



W. LOVE/AGE/GETTY

British gangster Ronnie Kray (right) was bisexual, unlike his twin, Reggie (left). The disparity could be down to epigenetics.

EPIGENETICS

Different under the skin

Michael G. Sargent enjoys a discussion of twin studies that aims to unpick the effects of nurture on nature.

Human personality traits apparently governed by genes may change in response to crucial life experiences. But how? Through epigenetics — chemical modifications of the genome and certain associated proteins. In *Identically Different*, genetic epidemiologist Tim Spector argues that identical twins offer a unique opportunity to understand this mysterious process.

Far from presenting a put-down of a gene-centred view of heredity, Spector believes that the influence of genes is paramount, but that identical-twin studies reveal possibilities for variation. He focuses on twin studies because they are a well-trodden way of exploring how environmental triggers can initiate a chronic disease such as rheumatism in one twin by an epigenetic process, while the DNA sequence remains constant.

Spector also seeks to identify environmental cues that affect personality traits — criminality, talent, homosexuality, fidelity, autism and many others — that have sometimes been simplistically ascribed to specific genes. (With some irony, Spector names his chapters after phrases

used by the media — such as ‘the fat gene’ or ‘the gay gene’.) Although the differences between twins cannot yet be attributed to specific epigenetic processes, animal-behaviour studies suggest that this is plausible.

A number of the case studies in *Identically Different* are of identical twins who were separated at birth, but grew up with spookily similar behaviour. The main focus, however, is on separated twins who showed important differences, such as Nina and Gill.

Nina grew up an only child in privileged circumstances. Gill had five siblings in a rough-and-tumble home with no encouragement or material benefits. As teenagers, both were wayward, fell pregnant and were married very early to abusive men. Nina quickly divorced her tormentor, went to university and lived happily thereafter; Gill endured many years of misery before she escaped, completed her education, became a civil servant and married happily, albeit dogged by significant health problems that were perhaps related to neglect. So the huge difference in upbringing did not affect their personality, naughtiness as children or susceptibility to temptation — but decisively affected their education, confidence and finances.

Spector observes that the influence of parental background rarely outweighs the genetic legacy. Occasionally, however, particular individuals make a crucial difference. Often these are teachers: small differences in encouragement perceived by each twin can markedly affect educational progress.

Twin studies show that most kinds of talent have a genetic element. But at the highest levels, only one twin tends to emerge as a star — as with actor Isabella Rossellini or car-racing champion Mario Andretti. Curiously, twins seem to avoid competing directly, which is usually attributable to a difference in motivation and hard work, perhaps influenced by lucky or unlucky random events.

Spector reports that a strong genetic component to criminality emerges from investigations of identical twins, but a history of abuse



Identically Different: Why You Can Change Your Genes

TIM SPECTOR
Weidenfeld &
Nicolson: 2012.
336 pp. £20/\$25.10

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For another review on
epigenetics, see:
go.nature.com/ngbo5g

is also a factor in children drifting towards a life of crime. In one study, those carrying a specific gene variant who were also victims of abuse were nine times as likely to become delinquents than carriers who were not abused. The variant encoded a defective version of monoamine oxidase, an enzyme that regulates levels of certain neurotransmitters.

The significance of genetic factors in criminality is evident in Spector's observation that only one-third of identical-twin pairs who experienced childhood abuse are both inclined towards criminality. Magnetic resonance imaging of the brains of individuals in that criminal subgroup revealed an excess of grey matter — generally regarded as a sign of brain immaturity, and also seen in psychopaths and individuals with autism spectrum disorder. Spector suspects that this pathology involves the epigenetic modification of genes that profoundly affect behaviour, such as the stress response, mood-regulating neurotransmitters and the “trust hormone” oxytocin.

Spector believes that sexual preferences are governed by a substantial genetic factor, but there are many instances in which one twin is straight and the other gay — notably Ronnie Kray, the British gangster, who was bisexual, unlike his brother Reggie, and also had schizophrenia. One possibility is that sexual orientation relates to prenatal hormonal exposure, which affects brain development. It also leaves a curious anatomical signature: in heterosexual males, the index finger tends to be shorter than the ring finger. The reverse is true in gay men.

