

Replicating research: Mid-Atlantic Twin Registry helps inform science and advance human health for more than 40 years

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Fraternal twins Cathy, left, and Christine Davison have participated in twin studies through the Mid-Atlantic Twin Registry since early childhood. Credit: Virginia Commonwealth University

When twins Cathy and Christine Davison were 9 years old, Virginia Commonwealth University researchers attached electrodes to their arms and asked them a series of increasingly difficult math questions. "Then they had us run on a treadmill with the electrodes," Cathy recently recalled, 25 years after the test. By that point, the twins were already regular participants in studies and had grown accustomed to the odd requests of researchers, who on another occasion had allowed them to drink more sugary soda than their parents would ever permit, later collecting their urine in plastic cups.

Sometimes researchers visited the [twins](#) at their home in Spotsylvania County.

"They would ask us a ton of questions about our thoughts and feelings," Cathy said.

"If you ever said yes," Christine said, "there would be a zillion follow-up questions."

The fraternal twins, now 34 years old, have participated in twin studies through the [Mid-Atlantic Twin Registry](#) since early childhood. The registry, which is located at the Virginia Biotechnology Research Park on VCU's MCV campus, is one of the largest twin databases in the world. For more than four decades, researchers have been working with MATR twins to uncover the roots of psychiatric and physical conditions.

"Twin studies help us gain insight into why people manifest certain traits," said Judy Silberg, Ph.D., scientific director for MATR and a clinical psychologist. Equipped with a better understanding of how certain traits are influenced by genes and the environment, scientists gain insight that may improve disease treatment and prevention as well as contribute to the understanding of what drives human behaviors. As home to the MATR, VCU provides an international resource to

researchers dedicated to improving human health around the world, while offering a collaborative learning environment for students who want to engage in real-world research.

"Twin studies contribute to generalizable knowledge," Christine said of her motivation for continuing to participate in studies throughout her life. "They help inform science."



Cathy, left, and Christine Davison, age 7, standing in the front yard of their childhood home in Spotsylvania County. Credit: Virginia Commonwealth University

The scientific method

Among their chief benefits, twin studies help reveal how much someone's susceptibility to a disease is influenced by genes versus the environment. "Twins are a natural experiment," Silberg said.

Identical twins arise from the same fertilized egg, so they share duplicated genetic material and have predominantly shared environments during childhood. Fraternal twins are genetically no more alike than ordinary siblings, sharing about half their genes, but typically experiencing a shared environment during their upbringing that is similar to that of [identical twins](#). The comparison of identical versus fraternal twins provides researchers with estimates of the influence of genetic and environmental factors. If genes are important, researchers would expect identical twins to be more similar than fraternal twins.

Identical twins also represent a powerful genetic control for understanding the influence of the environment. Since they are genetically identical, differences between identical twins indicate non-genetic effects.

Silberg recently utilized a twin design to understand the effect of bullying victimization on psychiatric outcomes in children and young adults. "We found a genuine environmental impact of bullying based on differences in outcomes in the identical twins," she said. "The identical twin that had been bullied had a significantly higher rate of suicidal

thinking in young adulthood compared to their identical twin who was not bullied." Results from the study were published in a recent issue of the journal *Psychological Medicine*.

"When we understand the contribution of genes and environment, we can then start to understand how to intervene in improving people's lives," Silberg said.



"Twin studies contribute to generalizable knowledge," said Christine Davison, right. "They help inform science.". Credit: Virginia Commonwealth University

Historically innovative

The origins of the MATR date to the mid-1970s, when Walter Nance, M.D., Ph.D., and Linda Corey, Ph.D., of VCU established the Virginia Twin Registry. The two doctors obtained records of twin and higher order multiple births in the state from the Virginia Department of Health's Division of Vital Records. In the early '90s, Lenn Murrelle, Ph.D., of the University of North Carolina at Chapel Hill established the North Carolina Twin Registry. Murrelle joined VCU's Department of Human Genetics in 1995. In 1997, the VTR and NCTR merged into one registry, which is now the MATR. In 1998, twin data from South Carolina was added to the MATR. The institution became a part of VCU's Office of Research in 2006.

The registry now contains a population-based record of more than 60,000 twin pairs of all ages and backgrounds who are largely from Virginia, North Carolina and South Carolina. It also contains higher order multiples such as triplets, quadruplets and quintuplets. Last year the registry started a blood repository that contains DNA samples provided by more than 1,500 twins. "When you have DNA on people, you can go back to them and conduct assessments," Silberg said, adding that students often draw on data from previous twin studies to carry out research projects. "We are very supportive of students. The MATR and the research investigators are both invested in the development of young researchers."

The bulk of the work done at the MATR is in updating the registry and recruiting twins for study participation. "There is a tremendous industry involved in getting the word out to people and making them feel that their participation is important scientifically," Silberg said. "The biggest challenge is finding people, but once we are able to reach them, the rates are good for participation." Once study participants are recruited, and the twins provide their consent, the MATR provides the twin families' contact information to the researchers, who subsequently conduct their studies independently.

MATR twins have contributed to research that has led to major findings in the national and international scientific and medical communities. MATR-based studies demonstrated that genetic factors account for more than half of the variation in obesity in both adult men and women. They also show that genes appear to influence depression in girls after the onset of puberty and that genetic factors account for stability of blood pressure from early to late adolescence.

Currently, the MATR is recruiting twins for the largest longitudinal neuroimaging study of human brain development ever launched. The National Institutes of Health's Adolescent Brain Cognitive Development study aims to relate brain development and neurobehavioral outcomes to various environmental variables, such as drug abuse. During the five-year study, participating twins will undergo MRI scans that screen for changes in brain structure and function. They will also take part in psychiatric interviews and answer questionnaires on academic achievements and cognition measurements.

"Studying twins provides an opportunity to separate genetic and environmental sources of individual differences in development," said co-principal investigator Michael C. Neale, Ph.D., professor of psychiatry and behavioral genetics in the VCU School of Medicine. Neale said that access to twins will permit researchers to test how people's experiences result in changes in brain structure and function.

While scientists have worked with MATR twins in the past to explore topics such as cardiovascular disease, diabetes and cancer, Silberg said there is currently great interest in research focused on the causes and effects of drugs, alcohol and smoking.

"Genetic studies of substance use are important," Silberg said. "Those studies are interesting because they center on the influence of genes and the interplay of genes and the environment. Findings from substance use

studies have major implications for psychiatry and help to identify people who are at genetic and environmental risk."

Provided by Virginia Commonwealth University

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