# Readings in Human Development

## *For Psychology 230*
## *Fall 2002 and Spring 2003*

*Warren Phillips*
*Iowa State University*

**McGraw-Hill Primis Custom Publishing**

*New York St. Louis San Francisco Auckland Bogotá*
*Caracas Lisbon London Madrid Mexico Milan Montreal*
*New Delhi Paris San Juan Singapore Sydney Tokyo Toronto*

*McGraw-Hill Higher Education*
*A Division of The McGraw-Hill Companies*

**Readings in Human Development**
Fall 2002 and Spring 2003



1 2 3 4 5 6 7 8 9 0 QSR QSR 0 9 8 7 6 5 4 3 2

**ISBN 0-07-283271-1**

***Custom Editor: Pat Dausener***
***Printer/Binder: Quebecor World***

# Contents

# *Unraveling* the Mystery of Life

***Boston University researchers, in collaboration with other medical science teams, continue to make significant contributions with their discoveries in the field of genetic knowledge.***

**Mariette DiChristina**

**Mariette DiChristina** (COM '86) *is a senior editor at* Popular Science.

EACH OF THESE SAMPLES HOLDS A PIECE OF genetic code," says Chris Amemiya, Ph.D., his scarlet and navy paisley tie and khakis poking out from a long white lab coat. In tiny breakers resting atop a black ice bucket like shrimp cocktail, these crucial codes look surprisingly inconsequential—rather like simple tap water.

Yet codes like these have awesome power over human destiny. They determine whether you are tall or short, have blue eyes or brown, curly hair or straight. And more important, they may tell whether you will get sick someday, and from what. There are perhaps 3,000 to 4,000 ailments caused by genetic defects.

In this tidy, well-lit lab, Amemiya, an assistant professor at the Center for Human Genetics at the Boston University School of Medicine, and others are working to help figure out, or characterize, sequences of these genetic codes. Their efforts are just one small part of the impressive ongoing genetic research at the University.

Individually as well as in collaboration with other medical science teams, BU scientists have contributed to many nationally recognized achievements in the complex arena of genetic research. Their work covers the spectrum of discovery—from persevering with pipettes in the lab to number-crunching reams of data with computers to dealing with the human consequences of the search for greater genetic knowledge.

On the world stage, genome research has seen some remarkable advances. So far, some two dozen genes have been linked to human diseases. The past year alone has seen the discovery of a gene commonly implicated in many varieties of cancer, as well as ones for breast cancer, obesity, a form of youth-onset Alzheimer's, even the general site of a gene linked with persistent bed-wetting in children.

Not so long ago, no one even knew what a gene was. Since Gregor Mendel's famous work with peas, scientists have known the importance of heritage. But it wasn't until 1952 that scientists discovered the DNA is the basic stuff of heredity. Short for deoxyribonucleic acid, DNA is a long thread-like molecule that is part of a gene (see "A Genetic Dictionary"). Today we know that DNA acts like a biological computer program some three billion bits long. This program spells out the key instructions for making proteins, the basic building blocks of life. If you could print it out, the entire human genome—the blueprint that makes each of us a unique individual—would fill a thousand 1,000-page telephone books.

The genome is so large and the work to decipher it so painstaking that fewer than 5 percent of these genetic codes have been sequenced. To explain why this is so, many researchers cite the example of the landmark 1989 discovery of the gene for cystic fibrosis. The many independent groups that worked simultaneously on the project often duplicated one another's efforts, and the total cost probably exceeded $120 million.

## 5,000 Genes a Year

Enter the Human Genome Project. Launched in 1990, the massive, multibillion-dollar project seeks to identify an estimated 50,000 to 100,000 human genes by the year 2005. An international effort involving hundreds of scientists at dozens of universities and medical institutions, the project is supported in the

Reprinted with permission from *Bostonia* magazine, Fall 1995, pp. 15–18. 

United States by the National Institutes of Health and the Department of Energy.

A pioneer was Charles DeLisi, Ph.D., who initiated the project in the 1980s as a director of the Department of Energy's health and environment research programs. An internationally recognized researcher in molecular structure and function, DeLisi is now professor of biomedical engineering and dean of BU's College of Engineering.

Among those continuing in the wake of DeLisi's efforts are scientists at the BU Center for Advanced Biotechnology, on the Charles River Campus. Charles Cantor, Ph.D., the center's director and a member of the National Academy of Sciences, says a key goal of the researchers is to reduce the tremendous cost and time involved in genetic research.

## Shortcuts

To ease the arduous task of sifting through forty-six human chromosomes of marvelous complexity, many scientists seek to create some basic road maps. Cassandra L. Smith, Ph.D., deputy director of the Center for Advanced Biotechnology, is one researcher who focuses on new methods of faster DNA mapping and sequencing.

"The technical problem is that the genome is very large and you can't look at the whole genome at one time with current technology," says Smith. "So we've developed methods of looking at subsets of the genome that are likely to have changes that might cause diseases. When a gene falls into such a region, you already might have a lot of the resources to help pinpoint it."

To explain the point, Smith offers an analogy. Imagine you're looking for a certain house in a city. You could start at any random street and then search block by block. Or you could look at an overall map of the city and get a general idea of where to begin. Having the genetic markers, she says, "is like having a map of the city."

One marking technique is to use restriction enzymes, which chemically clip DNA at places where the enzymes recognize specific base sequences. Eventually gene mappers would like to create a regularly spaced set of markers at close intervals. Using these markers as signposts for genetic "neighborhoods" on the imaginary city map, scientists can then find the important "streets" and "houses." When there are differences around these markers in family members who have a genetic disease—but not in disease-free members—scientists can locate the genetic cause.

This method of gene hunting has produced some notable successes at BU: location of the genes for Waardenburg's syndrome as well as for Huntington's disease.

In 1992 a team led by Clinton T. Baldwin, Ph.D., an associate professor of pediatrics and the director of molecular genetics research at the Center for Human Genetics, found the genetic cause of a form of deafness called Waardenburg's syndrome. Waardenburg's, which is accompanied by pigment disorders of the skin, eyes, and hair, causes about 3 percent of all cases of congenital deafness.

