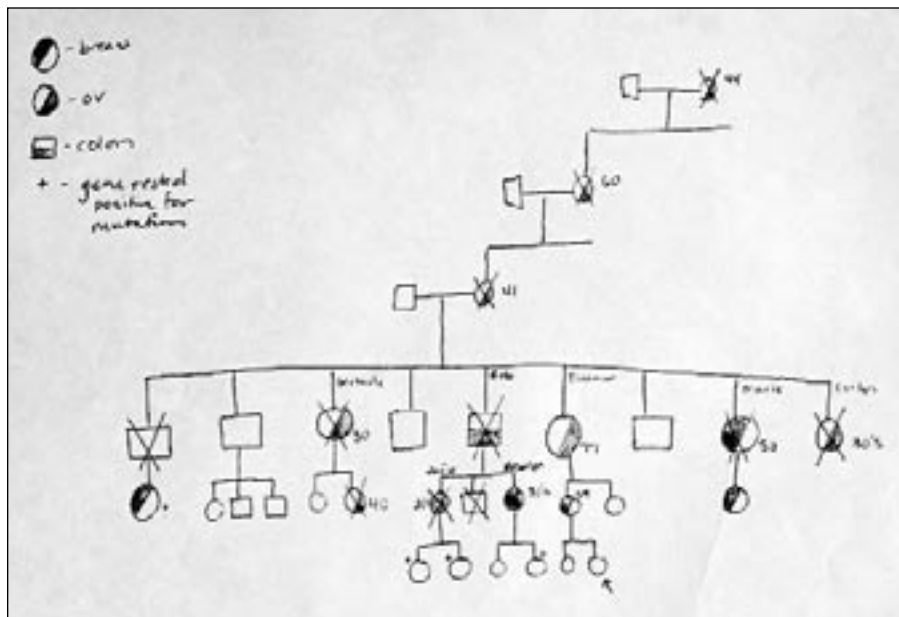


# Health

The New York Times

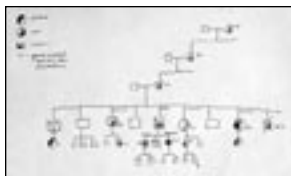
## The DNA Age



The articles in this Pulitzer Prize-winning series by Amy Harmon have explored the impact of new genetic technology on American life.

# Health: The DNA Age

The New York Times



The articles in this Pulitzer Prize-winning series have explored the impact of new genetic technology on American life.

**ONLINE:** Video reports, interactive graphics, relevant links and related articles can be found on the Times web site along with these articles at: [nytimes.com/dnaage](http://nytimes.com/dnaage)

E-mails to Amy Harmon about this series may be sent to:

[dna@nytimes.com](mailto:dna@nytimes.com)

This digital newsbook was produced for *The New York Times* at the Donald W. Reynolds Journalism Institute in Columbia, Missouri. [www.rjionline.org](http://www.rjionline.org)

## 1. ALL ABOUT STATUS

PUBLISHED: APRIL 12, 2006

### Seeking Ancestry in DNA Ties Uncovered by Tests

WHAT GENETIC TESTS CAN DO

## 2. MYGENES, MYSELF

PUBLISHED: JUNE 15, 2006

### That Wild Streak? Maybe It Runs in the Family

GENES LINKED TO BEHAVIORS

## 3. CHOOSING CHILDREN

PUBLISHED: SEPTEMBER 3, 2006

### Couples Cull Embryos to Halt Heritage of Cancer

SCREENING EMBRYOS FOR FUTURE DISEASE

## 4. THE GENOGRAPHIC PROJECT

PUBLISHED: DECEMBER 10, 2006

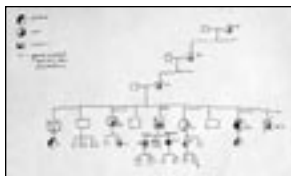
### DNA Gatherers Hit Snag: Tribes Don't Trust Them

IDENTIFYING COMMON ANCESTORS

TRACING HUMAN HISTORY WITH GENETICS

# Health: The DNA Age

The New York Times



The articles in this Pulitzer Prize-winning series have explored the impact of new genetic technology on American life.

➤ **ONLINE:** Video reports, interactive graphics, relevant links and related articles can be found on the Times web site along with these articles at: [nytimes.com/dnaage](http://nytimes.com/dnaage)

E-mails to Amy Harmon about this series may be sent to:

[dna@nytimes.com](mailto:dna@nytimes.com)

This digital newsbook was produced for *The New York Times* at the Donald W. Reynolds Journalism Institute in Columbia, Missouri.  
[www.rjionline.org](http://www.rjionline.org)

## 5. CHOOSING TO KNOW

PUBLISHED: MARCH 18, 2007

### Facing Life With a Lethal Gene

TALE OF A DOMINANT GENE

KATHARINE MOSER'S FAMILY

## 6. EXTREME GENEALOGY

PUBLISHED: APRIL 2, 2007

### Stalking Strangers' DNA To Fill in the Family Tree

## 7. IN THEIR SHOES

PUBLISHED: MAY 9, 2007

### Prenatal Test Puts Down Syndrome in Hard Focus

## 8. NOT YOUR AVERAGE PET

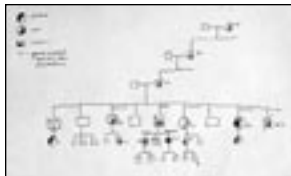
PUBLISHED: JUNE 12, 2007

### As Breeders Test DNA, Dogs Become Guinea Pigs

WHY FAST WHIPPETS BREED BULLIES

# Health: The DNA Age

The New York Times



The articles in this Pulitzer Prize-winning series have explored the impact of new genetic technology on American life.

**ONLINE:** Video reports, interactive graphics, relevant links and related articles can be found on the Times web site along with these articles at: [nytimes.com/dnaage](http://nytimes.com/dnaage)

E-mails to Amy Harmon about this series may be sent to:

[dna@nytimes.com](mailto:dna@nytimes.com)

This digital newsbook was produced for *The New York Times* at the Donald W. Reynolds Journalism Institute in Columbia, Missouri.  
[www.rjionline.org](http://www.rjionline.org)

## 9. CHANGING THE ODDS

PUBLISHED: SEPTEMBER 16, 2007

### Cancer Free at 33, But Weighing a Mastectomy

## 10. DISCOVERING THE DISCOVERER

PUBLISHED: OCTOBER 8, 2007

### Seeking Columbus's Origins, With a Swab

**GENOESE THEORY, CATALAN THEORY,  
PORTUGUESE THEORY, MAJORCAN THEORY,  
JEWISH THEORY, OTHER THEORIES**

## 11. A DELICATE DISCUSSION

PUBLISHED: NOVEMBER 11, 2007

### In DNA Era, New Worries About Prejudice

## 12. PERSONAL TESTS

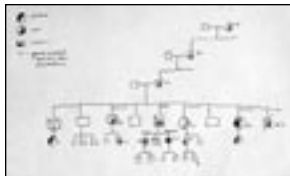
PUBLISHED: NOVEMBER 17, 2007

### My Genome, Myself: Seeking Clues in DNA

**WHERE TO GO FOR DNA TESTS  
TINY VARIATIONS IN OUR GENETIC CODE**

# Health: The DNA Age

The New York Times



The articles in this Pulitzer Prize-winning series have explored the impact of new genetic technology on American life.

**ONLINE:** Video reports, interactive graphics, relevant links and related articles can be found on the Times web site along with these articles at: [nytimes.com/dnaage](http://nytimes.com/dnaage)

E-mails to Amy Harmon about this series may be sent to:

[dna@nytimes.com](mailto:dna@nytimes.com)

This digital newsbook was produced for *The New York Times* at the Donald W. Reynolds Journalism Institute in Columbia, Missouri.

[www.rjionline.org](http://www.rjionline.org)

## 13. CHROMOSOME KINSHIP

PUBLISHED: DECEMBER 28, 2007

After DNA Diagnosis:  
'Hello, 16p11.2. We're Kin.'

## 14. PRIVACY AT A PRICE

PUBLISHED: FEBRUARY 24, 2008

Insurance Fears Lead Many to  
Shun DNA Tests

## 15. \$350,000 GENOME

PUBLISHED: MARCH 4, 2008

Personal Gene Map Becomes a  
Luxury Item

## 16. GENETIC STAKEOUT

PUBLISHED: APRIL 3, 2008

Lawyers Fight DNA Samples  
Gained on Sly

# Seeking Ancestry in DNA Ties Uncovered by Tests

By **AMY HARMON**

PUBLISHED: APRIL 12, 2006


**A**LAN Moldawer's adopted twins, Matt and Andrew, had always thought of themselves as white. But when it came time for them to apply to college last year, Mr. Moldawer thought it might be worth investigating the origins of their slightly tan-tinted skin, with a new DNA kit that he had heard could determine an individual's genetic ancestry.

The results, designating the boys 9 percent Native American and 11 percent northern African, arrived too late for the admissions process. But Mr. Moldawer, a business executive in Silver Spring, Md., says they could be useful in obtaining financial aid.

"Naturally when you're applying to college you're looking at how your genetic status might

---

## ONLINE: GENETIC TESTING

 A video report by Amy Harmon explains how the use of genetic tests is influencing everyday lives:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

help you," said Mr. Moldawer, who knows that the twins' birth parents are white, but has little information about their extended family. "I have three kids going now, and you can bet that any advantage we can take we will."

Genetic tests, once obscure tools for scientists, have begun to influence everyday lives in many ways. The tests are reshaping people's sense of themselves — where they came from, why they behave as they do, what disease might be coming their way.

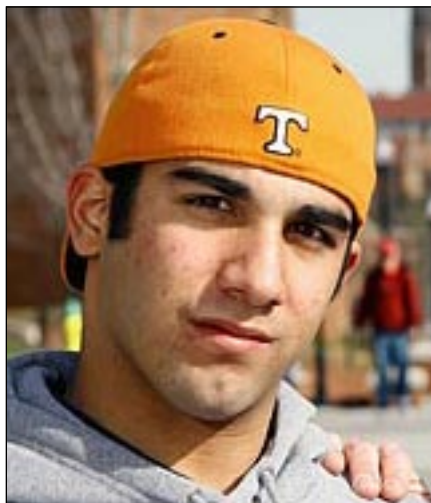
It may be only natural then that ethnic ancestry tests, one of the first commercial prod-

ucts to emerge from the genetic revolution, are spurring a thorough exploration of the question, What is in it for me?

Many scientists criticize the ethnic ancestry tests as promising more than they can deliver. The legacy of an ancestor several generations back may be too diluted to show up. And the tests have a margin of error, so results showing a small amount of ancestry from one continent may not actually mean someone has any.

Given the tests' speculative nature, it seems unlikely that colleges, governments and other institutions will embrace them. But that has not stopped many test-takers from adopting new DNA-based ethnicities — and a sense of entitlement to the privileges typically reserved for them.

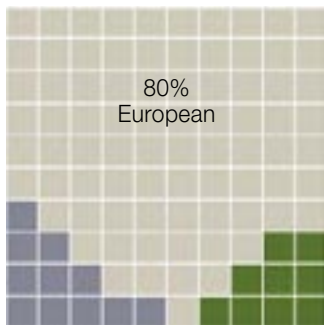
Prospective employees with white skin are using the tests to apply as minority candidates, while some with black skin are citing their European ancestry in claiming inheritance rights.



JASON R. DAVIS FOR THE NEW YORK TIMES

## Matthew Moldawer

TESTING COMPANY  
GeneTree DNA Testing Center



Results were derived from a test on his identical twin's DNA.

One Christian is using the test to claim Jewish genetic ancestry and to demand Israeli citizenship, and Americans of every shade are staking a DNA claim to Indian scholarships, health services and casino money.

“This is not just somebody’s desire to go find out whether their grandfather is Polish,” said Troy Duster, a sociologist at New York University who has studied the social impact of the tests. “It’s about access to money and power.”

Driving the pursuit of genetic bounty are start-up testing companies with names like DNA Tribes and Ethnoancestry. For \$99 to \$250, they promise to satisfy the human hunger to learn about one’s origins — and sometimes much more. On its Web site, a leader in this cottage industry, DNA Print Genomics, once urged people to use it “whether your goal is to validate your eligibility for race-based college admissions or government entitlements.”

Tony Frudakis, the research

director at DNAPrint, said the three-year-old company had coined the term American Indian Princess Syndrome to describe the insistent pursuit of Indian roots among many newly minted genetic genealogists. If the tests fail to turn up any, Mr. Frudakis added, “this type of customer is frequently quite angry.”

DNAPrint calls the ethnic ancestry tests “recreational genomics” to distinguish them from the more serious medical and forensic applications of genetics. But as they ignite a debate over a variety of genetic birthrights, their impact may be further-reaching than anyone anticipated.

Some social critics fear that the tests could undermine programs meant to compensate those legitimately disadvantaged because of their race. Others say they highlight an underlying problem with labeling people by race in an increasingly multiracial society.

“If someone appears to be



white and then finds out they are not, they haven't experienced the kinds of things that affirmative action is supposed to remedy," said Lester Monts, senior vice provost for student affairs at the University of Michigan, which won the right to use race as a factor in admissions in a 2003 Supreme Court decision.

Still, Michigan, like most other universities, relies on how students choose to describe themselves on admissions applications when assigning racial preferences.

Ashley Klett's younger sister marked the "Asian" box on her college applications this year, after the elder Ms. Klett, 20, took a DNA test that said she was 2 percent East Asian and 98 percent European.

Whether it mattered they do not know, but she did get into the college of her choice.

"And they gave her a scholarship," Ashley said.

Pearl Duncan has grander ambitions: she wants a castle.

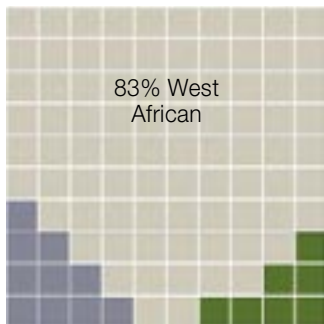


FRED R. CONRAD/THE NEW YORK TIMES

## Pearl Duncan

TESTING COMPANY

Roots for Real



10%  
British  
Isles

7%  
Middle Eastern-  
North African

A descendant of Jamaican slaves, Ms. Duncan had already identified the Scottish slave owner who was her mother's great-great-grandfather through archival records. But the DNA test confirming her 10 percent British Isles ancestry gave her the nerve to contact the Scottish cousins who had built an oil company with his fortune.

"It's one thing to feel satisfied to know something about your heritage, it's another to claim it," said Ms. Duncan, a writer in Manhattan. "There's a kind of checkmateness to the DNA."

The family's 11 castles, Ms. Duncan noted, were obtained with the proceeds of her African ancestors' labor. Perhaps they could spare one for her great-great-great-grandfather's black heirs? In case the paper records she had gathered were not persuasive, she invited male family members to take a DNA test that can identify a genetic signature passed from father to son. So far, no one has taken her up on the offer. Her appeal,

Ms. Duncan said, is mostly playful. Less so is her insistence that the Scots stop referring to their common ancestors as simply "Virginia and West India merchants."

"By acknowledging me, the Scots are beginning to acknowledge that these guys were slaveholders," she said.

Other slave descendants, known as the Freedmen, see DNA as bolstering their demand to be reinstated as members of the Indian tribes that once owned their ancestors. Under a treaty with the United States, the "Five Civilized Tribes" — Choctaws, Chickasaws, Creeks, Seminoles and Cherokees — freed their African slaves and in most cases made them citizens in the mid-1800's. More recently, the tribes have sought to exclude the slaves' descendants, depriving them of health benefits and other services.

At a meeting in South Coffeyville, Okla., last month, members of the Freedmen argued that DNA results revealing their

Indian ancestry underscore the racism of the tribe's position that their ancestors were never true Indians.

"Here's this DNA test that says yes, these people can establish some degree of Indian blood," said Marilyn Vann, a Cherokee Freedwoman who is suing for tribal citizenship in federal court. "It's important to combat those who want to oppress people of African descent in their own tribe."

As the assets of some tribes have swelled in the wake of the 1988 federal law allowing them to build casinos, there has been no shortage of petitioners stepping forward to assert their right to citizenship and a share of the wealth. Now, many of them are wielding genetic ancestry tests to bolster their claim.

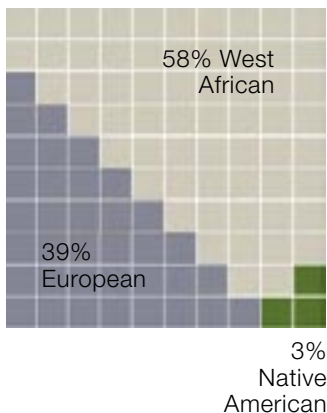
"It used to be 'someone said my grandmother was an Indian,' " says Joyce Walker, the enrollment clerk who regularly turns away DNA petitioners for the Mashantucket Pequot tribe, which operates the lucrative



JAMES GIBBARD FOR THE NEW YORK TIMES

## Marilyn Vann

TESTING COMPANY  
DNA Print Genomics



## What Genetic Tests Can Do

### CONFIRM IDENTITY

Identify your body after an accident

Tell if you were at a crime scene

### EXPAND A FAMILY TREE

Determine if an ancestor was someone famous

Describe where your ancestors came from

Help find unknown parents, siblings or other relatives

Determine paternity

### HELP PREDICT A MEDICAL CONDITION

Diagnose a genetic disorder like Huntington's disease

Warn you of a predisposition to addictions

Suggest which drugs might be most effective for you

Suggest certain foods or supplements to choose or avoid

Assess your risk with a mate of passing a genetic disease to a child

THE NEW YORK TIMES

Foxwoods Resort Casino in Connecticut. "Now it's 'my DNA says my grandmother was an Indian.'"

Recognizing the validity of DNA ancestry tests, some Indians say, would undermine tribal sovereignty. They say membership requires meeting the criteria in a tribe's constitution, which often requires documenting blood ties to a specific

tribal member. DNA tests cannot pinpoint to which tribe an individual's ancestor belonged.

But if tribes are perceived as blocking legitimate DNA applicants to limit payouts of casino money, experts say, it could damage their standing to enforce the treaties conferring the financial benefits so many covet.

"Ancestry DNA tests are

playing a part in the evolution of what the American public thinks matters,” said Kim Tallbear, an American Indian studies professor at Arizona State University. “And tribes are dependent on the American public’s good will, so they may have to bend.”

Under no such pressure, Israeli authorities have so far denied John Haedrich what he calls his genetic birthright to citizenship without converting to Judaism. Under Israel’s “law of return,” only Jews may immigrate to Israel without special dispensation.

Mr. Haedrich, a nursing home director who was raised a Christian, found through a DNA ancestry test that he bears a genetic signature commonly found among Jews. He says his European ancestors may have hidden their faith for fear of persecution.

Rabbis, too, have disavowed the claim: “DNA, schmeeNA,” Mr. Haedrich, 44, said the rabbi at a local synagogue in Los An-

geles told him when he called to discuss it.

Undeterred, Mr. Haedrich has hired a lawyer to sue the Israeli government. As in America, he argues, DNA is widely accepted as evidence in forensics and paternity cases, so why not immigration?

“Because I was raised a gentile does not change the fact that I am,” Mr. Haedrich wrote in a full-page advertisement in *The Jerusalem Post*, “a Jew by birth.”

Shonda Brinson, an African-American college student, is still trying to figure out how best to apply her DNA results on employment forms.

In some cases, she has chosen to write in her actual statistics — 89 percent sub-Saharan African, 6 percent European and 5 percent East Asian. But she figures her best bet may be just checking all relevant boxes.

“That way, of the three categories they won’t be able to determine which percentage is bigger,” Ms. Brinson said. □

# That Wild Streak? Maybe It Runs in the Family

By **AMY HARMON**

PUBLISHED: JUNE 15, 2006

**J**ASON Dallas used to think of his daredevil streak — a love of backcountry skiing, mountain bikes and fast vehicles — as “a personality thing.”

Then he heard that scientists at the Fred Hutchinson Cancer Research Center in Seattle had linked risk-taking behavior in mice to a gene. Those without it pranced unprotected along a steel beam instead of huddling in safety like the other mice.

Now Mr. Dallas, a chef in Seattle, is convinced he has a genetic predisposition for risk-taking, a conclusion the researchers say is not unwarranted, since they believe similar variations in human genes can explain why people perceive danger differently.

“It’s in your blood,” Mr. Dallas said. “You hear people say that



KEVIN P. CASEY FOR THE NEW YORK TIMES

Jason Dallas of Seattle says he believes he is genetically predisposed toward risky behavior like backcountry skiing and mountain biking.


kind of thing, but now you know it really is.”

A growing understanding of human genetics is prompting fresh consideration of how much control people have over who they are and how they act. The recent discoveries include genes that seem to influence whether an individual is fat, has a gift for dance or will be addicted to cigarettes. Pronouncements about the power of genes seem to be in the news almost daily, and are changing the way some Americans feel about themselves, their flaws and their talents, as well as the decisions they make.

For some people, the idea that they may not be entirely at fault for some of their less desirable qualities is liberating, conferring a scientifically backed reprieve from guilt and self-doubt. Others feel doomed by their own DNA, which seems less changeable than the more traditional culprits for personal failings, like a lack of discipline or bad childhoods. And many find it simply

---

**ONLINE: GENES AND SELF IMAGE**

 A video report by Amy Harmon on the discovery genes that seem to influence everything from obesity to addiction is changing the way people feel about themselves:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

depressing to think that their accomplishments might not be the result of their own efforts.

Parents, too, are rethinking their contributions. Perhaps they have not scarred their wayward children so much as given them bad genes. Maybe it was not their superior parenting skills that produced that Nobel laureate.

Whether a new emphasis on genes will breed tolerance or bigotry for inborn differences remains an open question. If a trait like being overweight comes to be seen as largely the result of genetic influence rather than lack of discipline, the social stigma connected to it could dissipate, for instance. Or fat people could start being viewed as genetically inferior.

## Genes Linked to Behaviors

Some recent genetic studies published in peer-reviewed academic journals have linked genes to behavior. Although a causal relationship between these genes and these behaviors has not been demonstrated, people with specific variants in these genes are more likely to manifest these behavioral traits. Links to the studies can be found at [nytimes.com/health](http://nytimes.com/health).

GENE	WHAT THE STUDY FOUND
<b>INSIG2</b> <i>Obesity</i>	This is a common gene variant associated with a significantly increased risk of becoming fat among the more than 25 million Americans who carry it.
<b>neuroD2</b> <i>Risk-taking</i>	Mice lacking neuroD2 have a greatly reduced sense of fear. Variants of the human version of this gene may lead to risk-taking behaviors.
<b>CYP2A6</b> <i>Nicotine addiction</i>	People with certain forms of this gene smoke more and are more likely to become addicted to cigarettes. Tailoring treatments based on which form of CYP2A6 a person has may help him or her quit.
<b>AVPR1a and SLC6A4</b> <i>Dance talent</i>	Variants of these genes are correlated with creative dance performance.
<b>DRD2</b> <i>Anorexia</i>	Variants of this receptor for the neurotransmitter dopamine have been preliminarily linked to the risk of developing anorexia.
<b>DRD4</b> <i>Sexual desire</i>	A dopamine receptor gene, DRD4 is linked in a study with sexual desire and performance.
<b>fruitless</b> <i>Sexual orientation</i>	Male and female fruit flies make different forms of this gene. Males carrying the female gene do not court females. Females carrying the male gene are attracted to other females.



Because tests for the genes that influence personality and behavioral traits are not yet commercially available, there is no way for most people to know which ones they have. And even if they could, the newly uncovered genes are thought merely to influence, not determine, their personalities.

Biologists are also quick to emphasize the role environment plays in activating genetic dispositions that might otherwise never be expressed, or mitigating those that are.

But that has not stopped people from acting on their assumptions.

Mr. Dallas's wife, Mari, for instance, convinced that her husband is in some sense hostage to his daredevil genes, has insisted he draw the line at certain activities.

"If he had his choice, he would be getting a motorcycle," said Ms. Dallas, a pediatric oncologist. "I don't think that's such a good idea."

The public embrace of genet-

ics may be driven as much by wishful thinking as scientific truth. In an age of uncertainty, biology can appear to provide a concrete answer for behavior that is difficult to explain. And the faith that genetics can illuminate the metaphysical aspects of being human is for some a logical extension of the growing hope that it can cure disease.

"More and more stories about who we are and how we live are becoming molecular," said Paul Rabinow, an anthropologist at the University of California, Berkeley, who studies the interrelation of science and culture. "The older liberal worldview that it's all a question of willpower is still very present in America, but genetics has become a strong countercurrent."

That may be partly because the science has become more credible. Armed with the human genome sequence, along with a catalog of genetic variation in the human population, and tools that can inexpensively gauge any individual's genetic makeup, scien-

tists can now pinpoint the genes associated with inherited traits.

Developed to dissect the genetic basis for complex ailments like heart disease and cancer, the methods are now being applied to less pressing areas like the way genes may influence sexual desire or attention deficit disorder. While scientists have yet to demonstrate any genetic cause that directly affects such behavior, they have found plausible associations. And for many people, that is all that matters.

“The scientific facts have changed,” said Steven Pinker, a psychologist at Harvard who documented cultural resistance to the influence of genetics on behavior in his 2002 book “The Blank Slate.”

“We now have real evidence that some of the variation in personality is inherited,” Dr. Pinker said, “and I think it may be affecting people’s everyday choices.”

Some people persist in believing in the power of the human spirit, but a growing number

prefer to submit it to a DNA test. In the wake of the recent discovery that millions of people who carry a specific genetic variation are more likely to gain weight, Mike DeWolfe, a computer programmer who considers himself overweight, cannot help wondering if he is one of them.

“I really would like to have a test, because it would help reduce my guilt over it,” said Mr. DeWolfe, 38, of Victoria, British Columbia, noting he would also welcome a genetic treatment as an alternative to his constant dieting. “That would make a big difference.”

