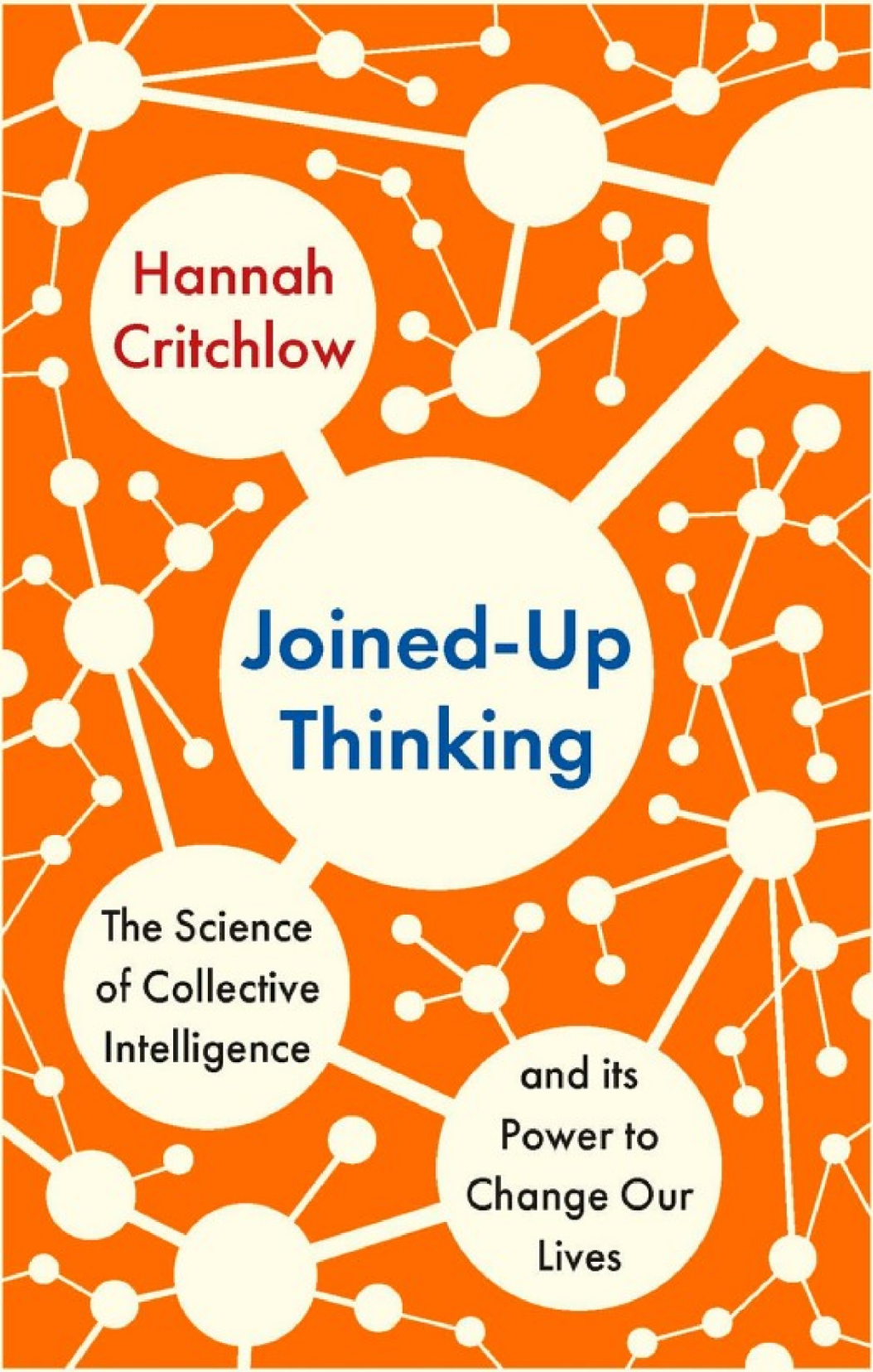

First published in Great Britain in 2022 by Hodder & Stoughton
An Hachette UK company

Cover design: Keenan

A CIP catalogue record for this title is available from the British Library

Hardback ISBN 978 1 529 39839 7
Trade Paperback ISBN 978 1 529 39840 3
eBook ISBN 978 1 529 39841 0

Hodder & Stoughton Ltd
Carmelite House
50 Victoria Embankment
London EC4Y 0DZ

www.hodder.co.uk

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Prologue

For nearly seventy years from the end of the Second World War, human beings seemed to be getting cleverer. The average IQ score of populations in countries including Britain, France, Japan and Korea showed a roughly three-point rise every decade. This so-called Flynn effect, named after the researcher who pinpointed it, was attributed to the impact of better education and better diet among children growing up in developed societies. Now it seems that the intelligence boom is over. IQ scores hit a peak for those born during the mid-seventies and are now falling across Europe.