"We determined the [key part of a] DNA sequence of an individual with the disease, compared it to a person without the disease, and found a single base change that resulted in a single amino acid change," explains Baldwin. "This was sufficient to destroy the ability of the protein to function." Using earlier research done on the genetics of mice and fruit flies—which have some genes similar to human genes—also helped the researchers understand the genes involved.

The gene for Huntington's was also located with this search technique. Huntington's is a deadly neurodegenerative disease whose best known victim was folksinger Woodie Guthrie. Unlike Waardenburg's, Huntington's is not a single error. Rather, explains Richard Myers, Ph.D., of the BU Medical Center, it is a "stutter" flaw. There are too many repeats of one tiny bit of code, as if the genetic photocopier went haywire. Myers, who was part of the team that made the 1993 discovery of the Huntington's gene after a decade-long search, says the more copies of this gene a Huntington's patient has, the more severe the symptoms and the earlier the onset of the disease. Continuing in his research, Myers is exploring some puzzling

## A GENETIC DICTIONARY

**DNA**—Two yards of DNA are packed into each one of the 100 trillion cells in your body. A strand of DNA, or deoxyribonucleic acid, is more than 37,000 times thinner than a human hair. The DNA is on twenty-three pairs of chromosomes; you get one set of twenty-three chromosomes from each of your parents.

**CHROMOSOME**—Each of the forty-six human chromosomes contains the DNA for thousands of individual genes, the chemical units of heredity.

**GENE**—A gene is a snippet, or sequence, of DNA that holds the recipe for making a specific molecule, usually a protein. These recipes are spelled out in four chemical bases: adenine (A), thymine (T), guanine (G), and cytosine (C). The bases form interlocking pairs. A always pairs with T and G pairs with C. In some cases, genetic defects are caused by the substitution of just one base pair for another.

**PROTEIN**—Amino acids make up proteins, which are key components of all human organs and chemical activities in your body. Their function depends on their shape, which is determined by the 50,000 to 100,000 genes in the cell nucleus.—*MD*

differences in the complexity of nerve cells of Huntington's patients and those without the disease.

Another place scientists look for gene clues is in people whose relationship is even closer than most family members: identical twins. Because identical twins develop from the same fertilized egg, they have the same genetic material.

Studies of gay men and their twin brothers by psychiatrists Richard Pillard of the BU School of Medicine and J. Michael Bailey of Northeastern University indicate that there is a heredity factor in homosexuality. When one brother is gay, they discovered, there is a far greater likelihood that the identical twin is gay too.

If one twin has a trait that the other doesn't have, this gives scientists a hint about where to look for the specific gene that causes that trait. For example, Cassandra Smith is conducting studies with twins in the search for genes responsible for schizophrenia. "I take identical twins who are discordants—that is, one has and one doesn't have schizophrenia—and compare the DNA to find the differences," she says. By doing so she seeks the triggers for this chronic disease.

A third way to shorten the search for genes is to differentiate between the 3 percent of DNA that creates coding and the 97 percent that is noncoding. Noncoding DNA is called *junk* because no one knows its purpose. "What could this 97 percent be doing?" asks H. Eugene Stanley, Ph.D., professor of physics and director of the Center for Polymer Studies at BU. "One idea is that it's just accumulated during evolution the way junk accumulates in my office," he says with a sweep of his arm taking in stacks of books and piles of paper.

Work by Stanley and colleagues at Boston University and Harvard indicates that the junk may be a language. One language feature in junk—a discovery led by team member S. Martina Ossadnik—is that it has correlations. That is, certain bits of information generally follow certain others—the way $u$ follows $q$ in English. Taking that a step further, Rosario Mantegna, then a BU graduate student and now a research associate in the physics department, computer-analyzed the junk, applying tests used by linguists. He found "word" repetitions, another common language feature. "Language is a structured thing," adds Stanley. "There is a lot of redundancy: I could leave out a word and you would understand me. A code is the opposite. It is very strict; you cannot make a mistake." Genetic codes do not share these language features.

So what does the junk say? No one is certain. "We can't prove it's a language," stresses Stanley, "but it passes the tests for language."

Once you find a gene for a disease, you can work to develop predictive tests. Richard Myers founded and heads Huntington's testing and counseling at the University. Boston University and Johns Hopkins University, which set up programs simultaneously in 1986, were the first institutions to offer such testing. Today more people

## TESTING WITHOUT CURES

Genetic research will undoubtedly bring unmatched abilities to improve the human condition. But rapidly advancing lab work is leaving society to face some difficult issues. While scientists have found the genetic causes of several diseases and developed predictive tests, treatments remain elusive.

The result, says George Annas, J.D., M.P.H., a professor of health law at the Boston University School of Public Health who has been widely quoted on genome ethics, is that "it gives you scary information that is not terribly useful in your daily life."

Perhaps few have come to know these punishing issues as well as Richard Myers at the BU Medical Center. Myers, whose twenty-year experience with the deadly, incurable Huntington's disease began with his dissertation, participated in the gene's discovery (see main article). At the University, he founded one of the first U.S. testing and counseling programs for Huntington's.

Considering the brutal, relentless progress of Huntington's, Myers speaks of its victims in measured tones tinged with sympathy. "There are plenty of diseases that are pretty nasty. A lot of times you might be better off not knowing how bad it can get," he says. "But for a person to get Huntington's disease, a parent would have had it. They [the children] would have had to watch." Many who come in for couseling choose not to be tested.

Worse, there are fears about twenty-first-century discrimination based on an individual's genetic heritage. For instance, Myers knows of one New England woman in her twenties who was fired from her pharmacy job after her boss discovered that the woman's mother had Huntington's and thus she was vulnerable to developing the disease. Anticipating such cases, the U.S. Equal Opportunity Commission this year concluded that the Americans with Disabilities Act protects healthy people carrying abnormal genes from discrimination.

