ, even after home environment had been partialed out. More recent reports using similar methodology (Gottfried & Gottfried, 1984;

Plomin et al., 1984; Yeates et al., 1983) have also confirmed Longstreth et al.'s finding that parental IQ is a major independent determinant of offspring IQ, but have also found that home environment measures have significant though in general smaller influences on offspring IQ independent of parental IQ. Recent studies with infants (Baker et al., 1983; Yeates et al., 1983) also suggest the possibility that the absolute and relative influences of parental cognitive abilities and home environment on offspring cognitive abilities may vary with age. A study by Johnson and Nagoshi (1984), using cognition data from HFSC families of Caucasian and Japanese ancestries and from a sample of Koreans living in Korea (see Park et al., 1978), found highly significant effects of parental cognitive abilities on offspring cognition independent of parental educational and occupational attainment for all groups and significant but smaller independent influences of parental status on offspring cognition for the Hawaii groups. For the Korean sample, however, where parents grew up in an essentially non-meritocratic (i.e., where ascribed status rather than personal attributes are the major determinants of achievement) society, parental education/occupation was only modestly correlated with offspring cognitive abilities, and these correlations were essentially reduced to zero when parental cognitive abilities were partialed out. These results for Koreans were similar to the results from a study by Ho (1979) on Hong Kong students. On the other hand, there is also empirical evidence that genetic influences on IQ are more greatly expressed in more advantaged (i.e., higher SES) environments than in less advantaged environments (Fischbein, 1980; Scarr-Salapatek, 1971), and the possibility that genetic and environmental correlations are themselves correlated is discussed in Plomin et al. (1980).

Studies of the relationship between shared home environment and offspring personality have typically been flawed by even more serious measurement problems, given the conceptual problems of defining both environment and personality, than in the cognitive domain. There has also been a lack of any generally accepted theory causally linking environmental variables to specific aspects of personality development. For these reasons, recently developed standardized measures of home environment have not been generally applied to the study of personality development, nor has consideration been given for the mediating effects of parental personality and ability on the correlations (if any) between shared home environment and offspring personality. McClelland and Pilon's (1983) follow-up after 26-27 years of offspring of families rated on an extensive list of childrearing practices found that scheduling of feeding and severity of toilet training were significantly associated with adult need for achievement and parental permissiveness for sexual and aggressive behaviors was significantly associated with adult need for power, but these personality variables (need for affiliation was also assessed) were not significantly correlated with the major dimensions of the home environment measure. Based on the lack of personality resemblance between adoptive parents and their adopted children, Loehlin et al. (1981) concluded that shared family environment had little influence on offspring personality development. Rowe and Plomin (1981) suggested that non-shared family environmental influences (i.e., those differential influences within families that tend to make siblings different from each other) may be the major determinant of offspring personality development and is probably also a major factor in offspring cognitive development.

Differences in parent-offspring associations across ethnic groups

The presence of large numbers of families of Caucasian, Japanese, and Chinese ancestry in the Hawaii Family Study of Cognition provide an opportunity for the testing of ethnic-group specific cohort effects on familial influences in offspring cognitive and personality development. Hawaii, until after World War II, was dominated by Caucasian business interests, while residents of Chinese and of Japanese ancestry (or their immediate forebearers) had been imported as plantation laborers and still had not gained substantial economic or political power (see Daws, 1968; Lind, 1980). The parents of the HFSC parents (i.e., the grandparents of the HFSC offspring generation) of Chinese and Japanese ancestries had far less education than did the parents of the Caucasian parent sample (Ahern et al., 1983) and were of considerably lower occupational status (Johnson et al., 1983b). In contrast, the offspring in the HFSC came from closely comparable, relatively advantaged homes, but with Caucasians at some disadvantage in terms of educational attainment, income, and political influence (Daws, 1968; Lind, 1980). Historical change has thus been much greater for HFSC families of Chinese and Japanese ancestry than for those of Caucasian ancestry, and differences across these groups in across-generational correlations may reflect the influence of group-specific cohort effects. In addition, there is evidence that, at least with regard to education, the status of women changed more than that of men across the generations involved in the HFSC (Ahern et al., 1983). While some cohort effects (i.e., historical, environmental changes) are probably present for all groups, if such cohort effects are important influences on behavior development, one would expect to obtain differential across-generational correlations across

ethnic groups and perhaps across sexes for the behaviors being considered.

As reported above, heritability estimates for cognitive abilities and personality traits are generally lower for HFSC AJA than for AEA families. Studies by DeFries et al. (1982), using HFSC cognition battery data, and Nagoshi and Johnson (1984), using HFSC WAIS data, both found highly significant ethnic group-by-generation interactions, with AEA offspring doing poorer than their parents, while AJA offspring did better than their parents on these cognitive tests. DeFries et al. also obtained significant sex-by-generation interactions, with daughters doing considerably better than their mothers on the tests. These large group-specific cohort effects provide some of the strongest evidence for the importance of environmental factors in the development of cognitive abilities. In contrast, studies by Johnson et al. (1983c, 1984) did not find significant ethnic group-by-age or sex-by-age interactions on HFSC measures of personality (Adjective Check List, Comrey, and 16PF scales), indicating that age-related changes in personality appeared to be a function of age and not cohort. Besides these across-generational analyses, the Johnson et al. (1983b) analyses of the educational and occupational attainments of the HFSC parent generation found that personal attributes were more closely associated with AJA than with AEA attainment, suggesting that degree of meritocracy was not negatively influenced by racial/ethnic differences in status in Hawaii.

Using data from HFSC families of Caucasian and Japanese ancestries, all of whom completed the HFSC cognition battery and a home environment questionnaire and most of whom also completed the Adjective Check List, the present paper will present the within-generation correlations of the HFSC cognition factors with Adjective Check List factors separately by ethnic

group, generation, and sex. Correlations of parental cognition and ACL factors with selected environmental variables, including educational and occupational attainment, visitors to and relatives in the home, print media and television usage, and the presence of offspring prenatal and developmental problems in the family, will be presented separately by ethnic group and sex. Correlations of parental cognitive abilities, ACL factors, and home environment variables with offspring cognitive abilities and ACL factors will be presented separately by ethnic group and by each of the four sex of parent/sex of offspring combinations. The combined influences of the parental variables (i.e., the combined influences of genetic and environmental shared familial factors) on offspring cognition and personality will be assessed through hierarchal multiple regression procedures rather than path analyses, although the data is amenable to the latter (spouse correlations for cognitive abilities (DeFries et al., 1979) and personality (Ahern et al., 1982) are also available). Direction and priority of causality are problematic for both path analysis (Goldberger, 1978; Loehlin, 1978) and multiple regression analysis, but the assumptions and results of multiple regressions are more explicit and interpretable.

METHODOLOGY

Subjects

As briefly described earlier, the Hawaii Family Study of Cgonition (HFSC) was a large-scale study of familial factors (genetic and environmental) in mental ability (see DeFries et al., 1979, and Wilson et al., 1975, for further descriptions of the HFSC). Families (both biological parents, 60 years of age or younger, and one or more of their offspring, 13 years of age or older) living on the island of Oahu were solicited by letter, by radio and television announcements, by contacting clubs and organizations, and by personal referral from previous participants. A check for $50 was given to each family immediately after they completed all test procedures. A total of 1816 families (6581 individuals) were ultimately recruited and completed the battery of cognitive tests and the home environment questionnaire described below. A majority of these subjects (3402 individuals in 1554 families) also completed the Adjective Check List (Gough & Heilbrun, 1965). The present analyses will employ the data obtained from families of Caucasian (AEA) and Japanese (AJA) ancestry. The numbers of subjects are presented in Table 1 by ethnic group, generation, and sex.

