

conspire to prevent time machines' construction (or natural occurrence) in the first place.

Some take a more nuanced, if less physically plausible, approach. Stephen King's book *11/22/63* is premised on attempts to change the history of the day on which President John F. Kennedy was shot. "There's a kind of a rule that you'd express as a ratio," King told *Wired* magazine. "The more potential a given event has to change the future, the more difficult that event would be to change." But not all fictional time travel needs to involve material bodies and the problem of causality. In Kurt Vonnegut's *Slaughterhouse-Five*, it is Billy Pilgrim's consciousness that has "come unstuck in time" and travels between upstate New York, the planet Tralfamadore and the firebombed city of Dresden.

More than a century ago, writers were already using time travel for dramatic ends. Mark Twain's *A Connecticut Yankee in King Arthur's Court* skewers the American technophiles of the 1880s as much as the early-medieval Brits whose world he enters. And H. G. Wells's *The Time Machine* is a polemic on the social stratification of late-Victorian Britain, couched in the language of extra dimensions that would inform Einstein's relativistic merger of space and time in the following decades.

In 1899, the playwright Alfred Jarry leapt off from Wells's ideas to make time travel part of his knowingly absurd 'pataphysics', in his pamphlet *Commentary and Instructions for the Practical Construction of the Time Machine*. As part of the Beyond Entropy project with the Architectural Association in London, architect Shin Egashira and I tried to realize some of Jarry's machine. Alas, our success, if any, was aesthetic rather than technological.

And then, of course, there is the time lord himself. Paradoxes rarely trouble the Doctor. Time travel serves mostly as a plot device allowing him to visit humans (much easier on the special-effects budget than aliens) in different circumstances, from the recognizable past to the distant future, defeating his enemies again and again. More recently, however, the show has attempted some sort of cross-temporal continuity, even when this means retroactively changing the past and future to bring his nemeses, the Daleks, back from the dead.

The creators of Doctor Who have tended to favour thrills and chills over scientific (or pseudoscientific) precision. But they have also inspired millions to ponder profound questions about the nature of space and time and our movements through them. Here's to the next 50 years. ■

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PSYCHOLOGY

The appetite for right

John Whitfield explores two studies that take us from infant ethics to moral choices faced by adults in society.

It would be nice to think that ideas of right and wrong were founded on a blend of insight, experience and instruction. But mostly, instinct is in charge. Morality is an appetite for certain types of behaviour in oneself and others. Like tastes in food and sex, it is rooted in biology, shaped by culture and imperfectly controlled by reason.

As with those other appetites, we develop moral urges because our ancestors prospered by heeding them. Morality underpins social life by guarding against the selfishness that threatens cohesion, and turning that togetherness into a weapon against outsiders. But ethical instincts that put 'us' before 'them' are poorly suited to a globalized world in which different moral systems are in constant contact and problems such as climate change demand cooperation on an unprecedented scale.

Psychologists Paul Bloom and Joshua Greene share this view of the evolutionary roots, social function and limitations of morality. They diverge,

Just Babies: The Origins of Good and Evil

PAUL BLOOM
Crown: 2013.

Moral Tribes: Emotion, Reason, and the Gap Between Us and Them

JOSHUA GREENE
Penguin: 2013.

however, on the aspects of it that they tackle.

In *Just Babies*, Bloom looks at how moral psychology develops in childhood. Using puppet shows or animations that depict helpful or antisocial behaviour, researchers are probing how the ability to judge others develops in infants. These studies, many of which are the work of Bloom and his colleagues, show that ideas of right and wrong begin to emerge so early in life that they must be innate: three-month-olds show that they recognize and prefer good deeds by, for example, looking longer at a kind character than a mean one.

Bloom, ever brisk and authoritative, generally focuses on how things are rather than on how developmental psychology might inform philosophy. His discussion of disgust is particularly good. This is partly because the experiments he describes are nifty. Moral purity, for example, is a value associated with conservative philosophies, and students' political views have been shown to move rightwards when they are standing next to a hand-sanitizer dispenser. And it is partly because he pursues the implications further, arguing that disgust is a poor guide to right and wrong and is liable to make people prejudiced and abusive.

In two senses, Greene picks up where Bloom leaves off. *Moral Tribes* looks at how adults resolve ethical dilemmas, and makes a detailed case for how they should do this.

Greene argues that we have two moral systems that engage different parts of the brain. A fast, automatic, 'tribal' one operates through the emotions and is well suited for solving problems within groups; a slower, deliberative one allows a more impartial perspective. This echoes ideas in Daniel Kahneman's *Thinking, Fast and Slow* (Farrar, Straus and Giroux, 2011); the relevant bit of Greene's book is even called 'Morality Fast and Slow'. Greene's research has focused on conflicts between the



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two systems, using a philosophical problem called the trolley dilemma, which asks whether it is right to put one person in the path of a runaway tram to save the lives of several more. Most people believe it is wrong to stop the trolley by pushing a man onto the tracks. But most think it is right to flick a switch that diverts the car from a track on which it hits five people onto one where it hits only one.