Annas and two School of Public Health colleagues—Leonard Glantz, J.D., health law professor, and Patricia Roche, J.D., instructor—aim to take that a step further: this spring they proposed legislation to prevent the collection, analysis, and storage of DNA, and disclosure of information derived from such analysis, without the individual's written authorization. The proposed legislation, called the Genetic Privacy Act, was developed over two years under a grant awarded from that portion of the Human Genome Project's budget that goes to ethics research. The act has been introduced in a half-dozen state legislatures, says Annas, who also expects it to be considered as a federal statute.

"Everyone has some bad genes," says Annas. "The problem is these genes are being discovered long before there is any hope for treating these conditions. Nonetheless, there are many opportunities for employers, insurance companies, and others to discriminate on the basis of someone's genetic makeup."—*MD*

have undergone testing for Huntington's than for any other disease that appears in adulthood (see sidebar, "Testing Without Cures").

While locating a gene doesn't guarantee a cure, it may point the way. Researchers hope to design drugs that can target the cause of an ailment rather than the symptoms. In collaboration with colleagues from other universities and biotechnology companies, Charles Cantor of the Biotechnology Center is working to take advantage of the natural lock-and-key mechanism of a type of protein—a string of amino acids—called streptavidin. One example of a natural lock and key is how antibodies fight infection in your body; the antibody chemically matches the infecting virus and adheres to it—rendering the virus harmless. Streptavidin's lock-and-key binding, however, is a million times stronger than that of antibodies. "You could use this natural mechanism to bring radiation right to the site of a cancerous tumor in a precise way," says Cantor.

Another possible way to treat genetic disease is to correct or replace the altered gene through gene therapy. This involves inserting corrective DNA into human cells to replace flawed genes or to produce proteins that stimulate the body's natural immune system. Such experimental gene therapy to treat Parkinson's disease is just one example of the more than 100 gene-therapy procedures now undergoing testing.

In some cases, too, finding out you are predisposed to a genetic ailment could help you take preventive actions or enable you to get treatment earlier, when it is more likely to be effective. Clinical research will also provide a piece of the genetic puzzle.

A leader in this area is Aubrey Milunsky, M.D., a professor of human genetics, pediatrics, pathology, and obstetrics at BU's School of Medicine and director of the Center for Human Genetics. As head of the human genetics program, Milunsky's landmark work has supported the development of national guidelines for folic acid supplementation to prevent neural tube defects and has focused on prenatal diagnosis and early pregnancy screening for birth defects.

"The power of genetics is that if you have the time and money, you are almost guaranteed to find the gene," says Cassandra Smith. Speaking for many researchers, she adds, "It's just a matter of perseverance."

# Nature's Clones

Can genes explain our passions and prejudices, the mates we choose, that mystery we call the self? New research on twins upsets some of our most cherished notions about how we become who we are—and gives nature and nurture a whole new meaning. By Jill Neimark

**Last April I went down to West 27th Street** in Manhattan to sit in the audience of the *Maury Povich* show, and meet four sets of identical twins who had been separated at birth and adopted into different families. I wanted to see if the same soul stared out of those matched pairs of eyes, to contemplate the near miracle of DNA—double helix twisting around itself like twin umbilical cords—ticking out a perfect code for two copies of a human. One pair, a Polish nun and a Michigan housewife, had been filmed at the airport by CNN the week before, reunited for the first time in 51 years and weeping in each other's arms, marveling at their instinctive rapport. Yet how alike were they really, if one spent her days on rescue missions to places like Rwanda, while the other cleaned houses to supplement her husband's income?

Twins are nature's handmade clones, doppelgangers moving in synchrony through circumstances that are often eerily similar, as if they were unwitting dancers choreographed by genes or fate or God, thinking each other's thoughts, wearing each other's clothes, exhibiting the same quirks and odd habits. They leave us to wonder about our own uniqueness and loneliness, and whether it's possible to inhabit another person's being. Twins provoke questions about the moment our passions first ignite—for they have been seen on sonogram in the womb, kissing, punching, stroking each other. They are living fault lines in the ever shifting geography of the nature/nurture debate, and their peculiar puzzle ultimately impacts politics, crime and its punishment, education, and social policy. It isn't such a short leap from studies of behavioral genetics to books like the infamous *The Bell Curve* (by Richard Herrnstein and Charles Murray) and a kind of sotto-voce eugenics. And so everything from homosexuality to IQ, religious affiliation, alcoholism, temperament, mania, depression, height, weight, mortality, and schizophrenia has been studied in identical and fraternal twins and their relatives.

Yet the answers—which these days seem to confirm biology's power—raise unsettling questions. Twin research is flawed, provocative, and fascinating, and it topples some of our most cherished notions—the legacies of Freud and Skinner included—such as our beliefs that parenting style makes an irrevocable difference, that we can mold our children, that we are free agents piecing together our destinies.

Today, we've gone twin-mad. Ninety thousand people gather yearly at the International Twins Day Festival in Twinsburg, Ohio. We're facing a near epidemic of twins. One in 50 babies born this year will have a fraternal or identical double; the number of such births rose 33 percent in 1994 alone, peaking at over 97,000—largely due to women delaying childbirth (which skewers the odds in favor of twins) and to the fertility industry, which relies on drugs that superovulate would-be mothers. Recently, a stunning scientific feat enabled an ordinary sheep to give up a few cells and produce a delayed identical twin—a clone named Dolly, who was born with her donor's 6-year-old nucleus in every cell of her body. The international furor this Scottish lamb engendered has at its heart some of the same wonder and fear that every twin birth evokes. Twins are a break, a rift in the customary order, and they call into question our own sense of self. Just how special and unique are we?

The history of twins is rich with stories that seem to reveal them as two halves of the same self—twins adopted into different families falling down stairs at the same age, marrying and miscarrying in the same year, identical twins inventing secret languages, "telepathic" twins seemingly connected across thousands of miles, "evil" twins committing arson or murder together, conjoined twins sharing a single body, so that when one coughs the other reflexively raises a hand to cover the first one's mouth. And yet the lives of twins are full of just as many instances of discordance, differences, disaffection. Consider the 22-year-old Korean twins, Sunny and Jeen Young Han of San Diego County; Jeen hired two teenagers to murder her sister, hoping to assume her identity.