Measures

Cognitive abilities. The HFSC cognitive test battery consisted of Primary Mental Abilities (PMA) Vocabulary, Visual Memory (immediate recall), Things (a fluency test), Sheppard-Metzler Mental Rotations, Subtraction and Multiplication, Elithorn Mazes ("lines and dots"), Educational Testing Service (ETS) Word Beginnings and Endings, ETS Card Rotations, Visual Memory (delayed recall), PMA Pedigrees (a reasoning test), ETS Hidden

Table 1

Numbers of Subjects by Ethnicity, Generation, and Sex

	cognition battery	Adjective Check List
Americans of European Ancestry		
fathers	998	392
mothers	963	375
sons	716	391
daughters	740	401
Americans of Japanese Ancestry		
fathers	358	193
mothers	409	212
sons	262	156
daughters	266	174

Patterns, Paper Form Board, ETS Number Comparisons, Whiteman Test of Social Perception, and Raven's Progressive Matrices. These were brief paper-and-pencil tests meant to separately assess a number of different cognitive abilities. Measures of internal consistency (coefficient alpha or similar reliabilities) for these tests are reported in DeFries et al. (1979) and Wilson et al. (1975), while test-retest reliabilities are reported in DeFries et al. (1978). Principal component analyses with varimax rotation of these tests produced a four-factor solution, with the factors clearly representing verbal, spatial visualization, perceptual speed and accuracy, and visual memory ability (DeFries et al., 1979). This factor structure was found to be virtually identical for AEA and AJA subjects and across sexes (DeFries et al., 1979). The unrotated first principal component correlated 0.73 with full-scale Wechsler Adult Intelligence Test scores and may be regarded as a measure of "general intelligence" (Kuse, 1977). The factor scores used in the present study were age corrected by standardizing scores within age bands (Wilson et al., 1975).

Personality traits. The Adjective Check List (ACL) is a 300-adjective checklist originally scored by Gough and Heilbrun (1965) to yield 24 scale scores. Fifteen of the scale scores were developed on a rational or theoretical basis to measure the needs outlined by Murray (1938), five other scales were developed empirically on the basis of relevant criteria, while the remaining scales are primarily indices of test-taking behavior. Because of criticisms with regard to the lack of independence and psychometric properties of these scales (Masterson, 1974), it was decided to rescore the 300 items of the ACL, using the results of an item factor analysis by Parker and Veldman (1969).

Parker and Veldman's analyses yielded the following seven factors (alpha reliability coefficients calculated on the 3402 HFSC individuals who took the ACL, the number of adjectives loading on the factor, and some representative adjectives are given in parentheses): social desirability (0.90; 28 items; pleasant, kind, warm); interpersonal abrasiveness (0.65; 9 items; rude, lazy, foolish); ego organization (0.87; 20 items; industrious, thorough, efficient); introversion-extraversion (0.66; 8 items; quiet, silent versus talkative, outgoing); internal discomfort (0.79; 14 items; emotional, nervous, worrying); intraception (0.71; 9 items; reflective, unconventional, idealistic); and social attractiveness (0.76; 10 items; polished, clever, charming). All scales were corrected for number of adjectives checked by regressing the raw scale scores on number of adjectives checked and number of adjectives checked squared, then outputting the standardized residuals. Similar procedures were also used to correct the scales for age and age squared. Even with these corrections, however, several of the scales are still substantially correlated with each other, as can be seen in Table 2.

Shared home environment. All HFSC subjects completed an environmental questionnaire containing items on use of "pidgin" English (Hawaiian Creole) in the home, number of books and magazines read, television usage, and numbers of relatives, friends, and others living in or visiting the home. Parents reported on their educational attainment and occupation, with mothers also reporting on any pregnancy and developmental problems associated with each child in the study. From these diverse items, some of the more stable ones (in terms of number of subjects completing the item and its relationship to items used in other studies) were retained and two

Table 2

Significant Within-Generation Intercorrelations Among the ACL Factors by Ethnicity, Generation, and Sex[a]

	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
ACL social desirability							
fathers		-.31***	.13**		-.44***	-.23***	
mothers		-.41***	.18***		-.42***	-.10*	
sons		-.32***			-.21***	-.17***	
daughters		-.35***	.21***		-.37***	-.22***	
ACL interpersonal abrasiveness							
fathers	-.33***		-.48***	.11*	.25***	-.11*	-.22***
mothers	-.28***		-.49***		.16**	-.14**	-.11*
sons	-.29***		-.49***		.11*	-.10*	-.18***
daughters	-.31***		-.49***		.27***	-.11*	-.18***
ACL ego organization							
fathers	.16*	-.50***			-.40***	-.13*	
mothers	.16*	-.43***			-.44***		
sons		-.46***			-.33***		
daughters		-.48***			-.43***		-.10*
ACL introversion-extraversion							
fathers						-.12*	-.11*
mothers						-.18***	-.24***
sons							-.17***
daughters							-.16***
ACL internal discomfort							
fathers	-.51***	.38***	-.54***			.10*	-.16**
mothers	-.48***	.26***	-.44***	.14*			-.15***
sons	-.27***	.25**	-.40***			-.15**	-.16**
daughters	-.37***	.36***	-.49***				-.25***
ACL intraception							
fathers	-.26***			-.20**			
mothers	-.24***						.24***
sons	-.32***						-.12*
daughters	-.23**						
ACL social attractiveness							
fathers				-.29***	-.24***		
mothers		-.20***		-.20**	-.23***		
sons		-.27***	.28***	-.21**	-.21**		
daughters	-.19*				-.18*		

a - AEA subjects above diagonal, AJA subjects below diagonal. See Table 1 for N's.

* $p < .05$
** $p < .01$
*** $p < .001$

new scales were computed to be used in the present analyses. Only the parental environmental questionnaire results were used.

As noted above, parents provided information on their own years of education, from which educational attainment is quantified, and occupation. Occupational level (an indicator of SES) was quantified using Duncan's National Opinion Research Council (NORC) rating system (Reiss et al., 1961), with only those mothers employed outside of the home included for analyses involving mother's NORC rating. Studies (see Harasmiw et al., 1977, for a review and new data) have confirmed the reliability, stability over time, and meaningfulness in American society of the concept of occupational status as measured by NORC ratings. Data also indicate that NORC scores are highly comparable in all industrialized countries (Hodge et al., 1966).

Among the single-item home environment variables retained as being possibly important in influencing offspring cognition and personality were the number of family members visiting the home per month, the number of non-family members visiting the home per month, and the number of relatives living in the home. The environmental questionnaire for parents also contained single items on the number of magazines read each month, the number of books read each month, and the number of books in the home, as well as items on the frequency of television viewing for each of a number of different kinds of TV programs (daytime serials, quiz and game shows, cartoons, newscasts, talk shows sports, movies, comedy series, drama or adventure series, variety-entertainment shows, and documentary shows). These items were all responded to on 5-point categorical scales. For the purposes of the present analyses, the magazines and books read, books in the home, and the watching of TV news and documentary shows items were

summed to produce a rough scale of parental media use for informational purposes, while the remaining TV items were summed to produce a scale of parental media use for entertainment purposes. The pidgin English variables were not included in these analyses, since only the non-AEA parents reported a significant amount of pidgin English usage in the home. On the average, use of pidgin English in the home was correlated -0.15 and use of standard English 0.15 with AJA offspring verbal ability and first principal component scores, while no significant correlations were found for AEA families on these variables.

