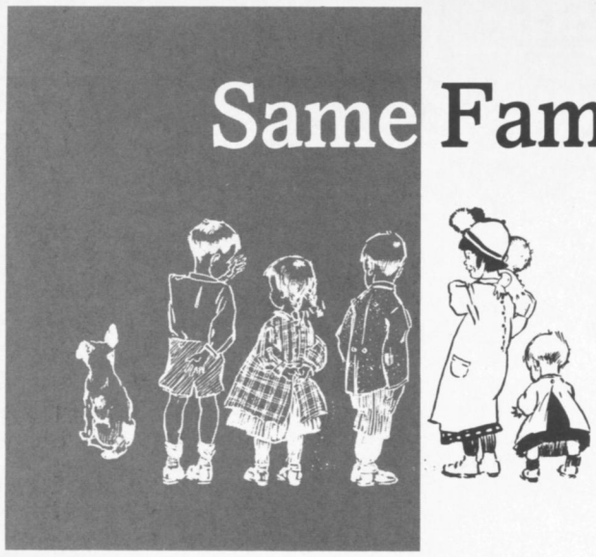
Same Family, Different Lives



Family experiences may make siblings different, not similar

By BRUCE BOWER

Psychologists uncovered a curious feature of military morale during World War II. Those in branches of the service handing out the most promotions complained the most about their rank. The investigators cited "relative deprivation" as an explanation for the trend — it's not what you have, but what you have compared with others in the same situation.

Relative deprivation achieves a more profound influence through the daily battles and negotiations that constitute life in the nuclear family, maintain researchers in human behavioral genetics. Each child in a family harbors an exquisite sensitivity to his or her standing with parents, brothers and sisters, and thus essentially grows up in a unique psychological environment, according to these investigators. The result: Two children in the same family grow to differ from one another in attitudes, intelligence and personality as much as two youngsters randomly plucked from the population at large.

While one-of-a-kind experiences and perceptions of family life combine with each child's genetic heritage to create pervasive sibling differences, shared genes — which account for half the genes possessed by all siblings save for identical twins — foster whatever similarities they display, argue scientists who apply behavioral genetics to child development.

The emphasis on children's diverse experiences cultivating sibling differences seems ironic coming from scientists dedicated to estimating the genetic contribution to individual development. Yet behavioral genetic data provide a compelling antidote to the increasingly influential notion among psychiatrists that defective genes and broken brains primarily cause mental disorders, asserts psychologist Robert Plomin of Pennsylvania State University in University Park, a leading researcher in human behavioral genetics. Ongoing studies also challenge the assumption of many developmental psychologists that important family features, such as parental education, child-rearing styles and the quality of the marital relationship, affect all siblings similarly, Plomin adds.

"What runs in families is DNA, not shared experiences," Plomin contends. "Significant environmental effects are specific to each child rather than common to the entire family."

In a further challenge to child development researchers, Plomin and psychologist Cindy S. Bergeman of the University of Notre Dame (Ind.) contend that genetic influences substantially affect common environment measures, such as self-reports or experimenter observations of family warmth and maternal affection. "Labeling a measure environmental does not make it environmental," they conclude in the September BEHAVIORAL AND BRAIN SCIENCES. "We need measures ... that can capture the individual's active selection, modification and creation of environments."

Not surprisingly, the trumpeting of "non-shared" sibling environments and the questioning of traditional measures of the family milieu have drawn heated rebukes from some psychologists. In particular, critics claim that behavioral genetics studies rely on statistical techniques that inappropriately divvy up separate genetic and environmental effects on individual traits, rather than examining more important interactions between genes and environment.

Human behavioral genetics use family, adoption and twins studies to estimate the importance of genes and environment to individual development. Family studies assess the similarity among genetically related family members on measures of intelligence, extroversion, verbal ability, mental disturbances and other psychological traits. Adoption studies obtain psychological measures from genetically related individuals adopted by different families, their biological parents, and their adoptive parents and siblings. Researchers assume that similar scores between adoptees and biological parents reflect a greater genetic contribution, while adoptees showing similarity to adoptive parents and their children illuminate environmental effects. Twin studies compare the resemblance of identical twins on various measures to the resemblance of fraternal twins on the same measures. If heredity shapes a particular trait, identical twins display more similarity for it than fraternal twins, behavioral geneticists maintain.

