ARTICLE

THE NEUROSCIENCE OF THE SECOND TRACK

Peter Fritz AO

Humanity's evolutionary advantage lies in our ability to cooperate and communicate within groups towards shared goals. Entrepreneur and philanthropist Peter Fritz AO argues that the Second Track process is more effective than other approaches because its format is aligned with our natural desire for positive group interaction.

INTRODUCTION

> 'If you want to go fast, go alone, if you want to go far, go together.' – African proverb

This article explores the potential links between current research into human neuroscience and the positive individual effects and social interactions facilitated by the Second Track Process. It suggests that future studies of participants' brain functions in Second Track groups could contribute to the burgeoning study of the neuroscience of social interaction[1].

Global Access Partners' (GAP) Second Track process[2] has progressed over 20 years of practical experience through the unstinting work of thousands of participants from Australia and overseas. Its outcomes include a report on genetic screening for a breast cancer drug which changed Victoria's health policy (2007); the establishment of the Centre for Social Impact (2008), a national centre for philanthropy and social investment; public consultation on NSW strata law reform (2012); the development of Australia's first National Cloud

1. Pfeiffer et al., 2013
2. Global Access Partners, 2021

Computing Strategy (2013); the establishment of the International Centre for Democratic Partnerships to build stronger relationships between Australia and the Pacific (2017); the Australian Space Initiative, which encouraged the creation of Australia's space agency (2017); and Federal government's embrace of soil carbon credits to mitigate carbon emissions (2019).[3]

The format's heuristics have been winnowed by GAP from this collective experience, rather than derived from prior theory, just as the individuals shape the activities of each Second Track group within it. While GAP remains focused on pursuing positive change globally, it has now turned the spotlight upon itself to understand better the Second Track and the neurological processes that drive it.

The Second Track brings groups of disparate stakeholders and subject experts together to discuss, recommend and implement initiatives to address complex problems or 'wicked' issues[4] in a safe and sound environment. Wicked social, economic or political problems tend to frustrate traditional 'first track' administrative solutions because they cross different government jurisdictions, affect powerful or deeply entrenched vested interests or are intertwined with other, seemingly intractable, problems.

Experience suggests that GAP's Second Track circumvents some of the barriers to discussing and implementing solutions for several reasons. Participants attend voluntary and individual capacity, rather than representatives of particular interest groups, and drawn from a wide range of stakeholders. While each may be an expert in their field, the groups' discussions – reported under the Chatham House rule of non-attribution – encourage a franker and broader exchange of information and ideas. Fluid agendas, the ability to create and accomplish tasks, and the implied requirement to adopt as well as advocate change also encourage a more 'open-minded' and practical approach.

While the opportunity to progress particular agendas attracts participants, exploring the hidden psychological drivers that produce the positive group interactions empowered by the Second Track may help explain its high rate of successful outcomes.[5]

Exploring the hypothesis that the Second Track changes the way participants consider issues through the positive neurological feedback it engenders may prompt future research, encouraging the method's wider adoption to complement traditional 'first track' approaches. The links this paper draws between the Second Track and ongoing streams of neurological research may also encourage the use of Second Track groups by researchers investigating the mysterious neurobiology[6] of human social interactions.

The objective testing of participants' physiological reactions in Second Track groups, alongside similar monitoring of subjects in other forms of groups and committees, could in the future support the proposition that a Second Track process is indeed more effective than other approaches because its format is aligned with our natural desire for positive group interaction.

Emergent Communities of Practice: A complexity theory lens[7] by Peter Massingham, Catherine Fritz-Kalish and Ian McAuley, published in the

3. Fritz-Kalish, 2019
4. Kolko, 2012
5. GAP initiatives have led to a number of policy reforms at both state and national level and the creation of several permanent institutions including the Centre for Social Impact.
6. Neurobiology is a subset of both physiology and neuroscience and explores the operations of the brain and nervous system.
7. Massingham et al., 2020

previous edition of *BESS*™, viewed GAP's Second Track process as an 'emerging type of community of practice'. While this group-based, outcome-oriented framework is instructive, the unique power of the Second Track can be explored through the positive and often unconscious psychological effects and benefits it brings to its participants.