This seems like an instinctive manifestation of the doctrine of double effect — the philosophical principle that holds that using people as a means to an end is worse than harming them as collateral damage. Greene's experiments, however, seem to show that we think that flicking a switch is more ethical than pushing a person not because of any moral distinction, but because it is socially useful to recoil from physical violence that might provoke retaliation or ostracism.

In place of moral absolutes, Greene carries a flag for utilitarianism. This pragmatic philosophy, developed in the eighteenth and nineteenth centuries by Jeremy Bentham and John Stuart Mill, argues that, to quote Bentham, "it is the greatest happiness of the greatest number that is the measure of right and wrong". The brain's slow moral system, Greene says, naturally arrives at utilitarian decisions, and the philosophy's universality and impartiality transcend faster 'tribal' thinking.

As a science writer who touches on issues beyond science, Greene should be cherished for pursuing his questions wherever they take him and for having the interdisciplinary skills to do so. *Moral Tribes* is clever and absorbing. But although Greene makes a persuasive case for utilitarianism as a means for individuals to live a good life, there is a politics-shaped hole in his suggestion that it might offer a cure for social divides.

It is difficult, for example, to imagine pro-lifers being swayed by Greene's utilitarian argument for the legality of abortion — as the satirist Jonathan Swift remarked, you cannot reason a man out of something that he was not reasoned into. It seems that those who succeed in harnessing a group's tribal instincts tend to defeat those who aim to rise above them. Policy-makers could benefit from reading Greene's book, but anyone with an election to win might be better off with Bloom's focus on morality's automatic weaponry. ■

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SPACE SCIENCE

Zero-gravity hero

John Gilbey is gripped by the memoir of Chris Hadfield, a former International Space Station commander.

The third-brightest object in Earth's night sky is the International Space Station (ISS), according to NASA. The station's cultural impact on humanity has perhaps been less brilliant — until this year. From March to May, the tenure of Chris Hadfield as commander of ISS Expedition 35 sparked a worldwide surge of interest in daily life in space.

Hadfield, the first Canadian to walk in space, charmed hundreds of thousands of followers as he tweeted stunning images of Earth rolling beneath him and the gripping and sometimes bizarre minutiae of his day-to-day schedule. (Take this tweet from 8 May: "Yesterday was so cool: as we tested our Soyuz thrusters we could hear and feel them firing, and how they shook and flexed the whole Station.") He even managed an inspired zero-gravity rendering of the Bowie classic *Space Oddity*, complete with guitar. Hadfield brought us a new connectivity with, and understanding of, the work of the ISS crews.

An Astronaut's Guide to Life on Earth describes cogently the core skills that twenty-first-century astronauts need to master — from the unsavoury task of mending the zero-gravity toilet to the challenge of running complex science experiments in orbit. It is clear from the detailed descriptions that working in space remains an enormously complex and routinely dangerous career — Hadfield knew well all seven members of the lost *Columbia* shuttle crew.

Equally compelling is his analysis of the key behaviours required of the aspiring astronaut. The right person fits in with the human and technical environment with the least disruption; a true team member can embed their own skills and expertise in the single entity that is the ISS crew. Only in this way, Hadfield urges, can the apparently trivial and minor everyday faults of such a massively complex system



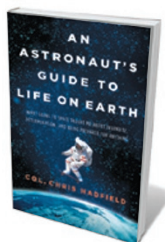
Chris Hadfield prepares for a mission in 2012.

be prevented from escalating into major, life-threatening incidents.

Hadfield's description of his time on the ISS — and the long, complex pathway that took him there — is detailed, frequently technical, amusingly pragmatic and often self-deprecating. The narrative is far from linear — the highlights and weird events pour out in a torrent, leaving you wishing desperately that you had travelled with him.

An Astronaut's Guide to Life on Earth is an impressive memoir of Hadfield's part in developing a permanent home for humanity in Earth's orbit. As the title suggests, the book has many important lessons for those of us destined to remain Earthbound — and especially for those seeking to build a new openness for science and technology through public engagement. Every secondary school student should be given a copy: in terms of inspiration, motivation and a sense of belief in the future of humanity in space, this book ranks alongside the accounts published by the *Apollo 11* astronauts. I can think of no higher praise. ■

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An Astronaut's Guide to Life on Earth: What Going to Space Taught Me About Ingenuity, Determination, and Being Prepared For Anything
CHRIS HADFIELD
Little, Brown: 2013.