In the spirit of full disclosure I should point out that I was a mere twinkle in my parents' eyes in the mid-seventies so I'm part of a cohort born on the downward slide from the supposed peak of human intelligence! But can it really be that we're getting stupider? Are our junk-food diets and too much screen time decimating our cognitive powers? Or is it the tests that are faulty, rather than our brains? Are they perhaps out of date for the world we now live in?

Intelligence researchers, including James Flynn himself, continue to dispute the size and significance of the Flynn effect, and yet this story never quite goes away. In 2018, a decades-long study on Norwegian army conscripts concluded that IQ levels *were* falling; the media seized on it, and the whole conversation started up again. The Flynn effect may not tell us anything definitive about human intelligence, but it tells us plenty about

our fixation on and confusion over the 1.5kg of soft grey flesh within our skulls.

When I read another story in the press about falling IQ levels, part of me wonders whether humanity has hit the limit of our brain power. I also ask myself what conventional thinking about cleverness means, if even intelligence researchers can't agree on terms and trends. I go back to questioning the effectiveness of our educational system, and the faith we have in mental agility as a panacea for problems and a marker of individual success. I think about the people I met when I worked in a psychiatric hospital, whose situation inspired me to study the workings of the brain. Above all, I come back to my conviction that our thinking about intelligence needs an update for the twenty-first century.

Many of us are highly invested in the competitive business (and it really is a business) of boosting and proving our intellectual powers. It starts early. Young people are experiencing more anxiety over exam performance than ever before. As part of my work as a science fellow at Magdalene College, University of Cambridge, I've talked with hundreds of high-school students about the use of smart drugs among their peers. They tell me about buying drugs online in an effort to boost their grades. I've attended academic conferences on gene--editing to tweak the cognitive abilities of unborn babies. I've seen US-based companies advertising pre-implantation screening of embryos to assist parents to avoid having 'intellectually disabled' children. I've met people with medical prosthetics implanted in their brains that alter their feelings, mental faculties and how they interact with the world. The emphasis is always on how our individual brain power (and perhaps, at a push, that of our children) can be boosted, in order to be fitter for this competitive game called life.

I've come to believe that the emphasis on individual smartness, as measured by exam performance and IQ tests and promotion at work, is not in our best interests. That it is limiting to most of us and damaging to many. That it isn't even the most effective model for coming up with the innovative solutions to complex problems that we all need. As neuroscience begins to broaden its focus and investigate how our brains work together to communicate and collaborate, there is a whole host of evidence emerging that our society's emphasis on individual intelligence is out of date.

We now know that all brains, even the most agile and successful, are still fundamentally flawed in the way they perceive the world. Every human brain is subject to bias and blind spots, limitations in thinking, emotional contagion and covert influence by other people. We are all, to some extent, less rational and less intelligent than we like to think we are. We are biased against unusual or unconventional cognitive approaches. We get stuck in our own little bubbles, overlooking ideas and people that could disrupt our thinking in useful ways. We don't talk or listen with enough curiosity and patience to actually learn. We pay lip service to the value of collaboration without knowing how to really do effective joined-up thinking, or what it might mean for us if we did. We've got stuck with a view of intelligence that's no longer fit for purpose.

Rather than obsessing over individual exam grades and relying on the undoubted achievements of the people our system labels as exceptionally clever, could we expand our thinking about thinking? Is there a different, more creative, inclusive and efficient way to think about intelligence, to drive innovation and solve problems?

Collective intelligence is precisely the approach we need to overcome our individual brains' limitations and hit new heights. Pooling ideas and gathering different perspectives allows us to

tap into the wisdom and experience embodied in a group of people. Our species' innate drive to share information and seek out new approaches has evolved as a workaround to cope with the gaps in our individual knowledge and perspective. It means that humanity has been practising collective intelligence ever since groups of our ancestors worked together to gather in the harvest; arguably since the first compassionate act that prioritised the wellbeing of the collective over an individual's immediate needs.

Millennia later, digital technology has shifted collective intelligence online, where it has produced the labyrinth of Wikipedia, the global conversation of Twitter and citizen science campaigns to control Ebola in central Africa, and enabled experiments in direct participatory democracy. Idea-sharing and cooperation are literally in our DNA, and are constantly evolving.