Another possibly important aspect of shared family environment is the physiological variation between mothers in the quality of the prenatal environment they provide to all of their offspring. Using responses from the HFSC mother's environmental questionnaire, mothers were scored in terms of whether they reported any pregnancy or delivery problem (difficulty in getting pregnant, Rh incompatibility, difficult pregnancy, delayed labor, difficult labor, very quick labor, delivery problems, premature birth, minor physical abnormalities, major physical abnormalities) for any of their children, whether they reported any developmental problem (frequent but minor illnesses, serious infant or early childhood illness, accidental serious head injury during infancy or childhood, slower than normal development, specific learning disability, slow learner, mentally retarded, emotionally disturbed) for any of their children, and for the number of prenatal and early infant deaths (stillborn or death before 1 year, miscarriage or spontaneous abortion). Associations of these three variables with offspring cognition and personality may indicate the influence of shared prenatal environment on later development. The correlations among

all the environmental measures used in the present study are presented in Table 3. With the important exception of the intercorrelations among the parental education, occupation, and media use variables, the diverse variables used are surprisingly independent of each other.

Table 3

Significant Intercorrelations Among the Parental Environmental Variables by Ethnicity and Sex[a]

	occup. (NORC)	educ.	family visits	non-fam. visits	relatives in home	inform. media	enter. media	preg. problems	dev. problems	prenatal deaths
occupation (NORC)										
fathers (987/387)[b]		.47***			-.07*	.09**	-.27***			
mothers[c] (293/316)		.41***				.12*	-.20***			
education (years)										
fathers (1024/389)	.49***		-.10***	.07*		.14***	-.28***			
mothers (991/441)	.52***				-.07*	.21***	-.29***			
# family visits per month										
fathers (817/370)							.07*			
mothers (689/386)				.10*						
# non-family visits per month										
fathers (764/230)			.19**		.09*	.11**				
mothers (551/193)			.20**			.09*				
# relatives living in home										
fathers (1027/395)		.11*								
mothers (997/442)				.15*		-.06*		.09**	.12***	
information media use										
fathers (992/359)	.28***	.31***	.14*				.14***			
mothers (944/393)	.25***	.29***					.07*			.08*
entertainment media use										
fathers (956/332)	-.19***									
mothers (908/383)	-.17**	-.15**				.21***				-.07*
pregnancy problems reported										
mothers (998/446)									.26***	.13***
developmental problems rep.										
mothers (998/446)		.10*						.27***		.08*
# prenatal or infant deaths										
mothers (998/446)								.12*		

a - AEA subjects above diagonal, AJA subjects below diagonal. b - N of AEA subjects/N of AJA subjects.
c - mothers employed outside of the home.
* $p < .05$ ** $p < .01$ *** $p < .001$

RESULTS

In evaluating the various significant correlations to be presented in Tables 4 to 12, several qualifiers need to be kept in mind. The first qualifier is that, given the large number of possible correlations in each of the tables, a certain number of correlations would be expected to be found significant just due to chance, e.g., of the 280 possible correlations (5 cognition scales by 7 ACL scales by 2 ethnic groups by 2 generations by 2 sexes) in Table 4, 14 would be expected to be found significant at the .05 level if the correlations are independent of each other. The second qualifier is that, in fact, many of the correlations are not independent of each other. The intercorrelations among the ACL scales and the environmental variables have already been presented in Tables 2 and 3, respectively, but it should also be remembered that the first principal component of the cognition battery is a linear combination of and hence correlated with the four cognition factors. The third qualifier is that, given the great variability in N's for different measures and across ethnic groups, generations, and sexes, correlations will also vary in the magnitudes required to achieve statistical significance. On the other hand, given the large N's for some of the correlations, a correlation found to be statistically significant may be practically trivial in magnitude. A fourth qualifier is that the magnitudes of correlations may be affected by the differential reliabilities of the various measures used. The alpha reliabilities reported for the ACL scales in the Methodology section are in general lower than the reliabilities reported for the HFSC cognition battery reported in deFries et al. (1979) and Wilson et al. (1975), and the reliabilities for the items on the environmental questionnaire are mostly

unknown. For the above reasons, "meaningful" correlations will be discussed in this section only if the number of significant correlations in a table is greater than what would be expected by chance and the correlations themselves are large in magnitude, consistent with previous research, consistent across several measures, and/or consistent across ethnic groups, generations, and sexes.

Relationships among the variables within generations

Table 4 presents the significant within-generation correlations of the cognition factors with the ACL personality factors. Of the 280 possible correlations, 64 are signifcant, clearly far more than would be expected by chance. The most consistent finding in this table is the positive correlation between ACL intraception and verbal ability and first principal component scores. ACL intraception is conceptually similar to 16PF Imaginative and Comrey Rebelliousness, and its association with verbal ability is consistent with the studies by Turner and Horn (1977), Nagoshi et al. (1982), and Johnson et al. (1983a). ACL internal discomfort, a neuroticism versus emotional stability measure, was found to be negatively correlated with spatial but not verbal ability, while previous studies had found a moderately negative relationship of neuroticism with both types of cognitive measures. There was some evidence that ACL ego organization, similar to 16PF Self-Sufficiency, was positively related to all of the cognition factors, and as with the studies cited above, ACL introversion-extraversion was not found to be related to cognitive ability. These significant associations of cognitive abilities and personality traits had a high degree of consistency across ethnic groups, generations, and sexes.

Table 5 presents the significant correlations of the cognition factors

Table 4

Significant Within-Generation Correlations of Cognition Factors with ACL Factors by Ethnicity, Generation, and Sex

Americans of European Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
verbal factor							
fathers (N = 384)						.19***	
mothers (N = 365)					-.21***	.35***	.24***
sons (N = 382)	-.13*		.12*			.25***	
daughters (N = 393)	-.22***					.31***	
spatial factor							
fathers					-.17***		-.12*
mothers					-.19***		
sons			.15**		-.10*		
daughters					-.14**		
perceptual speed factor							
fathers	.18***	-.15**		.11*			
mothers			.18***			-.11*	
sons		-.14**	.16**				
daughters							
visual memory factor							
fathers							
mothers			.13*	-.11*			
sons	.11*						
daughters							
first principal component							
fathers			.10*		-.18***	.12*	
mothers			.19***		-.30***	.19***	.21***
sons		-.13*	.23***		-.10*	.25***	
daughters	-.14**				-.15**	.22***	

* p < .05
** p < .01
*** p < .001

Table 4 (continued)

Americans of Japanese Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
verbal factor							
fathers (N = 175)	-.22***					.33***	
mothers (N = 202)			.15*			.35***	-.14*
sons (N = 155)						.25**	
daughters (N = 172)	-.25***					.31***	
spatial factor							
fathers		-.15*	.17*		-.17*		
mothers			.17*		-.14*		
sons							.19*
daughters							-.16*
perceptual speed factor							
fathers					-.16*		
mothers						-.23***	
sons							.18*
daughters							
visual memory factor							
fathers							
mothers							
sons							
daughters							
first principal component							
fathers			.23**		-.20**	.20**	
mothers			.23***				
sons							
daughters		-.15*				.25***	-.22**

* p < .05
** p < .01
*** p < .001

Table 5

Significant Correlations of Parental Cognition Factors and Environmental Variables by Ethnicity and Sex

Americans of European Ancestry	occup. (NORC)	educ.	family visits	non-fam. visits	relatives in home	inform. media	enter. media	preg. problems	dev. problems	prenatal deaths
verbal factor										
fathers	.34***	.37***	-.09**			.22***	-.18***			
mothers	.29***	.42***				.30***	-.26***	.07*		.09**
spatial factor										
fathers	.14***	.17***	-.09*				-.13***			
mothers	.15**	.18***					-.18***			
perceptual speed factor										
fathers	.09**	.13***								
mothers		.09**	-.13***					-.08*		-.07*
visual memory factor										
fathers										
mothers								.09**		
first principal component										
fathers	.36***	.41***	-.12***			.16***	-.19***			
mothers	.31***	.41***	-.09*			.21***	-.28***			
N's										
fathers	958	993	795	748	996	965	931			
mothers	284	957	664	532	962	916	881	962	962	962

* p < .05
** p < .01
*** p < .001

Table 5 (continued)

