two systems, conscious and unconscious, that are continuously at play. In *Thinking, Fast and Slow* he shows why his ideas shook the existing model of rational decision-making. In *Who's in Charge?*, cognitive neuroscientist Michael Gazzaniga tackles a related question: given the range of automatic and deliberative factors that underlie our choices, why do we feel so in control when we make them?

The books complement each other beautifully. Kahneman provides a detailed, yet accessible, description of the psychological mechanisms involved in making decisions. Gazzaniga descends into the neural circuits that underpin those mechanisms. There are instructive contrasts too. Kahneman focuses on practical dimensions of the choice 'machinery', such as the role of attention, where biases come from and ways of avoiding judgement errors. Gazzaniga, meanwhile, attempts to understand inherent philosophical issues, such as the roots and nature of consciousness and free will. Both books deliver an up-to-date review of the research in psychology and neuroscience.

Kahneman proposes a dual scheme for decision-making in the brain. System I is fast, effortless and intuitive, whereas System II is more deliberative and logical, and consequently slower. Both operate continuously while we are awake, with System I as the default controlling our actions, and System II monitoring and activating whenever System I runs into difficulty. An experienced driver, for example, will drive 'on autopilot' until they reach something unexpected, such as a detour. They will then need System II to find their way through unfamiliar streets.

Neither system, Kahneman shows, is foolproof on its own. You can suppress your intuitions but cannot turn them off at will: that is why errors of System I occur. But System II is too slow to be efficient for making routine decisions.

Discoveries regarding these two systems — their motivating factors, limitations, operating principles and the interplay between them — have had an impact on disciplines ranging from psychology and economics to law and philosophy. Kahneman, through his work on how life satisfaction affects decision-making, has contributed to the development of positive psychology

NEUROSCIENCE

Capturing free will

Jacek Debiec enjoys two complementary books charting the psychology and neuroscience of decision-making.

Wrong or right, we are constantly making choices. Decision-making is not just about choosing careers, political representatives or the person you want to share your life with. Most of the time it is deciding where to put your foot as you take your next step, when to take a bite of your sandwich or whether to scratch that itch on your shoulder. Over your lifetime, you make trillions of decisions, mostly remaining unaware of doing so.

Two books examine different aspects of how we make judgements and choices.

Thinking, Fast and Slow

DANIEL KAHNEMAN

Allen Lane/Farrar, Straus and Giroux: 2011.
512 pp. £25/\$30

Who's in Charge? Free Will and the Science of the Brain

MICHAEL S. GAZZANIGA

Ecco: 2011. 272 pp. \$27.99, £18.24

Psychologist Daniel Kahneman, a pioneer in the science of decision-making who won the 2002 Nobel prize in economics, sees the workings of the mind as the interaction of

The Mind's Eye

Oliver Sacks (Picador, 2011; £8.99)

A tumour led neurologist Oliver Sacks to lose his stereoscopic vision, prompting him to study other visual disorders and their effects on people. He reveals "the complex roles of sight in human life and the constitution of personal identity", wrote Steve Silberman (*Nature* **467**, 1036–1037; 2010).

Brain Storm: The Flaws in the Science of Sex Differences

Rebecca M. Jordan-Young (Harvard Univ. Press, 2011; \$19.95)

Rebecca Jordan-Young reviews the research on supposed differences in male and female brains, arguing for more rigour. Virginia Valian called it "a welcome corrective" (*Nature* **470**, 332–333; 2011).

as a subfield. In law, descriptions of the origins of biases help us to understand the limitations of witness testimonies.

Gazzaniga approaches the neural mechanism of decision-making by looking at the big picture. There is no central commander in our brain, he argues. Instead, there are millions of serially wired local circuits, diversified and distributed across the brain, all running together and making relevant decisions. Despite this wiring, we feel unified when making those decisions, and Gazzaniga looks at why.

He gleans some insights from studies of 'split-brain' patients, who have had surgery to halt their intractable epileptic seizures by severing the corpus callosum that connects the brain hemispheres. Each half of their brain works in isolation and can be studied as such.

Gazzaniga and his colleagues found that when the language centres of a person's dominant hemisphere — usually the left — are disconnected from the other hemisphere and the information it processes, that person will still explain actions triggered by

the non-dominant hemisphere with the most probable answer. For example, when a picture of a bell was flashed to one subject's non-dominant hemisphere and the word 'music' was shown to the dominant one, the person — asked to select an image best

BELIEVING IN FREE WILL COULD BOLSTER A PERSON'S CONTROL OF THEIR AUTOMATIC IMPULSE.

depicting music — pointed to one of a bell. He explained his choice by saying that he had last heard the sound of a bell. He had not, but he made up a story that seemed probable.

Our dominant hemisphere is hard-wired to function as an interpreter, Gazzaniga says — it is trying to make sense of our actions given the available information. If information is missing, as in the above example, the interpreter will make up probable answers. It searches for patterns and attributes causes after an event occurs. It also responds to input about our actions, emotions and

thoughts, and links them together to build a narrative. Over time, these accumulated impressions give rise to a feeling of agency and an impression of free will.

That impression could affect decision-making in socially important ways. People who were asked to read inspiring passages about free will versus deterministic depictions of human actions were found to cheat less when tested afterwards. So, Gazzaniga notes, believing in free will could bolster a person's control of their automatic impulse — in this example, causing them to act less selfishly. The mind, as a property of the brain, can regulate some of the brain's functions, just as software defines how hardware is used.

Kahneman and Gazzaniga take us on a journey into the machinery of human decision-making, its constrictions and flaws. By studying how we make choices, we can learn to make better ones. ■

Jacek Debiec is a psychiatrist at the New York University Child Study Center, New York, USA, and a researcher at the Copernicus Center for Interdisciplinary Studies, Krakow, Poland.
e-mail: jacek.debiec@nyu.edu

➔ **NATURE.COM**

Philip Ball muses on Daniel Kahneman's happiness studies: go.nature.com/1qsswh