As concrete, real-world outcomes can take months or years to eventuate and may not reward particular participants in any tangible way, it may be the unconscious benefits produced by the process itself in the participants' brains that maintain and encourage their involvement. The chemical rewards produced by the brain, and the spirit of positive human interaction, cooperation and open-mindedness they encourage, may hold the clue to the success of a Second Track's 'group brain'.

After examining the unique factors which differentiate GAP's Second Track from other types of meetings that might claim to produce similar rewards, this paper outlines several recent experiments on both animal and human subjects, in both laboratory and real-world settings, which uncover a range of observable, physical mechanisms for this positive feedback to occur.

WHAT DIFFERENTIATES THE SECOND TRACK?

> **'Coming together is a beginning, staying together is progress, and working together is a success.' – Henry Ford**

An exploration of the neuroscience underpinning the Second Track's effectiveness should begin by differentiating GAP's approach from other types of meetings, inquiries, collaborations and committees.

There is no shortage of worthy committees, inquiries and multi-sectoral groups considering the full range of 'wicked' social, economic and environmental problems facing Australia. However, these lengthy discussions often produce recommendations of tried and failed solutions, with an absence of any responsibility to implement these changes by participants.

While the difficulty of such issues naturally precludes a simple solution, the institutional ineffectiveness of traditional approaches may result from the obstacles the form and the content of these discussions present to positive human interactions. The progress made through the Second Track in diverse sectors with thousands of participants over two decades suggests GAP's approach has developed to overcome many of the barriers that frustrate other approaches, regardless of the individuals or institutions involved.

There is nothing new about collaboration between different groups and stakeholders in a particular sector to achieve jointly agreed ends. However, these tend to be organised by official bodies with well-resourced staff to do much of the heavy lifting. The relative lack of funding for unofficial GAP groups may have proved a blessing in disguise by forcing reliance on the skills, experience and personalities of those who volunteer to participate, rather than subcontracting responsibilities to staff. Furthermore, the lack of official sanction allows participants to ponder 'off the wall' solutions and forces them to consider implementing these solutions themselves.

While less structured in content than 'first track' processes, Second Track groups have a more formalised format than most communities of practice, and their discussion aims to produce concrete projects, policy and pilots, rather than continue the debate as an end in itself. They are consciously created, their participants are expressly invited, and a chair is appointed to run

a limited number of scheduled meetings, although participants are also encouraged to communicate offline. A secretariat then summarises these discussions and the minutes distributed to members to inform further consideration, unlike informal communities of practice whose discussions are seldom summarised or aggregated.

While a range of other meeting and collaboration formats – from office brainstorming and company project teams to parliamentary sub-committees – may appear similar to GAP's Second Track, GAP's method is distinguished by several unique factors.

Traditional collaborations tend to be between organisations rather than individuals, for example. While GAP's Second Track groups invite experts from business, academia and government who may well have served on traditional committees, these people represent only themselves within the GAP process rather than their companies, departments or organisations. This demands a more significant measure of individual commitment to the group and its aims, and, as Vince Lombardi[8] notes, 'Individual commitment to a group effort – that is what makes a teamwork, a company work, a society work, a civilisation work'.

This freedom tends to attract individuals who may hold powerful positions but also seek alternative approaches. It also implies a willingness to embark on new activity on common ground, rather than defending old battle lines, as participants are volunteers rather than appointees, have no official standing and receive no direct financial remuneration.

The nature of the Second Track turns every participant, no matter how eminent, into a learner and speaker and forces them to acknowledge the gaps in their understanding of a complex issue and expand on their experience of any particular facet. As Patrick Lencioni, the author of *The Five Dysfunctions of a Team, A Leadership Fable,*[9] observes, 'Teamwork begins by building trust. Furthermore, the only way to do that is to overcome our need for invulnerability'.

The Second Track's generation of ideas differs from traditional 'brainstorming' because the group is initially invited to raise critical problems to be solved within a broader discussion of the group's central issue. Brainstorming, by contrast, tends to involve members of a single department being asked to suggest a range of solutions to a tightly defined problem, presented to them by a person in authority in a single session.