So what is truly *other*, what is *self*? As the living embodiment of that question, twins are not just the mirrors of each other, they are a mirror for us all.

Reprinted with permission from *Psychology Today*, July/August 1997, pp. 36-44, 64, 66-69. 

# MY TWIN MARRIAGE

A few years ago, I was playing the messages back on my answering machine just as my husband, Jeff, was coming into the apartment. He heard a familiar voice and ran for the answering machine.

"It's Phil!" he yelled, shrugging out of his coat. "Pick up the phone. Phil's calling."

Only it wasn't Phil. It was Phil's identical twin brother, Jeff.

"Oh, it's me," my husband said sheepishly. Sheepish in the sense of Dolly, the cloned sheep.

When I was first dating Jeff, the prospect of marrying an identical twin seemed magical. Jeff spoke of his brother as if he were talking about himself, almost as if he could bilocate and live two contrasting yet mutually enriching lives. Jeff worked at a literary agency in Manhattan and loved boy fiction, thrillers, and horror novels, while Phil was overtly spiritual, editing a journal dedicated to the study of myth and tradition. When they were together they seemed to merge into one complex yet cohesive personality. They talked like hyper-bright little boys, each of them bringing equal heat and erudition to Stephen King and esoteric teachings, baseball, and the possibility of spiritual transformation. They argued—and still argue—like Trotsky and Lenin, desperate to define themselves as individuals, yet they define themselves against each other. Jeff and Phil love their wives and children, but they obey the orders they get from the mothership of their identical DNA.

My husband and his twin brother live by E. M. Forster's admonition, "Only connect." The pair e-mail each other at their respective offices two, four, even more times a day. A few weeks ago, Phil wrote Jeff that he was trying to decide his favorite 10 films of all time. He listed *Journey to the Center of the Earth*, *Star Wars*, seven other boy classics, and asked for Jeff's help thinking up a 10th.

"Phil and I decided that *Jurassic Park* is our favorite movie of all time," announced Jeff the other evening at dinner. In the course of dozens of soothing little dispatches Phil's movie list and Jeff's movie list had become one.

My marriage to Jeff has locked me into a triangle. The bond between these twins amazes and amuses me, yet it fills me with an unappeasable longing. After all, unlike Phil's wife, Carol, who is an only child, I was conditioned even before I was born to be with a twin. I am a fraternal twin, a girl born 10 minutes after a boy.

"What do you get out of being a twin?" I asked my husband the first day we had lunch. "What insight does it give you that's harder for single people to understand?"

"Trust," said my husband. "That pure physical trust that comes when you know someone loves and accepts you completely because they are just like you are."

I knew the primordial closeness he was talking about. As tiny premature babies, my brother Steve and I used to cuddle in the same crib holding hands. My earliest memory is of being lifted up high and feeling incredible joy as I gazed into my mother's vast, radiant face. I was put back down on a big bed. I remember sensing another baby lying next to me, my twin. His presence felt deeply familiar, and I know I had sensed him before we were born. For me, in the beginning there was the light but there was also the son. In addition to the vertical relationship I had with Mommy, I also had a lateral relationship, a constant pre-verbal reassurance that I had a peer. I was in it with somebody else. This feeling of extending in two directions, horizontal and vertical, made up the cross of my emotional life.

## Separated at Birth But Joined at the Hip

The woman seated alone onstage at the opening of the *Maury Povich* show was already famous in the twin literature: Barbara Herbert, a plump 58-year-old w[illegible] broad, pretty face and short, silver hair, found her twin, Daphne Goodship, 18 years ago. Both had been adopted as babies into separate British families after their Finnish single mother killed herself.

The concordances in their lives send a shiver up the spine: both women grew up in towns outside of London, left school at 14, fell down stairs at 15 and weakened their ankles, went to work in local government, met their future husbands at age 16 at the Town Hall dance, miscarried in the same month, then gave birth to two boys and a girl. Both tinted their hair auburn when young, were squeamish about blood and heights, and drank their coffee cold. When they met, both were wearing cream-colored dresses and brown velvet jackets. Both had the same crooked little fingers, a habit of pushing up their nose with the palm of their hand—which both had nicknamed "squidging"—and a way of bursting into laughter that soon had people referring to them as the Giggle Twins. The two have been studied for years now at the University of Minnesota's Center for Twin and Adoption Research, founded by Thomas J. Bouchard, Ph.D. It is the largest, ongoing study of separated twins in the world, with nearly 100 pairs registered, and they are poked, probed, and prodded by psychologists, psychiatrists, cardiologists, dentists, ophthalmologists [illegible]athologists, and geneticists, testing everything from [illegible] pressure to dental caries.

At the center, it was discovered that the two women had the same heart murmurs, thyroid problems, and allergies, as well as IQ's a point apart. The two showed remarkably similar personalities on psychological tests. So do the other sets of twins in the study—in fact, the genetic influence is pervasive across most domains tested. Another set of twins had been reunited in a hotel room when they were young adults, and as they unpacked found that they used the same brand of shaving lotion (Canoe), hair tonic (Vitalis), and toothpaste (Vademecum). They both smoked Lucky Strikes, and after they met they returned to their separate cities and mailed each other identical birthday presents. Other pairs have discovered they like to read magazines from back to front, store rubber bands on their wrists, or enter the ocean backwards and only up to their knees. Candid photos of every pair of twins in the study show virtually all the identicals posed the same way; while fraternal twins positioned hands and arms differently.

Bouchard—a big, balding, dynamic Midwesterner who can't help but convey his irrepressible passion about this research—recalls the time he reunited a pair of twins in their mid-30s at the Minneapolis airport. "I was following them down the ramp to baggage claim an[illegible]y started talking to each other. One would stop a[illegible] a

nanosecond later the other would start, and when she stopped a nanosecond later the other would start. They never once interrupted each other. I said to myself, 'This is incredible, I can't carry on a conversation like that with my wife and we've been married for 36 years. No psychologist would believe this is happening.' When we finally got to baggage claim they turned around and said, 'It's like we've known each other all our lives.' "

## Just Puppets Dancing To Music of the Genes?

I asked Bouchard if the results of his research puncture our myth that we consciously shape who we are.