There is nothing new about the idea that temperament and behavior are shaped by genetic endowment. Families have long clucked over a trademark stubborn streak showing up in a new generation, or crowed about inherited creative abilities. But as science begins to corroborate intuition, the public is reassessing where credit and responsibility lie for character traits that may be in part genetically preordained.

“To summarize, want to live until a ripe old age? Have parents that live long,” Joe Pickrell, a 23-year-old graduate genetics student wrote in a recent blog entry. “Think you’re a friendly, peaceful guy ‘cause your mom raised you right? Think again. Able to try drugs just a couple times and never get hooked because of your strong will? Nope.” (Mr. Pickrell, of Chicago, punctuated each clause with a link to a recent scientific journal article describing the genetic component of life expectancy, aggression and susceptibility to drug addiction.)

Jacki Thorpe wondered for years why her older sister could quit smoking so easily, while her own numerous attempts have failed. After all, their upbringing had been virtually identical, and they had started smoking together when they were 12 and 14. Then she heard about a genetic variation that predisposes some people to nicotine addiction.

“I have it,” guessed Ms. Thorpe, 42, an administrative assis-

tant in Whidbey Island, Wash. “My sister doesn’t.” Determined to fight her presumed genetic destiny, Ms. Thorpe has sworn to try quitting one more time this summer.

A Stanford University student in a focus group on smoking and genetics was more accepting: “Let’s say I’m still addicted to cigarettes 10 years from now,” the student said in a telephone interview, asking that his name not be used because he has concealed his smoking habit from his family. “It might feel like it’s not a total personal failure, just that certain things made it harder for me than other people. It kind of takes the weight off.”

Friends and family members who worry about behavior that seems unhealthy or self-destructive sometimes suspect that blaming genes is an easy out. When Representative Patrick J. Kennedy, Democrat of Rhode Island, cited his family’s history of addiction in admitting to a prescription drug addiction after he crashed his car near the Capitol

last month, for instance, some scoffed. “Kennedy blames crash on ‘car accident gene,’ “ read the headline on Antimatternews.com, a satirical blog, an allusion to the 1969 crash in which his father, Senator Edward M. Kennedy, was driving and a passenger was killed. Some bioethicists warn that the embrace of genetics as an explanation for troubling behavior threatens to let society off the hook, too. Taxing cigarettes, banning smoking in bars and not glamorizing it in movies is far more likely to lower smoking rates than drugs tailored to certain genotypes, these critics say.

Still, at Hazelden, an addiction-treatment center in Minnesota, teaching about genetics has become standard. Learning that roughly half the risk of alcohol addiction is associated with genes can remove a burden of guilt that otherwise serves as an obstacle to recovery, said Dr. Marvin D. Seppala, the center’s chief medical officer.

“They’ve driven drunk, and they have children, and they’re

saying, ‘I can’t believe I did this,’ “ Dr. Seppala said. “To learn they have a disease with a genetic component like other diseases really helps them understand these crazy sort of behaviors.”

As genetics comes to rival childhood experience as the favored lens through which to interpret behavior seen as deviant, parents who blamed themselves for their children’s disorders are also finding some relief. Recent research has found that conditions like anorexia or autism, once thought to be largely psychological, are at least partly genetic.

“You would wonder, ‘What’s wrong, what aren’t we providing?’ “ said Kathy Ramsay, 55, a legal secretary in Sacramento who has had three daughters who suffered from anorexia. The new DNA paradigm, however, can come with a new guilt trip.

“I passed it on to them,” added Ms. Ramsay, whose daughter Heather volunteered for a genetic study of anorexia at the University of North Carolina after reading about the research

in her local newspaper this year. “It was in me.”

Some adults are more forgiving of parents’ sins they now consider DNA-enabled. Others get angry, however irrationally, for being saddled with inferior genes. Tim McGrath, 45, said learning about the genetics of alcoholism had made him more determined not to follow the path of his father. Still, he is haunted that he has seen his own fate.

“It’s like this demon out there, lurking,” said Mr. McGrath, a teacher in Chicago. “And without the proper vigilance, or whatever, it could strike.”

By suggesting a genetic basis for behavior previously believed by some to be the result of character flaws, scientists and others say the discoveries could make for more understanding of human differences. Some overweight people, for instance, hope it will reduce the stigma associated with being fat.

“Maybe it will help the rest of the world realize it’s not lack of willpower, it’s not stubbornness,



KEVIN P. CASEY FOR THE NEW YORK TIMES

Heather Ramsay of Seattle suffered from anorexia as a teenager. Two of her three sisters also had the eating disorder, she says.

it’s not laziness,” said Jane Perrotta, 52, a medical writer and contributor to the weight-loss blog *The Skinny Daily Post*.

“It’s the hand you’re dealt,” Ms. Perrotta said.

Others fear that when certain

behaviors once ascribed to personal choice are seen as genetic, the next step will be not tolerance for difference, but support for intervention. On a “fat-acceptance” e-mail list, several members suggested recent research will lead only to new ways for them to lose weight through genetic alteration, rather than be accepted as they are. And when scientists caused fruit flies to pursue flies of the same sex by altering a gene last year, some gay-rights advocates worried it would lend credence to the notion that homosexuality could be “cured.”

People could also find their genes being held against them. Already, some scientists suspect a specific gene plays a role in violent behavior, for instance, and a discussion has already begun over how people bearing such genes should be treated.

“If we find a murder mutation, are we going to be more accepting of murderers, or are we going to lock them up even more tightly?” asked Jeffrey M. Friedman, director of the Starr Center for

Human Genetics at Rockefeller University. “The more we find genes that play a role in determining all sorts of attributes, the more we’re going to face these kinds of ethical issues.”

Of course, for traits that are socially desirable, people may not be as eager to accept genetic explanations that seem to trivialize their skills or accomplishments. When scientists this year found two gene variations that appear at higher rates in professional dancers than in the general population, many dancers bristled at the news. In online message boards for the ballet magazine *Pointe*, several writers said success in dance was the result of hard work, passion and good mentors. “Being a dancer requires so much more than what’s there in your body, an emotional strength,” said Virginia Johnson, editor of *Pointe* and a former principal dancer with the Dance Theater of Harlem.

She paused.

“That genes can’t really — well, I guess that’s genetic, too, isn’t it?” □



SALLY RYAN FOR THE NEW YORK TIMES

Chad Kingsbury, who has a genetic mutation that makes him susceptible to an inherited form of colon cancer, and his wife, Colby, decided to use genetic testing to ensure that their daughter, Chloe, would not inherit the defective gene.

# Couples Cull Embryos to Halt Heritage of Cancer

By **AMY HARMON**

PUBLISHED: SEPTEMBER 3, 2006

**A**S Chad Kingsbury watches his daughter playing in the sandbox behind their suburban Chicago house, the

thought that has flashed through his mind a million times in her two years of life comes again: Chloe will never be sick.

Not, at least, with the inherited form of colon cancer that has

devastated his family, killing his mother, her father and her two brothers, and that he too may face because of a genetic mutation that makes him unusually susceptible.


By subjecting Chloe to a genetic test when she was an eight-cell embryo in a petri dish, Mr. Kingsbury and his wife, Colby, were able to determine that she did not harbor the defective gene. That was the reason they selected her, from among the other embryos they had conceived through elective in vitro fertilization, to implant in her mother's uterus.

Prospective parents have been using the procedure, known as preimplantation genetic diagnosis, or P.G.D., for more than a decade to screen for genes certain to cause childhood diseases that are severe and largely untreatable.

Now a growing number of couples like the Kingsburys are crossing a new threshold for parental intervention in the genetic makeup of their offspring:

---

**ONLINE: EMBRYO SCREENING**

 A video interview with Chad and Colby Kingsbury, a couple who used preimplantation genetic diagnosis:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

They are using P.G.D. to detect a predisposition to cancers that may or may not develop later in life, and are often treatable if they do.

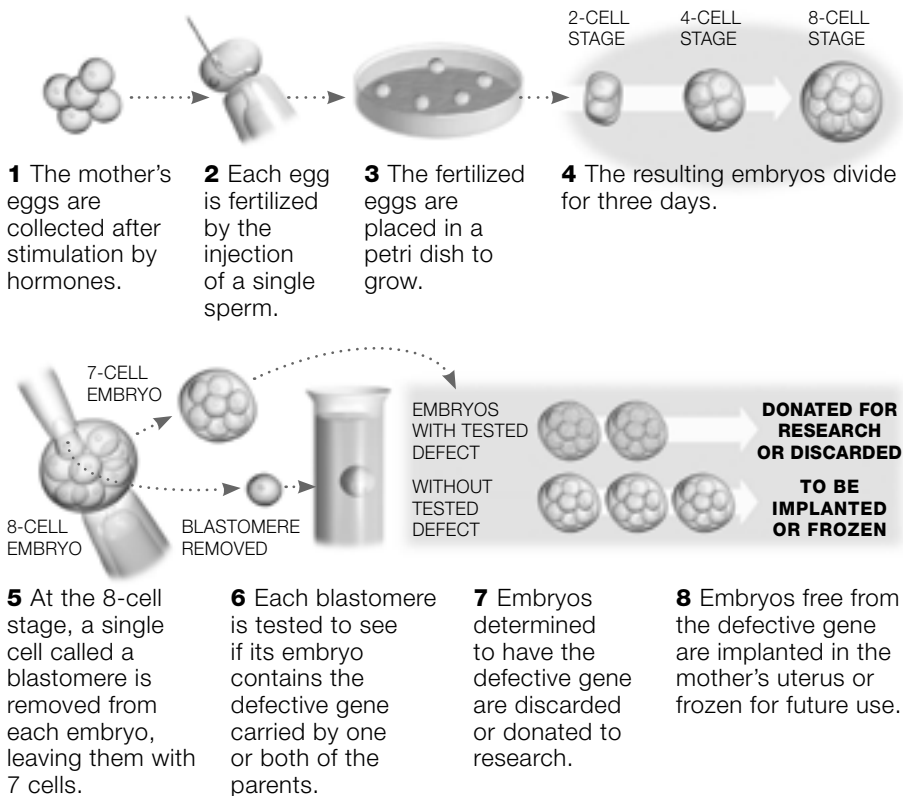
For most parents who have used preimplantation diagnosis, the burden of playing God has been trumped by the near certainty that diseases like cystic fibrosis and sickle cell anemia will afflict the children who carry the genetic mutation that causes them. The procedure has also been used to avoid passing on Huntington's disease, a severe neurological disease that typically does not surface until middle age but spares no one who carries the mutation that causes it.

Couples like the Kingsburys, by contrast, face an even more complex calibration. They must weigh whether their desire to



## Screening Embryos for Future Disease

Preimplantation genetic diagnosis, or P.G.D., which starts with in vitro fertilization, allows prospective parents to test their embryos for genetic traits that raise the risk of developing diseases like cancer later in life. The results of the tests determine which embryos are implanted.



Source: Memorial Sloan-Kettering Cancer Center; Genesis Genetics Institute

AL GRANBERG/THE NEW YORK TIMES

prevent suffering that is not certain to occur justifies the conscious selection of an embryo and the implicit rejection of those that carry the defective gene.

As doctors and genetic counselors at leading cancer centers like Memorial Sloan-Kettering in New York start to suggest the possibility of P.G.D., more young patients are finding that their answer lies in trading natural conception for the degree of scientific control offered by the procedure. And if the growing interest in screening for cancer risk signals an expanded tolerance for genetic selection, geneticists and fertility experts say it may well be accompanied by the greater use of preimplantation diagnosis to select for characteristics that range from less serious diseases to purely matters of preference.

Already, it is possible to test embryos for an inherited form of deafness or a mild skin condition, or for a predisposition to arthritis or obesity. Some clin-

ics test for gender. As scientists learn more about the genetic basis for inherited traits, and as people learn more about their genetic makeup, the embryo screening menu and its array of ethical dilemmas are only expected to grow.

“From a technology perspective we can test anything,” said

---

The embryo screening menu and its array of ethical dilemmas are only expected to grow.

---

Mark Hughes, director of the Genesis Genetics Institute in Detroit, who is performing P.G.D. this month for two couples who want to avoid passing on a susceptibility to breast cancer. “The issue becomes what is considered serious enough to warrant such testing and who decides that.”

The process is also difficult and expensive. P.G.D., which re-

quires in vitro fertilization, can cost tens of thousands of dollars. While insurance companies often pay for the more traditional uses of the procedure, they have not done so for cancer-risk genes, fertility experts say. The barrier to affordability, some critics fear, could make preimplantation diagnosis for cancer risk the first significant step toward a genetic class divide in which the wealthy will become more genetically pure than the poor.

Knowing that Mr. Kingsbury had tested positive for the colon cancer mutation, the Kingsburys started with the basic laws of genetics: because children randomly inherit half of each parent's genes, he had a 50 percent chance of passing it on. Since the mutation raises the risk of developing the cancer by about twentyfold, that means any child of theirs conceived the traditional way would have about a one in three chance of getting it, usually around age 45. Those who did develop the cancer would also

have a nearly 90 percent chance of surviving it, but only if it was caught early.

The jumble of odds meant little to the Kingsburys as they tried to think about starting a family while the cancer claimed Mr. Kingsbury's second uncle. Then, from a cousin of Mr. Kingsbury's who had also fought colon cancer, they heard about P.G.D., the technology that offered them a way to reload the genetic dice.

To do it, they had to overcome their own misgivings about meddling with nature. They had to listen to the religious concerns of Mr. Kingsbury's family and to the insistence of Ms. Kingsbury's that the expense and physical demands of in vitro fertilization were not worth it, given that the couple could probably get pregnant without it. They had to stop asking themselves the unanswerable question of whether a cure would be found by the time their child grew up.

It took them two months to make the decision. But ev-

ery time Mr. Kingsbury looks at Chloe, with her blue saucer eyes and her tantrums that turn abruptly to laughter — and back — he knows it was worth it.

“I couldn’t imagine them telling me my daughter has cancer,” he said, “when I could have stopped it.”

### Shifting Medical Advice

Cancer-prone families are only just beginning to hear about P.G.D. in part because the procedure falls through the cracks in medicine. Oncologists tend not to think about family planning, and obstetricians tend not to think about cancer genetics. Doctors may also shy from raising the prospect of what some critics call “unnatural selection.”

For many couples, going to such lengths to ensure that a child will be born free of a predisposition to a certain kind of cancer is anathema. Breast and colon cancer, the two most common cancers for which genetic susceptibility tests are available,

can be detected early and are often treatable, and even those who die of them often lead long and productive lives.

Many people without the risk-raising genes still get one of the cancers, and those who do carry the genetic mutations are just as likely as anyone else to develop other forms of the disease.

Prospective parents who want to avail themselves of P.G.D. must first undergo the same in vitro fertilization process often used to assist infertile couples, in which eggs are extracted from the mother and fertilized with the father’s sperm in a petri dish. When the resulting embryos are three days old, doctors remove a single cell from each and analyze its DNA. Only embryos without the defective gene are then considered candidates to implant in the mother’s uterus.

The out-of-pocket costs often exceed \$25,000, depending on how many in vitro cycles are required. Because embryos are selected for their genetic status, rather than solely by which look

the healthiest, the chance that they will fail to develop after implantation is higher. And despite the birth of thousands of apparently healthy babies after P.G.D., there is still concern that the long-term effects of removing a cell from an eight-cell embryo have not been studied enough.

That has not stemmed the rising demand to screen embryos for cancer-risk genes. No one tracks the number of such procedures in the United States, but an article in next month's issue of *The Journal of Clinical Oncology* reports that clinics around the country have been quietly performing P.G.D. for hereditary cancers of the breast and the colon. The article, written by Dr. Kenneth Offit, chief of clinical genetics at Memorial Sloan-Kettering Cancer Center, suggests there would be even more interest in P.G.D. if oncologists were to begin informing prospective patients of the option.

About one in every 200 Americans carry a genetic mutation that makes them more suscep-

tible to breast or colon cancer. The half-million or so who carry mutations in several genes associated with colon cancer have up to a 70 percent chance of developing the disease, compared with 6 percent for those with normal copies of the genes. One in eight American women will develop breast cancer in their lifetimes, but for those who carry mutant forms of the BRCA1 or BRCA2 genes, the risk jumps to one in two.

Until the last year or so, Dr. Offit said in an interview, he questioned the utility of P.G.D. for his patients, focusing instead on the increasingly effective prevention and treatment options for anyone born with an elevated cancer risk. Genetics, he said, is not necessarily destiny.

But learning of its existence, Dr. Offit noticed, could make many young patients less fatalistic about their genes and more optimistic about starting a family. The sense of relief it offered was especially strong among

those who had seen a parent or a sibling die of cancer.

“Having seen so many children from cancer-prone families, I’m more sensitive to the sentiment that they would rather avoid the syndrome altogether,” Dr. Offit said. “Our genetic counselors now try to bring up the potential of this technology in circumstances where we think it may be empowering to young couples.”

### Too Late for Some Carriers

If other cancer centers follow Sloan-Kettering’s lead, the shift will still come too late for some cancer gene carriers. One woman, a professional in New York, said she blamed bad medical advice for her having possibly passed to her 4-year-old daughter a chance of developing breast cancer this is five times as great as that of women in the general population.

Unaware of P.G.D., she followed the counsel given to most women with a family history of breast cancer and had her chil-

dren before getting tested for the gene. The logic is that women ought not worry about their genetic status until they can consider the most effective prophylactic measures, removing their breasts and ovaries.

But in postings to an online breast cancer support group, facingourrisk.org, the woman said she suspected that the prevailing unease over genetic selection and the question of when life begins also kept doctors from suggesting P.G.D.

“Those values should not be dictating recommendations by doctors,” said the woman, 40, who declined to be identified by name because her words might be hurtful to her family. “That’s what I resent. I feel like the choice was taken away from me.”

In Europe, divergent values are quite explicitly shaping different P.G.D. policies. This spring, England approved the use of preimplantation diagnosis for the breast and colon cancer risk genes. In Italy, the

procedure has been effectively banned for any condition.

In the United States, where the technology is not regulated, decisions about when it is appropriate are left largely to fertility specialists and their patients. Reflecting the growing demand for the procedure, the company that owns the tests for the breast cancer genes recently licensed the right to use them to three fertility centers.

“We decided we don’t want to do it here,” said William Hockett, a spokesman for the company, Myriad Genetics of Salt Lake City, citing both moral preferences and a disinclination to invest in the technique for business reasons. “But we don’t want to impose our values on society, so we felt we should allow others to do it if they wished.”

The interest in embryo testing is being driven largely by a greater knowledge of genetics among cancer patients and their family members. In the last five years, nearly 10 times as many Americans have been tested for

the breast-cancer-risk genes as in the previous five, according to Myriad, surpassing a total of 100,000 since the test was made available in 1996.

Familiarity with their own genetic profile makes some people more comfortable with intervening to alter their children’s. For them, genetic traits can seem less like destiny and more like any other part of their lives that can be improved by technology.

Many of those exploring P.G.D. are the first generation of women to have reached reproductive age after their mothers developed cancer and tested positive for one of the breast cancer mutations. They see it as saving not just their children but generations of descendants from the same fate.

“I was very relieved to know that I would not have to pass this gene on to my children,” said Michaela Walsh, 20, a junior at Susquehanna University in Selinsgrove, Pa., who found out she carries a BRCA mutation. She has already decided she wants

to use P.G.D. when she has children. “My mother told me that the only worse thing than having cancer twice was having to give the gene to me.”

But the same knowledge makes others who carry the mutations take particular offense at the selection procedure, which they say implies that they themselves, and many members of their family, should never have existed. It raises the specter of eugenics, they say, in the most personal terms.

“It’s like children are admitted to a family only if they pass the test,” said Denise Toeckes, 32, a teacher who tested positive for a BRCA mutation. “It’s like, ‘If you have a gene, we don’t want you; if you have the potential to develop cancer, you can’t be in our family.’”

Other critics oppose pre-implantation diagnosis on the grounds that it could be used to select against homosexuals, women or people with disabilities. It reduces people to their genes, they say, and paves the

way for the pursuit of children designed to suit parental ideals and for discrimination against those born with perceived imperfections.

Proponents of the technology say that confusing the concept of “designer babies” with people trying to avoid deadly illnesses is hurtful and misleading. No one,

---

The selection procedure  
has raised the specter  
of eugenics and  
“designer babies.”

---

they say, would endure the substantial physical and emotional difficulty posed by the process to make a baby with blue eyes and a wicked curveball. Still, the hostility couples have encountered from friends, family, colleagues and even medical professionals caused several of those interviewed for this article to request that their names be withheld.



One prospective father, a medical resident at Johns Hopkins Hospital in Maryland, said the Shady Grove Fertility Center, the local fertility clinic, required that he and his wife, also a resident at Hopkins, write a letter justifying their request for P.G.D. to the clinic's ethics committee.

The doctor's own father continually warned that in trying to prevent cancer, removing a cell from the embryo would create a mentally retarded child — no matter how many times his son cited studies to the contrary. Reactions from colleagues made the couple worry that if they allowed their names to be used, it might hurt their chances when applying for jobs at medical or research institutions.

"It became such a negative topic of conversation that my wife and I decided, 'We're not talking about this to anyone,'" said the doctor, 30, whose mother has had her breasts, uterus and ovaries removed to combat her cancer, in addition to undergoing dozens of chemotherapy sessions.

The couple held firm in their belief that there was no virtue in letting nature take its course when its outcome was so potentially damaging. "We hope to look back on this as really the first decision we made as parents," they wrote in a letter to the ethics committee that persuaded the clinic to let them move ahead.

## Multiplying Decisions

Even for those who choose it, the burden of selection weighs heavily. Kim Surkan, who carries the BRCA1 breast cancer mutation, said her partner had initially described preimplantation diagnosis as a "pact with the devil." As Ms. Surkan prepares for her eggs to be extracted next month, she has nightmares that the child she selects will drown in a swimming pool, as opposed to a child chosen by fate, who might carry the cancer-risk gene but would have been a good swimmer.

"At least I know I've done whatever I can do with the infor-

mation I have,” said Ms. Surkan, an adjunct lecturer in women’s studies at the Massachusetts Institute of Technology. “I can’t control everything.”

Like many people who want to take advantage of P.G.D. but cannot easily afford it, Ms. Surkan had to first convince her insurance company that she was infertile so that it would pay for the in vitro fertilization process. Because she is in a same-sex couple, that meant she had to undergo several cycles of insemination, hoping that she would in fact not get pregnant, so that she could proceed with preimplantation diagnosis.

Now more decisions are coming. What if, she wonders, she is unlucky, and all her embryos have disease genes? Should she implant a male one, since men rarely develop breast cancer, even if she is opposed to selection based on gender?

If she does get pregnant with an embryo found to be free of the gene, should she test the fetus at 16 weeks, since there

is up to a 3 percent chance that P.G.D. will fail to detect an unwanted mutation? If she has two embryos implanted, and one has the defective gene, should she terminate it?

For many couples, preimplantation diagnosis is an appealing option precisely because it does not require terminating a pregnancy, a step that is common after an amniocentesis reveals that a fetus has a severe genetic disease but is essentially unheard of for predisposition to common cancers.

Danielle Jamond, who carries a gene for a severe form of inherited colon cancer, said she and her husband were considering that option a year ago. But she was saved from making the choice when she heard of a doctor who had developed a P.G.D. procedure for her form of the disease.

“At that point, the choice was obvious,” said Ms. Jamond, a human resources manager in a suburb of Paris, who has had her large intestines removed to

avoid getting the cancer, a prophylactic measure for people with her genetic mutation.

Four embryos were created from her 12 eggs, and three did not have the genetic mutation. One died, the other two were implanted, and one survived. She is now six months pregnant with the surviving one, a girl.

But some people who believe life begins with conception think P.G.D. is as unethical as abortion and perhaps more pernicious because it is psychologically less burdensome. Unused embryos may be frozen indefinitely, skirting one moral issue, but at a cost of several hundred dollars a year. Reproductive Genetics Institute, a leading P.G.D. lab in Chicago that performed the preimplantation diagnosis for the Kingsburys, said about half the embryos containing the unwanted genetic profile were discarded and half donated to research.

### **‘Is This Genetic Engineering?’**

Already, thousands of couples who are undergoing in vitro fer-

tilization to overcome infertility use P.G.D. to weed out embryos that harbor common chromosomal disorders that would otherwise be screened for by amniocentesis. Fertility experts say they may be the first to take advantage of the procedure for a range of other genetic conditions.

Dr. Ina N. Cholst, a reproductive endocrinologist at Weill Medical College of Cornell University, said a fertility patient of hers who suffers from an inherited arthritic condition called ankylosing spondylitis was planning to add genetic diagnosis to her in vitro procedure. She has a 50 percent chance of passing the gene to a child. Of those who carry it, four of five will be unaffected. The others will have arthritis, sometimes mild and sometimes quite severe, but increasingly treatable.

“We brought it up,” said Dr. Cholst, who consulted with the patient’s rheumatologist. “At the same time, I am thinking, ‘Is this a wonderful thing, or is this genetic engineering?’”

In the future, many specialists believe, most in vitro fertilizations will be performed for fertile couples seeking genetic diagnosis, not as a treatment for infertility. But as it becomes easier to identify the possible consequences of more kinds of genes, the decisions for parents may become harder. Having passed over 4 embryos with the defective gene and identified 10 healthy ones, the Kingsburys were asked if they wanted to pay \$2,000 extra to test them for Down syndrome. That test eliminated two more.

“You kind of feel like you shouldn’t be doing it,” Ms. Kingsbury said. “But then why would we go through all of this and not

take those extra precautions?”

Soon, experts say, prospective parents may be able to choose between an embryo that could become a child with a lower risk of colon cancer who is likely to be fat, or one who is likely to be thin but has a slightly elevated risk of Alzheimer’s, or a boy likely to be short with low cholesterol but a significant risk of Parkinson’s, or a girl likely to be tall with a moderate risk of diabetes.

For the Kingsburys, the choice is still clear. Like any parents, they plan to tell Chloe the story of her birth. And if all goes well, they say, she will soon have a sibling who shares a similar tale. □

The New York Times

HEALTH

[nytimes.com/health](http://nytimes.com/health)

**Times Health Guide:** Comprehensive reference and special reports about diseases, conditions, tests, injuries and surgeries.

