DOCTORS AND SCIENTISTS have long known that ADHD runs in families, and plenty of parents have suspected it. In fact, many parents first realize they might have ADHD after going through the process of their child's assessment.

The science of genetics

Genes play a role in everything that makes us individuals, from eye color to blood type to the likelihood we will get certain diseases—all our unique traits. Our DNA is made up of three billion pairs of amino acids, groups of which form the genes that contain the code for building our bodies. For the most part, genes are passed down to every human from his or her biological parents.

By collecting a small sample of blood, saliva, or cells from the inside of someone's cheek, scientists can learn about that person's genetic profile. Researchers can study our genome to see the genes that make up a human being. In a genome-wide scan, researchers compare the genomes of a large group of people who share a diagnosis such as ADHD with those of people without ADHD, and then identify which parts of the genome might be different. Those differences can suggest possible causes of the disorder.

Sometimes a small change in our genome can lead to a disease, other times large chunks of our genome may be changed. Think of a large book with many letters, words, sentences, paragraphs, and so on. Some diseases can arise when a single letter is misspelled; other times when an entire paragraph is missing or repeated. These changes can affect the way a gene functions and cause some unhelpful change in our biology. Scientists think that many such genetic changes might be involved in ADHD. These changes might all add up, helping us to explain why ADHD seems to be the extreme of a trait that everybody

THE GENETICS

by Russell Schachar, MD

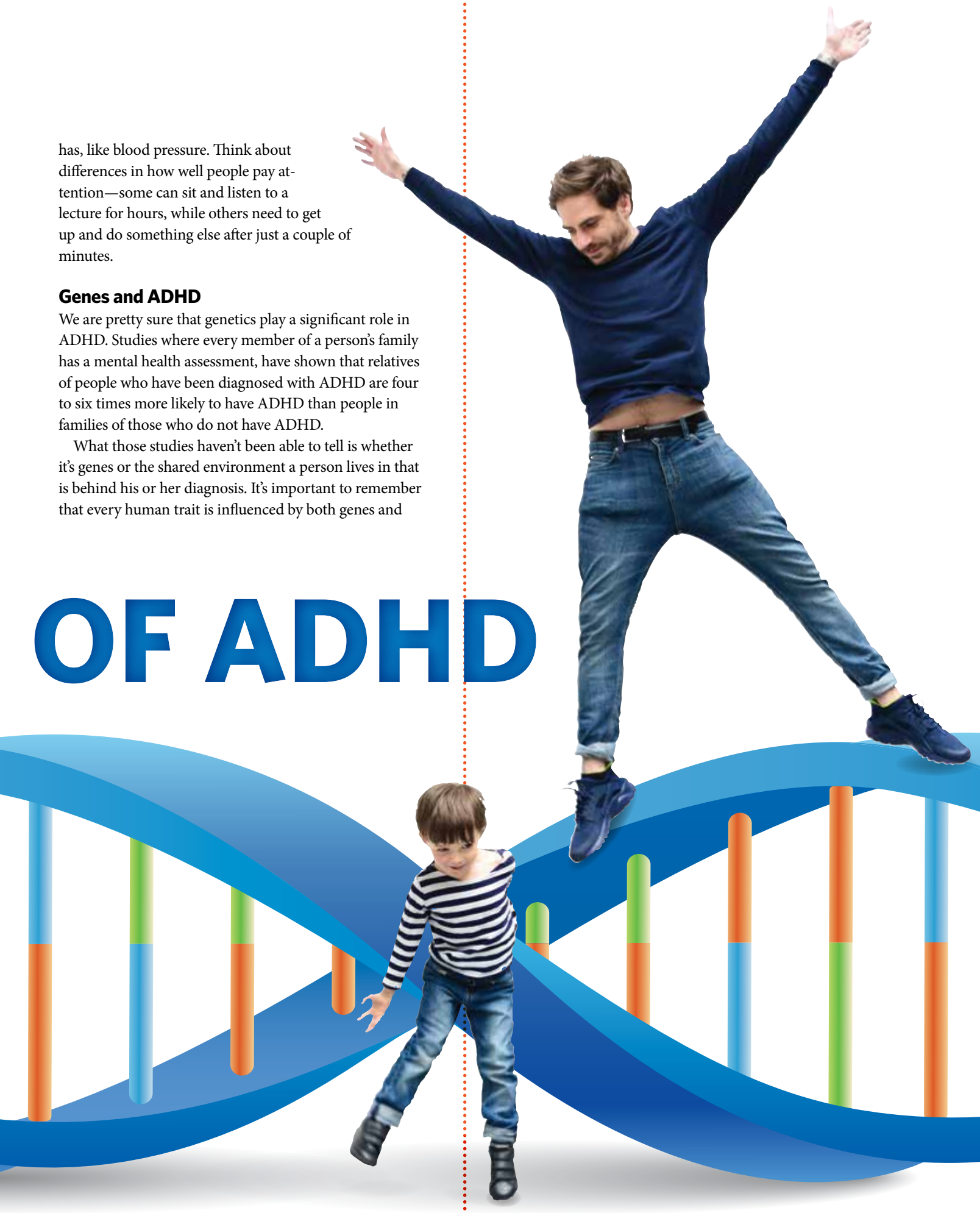
has, like blood pressure. Think about differences in how well people pay attention—some can sit and listen to a lecture for hours, while others need to get up and do something else after just a couple of minutes.