"You're not a believer in free will, are you?" he laughed, a little too heartily. "What's free will, some magical process in the brain?"

Yet I am a believer (a mystical bent and fierce independence actually run in my family, as if my genes have remote controlled a beguiling but misbegotten sense of freedom and transcendence). I was mesmerized and disturbed by the specificity of the twins' concordances. David Teplica, M.D., a Chicago plastic surgeon who for the last 10 years has been photographing more than 100 pairs of twins, has found the same number of crow's feet at the corners of twins' eyes, the same skin cancer developing behind twins' ears in the same year. Says Teplica, "It's almost beyond comprehension that one egg and one sperm could predict that."

I could imagine, I told Bouchard, that since genes regulate hormones and neurochemicals, and thus impact sexual attraction and behavior, DNA might influence the shaving lotion twins liked or the hue they tinted their hair. But the same esoteric brand of toothpaste? Walking into the sea backwards? This implies an influence so far-reaching it's unnerving.

"Nobody has the vaguest idea how that happens," he admitted, unfazed. "We're studying a set of triplets now, two identical females and a brother, and all three have Tourette's syndrome. How can the genes get so specific? I was talking yesterday in Houston to a bunch of neuroscientists and I said, 'This is the kind of thing you guys have to figure out.' There is tons of stuff to work on here, it's all open territory."

He paused to marvel over the tremendous shift in our understanding of human behavior. "When we began studying twins at the university in 1979, there was great debate on the power of genetics. I remember arguing in one graduate school class that the major psychoses were largely genetic in origin. Everyone in the classroom just clobbered me. It was the era of the domination of behaviorism, and although there's nothing wrong with Skinner's work, it had been generalized to explain everything under the sun. Nothing explains everything. Even genetics influences us, on the average, about 50 percent."

Yet that 50 percent seems omnipresent. It impacts everything from extroversion to IQ to religious and social attitudes—and drops only in the influence on homosexuality and death. Though some researchers have criticized Minnesota's twin sample for being too small and perhaps self-selected (how many separated twins out there don't participate or don't even know they're twins?), it generally confirms the results of larger studies

At the age of 3, I remember standing in the grass on a hot, bright day in El Paso, Texas, aware as never before that my brother was different from me, not just because he was smaller then and a boy, but because he was different inside. I loved him and felt protective towards him, as I would throughout my childhood, but I also felt the first stirrings of rebellion, of wanting to go vertical in my identity, to make it clear to my parents and everybody else that I was not the same as Steve.

I began to relish the idea of not being completely knowable. I developed a serious underground life. At 8, I twinned myself with an invisible black panther I called Striker. At 10, I became a spy. I made cryptic notes in a notebook. I had sinister passport photos taken. I had a plastic revolver I carried in a plastic attaché case. You may call me one of the twins, I thought to myself, but I come from a foreign country that has malevolent designs on your own.

No one ever calls me and Steve "the twins" anymore, except as an artifact of childhood. I tend to think of my birth twin, who is now a Porsche mechanic and a big, outdoorsy guy who lives with his wife and two kids in a small town outside of Boston, as the brother who was with me when I was born, who shared space with me in the womb. I feel close to him not because we are exactly the same, but because I still have bedrock sensation and empathy for his life.

Jeff claimed that his knowledge of trust from being an identical let him know that I was the person he wanted to marry. He felt twinship towards me right from the start he said, and I wasn't surprised. Accustomed to being twins, my husband and I fell right into acting like twins. We coauthored a book and both edit at *Publisher's Weekly*, yet we sometimes argue over who gets to use the little study in our apartment as if our identities were at stake. Lately, I've noticed that when I feel dominated by Jeff I tend to yearn for a "real" twin, a twin who mirrors me so lovingly and acceptingly that I can let go and be myself without fear or explanation. A single person might escape by daydreaming about a perfect lover, but my fantasies of romantic enmeshment have always incorporated the twin.

Years ago in Manhattan I was invited to attend a ceremony for the Santeria religion's god of thunder, Shango, because Shango loves twins. On the way, a revered old Cuban santera told me that twins were sacred in Santeria and in the African mother religion of Yoruba because they reflect the intersection of spirit and matter. Girl and boy twins were especially fascinating, according to the santera. Most girls were killed by the boy energy, they believed. A girl had to be very strong to survive.

The moment I heard that I realized that being a twin has heightened the drama of my life. Human beings are born double, pulled between the desire to merge with another yet emerge as an authentic self. Twins fascinate, I believe, because we are an externalized representation of an internal struggle everybody lives with all their lives. We cast the illusion of solving the unsolvable, though we're no closer than anyone else.—*Tracy Cochran*

# BEYOND NATURE AND NURTURE: TWINS AND QUANTUM PHYSICS

I've been interested in identical twins ever since I was old enough to realize I am one. When my brother and I were young we were close but nonetheless epitomized the struggle of twins to achieve individual identities. Now in our 50s, we have both noticed a real convergence of our intellectual, spiritual and philosophical views.

Are the strikingly similar thoughts and behaviors of twins, even those reared apart, due to nature or nurture—or to a third factor? What if what I call the "nonlocal" nature of the mind is involved?

Nonlocal mind is a term I introduced in 1989 to account for some of the ways consciousness manifests, ways suggesting that it is not completely confined or localized to specific points in space or time. Nobel physicist Erwin Schrödinger believed that mind by its very nature is singular and one, that consciousness is not confined to separate, individual brains, that it is ultimately a unified field. David Chalmers, a mathematician and cognitive scientist from the University of California at Santa Cruz, has suggested that consciousness is fundamental in the universe, perhaps on a par with matter and energy, and that it is not derived from, nor reducible to, anything else. Nobel physicist Brian Josephson, of Cambridge University's Cavendish Laboratory, has proposed that nonlocal events at the subatomic level for example, the fact that there are correlations between the spin of subatomic particles, even after they are separated—can be amplified and may emerge in our everyday experience.

In other words, the macrocosm reflects the microcosm. Systems theorist Erwin Laszio has suggested that nonlocal mind may mediate events such as intercessory prayer, telepathy, precognition, and clairvoyance.