# DNA Gatherers Hit Snag: Tribes Don't Trust Them

By **AMY HARMON**

PUBLISHED: DECEMBER 10, 2006

SOUTH NAKNEK, ALASKA


**T**HE National Geographic Society's multimillion-dollar research project to collect DNA from indigenous groups around the world in the hopes of reconstructing humanity's ancient migrations has come to a standstill on its home turf in North America.

Billed as the "moon shot of anthropology," the Genographic Project intends to collect 100,000 indigenous DNA samples. But for four months, the project has been on hold here as it scrambles to address questions raised by a group that oversees research involving Alaska natives.

At issue is whether scientists who need DNA from aboriginal populations to fashion a window on the past are underselling the risks to present-day donors.

---

## ONLINE: DNA COLLECTION

 A video interview with Dr. Steven Wells, the population geneticist who directs the Genographic Project: [nytimes.com/danage](http://nytimes.com/danage)

---

Geographic origin stories told by DNA can clash with long-held beliefs, threatening a world view some indigenous leaders see as vital to preserving their culture.

They argue that genetic ancestry information could also jeopardize land rights and other benefits that are based on the notion that their people have lived in a place since the beginning of time.

"What if it turns out you're really Siberian and then, oops, your health care is gone?" said Dr. David Barrett, a co-chairman of the Alaska Area Institutional Review Board, which is sponsored by the Indian Health Service, a federal agency. "Did any-

one explain that to them?”

Such situations have not come up, and officials with the Genographic Project discount them as unlikely. Spencer Wells, the population geneticist who directs the project, says it is paternalistic to imply that indigenous groups need to be kept from the knowledge that genetics might offer.

“I don’t think humans at their core are ostriches,” Dr. Wells said. “Everyone has an interest in where they came from, and indigenous people have more of an interest in their ancestry because it is so important to them.”

But indigenous leaders point to centuries of broken promises to explain why they believe their fears are not far-fetched. Scientific evidence that American Indians or other aboriginal groups came from elsewhere, they say, could undermine their moral basis for sovereignty and chip away at their collective legal claims.

“It’s a benefit to science, probably,” said Dr. Mic LaRoque, the Alaska board’s other co-chairman and a member of

the Turtle Mountain Chippewa Tribe of North Dakota. “But I’m not convinced it’s a benefit to the tribes.”

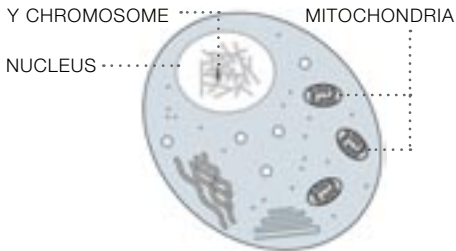
The pursuit of indigenous DNA is driven by a desire to shed light on questions for which the archeological evidence is scant. How did descendants of the hunter-gatherers who first left humanity’s birthplace in east Africa some 65,000 years ago come to inhabit every corner of the Earth? What routes did they take? Who got where, and when?

As early humans split off in different directions, distinct mutations accumulated in the DNA of each population. Like bread crumbs, these genetic markers, passed on intact for millennia, can reveal the trail of the original pioneers. All non-Africans share a mutation that arose in the ancestors of the first people to leave the continent, for instance. But the descendants of those who headed north and lingered in the Middle East carry a different marker from those who went southeast toward Asia.

# Using Genetics to Identify Common Ancestors

The Genographic Project seeks to clarify human history by testing genes from different groups for common ancestors. Here is how it works.

Some bits of genetic material are not subject to shuffling when parents' DNA mixes. Examples are the Y chromosome and the DNA in mitochondria, tiny structures that provide energy to the cell.



Since only males have a **Y chromosome**, mutations on this gene give information about the history of the paternal lineage.

All **mitochondrial DNA** comes from the mother. Thus, mutations in the mitochondrial DNA track changes through the maternal lineage.

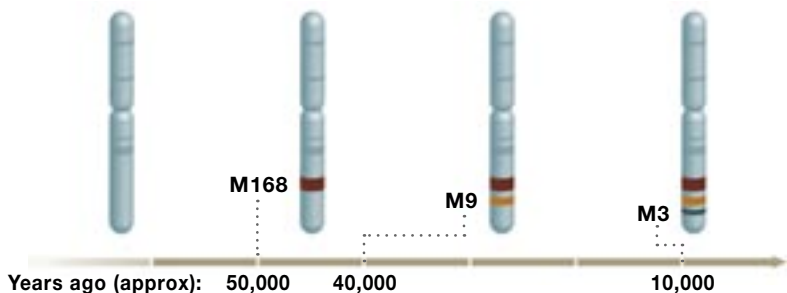
Specific mutations serve as markers that tie people to a common ancestor. As they build up, they tell the history of a particular group.

Basic pattern of Y chromosome, shared by all men.

Non-African men have the M168 marker, which arose in people who left Africa.

M9 arose in the Middle East or Central Asia.

Eurasians who crossed into the Americas share the M3 mutation.

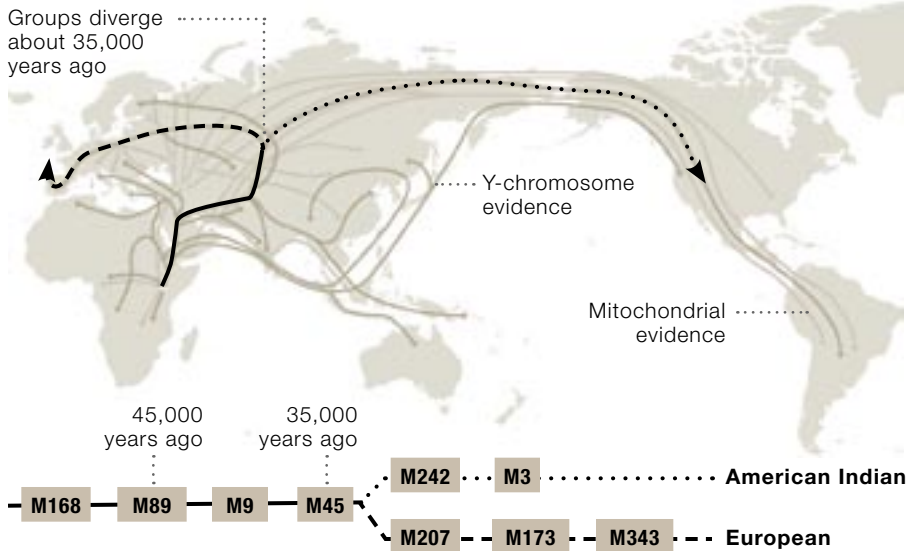


Source: National Geographic; The Genographic Project

JAMES BRONZAN/THE NEW YORK TIMES

# Tracing Human History With Genetics

As an example, two men who might live in the United States — an American Indian and a descendent of Europeans — shared an ancestor in Asia about 35,000 years ago, markers on their Y chromosomes show.



Source: National Geographic; The Genographic Project

JAMES BRONZAN/THE NEW YORK TIMES

Most of the world's six billion people, however, are too far removed from wherever their ancestors originally put down roots to be useful to population geneticists. The Genographic Project is focusing on DNA from people still living in their ancestral home-

lands because they provide the crucial geographic link between genetic markers found today and routes traveled long ago.

In its first 18 months, the project's scientists have had considerable success, persuading more than 18,000 people in



off-the-grid places like the east African island of Pemba and the Tibesti Mountains of Chad to donate their DNA. When the North American team arrived in southwestern Alaska, they found volunteers offering cheek swabs and family histories for all sorts of reasons.

The council members of the Native Village of Georgetown, for instance, thought the project could bolster a sense of cultural pride.

Glenn Fredericks, president of the Georgetown tribe, was eager for proof of an ancient unity between his people and American Indians elsewhere that might create greater political power. "They practice the same stuff, the lower-48 natives, as we do," Mr. Fredericks said. "Did we exchange people? It would be good to know."

Others said the test would finally force an acknowledgment that they were here first, undermining those who see the government as having "given" them their land.

Still others were interested in the mechanics of migration: "Were the lands all combined? Did they get here by boat?" For many nonindigenous Americans who feel disconnected from their roots, the project has also struck a chord: nearly 150,000 have scraped cells from their cheek and sent them to the society with \$100 to learn what scientists know so far about how and where their individual forebears lived beyond the mists of prehistory.

By giving the broader public a way to participate, though it is likely to generate little scientific payoff, the project has created an unusual set of stakeholders with a personal interest in its success. More details, the project explains in the ancestral sketches it gives individuals, will come only with more indigenous DNA.

"I think you have to be sensitive to these cultures," said Jesse R. Sweeney, 32, a bankruptcy lawyer in Detroit who hopes the millennia-size gaps in his own

ancestors' story will eventually be filled in. "But hopefully they will change their mind and contribute to the research."

Mr. Sweeney's DNA places his maternal ancestors in the Middle East about 50,000 year ago. After that, they may have gone north. Or maybe south: "This is where the genetic clues get murky and your DNA trail goes cold," read the conclusion to his test results on the project's Web site. "By working together with indigenous peoples around the globe, we are learning more about these ancient migrations."

The Genographic Project has drawn quiet applause from many geneticists for resurrecting scientific ambitions that have grown more pressing. As indigenous groups intermarry and disperse at an ever-accelerating pace, many scientists believe the chance to capture human history is fast disappearing.

"Everyone else had given up," said Mark Stoneking, a professor at the Max Planck Institute for Evolutionary Anthropology.

"If they get even a fraction of what they are trying for, it will be very useful."

Unlike the earlier Human Genome Diversity Project, condemned by some groups as "biocolonialism" because scientists may have profited from genetic data that could have been used to develop drugs, the Genographic Project promises to patent nothing and to avoid collecting medical information. The project has designated half the proceeds from the sale of kits to the public for programs designed to preserve traditional cultures and language.

In May, project officials held a stormy meeting in New York with the indigenous rights group Cultural Survival while protestors carried signs reading "National Geographic Sucks Indigenous Blood." Shortly after, the United Nations Permanent Forum on Indigenous Issues recommended suspending the project.

On the ground, every region has its challenges. To make scientific progress, the project's geneticists are finding they

must first navigate an unfamiliar tangle of political, religious and personal misgivings.

Pierre Zalloua, the project director in the Middle East, faces suspicion that he is an emissary of an opposing camp trying to prove their lineages are not important. Himla Soodyall, the project's South African director, finds herself trying to explain to people who worship their ancestors what more her research could add. In Australia, some aboriginal groups have refused to cooperate.

But among the 10 geneticists the society has given the task of collecting 10,000 samples each by the spring of 2010, Theodore G. Schurr, the project's North American director, is in last place. Fewer than 100 vials of DNA occupy a small plastic box in his laboratory's large freezer at the University of Pennsylvania, where he is an assistant professor of anthropology. And at the request of the Alaska review board, he has sent back the 50 or so samples that he collected in Alaska to be stored in a speci-

men bank under its care until he can satisfy their concerns.

American Indians, Dr. Schurr says, hold the answer to one of the more notable gaps in the prehistoric migration map. Although most scientists accept that the first Americans came across the Bering Strait land bridge that connected Siberia and Alaska some 20,000 years ago, there is no proof of precisely where those travelers came from, and the route they took south once they arrived.

Comparing the DNA of large numbers of American Indians might reveal whether their ancestors were from a single founding population, and when they reached the Americas. And knowing the routes and timing of migrations within the Americas would provide a foundation for studying how people came to be so different so quickly.

But almost every federally recognized tribe in North America has declined or ignored Dr. Schurr's invitation to take part. "What the scientists are trying

to prove is that we're the same as the Pilgrims except we came over several thousand years before," said Maurice Foxx, chairman of the Massachusetts Commission on Indian Affairs and a member of the Mashpee Wampanoag. "Why should we give them that openly?"



THE NEW YORK TIMES

A review board stopped DNA research in South Naknek, Alaska.

Some American Indians trace their suspicions to the experience of the Havasupai Tribe, whose members gave DNA for a diabetes study that University of Arizona researchers later used to link the tribe's ancestors to Asia. To tribe members raised to believe the Grand Canyon is humanity's birthplace, the suggestion that their own DNA says otherwise was deeply disturbing.

When Dr. Schurr was finally invited to a handful of villages in Alaska, he eagerly accepted. But by the time he reached South Naknek, a tiny native village on the Alaska Peninsula, to report his analysis of the DNA he had taken on an earlier mission, the Alaska review board had complained to his university supervisors.

The consent form all volunteers must sign, the Alaska board said, should contain greater detail about the risks, including the fact that the DNA would be stored in a database linked to tribal information.

Dr. Schurr's latest attempt at a revised form is to be reviewed this

month by the board in Alaska and the by University of Pennsylvania board supervising the project.

In the meantime, his early results have surprised some of the Alaskans who gave him their DNA. In South Naknek, Lorianne Rawson, 42, found out her DNA contradicted what she had always believed. She was not descended

from the Aleuts, her test results suggested, but from their one-time enemies, the Yup'ik Eskimos.

The link to the Yup'iks, Ms. Rawson said, only made her more curious. "We want them to do more research," she added, offering Dr. Schurr more relatives to be tested.

But she will have to wait. □

## **In the world of second opinions, get the facts first.**

Authoritative, in-depth information on thousands of health and fitness topics. Plus expert advice, blogs, reader discussions and more.

**The New York Times**  
**[nytimes.com/health](http://nytimes.com/health)**

All the news that's fit to click.





SUZANNE DECHILLO/THE NEW YORK TIMES

Katharine Moser at a nursing home in Manhattan with her cousin James Dowd, who has Huntington's disease.

# Facing Life With a Lethal Gene

By **AMY HARMON**

PUBLISHED: MARCH 18, 2007

**T**HE TEST, the counselor said, had come back positive.

Katharine Moser inhaled sharply. She thought she was

as ready as anyone could be to face her genetic destiny. She had attended a genetic counseling session and visited a psychiatrist, as required by the clinic. She had undergone the recommended neurological exam. And

yet, she realized in that moment, she had never expected to hear those words.

“What do I do now?” Ms. Moser asked.

“What do you want to do?” the counselor replied.

“Cry,” she said quietly.


Her best friend, Colleen Elio, seated next to her, had already begun.

Ms. Moser was 23. It had taken her months to convince the clinic at NewYork-Presbyterian Hospital/Columbia University Medical Center in Manhattan that she wanted, at such a young age, to find out whether she carried the gene for Huntington’s disease.

Huntington’s, the incurable brain disorder that possessed her grandfather’s body and ravaged his mind for three decades, typically strikes in middle age. But most young adults who know the disease runs in their family have avoided the DNA test that can tell whether they will get it, preferring the torture — and hope — of not knowing.

---

**ONLINE: CHOOSING TO KNOW**

 A video report by Amy Harmon on why Katharine Moser chose to be tested for Huntington’s disease:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

Ms. Moser is part of a vanguard of people at risk for Huntington’s who are choosing to learn early what their future holds. Facing their genetic heritage, they say, will help them decide how to live their lives.

Yet even as a raft of new DNA tests are revealing predispositions to all kinds of conditions, including breast cancer, depression and dementia, little is known about what it is like to live with such knowledge.

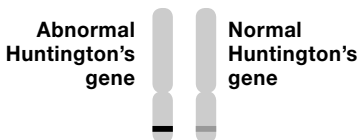
“What runs in your own family, and would you want to know?” said Nancy Wexler, a neuropsychologist at Columbia and the president of the Hereditary Disease Foundation, which has pioneered Huntington’s research. “Soon everyone is going to have an option like this. You make the decision to test, you have to live with the consequences.”

# Tale of a Dominant Gene

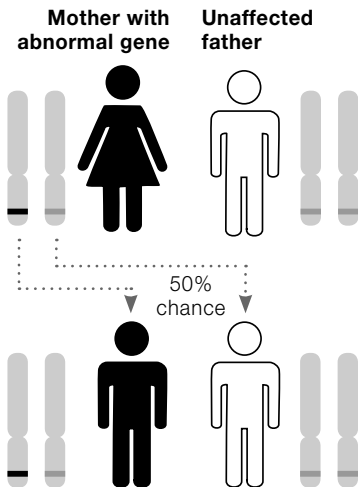
Huntington's disease is a degenerative neurological condition that arises from a dominant mutation in a gene on the fourth chromosome. Here is how it travels in families.

## Genetic Inheritance of Huntington's Disease: The Basics

Each person carries two copies of the Huntington's gene, one inherited from each parent. A person needs only one abnormal copy to have the disease.



Parents randomly transmit one of their two copies to each child. Each copy is equally likely to be passed on. Thus, someone with one affected parent has a 50% chance of having inherited the abnormal copy of the gene from that parent (which copy they receive from the unaffected parent is irrelevant).



## Multiple Generations

Descendants of a person who has or had Huntington's disease, but who have not had a genetic test, are "at risk" for the disease. Because symptoms develop later in life, there are often many generations of at risk descendants. Children of someone with Huntington's have a 50% chance of carrying the diseasecausing gene. Their children have a 25% chance, and so on.

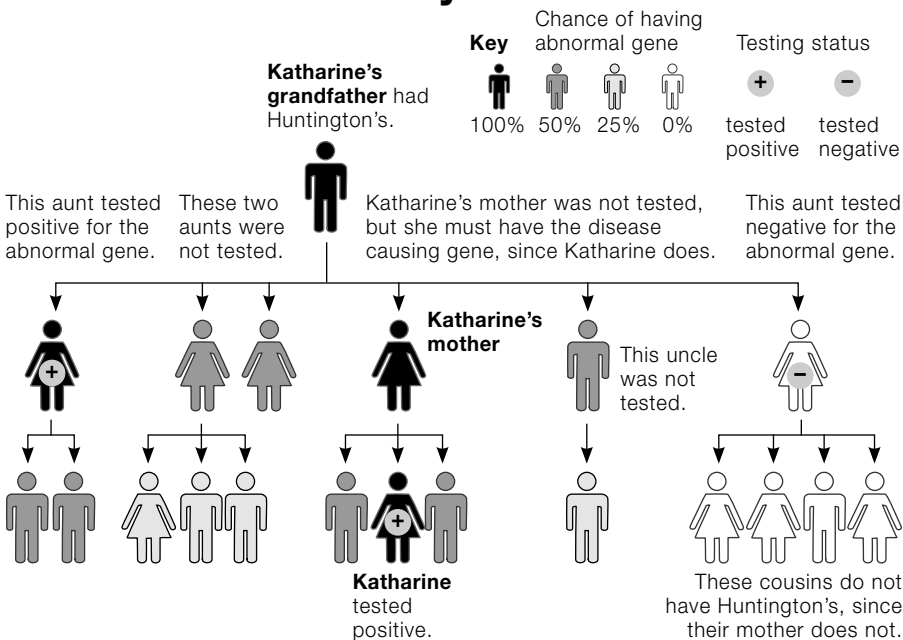


Source: Huntington's Outreach Project for Education, Stanford

JAMES BRONZAN/THE NEW YORK TIMES



# Katharine Moser's Family



JAMES BRONZAN/THE NEW YORK TIMES

On that drizzly spring morning two years ago, Ms. Moser was feeling her way, with perhaps the most definitive and disturbing verdict genetic testing has to offer. Anyone who carries the gene will inevitably develop Huntington's.

She fought her tears. She tried for humor.

Don't let yourself get too thin, said the clinic's social worker. Not a problem, Ms. Moser responded, gesturing to her curvy frame. No more than two drinks at a time. Perhaps, Ms. Moser



Katharine Moser at 13 in a family photo with her grandfather, who had Huntington's disease.

suggested to Ms. Elio, she meant one in each hand.

Then came anger.

“Why me?” she remembers thinking, in a refrain she found hard to shake in the coming months. “I’m the good one. It’s not like I’m sick because I have emphysema from smoking or I did something dangerous.”

The gene that will kill Ms. Moser sits on the short arm of everyone’s fourth chromosome, where the letters of the genetic alphabet normally repeat C-A-G

as many as 35 times in a row. In people who develop Huntington’s, however, there are more than 35 repeats.

No one quite knows why this DNA hiccup causes cell death in the brain, leading Huntington’s patients to jerk and twitch uncontrollably and rendering them progressively unable to walk, talk, think and swallow. But the greater the number of repeats, the earlier symptoms tend to appear and the faster they progress.

Ms. Moser's "CAG number" was 45, the counselor said. She had more repeats than her grandfather, whose first symptoms — loss of short-term memory, mood swings and a constant ticking noise he made with his mouth — surfaced when he turned 50. But it was another year before Ms. Moser would realize that she could have less than 12 years until she showed symptoms.

Immediately after getting her results, Ms. Moser was too busy making plans.

"I'm going to become super-strong and super-balanced," she vowed over lunch with Ms. Elio, her straight brown hair pulled into a determined bun. "So when I start to lose it I'll be a little closer to normal."

In the tumultuous months that followed, Ms. Moser often found herself unable to remember what normal had once been. She forced herself to renounce the crush she had long nursed on a certain firefighter, sure that marriage was no longer an option for her. She threw herself

into fund-raising in the hopes that someone would find a cure. Sometimes, she raged.

She never, she said, regretted being tested. But at night, crying herself to sleep in the dark of her lavender bedroom, she would go over and over it. She was the same, but she was also different. And there was nothing she could do.

## A Lesson in Stigma

Ms. Moser grew up in Connecticut, part of a large Irish Catholic family. Like many families affected by Huntington's, Ms. Moser's regarded the disease as a curse, not to be mentioned even as it dominated their lives in the form of her grandfather's writhing body and unpredictable rages.

Once, staying in Ms. Moser's room on a visit, he broke her trundle bed with his violent, involuntary jerking. Another time, he came into the kitchen naked, his underpants on his head. When the children giggled, Ms. Moser's mother defended her fa-

ther: "If you don't like it, get out of my house and go."

But no one explained what had happened to their grandfather, Thomas Dowd, a former New York City police officer who once had dreams of retiring to Florida.

In 1990, Mr. Dowd's older brother, living in a veteran's hospital in an advanced stage of the disease, was strangled in his own restraints. But a year or so later, when Ms. Moser wanted to do her sixth-grade science project on Huntington's, her mother recoiled.

"Why," she demanded, "would you want to do it on this disease that is killing your grandfather?"

Ms. Moser was left to confirm for herself, through library books and a CD-ROM encyclopedia, that she and her brothers, her mother, her aunts, an uncle and cousins could all face the same fate.

Any child who has a parent with Huntington's has a 50 percent chance of having inherited the gene that causes it, Ms. Moser learned.

Her mother, who asked not to be identified by name for fear of discrimination, had not always been so guarded. At one point, she drove around with a "Cure HD" sign in the window of her van. She told people that her father had "Woody Guthrie's disease," invoking the folk icon who died of Huntington's in 1967.

But her efforts to raise awareness soon foundered. Huntington's is a rare genetic disease, affecting about 30,000 people in the United States, with about 250,000 more at risk. Few people know what it is. Strangers assumed her father's unsteady walk, a frequent early symptom, meant he was drunk.

"Nobody has compassion," Ms. Moser's mother concluded. "People look at you like you're strange, and 'What's wrong with you?'"

Shortly after a simple DNA test became available for Huntington's in 1993, one of Ms. Moser's aunts tested positive. Another, driven to find out if her own medical problems were related

to Huntington's, tested negative. But when Ms. Moser announced as a teenager that she wanted to get tested one day, her mother insisted that she should not. If her daughter carried the gene, that meant she did, too. And she did not want to know.

"You don't want to know stuff like that," Ms. Moser's mother

said in an interview. "You want to enjoy life."

Ms. Moser's father, who met and married his wife six years before Ms. Moser's grandfather received his Huntington's diagnosis, said he had managed not to think much about her at-risk status.

"So she was at risk," he said.



SUZANNE DECHILLO/THE NEW YORK TIMES

Before she learned she had the Huntington's gene, Ms. Moser took a job at Terence Cardinal Cooke Health Care Center, which has a unit devoted to Huntington's patients.

“Everyone’s at risk for everything.”

The test, Ms. Moser remembers her mother suggesting, would cost thousands of dollars. Still, in college, Ms. Moser often trolled the Web for information about it. Mostly, she imagined how sweet it would be to know she did not have the gene. But increasingly she was haunted, too, by the suspicion that her mother did.

As awful as it was, she admitted to Ms. Elio, her freshman-year neighbor at Elizabethtown College in Pennsylvania, she almost hoped it was true. It would explain her mother’s strokes of meanness, her unpredictable flashes of anger.

Ms. Moser’s mother said she had never considered the conflicts with her daughter out of the ordinary. “All my friends who had daughters said that was all normal, and when she’s 25 she’ll be your best friend,” she said. “I was waiting for that to happen, but I guess it’s not happening.”

When Ms. Moser graduated

in 2003 with a degree in occupational therapy, their relationship, never peaceful, was getting worse. She moved to Queens without giving her mother her new address.

## Wanting to Know

Out of school, Ms. Moser soon spotted a listing for a job at Terence Cardinal Cooke Health Care Center, a nursing home on the Upper East Side of Manhattan. She knew it was meant for her.

Her grandfather had died there in 2002 after living for a decade at the home, one of only a handful in the country with a unit devoted entirely to Huntington’s.

“I hated visiting him growing up,” Ms. Moser said. “It was scary.”

Now, though, she was drawn to see the disease up close.

On breaks from her duties elsewhere, she visited her cousin James Dowd, the son of her grandfather’s brother who had come to live in the Huntington’s unit several years earlier. It was



SUZANNE DECHILLO/THE NEW YORK TIMES

Ms. Moser, a prolific baker, delivering a homemade cake to her local firehouse.

there, in a conversation with another staff member, that she learned she could be tested for only a few hundred dollars at the Columbia clinic across town. She scheduled an appointment for the next week.

The staff at Columbia urged Ms. Moser to consider the downside of genetic testing. Some people battle depression after they test positive. And the information, she was cautioned, could make it harder for her to get a job or health insurance.