Genes and ADHD

We are pretty sure that genetics play a significant role in ADHD. Studies where every member of a person's family has a mental health assessment, have shown that relatives of people who have been diagnosed with ADHD are four to six times more likely to have ADHD than people in families of those who do not have ADHD.

What those studies haven't been able to tell is whether it's genes or the shared environment a person lives in that is behind his or her diagnosis. It's important to remember that every human trait is influenced by both genes and

OF ADHD



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environment, which can include everything from the quality of air a person breathes to the amount of light in their home. Family members share more than their genes.

If all human beings lived in exactly the same environment, we would know for certain that any differences among us were due entirely to genetics. On the flip side, if we all had the same genetic makeup, then any differences would be caused by environmental factors. One way to separate the genetic influences from the environmental influences is to compare identical (monozygotic, or originating from a single egg) and fraternal (dizygotic, or originating from two eggs) twins. Twin studies are a useful way to learn about genetics because identical twins share one hundred percent of their genes, while fraternal twins share only about fifty percent of theirs. If something like ADHD were genetic, then identical twins with ADHD would be more alike than fraternal twins. What twin studies have found is that seventy percent of the variation in ADHD traits is influenced by genes, and the remaining thirty percent is due to environmental factors. This means that ADHD is affected by both genetic and environmental factors and probably by the interaction between genetic and environmental factors. Some environments might protect people from genetic risk, while others might lead to the expression of that risk.

Scientists would now like to determine which genes are responsible for ADHD. Knowing that would make it easier for them to find medications or other treatments that work better, and for doctors to prescribe the best treatment for each person. They might also be able to predict who is likely to develop ADHD, as well as identify those whose ADHD symptoms might improve as they get older or even those who might respond to medications of various kinds. Finally, recognizing that not everyone who has the genes for any given condition will develop it, understanding the genetic risks might allow researchers to figure out which environmental factors matter.

What this means for you and your family

ADHD genetic studies provide some interesting information. First, the long-held belief that genetics plays a role in the development of ADHD is being confirmed. From a genetic perspective, ADHD is just as variable as height.

Another striking feature of these studies is the way the same genetic risks show up across disorders. ADHD seems to share genetic risks with major depressive disorder, autism spectrum disorder, and migraine headaches. So it may not be a coincidence when one person has several disorders. More research is needed, but shared genetic risks could help explain why ADHD is so often associated with other mental health and medical disorders.

Finally, researchers are finding people who have genetic variations that are often associated with ADHD, but who do not have ADHD. This might be proof that several interacting genes must be present before ADHD is triggered, or that environmental factors play a larger role in its development than the thirty percent figure that twin studies might lead one to believe. Genes and environments work together. The right environment might protect against a genetic tendency.

Genetic testing still can't tell someone whether they are at an increased risk for ADHD, although scientists are now working toward that goal. For now, genetic testing for the majority of people with a diagnosis of ADHD does not seem justified outside of the research environment.

Russell Schachar, MD, *is a practicing child and adolescent psychiatrist, a professor in the department of psychiatry at the University of Toronto. He is also senior scientist in the research institute at the Hospital for Sick Children in Toronto, Canada, where he holds the Toronto Dominion Bank Chair in child and adolescent psychiatry and heads a cognitive neurosciences laboratory which focuses on psychiatric disorders of childhood and adolescence. The lab consists of graduate students, technicians, and associate scientists with diverse expertise. Current projects are aimed at elucidating the genetic architecture of cognition and impulsivity in the general population, the genetics of ADHD and OCD, the neural basis of executive control and psychopathology through functional neuroimaging studies and investigations of the cognitive and behavioral consequences of traumatic brain injury, and treatment of acute lymphoblastic leukemia. Over the last five years, he has been principal investigator on $2.5 million of external grant funds and co-PI on $29 million dollars of grant funds. He has published 65 journal articles in the last six years. Dr. Schachar is a member of CHADD's professional advisory board.*

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