If consciousness is unbounded and unitary, strikingly similar thoughts and behaviors of identical twins, even separated twins, would not be surprising. Genes do determine how individual brains function, how we each process information, and nonlocal mind could be easier to access if two brains were almost identical in their functioning. Indeed, some people see analogies between the behavior of separated, identical twins and separated, identical subatomic particles.

According to the late Irish physicist John S. Bell, if two subatomic particles once in contact are separated to some arbitrary distance, a change in one is correlated with a change in the other—instantly and to the same degree. There is no travel time for any known form of energy to flow between them. Yet experiments have shown these changes do occur, instantaneously. Neither can these nonlocal effects be blocked or shielded—one of the hallmarks of nonlocality. Perhaps distant twins are mysteriously linked, like distant particles—or, to quote Ecclesiastes, "All things go in pairs, one the counterpart of the other."

*—Larry Dossey, M.D.*

of twins reared together—studies that have taken place around the world.

Twin studies allow us to double blind our nature/nurture research in a unique way. Identical twins share 100 percent of their genes, while fraternals share 50 percent. But usually they grow up together, sharing a similar environment in the womb and the world. When separated, they give us a clue about the strength of genetic influence in the face of sometimes radically different environments. Soon Bouchard and his colleagues will study siblings in families that have adopted a twin, thus testing environmental influences when no genes are shared. Like a prism yielding different bands of light, twin studies are rich and multifaceted. Here are some of the major findings on nature and nurture thus far:

• **Political and social attitudes,** ranging from divorce to the death penalty, were found to have a strong genetic influence in one Australian study. A Swedish study found genes significantly influenced two of the so-called "big five" personality traits—"openness to experience" and "conscientiousness"—while environment had little impact. In contrast, environment influenced "agreeableness" more than genes did. (The two other traits are "neuroticism" and "extroversion.") Another study, at the University of Texas at Austin, found that personality in identicals correlated 50 percent, in fraternals about 25 percent.

• **Body fat is under genetic influence.** Identical twins reared together will have the same amount of body fat 75 percent of the time; for those reared apart it's 61 percent, showing a heavy genetic and mild environmental influence, according to a 1991 study.

• **Both optimism and pessimism** are heavily influenced by genes, but shared environment influences only optimism, not pessimism, according to a study of pairs of middle-aged identical and fraternal twins. Thus family life and genes can be equal contributors to an optimistic outlook, which influences both mental and physical health. But pessimism seems largely controlled by genes.

• **Religiosity is influenced by genes.** Identical and fraternal twins, raised together and apart, demonstrate that 50 percent of religiosity (demonstrated by religious conviction and church attendance) can be attributed to genes.

• **Sexual orientation** is under genetic influence, though not solely, according to studies by Michael Bailey, Ph.D., associate professor of psychology at Northwestern University. In one study he found that if one identical twin is gay, the other is also gay 50 percent of the time. However, when Bailey analyzed a sample of 5,000 twins from the Australian twin registry, the genetic impact was less. In identical male twins, if one was gay the likelihood of his twin being gay was 20 percent; in fraternal twins the likelihood was almost zero. In women, there was little evidence of heritability for homosexuality.

• **When substance abuse** was studied in 295 identical and fraternal twin pairs, year of birth was the most powerful predictor of drug use. Younger twins were most likely to have abused drugs, reflecting widespread drug use in the culture at large. Alcoholism, however, has a significant genetic component, according to Andrew Heath, Ph.D., at the Virginia Institute for Psychiatric and

Behavioral Genetics at Virginia Commonwealth University School of Medicine.

• **Attention deficit disorder** may be influenced by genes 70 percent of the time, according to Lindon Eaves, M.D., director of the Virginia Institute for Psychiatric and Behavioral Genetics. Eaves and colleagues studied 1,400 families of twins and found genetic influence on "all the juvenile behavior disorders," usually in the range of 30 to 50 percent.

• **Twins tend to start dating,** to marry, and to start having children at about the same time. David Lykken, Ph.D., and Matthew McGue, Ph.D., at the University of Minnesota, found that if an identical twin had divorced, there was a 45 percent chance the other had also. For fraternals, the chance was 30 percent. The researchers think this is due to inherited personality traits.

• **Schizophrenia** occurs more often in identical twins, and if one twin suffers from the disorder, the children of the healthy identical sibling are also at greater risk, according to psychiatrist Irving Gottesman, M.D., of the University of Virginia. The risk is about twice as high for the children of a twin whose identical counterpart is ill, as it is for the children of a twin whose fraternal counterpart is ill.

## Hidden Differences Between Twins

A few fascinating kinks in the biology of twin research have recently turned up, weaving an even more complex pattern for us to study and learn from. It turns out that not all identical twins are truly identical, or share all their genetic traits. In one tragic instance, one twin was healthy and a gymnast, while the other suffered from severe muscular dystrophy, a genetic disorder, and was dead by age 16. Yet the twins were identical.

One way twins can differ is in the sex chromosomes that turn them into a male or female, and which contain other genes as well, such as those that code for muscular dystrophy or color blindness. All girls inherit two X chromosomes, one from each parent, while boys inherit an X and a Y. Girls automatically shut off one X in every cell—sometimes some of the mother's and some of the father's, in other cases all the mother's or all the father's. A girl may not shut off her extra set of X chromosomes in the same pattern as her identical twin does.

Identical twins may not be exposed to the same world in the womb, either. It depends on the time their mother's fertilized egg splits—and that timing may explain why some identical twins seem more eerily alike than others. At Lutheran University, researchers have looked at the placentas of some 10,000 twin births. They've found that an egg that separates in the first four days of pregnancy develops not only into separate twins, but results in separate placentas, chorionic casings, and amniotic sacs. These twins are like two singletons in the womb and have the best chance of survival. Twins who separate between the fifth and eighth days share a single placenta and chorion, but still have the benefit of two amniotic sacs. Here, one twin can have a distinct advantage over the other. The umbilical cord may be positioned centrally on one sac, while the other is on the margin, receiving fewer nutrients. Studies of these twins show that with a nurturing environment, the weaker twin will catch up in the first few years of life. However, it's possible that viruses may penetrate separate sacs at different rates or in different ways—perhaps increasing the risk for schizophrenia or other illnesses later in life.