This book is the result of my two-year-long deep dive into the cutting-edge neuroscience of humanity's collective intelligence. That journey convinced me that we're at a pivotal moment in our evolution. It's time to return to thinking of intelligence as a collaborative act, not an individual's test score. The range and complexity of problems that we face, from the climate emergency to global water and food shortages and the threat of the next pandemic, mean that we need all brains on deck. We must develop ways of collaborating across groups of people with different perspectives and experiences from our own. We need to value a collectivist approach to intelligence and understand how it emerges, what skills it depends on and which activities in the brain drive those skills.

We can all think so much more intelligently about our interactions with one another, and our approach to our biggest challenges. When we make this shift, from 'me' to 'we' thinking, our worldview changes, our imagination is unleashed and every

single one of us is able to contribute our unique viewpoint to humanity's pool of intelligence. It's exactly this exhilarating joined-up thinking that we need now. Let's harness our collective brain power and see how far it can take us.

CHAPTER ONE

The Power of Joined-up Thinking

Neuroscience has been investigating intelligence for decades but until very recently it has treated the brain as a single entity. A lot of work has focused on understanding how nature (our particular brain, built on the blueprint of our DNA) interacts with nurture (the experiences we learn from, especially in early childhood) to give rise to our consciousness and our unique experiences.

It's only in the last few years that neuroscience has broadened its focus. It has shifted away from studying brain regions as separate areas with specific functions, to treating them as a network of staggering sophistication: the connectome. Now, scientists are looking at how intelligence arises within the brain–body system as a whole, and between a group of minds that influence one another. Did you know, for example, that electrical oscillations between people's brains synchronise when they're engaged in a communal activity, so that people are more likely to literally see the world in the same way? This boosts our capacity to learn together or to build a consensus. But during periods of stress, fear and conflict the process can go awry, undermining the extent to which ideas can hop from brain to brain and become seeded in a collective way of thinking.

The ongoing revolution in brain-imaging technology allows scientists to study the brains of living, breathing, learning, interacting creatures in detail. This means that neuroscience is increasingly able to illuminate the way we think and behave.

Cognitive scientists can now investigate even highly abstract behaviours such as compassion and guilt. They are also delving into the way brains collaborate, looking at how a group works harmoniously to solve a problem and what happens in people's brains to enable this collective success.

A lot of the cutting-edge research now coming out will revolutionise how we think about intelligence. Studies into embodied cognition are investigating how we can tap into the vast amounts of information stored in our bodies, much of it picked up unconsciously from signals given off by other people. The interface between artificial intelligence and human intelligence is another space of pioneering exploration for cognitive scientists, and science-fiction-type innovations are coming thick and fast. Memories can now be electrically imprinted from a donor's brain into a recipient's, opening up a route towards the possibility of downloading expertise. Brainets are being created, in which brains are wired up to allow individuals to collaborate through direct brain-to-brain transfer of information.

But to my mind, some of the most exciting conclusions are less futuristic and much closer to home. The studies that show how healing from anxiety and distress can be a collective endeavour, for example, or how essential it is to break down dominance dynamics so that good ideas can emerge and seed themselves in a group.

Collective intelligence is the stuff of our everyday lives and we all do it, often without even noticing. Every time we diffuse a family row, organise a big social gathering or collaborate on a project at work, it comes into play. Family life, social life, working life – all of them are built on collective intelligence. The cognitive skills it depends on are as much emotional as they are analytical. They involve communication, trust, empathy, persuasion, negotiation, imagination, wit, emotions and

language. Collective intelligence flows from one brain to another, morphing and enriching itself as it goes to create an extended mind that transcends any individual brain. A mind that's infinitely smarter than any single one of us.

Collective intelligence emerges and flourishes in certain conditions, as we will see. A fundamental precondition is of course social connection. Without contact between people, preferably real-world contact, there can be no joined-up thinking. Nothing could make the point more clearly than the lockdowns imposed in response to the coronavirus pandemic. Social isolation increased and then fluctuated over a period of months, as countries came in and out of lockdown. This created the ideal conditions for neuroscientists and psychologists to study numerous aspects of human behaviour, including those that influence intelligence.

Not that you needed to be a cognitive scientist to observe the impact of lockdown on our ability to focus, think or communicate. Many of us experienced a sort of brain fog that combined feelings of low mood, mental exhaustion and distraction. Studies conducted in Scotland and Italy, among others, measured cognitive functions as the pandemic progressed, observing that lockdown periods coincided with a fall in people's brain power, which picked up as restrictions on social interactions eased. Those who shielded improved more slowly.