Americans of Japanese Ancestry	occup. (NORC)	educ.	family visits	non-fam. visits	relatives in home	inform. media	enter. media	preg. problems	dev. problems	prenatal deaths
verbal factor										
fathers	.49***	.46***				.39***				
mothers	.49***	.51***				.33***	-.17***		.11*	
spatial factor										
fathers		.11*								
mothers		.16***						.10*	.11*	
perceptual speed factor										
fathers	.30***	.15**								
mothers	.32***	.15**				-.10*	-.10*			
visual memory factor										
fathers	.18***									
mothers			.11*		.10*					
first principal component										
fathers	.52***	.43***				.28***				
mothers	.52***	.48***				.21***	-.20***	.12*	.13**	
N's										
fathers	350	353	336	214	357	331	311			
mothers	296	405	359	181	407	372	363	409	409	409

* p < .05
** p < .01
*** p < .001

of parents with their environmental questionnaire variables. Of the 170 possible correlations, 65 are significant, and it is clear these significant correlations are associated with only 4 of the environmental variables. As was reported in Johnson et al. (1983b), cognitive abilities, particulary verbal ability and general intelligence (first principal component), are highly positively associated with occupational and educational attainment for AEA and AJA fathers and mothers (for mothers employed outside of the home). Verbal ability and the first principal component were also consistently positively associated with the use of information media and negatively associated with the use of entertainment media (i.e., generalized television viewing). The other home environment variables were not found to be consistently related to cognitive abilities.

Table 6 presents the significant correlations of the ACL factors of parents with their environmental questionnaire variables. Of the 238 possible correlations, 43 are significant and mostly associated with the same environmental questionnaire variables that were significant in Table 5. As was reported in Johnson et al. (1983b), ACL ego organization and intraception are positively related and ACL internal discomfort is negatively related to educational attainment, with a few correlations indicating similar relationships for occupational attainment. These results were generally consistent for both AEA and AJA fathers and mothers. The only other consistent findings are the positive correlations between ACL intraception and information media use and negative correlations between ACL intraception and entertainment media use.

Overall, the results presented in Table 4, 5, and 6 indicate that in many instances there are substantial relationships between cognitive abilities,

Table 6

Significant Correlations of Parental ACL Factors and Environmental Variables
by Ethnicity and Sex

Americans of European Ancestry	occup. (NORC)	educ.	family visits	non-fam. visits	relatives in home	inform. media	enter. media	preg. problems	dev. problems	prenatal deaths
ACL social desirability										
fathers										
mothers				.17*						
ACL interpersonal abrasiveness										
fathers		-.13*								
mothers										
ACL ego organization										
fathers	.11*	.18***								
mothers		.25***					-.14*			
ACL introversion-extraversion										
fathers										
mothers				-.20**						
ACL internal discomfort										
fathers		-.16**					.11*			
mothers		-.23***					.21***			.12*
ACL intraception										
fathers	.18***	.29***	-.18**			.16**	-.20***			
mothers		.27***		-.15*		.20***	-.24***			
ACL social attractiveness										
fathers										
mothers		.14**		-.17**	-.11*		-.11*			
N's										
fathers	369	391	299	284	391	375	364			
mothers	127	371	264	214	375	351	336	375	375	375

* p < .05
** p < .01
*** p < .001

Table 6 (continued)

Americans of Japanese Ancestry	occup. (NORC)	educ.	family visits	non-fam. visits	relatives in home	inform. media	enter. media	preg. problems	dev. problems	prenatal deaths
ACL social desirability										
fathers										
mothers					.14*					
ACL interpersonal abrasiveness										
fathers	-.17*									
mothers		-.16*								
ACL ego organization										
fathers	.34***	.27***					-.24**			
mothers		.19**				.19**				
ACL introversion-extraversion										
fathers										
mothers										
ACL internal discomfort										
fathers	-.15*	-.16*								
mothers		-.20**								
ACL intraception										
fathers		.30***					-.19*			
mothers		.34***				.34***	-.17*			
ACL social attractiveness										
fathers		-.14*		.22*						
mothers										
N's										
fathers	188	191	176	113	193	171	160			
mothers	153	211	191	92	211	194	185	212	212	212

* p < .05
** p < .01
*** p < .001

personality traits, and home environment, and this should be kept in mind when considering the relationship of the parental variables with offspring cognition and personality.

Relationships of parental variables with offspring variables

The offspring cognition and ACL factor scores used in the across-generation analyses to be presented are mid-son and mid-daughter scores, i.e., means for all sons in a family and means for all daughters in a family. Mid-son and mid-daughter rather than single offspring scores are used so that families rather than offspring (with the resulting repetition of parental data for families with more than one offspring) are the units of analysis. This use of families as the units of analysis does reduce the N's for the parent-offspring correlations, thus making it less likely that correlations will achieve statistical significance, but this is partially offset by the greater reliability of means calculated across several offspring.

Table 7 presents the significant correlations of the cognition factors of parents with the cognition factors of offspring. Of the 200 possible correlations, 82 are significant. The on-diagonal correlations, i.e., parent-offspring resemblance on the same cognitive ability, have been reported in DeFries et al. (1979) and are in general consistently significant across the different cognitive factors (lower on the visual memory factor), across ethnic groups (except for verbal ability, somewhat lower for AJA than for AEA families), and across the four parent-offspring combinations. As noted in the Introduction, parent-offspring resemblances in general intelligence (first principal component) in the HFSC are clearly lower than the 0.50 average correlation reported in earlier studies (Dixon & Johnson,

Table 7

Significant Correlations of Parental Cognition Factors and Offspring Cognition Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
verbal factor					
father-son (N = 555)	.24***				.15***
father-daughter (N = 551)	.30***		-.09*		.21***
mother-son (N = 551)	.32***	.08*			.25***
mother-daughter (N = 556)	.28***	.18***			.26***
spatial factor					
father-son		.32***			.16***
father-daughter		.32***			.24***
mother-son		.28***			.19***
mother-daughter	.12**	.40***			.34***
perceptual speed factor					
father-son			.30***		.13***
father-daughter			.18***		.09*
mother-son		.13**	.23***		.18***
mother-daughter			.28***		.17***
visual memory factor					
father-son				.09*	
father-daughter				.18***	
mother-son				.13***	.08*
mother-daughter				.15***	
first principal component					
father-son	.16***	.24***			.28***
father-daughter	.24***	.27***			.35***
mother-son	.27***	.26***			.36***
mother-daughter	.26***	.36***			.42***

a - offspring scores are mid-son and mid-daughter scores.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 7 (continued)

parents/offspring Americans of Japanese Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
verbal factor					
father-son (N = 191)	.38***				.18*
father-daughter (N = 199)	.33***				.16*
mother-son (N = 194)	.36***				.28***
mother-daughter (N = 209)	.34***	.15*			.33***
spatial factor					
father-son	-.18*	.28***			
father-daughter		.30***			.23***
mother-son		.19**		.22**	.24***
mother-daughter		.14*			.14*
perceptual speed factor					
father-son		.21**	.20**		.21**
father-daughter			.15*		
mother-son			.18*		
mother-daughter					
visual memory factor					
father-son					
father-daughter					.17*
mother-son				.16*	
mother-daughter					
first principal component					
father-son		.23***			.24***
father-daughter	.32***	.14*			.32***
mother-son	.30***			.17*	.34***
mother-daughter	.31***	.18**			.32***

* p < .05
** p < .01
*** p < .001

1980; Plomin et al., 1980), although still highly statistically significant. The off-diagonal parent-offspring correlations in Table 7 are generally non-significant for the specific cognitive factors, indicating that these cognition factors, orthogonally defined within generations, may in fact be developmentally distinct cognitive abilities. The significant correlations involving parent and offspring first principal components are thus a function of the additive influence of parent-offspring resemblances on each cognitive ability and not to some global influence affecting several abilities.