> Some twins are bonded by a lifelong passion for each other that the rest of us experience only in the almost unbearably intense first flush of romantic love. England's notorious Gibbons twins were one such pair.

Twins who split between the eighth and 12th days share their amniotic sac, and often their cords get entangled. One cord may be squeezed until no blood flows through it, and that twin dies. Finally, twins who split after the 12th day become conjoined—and even though they share organs and limbs, anecdotal evidence suggests that they often have distinctly different temperaments, habits, and food cravings.

In one hotly debated hypothesis, pediatrician and geneticist Judith Hall, of the University of British Columbia in Vancouver, speculates that twinning occurs because of genetic differences within in an embryo. Perhaps mutations occur at a very early stage in some cells, which then are sensed as different, and expelled from the embryo. Those cells may survive and grow into a twin. Hall suggests this could account for the higher incidence of birth defects among twins.

While identical twins can be more distinct than we imagine, fraternal twins might come from the same egg, according to behavioral geneticist Charles Boklage, M.D., of the East Carolina University School of Medicine. Boklage proposes that occasionally an older egg may actually split before it is fertilized by two of the father's sperm. With advances in gene mapping and blood testing, he says, we may find that one-egg fraternal twins occur as often as do two-egg fraternals. We may be mistaking some same sex fraternal twins for identical twins.

## Twins Who Vanish, Twins Who Merge

Whatever the cause of twinning, once it beings, mysterious and unsettling events can occur. Some twins dis-

appear or even merge together into one person. Ultrasound equipment has revealed twin pregnancies that later turn into singletons. One of the twins is absorbed into the body, absorbed by the other twin, or shed and noticed by the mother only as some extra vaginal bleeding.

"Only one in 80 twin conceptions makes it to term as two living people," notes Boklage. "For every one that results in a twin birth, about 12 make it to term as a sole survivor. And those people never know they were twins." Because twins tend to be left-handed more often than singletons, Boklage speculates that many left-handers could be the survivors of a twin pregnancy. And a few of those twin pregnancies may lead to what Boklage terms a "chimera," based on the Greek monster with a tail of a serpent, body of a goat, and head of lion—a mosaic of separate beings. "We find people entirely by accident who have two different blood types or several different versions of a single gene. Those people look perfectly normal, but I believe they come from two different cell lines."

It's as if fantastical, primitive acts of love, death, merging, and emerging occur from the very moment life ignites, even as the first strands of DNA knit themselves into the human beings we will later become—carrying on those same acts in the world at large, acts that define us, and that we still are not certain we can call our own.

## When Twins Die, Kill, Hate, and Burn

Though it doesn't happen often, occasionally in history a set of mythic twins seem to burst into our awareness, more wedded and bonded than any couple, even darkly so. Some twins live with a passion the rest of us experience only in the almost unbearably intense first flush of romantic love. England's Gibbons twins are one such pair.

Jennifer and June Gibbons were born 35 years ago, the youngest children of Aubrey Gibbons, a West Indian technician for the British Royal Air Force. The girls communicated with each other in a self-made dialect and were elective mutes with the rest of the world. By the time they were 11, they refused to sit in the same room with their parents or siblings. Their mother delivered their meals on a tray and slipped mail under the door. They taught themselves to read, and eventually locked themselves in their bedroom, writing literally millions of words in diaries.

Later they lost their virginity to the same boy within a week of each other, triggering jealous rage. Jennifer tried to strangle June with a cord, and June tried to drown Jennifer in a river. When publishers rejected their work, they went on a spree of arson and theft, and were committed to Broadmoor, England's most notorious institution for the criminally insane.

"Nobody suffers the way I do," June wrote in her diary. "This sister of mine, a dark shadow robbing me of sunlight, is my one and only torment." In another passage, Jennifer described June lying in the bunk bed above her: "Her perception was sharper than steel, it sliced through to my own perception... I read her mind, I knew all about her mood... My perception. Her perception... clashing, knowing, cunning, sly."

After more than a decade of confinement, they were set free. That same afternoon, Jennifer was rushed to the hospital with viral myocarditis, an inflammation of the heart, and that night she died. The pathologist who saw her heart seemed to be speaking poetically of their lethal passion when he described Jennifer's illness as "a fulminating, roaring inflammation with the heart muscle completely destroyed." June, the survivor, has said that she was "born in captivity, trapped in twinship." Eventually, June claims, they began to accept that one must die so the other could be free. Today, June lives in Wales.

Another set of twins, 22-year-old Jeen Young Han (nicknamed Gina) and her sister Sunny, have been dubbed the "evil" and "good" twins by the media, after one tried to murder the other. Although the twins were both valedictorians at their small country high school in San Diego County and got along well, after they graduated they began to battle one another. Both sisters were involved in petty crime, but when Gina stole Sunny's BMW and credit cards, Sunny had her jailed. She escaped, but in November 1996 Sunny and her roommate were attacked and Gina was arrested for conspiracy to commit murder. She'd planned to have Sunny killed at her Irvine condominium, and then assume her identity.

For twin researcher and obstetrician Louis Keith, M. of Northwestern University Medical School, the idea of killing a twin is practically unthinkable. "I'm an identical twin, and yesterday I attended the funeral of another identical twin. I kept trying to imagine what my life would be like without my twin. My brother and I have had telepathic experiences. I was in East Germany, being driven on a secluded highway with evening snow falling, and suddenly felt intense heat over the entire front of my body and knew it could only mean one thing, that my brother was sending intense signals to me to call him. When one of the Communist telephone operators agreed to put the call through, I found out that my aunt had died and my twin wanted me to come to the funeral. The twin bond is greater than the spousal bond, absolutely."

Raymond Brandt, publisher of *Twins World* magazine, agrees. "I'm 67, and my identical twin died when we were 20. I love my wife and sons in a very special way, but my twin was one half of me, he was my first love. Living without my twin for 47 years has been a hell of an existence."