There is a heap of data from long before the pandemic to support the assertion that we all benefit from interaction with others; that in fact, our most fundamental skills depend on it. Human beings are social animals. Our physical and mental wellbeing, cognitive functioning, language acquisition and emotional regulation all develop in and depend on an open and diverse collective life. Our thinking power becomes greater when we are part of a group that includes individuals from

outside the family. We all need exposure to diverse role models and the perspectives of people beyond our genetic kin and our immediate living and working situation. When we are in communication with ideas and people from beyond our bubble, our individual cognitive abilities increase and we can contribute our unique perspective to the collective mind.

Luckily for us, we've created a dazzling array of technological tools to support the connectivity we need in order to function, even during periods of physical isolation. Increasingly we live in a world where the collective mind no longer depends on interactions in real life but exists on internet-enabled platforms. We can share ideas and opinions across the globe, in nanoseconds. We have access to all the information in the world.

The interplay between technological development and social change is a constant of our species' intellectual progress. We come up with new tools to investigate and implement the new ideas we're having, and those tools then create new possibilities, which drive further cultural and social evolution. It fascinates me that over the last thirty years, we have been driven, both scientifically and socially, to develop technologies that allow us to observe and utilise our connections – both between brain cells and between brains. Magnetic Resonance Imaging (MRI scans) and high-powered electron microscopy have shown us the nerve tracts and synaptic connections that link up regions in our brains. New media and internet-based technology facilitate information exchange between us. It's as if we've created the perfect environment to jump-start our evolution towards the joined-up thinking we need.

This seems to be precisely what's happening. Studies undertaken by cognitive scientists between 2020 and 2022 suggested that for the first time in human evolution, our environment – this techno-enabled, networked, communication-driven landscape that we inhabit – is now directing our species'

evolution at such a rate that its effect supersedes even the value of our genes. Our group-level cultural evolution is now more adaptive and more rapid than genetic evolution, which means that our environment – the various cultures we grow up in and inhabit – is becoming the ultimate force that shapes how we as a species will progress.

This concept is the antithesis of what I was taught as an undergraduate studying cellular and molecular biology, and, if confirmed, it will constitute a completely unprecedented shift in humanity's cognitive development. As Timothy Waring and Zachary Wood concluded in their 2021 Royal Society review, 'If genes hold culture on a leash, culture is dragging them straight off the trail.'

Why is this so important? Well, it's thought that big evolutionary transitions occur when groups have developed the ability to cooperate so well that competitive selection between individuals becomes less important. One such transition drove the evolution of life as we know it today. When the individual cells that arose on Earth around 3.8 billion years ago developed enough ability to communicate, cooperate and integrate, eventually, through trial and error, they assembled into complex biological organisms – including us.

Our species may be entering another evolutionary transition, where our collective intelligence can begin to properly evolve and emerge from behind the individuality of our past. Might we be about to enter a new era of development, evolving towards becoming a socially integrated mega-group, much like beehives and ant colonies? This concept might feel alien, but it could usher in a utopian era of human cooperation.

Meanwhile, there's no shortage of excitement and positivity in the era of the brain in which we already live. The mesmerising cartography of our minds is being revealed in ever more detail through MRI scans. This allows us to observe the natural breadth

in thinking styles offered up by the range of human brains. We are starting to appreciate the strength of neurodiversity among our species, and how it can benefit us all. A person diagnosed with autism has a brain that perceives the world in a different way from that of a person without, or one with a diagnosis of dyslexia. The brain of a teenager is structurally different from that of a pensioner. These distinctions have profound implications for cognitive style. If we can value and capture the diversity of thinking available to humanity, how much greater could our problem-solving and creative capacities be?

The dedication page of this book features a piece of art entitled *This Place*. It was painted by Alicia Adams, a proud Kamilaroi woman. The Kamilaroi nation is of vast expanse and the second largest nation on the east coast of Australia. The dots represent the saltwater and freshwater people, different clans coming together to collaborate and celebrate their creativity. It depicts collective intelligence forming, from a bird's-eye view. At the centre the tribes merge in a place for storytelling where they share their perspectives. Out of this, new knowledge arises. Space is also made for reflection on historical wisdom so that it can be passed down the generations and incorporated afresh into their ongoing thinking.

I love this image. Alicia's passion for the wisdom held within her community resonates so strongly with my own scientific knowledge. Her dot paintings recall the maps that researchers construct to visualise the constant flow of data across the brain's connectome, which functions as the storytelling machine that generates the unique narrative of our lives. For me, Alicia's image is like one of these maps but on a larger scale. Rather than each dot representing a separate brain region, it stands for an individual person. The picture describes the interactions between people that add up to the story of a community. They are a portrait of collective intelligence at work.