Table 8 presents the significant correlations of the ACL factors of parents with the ACL factors of offspring. Of the 392 possible correlations, only 36 are significant, where 20 would be expected by chance, and these significant correlations do not form any easily interpretable pattern, since they vary considerably across scales, ethnic groups, and the four parent-offspring combinations. Clearly, familial effects for these personality measures are much weaker than for cognitive abilities and are not confined to parent-offspring resemblances on the same measures.

Table 9 presents the significant correlations of the cognition factors of parents with the ACL factors of offspring. Of the 280 possible correlations, only 18 are significant, barely more than the 14 expected by chance. As with Table 8, these significant correlations vary considerably across scales, ethnic groups, and the four parent-offspring combinations, making any interpretation tenuous.

Table 10 presents the significant correlations of the ACL factors of parents with the cognition factors of offspring. Of the 280 possible correlations, 28 are significant, but the only consistent finding seems to be that for AEA families parental ACL intraception is positively related to

Table 8

Significant Correlations of Parental ACL Factors and Offspring ACL Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
ACL social desirability							
father-son (N = 199)							
father-daughter (N = 213)	.15*	-.14*					
mother-son (N = 198)					-.15*		
mother-daughter (N = 213)				.14*			
ACL interpersonal abrasiveness							
father-son			-.19**				
father-daughter		.18**	-.16*				
mother-son							
mother-daughter							
ACL ego organization							
father-son							
father-daughter			.14*				
mother-son							
mother-daughter							
ACL introversion-extraversion							
father-son							
father-daughter							
mother-son							
mother-daughter					.15*		
ACL internal discomfort							
father-son							
father-daughter			-.14*				
mother-son					.26***		
mother-daughter							
ACL intraception							
father-son						.17*	
father-daughter							
mother-son			.20**				
mother-daughter							
ACL social attractiveness							
father-son				-.15*		.15*	
father-daughter		-.16*	.16*		-.17		.29***
mother-son	.17*						
mother-daughter			.19**		-.20**		

a - offspring scores are mid-son and mid-daughter scores.
* $p < .05$
** $p < .01$
*** $p < .001$

Table 8 (continued)

parents/offspring Americans of Japanese Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
ACL social desirability							
father-son (N = 94)							
father-daughter (N = 109)							
mother-son (N = 94)							
mother-daughter (N = 110)							
ACL interpersonal abrasiveness							
father-son			-.23*				
father-daughter		.22*					
mother-son		.25*	-.22*				-.30**
mother-daughter							
ACL ego organization							
father-son			.26*				.21*
father-daughter		-.22*					
mother-son							
mother-daughter							
ACL introversion-extraversion							
father-son							
father-daughter							
mother-son							
mother-daughter							
ACL internal discomfort							
father-son							
father-daughter							
mother-son							
mother-daughter				.21*			
ACL intraception							
father-son		.21*					
father-daughter	-.28**						
mother-son						.24*	
mother-daughter							
ACL social attractiveness							
father-son							
father-daughter				.24*			
mother-son				.21*			
mother-daughter							

* $p < .05$
** $p < .01$
*** $p < .001$

Table 9

Significant Correlations of Parental Cognition Factors and Offspring ACL Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
verbal factor							
father-son (N = 283)						.12*	
father-daughter (N = 294)							
mother-son (N = 282)							
mother-daughter (N = 296)							.13*
spatial factor							
father-son				.12*			
father-daughter							
mother-son							
mother-daughter					-.16**	.12*	
perceptual speed factor							
father-son							
father-daughter						.13*	
mother-son							
mother-daughter							
visual memory factor							
father-son							
father-daughter							
mother-son							
mother-daughter					-.14*		
first principal component							
father-son			.15*	.12*			
father-daughter							
mother-son							
mother-daughter					-.19***	.12*	

a - offspring scores are mid-son and mid-daughter scores
* p < .05
** p < .01
*** p < .001

Table 9 (continued)

parents/offspring Americans of Japanese Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract
verbal factor							
father-son (N = 122)							
father-daughter (N = 126)						.22*	
mother-son (N = 120)						.21*	
mother-daughter (N = 138)							
spatial factor							
father-son							
father-daughter							
mother-son	-.18*						
mother-daughter				-.17*			
perceptual speed factor							
father-son							
father-daughter							
mother-son		.21*					
mother-daughter							
visual memory factor							
father-son	-.20*						
father-daughter							
mother-son							
mother-daughter							
first principal component							
father-son							
father-daughter							
mother-son	-.21*						
mother-daughter							

* $p < .05$
** $p < .01$
*** $p < .001$

Table 10

Significant Correlations of Parental ACL Factors and Offspring Cognition Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
ACL social desirability					
father-son (N = 201)					
father-daughter (N = 214)					-.16*
mother-son (N = 199)	-.19**				-.17*
mother-daughter (N = 213)					
ACL interpersonal abrasiveness					
father-son					
father-daughter					
mother-son					
mother-daughter					
ACL ego organization					
father-son			.20**		
father-daughter					
mother-son					.17*
mother-daughter		.15*			
ACL introversion-extraversion					
father-son					
father-daughter					
mother-son				-.14*	
mother-daughter					
ACL internal discomfort					
father-son					
father-daughter					
mother-son					
mother-daughter					
ACL intraception					
father-son	.18*	.18**			.19**
father-daughter	.20**				.14*
mother-son	.29***				.22***
mother-daughter					
ACL social attractiveness					
father-son					
father-daughter					
mother-son					
mother-daughter					

a - offspring scores are mid-son and mid-daughter scores.

* $p < .05$
** $p < .01$
*** $p < .001$

Table 10 (continued)

parents/offspring Americans of Japanese Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
ACL social desirability					
father-son (N = 94)					
father-daughter (N = 111)					
mother-son (N = 95)					
mother-daughter (N = 112)					
ACL interpersonal abrasiveness					
father-son					
father-daughter					
mother-son		-.22*			-.30**
mother-daughter					
ACL ego organization					
father-son		.25*			
father-daughter					.29**
mother-son	.28**				
mother-daughter					
ACL introversion-extraversion					
father-son		.39***			.31**
father-daughter			.24**		
mother-son	-.21*				
mother-daughter					
ACL internal discomfort					
father-son					-.23*
father-daughter		-.21*			-.30**
mother-son					
mother-daughter					
ACL intraception					
father-son					-.23*
father-daughter					
mother-son					
mother-daughter					
ACL social attractiveness					
father-son		-.26*			
father-daughter					
mother-son					
mother-daughter					

* $p < .05$
** $p < .01$
*** $p < .001$

offspring verbal ability and general intelligence. Other significant correlations, if not merely due to chance, are associated with only one of the ethnic groups and/or particular parent-offspring combinations.

Table 11 presents the significant correlations of home environment variables reported by parents with the cognition factors of offspring. Of the 340 possible correlations, 80 are significant, with the great majority of these on the same 4 environmental variables that were significant in Tables 5 and 6. As was reported in Johnson and Nagoshi (1984), parental occupational and educational attainment is consistently positively related to offspring verbal factor and first principal component scores. The Johnson and Nagoshi study found that although parental education/occupation is highly correlated with parental cognitive ability and is clearly not as strong a predictor of offspring cognitive ability as is parental cognitive ability, parental education/occupation still accounted for a small but significant amount of the variation in offspring cognitive ability, even after partialing out parental cognitive ability. From Table 11 it can also be seen that parental use of information media, which is correlated with parental verbal ability (Table 5), occupation, and education (Table 3), is significantly positively related to offspring verbal ability, while for AEA families, there was also a negative relationship between parental entertainment media use and offspring verbal ability.

