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There is no such thing as identical where twins are concerned

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Identical twins have identical genomes, but that is where it stops. There are subtle differences in their personalities, how they look, how they act and in their susceptibility to disease. How can this be?

It all depends on how the "epigenome" is modified by the environment, say scientists from Sydney's Garvan Institute of Medical Research and Queensland Medical Research Institute, who have just completed an 8-year study involving 512 adolescent twins (128 identical twin pairs, as well as 128 non-identical twin pairs), with an average age of 14.15 years.

More specifically, it depends on exactly how particular parts of the genome are affected by 'methylation', or the attachment of hydrocarbon molecules - 'methyl groups', that literally change the voice of the genome, silencing some genes and amplifying others.

Garvan epigeneticists Dr Marcel Coolen and Professor Susan Clark focused on the methylation profiles of a group of 'imprinted' genes that are important in the control of growth during early development. They found differences in the methylation profiles of these imprinted genes, even in genetically identical twins. It is these changes, they say, that probably give rise to differences we observe in identical twins. Their findings are published in the International journal *PLoS One*, now online.

"The aim of our study was to understand what role genetics plays in determining who we are, versus the role of environmental factors," said project leader Professor Susan Clark.

"We compared genetically related people with genetically identical people, seeing how closely their methylation patterns matched."

"Our findings support the hypothesis that changes in methylation reflect the interplay between the environment and genetics."

"We showed that methylation patterns are exquisitely inherited, and so the methylation patterns of identical twins are still very similar to each other. This demonstrated that the DNA sequence does instruct the methylation pattern. When that methylation pattern changes, however, it gives rise to potential changes in phenotype, or who we are."

"This is one of the largest studies ever undertaken of this sort, and these are challenging studies, so having proof of principle is important."

"We now have evidence that changes in methylation patterns occur in genetically identical people and therefore these changes can potentially change disease susceptibility. The next step will be to examine twins that are discordant for a particular disease – such as Type 2 diabetes. In those cases, we will be looking for discordance in methylation of the key genes."

Provided by Garvan Institute of Medical Research