Let's start our exploration of this new approach to intelligence by looking at how our brains develop to work together within our family units. The family is the cradle of collective intelligence. It is the first group we join and the smallest group in which most of us live. From our birth families we inherit our genetically determined capacities and dispositions. We also learn early lessons about how to deploy them: how to think and how to behave. The family is the perfect context to ask questions about how an individual's intelligence emerges, interacts with and is influenced by that of others.

From there we will move on to look at bigger, more diverse groups of people, such as those who come together at work. In these groups we interact with people who are not genetically related to us, so there is a greater diversity of cognitive skills and points of view. This has the potential to increase collective intelligence but also presents challenges because as the group gets larger, there is a risk that perspectives can go unheard and conflicts can arise. What are the skills and behaviours we can use to get round the challenges and be successful? How can we embed intelligent strategies for leadership and collaboration?

Throughout the book we'll be expanding the size of the groups we're thinking about and looking at collective intelligence in ever broader terms. How do different tribes treat each other in ways that either foster collaboration, or trigger a collapse into conflict? Are there ways to scale up the positive social skills that underpin collective intelligence or do they inevitably get lost in the competing crowds?

Social life has to a great extent shifted online, and we will look at how it plays out (both intelligently and not so intelligently) over the web. Human beings are driven to share ideas and learn from each other but we are also vulnerable to manipulation and disinformation. Sometimes groups encourage each other's limitations and prejudices, stifling debate and ramping up

attacks. This can have potentially serious consequences, not just for problem-solving and the exchange of ideas but for people's safety and wellbeing. We should not underestimate our species' capacity to behave in profoundly self-defeating ways; but evidence shows that the best way to steer away from them is to practise embedding the positive social and emotional skills that underpin all collective intelligence.

In order to tackle the really big tasks that challenge us, we need to be able to harness huge amounts of cognitive capacity. Where are the inspiring examples of ambitious joined-up thinking that spans sectors, countries and even generations? Can we learn from our ancestors how to build flexibility and resilience into our thinking and how to have faith that the generations who come after us will complete the projects we start? If we can learn how to be good ancestors ourselves, we will maximise the chance that we pass on a positive legacy of social and emotional skills that will enable our descendants to flourish.

Perhaps artificial intelligence could give us the brain boost we need to take on these enormous tasks? The intersection between our human intelligence and artificial intelligence is getting more intimate all the time. Communications technology and neuro-technology are evolving in tandem and in dialogue with one another. Can we embrace this new strand of diversity or should we fear it? And what can it tell us about our limitations and possibilities as intelligent, empathetic, creative beings?

The starting point for this journey is a dive into what we know about intelligence. What is it? Where did it come from? How do human beings' intellectual capacities compare with those of other intelligent creatures? If we begin to think of it not so much as an individual's intellectual capacity but as a shared survival strategy that makes us fitter for life, we will be ready to reimagine it for the challenges of the twenty-first century,

enabling us to thrive in a hyperconnected world of increasing uncertainty and escalating change.

I believe we are now at a tipping point where we can perceive the limits of individual intelligence. Now is the time for a renaissance in joined-up thinking that harnesses the diverse cognitive reserves at humanity's disposal. If we can nurture the combined brain power of the many, across groups and across generations, by opening up to ancient wisdom, to intellectual mavericks and outlier ideas, we can shift from 'me' thinking to 'we' thinking. This is the mindset that will drive our success, both as individuals and as part of our many collectives, over the next crucial decades.

CHAPTER TWO

What Is This Thing Called Intelligence?

Most of us associate intelligence with certain skills (mathematical reasoning, say, or being able to speak a number of foreign languages) and also with concrete achievements in the form of test results, discoveries, innovations and prizes. As children, our history lessons focus on the stories of outstanding individuals, the Marie Curies and Charles Darwins, the Mary Annings and George Eliots. We know of course that geniuses are by definition exceptional, but we usually accept that some of us are just provably, measurably smarter than others. We learn this at school as we experience streaming for ability, and sit exams. By the time we arrive at adulthood we have absorbed a whole set of beliefs about what intelligence is, what it produces and what it looks like. We have grown up in a society that is heavily invested in a hierarchy of cleverness, and the need for institutions such as universities and corporations to define, develop, test, monetise and reward it.

In this model of thinking, where our individual intelligence is equated with success at school, college and work, intelligence stems from the innate cognitive gifts we were born with and is then developed through education, measured with exams and finally presented with opportunities to prove itself through innovative products or ideas. Intelligence becomes a competition, with winners and losers.