Psychologist John C. Loehlin of the University of Texas at Austin directed a twin study published in 1976 that greatly influenced human behavioral genetics. Averaging across a broad range of personality measures obtained from 514 identical and 336 fraternal pairs of twins culled from a national sample of high school seniors, Loehlin's group found a correlation of 0.50 for identical twins and 0.28 for fraternal twins.

Correlations numerically express associations between two or more variables. The closer to 1.0 a correlation figure reaches, the more one variable resembles another — say, one twin's IQ and the corresponding twin's IQ. A correlation of zero between twin IQs would signify a complete lack of resemblance, with twin pairs as different in intelligence scores as randomly selected pairs of youngsters.

The Texas researchers doubled the difference between identical and fraternal twin correlations to obtain a "heritability estimate" of 0.44, or 44 percent, an estimate of how much genes contribute to individual differences. This means that genes accounted for just under half of the individual personality differences ob-

served in the sample of twins. Thus, environment accounted for slightly more than half of the twin's personality variations.

A further finding intrigued the scientists. The correlation on personality measures for identical twins only reached 0.50, suggesting the environment orchestrated one-half of their personality differences. Since these twins carried matching sets of genes and grew up in the same families, only "non-shared" family experiences could account for such differences, Loehlin's group argued.

Subsequent twin and adoption studies carried out in Colorado, Minnesota, Sweden and England confirmed the importance of the non-shared environment for most aspects of personality, as well as intelligence and mental disorders such as schizophrenia, Plomin asserts. He and psychologist Denise Daniels of Stanford University reviewed much of this data in the March 1987 BEHAVIORAL AND BRAIN SCIENCES, followed by a book on the subject written with Penn State psychologist Judy Dunn titled *Separate Lives: Why Siblings Are So Different* (1990, Basic Books).

All the correlations and heritability estimates boil down to a simple point, Plomin maintains: Allegedly shared family influences, such as parent's emotional warmth or disciplinary practices, get filtered through each child's unique perceptions and produce siblings with strikingly diverse personalities. For example, a shy 9-year-old who gets picked on by schoolmates will react differently to an emotional, permissive mother than a gregarious 7-year-old sibling who attracts friends easily.

Many factors divide sibling's perceptions of family life, Plomin says, including age spacing, peer and school experiences, accidents, illnesses, random events and — to a lesser extent — birth order and sex differences.

Each sibling's temperament and behavior also generate specific perceptions and responses from parents that further shape non-shared environments, he argues.

As researchers in molecular genetics vigilantly pursue genes that predispose people to a variety of mental disorders, psychiatrists should not neglect the importance of the environment specific to each child in a family, contends Plomin and two colleagues — psychiatrist David Reiss of George Washington University in Washington, D.C., and psychologist E. Mavis Hetherington of the University of Virginia in Charlottesville — in the March AMERICAN JOURNAL OF PSYCHIATRY.

The three researchers bluntly warn psychiatrists enamored of the new genetic techniques that biology alone cannot explain the development of serious mental disorders. For example, a large, ongoing study in Sweden — conducted by Plomin and several other researchers — has found that when one identical twin develops schizophrenia, the other twin contracts the disorder about one-third of the time. Heredity shoulders considerable responsibility for fomenting schizophrenia, Plomin acknowledges, but an individual's experience of family life, peers and chance events plays at least as strong a role in triggering the devastating fragmentation of thought and emotion that characterizes the disorder.

Research directed by George Washington's Reiss, and described in his article with Plomin and Hetherington, suggests non-shared experiences protect some siblings, but not others, from alcoholism when one or both parents drink alcohol uncontrollably. Family members often shield the protected child from alcoholic behavior during that child's most cherished family practices, such as Christmas celebrations, Reiss' team finds. In this way, the protected sibling gradually learns to minimize brushes with the corrosive effects of alcoholism within and outside the family, the investigators observe. Upon reaching adolescence and adulthood, the protected sibling maintains limited family contacts to avoid the influence of an alcoholic parent and often marries a non-alcoholic person.

Given the importance of non-shared environments, developmental researchers need to study more than one child per family and devise better measures of children's perceptions of family experiences, Plomin contends. He and Bergeman find that several self-report tests currently used to assess the home environment largely ignore unique individual experiences within the family and rely on measures that show substantial genetic influence. In one case they cite, unpublished data from a study of 179 reared-apart twin pairs (both identical and fraternal) and 207 reared-together twin pairs indicate that genes account for one-quarter of the individual differences plumbed by the widely used Family Environment Scales, which is generally regarded to measure environmental influences. These scales include ratings of emotional warmth, conflict, cohesion and cultural pursuits within the family.