But Ms. Moser bristled at the idea that she should have to remain ignorant about her genetic status to avoid discrimination. “I didn’t do anything wrong,” she said. “It’s not like telling people I’m a drug addict.”

She also recalls rejecting a counselor’s suggestion that she might have asked to be tested as a way of crying for help.

“I’m like, ‘No,’” Ms. Moser recalls replying. “I’ve come to be tested because I want to know.”

No one routinely collects demographic information about who gets tested for Huntington's. At the Huntington's Disease Center at Columbia, staff members say they have seen few young people taking the test.

Ms. Moser is still part of a distinct minority. But some researchers say her attitude is increasingly common among young people who know they may develop Huntington's.

More informed about the genetics of the disease than any previous generation, they are convinced that they would rather know how many healthy years they have left than wake up one day to find the illness upon them. They are confident that new reproductive technologies can allow them to have children without transmitting the disease and are eager to be first in line should a treatment become available.

"We're seeing a shift," said Dr. Michael Hayden, a professor of human genetics at the University of British Columbia in Vancou-

ver who has been providing various tests for Huntington's for 20 years. "Younger people are coming for testing now, people in their 20s and early 30s; before, that was very rare. I've counseled some of them. They feel it is part of their heritage and that it is possible to lead a life that's

---

Young people today  
are more informed  
about the genetics of  
the disease than any  
previous generation.

---

not defined by this gene."

Before the test, Ms. Moser made two lists of life goals. Under "if negative," she wrote married, children and Ireland. Under "if positive" was exercise, vitamins and ballroom dancing. Balance, in that case, would be important. Opening a bed-and-breakfast, a goal since childhood, made both lists.



In the weeks before getting the test results, Ms. Moser gave Ms. Elio explicit instructions about acceptable responses. If she was negative, flowers were O.K. If positive, they were not. In either case, drinking was acceptable. Crying was not.

But it was Ms. Elio's husband, Chris Elio, who first broached the subject of taking care of Ms. Moser, whom their young children called "my Katie," as in "this is my mom, this is my dad, this is my Katie." They should address it before the results were in, Mr. Elio told his wife, so that she would not feel, later, that they had done it out of a sense of obligation.

The next day, in an e-mail note that was unusually formal for friends who sent text messages constantly and watched "Desperate Housewives" while on the phone together, Ms. Elio told Ms. Moser that she and her husband wanted her to move in with them if she got sick. Ms. Moser set the note aside. She did not expect to need it.

## 'It's Too Hard to Look'

The results had come a week early, and Ms. Moser assured her friends that the "Sex and the City" trivia party she had planned for that night was still on. After all, she was not sick, not dying. And she had already made the dips.

"I'm the same person I've always been," she insisted that night as her guests gamely dipped strawberries in her chocolate fountain. "It's been in me from the beginning."

But when she went to work the next day, she lingered outside the door of the occupational therapy gym, not wanting to face her colleagues. She avoided the Huntington's floor entirely, choosing to attend to patients ailing of just about anything else. "It's too hard to look at them," she told her friends.

In those first months, Ms. Moser summoned all her strength to pretend that nothing cataclysmic had happened. At times, it seemed easy enough. In the mirror, the same green eyes looked back at her. She was still tall, a

devoted Julia Roberts fan, a prolific baker.

She dropped the news of her genetic status into some conversations like small talk, but kept it from her family. She made light of her newfound fate, though often friends were not sure how to take the jokes.

“That’s my Huntington’s kicking in,” she told Rachel Markan, a co-worker, after knocking a patient’s folder on the floor.

Other times, Ms. Moser abruptly dropped any pretense of routine banter. On a trip to Florida, she and Ms. Elio saw a man in a wheelchair being tube-fed, a method often used to keep Huntington’s patients alive for years after they can no longer swallow.

“I don’t want a feeding tube,” she announced flatly.

In those early days, she calculated that she had at least until 50 before symptoms set in. That was enough time to open a bed-and-breakfast, if she acted fast. Enough time to repay \$70,000 in student loans under her 30-year term.

Doing the math on the loans, though, could send her into a tailspin.

“I’ll be repaying them and then I’ll start getting sick,” she said. “I mean, there’s no time in there.”

## Finding New Purpose

At the end of the summer, as the weather grew colder, Ms. Moser forced herself to return to the Huntington’s unit.

In each patient, she saw her future: the biophysicist slumped in his wheelchair, the refrigerator repairman inert in his bed, the onetime professional tennis player who floated through the common room, arms undulating in the startlingly graceful movements that had earned the disease its original name, “Huntington’s chorea,” from the Greek “to dance.”

Then there was her cousin Jimmy, who had wrapped papers for The New York Post for 19 years until suddenly he could no longer tie the knots. When she greeted him, his bright blue eyes

darted to her face, then away. If he knew her, it was impossible to tell.

She did what she could for them. She customized their wheelchairs with padding to fit each one's unique tics. She doled out special silverware, oversized or bent in just the right angles to prolong their ability to feed themselves.

Fending off despair, Ms. Moser was also filled with new purpose. Someone, somewhere, she told friends, had to find a cure.

It has been over a century since the disease was identified by George Huntington, a doctor in Amagansett, N.Y., and over a decade since researchers first found the gene responsible for it.

To raise money for research,



SUZANNE DECHILLO/THE NEW YORK TIMES

Ms. Moser, left, in Milwaukee at the annual convention of the Huntington's Disease Society.

Ms. Moser volunteered for walks and dinners and golf outings sponsored by the Huntington's Disease Society of America. She organized a Hula-Hoop-a-thon on the roof of Cardinal Cooke, then a bowl-a-thon at the Port Authority. But at many of the events, attendance was sparse.

It is hard to get people to turn out for Huntington's benefits, she learned from the society's professional fund-raisers. Even families affected by the disease, the most obvious constituents, often will not help publicize events.

"They don't want people to know they're connected to Huntington's," Ms. Moser said, with a mix of anger and recognition. "It's like in my family — it's not a good thing."

Her first session with a therapist brought a chilling glimpse of how the disorder is viewed even by some who know plenty about it. "She told me it was my moral and ethical obligation not to have children," Ms. Moser told Ms. Elio by cellphone as soon

as she left the office, her voice breaking.

In lulls between fund-raisers, Ms. Moser raced to educate her own world about Huntington's. She added links about the disease to her MySpace page. She plastered her desk at work with "Cure HD" stickers and starred in a video about the Huntington's unit for her union's Web site.

Ms. Moser gave blood for one study and spoke into a microphone for researchers trying to detect subtle speech differences in people who have extra CAG repeats before more noticeable disease symptoms emerge.

When researchers found a way to cure mice bred to replicate features of the disease in humans, Ms. Moser sent the news to friends and acquaintances.

But it was hard to celebrate. "Thank God," the joke went around on the Huntington's National Youth Alliance e-mail list Ms. Moser subscribed to, "at least there won't be any more poor mice wandering around with Huntington's disease."

In October, one of Ms. Moser's aunts lost her balance while walking and broke her nose. It was the latest in a series of falls. "The cure needs to be soon for me," Ms. Moser said. "Sooner for everybody else."

### **A Confrontation in Court**

In the waiting room of the Dutchess County family courthouse on a crisp morning in the fall of 2005, Ms. Moser approached her mother, who turned away.

"I need to tell her something important," Ms. Moser told a family member who had accompanied her mother to the hearing.

He conveyed the message and brought one in return: Unless she was dying, her mother did not have anything to say to her.

That Ms. Moser had tested positive meant that her mother would develop Huntington's, if she had not already. A year earlier, Ms. Moser's mother had convinced a judge that her sister, Nora Maldonado, was neglect-

ing her daughter. She was given guardianship of the daughter, 4-year-old Jillian.

Ms. Moser had been skeptical of her mother's accusations that Ms. Maldonado was not feeding or bathing Jillian properly, and she wondered whether her effort to claim Jillian had been induced by the psychological symptoms of the disease.

Her testimony about her mother's genetic status, Ms. Moser knew, could help persuade the judge to return Jillian. Ms. Maldonado had found out years earlier that she did not have the Huntington's gene.

Ms. Moser did not believe that someone in the early stages of Huntington's should automatically be disqualified from taking care of a child. But her own rocky childhood had convinced her that Jillian would be better off with Ms. Maldonado.

She told her aunt's lawyer about her test results and agreed to testify.

In the courtroom, Ms. Moser took the witness stand. Her

mother's lawyer jumped up as soon as the topic of Huntington's arose. It was irrelevant, he said. But by the time the judge had sustained his objections, Ms. Moser's mother, stricken, had understood.

The next day, in the bathroom, Ms. Maldonado approached Ms. Moser's mother.

"I'm sorry," she said. Ms. Moser's mother said nothing.

The court has continued to let Ms. Moser's mother retain guardianship of Jillian. But she has not spoken to her daughter again.

"It's a horrible illness," Ms. Moser's mother said, months later, gesturing to her husband. "Now he has a wife who has it. Did she think of him? Did she think of me? Who's going to marry her?"

## Facing the Future

Before the test, it was as if Ms. Moser had been balanced between parallel universes, one in which she would never get the disease and one in which

she would. The test had made her whole.

She began to prepare the Elio children and Jillian for her illness, determined that they would not be scared, as she had been with her grandfather. When Jillian wanted to know how people got Huntington's disease "in their pants," Ms. Moser wrote the text of a children's book that explained what these other kinds of "genes" were and why they would make her sick.

But over the winter, Ms. Elio complained gently that her friend had become "Ms. H.D." And an impromptu note that arrived for the children in the early spring convinced her that Ms. Moser was dwelling too much on her own death.

"You all make me so happy, and I am so proud of who you are and who you will be," read the note, on rainbow scratch-and-write paper. "I will always remember the fun things we do together."

Taking matters into her own hands, Ms. Elio created a pro-

file for Ms. Moser on an online dating service. Ms. Moser was skeptical but supplied a picture. Dating, she said, was the worst thing about knowing she had the Huntington's gene. It was hard to imagine someone falling enough in love with her to take on Huntington's knowingly, or asking it of someone she loved. At the same time, she said, knowing her status could help her find the right person, if he was out there.

"Either way, I was going to get sick," she said. "And I'd want someone who could handle it. If, by some twist of fate, I do get married and have children, at least we know what we're getting into."

After much debate, the friends settled on the third date as the right time to mention Huntington's. But when the first date came, Ms. Moser wished she could just blurt it out.

"It kind of just lingers there," she said. "I really just want to be able to tell people, 'Someday, I'm going to have Huntington's disease.'"

## 'A Part of My Life'

Last May 6, a year to the day after she had received her test results, the subject line "CAG Count" caught Ms. Moser's attention as she was scrolling through the online discussion forums of the Huntington's Disease Advocacy Center. She knew she had 45 CAG repeats, but she had never investigated it further.

She clicked on the message.

"My mother's CAG was 43," it read. "She started forgetting the punch line to jokes at 39/40." Another woman whose husband's CAG count was 47 had just sold his car. "He's 39 years old," she wrote. "It was time for him to quit driving."

Quickly, Ms. Moser scanned a chart that accompanied the messages for her number, 45. The median age of onset to which it corresponded was 37.

Ms. Elio got drunk with her husband the night Ms. Moser finally told her.

"That's 12 years away," Ms. Moser said.

The statistic, they knew, meant

that half of those with her CAG number started showing symptoms after age 37. But it also meant that the other half started showing symptoms earlier.

Ms. Moser, meanwhile, flew to the annual convention of the Huntington's Disease Society, which she had decided at the last minute to attend.

"Mother or father?" one woman, 23, from Chicago, asked a few minutes after meeting Ms. Moser in the elevator of the Milwaukee Hilton. "Have you tested? What's your CAG?"

She was close to getting herself tested, the woman confided. How did it feel to know?

"It's hard to think the other way anymore of not knowing," Ms. Moser replied. "It's become a part of my life."

After years of trying to wring conversation from her family about Huntington's, Ms. Moser suddenly found herself bathing in it. But for the first time in a long time, her mind was on other things. At a youth support group meeting in the hotel hallway, she

took her place in the misshapen circle. Later, on the dance floor, the spasms of the symptomatic seemed as natural as the gyrations of the normal.

"I'm not alone in this," Ms. Moser remembers thinking. "This affects other people, too, and we all just have to live our lives."

## Seizing the Day

July 15, the day of Ms. Moser's 25th birthday party, was sunny, with a hint of moisture in the air. At her aunt's house in Long Beach, N.Y., Ms. Moser wore a dress with pictures of cocktails on it. It was, she and Ms. Elio told anyone who would listen, her "cocktail dress." They drew the quotation marks in the air.

A bowl of "Cure HD" pins sat on the table. Over burgers from the barbecue, Ms. Moser mentioned to family members from her father's side that she had tested positive for the Huntington's gene.

"What's that?" one cousin asked.





SUZANNE DECHILLO/THE NEW YORK TIMES

The New York chapter of the Huntington's society honored Ms. Moser for her outreach efforts.

"It will affect my ability to walk, talk and think," Ms. Moser said. "Sometime before I'm 50."

"That's soon," an uncle said matter-of-factly.

"So do you have to take medication?" her cousin asked.

"There's nothing really to take," Ms. Moser said.

She and the Elios put on bathing suits, loaded the children in a wagon and walked to the beach.

More than anything now, Ms. Moser said, she is filled with a sense of urgency.

"I have a lot to do," she said. "And I don't have a lot of time."

Over the next months, Ms. Moser took tennis lessons every Sunday morning and went to church in the evening.

When a planned vacation with the Elio family fell through at the last minute, she went anyway, packing Disney World, Universal Studios, Wet 'n Wild and Sea World into 36 hours with a high school friend who lives in Orlando. She was honored at a dinner by the New York chapter of the Huntington's society for her outreach efforts and managed a brief thank-you speech despite her discomfort with public speaking.

Having made a New Year's resolution to learn to ride a unicycle, she bought a used one. "My legs are tired, my arms are tired, and I definitely need protection," she reported to Ms. Elio. On Super Bowl Sunday, she waded into the freezing Atlantic Ocean for a Polar Bear swim to raise money for the Make-a-Wish Foundation.

Ms. Elio complained that she hardly got to see her friend.

But one recent weekend, they packed up the Elio children and drove to the house the Elios were renovating in eastern Pennsylvania. The kitchen floor needed grouting, and, rejecting the home improvement gospel that calls for a special tool designed for the purpose, Ms. Moser and Ms. Elio had decided to use pastry bags.

As they turned into the driveway, Ms. Moser studied the semi-attached house next door. Maybe she would move in one day, as the Elios had proposed. Then, when she could no longer care for herself, they could put in a door.

First, though, she wanted to travel. She had heard of a job that would place her in different occupational therapy positions across the country every few months and was planning to apply.

"I'm thinking Hawaii first," she said.

Then they donned gloves, mixed grout in a large bucket of water and began the job. □

# Stalking Strangers' DNA To Fill in the Family Tree

By **AMY HARMON**

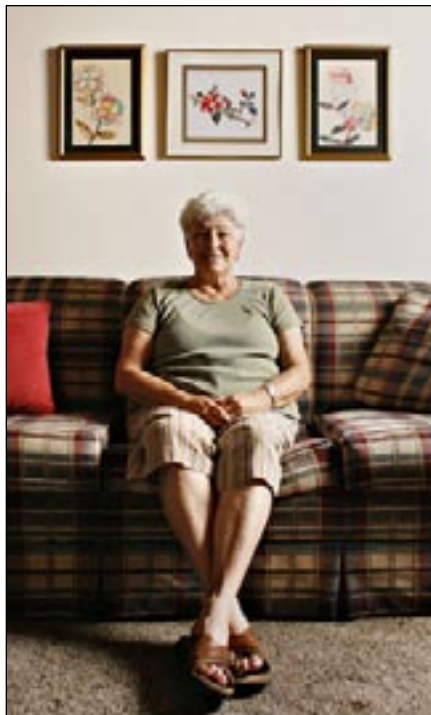
PUBLISHED: APRIL 2, 2007

**T**HEY swab the cheeks of strangers and pluck hairs from corpses. They travel hundreds of miles to entice their suspects with an old photograph, or sometimes a free drink. Cooperation is preferred, but not necessarily required to achieve their ends.

If the amateur genealogists of the DNA era bear a certain resemblance to members of a “CSI” team, they make no apologies. Prompted by the advent of inexpensive genetic testing, they are tracing their family trees with a vengeance heretofore unknown.

“People who realize the potential of DNA,” said Katherine Borges, a co-founder of the International Society of Genetic Genealogy, “will go to great lengths to get it.”

Unlike paper records, which



MELISSA LYTTLE FOR THE NEW YORK TIMES

Derrell Teat, determined in her research, once waited outside a restaurant with a test kit hoping to capture a reluctant would-be relative's DNA on a coffee cup.

can be hard to come by and harder to verify, a genetic test can quickly and definitively tell if someone is a relative. But not all potential kin are easily parted from their DNA. Some worry about revealing family secrets. Some fear their sample could be used to pry into other areas of their lives. Some just do not want to be bothered.

Those cases inspire tactics that are turning the once-staid pursuit of genealogy, perhaps second only to gardening among American hobbies, into an extreme sport.

Derrell Teat, 63, a wastewater coordinator, recently found herself staking out a McDonald's. The man she believed was the last male descendant of her great-great-great grandfather's brother had refused to give her his DNA. So she decided to get it another way.

"I was going to take his coffee cup out of the garbage can," said Ms. Teat, who traveled to the Georgia mountains from Tampa, Fla., with her test kit. "I was will-

ing to do whatever it took."

At one time, she might have been satisfied with a cousin's census research, which revealed that they had descended from one John B. Hodgins living in South Carolina in 1820. But a DNA test of an Oklahoma Hodgins, who was found through the phone book, confirmed they were related. Now Ms. Teat wants to identify all of John B.'s living descendants by July, when she will preside over a Hodgins family reunion.

Alas, cornered in his garage, Ms. Teat's quarry refused to listen to her pitch. Perhaps he thought she was seeking a paternity test. In any case, he did not show at his usual breakfast spot.

"It drives me nuts," Ms. Teat said. "Knowing I can get to the bottom of it, if people would just cooperate."

By next year, close to half a million people will have taken a DNA genealogy test, according to estimates from companies that provide them. The tests detect

genetic markers that distinguish the descendants of an individual and reveal if two people share a recent common ancestor.

Seeking to expand their family trees, thousands of amateur family historians have begun asking people with the same last names to compare genes, even though most are total strangers. That is where the free drinks come in.

“I always say, never ask for DNA on a first date,” said Georgia Bopp, 65, a retired banker in Kailua, Hawaii. “A courtship is involved.”

Ms. Bopp woos with family tree diagrams from Web sites like Ancestry.com. Only after several e-mail exchanges does she mention DNA, and then she is quick to clarify that the test does not involve needles.

But when a detour on a recent trip brought her within miles of the only living male descendant of her maternal great-grandfather, she went for the direct approach. Determined to get the purest sample, she grabbed his



EARL MA FOR THE NEW YORK TIMES

Georgia Bopp is tracing the lineage of her maternal grandfather.

glass at a local restaurant before the waitress filled it.

“Have you had anything to eat or drink in the last hour?” Ms. Bopp asked, whipping out the DNA kit stashed in her purse.

“She wanted my saliva, basically,” said Warren Lenhart, 60,

a foreign policy analyst whose test confirmed that they both had descended from a man who emigrated to Philadelphia from Germany in 1748. "There was no time for small talk."

DNA genealogy tests hold out new hope for adoptees like Paul Gilbert, 77, of Los Angeles. Searching for his biological relatives, Mr. Gilbert uncovered his birth mother's name in records, which pointed him to a man he believed to be his half-brother. But the man was not eager to verify it through a DNA test. "I can't imagine my father consorting with a woman like that," he wrote to Mr. Gilbert of his mother.

When the man finally came around, Mr. Gilbert, a retired lawyer, was just as glad that there was no genetic match. "He didn't sound very nice," he said.

Since learning that she shares some markers with St. Luke the Evangelist, Kathy Johnston, 54, a dermatologist in Torrance, Calif., has been lobbying to have the saint's remains more thoroughly analyzed.

She believes St. Luke's mother was Celtic, as is her own lineage, not Syrian, as previous genetic tests on remains in Padua, Italy, have suggested. She is willing to pay for the test, but scientists at the University of Ferrara and the Roman Catholic Church have ignored her theories.

The basic tests are sold for \$99, a small fraction of what they might have cost a decade ago. But test 40 relatives, and costs can add up.

To her husband's dismay, Melissa Robards, nee Springer, has spent more than \$1,000 testing Springers around the country to see if they are related. She has been known to send flowers to stubborn holdouts.

More drastic measures may be necessary to secure DNA from the talk-show host Jerry Springer, who has so far ignored her three e-mail messages. Ms. Robards, a 55-year-old mother of two in Sparks, Nev., has not entirely dismissed posing as a cross-dresser to get on his show.



DAVID CALVERT FOR THE NEW YORK TIMES

Melissa Robards has collected thousands of documents on the Springers, her father's family, and spent over \$1,000 on DNA testing of potential relatives.

There is, after all, only so much time. DNA may be the essence of life, but it is the fear of impending death that drives the current genetic genealogy frenzy. "If you don't catch the people before they die," Ms. Robards said, "you're out of luck."

Not necessarily. Susan Meates, a retired business executive, has discovered dozens of cousins because of her campaign to salvage her brother's DNA in the

hours after his death in a car crash.

Ms. Meates prevailed on her brother's former wife to retrieve his clothes from the funeral home and put them in her refrigerator. From North Carolina, she instructed the medical examiner in Maryland to save blood from the autopsy and persuaded the mortician to take a cheek swab.

Some funeral homes now offer post-mortem DNA collec-



tion. But Linda Jonas saw no need for professional help when she tugged several hairs from her grandmother's head as she lay in her casket.

She made sure to get the root.

"Obviously, it's not going to hurt her," said Ms. Jonas, a family historian in McLean, Va. "I had a little Ziploc."

Genetic testing companies encourage the use of cheek cells whenever possible, but that does not stop customers from dispatching DNA in a multitude of forms. For a premium, Family Tree DNA, a provider of the tests, has extracted genetic material from toothbrushes, hearing aids, nail clippings and postage stamps. (Hair remains tricky).

The talismans come mostly from people trying to glean genealogical information on dead relatives. But they could also be purloined from the living, as the police do with suspects. The law views such DNA as "abandoned."

"If you won't give me your

DNA but I run after your cigarette butt and I don't contaminate it, can we get your DNA?" said Bennett Greenspan, president of Family Tree DNA, which nearly doubled its kit sales last year. "The answer is yes."

But that does not mean genetic genealogy companies want to encourage the practice.

Mr. Greenspan invited a bioethicist to speak at the company's third annual genetic genealogy conference in Houston last fall. "Don't do anything you wouldn't do in broad daylight," the speaker told the audience.

The message did not resonate, according to several attendees.

"We're all like, 'I'd pick up the cup in broad daylight,' " one recalled.

For now, genetic genealogists are striking their own ethical balance.

Rebekah Lloyd, 53, of Denver wrestles with her conscience as she plots to visit an 86-year-old aunt, who has dementia. "I feel a little like a DNA vampire," Ms. Lloyd said. But her aunt's cells,



Ms. Lloyd believes, may hold crucial confirmation of her own American Indian ancestry.

Bob Grieve, 55, stores a DNA kit in his refrigerator to use upon his father's death.

After testing his own DNA at the request of a distant cousin, Mr. Grieve was shaken to discover that he did not match any of his extended family, including his first cousin, the son of his father's brother.

That could only mean an occurrence of what genetic genealogists call a "nonpaternal event." Either his father was not his father, or his grandfather was not his father's father. But the elder Mr. Grieve has refused

to surrender to the swab.

"I don't put blame on anybody," said Mr. Grieve, an engine design checker in Dearborn, Mich. "It would just be nice to know where I came from."

Roberta Estes, for her part, is contemplating exhumation. After three decades researching the Estes family tree, and recruiting 70 Esteses for DNA testing, Ms. Estes found reason to question whether her father was, in fact, an Estes.

He has been dead for 43 years.

Ms. Estes, a technology consultant in Brighton, Mich., recently got a \$20,000 estimate for digging him up. □

---

---

The New York Times

HEALTH

[nytimes.com/health](http://nytimes.com/health)

**Times Health Guide:** Comprehensive reference and special reports about diseases, conditions, tests, injuries and surgeries.



JAMES ESTRIN/THE NEW YORK TIMES

Trevor Taylor helped Megan Talbot with her coat as they left for a meeting in Detroit her mother organized to educate people on Down syndrome.

# Prenatal Test Puts Down Syndrome in Hard Focus

By **AMY HARMON**

PUBLISHED: MAY 9, 2007

DETROIT

**S**ARAH Itoh, a self-described “almost-eleven-and-a-half,” betrayed no trace of nervousness as she told a roomful

of genetic counselors and obstetricians about herself one recent afternoon.

She likes to read, she said. Math used to be hard, but it is getting easier. She plays clarinet in her school band. She is

a junior girl scout and an aunt, and she likes to organize, so her room is very clean. Last year, she won three medals in the Special Olympics.


“I am so lucky I get to do so many things,” she concluded. “I just want you to know, even though I have Down syndrome, it is O.K.”

Sarah’s appearance at Henry Ford Hospital here is part of an unusual campaign being undertaken by parents of children with Down syndrome who worry about their future in the face of broader prenatal testing that could sharply reduce the number of those born with the genetic condition.

Until this year, only pregnant women 35 and older were routinely tested to see if their fetuses had the extra chromosome that causes Down syndrome. As a result many couples were given the diagnosis only at birth. But under a new recommendation from the American College of Obstetricians and Gynecologists, doctors have begun to of-

---

**ONLINE: DIFFICULT DIAGNOSIS**

 A 4-year-old with Down syndrome helps one family learn more about the genetic disorder in a video, and Amy Harmon talks with parent advocates:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

fer a new, safer screening procedure to all pregnant women, regardless of age.