Now, I admire conventionally intelligent people as much as you would expect from someone who is lucky enough to work

alongside some very brainy individuals. There's no denying that some people have unusual gifts, and I am grateful for all the contributions they have made throughout human history. But as a biologist and a neuroscientist, I also know the perils of over-investing in any single individual trait – or individual person. When we conceive of intelligence in narrow terms, we are falling into that trap.

Our species has thrived because of diversity (as have all other social animals). Any and all contributions might prove to be crucial to solving a problem. Investing too much in the usual suspects – the high-achiever or the lone genius – can blind us to the range of skills and capacities that other people have to offer. The breakthrough might come from the introvert who has a completely novel approach to a long-standing challenge but lacks the communications skills to present it. Or from the employee who's considered too young to be up to the job, or the one who's reckoned to be past it, or the person with a diagnosis of attention-deficit/hyperactivity disorder (ADHD), whose creativity and lateral thinking could generate ideas for new products and approaches.

I'm not for a second saying that conventionally intelligent people or experts aren't needed any more, just that broadening our definitions of talent and expertise will yield more breakthroughs in every area of life, from science to our personal relationships. We limit ourselves and others when we fall back on our ingrained thinking about how to be skilful, successful and smart. We need to find new answers to the question of what it means to be intelligent, by pushing beyond our immediate associations with certain skills and certain kinds of people. That will free us up to imagine intelligence anew and, from there, figure out how we can build more of its variety into our own thinking and into our groups' interactions.

All Brains Are Not Alike

Human beings have always been proud and possessive of our intellectual prowess. For centuries Western thought rested on the belief that we alone of all animals were conscious, thinking creatures. But just as people have always admired and desired intelligence, so too have they questioned what it means to be clever. Discussing, let alone measuring, intelligence has always thrown up questions. Is it an output or a process? Is it innate or can it be taught? Is it flexibility of mind, capacity to reason, flair for creativity or something else entirely?

Most people would probably agree that a high IQ or a clutch of good exam results can tell you *something* about a person's abilities but doesn't capture what we understand by intelligence in a broader sense. A straight-A student may have a superb memory and excellent powers of analysis, but how's their emotional intelligence? Do they come up with unusual and original insights? Are they witty? Are they shrewd, adaptable, a quick learner, curious? Do they have good social skills? Do they empathise, and communicate well? What exactly are we talking about here? And beyond IQ tests or exams, can we judge intelligence by the quality of someone's conversation or by their life choices?

The answer is that we can and do make such judgements all the time, but they are subject to our own partial and biased notions of what it means to be an intelligent person. If we rely on a set of A grades as proof of intelligence, how do we accommodate the fact that coaching can significantly increase a student's chances of achieving those grades? If we define it, consciously or unconsciously, as a set of accomplishments and tastes, can we recognise that such judgements are subject to our bias about social groups? At various times over the last hundred years, IQ tests have been used to justify the belief that certain

races are inherently more intelligent than others. This has been soundly disproven over and over again but it shows us that a little bit of science, selectively applied, can be used in the service of almost any argument. Intelligence, even in the narrow sense of an IQ score, is less a measurable fact and more a label that we use to define and value certain qualities.

My discipline of neuroscience is naturally the main framework for my own thinking about thinking, and neuroscientists are always looking out for the divergences between what brains *generally* do and what particular brains do differently from one another. Neuroscience has its sights trained on what a baby's brain can do and what it can't, yet; or what a person with schizophrenia's brain does, compared with the brain of someone who doesn't have that diagnosis. This focus on difference and diversity feeds into the definition of collective intelligence that we will be exploring throughout the book.

In functions that underpin a traditional view of intelligence – such as short-term memory and problem-solving – neuroscientists have demonstrated that certain groups have physiologically different brains, with different functionality. Information processing slows down with age, for example, and the older brain is more vulnerable to bias because it relies on stored wisdom (or ingrained ideas!) to compensate for slower speed. The teenage brain has fewer connections between regions, making it harder for teenagers to integrate reasoning and emotion. Consequently they are prone to impulsive decision-making, but also to coming up with new solutions to problems. The brain of a person with ADHD is more sensitive than average to the rewards of novelty, which can fuel high levels of curiosity.

These differences are subject to a range of variation according to the individual's particular neural circuitry, but they are observable differences in the physiology of the brain that

One way of broadening our thinking about intelligence is to consider it as an evolved strategy that tends towards the success of the species, as well as the individual. There are certain aspects of intelligence that almost all of us share – our species' incredible inheritance of reason and language, creativity and agility – and then there are particular adaptations. It's the power and value of this diversity that I want to look at in more detail.

