

BOOK REVIEW

Identically Different: Why You *Can* Change Your Genes

Tim Spector. London, UK: Weidelfeld & Nicolson. 293 pp. e-book/336pp. Hardcover, ISBN 0297866311
Reviewed by Jeffrey M. Craig, Early Life Epigenetics Group, Murdoch Childrens Research Institute and Department of Paediatrics, University of Melbourne, Royal Children's Hospital, Melbourne, Australia

doi:10.1017/thg.2012.136

Tim Spector, Professor of Genetic Epidemiology at King's College London is well known as a distinguished twins researcher to most of the readers of this journal. Through his expertise in the fields of twins research and human genetics, he has also made many media appearances in the United Kingdom and internationally.

When he looks at the human condition, Spector sees it written large in twins. This book is a fascinating exploration of our current understanding of what makes us what we are: health, behavior, and personality. He steers a steady course away from the twin pillars of genetic and environmental determinism and provides many clear examples throughout this of how twin studies have brought him to this belief.

One of Spector's main points is that differences within twin pairs have often been ignored outside the twin research community, and by focusing on the differences, we can learn a lot about what makes us human. He starts the book with the stark example of Ladan and Laleh, the conjoined twins who sadly died during the operation meant to separate them. Despite being joined at the head, and thus spending their entire lives together, each had different interests, abilities, and aspirations. Spector asks 'if our genes and environment are the same, how can there be any room for differences between us? And if so, how do these differences arise?'

This is where epigenetics comes into play. Epigenetics, Spector explains, describes how factors literally 'around' our genes but not part of their DNA sequence, control their activity. Put simply, environment can impact on epigenetics and cause monozygotic twins to differ in phenotype. This book, while written in an informal and entertaining way, manages to cover the major findings and concepts of epigenetics without going into too much unnecessary detail.

Indeed, those wanting an in-depth discussion of the mechanisms of epigenetics will be disappointed and should turn to books such as *The Epigenetics Revolution* by Nessa Carey and *The Genome Generation* by Elizabeth Finkel. Instead, Spector provides plenty of lucid examples, from Meany's rats to the Dutch Hunger Winter.

Spector does not limit himself to epigenetics, and constantly brings us back to the idea that we are a product from variable contributions of our fixed genetic sequence and our environment, acting via epigenetic mechanisms on the activity of our genes. Furthermore, he pushes home the recent realization that for any 'complex' disease such as cardiovascular disease or autism, these effects happen through the involvement of hundreds of genes. Spector uses the analogy of a giant musical organ (the genome) with 25,000 pipes (genes) that function in harmony and being 'opened and closed by the mysterious (epigenetic) organist to control the music'. He then goes on to lambaste the simplistic interpretation by the popular press by saying: 'It no longer makes any sense to talk of the "heart attack genes" any more than you can say there is a single note for Bach's Fugue in D minor'.

Spector then travels into murky waters by raising the issue of trans-generational epigenetic inheritance. Such 'soft' inheritance was suggested by the 18th-century scientist Jean-Baptiste Lamarck, and is exemplified by the saying 'you are what your mother ate'. There is much debate in scientific circles about the precise meaning of trans-generational epigenetic inheritance, from pregnant mothers influencing the epigenetics of their offspring in utero (direct evidence in animals and humans), to the effect of parental diet and lifestyle prior to conception on their offspring's epigenetics (direct evidence from animals, indirect evidence from humans),

through to a similar effect lasting for three or more generations. Although Spector doesn't make this differentiation and makes the unproven assumption of a pre-gestational influence on the epigenetics of the next generation in humans, it is highly unlikely that examples of such effects are yet to be found. Irrespective of the source or the timing of exposure, he asserts that knowledge of which altered epigenetic marks are attached to which genes, together with knowledge of your entire DNA sequence, will help predict future disease. He presents emerging evidence from animal and human studies that, due to their reversible nature, epigenetic marks associated with adverse environment can be recognized and provides a small number of examples of how they are being reversed — hence the subtitle of the book: 'Why you *can* change your genes'. Although much of this is speculation, without discussing such scenarios we cannot debate the ethical issues that will inevitably come hand in hand with them.

Another important theme that emerges in the book is the ability of seemingly stochastic events to influence our destiny and even our epigenetics. Examples are given of how accidents, divorce, illnesses, and even differing perceptions of the same stressful situation can affect monozygotic twin siblings differently. Spector explains how genetically identical brains could develop differently through so-called 'neural Darwinism'. He also tells us of how studies showing epigenetic differences between disease-discordant monozygotic twins, controlled for genetics and shared environment, are revealing clues to their origin.

One of the strengths of the book is its humanity; it comes across that Spector works *with* twins, not *on* twins; the twins themselves are quoted recalling their case histories. These illustrative examples of the combined effects of nature and nurture more than adequately explain the field of twin research to the educated layperson. Spector is an excellent ambassador for twin research and I suggest that twin researchers recommend this book to twins themselves. However, this book does not go into technical details of twin studies or present in-depth discussions about specific twin studies, topics discussed in books such as *Entwined Lives* by Nancy Segal. The book is also ideal for those twin researchers wishing to be brought up to date with the fields of genetics and epigenetics.

Spector's stories are told with humor and with irony, the latter exemplified in the chapter titles, which contradict Spector's dislike of genetic determinism; for example, 'The parenting gene', 'The fat gene', 'The cancer gene', and 'The gay gene'. The book also explores a wide range of topics as diverse as fidelity, happiness, religious fervor, and sexual behavior; topics that will appeal to many.

Identically Different ends with quotes from twins about what it's like being a twin and with a reiteration of the optimistic hope that knowledge gained from twins studies will allow doctors to recognize which gene changes, both genetic and epigenetic, confer risk for disease and how, ultimately, this knowledge will allow them to change the epigenetics of our genes to reverse these risks.