This 'blank page' agenda allows grassroots issues to be identified and considered without the constraints and blindspots imposed by participants' 'day jobs'. Unlike traditional think tanks, participants are expected to help implement their recommendations, often through standalone projects or pilots, to prove their potential to policymakers rather than simply call for more public spending.

Many intelligent, capable and civic-minded professionals in both the public and private sector begin their careers with idealistic plans to change the world, which are soon frustrated. Other people may only come to realise the failings of particular systems and processes after long years of experience. Some attendees promote a particular vested interest – an approach the Second Track acknowledges and embraces, given its motivating power.

The Second Track gives all of them a safe opportunity to express long-held opinions or create fresh ideas free from their day-to-day constraints. The recording of minutes under the Chatham House rule of non-attribution[10] and the confidential

8. Vincent Thomas Lombardi (1913-1970) was an American football coach, and executive in the National Football League.
9. Lencioni, 2002
10. Chatham House, https://www.chathamhouse.org/about-us/chatham-house-rule

nature of these discussions encourage people to speak their minds without fear or favour. This initial frankness is a crucial part of the Second Track process, as 'politeness is the poison of collaboration', in the words of Edwin Land.[11]

The 'safe space' offered by the Second Track can therefore refresh curiosity about the views of others, encourage a holistic, rather than a partisan, view of the issues at hand, and rekindle creativity suppressed by the demands of careers and institutions. More fundamentally, the mere process of being heard and acknowledged by their peers, as outlined later in this paper, is in itself precious for group attendees.

By dispensing with hierarchies – a radical step in itself – Second Track groups are forced to assess the ideas they generate by their merit, rather than prejudging them by the eminence of their source. As the group decides which ideas to pursue, they are more likely to remain engaged with them, as they cannot devolve responsibility to others. This opportunity for self-actualisation may be a rare experience for even the group's most senior members and becomes all the more valuable for that. It also means that the best ideas tend to be selected rather than those which align with pre-existing agendas or long-established ideas.

The non-official nature of the group and its ability to act outside existing boundaries ease the cognitive dissonance participants may feel when forced to confront the contradictions between their official positions and personal convictions. It also encourages personal relationships and common commitments with like-minded people they might never have met or seen only as rivals or opponents.

Although Second Track groups are outcome-oriented rather than debating societies and are encouraged to pursue several projects themselves, they differ from standard project teams in defining and creating their ends and activities, rather than delivering a given set of goals with a larger organisation. Members of project teams tend to hold the same formal role through their lifecycle, and the team is inevitably broken up once their particular task is completed. In contrast, the activities of Second Track members and the groups evolve, often continuing into an implementation phase or morphing into other groups or permanent institutions.

Just as the minutes and reports generated from those minutes are non-attributable, the group's achievements, rather than credit for particular individuals, are paramount. The absence of manoeuvring for career advancement also helps increase group solidarity, and 'It is amazing what you can accomplish if you do not care who gets the credit', as Harry Truman[12] once said.

The unique facet of GAP's Second Track frees participants to discuss a wide enough range of topics to create a holistic view of any given issue. Its members are invited as individuals, but they remain elite groups, as participants are chosen for their experience and decision-making ability across the sector at hand. Unlike other groups, these participants define specific points of leverage where progress is both practical and possible and turn their own words into deeds. At all times, the group's chair acts as a facilitator, encouraging involvement from all, rather than a controlling hand steering the group to rubber-stamp a preconceived conclusion.

Significant though these differences are, they are not the fundamental reasons why Second Track groups succeed. Instead, these processes and procedures are effective because they have evolved to provide further scope to more fundamental neurological drives in the individuals within them.

11. Edwin Herbert Land (1909-1991) was an American scientist and inventor, best known as the co-founder of the Polaroid Corporation.
12. Harry S. Truman (1884-1972) was the 33rd president of the United States from 1945 to 1953, succeeding upon the death of Franklin D. Roosevelt after serving as the 34th vice president. He implemented the Marshall Plan to rebuild the economy of Western Europe, and established the Truman Doctrine and NATO.