Even the time children spend watching television — a seemingly vacuum-sealed environmental measure employed in many studies — significantly stems from genetically influenced characteristics, Plomin and his colleagues argue in the November 1990 PSYCHOLOGICAL SCIENCE. Parental restrictions do not exert strong effects on children's television viewing, since about 70 percent of parents put no limits on how much time their offspring can spend watching the tube, they state.

Plomin's team tested 220 adopted children three times, at 3, 4 and 5 years of age, as well as their biological and adoptive parents, younger adopted and non-adopted siblings, and control families with no adopted children. Biological parents and their children adopted by others spent a surprisingly similar amount of time watching television, indicating an important genetic influence on the behavior, Plomin's team asserted. Shared home environment, such as the television viewing habits of parents, also influenced children's television time, but to a lesser extent.

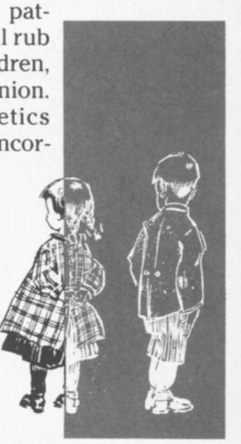
The results do not imply that some people follow a genetic imperative to sit glassy-eyed in front of the television for hours, day after day. "We can turn the television on or off as we please, but turning it off or leaving it on pleases individuals differently, in part due to genetic factors," the investigators conclude.

Some scientists who have long labored to understand family influences on psychological development take no pleasure in the conclusions of behavioral genetics researchers. Psychologist Lois W. Hoffman of the University of Michigan in Ann Arbor offers a critique of research highlighting sibling differences in the September PSYCHOLOGICAL BULLETIN.

Behavioral genetics tends to overestimate sibling differences because it concentrates on self-reports of personality traits, rather than on observations of coping skills and social behavior typically relied upon by developmental psychologists, Hoffman holds. A child may exaggerate differences from siblings on self-reports, whereas behavioral observations by experimenters may turn up sibling similarities in aggression or other attributes, she maintains.

Even in behavioral genetics research, significant sibling similarities apparently due to shared family environment turn up in political and religious beliefs and in general interests such as music, Hoffman adds.

Some family environments may more easily produce similarities among siblings than others, she argues. When both parents share the same values, attitudes and child-rearing styles, the chances increase that their pattern of behavior will rub off on all their children, in Hoffman's opinion.



Behavioral genetics researchers also incorrectly assume that only strong correlations between the personalities of adoptive parents and their adopted children reflect an environmental influence, the Michigan psychologist

contends. Parental influences can weaken parent-child correlations on all sorts of personality measures, she points out. For instance, domineering, powerful parents may produce an anxious child, and an extremely self-assured, professionally successful parent may make a child feel inadequate.

Behavioral genetics comes under additional fire for its reliance on statistics that treat genetic and environmental influences on personality separately. This approach simply lacks the statistical power to pick up the interactions between genes and environment that primarily direct physical and psychological development, rendering current research in human behavioral genetics meaningless, argues Canadian psychologist Douglas Wahlsten of the University of Alberta in Edmonton. Much larger samples might begin to pick up such interactions, he adds.

Behavioral geneticists rely on statistics derived from a technique known as analysis of variance (ANOVA). This method is used throughout psychology to calculate whether a significant relationship, or correlation, exists between experimental variables by comparing variations in individual scores from a group's average value. Statisticians developed ANOVA in the 1920s as a way to estimate whether different types and amounts of fertilizer substantially increased the yield of various agricultural crops.

When applied to human personality and behavior, an ANOVA-based approach treats heredity and environment as mutually exclusive influences on personality, Wahlsten argues. Psychologists possess no conclusive test of interactions between genes and environments. But evidence of their interplay – as in the widely accepted theory that specific genes combine with particular family experiences to produce a psychotic disorder – may begin to emerge in behavioral genetics studies employing samples of 600 or more individuals, Wahlsten maintains. Mathematical formulas used in conjunction with ANOVA stand a better chance of ferreting out gene-environment interactions in extremely large samples, Wahlsten concludes in the March 1990 BEHAVIORAL AND BRAIN SCIENCES.

Psychologist Daniel Bullock of Boston University takes a bleaker view of ANOVA, citing its neglect of the intertwined forces guiding personality development. "The special status of ANOVA in psychology is an utter anachronism," he contends. "Many past claims by behavioral geneticists are unreliable."