Why Groups Are Smarter

Intelligence is a survival mechanism of staggering sophistication. In human beings it has evolved into a system of intersecting behaviours that, when they are deployed skilfully, make a successful outcome more likely. Whatever the field or the goal, whether it's developing a new product or crossing a road safely, the skills that make success more likely will have similar biological underpinnings. They will be in the interests of our species' collective long-term survival, written into our brains through evolution, and coded for by our particular DNA. There's no denying that us human beings have evolved to be, generally speaking, incredibly clever.

That said, many of us still fail to understand our limitations. We struggle to grasp that the human brain is not a single entity that serves our unified being but a staggeringly complex electrochemical network that, though infinitely sophisticated, is also fundamentally flawed. Perception, for example, relies on your brain working round the clock to interpret your surroundings and put together a model of reality for you to inhabit.

This is a vast job. It's been calculated that a whopping 11 million bytes of data are sent to your brain *every single second*. Signals are picked up by your sense organs and turned to

electricity as your brain pumps sodium and potassium ions into and out of its 86 billion or so nerve cells. The resultant dance of data zips across your brain network at speeds of up to 250mph via the 86 trillion or so synapses that connect neurons to their neighbours, to form the most intricate and complicated circuit board imaginable. Each cell plays its small part in the processing that generates your eventual behaviour.

It's a phenomenal feat but it's a rushed job, and the brain makes errors as it goes. Perception is not a matter of the sense organs recording reality and the brain interpreting it, but something much messier. Neuroscience has shown that all of us, however clever we may be, are vulnerable to the same cognitive errors in perception and decision-making. We're limited and we're biased, because our brains have so many jobs to do that they must rely on short-cuts, deferring to interpretations that have served us in the past rather than evaluating whether the situation is different this time. We prioritise some information and ignore other bits. Some signals get dumped (unconsciously) into the bin marked 'unimportant trivia'. Errors can creep insidiously into our decision-making and opinions. We jump to conclusions, defer to authority, conform to our peer groups and even miss the gorilla on the basketball court if our attention is directed elsewhere. (Literally, as we'll see in the next chapter.)

The limitations of our individual brains provide one of the most compelling reasons for why we've evolved with the capabilities and inclinations to support collective intelligence: the so-called 'pro-social behaviours' (empathy, altruism, effective communication). They are the key skills that underpin collective intelligence. Two brains really are better than one for arriving at a reliable and objective understanding of a situation, precisely because two people can, to a certain extent, correct each other's perception errors and biases, and negotiate their

way towards the most robust interpretation of whatever they're engaged with.

Most of us are pretty invested in thinking of our particular brain as a smooth operator, even once we know the extent to which our thinking is full of holes and riddled with bias. We imagine our brains as the seats of our consciousness and the factories of our identities, and though this belief may be a fiction of our egos, it's certainly a useful fiction. Life in all its rich emotional, sexual, cultural significance would be less interesting without the idea that I am me and you are you and we are not just different, not even unique but special. (We human beings have big egos to go with our big brains!)

But while it's both necessary and valuable to be invested in our ideas of selfhood, there is much more to know about ourselves and our collective identities and capabilities. If we can see past the 'I' to the 'We' that lies beyond, our understanding of ourselves gets more nuanced, not less. Collective intelligence doesn't take anything away from our individual intelligence. It's not an either/or situation so much as a widening of perspective. We are extraordinary and unique individuals *and* we are collective organisms, both at the micro level of our bodies' organs and the macro level of our need to live in contact with other people.

Survival Is All about Networks

In the early part of the twenty-first century a new field of biology emerged that focused on the way cells interact as part of a complex system. This system was termed the 'sociome', which rather anthropomorphises molecules and cells, but it's an evocative description of their ability to communicate in such complex ways that they might almost be said to be 'socialising'. Since then it's been increasingly accepted by biologists that all

life, at every level, is social: from genes cooperating to form organisms, to animals cooperating to form groups.

Every element of our bodies depends on connected networks functioning across groups of cells and even across distinct organisms. Our guts host a microbiome of millions of microbes, which have a huge influence on health, happiness and – you guessed it – intelligence. There is a society of biological processes occurring in each and every organ of our bodies, which is in turn connected with multiple others. Our brains are connected to our peripheral nervous systems and in constant communication with the heart and the gut, which are both rich in nerve cells and keep hold of a lot of the extraneous data that the brain can't process, storing it for possible use in the future. A thick cable of nerves called the vagus nerve connects the gut to the heart to the brain, rooting through to the insula, a brain region involved in forming our perception of the world. All of which helps explain that 'gut instinct' or 'feeling of the heart' when we suddenly feel we know something, almost unconsciously.