About 90 percent of pregnant women who are given a Down syndrome diagnosis have chosen to have an abortion.

Convinced that more couples would choose to continue their pregnancies if they better appreciated what it meant to raise a child with Down syndrome, a growing group of parents is seeking to insert their own positive perspectives into a decision often dominated by daunting medical statistics and doctors who feel obligated to describe the difficulties of life with a disabled child.

They are pressing obstetricians to send them couples who have been given a prenatal diag-

nosis and inviting prospective parents into their homes to meet their children. In Massachusetts, for example, volunteers in a “first call” network linking veteran parents to new ones are now offering support to couples deciding whether to continue a pregnancy.

The parent evangelists are driven by a deep-seated fear for their children’s well-being in a world where there are fewer people like them. But as prenatal tests become available for a range of other perceived genetic imperfections, they may also be heralding a broader cultural skirmish over where to draw the line between preventing disability and accepting human diversity.

“We want people who make this decision to know our kids,” said Lucy Talbot, the president of a support group here who prevailed on the hospital to give Sarah and two teenage friends an audience. “We want them to talk to us.”

The focus on the unborn is new for most parent advocates,

who have traditionally directed their energy toward support for the born. But after broader testing was recommended in January, the subject began to hijack agendas at local support group meetings.

A dwindling Down syndrome population, which now stands at about 350,000, could mean less institutional support and reduced funds for medical research. It could also mean a lonelier world for those who remain.

“The impact of these changes on the Down syndrome community is going to be huge,” said Dani Archer, a mother in Omaha who has set aside other Down syndrome volunteer work to strategize about how to reach prospective parents.

The 5,500 children born with Down syndrome each year in the United States suffer from mild to moderate mental retardation, are at high risk for congenital heart defects and a variety of other medical problems, and have an average life expectancy

of 49. As adults, some hold jobs, but many have difficulty living independently.

“There are many couples who do not want to have a baby with Down syndrome,” said Deborah A. Driscoll, chief of the obstetrics department at the University of Pennsylvania and a lead author of the new recommendation from the obstetricians’ group. “They don’t have the resources, don’t have the emotional stamina, don’t have the family support. We are recommending this testing be offered so that parents have a choice.”

But the richness of their children’s lives, parent advocates say, is poorly understood. Early medical intervention and new expertise in infant heart surgery stave off many health problems; legally mandated inclusion in public schools has created opportunities for friendship and fostered broader social awareness of the condition.

With no formal financing or organization, parents are arranging to meet with local obstetri-

cians, rewriting dated literature and pleading with health care workers to give out their phone numbers along with test results. Medical professionals have for the most part responded with caution. Genetic counselors, who often give test results to prospective parents, say they

---

Putting a human face  
on what is usually  
addressed with some  
disapproval.

---

need to respect patients who may have already made up their minds to terminate their pregnancy. Suggesting that they read a flyer or spend a day with a family, they say, can unnecessarily complicate what is for many a painful and time-pressured decision.

Their goal, parents say, is not to force anyone to take on the task of parenting a child with

disabilities. Many participants in the ad-hoc movement describe themselves as pro-choice. Yet some see themselves as society's first line of defense against a use of genetic technology that can border on eugenics.

"For me, it's just faces disappearing," said Nancy Iannone, of Turnersville, N.J., mother to four daughters, including one with Down syndrome. "It isn't about abortion politics or religion, it's a pure ethical question."

Others admit freely to a selfish motive for their new activism. "If all these people terminate babies with Down syndrome, there won't be programs, there won't be acceptance or tolerance," said Tracy Brown, 37, of Seattle, whose 2-year-old son, Maxford, has the condition. "I want opportunities for my son. I don't know if that's right or wrong, but I do."

Ms. Brown has taken it upon herself to serve as a community resource on Down syndrome for prospective parents. She was encouraged when a counselor

at the University of Washington Medical Center sent her an e-mail message recently with a question from a patient.

What developmental age equivalent, the patient wanted to know, do most people with Down syndrome reach?

For parents on an e-mail list where Ms. Brown solicited answers, the question underscored the difficulty in conveying the pleasure of parenting a child with Down syndrome to someone who has the option to reject it.

"Verbally," wrote one mother of her teenager, "she's at a 6-month level, but what 6-month-old do you know who can climb out a window and dance on a roof? We joke that she could climb Mt. Everest."

"If someone had told me Sam would still be in diapers at age 5 — ugh — I probably would have died," wrote another. "Living through it, not such a big deal. Because you don't give birth to a 5-year-old, you grow with and love this kid for five years."

Doctors have long recommend-

ed an amniocentesis test for pregnant women 35 and over, whose age puts them at greater risk for chromosomal defects. But because it carries a small risk of miscarriage, it has not been routinely offered to younger women, who give birth to the majority of children with Down syndrome.

Now, with a first-trimester sonogram and two blood tests, doctors can gauge whether a fetus has the extra 21st chromosome that causes Down syndrome with a high degree of accuracy and without endangering the pregnancy.

But many parents see expanded testing as a step toward a society where children like theirs would be unwelcome. The Newsweek columnist George F. Will labeled it a “search and destroy mission” for a category of citizens that includes his adult son, Jon Will.

Dr. Brian Skotko, a medical resident who has studied how mothers were told of prenatal diagnoses, found a high level of dissatisfaction. He said that most

doctors have little or no training on how to relay a prenatal diagnosis of Down syndrome.

When he talked to obstetricians, geneticists and medical students at Massachusetts General Hospital in Boston about the subject last month, though,

---

Many parent see expanded testing as a step toward a society where children like theirs would be unwelcome.

---

he was questioned sharply.

One doctor asked about studies suggesting there is a higher risk of early-onset Alzheimer’s disease in people with Down syndrome, potentially saddling parents with another caretaking burden as they themselves age. Others take issue with the notion that they do not give parents a balanced portrayal of the condition.

“It’s a mistake to say ‘your baby is going to be mentally retarded, you should have a pregnancy termination,’” said Dr. Allan Nadel, director of prenatal diagnosis at the hospital. “By the same token, I don’t think it’s quite fair to say ‘these are wonderful lovely human beings, you can deal with all of their problems and it’s not that big of a deal.’ We strive to have the proper balance.”

Parent advocates have some advice: don’t begin with “I’m sorry,” or “I have bad news,” as many of their own doctors did.

Weeks after Patricia Lanter decided to continue her pregnancy, having learned that Down syndrome had been diagnosed in her fetus, her doctor reminded her that she could still get an abortion in Kansas if an ultrasound indicated the baby would need heart surgery. Ms. Lanter, an emergency physician from Norwich, Vt., has secured an invitation to lecture the obstetricians in her hospital this summer.

In Wilmington, Del., Kristin

Pidgeon recalled her doctor’s gloomy forecast for a local hospital audience: “She may be able to count change for the bus,” he had said of her as-yet-unborn daughter. “But what’s going to happen when the bus doesn’t come?” (Her daughter Aliza, now 5, does not yet take the bus, Ms. Pidgeon said, but she does ride horses as part of her therapy.)

In the Detroit suburbs, Ms. Talbot is still working out the best strategy to drive her points home to medical professionals. When one doctor suggested she had chosen to show them only “high-functioning kids” like Sarah and her own daughter, Megan, she asked Trevor Taylor, who lacks the ability to communicate verbally, to join the lineup.

At the Henry Ford visit, Mr. Taylor, 19, a natural ham, acted out his speech as Megan, 18, read it, before hitting the music and signing along to “What a Wonderful World.”

At the end, he blew a kiss to the audience. Then he hugged his mother. □





STUART ISETT FOR THE NEW YORK TIMES

Wendy, right, is a “bully whippet,” while Fox is a regular whippet.

# As Breeders Test DNA, Dogs Become Guinea Pigs

By **AMY HARMON**

PUBLISHED: JUNE 12, 2007

FORT MOTT STATE PARK, N.J.

**W**HEN mutant, muscle-bound puppies started showing up in litters of champion racing whippets, the breeders of the normally sleek dogs invited scientists to take

DNA samples at race meets here and across the country. They hoped to find a genetic cause for the condition and a way to purge it from the breed.

It worked. “Bully whippets,” as the heavysets dogs are known, turn out to have a genetic mutation that enhances muscle de-

velopment. And breeders may not want to eliminate the “bully” gene after all. The scientists found that the same mutation that pumps up some whippets makes others among the fastest dogs on the track.

With a DNA screening test on the way, “We’re going to keep the speed and lose the bullies,” Helena James, a whippet breeder in Vancouver, British Columbia, said.

Free of most of the ethical concerns — and practical difficulties — associated with the practice of eugenics in humans, dog breeders are seizing on new genetic research to exert dominion over the canine gene pool. Companies with names like Vetgen and Healthgene have begun offering dozens of DNA tests to tailor the way dogs look, improve their health and, perhaps soon, enhance their athletic performance.

But as dog breeders apply scientific precision to their age-old art, they find that the quest for genetic perfection comes with

unforeseen consequences. And with DNA tests on their way for humans, the lessons of intervening in the nature of dogs may ultimately bear as much on us as on our best friends.

“We’re on the verge of a real radical shift in the way we apply genetics in our society,” said

---

The tale of the bully  
whippet and — could  
it be? — the end of the  
dreaded ‘fluffies.’

---

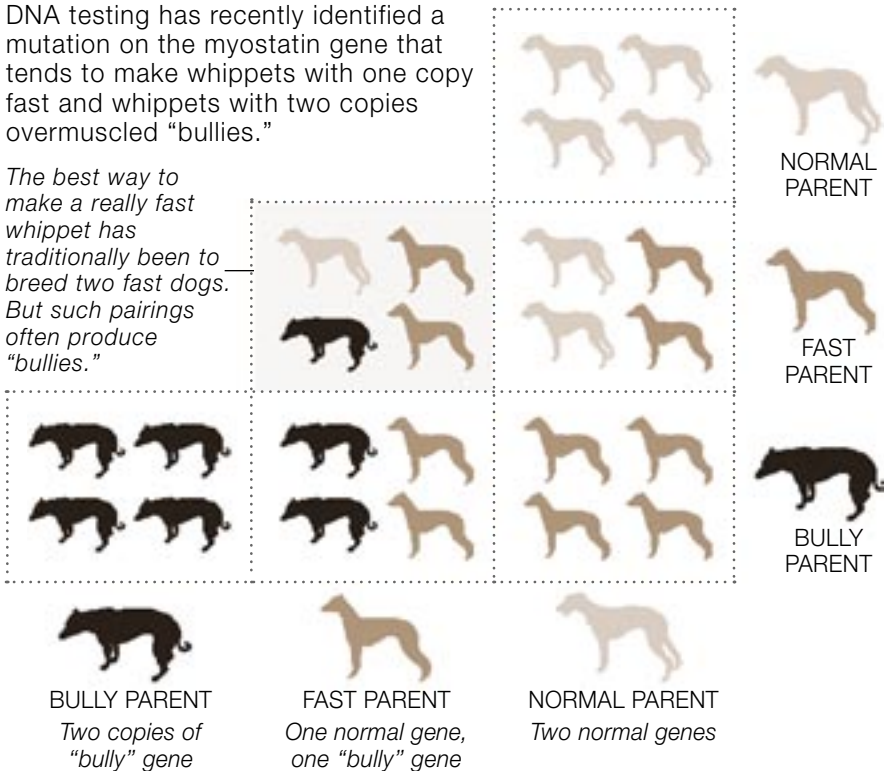
Mark Neff, associate director of the veterinary genetics laboratory at the University of California, Davis. “It’s better to be first confronted with some of these issues when they concern our pets than when they concern us.”

Some Labrador breeders are using DNA tests for coat color to guarantee exotic silver-coated retrievers. Mastiff breeders test for shaggy fur to avoid “fluffies,” the long-haired whelps oc-

# Why Fast Whippets Breed Bullies

DNA testing has recently identified a mutation on the myostatin gene that tends to make whippets with one copy fast and whippets with two copies overmuscled “bullies.”

*The best way to make a really fast whippet has traditionally been to breed two fast dogs. But such pairings often produce “bullies.”*



THE NEW YORK TIMES

asionally born to short-haired parents.

Next up, geneticists say, could be tests for big dogs, small dogs, curly-tailed dogs, dogs with the

keenest senses of smell and dogs that cock their heads endearingly when they look at you.

Scientists who recently completed the first map of a dog gene-

nome (of a boxer named Tasha) are now soliciting samples from dog owners across the world to uncover the genetic basis for a slew of other traits.

Some discoveries grow out of government-financed research aimed at improving human health. Others are paid for by breed clubs carrying out their mission to better their breeds. By screening their dogs' DNA for desirable and undesirable traits that might appear in their offspring, breeders can make more informed decisions about which dogs to — or not to — mate.

But because genes are often tied to multiple traits, scientists warn, deliberate selection of certain ones can backfire. The gene responsible for those silver-coated Labradors, for example, is tied to skin problems.

With the genetic curtain lifted, breeders also take on a heavier burden for the consequences of their choices. Whippet breeders who continue to mate fast dogs with one another, for instance, now do so knowing they may

have to destroy the unwelcome bullies such pairings often produce.

Moreover, the prospect of races being won by dogs intentionally bred to have a genetic advantage may bring new attention to the way that genes contribute to canine — and human — achievement, even when the genetic deck is not stacked. In-born abilities once attributed to something rather mystical seem to lose a certain standing when connected to specific genes.

A mutation similar to the one that makes some whippets faster also exists in humans: a sliver of genetic code that regulates muscle development, is missing.

“It would be extremely interesting to do tests on the track finalists at the Olympics,” said Elaine Ostrander, the scientist at the National Institutes of Health who discovered that the fastest whippets had a single defective copy of the myostatin gene, while “bullies” had two.

“But we wouldn't know what to do with the information,” Ms.

Ostrander said. “Are we going to segregate the athletes who have the mutation to run separately?” For the moment, it is whippet owners who find themselves on the edge of that particular bio-ethical frontier.

It was not exactly news to breeders that speed is an inherited trait: whippets were developed in the late 1800s specifically for racing. But knowing that one of her dogs was sired by a carrier of the gene, said Jen Jensen, a whippet owner in Fair Oaks, Calif., makes its championships seem “less earned.” Ms. Jensen’s suggestion that a DNA test be required for all dogs and that the fastest ones without the mutation be judged and raced separately, however, has not gone over well.

At a recent race here in southern New Jersey, some whippet owners wanted the mutation eliminated altogether, even if that meant fewer fast dogs. But as the dogs pounded after a lure at 35 miles per hour, several owners allowed that they would

prefer a whippet with the gene for speed.

“It’s more fun having fast dogs than slow dogs,” said Libby Kirchner, of Glassboro, N.J.

The headaches are enough to make some breeders long for the time when decisions about breeding were dominated by intuition and pedigree charts. Selecting a mate, they say, was meant to involve mystery — in any species.

“It makes it so there’s no creative expression,” said Cheryl Shomo, of Chesapeake, Va. “Now everyone’s just going to do the obvious thing.”

Even so, many veteran breeders welcome the transparency the tests confer. Because while like tends to beget like, it doesn’t always work that way.

Mary-Jo Winters, a poodle breeder, uses a DNA coat-color test to ensure there are no genes for brown fur lurking beneath her black-and-cream-colored dogs.

“I don’t want brown,” said Ms. Winters. “It’s not my thing.”

Judy Pritchard, a Doberman breeder in Toledo, Wash., screens dogs she is considering breeding for a gene responsible for von Willibrand disease, a bleeding disease like hemophilia that also affects humans.

DNA tests, Ms. Pritchard said, “are the greatest tools that have been offered to dog breeders since the beginning of dogs. You need to use them to improve the breed.”

Many breeders hope this new effort to corral nature will weed out the numerous recessive diseases that plague purebred dogs after generations of human-imposed inbreeding. But some question the wisdom of escalating intervention. Mark Derr, an author who has written about the history of dog breeding, urges everyone to reconsider the goal of genetic purity.

“I always use dogs as the example of why we don’t want to be mucking around with our own genome,” Mr. Derr said. “These people are trying to use DNA tests to solve problems of

their own making.”

Still, some proponents of using the DNA palette are proposing to go even further. Dr. Neff, the University of California researcher, has proposed screening successive generations of dogs with DNA tests and breeding only those with genes for traits like stamina and scent detection to create a new breed of dogs to patrol subways and airports. It could be done within a few years, he said, instead of the centuries it took shepherds to breed the sheepdogs that patrol their flocks.

Even those who want to exert more direct control over dog DNA, however, agree that no genetic test can predict the intangible qualities that make a dog great.

If a dog does not have the spirit to run a race, it is not going to win, said Betsy Browder, a whippet owner in College Station, Tex.

“‘Keeness’ is what we call it,” she said. “Just like you can have a human athlete who’s really lazy, and all the genes in the world aren’t going to help.” □



SALLY RYAN FOR THE NEW YORK TIMES

Deborah Lindner, 33, faced family tumult as she considered surgery after a genetic test revealed a high breast cancer risk.

# Cancer Free at 33, but Weighing a Mastectomy

By **AMY HARMON**

PUBLISHED: SEPTEMBER 16, 2007

CHICAGO

**H**ER latest mammogram was clean. But Deborah Lindner, 33, was tired of constantly looking for the lump.

Ever since a DNA test had re-

vealed her unusually high chance of developing breast cancer, Ms. Lindner had agonized over whether to have a mastectomy, a procedure that would reduce her risk by 90 percent.

She had stared at herself in the mirror, imagining the loss of

her familiar shape. She had wondered, unable to ask, how the man she had just started dating would feel about breasts that were surgically reconstructed, incapable of feeling his touch or nursing his children.

But she was sure that her own mother, who had had chemotherapy and a mastectomy after a bout with the cancer that had ravaged generations of her family, would agree it was necessary.

“It could be growing inside of me right now,” she told her mother on the phone in February, pacing in her living room here. “We could find it any time.”

Waiting for an endorsement, she added, “I could schedule the surgery before the summer.”


But no approval came.

“Oh, sweetheart,” her mother said. “Let’s not rush into this.”

Joan Lindner, 63, is a cancer survivor. Her daughter, by contrast, is one of a growing number of young women who call themselves previvors because they have learned early that they are genetically prone to breast

---

**ONLINE: STORY OF A ‘PREVIVOR’**

 Deborah Lindner’s postsurgery video diary; mother and daughter on the genetic generational divide; and a surgeon on his procedure:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

cancer, and have the chance to act before it strikes.

As they seek to avoid the potentially lethal consequences of a mutant gene, many of them turn to relatives who share its burden. But at a moment when a genetic test has made family ties even more tangible, they are often at their most strained.

Parents who have fought cancer typically have no experience with the choices that confront their children, and guilt over being the biological source of the problem can color their advice. Siblings and cousins who carry the risk gene evangelize their own approach to managing it, while those who dodged its inheritance seem unqualified to judge.

Even as she searched for her own answer in the year after her DNA test, Deborah Lindner,



medical resident, found herself navigating her family’s strong and divergent opinions on the imperfect options that lay before her.

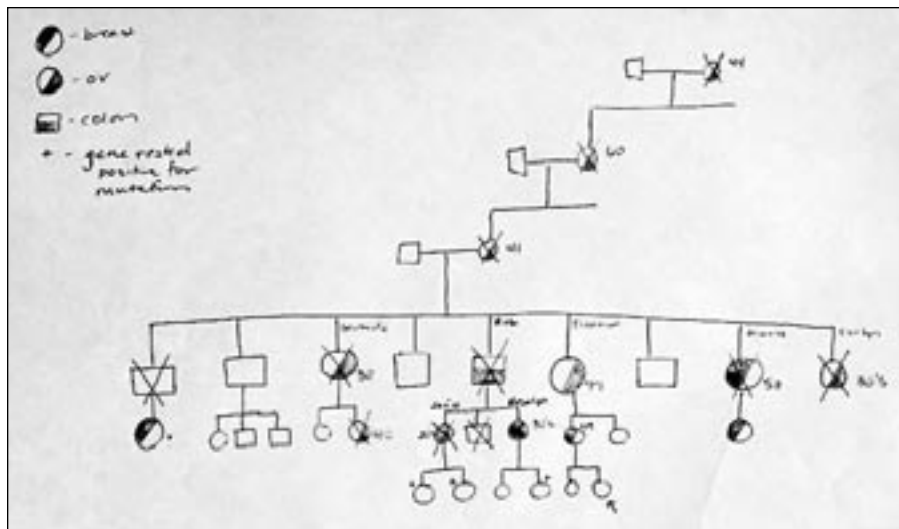
Her father, who once feared he would lose his wife to cancer, encouraged the surgery. Her sister reminded her that cancer might be cured in a few years if she could wait.

Her aunt said she hated to see her niece embrace a course of

action akin to “leechings of the Dark Ages.” A cousin declined even to take the DNA test.

But it was her mother’s blessing that Deborah most eagerly sought.

Mrs. Lindner, who had passed her defective gene to her daughter, wanted to will her more time. When she had her own breasts removed she had been married for 27 years and had raised two daughters. Now Mrs. Lindner



A Lindner family chart showing the path of breast and ovarian cancer in relatives, and those who had died.

couldn't shake the fear that her daughter might trade too much in her quest for a cancer-free future. What if taking such a radical step made it harder for Deborah to find someone special and become a mother herself?

"I have this amazing gift of knowing my risk," her daughter told her over the phone that winter night, gazing out over the frozen city from her apartment on the 38th floor. "How can I not do anything about that?"

The Lindners share a defective copy of a gene known as BRCA1 (for breast cancer gene 1) that raises their risk of developing breast cancer sometime in their lives to between 60 and 90 percent. Only 30,000 of more than 250,000 American women estimated to carry a mutation in BRCA1 or a related gene, BRCA2, have so far been tested. But their numbers have doubled in the last two years, and with a sharp increase in genetic testing, are expected to double again in the coming one.

About a third opt for preventive mastectomies that remove

the tissue where the breast cancer develops. A majority have their ovaries removed, halving their breast cancer odds while decreasing the risk of highly lethal ovarian cancer, to which they are also prone. Some take drugs that ward off breast cancer. Others hope that frequent checkups will catch the cancer early, or that they will beat the odds.

Their decisions, which require weighing an inborn risk against other life priorities, are highly individual. But with DNA forecasts of many other conditions on their way, BRCA carriers offer the first clues for how to reckon with a serious disease that may never arise — and with the family turmoil that nearly always does.

## A 50-50 Chance

Deborah Lindner's sister, Lori French, got her results first.

Long ago, before she knew about the DNA test, Ms. French, 37, had resolved to have her breasts and ovaries removed by age 40 to avoid the family cancer. Nor did she want reconstructive

surgery, having seen her mother struggle with the pain and cosmetic disappointment of hers.

“Plan on it,” she had told her husband before they got married a decade earlier. “I’m going to get old and have big hips and no breasts.”

The envelope with the test results that Ms. French opened with shaking hands in the summer of 2005 offered a reprieve. She and her husband sobbed, hugging each other in the knowledge that she was free of the genetic defect. While she still had the 12 percent chance any woman has of developing breast cancer, she could not have passed on the steep BRCA risk to either her daughter or son.

“It’s done!” Ms. French told her family. “In our line, it’s ended.”

For years, the sisters had united in a common dread. Now it was Deborah’s alone.

“I’m so sorry you have to be the one,” Ms. French said when her sister called a week later with the news that she had tested positive for the mutation.

“I’m so glad it’s not you,” Deborah replied.

It could have been either, neither or both of them — each sister, she knew, had had a 50 percent chance of inheriting the defective gene from their mother, dictated solely by a roll

---

Each sister had a 50 percent chance of inheriting the defective gene from their mother, dictated solely by a roll of the genetic dice.

---

of the genetic dice. But if it was going to be one of them, Deborah thought she was in a better position to handle it. Her sister taught at a missionary school in the Philippines, where she lived with her family, while Deborah was single and in the second year of her medical residency program at Northwestern Uni-



SALLY RYAN FOR THE NEW YORK TIMES

Deborah Lindner jogging along Lake Michigan in Chicago the day before undergoing a double mastectomy.

versity, with ready access to quality health care.

Yet in the weeks that followed, Deborah fought off pangs of jealousy and the fantasy that fate could somehow be rearranged.

“She already has a husband, she already has kids,” Deborah thought on morning runs along Lake Michigan.

She enrolled in a stepped-up surveillance program that required alternating mammograms and sonograms with M.R.I.’s every six months. But on the mornings of her appointments, and at unpredictable moments in between, she was overwhelmed with fear. Often, she would examine her breasts every other day.

“It’s taking over my mind,” she told Erin King, a close friend and fellow resident in the obstetrics and gynecology program.

Ms. King, 33, who had had breast implants for cosmetic reasons, and another resident friend were proponents of preemptive surgery.

“Get them off and get new ones,” they told her. “They’ll be awesome and perky and cute.”

But they sympathized with her distress at the appearance of traditional reconstruction, with skin grafts molded into a fake nipple that can never quite match the texture of a real one and the areola simulated by a tattoo.

“They just don’t look normal,” Deborah sighed as they debated the question over the barbecue grill at Ms. King’s apartment one night.

Accustomed to seeking her mother’s counsel, Deborah kept her distance in those months, not wanting to worry her. Instead, she pestered breast specialists. How many cancers do you actu-

ally catch? How many in an early stage? The answers were vague. Still, they discouraged her from surgery. Most women who had a preventive mastectomy, a breast surgeon told her, already had a family.

## A Frightening Pattern

In the fall of 2006, Deborah turned her residency research requirement into a personal quest for better information, analyzing the records of BRCA mutation carriers who had been counseled at Northwestern.

One file told of a woman who had developed cancer and chosen a lumpectomy, a procedure that leaves the breast mostly intact. The cancer came back — while she was pregnant. When she had an early Caesarean section so she could get chemotherapy without harming the baby, doctors discovered an ovarian tumor that had already spread to her abdomen.