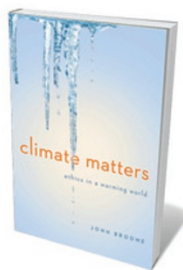
Perhaps the strangest idea to emerge from twin studies is that belief in a deity may have a substantial genetic component. This seems to transcend particular faiths and, mysteriously, maps to a region of chromosome 15 that lacks any protein-coding sequence.

Spector skates over the biochemistry of epigenetics, without reference to recently recognized players, such as microRNAs, that might modify neuronal activity. More discussion about different sorts of identical twin might have been informative. Are twins who shared a placenta more similar than those who did not? Are ‘mirror-image’ twins — those with small asymmetries in appearance — more different than those who are truly identical?

Real case histories of identical twins may be the only way to help us to understand how life experiences influence personality and behaviour. They may also suggest how some problems might be more manageable than we had imagined. ■

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Books in brief



Climate Matters: Ethics in a Warming World

John Broome NORTON 224 pp. £14.99 (2012)

With climate-change policy looking increasingly toothless, we need fresh ways of grappling with this environmental catastrophe. Philosopher and “lapsed economist” John Broome vaults in where policy-makers fear to tread, exploring the moral aspects of climate choices. In the latest instalment in the Amnesty International Global Ethics Series, Broome argues that countries and individuals are ethically obliged to curb emissions. With penetrating clarity, he uses science and economics as a springboard to cover big issues, from the need for action despite uncertainty to the value of human life.



Beyond the Blue Horizon: How the Earliest Mariners Unlocked the Secrets of the Oceans

Brian Fagan BLOOMSBURY 336 pp. £20 (2012)

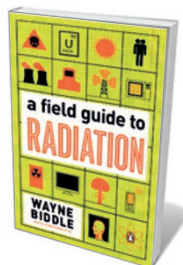
What motivated the first seafarers to take to uncharted open water — land grabs, a thirst for trade, conflicts at home or restlessness? Anthropologist Brian Fagan sails far back, beyond explorers such as Magellan and Cook, to when those intrepid pioneers travelled in rafts, coracles and longboats. Starting 50,000 years ago with the southeast Asian exodus to the Pacific Islands, he also examines early sailors in the Aegean Sea, monsoon winds, Norse voyages and the complexities of marine exploration in the ancient Americas.



The Universe: In 100 Key Discoveries

Giles Sparrow QUERCUS 416 pp. £19.99 (2012)

If you hanker for a compact compendium of cosmological breakthroughs, this is it. Astronomy writer Giles Sparrow is an able guide through 100 discoveries that have shaped understanding of the Universe and its workings. Trawling the eons, we explore the scientific revolution that unseated Earth from the centre of the Universe, the bombardment of Earth 4 billion years ago, flare stars and much more, finishing with speculation about the cosmological endgame. Essays and stunning images are framed by a definition and description of each breakthrough and its relative importance.



A Field Guide to Radiation

Wayne Biddle PENGUIN 288 pp. £10.23 (2012)

Pulitzer prizewinning writer Wayne Biddle, author of the award-winning *A Field Guide to Germs* (Henry Holt, 1995), here tackles another ubiquitous aspect of daily life: radiation. He briefly covers the history — pioneering researcher Marie Curie, to whom the “glowing tubes looked like fairy lights”, the stockpiling of nuclear warheads and the spread of nuclear power — before moving on to radioactive elements and related phenomena, from critical mass and decay products to fallout and occupational radiation. Witty, succinct and handily organized in an A–Z format.



When Can You Trust the Experts?: How to Tell Good Science from Bad in Education

Daniel T. Willingham JOSSEY BASS 272 pp. £16.99 (2012)

Cognitive psychologist Daniel Willingham offers a cautionary tale about poor science in education. With some teaching tools backed by research that is far from robust, Willingham calls for a four-step process for selecting the best of them: ‘strip it’ (look at the claim and decipher the promised outcome); ‘trace it’ (find the source of the idea and how others view it); ‘analyse it’ (determine whether the evidence is sound); and ask, ‘should I do it?’ (factor in the urgency of the need).