Professors Sarah Garfinkel and Joel Pearson, at University College London and the University of New South Wales respectively, have discovered that for some people this connection between the organs is stronger and more accessible to their awareness than it is for most of us. These individuals are highly sensitive to information they're receiving subliminally. Their intelligence is optimised by the power of what neuroscientists call 'embodied cognition' so that it's almost as if they're thinking with their guts and hearts as well as their brains. They have access to a kind of collective intelligence that emerges from within their own bodies. We'll come back to this later and look at the evidence that we can all develop our own internal collective intelligence by tapping into our embodied cognition to develop our intuition.

As well as the connections between cells and organs that determine our health, happiness and intelligence, evolution has also prioritised connections between individual people. Essentially, human beings have evolved to live in groups. Faced with stronger, faster predators or the constant work of childbearing and food gathering, an individual or pair bond of human beings was vulnerable. Our ancestors relied on one another in multigenerational families and tribes, for support to bring up their children and provide the basic necessities for survival. They developed communication in order to share ideas, and empathy so that they could, when required, prioritise the needs of another person or the group over their own. Without these propensities to communicate and look out for one another, our species may not have survived and almost certainly would not have thrived as we have. The individual benefited too, because a person whose skills were of value to the group was powerful and secure.

You could say the same things about any social species, mind you, and when we start to drill down into sociability it turns out that it's everywhere, from ants to honey bees, and even forests. Collective intelligence in all manner of organisms arises from social interactions, and it serves the needs of the group while reinforcing the status of the individual. We're not so different from ants in this respect.

Understood in this way, collective intelligence is part of our evolutionary inheritance and a superpower hiding in plain sight. Rather than over-relying on our individual flawed brains or even the individual flawed brain of a high-achiever, it's time to learn from the way things are in the rest of nature.

Intelligence Is Always Collective

ant-ish?) kindness and more about maximising our individual and our species' survival.

Members of our species may occasionally headbutt like disagreeing bees, but generally we are well equipped to work collaboratively. Robin Dunbar, professor of evolutionary psychology at Oxford University, has spent his career researching the social brain and says, 'Most people, even the relatively shy or introverted, have a staggering capacity to navigate our complex social world, and much of this functioning takes place with seemingly unconscious ease. This suggests that all relationships are to some extent reliant on deep-brain functioning to do with pleasure, reward and motivation.' Human beings seem to be biologically driven to find the process of reciprocating attention rewarding, and Dunbar suggests that this pleasure in communication and collaboration has helped us to evolve as a species.

Bottom line: whether we are an ant, a tree or a human being, as individuals we are vulnerable. In our species, the social neural circuit, which is not so much a brain region as a labyrinthine system, has evolved to offset this vulnerability. It drives us to form connections with other people that will come in handy in times of crisis and buffer us against loneliness, sadness and ill-health.

Humanity's Unique Contribution to Collective Intelligence

Effective collaboration on any kind of project, whether it's farming aphids or building a space station, is the output of an evolutionary strategy that has prioritised the necessary skills for working together as a group. But Robin Dunbar's research has shown that the size of the group matters. In humans, once it passes approximately 150 individuals, cohesiveness starts to break down. The bonds of trust and reciprocity on which

collaboration depend cannot be maintained. Group size varies from species to species but all species have an upper limit beyond which they must break away and form a second group. This places a limit on the amount of brain power that any group can harness.

Human beings are the only animal, as far as we know, that has come up with mechanisms for getting round this limitation. By developing rules to govern interactions, as well as institutions to oversee them and arbitrate over differences, we have been able to massively extend our networks and so work effectively in ever larger groups. This has been invaluable to our species' development. If we were only able to rely on straight reciprocity – you do something for me and I'll do something for you – then our cooperative world would be far smaller, probably confined to our core circle of family and significant friends. There would have been limited possibilities for trade, commerce, travel or culture to develop. Human activity would have remained tribal or feudal.

Nichola Raihani traced the development of social rules and institutions in her book *The Social Instinct.* As far back as the Pleistocene era there was a shift away from the winner-takes-all dynamics of a strictly hierarchical group structure, and towards governing by coalitions. This helped our species to flourish. In the kinds of hierarchies we see in other primate groups such as chimps, a single high-status individual battles it out with others at the very top. Chimps do form strategic alliances around the alpha but since there is only one winner the rewards are highly concentrated. By joining a team or becoming part of a syndicate, the chance of receiving some sort of reward is much better for many more individuals. There's an incentive to collaborate, especially in a challenging environment. As this approach beds in and it makes sense to more and more individuals to work


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