Table 12 presents the significant correlations of home environment variables reported by parents with the ACL factors of offspring. Of the 476 possible correlations, only 35 are significant, where 24 would be expected by chance. The only consistent finding across both ethnic groups is that parents' report of the number of relatives living in the home is

Table 11

Significant Correlations of Parental Environmental Variables and Offspring Cognition Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
occupation (NORC)					
father-son (N = 549)	.11*	.10*			.15***
father-daughter (N = 554)	.14***	.11**			.17***
mother-son (N = 147)					
mother-daughter (N = 171)			.18*		.22**
education (years)					
father-son (N = 565)	.23***	.12**	.08*		.26***
father-daughter (N = 571)	.23***	.18***			.27***
mother-son (N = 563)	.18***	.17***			.24***
mother-daughter (N = 568)	.25***	.16***			.27***
# family visits per month					
father-son (N = 444)					
father-daughter (N = 450)					
mother-son (N = 373)			-.12*		
mother-daughter (N = 393)					
# non-family visits per month					
father-son (N = 432)					
father-daughter (N = 432)					
mother-son (N = 299)					
mother-daughter (N = 328)					
# relatives living in home					
father-son (N = 566)				.08*	
father-daughter (N = 573)					
mother-son (N = 566)					
mother-daughter (N = 572)					
information media use					
father-son (N = 553)	.16***				.15***
father-daughter (N = 555)	.10*				
mother-son (N = 537)	.17***	.08*			.17***
mother-daughter (N = 540)	.19***				.13**
entertainment media use					
father-son (N = 533)	-.11**				-.10*
father-daughter (N = 541)	-.25***	-.09*			-.18***
mother-son (N = 520)	-.13**				-.11**
mother-daughter (N = 517)	-.16***	-.12**			-.17***
pregnancy problems reported					
mother-son (N = 566)					
mother-daughter (N = 573)					
developmental problems rep.					
mother-son (N = 566)	-.12**		-.18***		-.17***
mother-daughter (N = 573)		-.10*	-.20***		-.17***
# prenatal or infant deaths					
mother-son (N = 566)					
mother-daughter (N = 573)	.13***				.11**

a - offspring scores are mid-son and mid-daughter scores.
* p < .05
** p < .01
*** p < .001

Table 11 (continued)

parents/offspring Americans of Japanese Ancestry	verbal factor	spatial factor	perc. speed factor	vis. memory factor	1st prin. comp.
occupation (NORC)					
father-son (N = 204)	.22***				.17*
father-daughter (N = 218)	.33***				.21**
mother-son (N = 152)	.20*				
mother-daughter (N = 168)	.31***				.22***
education (years)					
father-son (N = 205)	.16*		-.15*		
father-daughter (N = 217)	.23***				.21**
mother-son (N = 206)	.21**				.19**
mother-daughter (N = 220)	.25***				.22***
# family visits per month					
father-son (N = 195)	.17*				.15*
father-daughter (N = 207)					
mother-son (N = 183)					
mother-daughter (N = 196)					
# non-family visits per month					
father-son (N = 125)					
father-daughter (N = 124)					
mother-son (N = 94)					
mother-daughter (N = 102)			-.22*		
# relatives living in home					
father-son (N = 207)					
father-daughter (N = 223)					
mother-son (N = 206)					-.15*
mother-daughter (N = 222)					
information media use					
father-son (N = 192)	.22**		-.19**		
father-daughter (N = 200)	.26***	-.15*			
mother-son (N = 186)	.20**				.14*
mother-daughter (N = 199)	.22**			-.15*	
entertainment media use					
father-son (N = 181)		-.15*			
fahter-daughter (N = 179)					
mother-son (N = 183)					
mother-daughter (N = 199)					
pregnancy problems reported					
mother-son (N = 207)					
mother-daughter (N = 224)					
developmental problems rep.					
mother-son (N = 207)					
mother-daughter (N = 224)			-.24***		
# prenatal or infant deaths					
mother-son (N = 207)	.17*				
mother-daughter (N = 224)	.15*				

* p < .05
** p < .01
*** p < .001

Table 12

Significant Correlations of Parental Environmental Variables and Offspring ACL Factors by Ethnicity and Sex[a]

parents/offspring Americans of European Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract
occupation (NORC)							
father-son (N = 278)							
father-daughter (N = 286)						.12*	
mother-son (N = 91)				-.27**			
mother-daughter (N =108)					-.19*		
education (years)							
father-son (N = 287)						.24***	
father-daughter (N = 300)						.13*	
mother-son (N = 285)				-.13*		.18**	
mother-daughter (N = 297)						.12*	
# family visits per month							
father-son (N = 218)					.17*		
father-daughter (N = 223)							
mother-son (N = 190)							
mother-daughter (N = 203)							
# non-family visits per month							
father-son (N = 216)							
father-daughter (N = 222)							
mother-son (N = 153)							-.19*
mother-daughter (N = 174)						.16*	
# relatives living in home							
father-son (N = 288)						-.16**	
father-daughter (N = 302)	.17**					-.19***	
mother-son (N = 288)						-.14*	
mother-daughter (N = 302)	.19***					-.20***	
information media use							
father-son (N = 279)			.12*				
father-daughter (N = 292)							
mother-son (N =273)							
mother-daughter (N = 284)	-.12*						
entertainment media use							
father-son (N = 272)						-.19**	
father-daughter (N = 286)						-.18**	
mother-son (N = 261)							
mother-daughter (N = 275)						-.16**	
pregnancy problems reported							
mother-son (N = 288)							
mother-daughter (N = 302)							
developmental problems rep.							
mother-son (N = 288)							
mother-daughter (N = 302)							
# prenatal or infant deaths							
mother-son (N = 288)							
mother-daughter (N = 302)							

a - offspring scores are mid-son and mid-daughter scores.

* p < .05
** p < .01
*** p < .001

Table 12 (continued)

parents/offspring Americans of Japanese Ancestry	ACL social desir.	ACL interp. abras.	ACL ego organ.	ACL intro.-extra.	ACL intern. discom.	ACL intra-ception	ACL social attract.
occupation (NORC)							
father-son (N = 126)					-.18*		
father-daughter (N = 138)							
mother-son (N = 96)							
mother-daughter (N = 103)			.21*				
education (years)							
father-son (N = 127)							
father-daughter (N = 137)				-.18*			
mother-son (N = 127)							
mother-daughter (N = 138)							
# family visits per month							
father-son (N = 120)							
father-daughter (N = 130)							
mother-son (N = 115)							
mother-daughter (N = 127)							
# non-family visits per month							
father-son (N = 77)							
father-daughter (N = 75)							
mother-son (N = 57)							
mother-daughter (N = 65)							
# relatives living in home							
father-son (N = 128)	.20*					-.23**	
father-daughter (N = 142)							-.17*
mother-son (N = 128)	.22*					-.30***	
mother-daughter (N = 141)							
information media use							
father-son (N = 119)							
father-daughter (N = 128)							
mother-son (N = 117)							
mother-daughter (N = 130)						.18*	
entertainment media use							
father-son (N = 109)						-.23*	
father-daughter (N = 115)	.21*						
mother-son (N = 114)					.23*		
mother-daughter (N = 128)							
pregnancy problems reported							
mother-son (N = 128)							
mother-daughter (N = 142)							
developmental problems rep.							
mother-son (N = 128)							
mother-daughter (N = 142)							
# prenatal or infant deaths							
mother-son (N = 128)							
mother-daughter (N = 142)					-.17*		

* p < .05
** p < .01
*** p < .001

significantly negatively correlated with offsprings' ACL intraception scores. For AEA families, the data also indicate a significant positive correlation between parental education and offspring ACL intraception and a significant negative correlation between parental entertainment media use and offspring ACL intraception.