The pattern was not uncommon. BRCA-related breast cancer usually strikes early, before

age 50, and is more likely to recur in the other breast. Ovarian cancer, which strikes about 50 percent of BRCA1 carriers, compared with 2 percent of the general population, is rarely detected early and is fatal three-quarters of the time.

“It’s like I’m reading this book and I know what’s coming,” Deborah told her fellow residents. “I

see the note, ‘Patient opts for surveillance,’ and I’m like, ‘No, don’t do it, don’t do it!’ ”

Several times during her oncology rotation that term, she slipped out of an ovarian cancer patient’s room to cry in the stairwell. To eliminate her risk of ovarian cancer, doctors had recommended that she have her own ovaries removed by age 40,



SALLY RYAN FOR THE NEW YORK TIMES

Ms. Lindner and her mother, Joan Lindner, getting pedicures the night before the preventive surgery.

or as soon as she had children. Removing her ovaries would halve her breast cancer risk as well, but the hormones that are generally used to treat the harsh menopausal symptoms brought on by the procedure, Deborah learned, would then raise the risk again — unless she had her breasts removed first.

## Unspoken Questions

Over Thanksgiving at her parents' winter home in Florida, Deborah ran through her risk analysis. Her father, Philip Lindner, listened and nodded. Mammograms and ultrasounds, she noted, may miss more than half of cancers in younger women with denser breasts. Magnetic resonance imaging tests are more reliable but produce more false positives, which can lead to unnecessary biopsies and worry. And it is not yet clear that early detection improves survival rates in women with BRCA mutations.

"You can't argue with statistics," said Mr. Lindner, a finan-

cial executive. "You don't want to get cancer and then say, 'I wish I would have done thus and so.'"

Deborah's mother agreed it was important to know the risks. But not knowing them could be a luxury, too. Had she had the same options as her daughter, would she have found a man and had a family? It might have altered her whole life.

"I know the joy that my girls have brought to me," she confided to a friend. "If Deb misses it, she won't know what she missed. But having experienced it, I would never have wanted to miss it."

Tentatively, she broached the subject of breast-feeding with her daughter. "That was something very special to me," Mrs. Lindner said.

"Wouldn't it be more special," Deborah shot back with uncharacteristic edge, "if I was around to have children in the first place?"

But if her mother worried that surgery would make her less at-

tractive to men, Deborah shared those concerns.

“Do fake boobs freak you out?” she often imagined asking Jeff Zehr, the man she had begun dating a few months before.

Mr. Zehr, a fellow marathon runner who attended her church, had told her she was special to him, and she felt similarly. But she didn’t want to scare him away or, worse, put pressure on the relationship to proceed faster than it otherwise would.

As Deborah felt increasingly torn between life events that couldn’t be rushed, and surgeries that shouldn’t wait, there was one more piece of information she thought would sway her mother.

“Will you do something for me?” she asked. “Look through the family tree and find out how old everyone was when they got their cancer.”

The answers were chilling. One of her first cousins, Mrs. Lindner learned, had breast cancer at age 33. Now the cancer had returned, and she was losing the fight.

Another first cousin got her breast cancer diagnosis at 34; she died. Her daughter, at 33, had recently learned she had the disease.

Mrs. Lindner called her daughter. “Have the surgery as soon as possible,” she said.

But a few days later, Mrs. Lindner called back. Her mother’s ovarian cancer, she remembered, had not surfaced until she was in her 70s — and she had survived. Joan Lindner had been 48 when the doctors detected her breast cancer, and she had survived too.

“We were really on the far side of the bell curve,” she said.

## Memories of Chemotherapy

Deborah remembered her mother’s cancer diagnosis, which came just before her graduation from high school. Her school choir had been selected to sing at Carnegie Hall, and her parents had planned to come as chaperones. Instead, she went alone while her father accompanied Mrs. Lindner to



chemotherapy appointments. During that summer, her mother's bedroom door, always open, stayed closed.

Now Deborah reminded her what she had always said about her chemotherapy. Her eyelashes, once long and curly, had been rendered short and stubby. Food tasted different. It had, in so many subtle ways, aged her.

"I don't want that for myself," Deborah said. "I don't want to treat cancer. I just never want to get it."

She began to seek support elsewhere. A genetic counselor gave her a brochure for Bright Pink, a group of young women who have tested positive for the BRCA genes. Lindsay Avner, its 24-year-old founder, lived in Chicago, and their meeting over coffee in the hospital lounge one evening in March lasted four hours. Ms. Avner had had a prophylactic mastectomy last year.

"You've got to see my breasts," she told Deborah, escorting her into the bathroom.

Ms. Avner's surgeon at Me-

morial Sloan-Kettering Cancer Center in Manhattan had used a technique that preserved the breast skin and nipples, leaving a scar only under the breast.

Deborah, still in her scrubs, said, "Wow."

Mr. Zehr drove her to an appointment with Geoffrey Fenner, the chief of plastic surgery at Evanston Memorial Hospital one evening in mid-April. If she could find a surgeon to perform the mastectomy, Dr. Fenner said he would perform the reconstruction.

The nipple-sparing technique, the doctor explained, is not popular in the United States; a decade-old study suggested that leaving the nipple increased the risk of cancer. But more recent research indicated that the risk was perhaps only 1 percent greater than with traditional reconstruction.

"I can live with that," Deborah said.

Mr. Zehr, a corporate insurance underwriter, waited outside. On the car ride home, Deb-

orah lobbed her question into the darkness.

“Does the thought of plastic surgery bother you?” she asked.

A moment passed.

“It would if I thought the person I was with was doing it because they didn’t like the way they looked,” he said. “But that isn’t this situation.”

He looked at her. “So, no, it doesn’t bother me.”

Deborah announced her intention to have surgery in a long e-mail message to family members at the end of April.

“I want to share with you what I feel is the right answer for me,” she wrote.

Like anyone who carried the defective gene, she might never get cancer, she acknowledged. Or she might only get it when she was old. “But I’m not a gambler,” she wrote.

Her aunt, Gloria Spurlock, a music teacher in Louisville, Ky., immediately called Mrs. Lindner, her sister, at her home in Des Moines.

“How could you let her dis-

member her body?” she demanded. “You have to talk her out of it.”

Stung, Mrs. Lindner tried to defend her daughter. But Mrs. Spurlock was voicing some of her own worst fears.

“Gloria,” she replied. “This is Deb’s decision.”

It was the first of several heated phone calls between the sisters. Mrs. Spurlock had considered getting tested after Mrs. Lindner found out she had a BRCA mutation. The sisters knew the gene must have come from their mother, who had had ovarian cancer a decade earlier, and whose own mother had died of the same disease. But Mrs. Spurlock concentrated instead on a healthy diet, rest and positive thinking.

The medical profession, she had long believed, was far too eager to administer drugs and remove body parts that could be healed.

Mrs. Spurlock’s daughter, Lisa Spurlock, 24, also expressed dismay.

"I'm sorry you have to be so scared of this disease," Ms. Spurlock wrote to her cousin.

The reactions gave Deborah pause. Then they made her angry.

"Why are they saying things like this to me?" she demanded of her mother.

From the Philippines, her sister suggested that Deborah was exposed to the worst-case scenarios as a doctor. Can't breast cancer often be cured?

"You're right, it can often be cured," Deborah wrote back. "The problem is that the cure involves cancer, surgery, chemotherapy, sometimes radiation and the possibility of metastasis and death."

When a second surgeon in Chicago gave the idea of the preventive mastectomy a lukewarm reception because of her age, Deborah flew to New York for a consultation with the doctor who had performed Ms. Avner's surgery. She invited her mother to come with her.

On the plane, Deborah showed

her mother a PowerPoint presentation she had created, making the case for preventive surgery. Mrs. Lindner listened. But mostly she watched the relief in her daughter's face as she talked about escaping her genetic prognosis.

It was there again the next day in Dr. Patrick I. Borgen's office on Park Avenue, when the doctor supplied the first unconditional medical affirmation of Deborah's view.

"Maybe your grandchildren will have better options," said Dr. Borgen, director of the Brooklyn Breast Cancer Project at the Maimonides Cancer Center. "But right now a draconian operation is the best thing we can do for you."

Back home in Iowa, Mrs. Lindner asked her husband: "What would we have done? What if we had known when we were dating?"

"We would have done the same thing," he said. "We would have wanted you to live."

At Dr. Borgen's recommen-

dation, Deborah scheduled the double mastectomy with Dr. D. J. Winchester at Evanston Northwestern hospital for the last weekend in June, three days after her medical board exam. Her insurance agreed to pay after requesting a letter of support from her surgeons. There would be just enough time to recover before she began practicing in the fall.

### **A Glance in the Mirror**

But with the date fixed, Deborah, for the first time in months, began to doubt her decision.

Glancing in the mirror on her way out for a run, she looked herself over.

"I was like, all right, there's me, those are my breasts," she told a friend. "That is what I see."

It did not help that Mr. Zehr did not seem to quite understand what the surgery entailed. "I won't be able to breast-feed," she reminded him.

"I thought you were having reconstruction," he said, puzzled.

"Yes," she said, "but they'll be silicone."

With three days to go, Deborah met with a nurse to go over the details of the procedure she had discussed with the surgeon. She wanted to be sure about where the incisions would be, and the size of the implants.

"We had talked about the scars on the side," she told the nurse, "and not touching the nipple."

"Oh, you may have incisions everywhere," the nurse said. "There may be one up the front and underneath and up the nipple."

Deborah burst into tears.

"Am I doing the right thing?" she asked her mother from her cellphone after she left the office.

Mrs. Lindner, packing for the drive to Chicago to be with her daughter during her hospital stay, knew she was not just asking about the scars. And she had the answer.

"Yes," Mrs. Lindner said. "You are doing what is right for you."

On the morning of the sur-

gery, Mr. Zehr was there, holding Deborah's hand. "You look cute in your gown," he told her.

In the lounge, Mrs. Lindner waited. The surgery and reconstruction took seven and a half hours, twice as long as the doctors had expected. The incisions were small, Dr. Winchester explained when he came out, and

hidden under the breast, so it had taken a long time to scrape out all the breast tissue.

Then Mrs. Lindner rode up in the elevator with her daughter, still unconscious from the anesthesia. As they arrived at their floor, Deborah opened her eyes.

"Mom," she said, and managed a small smile. □



SALLY RYAN FOR THE NEW YORK TIMES

Ms. Lindner with her boyfriend, Jeff Zehr, after the surgery at Evanston Northwestern hospital.

# Seeking Columbus's Origins, With a Swab

By **AMY HARMON**

PUBLISHED: OCTOBER 8, 2007

BARCELONA, SPAIN

When schoolchildren turn to the chapter on Christopher Columbus's humble origins as the son of a weaver in Genoa, they are not generally told that he might instead have been born out of wedlock to a Portuguese prince. Or that he might have been a Jew whose parents converted to escape the Spanish Inquisition. Or a rebel in the medieval kingdom of Catalonia.

Yet with little evidence to support them, multiple theories of Columbus's early years have long found devoted proponents among those who would claim alternative bragging rights to the explorer. And now, five centuries after he opened the door to the New World, Columbus's revisionist biographers have

found a new hope for vindication.

The Age of Discovery has discovered DNA.

In 2004, a Spanish geneticist, Dr. Jose A. Lorente, extracted genetic material from a cache of Columbus's bones in Seville to settle a dispute about where he was buried. Ever since, he has been beset by amateur historians, government officials and self-styled Columbus relatives of multiple nationalities clamoring for a genetic retelling of the standard textbook tale.

Even adherents of the Italian orthodoxy concede that little is known about the provenance of the Great Navigator, who seems to have purposely obscured his past. But contenders for his legacy have no compunction about prospecting for his secrets in the cells he took to his grave. And the arrival on Oct. 8 of an-

other anniversary of Columbus's first landfall in the Bahamas has only sharpened their appetite for a genetic verdict, preferably in their own favor.

A Genoese Cristoforo Colombo almost certainly did exist. Archives record his birth and early life. But there is little to tie that man to the one who crossed the Atlantic in 1492. Snippets from Columbus's life point all around the southern European coast. He kept books in Catalan and his handwriting has, according to some, a Catalonian flair. He married a Portuguese noblewoman. He wrote in Castilian. He decorated his letters with a Hebrew cartouche.

Since it seems now that the best bet for deducing Columbus's true hometown is to look for a genetic match in places where he might have lived, hundreds of Spaniards, Italians, and even a few Frenchmen have happily swabbed their cheeks to supply cells for comparison.

"You would be proud to know that the man that goes to Amer-

## Genoese theory

*Columbus was born Cristoforo Colombo, the son of Domenico Colombo, a Genoese wool weaver.*



### EVIDENCE

There are dozens of documents in Genoa that detail the life of Cristoforo Colombo, including his activities in Portugal on behalf of Genoese merchants in the 1470s.

### COUNTEREVIDENCE

The Genoese Cristoforo Colombo may not have been the famous explorer. Columbus was never referred to as Colombo in any official documents. He wrote only in Latin and Castilian, even when corresponding with Italian friends. Analysis of Columbus's remains suggests he was about 60 years old when he died in 1506, about five years older than the Genoese man would have been.

### THE DNA TWIST

Scientists are comparing Columbus's DNA to that from 100 men in Genoa and northwestern Italy whose last name is Colombo. Because Y-chromosomal DNA is passed from fathers to sons, it often corresponds with surnames.

ica the first time was Catalan,” said Jordi Colom, 51, an executive at a local television station whose saliva sample will help test the contention that Columbus was born in Catalonia, the once-independent eastern region of modern Spain that still fosters its own language, culture and designs on independence.

No chance, said Renato Colombo, 62, a retired Italian engineer who proffered his DNA to reassert his nation’s hold on the status quo. “It has never been in doubt that he was from Liguria,” the region in northwest Italy of which Genoa is the capital, he insisted. “In his personality, there are the characteristics of the Genoese, mostly represented by his project and his visceral attachment to money and his determination.”

Mr. Colom and Mr. Colombo are both “Columbus” in their native tongues. And along with their names, each inherited from his father a Y chromosome — a sliver of DNA passed exclusively from father to son — which

## Catalan theory



*Columbus was born with the last name*

*Colom in Catalonia. He changed his name to the Castilian Cristóbal Colón to cover up his participation in a rebellion against Ferdinand’s father.*

### EVIDENCE

Columbus visited Barcelona after his first voyage, took many Catalonians on voyages, and possessed books in Catalan. His handwriting appears Catalanian, and his Castilian writing contains errors that suggest Catalan was his native language. He was called Colom in Castilian documents.

### COUNTEREVIDENCE

Columbus never said he was from Catalonia and never wrote in Catalan.

### THE DNA TWIST

Scientists are comparing Columbus’s DNA to that from 255 men living in eastern Spain whose last name is Colom.



would have been virtually unchanged since the 15th century. A Columbus match to either man's Y chromosome would tie him to that paternal line's Italian or Catalonian home.

"What I want to write is the final book on Columbus, and I will not be able to do it without science to settle this," said Francesc Albardaner, who was seduced by the possibility that DNA — a tool whose answers are treated as indisputable fact in courtrooms and on TV shows — would endorse his deeply held belief in the Catalonian Columbus.

Mr. Albardaner, a Barcelona architect, took more than three months off work, called 2,000 Coloms and persuaded 225 of them to scrape their cheeks at his Center for Columbus Studies in Barcelona. The swabs along with 100 Colombos collected in Italy are being analyzed by Dr. Lorente at the University of Granada and scientists in Rome.

A Colom match could over-

## Portuguese theory



*Columbus was Salvador Fernandes Zarco, the son of a Portuguese prince. He was sent by the Portuguese monarchy to encourage Isabella and Ferdinand to divert resources to exploring the West, far from Portugal's burgeoning empire in Asia.*

### EVIDENCE

Columbus married a Portuguese noblewoman, Filipa Moniz Perestrelo, and visited Portuguese territories not open to foreigners. He named several New World discoveries after places in Portugal. Some linguists believe the grammatical mistakes in his writing are evidence that Portuguese was his native tongue.

### COUNTEREVIDENCE

No documents are known to exist linking Columbus to Portugal, and the Portuguese royal family never claimed him as their own. Contemporary Portuguese chroniclers of Columbus said he was Italian. He named new discoveries after places in Castile and Catalonia, too.

### THE DNA TWIST

The current Duke of Bragança and the Count of Ribeira Grande, two descendants of the Portuguese royal family, have supplied their DNA for comparison with the Columbuses.

turn conventional wisdom about the nationality, class, religion, and motives of the man who began the age of American colonization. On the other hand, an association with Colombo DNA would cement Italy's national pride in a man who remains a hero to many, complaints from American Indians he slaughtered, Africans he enslaved and Vikings who got there first notwithstanding.

But some petitioners think it is a waste of time to scour the phone book for Columbus's long-lost kin. Insisting that they know who Columbus's father really was, they are asking Dr. Lorente to perform a 500-year postdated paternity test. The government council president of Majorca, for instance, has paid him to examine the exhumed remains of Prince Carlos of Viana, the one-time heir to the Catalonian crown who reportedly fathered a son with a woman on the island whose last name was Colom.

The vials of royal DNA in Dr.

## Majorcan theory

*Columbus was born on the island of*

*Majorca out of wedlock to Prince Carlos of Viana, step-brother of King Ferdinand.*



### EVIDENCE

A letter suggests the prince conceived a child in 1459, when he lived in Majorca, with Margalida Colom. This might have provided Columbus with the background required to marry into Portuguese nobility and could explain his access to Ferdinand and Isabella.

### COUNTEREVIDENCE

Columbus would have been born in 1460, which would have made him 46 at his death instead of the 60 suggested by forensic analysis of his bones. It has been recently suggested that the letter refers to a known mistress in Palermo with a different last name.

### THE DNA TWIST

The council president of Majorca is paying scientists to compare Columbus's DNA to that from remains purported to be those of Prince Carlos. A match would prove paternity.

Lorente's freezer also include contributions from two living members of the now deposed Portuguese royal line: those of the Duke of Bragança and the Count of Ribeira Grande who argue that Columbus was a member of their family — the product of an extramarital affair involving a Portuguese prince.

“This is the true story, forget the Italians, forget the Spanish,” said Count Jose Ribeira, 47, a real estate developer in Lisbon who attended the dedication of a new Columbus monument last year in the Portuguese town of Cuba that claims to be Columbus's birthplace. If it is, all three samples should contain the same Portuguese genetic imprint.

But this year, anyway, the Columbus Day parade in New York will feature Maserati sports cars, flag throwers from Siena and Lidia Bastianich, the Italian cooking show host, as grand marshal.

Those who had hoped DNA would crash the Italian party

## Jewish theory

*Columbus or his recent ancestors were Jewish and converted to avoid the Spanish Inquisition.*



## EVIDENCE

Many Jews converted, or pretended to convert to Catholicism, to avoid the Inquisition. Columbus used Hebrew symbols and dates in some writing. In a will written late in life he asked that “one-half mark of silver” be given to a beggar “at the gate of the Jewish district” in Lisbon.

## COUNTEREVIDENCE

Many educated Catholic men were interested in Hebrew texts in the 15th century. Most Jews in Southern Europe at the time were Sephardic Jews of North African descent, but preliminary analysis of Columbus's DNA suggests he was Caucasian.

## THE DNA TWIST

Certain genetic markers are strongly associated with Jewish ancestry. If they are found in Columbus's DNA it would suggest that he or his recent ancestors were Jewish.

expected a genetic pronouncement from the scientists on the 500th anniversary of Columbus's death last May. Or last Columbus Day. Surely by this one. After all those centuries in a crypt, however, a mere trace of DNA was all that could be extracted from Columbus's bones, and Dr. Lorente has said he is loath to use it indiscriminately.

To make things even tougher, he has found that Catalonian Coloms and Genoese Colombos are so closely related it is hard to distinguish them with the standard Y-chromosome tests. So he is searching for more subtle differences that would allow him to link Columbus to a single lineage.

"My heart," Mr. Albardaner said, "will not endure so many delays."

Others have accused Dr. Lorente of nationalist bias, of covering up results that suggest Columbus was a Jew and of withholding a historical treasure from the Western world.

"Will Lorente continue to

## Other theories

*Columbus may have been the son of Pope Innocent VIII or the King of Poland. He may trace his roots to the Balaeric island of Ibiza, or the Mediterranean island of Corsica. He could be from Greece or Norway. Or, for that matter, anywhere else that people have DNA.*

hide what the scientists know concerning Columbus's DNA?" asked Peter Dickson, a retired C.I.A. analyst whose self-published book on Columbus argues that he was part French, part Italian, part Spanish and part Jewish, in an e-mail message to fellow Columbus buffs. "Will he remain silent on Columbus Day once again?"

Dr. Lorente says he will. And in the absence of data, rumors are flying.

Olga Rickards, a Lorente collaborator at Tor Vergata University in Rome, has been quoted as saying that she "wouldn't bet on Columbus being Spanish." A graduate student of Dr. Lorente's who had studied the Colombo DNA led Italian news-

papers to believe Columbus was from Lombardy, north of Genoa, although she had apparently never seen Columbus's DNA. And Nito Verdera, a journalist from the Balearic island of Ibiza, who says the explorer was a Catalan-speaking Ibizan crypto-Jew, cited leaks from Dr. Lorente's team that link Columbus to North Africa.

"I'm very sorry about the great expectation among some historians that they all want the DNA to confirm their hypothesis," Dr. Lorente said. "But science needs its time and has its pace."

If Columbus was an adopted name, as some scholars believe, tests of Coloms and Colombos will have been in vain. Moreover, with dozens of generations separating all those Coloms, Colombos, princes and counts from Columbus's time, a long-hidden adulterous liaison could have severed the Y-chromosome-and-surname link.

Even with a match questions will remain. What if Coloms

moved to Genoa or Colombos to Barcelona? Today's distinct regional identities may not be reflected in the genetic code of the earlier era.

Mr. Albardaner still brings Columbus novices to the Historic Archive of Protocols in Barcelona, where they can hold a yellowed note from the 15th century filled with the calligraphic scrawl of the man he believes stumbled upon the Caribbean while looking for a western route to India.

He is less sure now that there will be a precise answer to who Columbus was or where he was from, but he is still hoping it will come from the DNA.

"Maybe it will say he's from Catalonia. Maybe it will be a complete lockout. Maybe we find his DNA is completely dissimilar to any known DNA, he comes from Mars, well, perfect, O.K."

"Then," he said, "I stop." □

---

*Peter Kiefer contributed reporting from Rome.*

# In DNA Era, New Worries About Prejudice

By **AMY HARMON**

PUBLISHED: NOVEMBER 11, 2007

**W**HEN scientists first decoded the human genome in 2000, they were quick to portray it as proof of humankind's remarkable similarity. The DNA of any two people, they emphasized, is at least 99 percent identical.

But new research is exploring the remaining fraction to explain differences between people of different continental origins.

Scientists, for instance, have recently identified small changes in DNA that account for the pale skin of Europeans, the tendency of Asians to sweat less and West Africans' resistance to certain diseases.

At the same time, genetic information is slipping out of the laboratory and into everyday life, carrying with it the inescapable message that people of dif-

ferent races have different DNA. Ancestry tests tell customers what percentage of their genes are from Asia, Europe, Africa and the Americas. The heart-disease drug BiDil is marketed exclusively to African-Americans, who seem genetically predisposed to respond to it. Jews are offered prenatal tests for genetic disorders rarely found in other ethnic groups.

Such developments are providing some of the first tangible benefits of the genetic revolution. Yet some social critics fear they may also be giving long-discredited racial prejudices a new potency. The notion that race is more than skin deep, they fear, could undermine principles of equal treatment and opportunity that have relied on the presumption that we are all fundamentally equal.

"We are living through an era

of the ascendance of biology, and we have to be very careful,” said Henry Louis Gates Jr., director of the W. E. B. Du Bois Institute for African and African American Research at Harvard University. “We will all be walking a fine line between using biology and allowing it to be abused.”

Certain superficial traits like skin pigmentation have long been presumed to be genetic. But the ability to pinpoint their DNA source makes the link between genes and race more palpable. And on mainstream blogs, in college classrooms and among the growing community of ancestry test-takers, it is prompting the question of whether more profound differences may also be attributed to DNA.

Nonscientists are already beginning to stitch together highly speculative conclusions about the historically charged subject of race and intelligence from the new biological data. Last month, a blogger in Manhattan described a recently published

study that linked several snippets of DNA to high I.Q. An online genetic database used by medical researchers, he told readers, showed that two of the snippets were found more often in Europeans and Asians than in Africans.

---

“We will all be  
walking a fine line  
between using biology  
and allowing it  
to be abused.”

---

No matter that the link between I.Q. and those particular bits of DNA was unconfirmed, or that other high I.Q. snippets are more common in Africans, or that hundreds or thousands of others may also affect intelligence, or that their combined influence might be dwarfed by environmental factors. Just the existence of such genetic differences between races, pro-

claimed the author of the Half Sigma blog, a 40-year-old software developer, means “the egalitarian theory,” that all races are equal, “is proven false.”

Though few of the bits of human genetic code that vary between individuals have yet to be tied to physical or behavioral traits, scientists have found that roughly 10 percent of them are more common in certain continental groups and can be used to distinguish people of different races. They say that studying the differences, which arose during the tens of thousands of years that human populations evolved on separate continents after their ancestors dispersed from humanity’s birthplace in East Africa, is crucial to mapping the genetic basis for disease.

But many geneticists, wary of fueling discrimination and worried that speaking openly about race could endanger support for their research, are loath to discuss the social implications of their findings. Still, some acknowledge that as their data

and methods are extended to nonmedical traits, the field is at what one leading researcher recently called “a very delicate time, and a dangerous time.”

“There are clear differences between people of different continental ancestries,” said Marcus W. Feldman, a professor of biological sciences at Stanford University. “It’s not there yet for things like I.Q., but I can see it coming. And it has the potential to spark a new era of racism if we do not start explaining it better.”

Dr. Feldman said any finding on intelligence was likely to be exceedingly hard to pin down. But given that some may emerge, he said he wanted to create “ready response teams” of geneticists to put such socially fraught discoveries in perspective.