THE PSYCHOLOGY OF GROUP INTERACTIONS

> **'Man is by nature a social animal... Anyone who either cannot lead the common life or is so self-sufficient as not to need to and therefore does not partake of society is either a beast or a god.' – Aristotle**[13]

John Donne observed that no man is an island,[14] and scientific research substantiates this long-held poetic truth. Humans are social[15] and empowered by language and the culture it helps create. This aspect of our nature has been the key to success, from hunting mammoths in the distant past to building mega-cities and the internet. Charles Darwin observed that in 'the long history of humankind (and animal kind, too), those who learned to collaborate and improvise most effectively have prevailed'.[16] In the more prosaic view of American industrialist Henry Ford, 'if everyone is moving forward together, then success takes care of itself'.

The complex yet subtle electrical and chemical processes in the human brain which produce and manage these social interactions are less well understood, mainly because physical dissection of a deceased brain can only go so far in helping us understand its operation. Michio Kaku notes that 'the human brain has 100 billion neurons, each neuron connected to 10 thousand other neurons', which means that 'the most complicated object in the known universe' is 'sitting on your shoulders'.[17] It may be true that if the human brain were simple enough to understand fully, we would be too simple to understand it, but great strides have been made towards comprehending its structure and myriad operations in recent years.

Unfortunately, most observations of the living brain have been undertaken on single subjects in controlled laboratory conditions due mainly to the cumbersome monitory machinery required for objective recording of brain functions. Given our social nature, it can be supposed that human brain functions would be observed in groups interacting in real-world conditions.

Advances in portable and less invasive monitoring technology are now allowing researchers to pay increasing attention to understanding the neural basis of social cognition and behaviour, as well as individual brain functions. Scientists in this exciting new field of social neuroscience are using non-invasive neuroimaging to identify the brain structures, chemicals, and biological circuits that underlie social cognitive processing. By doing so, the types of human interaction increase or decrease these impulses and secretions.

Individuals are hard-wired to survive and will put their interests ahead of the group in many circumstances, but as naked apes lacking the teeth, strength and speed of other predators, we evolved to depend on successful group dynamics to prosper and thrive. It, therefore, seems logical that our brains would evolve to reward positive and productive group interactions.

Despite this, most group behaviour studies have focused on the psychological and physiological forces that drive individual aggression and group competition with outsiders or other entities rather than positive cooperation. The study of outliers, diseases and unusual events may be more exciting, but the most critical area of study should be the everyday and commonplace. Given that humanity's evolutionary advantage lies in our ability

13. Aristotle, written around 350 BC
14. Donne, 1988
15. The Cooperative Human, 2018
16. Satterfield, 2013
17. Kaku, 2014

to cooperate and communicate within groups towards shared goals, it would seem more useful for researchers to use their new technology to focus on activities – such as the Second Track – which encourage positive cooperation and allow groups to become so much more than the sum of their parts.

The study of humans in real-life situations explains why many satisfying abstract theories fail to explain or predict human behaviour. Man is made of crooked timber indeed. Classical economics, for example, is based on the not unreasonable assumption that individuals will act rationally to pursue their economic interests. However, this theory also assumes perfect knowledge and market flexibility in the graphs it then draws, meaning the straight lines on paper will only hint at trends in real life rather than entirely explain them.

While Marxist economics scorns individual decision-making, it also assumes that classes defined by their role in the economy will act rationally in their interests, with the proletariat constrained only by the 'false consciousness' created by the ruling elite. In the real economy, people act for all kinds of personal and sometimes illogical reasons, or, conversely, soon find ways to 'game the system' for less than altruistic ends, creating unintended and usually adverse consequences for even the most well-meaning of policy initiatives.

Daniel Kahneman won a Nobel prize by exploring how human psychology affects economic decision-making, and the attention paid by policymakers and marketers to 'behavioural economics' and the potential to 'nudge' citizens or consumers in particular directions by subtle environmental or psychological clues suggests that its potential is permeating the rest of society.

Similarly, a better understanding of the real human drivers of group interactions, above and beyond the actual issues they debate, may help groups cooperate more effectively and achieve more practical ends. The Second Track works through a process of trial and error, shaped by experience rather than prior theoretical assumptions, but after 20 years of experiment, fomenting a theory of Second Track interactions should allow these processes to be consciously honed in the future and applied productively elsewhere.