Table 13 presents the results of hierarchal multiple regression analyses of selected parental variables as predictors of offspring first principal component scores. The major question to be answered by these analyses is the extent to which offspring intelligence is predictable from the combination of several familial variables, i.e., the proportion of variation in offspring intelligence that can be accounted for by shared (between-family) familial factors. A second question, but one that is dependent upon the a priori ordering of predictor variables in the regression equation, concerns the testing of the independent influences of each of the predictor variables. Since in a hierarchal multiple regression variables entered later in an equation are only tested for the amount of explained variation of the dependent variable they account for that is not shared with predictor variables previously entered into the equation, a "fair" test of the independent influence of each predictor might have entailed running several regression equations with different orderings of predictor variables. Instead, it was decided to run a single regression equation using an ordering of predictors based on certain logical (and debatable) assumptions about the nature of the relationships among the variables. Parental variables given priority in the equation were those that were assumed to be more enduring in their effects on offspring intelligence and/or causally prior to later-entered predictor variables.

Table 13

Hierarchal Multiple Regressions of Parental Variables
on Offspring First Principal Component by Ethnicity and Sex

Americans of European Ancestry

dependent variable: mid-son's first principal component (N = 176)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's first principal component	.255			
father's first principal component	.143	.420	.176	18.52***
mother's ACL intraception	.060			
father's ACL intraception	-.015	.443	.020	2.09
mother's education	.038			
father's education	.193	.483	.037	4.12*
father's information media use	.088			
mother's information media use	.069	.498	.015	1.65

dependent variable: mid-daughter's first principal component (N = 184)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's first principal component	.337			
father's first principal component	.136	.435	.189	21.10***
father's ACL intraception	.029			
mother's ACL intraception	-.030	.442	.006	0.70
father's education	.173			
mother's education	-.003	.466	.022	2.44
father's information media use	-.049			
mother's information media use	.092	.474	.007	0.83

a - beta for final equation
* $p < .05$
** $p < .01$
*** $p < .001$

Table 13 (continued)

Americans of Japanese Ancestry

dependent variable: mid-son's first principal component (N = 71)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's first principal component	.419			
father's first principal component	.139	.460	.211	9.11***
father's ACL intraception	-.363			
mother's ACL intraception	.203	.562	.105	5.05**
father's education	.165			
mother's education	-.184	.585	.027	1.29
father's information media use	-.195			
mother's information media use	.134	.616	.037	1.85

dependent variable: mid-daughter's first principal component (N = 80)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's first principal component	.169			
father's first principal component	.389	.366	.134	5.96**
mother's ACL intraception	-.102			
father's ACL intraception	-.289	.442	.062	2.87
father's education	.085			
mother's education	.062	.453	.010	0.44
mother's information media use	.166			
father's information media use	-.229	.504	.049	2.32

a - beta for final equation
* p < .05
** p < .01
*** p < .001

Thus, the variables entered on the first step of the multiple regression were father's and mother's first principal component scores, since they probably reflect genetic and long-term environmental influences on offspring intelligence and can be assumed to be causally prior to parental education and media use. In the second step, father's and mother's ACL intraception scores were entered, since these are also relatively enduring personological variables but are not as closely genetically linked to offspring intelligence as the variables in the first step. In the third step, father's and mother's education was entered, and in the fourth step, father's and mother's information media use. The predictor variables chosen were those that had been found to be relatively consistently correlated with offspring first principal component. The results of these multiple regressions are fairly consistent across ethnic groups and sexes, with an average multiple R of 0.52 or 27 percent of the variation in offspring intelligence accounted for by these shared familial factors. Father's and mother's first principal component accounted for the majority of the explained variation, with later predictors accounting for moderate, usually non-significant amounts of explained variation.

Table 14 presents the results of hierarchal multiple regression analyses of selected parental variables as predictors of offspring ACL intraception. This ACL scale was the only one with a sufficient number of significant across-generation correlations to justify a multiple regression analysis. Using the same logical assumptions as the previous regression analyses, the variables entered in the first step as predictors of offspring ACL intraception were father's and mother's ACL intraception scores. In the second step, father's and mother's first principal component scores were

Table 14

Hierarchal Multiple Regressions of Parental Variables on Offspring ACL Intraception by Ethnicity and Sex

Americans of European Ancestry

dependent variable: mid-son's ACL intraception (N = 161)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's ACL intraception	.078			
father's ACL intraception	.102	.276	.076	6.54**
father's first principal component	-.071			
mother's first principal component	.060	.292	.009	0.76
mother's education	.150			
father's education	.126	.356	.041	3.65*
mother's entertainment media use	-.011			
father's entertainment media use	.000	.356	.000	0.01
parent's # relatives in home	-.126	.377	.015	2.68

dependent variable: mid-daughter's ACL intraception (N = 175)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's ACL intraception	-.002			
father's ACL intraception	.061	.133	.018	1.54
father's first principal component	.069			
mother's first principal component	.060	.218	.030	2.68
father's education	.149			
mother's education	-.102	.246	.013	1.15
father's entertainment media use	-.048			
mother's entertainment media use	-.138	.284	.020	1.80
parent's # relatives in home	-.205	.347	.040	7.56**

a - beta for final equation
* p < .05
** p < .01
*** p < .001

Table 14 (continued)

Americans of Japanese Ancestry

dependent variable: mid-son's ACL intraception (N = 64)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's ACL intraception	.256			
father's ACL intraception	-.051	.335	.112	3.86*
father's first principal component	-.323			
mother's first principal component	.160	.424	.068	2.43
mother's education	-.000			
father's education	.164	.447	.020	0.72
mother's entertainment media use	.086			
father's entertainment media use	-.254	.512	.061	2.29
parent's # relatives in home	-.167	.532	.022	1.64

dependent variable: mid-daughter's ACL intraception (N = 72)

independent variables	beta[a]	multiple R	R^2 change	F change
mother's ACL intraception	.166			
father's ACL intraception	.083	.235	.055	2.02
mother's first principal component	-.068			
father's first principal component	.078	.253	.009	0.32
father's education	.129			
mother's education	-.010	.265	.006	0.20
father's entertainment media use	.044			
mother's entertainment media use	.009	.269	.002	0.08
parent's # relatives in home	-.164	.309	.023	1.57

a - beta for final equation
* p < .05
** p < .01
*** p < .001

entered. Father's and mother's education was entered in the third step, father's and mother's entertainment media use in the fourth step, and the mean of father's and mother's reports of number of relatives living in the home (father's and mother's scores are correlated 0.95 for both AEA and AJA families) in the fifth step. Again, variables were selected as predictors if they had been previously found to be consistently significantly correlated across generations with offspring ACL intraception. With the exception of AJA sons, the multiple R's obtained in these equations are generally low, indicating that only 10 to 15 percent of the variation in offspring ACL intraception is accounted for by these shared familial factors. Significant components of explained variation varied considerably across ethnic groups and sexes.

DISCUSSION

The purpose of the present analyses was to assess the separate, relative, and combined associations of relatively enduring familial influences--parental cognitive abilities and personality traits and aspects of the home environment as reported by parents--with offspring cognitive abilities and personality traits. These assessments were done through the use of correlation and multiple regression analyses of data obtained from families of Caucasian and Japanese ancestry living in Hawaii. A number of issues arising from these analyses will be dealt with in this section, but before even considering the results of the analyses, the issue of correlation versus causation should be dealt with again here. In behavioral genetic studies of human behavior, the most important independent variable, degree of genetic relatedness, cannot be actively manipulated, and confounding variables are very difficult to control. Data from such studies, as with data from studies on many of the most important variables in the social sciences, is of necessity mostly correlational. A correlation between two variables does not necessarily imply a causal relationship and may in fact be merely coincidental or more likely the result of antecedant or intervening third variables. Statistical techniques, such as path analysis and cross-lagged correlation, give one more justification in arguing that a correlational relationship is also a causal one, but these techniques are still based on debatable assumptions, e.g., that all important antecedant and mediating third variables have been accounted for. The empirical establishment of a causal relationship between many of the most socially and theoretically important variables in the social sciences requires the demonstration of consistencies across many correlational studies employing

different methodologies and samples, plus the linkage of these correlational results with the results from animal and human experimental studies on related variables. It is in this spirit that the present correlational results are presented. As stated in the Introduction, although the across-generational results are presented as merely associations, there is an implicit and untestable assumption that significant parent-offspring correlations indicate a causal relationship, with parents having more influence on offspring than the reverse, and that while more enduring variables may be the causal antecedants of less enduring variables they are correlated with, the reverse is not true. The implications of the present results to be discussed in this section are based on these implicit assumptions.