The authority that DNA has earned through its use in freeing falsely convicted inmates, preventing disease and reconstructing family ties leads people to wrongly elevate genetics



over other explanations for differences between groups.

“I’ve spent the last 10 years of my life researching how much genetic variability there is between populations,” said Dr. David Altshuler, director of the Program in Medical and Population Genetics at the Broad Institute in Cambridge, Mass. “But living in America, it is so clear that the economic and social and educational differences have so much more influence than genes. People just somehow fixate on genetics, even if the influence is very small.”

But on the Half Sigma blog and elsewhere, the conversation is already flashing forward to what might happen if genetically encoded racial differences in socially desirable — or undesirable — traits are identified.

“If I were to believe the ‘facts’ in this post, what should I do?” one reader responded on Half Sigma. “Should I advocate discrimination against blacks because they are less smart? Should I not hire them to my company

because odds are I could find a smarter white person? Stop trying to prove that one group of people are genetically inferior to your group. Just stop.”

Renata McGriff, 52, a health care consultant who had been encouraging black clients to volunteer genetic information to scientists, said she and other African-Americans have lately been discussing “opting out of genetic research until it’s clear we’re not going to use science to validate prejudices.”

“I don’t want the children in my family to be born thinking they are less than someone else based on their DNA,” added Ms. McGriff, of Manhattan.

Such discussions are among thousands that followed the geneticist James D. Watson’s assertion last month that Africans are innately less intelligent than other races. Dr. Watson, a Nobel Prize winner, subsequently apologized and quit his post at the Cold Spring Harbor Laboratory on Long Island.

But the incident has added to

uneasiness about whether society is prepared to handle the consequences of science that may eventually reveal appreciable differences between races in the genes that influence socially important traits.

New genetic information, some liberal critics say, could become the latest rallying point for a conservative political camp that objects to social policies like affirmative action, as happened with “The Bell Curve,” the controversial 1994 book that examined the relationship between race and I.Q.

Yet even some self-described liberals argue that accepting that there may be genetic differences between races is important in preparing to address them politically.

“Let’s say the genetic data says we’ll have to spend two times as much for every black child to close the achievement gap,” said Jason Malloy, 28, an artist in Madison, Wis., who wrote a defense of Dr. Watson for the widely read science blog

Gene Expression. Society, he said, would need to consider how individuals “can be given educational and occupational opportunities that work best for their unique talents and limitations.”

Others hope that the genetic data may overturn preconceived notions of racial superiority by, for example, showing that Africans are innately more intelligent than other groups. But either way, the increased outpouring of conversation on the normally taboo subject of race and genetics has prompted some to suggest that innate differences should be accepted but, at some level, ignored.

“Regardless of any such genetic variation, it is our moral duty to treat all as equal before God and before the law,” Perry Clark, 44, wrote on a New York Times blog. It is not necessary, argued Dr. Clark, a retired neonatologist in Leawood, Kan., who is white, to maintain the pretense that inborn racial differences do not exist.

“When was the last time a non-black sprinter won the Olympic 100 meters?” he asked.

“To say that such differences aren’t real,” Dr. Clark later said in an interview, “is to stick your head in the sand and go blah blah blah blah until the band marches by.”

Race, many sociologists and anthropologists have argued for decades, is a social invention historically used to justify prejudice and persecution. But when Samuel M. Richards gave his students at Pennsylvania State University genetic ancestry tests to establish the imprecision of socially constructed racial categories, he found the

exercise reinforced them instead.

One white-skinned student, told she was 9 percent West African, went to a Kwanzaa celebration, for instance, but would not dream of going to an Asian cultural event because her DNA did not match, Dr. Richards said. Preconceived notions of race seemed all the more authentic when quantified by DNA.

“Before, it was, ‘I’m white because I have white skin and grew up in white culture,’ ” Dr. Richards said. “Now it’s, ‘I really know I’m white, so white is this big neon sign hanging over my head.’ It’s like, oh, no, come on. That wasn’t the point.” □

The New York Times

HEALTH

[nytimes.com/health](http://nytimes.com/health)

**Times Health Guide:** Comprehensive reference and special reports about diseases, conditions, tests, injuries and surgeries.

# My Genome, Myself: Seeking Clues in DNA

By **AMY HARMON**

PUBLISHED: NOVEMBER 17, 2007

**T**HE exploration of the human genome has long been relegated to elite scientists in research laboratories. But that is about to change. An infant industry is capitalizing on the plunging cost of genetic testing technology to offer any individual unprecedented — and unmediated — entree to their own DNA.

For as little as \$1,000 and a saliva sample, customers will be able to learn what is known so far about how the billions of bits in their biological code shape who they are. Three companies have already announced plans to market such services, one yesterday.

Offered the chance to be among the early testers, I agreed, but not without reservations. What if I learned I was likely to die young? Or that I might have passed on a rogue gene to my daughter? And

more pragmatically, what if an insurance company or an employer used such information against me in the future?

But three weeks later, I was already somewhat addicted to the daily communion with my genes. (Recurring note to self: was this addiction genetic?)

For example, my hands hurt the other day. So naturally, I checked my DNA.

Was this the first sign that I had inherited the arthritis that gnarled my paternal grandmother's hard-working fingers? Logging onto my account at 23andMe, the start-up company that is now my genetic custodian, I typed my search into the "Genome Explorer" and hit return. I was, in essence, Googling my own DNA.

I had spent hours every day doing just that as new studies linking bits of DNA to diseases and

## Where to Go For DNA Tests

Three companies have started or are planning services to test customers' DNA at nearly one million locations where the human genome is known to vary between individuals. All are offering services to help consumers interpret the information contained in their own genomes.

### 23andMe

Mountain View, Calif.

Available now for \$999

Services: genotyping 580,000 SNPs using Illumina technology; Gene Journals reporting risk for 20 diseases and physical traits; tools for tracing ancestry and DNA similarity with family and friends; Genome Explorer to provide access to all data to allow customers to compare any published study with their own genotype; will provide referrals to genetic counselors

[www.23andme.com](http://www.23andme.com)

### deCODE Genetics

Reykjavik, Iceland

Available now for \$985

Services: genotyping one million SNPs using Illumina technology; deCODEme will provide risk reports for about 20 diseases and physical traits; tools for tracing ancestry and DNA similarity with family and friends; genetic counselors available for consultations

[www.decodeme.com](http://www.decodeme.com)

### Navigenics

Redwood Shores, Calif

Available in 2008 for \$2,500

Services: will genotype one million SNPs using Affymetrix technology; health Compass will provide risk reports for about a dozen diseases; results relayed by genetic counselor

[www.navigenics.com](http://www.navigenics.com)

aspects of appearance, temperament and behavior came out on an almost daily basis. At times, surfing my genome induced the same shock of recognition that comes when accidentally catching a glimpse of oneself in the mirror.

I had refused to drink milk growing up. Now, it turns out my DNA is devoid of the mutation that eases the digestion of milk after infancy, which became common in Europeans after the domestication of cows.

But it could also make me

question my presumptions about myself. Apparently I lack the predisposition for good verbal memory, although I had always prided myself on my ability to recall quotations. Should I be recording more of my interviews? No, I decided; I remember what people say. DNA is not definitive.

I don't like brussels sprouts. Who knew it was genetic? But I have the snippet of DNA that gives me the ability to taste a compound that makes many vegetables taste bitter. I differ from people who are blind to bitter taste — who actually like brussels sprouts — by a single spelling change in our four-letter genetic alphabet: somewhere on human chromosome 7, I have a G where they have a C.

It is one of roughly 10 million tiny differences, known as single nucleotide polymorphisms, or SNPs (pronounced “snips”) scattered across the 23 pairs of human chromosomes from which 23andMe takes its name. The company generated a list of my “genotypes” — AC's, CC's, CT's

and so forth, based on which versions of every SNP I have on my collection of chromosome pairs.

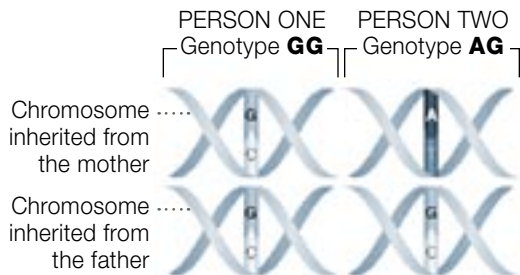
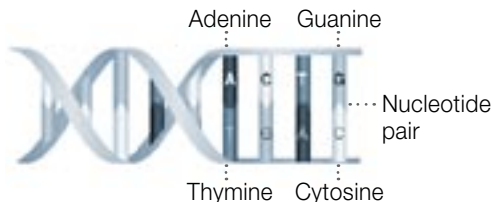
For instance, I tragically lack the predisposition to eat fatty foods and not gain weight. But people who, like me, are GG at the SNP known to geneticists as rs3751812 are 6.3 pounds lighter, on average, than the AA's. Thanks, rs3751812!

And if an early finding is to be believed, my GG at rs6602024 mean that I am an additional 10 pounds lighter than those whose genetic Boggle served up a different spelling. Good news, except that now I have only my slothful ways to blame for my inability to fit into my old jeans.

And although there is great controversy about the role that genes play in shaping intelligence, it was hard to resist looking up the SNPs that have been linked — however tenuously — to I.Q. Three went in my favor, three against. But I found hope in a study that appeared last week describing a SNP strongly linked with an increase in the I.Q. of breast-fed babies.

## Tiny Variations in Our Genetic Code

DNA is a chain of nucleotides, small molecules that come in four types, abbreviated **A**, **C**, **T** and **G**. The human genome contains several billion nucleotides, about 99 percent of which are identical from person to person.

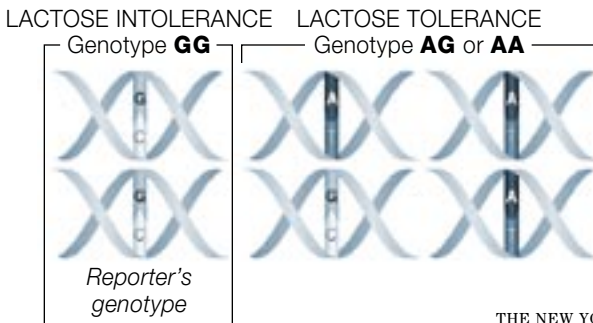


### INDIVIDUAL DIFFERENCES

At approximately 10 million points in the genome, known as single nucleotide polymorphisms or SNPs, different nucleotides are found in different people. In the example at left, Person One inherited the same nucleotide pair from each parent, while Person Two inherited different pairs. At this SNP, Person One has the genotype **GG** and Person Two has the genotype **AG**.

### INTERPRETING SNPs

Some SNPs are thought to be associated with specific traits. At right, a SNP near the LCT gene controls whether the lactase enzyme is turned on or off in adulthood. People with the genotype **GG** are more likely to be lactose intolerant than people with the genotype **AG** or **AA**.



Sources: 23andMe

THE NEW YORK TIMES

Babies with the CC or CG form of the SNP apparently benefit from a fatty acid found only in breast milk, while those with the GG form do not. My CC genotype meant that I had been eligible for the 6-point I.Q. boost when my mother breast-fed me. And because, by the laws of genetics, my daughter had to have inherited one of my C's, she, too, would see the benefit of my having nursed her. Now where did I put those preschool applications?

I was not always so comfortable in my own genome. Before I spit into the vial, I called several major insurance companies to see if I was hurting my chances of getting coverage. They said no, but that is now, when almost no one has such information about their genetic make-up. In five years, if companies like 23andMe are at all successful, many more people presumably would. And isn't an individual's relative risk of disease precisely what insurance companies want to know?

Last month, alone in a room at 23andMe's headquarters in Mountain View, Calif., with my password for the first time, I wavered (genetic?) and walked down the hall to get lunch.

Once I looked at my results, I could never turn back. I had prepared for the worst of what I could learn this day. But what if something even worse came along tomorrow?

Some health care providers argue that the public is unprepared for such information and that it is irresponsible to provide it without an expert to help put it in context. And at times, as I worked up the courage to check on my risks of breast cancer and Alzheimer's, I could see their point.

One of the companies that plans to market personal DNA information, Navigenics, intends to provide a phone consultation with a genetic counselor along with the results. Its service would cost \$2,500 and would initially provide data on 20 health conditions.



DeCODE Genetics and 23andMe will offer referrals. Although what they can tell you is limited right now, all three companies are hoping that people will be drawn by the prospect of instant updates on what is expected to be a flood of new findings.

I knew I would never be able to pass up the chance to fill in more pieces of my genetic puzzle.

But I had decided not to submit my daughter's DNA for testing — at least not yet — because I didn't want to regard anything about her as predestined. If she wants to play the piano, who cares if she lacks perfect pitch? If she wants to run the 100-meter dash, who cares if she lacks the sprinting gene? And did I really want to know — did she really want to know someday — what genes she got from which parent and which grandparent?

I, however, am not age 3. Whatever was lurking in my genes had been there my entire life. Not looking would be like

rejecting some fundamental part of myself.

Compelled to know (genetic?), I breezed through the warning screens on the site. There would be no definitive information, I read, and new discoveries might reverse whatever I was told. Even if I learned that my risk for developing a disease was high, there might well be nothing to do about it, and, besides, I should not regard this as a medical diagnosis. "If, after considering these points, you still wish to view your results," the screen read, "click here."

I clicked.

Like other testers of 23andMe's service, my first impulse was to look up the bits of genetic code associated with the diseases that scare me the most.

But in the bar charts that showed good genes in green and bad ones in red, I found a perverse sense of accomplishment. My risk of breast cancer was no higher than average, as was my chance of developing Alzheimer's. I was 23 percent less likely

to get Type 2 diabetes than most people. And my chance of being paralyzed by multiple sclerosis, almost nil. I was three times more likely than the average person to get Crohn's disease, but my odds were still less than one in a hundred.

I was in remarkably good genetic health, and I hadn't even been to the gym in months!

Still, just studying my DNA had made me more acutely aware of the basic health risks we all face. I renounced my mid-afternoon M&M's.

And then I opened my "Gene Journal" for heart disease to find that I was 23 percent more likely than average to have a heart attack. "Healthy lifestyle choices play a major role in preventing the blockages that lead to heart attacks," it informed me.

Thanks, Gene Journal. Yet somehow even this banal advice resonated when the warning came from my own DNA.

Back in New York, I headed to the gym despite a looming story

deadline and my daughter's still-unfinished preschool applications. At least I had more time. I had discovered a SNP that likely increased my life span.

But in what I have come to accept as the genomic law of averages, I soon found that I might well be sight impaired during those extra years. According to the five SNPs for macular degeneration I fed into the "Genome Explorer," I was nearly 100 times more likely to develop the disease than someone with the most favorable A-C-G-T combination.

And unlike the standard eat-right-and-exercise advice for heart health, there was not much I could do about it. Still, I found the knowledge of my potential future strangely comforting, even when it was not one I would wish for. At least my prospects for nimble fingers in old age were looking brighter. I didn't have the bad form of that arthritis SNP.

Maybe I was just typing too much. □

# After DNA Diagnosis: 'Hello, 16p11.2. We're Kin.'

By **AMY HARMON**

PUBLISHED: DECEMBER 28, 2007


**T**HE GIRLS had never met, but they looked like sisters. There was no missing the similarities: the flat bridge of their noses, the thin lips, the fold near the corner of their eyes. And to the families of 14-year-old Samantha Napier and 4-year-old Taygen Lane there was something else, too. In the likeness was lurking an explanation for the learning difficulties, the digestion problems, the head-banging that had troubled each of them, for so long.

Several of the adults wiped tears from their eyes. "It's like meeting family," said Jessica Houk, Samantha's older sister, who accompanied her and their mother to a Kentucky amusement park last July to greet Taygen.

But the two families are not related, and would never have

---

## ONLINE: GENETIC KIN

 Hello, 22q13! A video about the first meeting of two children with a rare genetic mutation:

[nytimes.com/danaage](http://nytimes.com/danaage)

---

met save for an unusual bond: a few months earlier, a newly available DNA test revealed that Samantha and Taygen share an identical nick in the short arm of their 16th chromosomes.

With technology that can now scan each of an individual's 46 chromosomes for minute aberrations, doctors are providing thousands of children lumped together as "autistic" or "developmentally delayed" with distinct genetic diagnoses. The symptoms, they are finding, can be traced to one of dozens of deletions or duplications of DNA that were previously hard or impossible to detect.

Some mutations are so rare

that they are known only by their chromosomal address: Samantha and Taygen are two of only six children with the diagnosis “16p11.2.”

Few of these mutations were inherited in the traditional sense, and the affected children are typically the only family member with the disorder. So, many parents are searching out strangers struck by the same genetic lightning bolt. They want solace, advice and answers to what the future might hold. From other families of children with the same chromosomal anomaly, they are seeking insight into their own. Sometimes what they find is unsettling. But in the emerging communities of the genetically rare, more often it is sustaining.

For three families, the impulse to find others in the same situation was immediate.

A few months before the Lanes crossed the state to meet Taygen’s chromosomal cousin, Jennie Dopp, a mother in Utah, was scouring the Internet for families with “7q11.23,” the diagno-

sis that explained her son’s odd behavior and halting speech.

“I want someone to say ‘I know what you mean,’” Ms. Dopp told her husband, “and really mean it.”

Noa Ospenson’s parents flew from Boston to South Carolina for a meeting of 100 families with children who, like Noa, are also “22q13.” Hoping for more information about their daughter’s diagnosis, they emerged as lifetime members of what they call “Noa’s tribe.”

For each of them, a genetic mutation became the foundation for a new form of kinship.

## **Jackson: The Search**

If one of his siblings is sitting at his place at the breakfast table, Jackson screams. If a schoolmate gets too close to him, Jackson screams. If someone interrupts him while he is speaking, Jackson screams.

“You ruined my talk!” shrieks the sweet-faced boy who must concentrate intently to string his words together.



BRIAN NICHOLSON FOR THE NEW YORK TIMES

Jackson Dopp of Layton, Utah, wearing a brace after facial surgery, is one of 11 children with a chromosomal duplication identified as 7q11.23.

Jackson has been to so many sleep doctors because of a bone structure that obstructs his airway that he wants to be one when he grows up. He talks to himself in church. No matter how many times, or how gently, his father asks him to play catch in the yard of their home in Layton, Utah, he refuses. He prefers

to play in his tree house, by himself.

“Don’t worry about it,” family members often told Ryan and Jennie Dopp when they recounted a difficult day with Jackson. “My kid is just like that.”

“Your kids,” Ms. Dopp finally snapped at her sister one afternoon, “are nothing like this!”

But for the first seven years of his life, the Dopps could not figure out what made Jackson different. They took him to neurologists and psychologists. He had three brain M.R.I.'s. And then there were the annual trips to the geneticist.

About one in 500 children are born with a chromosomal disorder, the geneticist, Dr. Alan Rope, told them. Such disorders are responsible for an unknown fraction of cases of mental retardation and autism as well as birth defects like a cleft palate or heart and kidney defects. Down syndrome, which occurs in individuals with an entire extra 21st chromosome in addition to the usual pair, is the most common, and the easiest to identify. But there were some 100 known disorders involving subtler duplications or deletions of pieces of chromosomes that were considerably harder to detect, Dr. Rope said. And he could test for only one at a time.

Fragile X syndrome. Smith-Magenis syndrome. Velocardio-

facial syndrome. Negative, negative, negative.

Desperate for a diagnosis, this February, the Dopps took Jackson to a psychiatrist. He told them Jackson was autistic.

"Autism covers so much," Mr. Dopp, a manager at American Express, complained to his wife. "It doesn't mean anything." And

---

About one in 500  
children are born with a  
chromosomal disorder.

---

Jackson did not quite seem like the other autistic children they knew.

Finally, at an appointment in March, the geneticist told them that a technology known as DNA microarray analysis had become available and that it could test all known chromosomal disorders at once. At about \$3,000, it was expensive, but one of the major insurers in the state had just agreed to cover it.

When Dr. Rope called to say that there was an extra stretch of DNA in the middle of Jackson's seventh chromosome, the Dopps rejoiced. His oddness was not the result of bad parenting. Nor was he just a little "off," as so many people had suggested. Perhaps, Ms. Dopp dared to fantasize, there would one day be a cure for her son. At least now they knew where to look.

But as the Dopps began to tell friends and family members about the source of Jackson's disabilities, they grew frustrated.

"You say autism, or Down syndrome, and people know somebody," said Ms. Dopp, who stays home with Jackson and his three siblings. "When you try to explain 7q to people and they barely know what a chromosome is, it's hard."

And Dr. Rope had little to offer by way of practical information.

"He said Jackson was the only one he had ever seen," Ms. Dopp told her husband.

Although they had shied from autism support groups, now they yearned for somewhere to

fit in. Finally, Ms. Dopp called an acquaintance whose child had Down syndrome. She had heard of an organization in Britain called Unique that seeks to link families with rare chromosomal disorders.

Ms. Dopp immediately sent away for the registration material. In the packet she received were the e-mail addresses of six other 7q11.23 families.

Jackson, she learned, was one of 11 known children in the world with the DNA duplication. The Dopps were the only one of those families in Utah. She wanted to meet them all. But for now, there was e-mail.

"We have seen occupational therapists, physical therapists, geneticists, speech therapists, neurology, cardiology and eye doctors," Ms. Dopp wrote. "Have you found certain therapies that work better than others? What doctors have you seen? Do you have any issues with intestinal problems, behavior, autism?"

She could not type fast enough.

## Taygen: The Meeting

The genetic counselor at the University of Louisville Hospital put Gaylene Napier and Heather Lane in touch. The deletion of DNA on their daughters' 16th chromosome had never before been detected.

In the fall, pictures of the girls would appear in a scientific journal: "Discovery of a previously unrecognized microdeletion syndrome of 16p11.2—p12.2."

The first time the mothers spoke, they stayed on the phone for hours.

Taygen was learning to hop, Ms. Lane, an office administrator, told Ms. Napier. Her occupational therapy was going well. Then Ms. Lane blurted out what she never said to other mothers.

"I just hate that she has to struggle to do things that we all take for granted," she said.

The Lanes live in Benton, in western Kentucky. The Napiers live in Berea, on the other side of the state. Immediately, they made plans to meet at Beech Bend, an amusement park in the middle.

Ms. Lane stayed in a hotel room nearby the night before with her husband, Dustin, and her mother, Debbie Duckett.

As Sami and Taygen rode the carousel together, Ms. Duckett peppered Ms. Napier with questions.

Was Sami sensitive to small noises? Even a cough or a sneeze can make Taygen shudder.

Sami, Ms. Napier said, makes her unplug the clock every night because she cannot stand the ticking.

Taygen is often sweet and then nasty in bewildering succession.

Sami slaps you and then hugs you, Ms. Napier said. You never know what is coming next.

Taygen does not cry when she is hurt.

Neither does Sami.

They had started trying to potty train Taygen. Sami, Ms. Napier said, had learned when she was 7.

The head-banging and rocking had tapered off for Sami when she was a few years older than



Taygen, Ms. Napier said. But she still had painful constipation.

“Oh,” Ms. Duckett sighed. “I hoped she was going to grow out of that.”

Ms. Lane could not take her eyes off Sami. She did not want to miss any detail.

The 14-year-old Sami wore slip-on shoes, because she could not tie laces. When she was concentrating, she hooked the tip of her index finger onto her bottom front teeth and kept it there.

After splashing in the kiddie pool, Sami curled up in her mother’s lap as Ms. Napier wrapped her in a towel. Later, Ms. Napier wiped her face as ice cream dribbled down her chin.

But she was different from Taygen. Sami had been given a diagnosis of mild retardation. Not Taygen, who had had speech therapy and physical therapy starting at nine months.

Sami could count only to 14, and was just learning her colors. Taygen knew all of her colors, though there were certain numbers, like “3,” that she refused to say.

It got easier, Ms. Napier, a factory inspector, told them. Sami has fewer tantrums. She had just recently learned her letters, matching each one to a person she loved. “J” for “Jessica,” her sister. “C” for “Carey,” her cousin.

Ms. Duckett asked Ms. Napier if Sami had started her period. They had wondered if Taygen would be able to have children.

She had, Ms. Napier said, right on schedule.

But did she think, Ms. Duckett persisted, that Sami would ever grow up and lead a normal life — have a home, a job, a car? “Or do you think these kids will always be at home?”

Ms. Napier looked at her. “I don’t know,” she said.

On the way home, Mr. Lane told his wife that he was sorry for Sami. Later, he cried. He hated to think, he said, that Taygen would be like her one day.

But they knew so much more than Ms. Napier had, Ms. Lane told him. Who was to say that Taygen would be just like Sami? “Besides,” she said. “Sami is

happy. She doesn't know there's anything wrong."

The following week, Mr. Lane moved out. It had nothing to do with the visit, he said. He said he had been unhappy for years.

"Do you think we scared him?" Ms. Napier asked Ms. Lane when they next spoke. She herself had been divorced when Sami was about Taygen's age.

Maybe, Ms. Lane said. But then, weren't they all scared?

Ms. Napier sent pictures of the girls from that visit. Ms. Lane keeps her favorite one on her desk.

## Noa: The Tribe

The hotel atrium was teeming with 22q13 children. Some were flapping or crawling on the floor. Some were in wheelchairs or oversize strollers. Others were in their parents' arms. They were making sounds like Noa made, a guttural growl hovering on the edge of language, the kind of sound that made Noa's father, Jim Ospenson, yearn all the more to hear her voice.

Noa, now age 4, does not speak.

In the month since Noa had been designated "22q13," her parents, Mr. Ospenson and Meryl Perlson, had already found two other children with the same chromosomal deletion.

They had read the Web site, recently assembled by the 22q13 Deletion Foundation, whose numbers were growing rapidly along with the accuracy of DNA diagnoses.

And then they went to the biennial meeting of 22q13 families in July 2006. But that first day, in Greenville, S.C., they wondered if they had made a mistake.

Few of the children, even the handful of teenagers, were toilet trained. Some had never gained the use of their hands, which had stiffened into a claw-like shape. Many were chewing on rubber tubes or "chew rags," to keep them from shredding their clothes.