These remarkable stories seem to indicate an extra dimension to the twin bond, as if they truly shared a common, noncorporeal soul. What little study has been done on paranormal phenomena and twins, however, indicates that—once again—genes may be responsible. study by British parapsychologist Susan Blackn.

found that when twins were separated in different rooms and asked to draw whatever came into their minds, they often drew the same things. When one was asked to draw an object and transmit that to the other twin, who then was asked to draw what she telepathically received, the results were disappointing. Blackmore concluded that when twins seem to be clairvoyant, it's simply because their thought patterns are so similar.

## Is There No Nurture?

Over a century ago, in 1875, British anthropologist Francis Galton first compared a small group of identical and fraternal twins and concluded that "nature prevails enormously over nurture." Time and research seem to have proved him right. "It's no accident that we are what we are," contends Nancy Segal, Ph.D., professor of developmental psychology at California State University at Fullerton and director of the Twin Studies Center there. "We are born with biological propensities that steer us in one direction or another."

Yet critics of twin studies scoff. Richard Rose, Ph.D., professor of psychology and medical genetics at Indiana University in Bloomington, has studied personality in more than 7,000 pairs of identical twins and concluded that environment, both shared and unshared, has nearly twice the influence of genes.

However, both the nature and nurture camps may be looking at the same data and interpreting it differently. According to Lindon Eaves, unshared environment may actually be "chosen" by the genes, selected because of biological preferences. Scientists dub this the "nature of nurture." Genetically influenced personality traits in a child may cause parents to respond in specific ways. So how can we ever tease out the truth? Nature and nurture interact in a never-ending Mobius strip that can't be traced back to a single starting point.

Yet if genes are a powerful and a-priori given, they nonetheless have a range of activity that is calibrated in the womb by nutrition and later in life by the world. "Remember," says Eaves, "only 50 percent of who you are is influenced by genes. The other 50 percent includes the slings and arrows of outrageous fortune, accidents of development, sheer chaos, small and cumulative changes both within and without."

Environment, it turns out, may be most powerful when it limits—through trauma, deprivation, malnutrition. Studies by Sandra Scarr, Ph.D., professor of psychology at the University of Virginia, show that IQ scores for white twins at the bottom of the socioeconomic ladder, and for all black twins, are heavily influenced by environment. Social and economic deprivation keep scores artificially lower than twins' genetic potential.

Otherwise, Scarr postulates, genes bias you in a certain direction, causing you to select what you are already genetically programmed to enjoy. Children may be tiny gene powerhouses, shaping their parents' behavior as much as parents shape their children.

"Where does this leave us?" concludes Bouchard. "Your job as a parent is really to maximize the environment so that you and your children can manifest your full genetic potential." Under the best of environmental circumstances, our genes might be free to play the entire symphony of self.

And yet what of Irina, the Michigan housewife, and her twin, Yanina, the Polish nun? I sat with them over lunch, newly united twins who couldn't stop smiling at each other, clasping each other's hands. Their luminous hazel eyes were virtual replicas, but the two women couldn't have appeared more different otherwise: Irina bejeweled and blonde, Yanina in a combat-green nun's habit, a few tufts of brown hair peeping out, skin weathered. She described rescuing bloodied children from the arms of mothers who'd been shot to death and rising at dawn in the convent to pray silently for hours; her American counterpart portrayed a life filled with errands, cleaning homes, and caring for family.

"Rushing, rushing, rushing to get everything done" was Irina's summary of her life. "Teaching love, the kind of love that will make you happy," was her sister's. Listening to them speak, one in slow, gentle Midwestern cadences, the other in the rolled drumbeat of a Slavic tongue enriched by laughter and hand gestures, it was hard to believe they carried the same genetic imprint.

To me, their differences are so striking they seem to defy the last 20 years of twin research. "Right now we understand a little bit about human behavior and its biological and cultural roots," says Eaves. "But our lived understanding is far richer than any of that. People are yielding the ground too easily to genetics."

As I mused over the intricate turnings of twin research, I could only conclude the findings were as complex as the self we hope to illuminate with these studies. Fascinating, tantalizing, yes, but twin research, like any great scientific endeavor, ultimately points us toward the ineffable, inexplicable.

As Charles Boklage notes: "The development of the self is chaotic, nonlinear, and dynamic. Very small variations in conditions can lead to huge changes. Different twin studies give different answers. And whenever the mind tries to understand something, it has to be bigger than the subject it compasses. You cannot bite your own teeth."

"In the end," says Eaves, "I don't give a damn whether you call it God or natural selection, we're trying to find words that instill reverence for the mysterious stuff from which we are made."

God, fate, genes, luck, a random event like a move to America or Poland, or perhaps something stubbornly individual and free about us all, something that can never be quantified but can only be lived . . . The play of self goes on, and whatever hand or eye has orchestrated us, who in the end, twin or not, can know the dancer from the dance?

# Prenatal Drug Exposure

## Meeting the Challenge

Linda C. Sluder, Lloyd R. Kinnison and Dennis Cates

*Linda C. Sluder is Associate Professor, Early Childhood and Lloyd R. Kinnisonis Professor, Special Education, Texas Woman's University, Denton. Dennis Cates is Associate Professor, Special Education, Cameron University, Lawton, Oklahoma.*

---

*Educators and child care providers today face a challenging new community of children identified as one of the fastest growing at-risk populations in America (Poulsen, 1992). These children have been labeled as "crack babies," "prenatal drug exposed," "peri-natal cocaine addicted" or "substance exposed infants and children" (Kinnison, Sluder & Cates, 1995, p. 35).*

The mainstream media first identified such children in the early 1990s, focusing on demographic projections and associated statistical implications. The pressing issue now, however, is that these children have reached school age. As these children enter early childhood programs, educators must be prepared to nurture and encourage them.

Children with prenatal drug exposure exhibit a complex range of cognitive abilities and behaviors (Chasnoff, 1992; Howard, Beckwith, Rodning & Kropenske, 1989). Wright (1994) emphasizes that identifying specific traits is difficult, however, because prenatal exposure has diverse effects.

From *Childhood Education*, Winter 1996/97, pp. 66-69. 