Before considering the relationships of parental cognition, personality, and home environment with offspring cognition and personality, it was necessary to look at the relationships between these variable domains within generations. These cross-domain within-generation relationships may be interesting in and of themselves, suggesting functional relationships and/or common developmental antecedants, but for the present analyses on familial influences on behavioral development, they are also important in that it is unlikely that parental cognition, personality, and home environment are independent influences on offspring cognition and personality. The results presented in Table 4 suggest that there are substantial relationships between certain cognitive abilities and personality traits and that these relationships are remarkably consistent across ethnic groups, generations, and sexes. These results, along with those of the few similar studies cited earlier, suggest that researchers in cognitive abilities should consider the

mediating effects of personality and vice versa. More cross-lagged correlational studies, such as that of Anthony (1983), would be useful in understanding the causal and developmental relationships between the two domains. It is apparent from the results presented in Tables 5 and 6 that certain parental cognitive abilities and personality traits in turn are substantially associated with and probably deterministic of certain aspects of the home environment in which offspring grow up. This seems to be an intuitively obvious finding, but the often overlooked implication, as Longstreth et al. (1981) and others have recently pointed out, is that researchers who report correlations of home environment measures with offspring cognitive abilities and personality traits without considering the influence of parental abilities and personality may be confounding genetic and environmental influences.

The parent-offspring associations reported in Tables 7 to 14, including the correlations of "environmental" variables with offspring behavior, represent both genetic and environmental influences. As Plomin et al. (1980) indicate, parent-offspring correlations, like sibling correlations, for the same behaviors in intact natural families allow one to estimate an upper limit to the heritability of the behavior. This is also the upper limit to the influence of shared (between-family) familial environmental factors on the behavior. The present analyses, looking at parent-offspring associations across two domains of relatively stable aspects of behavior and including a set of home environment variables, allows an assessment of the combined influences of a number of shared familial genetic and environmental factors on offspring cognitive abilities and personality traits. The overall findings from these analyses are that for predicting

offspring cognitive abilities most of the variation in scores is not accounted for by these shared familial factors, while for predicting offspring personality almost all of the variation in scores is not accounted for.

A couple of methodological factors can be cited to possibly account for these low degrees of association of shared familial factors with offspring cognition and personality. The first problem is simply that of measurement error. Rowe and Plomin (1981) point out that, based on reliability coefficients, instrument-based error of measurement typically accounts for 5% to 15% of the total variation for intelligence tests and 10% to 40% for personality measures. These errors of measurement include situation-specific factors influencing responses on a measure, as well as problems in conceptualizing and operationally defining particular behaviors of interest. As noted in the Results section, the measures used in the present study varied considerably in reliability, but it is very unlikely that even up to half of the variation in offspring cognition and personality not accounted for by shared familial factors can be attributed to measurement error. From the references cited in the Methodology section, it is apparent that the HFSC cognitive test battery was highly reliable. Although the ACL factors were of lower reliability than the cognition factors, the coefficients reported in the Methodology section and the many significant within-generation correlations reported involving the ACL factors suggest that these factors were not excessively unreliable.

A second methodological problem has to do with the characteristics of the sample used in the present study. The families in the HFSC are by no means representative of the population of persons living in Hawaii.

Although paid for their participation, they are essentially a volunteer sample of mostly middle and upper middle socioeconomic status, which not only limits the generalizability of the results from the HFSC, but also raises the possibility that the possible truncation of variable ranges in this more homogeneous sample may have reduced the magnitudes of correlations. On the other hand, the means and standard deviations for education and NORC rating for the HFSC parents (Johnson et al., 1983b) indicate that a fairly wide range of SES's of subjects was sampled. In addition, as Scarr-Salapatek (1971) and Fischbein (1980) have pointed out, heritability estimates for intelligence tend to be higher in higher SES samples, presumably because genetic predispositions are more likely to be expressed in a richer environment and/or random life events (e.g., accidents, illnesses, social disruptions, etc.) are less likely to occur during the developments of higher SES offspring. It therefore seems reasonable to believe that truncation of variable ranges due to sample characteristics had only a minimal effect on the correlations reported herein.

Another possibility to be considered is that the influence of shared home environment may have been greatly underestimated by not including in the present study some important home environment variables, such as the interpersonal interaction variables found on the Moos (1974) Family Environment Scale and Caldwell and Bradley's (1978) HOME Inventory. In fact, in selecting the set of items suitable for a self-report questionnaire from the myriad variables making up the "home environment," the developers of the HFSC environmental questionnaire probably did exclude some potentially significant factors. Two points noted in the Introduction, however, should be kept in mind. One is that parental socioeconomic status, which was

measured in the HFSC, has been found to be highly correlated with a wide range of aspects of the home environment (e.g., see Table 3), and two is that, at least for cognitive abilities and probably also for personality, more refined measures of the home environment do not account for large amounts of the explained variation in offspring cognitive abilities once parental ability is partialed out (Longstreth et al., 1981).

A more likely explanation for the variation in offspring cognition and personality not accounted for by shared familial factors seems to lie in the argument of Rowe and Plomin (1981) that a major proportion of the variation in cognitive ability and an even greater proportion of the variation in personality is due to the influence of non-shared (within-family) environmental factors. Non-shared familial influences, whether genetic or environmental, are defined as those factors that cause offspring to differ from each other within the same family. Some behavior geneticists (e.g., Hirsch, 1978), in fact, greatly emphasize how genetic processes of mutation, meiosis, and recombination act to make even related individuals different from each other, and such differences can be magnified by resulting differential environmental influences. Rowe and Plomin (1981) suggest five major sources of non-shared environmental influences on behavior development and review some of the existing literature on the relative importance of these sources. The first major source consists of accidental factors, such as congenital abnormalities, physical illnesses, prenatal and postnatal trauma, or early separation, that affect one sibling but not the other. Rowe and Plomin conclude that such factors are either so rare as to have little effect on total IQ variation (although they may certainly be important in individual cases) or if more common in occurrence (such as for

early separation), have been found to have few lasting effects. A second major source may be found in sibling interactions with each other, where siblings treat each other differently and/or seek to differentiate themselves from each other (deidentification). The few extensive observational studies of sibling interactions and questionnaire studies of sibling perceptions of each other have tended to find mutuality rather than contrasts in behavior, but there is certainly a need for more research on this source. Rowe and Plomin's third major source, family structure, including birth order and sibling spacing, has been extensively studied since a formal model and empirical support for the importance of such influences was proposed by Zajonc (1976). Rowe and Plomin's review of studies using Zajonc's confluence model concludes that results have generally been equivocal and only a small amount of variation in siblings' IQ's have been accounted for by the model. Rowe and Plomin's fourth source is differential parental treatment of children, perhaps because of differences in offspring characteristics, while the fifth source consists of the influences of extra-familial networks, such as peer group members not shared by siblings, relatives, teachers, and television. These latter two sources may be the most important non-shared environmental influences on offspring behavior development, but few studies have attempted to assess their effect in causing siblings to differ from each other. It would be tempting to attribute most of the variation in offspring cognition and personality not accounted for by shared familial factors to the non-shared familial factors described above, but there is clearly a need for more research that attempts to determine how much variation can be accounted for by these non-shared factors.

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