Ms. Perlson, a communications consultant, and Mr. Ospenson, a computer analyst, attend-

ed sessions on one of the genes that Noa is missing, which codes for a protein crucial to neurological development. They learned about the health problems, like seizures and kidney failure, that Noa might face in her 20s. The window onto her future was hard to digest.

But outside the lecture rooms,

they found, unexpectedly, that they were enjoying themselves. Ms. Perlson's mother, Claire Briller, made friends with Morton, a chunky 10-year-old who grabbed at passers-by from his wheelchair and tried to hold their hand. His parents had come from Denmark, and the family spoke little English. But on a



ERIK JACOBS FOR THE NEW YORK TIMES

At a meeting in Norton, Mass., for families of children with disorders at 22q13, from left, Joey Pedraza, Luis Pedraza, Noa Ospenson and Olivia Lockaby-Cotter.

number of occasions, Ms. Briller walked with Morton through the halls as he held tight to her arm. “I felt attached to him, like he was the same as Noa,” she told her daughter.

In the area behind the hotel, Mr. Ospenson watched another father play catch with his older son as his 22q13 son roamed around the grass. At the bar on the second evening, Ms. Perlson sat with a group of mothers. One told a story about being pulled over by a state police officer while speeding. In her car were several large packages of adult diapers, the size her 22q13 child now wore. The police officer did not seem to want to contemplate the explanation. He waved her on.

Everyone laughed. And for the first time that weekend, Ms.

Perlson did, too. “Oh, my God,” she thought, “maybe this is going to be O.K.”

The next day, Mr. Ospenson and Ms. Perlson watched Noa play on the floor with several other children. Some of them, because of the low muscle tone associated with the syndrome, flopped over. They all had the hallmark appearance of the syndrome, the flaky toenails, puffy eyes and cheeks, long eyelashes.

Looking at them, Mr. Ospenson said, made him think less about 22q13 for a moment than about how such a tiny bit of missing DNA could make such a big difference in how humans work.

He found himself looking forward, he said, “to seeing those kids grow up alongside my own.” □

---

---

The New York Times

**[www.nytimes.com/health](http://www.nytimes.com/health)**



BEN GARVIN FOR THE NEW YORK TIMES

Victoria Grove sometimes wears a mask against infection, knowing its added danger for her.

# Insurance Fears Lead Many To Shun DNA Tests

By **AMY HARMON**

PUBLISHED: FEBRUARY 24, 2008

**V**ICTORIA Grove wanted to find out if she was destined to develop the form of emphysema that ran in her family, but she did not want to

ask her doctor for the DNA test that would tell her.

She worried that she might not be able to get health insurance, or even a job, if a genetic predisposition showed up in her medical records, especially since

treatment for the condition, alpha-1 antitrypsin deficiency, could cost over \$100,000 a year. Instead, Ms. Grove sought out a service that sent a test kit to her home and returned the results directly to her.

Nor did she tell her doctor when the test revealed that she was virtually certain to get it. Knowing that she could sustain permanent lung damage without immediate treatment for her bouts of pneumonia, she made sure to visit her clinic at the first sign of infection.

But then came the day when the nurse who listened to her lungs decided she just had a cold. Ms. Grove begged for a chest X-ray. The nurse did not think it was necessary.

“It was just an ongoing battle with myself,” recalled Ms. Grove, of Woodbury, Minn. “Should I tell them now or wait till I’m sicker?”

The first, much-anticipated benefits of personalized medicine are being lost or diluted for many Americans who are

too afraid that genetic information may be used against them to take advantage of its growing availability.

In some cases, doctors say, patients who could make more informed health care decisions

---

The ability to more effectively prevent and treat genetic disease is faltering even as the means to identify risks people are born with are improving.

---

if they learned whether they had inherited an elevated risk of diseases like breast and colon cancer refuse to do so because of the potentially dire economic consequences.

Others enter a kind of genetic underground, spending hundreds or thousands of dollars of their own money for DNA tests

that an insurer would otherwise cover, so as to avoid scrutiny. Those who do find out they are likely or certain to develop a particular genetic condition often beg doctors not to mention it in their records.

Some, like Ms. Grove, try to manage their own care without confiding in medical professionals. And even doctors who recommend DNA testing to their patients warn them that they could face genetic discrimination from employers or insurers.

Such discrimination appears to be rare; even proponents of federal legislation that would outlaw it can cite few examples of it. But thousands of people accustomed to a health insurance system in which known risks carry financial penalties are drawing their own conclusions about how a genetic predisposition to disease is likely to be regarded.

As a result, the ability to more effectively prevent and treat genetic disease is faltering even as the means to identify risks peo-

ple are born with are improving.

“It’s pretty clear that the public is afraid of taking advantage of genetic testing,” said Dr. Francis S. Collins, director of the National Human Genome Research Institute at the National Institutes of Health. “If that continues, the future of medicine that we would all like to see happens stands the chance of being dead on arrival.”

## Caught in a Bind

For Ms. Grove, 59, keeping her genetic condition secret finally became impossible. When her symptoms worsened she was told to come back to the clinic before antibiotics would be prescribed. But there had been a snowstorm that day, and she could not summon the strength to drive.

“I have alpha-1,” she remembers sobbing into the phone. “I need this antibiotic!”

The clinic called in the prescription.

Ms. Grove, who does freelance accounting from home and has

health insurance through her husband's employer, allowed herself to be identified here because she said she felt an obligation to others — including some in her own family — to draw attention to the bind she sees herself in.

“Something needs to be done so that you cannot be discriminated against when you know about these things,” she said. “Otherwise you are sicker, your life is shorter and you're not doing what you need to protect yourself.”

Employers say discrimination is already prohibited in the workplace by the Americans with Disabilities Act and existing laws governing privacy of medical records. But employee rights advocates say nothing in those laws explicitly prevents employers hard-pressed to pay for mounting health care costs from trying to screen out employees they know are more likely to get sick.

Courts have yet to rule on the subject. When the Equal Employment Opportunities Commission sued the Burlington

Northern Santa Fe Railway for secretly testing the blood of employees who had filed compensation claims for carpal-tunnel syndrome in an effort to discover a genetic cause for the symptoms, the case was settled out of court in 2002.

And in 2005 when Eddy Curry, then the center for the Chicago Bulls, refused a genetic test to learn if he was predisposed to a heart ailment, the team traded him to the New York Knicks.

Insurers say they do not ask prospective customers about genetic test results, or require testing. “It's an anecdotal fear,” said Mohit M. Ghose, a spokesman for America's Health Insurance Plans, whose members provide benefits for 200 million Americans. “Our industry is not interested in any way, shape or form in discriminating based on a genetic marker.”

Still, a recent study by the Georgetown University Health Policy Institute found otherwise. In 7 of 92 underwriting decisions, insurance providers evaluating hypothetical applicants said they



would deny coverage, charge more for premiums or exclude certain conditions from coverage based on genetic test results.

## The Medical Cost

Regardless of whether discrimination actually occurs, many health care professionals say the pervasive anxiety over it demands legislative action. Geneticists complain that discrimination fears prevent them from recruiting research participants, delaying cures and treatments for disease. At Memorial Sloan-Kettering Cancer Center in New York, the same concern is a leading reason people cancel appointments for tests that detect cancer risk.

“We are dealing with potential lifesaving interventions,” said Dr. Kenneth Offit, chief of the center’s clinical genetics service. “It’s a tragedy that people are being scared off by this.”

The Genetic Information Nondiscrimination Act, which passed the House of Representatives by a wide margin last year,

would prohibit insurers from using genetic information to deny benefits or raise premiums for both group and individual policies. (It is already illegal to exclude individuals from a group plan because of their genetic profile.) The bill would also bar employers from collecting genetic information or using it to make decisions about hiring, firing or compensation. But it has yet to reach the Senate floor.

Meanwhile, a \$300 genetic test for prostate cancer risk announced last month immediately drew callers to a public radio station in Washington that was discussing the test, voicing fears of insurance discrimination. Dr. Karim Kader, who made the test possible with his discovery that men who carry certain DNA variants are four to five times likelier to develop prostate cancer, assured one caller that the test would be “very private.”

For some, that is not good enough.

Linda Vahdat, director of the breast cancer research program

at New York-Presbyterian Hospital/Weill Cornell Medical Center, estimates that 20 percent of her patients choose to pay for the DNA test for inherited breast cancer risk with cash, to avoid submitting insurance claims.

And last year, hundreds of customers paid the start-up company DNA Direct for tests that range in cost from \$175 to \$3,456 to ensure that no third party, not even a doctor, had access to their results. Mary, a freelance camera assistant in Brooklyn, for instance, sent a swab of her cheek cells to DNA Direct to find out if her extreme fatigue was caused by hemochromatosis, a genetic condition in which the body retains too much iron.

"I would rather not lay out the \$200 myself," said Mary, who requested that her last name be withheld for the same reason she paid for her own test. "But it seemed safer."

Treatment for hemochromatosis typically involves removing a unit of blood twice-weekly by phlebotomy. But that would mean

disclosing the condition to a doctor, so Mary is planning on becoming a frequent blood donor.

Kathy, a financial analyst in Houston who would like to know if she, like her two sisters, has a genetic predisposition to breast cancer, said she was not going to take even an anonymous test. "Then," she said, "I'm just in a position of having to lie."

The culture of secrecy around genetic information is stronger in the United States, some experts say, than in countries where people are guaranteed health care. Among Americans at risk for Huntington's disease, an incurable brain disorder, only 5 percent take the DNA test to determine if they will develop it, compared with 20 percent of Canadians in the same position, according to Michael R. Hayden, a professor of human genetics at the University of British Columbia in Vancouver.

Here, doctors often feel obligated to inform patients of the potential financial downside.

"I always warn them," said Dr. Stephen Moll, director of the



BRENDAN SMIALOWSKI FOR THE NEW YORK TIMES

Katherine Anderson, seen in a checkup last week, developed a blood clot last year partly due to an undiagnosed genetic condition.

Thrombophilia Program at the University of North Carolina, who uses a genetic test to determine the best treatment for patients with blood clots. “Especially if they are self-employed, I don’t want it to be a surprise if their health insurance premium goes up.”

### Unknown Risks

After receiving a similar warning from her doctor, Katherine

Anderson’s parents did not allow her to be tested for Factor V Leiden, a genetic condition she might have inherited from her father that increases the risk of blood clots.

But last year, with nothing in Ms. Anderson’s record to indicate reason for concern, a gynecologist prescribed a birth control pill to regulate her uneven periods. Six weeks later, Ms. Anderson, then 16, developed

a clot that stretched from her knee to her abdomen. The pill, combined with the gene she had indeed inherited, had increased her clotting risk by 30-fold.

Now largely recovered, her primary concern is whether she will be viewed as a health insurance liability for the future.

“I don’t want to have to work for a big business just to get insurance,” she said. “This could be determining what I can do for my whole life.”

For Judith Berman Carlisle, the price of privacy was forgoing the DNA test that would have convinced her not to have surgery. Ms. Carlisle, 48, who was setting up her own therapy practice, was afraid testing positive for the high-risk breast and ovarian cancer gene that runs in her family would prevent her from buying health insurance.

But her sister had developed ovarian cancer the year before, an aunt had died of it, and Ms. Carlisle was desperate not to get it herself. Her doctor agreed to remove her ovaries based on her

family history — the way such decisions were commonly made before a genetic test was available.

Ms. Carlisle was convinced the surgery would be less damning than proof that she carried a defective BRCA1 gene, which also confers a very high chance of developing breast cancer.

“There’s a big difference between someone saying, ‘I have a strong family history,’ ” Ms. Carlisle said, “and saying, ‘I only have a 13 percent chance of not getting breast cancer during the time you’re insuring me.’ ”

Last fall, after the surgery to remove her ovaries, she began to consider a double mastectomy to remove any chance of breast cancer, the disease her grandmother and another aunt had died of. Having secured health insurance, she took the test for the BRCA1 mutation. It came back negative.

“The first thing they said to me,” Ms. Carlisle said, “is that I have no higher risk than anyone on the street.” □



FRED MERZ FOR THE NEW YORK TIMES

Dan Stoicescu is paying a company to map his genome.

# Personal Gene Map Becomes A Luxury Item

By **AMY HARMON**

PUBLISHED: MARCH 4, 2008

**O**N a cold day in January, Dan Stoicescu, a millionaire living in Switzerland, became the second person in the world to buy the full sequence of his own genetic code.

He is also among a relatively small group of individuals who could afford the \$350,000 price tag.

Mr. Stoicescu is the first customer of Knome, a Cambridge-based company that has promised to parse his genetic

blueprint by spring. A Chinese executive has signed on for the same service with Knome's partner, the Beijing Genomics Institute, the company said.

Scientists have so far unraveled only a handful of complete human genomes, all financed by governments, foundations and corporations in the name of medical research. But as the cost of genome sequencing goes from stratospheric to merely very expensive, it is piquing the interest of a new clientele.

"I'd rather spend my money on my genome than a Bentley or an airplane," said Mr. Stoicescu, 56, a biotechnology entrepreneur who retired two years ago after selling his company. He says he will check discoveries about genetic disease risk against his genome sequence daily, "like a stock portfolio."

But while money may buy a full readout of the six billion chemical units in an individual's genome, biologists say the super-rich will have to wait like everyone else to learn how the small

variations in their sequence influence appearance, behavior, abilities, disease susceptibility and other traits.

"I was in someone's Bentley once — nice car," said James D. Watson, the co-discoverer of the structure of DNA, whose genome was sequenced last year by

---

'I'd rather spend my  
money on my genome  
than a Bentley.'

---

a company that donated the \$1.5 million in costs to demonstrate its technology. "Would I rather have my genome sequenced or have a Bentley? Uh, toss up."

He would probably pick the genome, Dr. Watson said, because it could reveal a disease-risk gene that one had passed on to one's children, though in his case, it did not. What is needed, he said, is a "Chevrolet genome" that is affordable for everyone.

Biologists have mixed feel-

ings about the emergence of the genome as a luxury item. Some worry that what they have dubbed “genomic elitism” could sour the public on genetic research that has long promised better, individualized health care for all. But others see the boutique genome as something like a \$20 million tourist voyage to space — a necessary rite of passage for technology that may soon be within the grasp of the rest of us.

“We certainly don’t want a world where there’s a great imbalance of access to comprehensive genetic tests,” said Richard A. Gibbs, director of the human genome sequencing center at Baylor College of Medicine. “But to the extent that this can be seen as an idiosyncratic exercise of curious individuals who can afford it, it could be quite a positive phenomenon.”

It was the stream of offers from wealthy individuals to pay the Harvard laboratory of George M. Church for their personal genome sequences

that led Dr. Church to co-found Knome last year (most people pronounce it “nome,” though he prefers “know-me”).

“It was distracting for an academic lab,” Dr. Church said. “But it made me think it could be a business.”

Scientists say they need tens of thousands of genome sequences to be made publicly available to begin to make sense of human variation.

Knome, however, expects many of its customers to insist on keeping their dearly bought genomes private, and provides a decentralized data storage system for that purpose.

Mr. Stoicescu said he worried about being seen as self-indulgent (though he donates much more each year to philanthropic causes), egotistical (for obvious reasons) or stupid (the cost of the technology, he knows, is dropping so fast that he would have certainly paid much less by waiting a few months).

But he agreed to be identified to help persuade others to

participate. With only four complete human genome sequences announced by scientists around the world — along with the Human Genome Project, which finished assembling a genome drawn from several individuals at a cost of about \$300 million in 2003 — each new one stands to add considerably to the collective knowledge.

“I view it as a kind of sponsorship,” he said. “In a way you can also be part of this adventure, which I believe is going to change a lot of things.”

Mr. Stoicescu, who has a Ph.D. in medicinal chemistry, was born in Romania and lived in the United States in the early 1990s before founding Sindan, an oncology products company that he ran for 15 years. Now living with his wife and 12-year-old son in a village outside Geneva, he describes himself as a “transhumanist” who believes that life can be extended through nanotechnology and artificial intelligence, as well as diet and lifestyle adaptations. His

genome sequence, he reasons, might give him a better indication of just what those should be. Last fall, Mr. Stoicescu paid \$1,000 to get a glimpse of his genetic code from deCODE Genetics. That service, and a similar one offered by 23andMe, looks at close to a million nucleotides on the human genome where DNA is known to differ among people.

But Mr. Stoicescu was intrigued by the idea of a more complete picture. “It is only a part of the truth,” he said. “Having the full sequence decoded you can be closer to reality.”

How close is a matter of much debate. Knome is using a technology that reads the genome in short fragments that can be tricky to assemble. All of the existing sequencing methods have a margin of error, and the fledgling industry has no agreed-on quality standards.

Knome is not the only firm in the private genome business. Illumina, a sequencing firm in San Diego, plans to sell whole ge-



nome sequencing to the “rich and famous market” this year, said its chief executive, Jay Flatley. If competition drives prices down, the personal genome may quickly lose its exclusivity. The nonprofit X Prize Foundation is offering \$10 million to the first group to sequence 100 human genomes in 10 days, for \$10,000 or less per genome. The federal government is supporting technology development with an eye to a \$1,000 genome in the next decade.

But for now, Knome’s prospective customers are decidedly high-end. The company has been approached by hedge fund managers, Hollywood executives and an individual from the Middle East who could be contacted only through a third party, said Jorge Conde, Knome’s chief executive.

“I feel like everyone’s going to have to get it done at some point, so why not be one of the first?” said Eugene Katchalov, 27, a money manager in Manhattan who has met with Mr. Conde twice.

Mr. Stoicescu, who wants to create an open database of genomic information seeded with his own sequence, hopes others will soon join him.

A few days after he wired his \$175,000 deposit to the company, a Knome associate flew in from Cambridge to meet him at a local clinic.

“What the heck am I doing?” Mr. Stoicescu recalls wondering. “And how many children in Africa might have been fed?”

Then he offered up his arm and gave her three test tubes of his blood. □

---

---

The New York Times

**[www.nytimes.com/health](http://www.nytimes.com/health)**

# Lawyers Fight DNA Samples Gained on Sly

By **AMY HARMON**

PUBLISHED: APRIL 3, 2008

**T**HE two Sacramento sheriff detectives tailed their suspect, Rolando Gallego, at a distance. They did not have a court order to compel him to give a DNA sample, but their assignment was to get one anyway — without his knowledge.

Recently, the sheriff's cold case unit had extracted a DNA profile from blood on a towel found 15 years earlier at the scene of the murder of Mr. Gallego's aunt. If his DNA matched, they believed they would finally be able to close the case.

On that spring day in 2006, the detectives watched as Mr. Gallego lit a cigarette, smoked it and threw away the butt. That was all they needed.

The practice, known among law enforcement officials as "surreptitious sampling," is

growing in popularity even as defense lawyers and civil liberties advocates argue that it violates a constitutional right to privacy. Mr. Gallego's trial on murder charges, scheduled for next month, is the latest of several in which the defense argues that the police circumvented the Fourth Amendment protection against unreasonable search and seizure.

Critics argue that by covertly collecting DNA contained in the minute amounts of saliva, sweat and skin that everyone sheds in the course of daily life, police officers are exploiting an unforeseen loophole in the requirement to show "probable cause" that a suspect has committed a crime before conducting a search.

"The law cannot tolerate such back-door methods, which seize something that any reasonable person expects to remain pri-

vate,” Mr. Gallego’s lawyer, David Lynch, wrote in a motion to suppress the DNA evidence extracted from the cigarette butt.

The privacy implications of surreptitious DNA sampling may extend beyond individual investigations. The police, critics say, could collect DNA deemed “abandoned” from targeted individuals and monitor their movements even if they are not suspected of committing a serious crime. Innocent people whose DNA turns up unexpectedly may find themselves identified by a database file that they did not know existed.

“Police can take a DNA sample from anyone, anytime, for any reason without raising oversight by any court,” said Elizabeth E. Joh, a law professor at University of California, Davis, who studies the intersection of genetics and privacy law. “I don’t think a lot of people understand that.”

Law enforcement officials say they are just trying to solve crimes. Over the last few years, several hundred suspects have

been implicated by the traces of DNA they unwittingly shed well after the crime was committed, according to law enforcement officials. Many more have been eliminated from suspicion without ever knowing that their coffee cups, tissues, straws, utensils and cigarette butts were subject

---

## An invasion of privacy to some is good police work to others.

---

to DNA analysis by the police.

“It’s a great tool,” said Micki Links, a sergeant in the Sacramento sheriff’s homicide division. “Our hands are tied on a lot of things as far as what we can do and what we can search, so when we find something that’s within the law, we’re going to use it.”

Sometimes the police dupe suspects into relinquishing their genetic identity by offering them a Coke during a routine in-

interview and picking up the can. In Buffalo last year, undercover police waited until Altemio Sanchez, suspected of strangling and raping several women over a quarter-century, paid the check and left after dinner with his wife at a local restaurant before confiscating his glass. He later admitted killing three women and received a life sentence.

Variations on the technique are multiplying as the adoption of DNA processing technology lets crime laboratories derive a full profile from ever smaller amounts of biological material at relatively low cost.

In Mr. Gallego's case, the detectives first checked the DNA extracted from the blood on the towel against the F.B.I. database of some 4 million convicted offenders. Finding no match, they turned to suspects in the unsolved murder of Leticia Estores, a hairdresser. Mr. Gallego, 49, was among them.

They could have asked a judge for a search warrant to compel him to give them a DNA swab,

but there was no guarantee that the judge would agree. Also, Mr. Gallego had passed a lie detector test in which he denied any involvement in the murder, and had they asked him to volunteer a sample, he might have refused.

Instead, the supervising detective ordered "the surreptitious collection of a DNA sample," according to his report.

Some legal experts advocate curbs on surreptitious sampling. Albert E. Scherr, a professor at Franklin Pierce Law Center in Concord, N.H., who has a grant from the National Institutes of Health to study the practice, suggests that the police be required to meet the "reasonable suspicion" standard before secretly collecting DNA. "You're not asking them to let criminals go free," he said. "You're just asking them to investigate a little more."

In the meantime, anyone with something to hide might want to keep in mind a recent decision by the Massachusetts Court of

Appeals, which admitted as evidence DNA collected after a suspected rapist spit on the street.

“We conclude that under the circumstances, the expectorating defendant had no reasonable expectation of privacy in his spittle,” the court ruled, “or in the DNA evidence derived therefrom.”

The United States Supreme Court has yet to address whether there are constitutional limits on the covert collection of DNA. But with a few exceptions, lower court judges in over a dozen recent cases have ruled that DNA clinging to water bottles left in interrogation rooms, on restaurant glassware and on those ubiquitous cigarette butts are fair game for police inspection.

“There is no subjective expectation of privacy in discarded genetic material, just as there is no subjective expectation of privacy in fingerprints or footprints left in a public place,” Washington State’s Supreme Court wrote last year in denying an appeal by John N. Athan, whose murder

conviction was based on surreptitiously collected DNA. Seattle police detectives posing as a law firm sent Mr. Athan a letter on fake stationery, asking him to join a lawsuit to recover overcharged parking tickets, of which they knew he had had many. DNA from saliva on the envelope that he sent back matched a semen sample from the 1982 murder and rape of a 13-year-old Seattle girl.

In a dissenting opinion, Justice Mary E. Fairhurst argued that the fingerprint analogy was inappropriate, because Mr. Athan’s DNA “provided the government with vast amounts of intimate information beyond mere identity” including race, gender, predisposition to disease and, perhaps, forms of conduct.

But Tim Bradshaw, a senior prosecuting attorney in King County, Wash., who worked on the case, said he had received calls from prosecutors around the country eager to employ a similar DNA ruse. (Courts generally allow the police to use all

sorts of deception to obtain evidence from people they suspect of committing crimes.)

“The success of it has emboldened investigators, and it should,” Mr. Bradshaw said. “Just because something is very clever doesn’t make it illegitimate.”

In Los Angeles, a Superior Court judge last year rejected a motion by attorneys for a suspected serial killer, Adolph Laudenberg, to suppress DNA evidence that the police had acquired by inviting him to a doughnut shop to discuss an unrelated case. One detective set aside Mr. Laudenberg’s Styrofoam coffee cup, and an undercover officer retrieved it.

Several court opinions on surreptitious sampling cite the United States Supreme Court decision in *California v. Greenwood*, which held that the Fourth Amendment did not apply when the police searched trash bags left on the curb by a suspected narcotics dealer.

But the Greenwood analogy, critics of surreptitious sampling

argue, ignores that most people have no idea that they risk surrendering their genetic identity to the police by, for instance, failing to destroy a used coffee cup. Moreover, even if they do realize it, there is no way to avoid abandoning one’s DNA in public, short of living in a bubble.

“Unlike garbage that can be withheld or destroyed before it is released into the world,” reads the motion to suppress the DNA evidence in the Gallego case, “we cannot do so with our biological tissues.”

A few courts have found that certain forms of surreptitious sampling do violate the Fourth Amendment.

DNA from a water bottle given to a suspected rapist, for instance, was deemed inadmissible in an Iowa court because a police officer had swapped the suspect’s water with a similar bottle when the man went to the bathroom. He retained a reasonable expectation of privacy, the court ruled, because he had not “abandoned” it.

And last year, the North Carolina Court of Appeals ordered a new trial for Blake J. Reed, a convicted burglar, because a police officer kicked a cigarette butt off his patio and later picked it up. The court said Mr. Reed had an expectation of privacy at home.

Suspects may be wising up.

After smoking another cigarette on the patio, Mr. Reed took apart the butt, removed the filter's wrapper and shredded it, according to court documents. He had seen the popular television show "CSI," where DNA often nails the suspect, he told the detective. Then he placed the remains in his pocket. □

## **In the world of second opinions, get the facts first.**

Authoritative, in-depth information on thousands of health and fitness topics. Plus expert advice, blogs, reader discussions and more.

**The New York Times**  
**[nytimes.com/health](http://nytimes.com/health)**

All the news that's fit to click.