Plomin rejects such charges. "To say that genetic and environmental effects interact and therefore cannot be disentangled is wrong," he states.

Twin and adoption studies consistently find strong separate effects of genes and non-shared environments on personality and other developmental measures, even when researchers painstakingly seek out possible interactions of nature and nurture, Plomin points out. Investigators may devise more sensitive statistical tests to illuminate cooperative ventures between genes and family experiences, but that will not invalidate the insights of behavioral genetics, he maintains.

That includes the discovery that what parents do similarly to two children does not importantly influence personality or problem behavior in the long run; rather, each child's perceptions of what goes on in the family prove critical. Appreciating the differences of offspring based on their individual qualities, with minimal preferential treatment of one child over another, seems a good general rule for concerned parents, Plomin says. Parents should recognize that siblings as well as "only children" harbor a keen sensitivity to their standing within the family, he adds.

"If we are reasonable, loving, but not perfect parents, the children will grow up to be themselves – all different but okay," says psychologist Sandra Scarr of the University of Virginia, a behavioral genetics researcher. "Children experience us as different parents, depending on their own characteristics, and we simply cannot make them alike or easily spoil their chances to be normal adults." □

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No pain, no game

I was pleased to read "Mass hysteria mars the music" (SN: 9/21/91, p.187), about the 600 junior and senior high school students who fell prey to "mass hysteria" before a concert they were to give. When I was a cheerleader in high school, many times before a game (especially before important games such as championships) six or seven of us would complain of the same muscle aching or the same limb in pain. At first we didn't think much of it, since we always got over the "pains." However, these complaints became so common and occurred so regularly that they were difficult to ignore. I now suspect that they were brought on by nervousness and excitement – what you call "mass hysteria" – because the pains were quickly forgotten with the start of the game.

Jodi Weikel
Sierra Vista, Ariz.

If only they'd asked

I wish to add a personal response to "Clues emerge from vowels of the brain" (SN: 9/21/91, p.180).

I experienced a medium-strength stroke in October 1982. Much of the damage is no longer visible to others; in most regards I no longer consider myself handicapped. One small hangover remains, however: When I spell words on paper, at the computer, on a blackboard or even aloud, I frequently omit final, silent vowels. A discipline I have learned over these past nine years has been to proofread my written work before submitting it to public view.

During the past nine years or so, SCIENCE NEWS has published a number of good articles on brain function in general and stroke damage in particular. But it always surprises me how few of the researchers you quote take the stroke victims' perceptions into consideration. Many of us have experienced very specific spelling/writing difficulties after the big bang; all the investigators needed to do was ask (or even listen). At any stroke victims' support-group meeting, your "Clues emerge" article would rate a review of "What's new?"

Raymond S. Sweeney
Tehachapi, Calif.

Tree-ring correlations

Atmospheric carbon dioxide is another factor that will probably correlate with the recent tree-ring data ("Tasmanian trees track recent warming," SN: 9/28/91, p.207), since plant growth often increases with increased carbon dioxide levels. Because accumulation of greenhouse gases, particularly carbon dioxide, correlates with global warming, are tree-ring increases due to temperature increases, or to carbon dioxide increases, or to a combination of both?

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Ubiquitous memories

Although Dr. Demetrios Christodoulou's discovery of a fascinating new mechanism by which a gravitational wave's permanent memory can be generated ("Found: Memories of gravitational waves," SN: 9/28/91, p.198) is of great importance for the theory of gravitational waves, there is no reason to expect it to have any impact on the design of gravitational wave detectors. The fact that gravitational waves can possess memories has been known for 20 years and has already been taken into account in the design of the Laser Interferometer Gravitational Wave Observatory (LIGO). From an experimenter's point of view, Christodoulou's discovery is important because it reveals that memories will be more ubiquitous than had been thought.

Any gravitational wave detector will have an unavoidable low-frequency cutoff in its sensitivity. For ground-based detectors, a fundamental lower-frequency limit lies around 1 hertz and is caused by fluctuating gravitational fields near the detector, due to atmospheric density variations. These gravitational fields cannot be screened out without simultaneously screening out the gravitational wave signal. This obstacle will prevent the detector from integrating up a wave's memory signal longer than a fraction of a second.

The best strategy for detecting a wave's memory is to push the detector's regime of operation to the lowest frequency and the highest sensitivity possible. This has been a LIGO project goal since its inception.

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