Published almost a decade ago in 2011,[18] Kahneman's *Thinking Fast and Slow* explains[19] how our powers of reason and emotion battle to control our behaviour. The book describes a slew of errors in memory, judgment, and decision-making, relying on impulsive 'gut feelings' can produce. However, given the effort which intellectual focus requires, most of us rely on instincts honed for the African savannah rather than the Australian city more often than we should. Humans are animals, rather than androids, risen apes, not fallen angels, in the phrase of Richard Dawkins.[20] We are diverse, impulsive and contradictory as individuals, whatever our achievements in groups. However clever we may think of ourselves, we are still prone to rely on thumb heuristics, which makes us see simple patterns in complex systems and lead us fatally astray.

John Stuart Mills' rational *homo economius*[21] would not differentiate between the risk of losing $100 to gain $100, for example, but the long-dormant hunter-gatherer in us remembers that a bird in the hand is worth two in the bush. So we still prefer to hold what we have and remain suspicious of change[22] if a new pasture harbours a tiger. This

18. Kahneman, 2013
19. Holt, 2011
20. Richard Dawkins is a British ethologist, evolutionary biologist, and author.
21. Wilson, 2018
22. Loss aversion is an important concept associated with prospect theory and is encapsulated in the expression 'losses loom larger than gains' (Kahneman and Tversky, 1979).

deep-seated aversion to loss has political and social implications, as people will tend to be less willing to embrace reforms than rationality suggests they should. This simple evolutionary imperative may speed the downfall of many traditional groups, as their members cling to long-held beliefs and interests rather than pursue mutually beneficial changes. Second Track groups, by explicitly divorcing participants from their traditional roles, at least ease these ties to the past, freeing individuals to seek change they also have the power to deliver.

However, once again, while individuals ostensibly participate in Second Track groups to explore issues of interest to them, forward a particular cause, solve an institutional problem or even seek commercial opportunities, they are not paid directly for their time, and not every group generates companies which participants become a part of. Second Track groups may well be more productive than other types of committees and task forces, but the reasons why people participate – and, most tellingly, why people tend to stay engaged throughout the one- or two-year Second Track process and join multiple groups over the years – must have deeper psychological drivers.

Mutually satisfying interactions between people and within a convivial group produce positive emotional states, as we evolved as social animals who relied on successful group dynamics for survival. We join sports clubs, choirs and civic groups as much for the bonds of friendship we create and the satisfaction of pursuing a purpose larger than ourselves as the activity itself. By recognising and fostering the network effect of participants' contacts, the Second Track multiplies its power to deliver results. However, it is the individual connections that people generate – notably the *Pacific Connect* community created by the International Centre for Democratic Partnerships[23] – which deepens individuals' involvement in the Second Track group.

In a world of texts and smartphones, the power of Second Track's emphasis on face-to-face meetings (albeit on hiatus given the social distancing required during the COVID-19 pandemic), should not be underestimated. Indeed, the value of real-life interactions, held in close physical proximity, rather than distanced by technology or an overly large group, is a feature of some of the experiments outlined below.

It is easy to ignore or dismiss information one may dislike when presented in the form of a news article or paper. Indeed, the algorithms that shape our social media and YouTube feeds expressly avoid confronting us with unfamiliar perspectives or contrary views. Organisations will also have a 'party line' about issues they are deeply engaged with, but only through a particular or partisan lens. An in-person roundtable discussion with individuals from every part of a sector, but without hierarchies or set agendas, forces participants to engage with their fellow human beings, which demands at least consideration of their opinions.

Rather than prepare and read out statements for the record, individuals in a Second Track group are encouraged to engage in a free-flowing discussion whose ends none of them can predict with any certainty. This ability to shape the form, content and result of the debate increases individual engagement, and therefore the pressure for group cohesion, to a much greater degree than more structured and impersonal 'first track' processes.

Positive group interactions and pleasurable social experiences have well-documented health benefits. As well as temporarily elevating one's mood, such experiences shown to relieve long-term depression, reduce blood pressure and even mitigate against cardiac disorders. However, as previously noted, most studies in socio-biology have concentrated on individuals or the interaction of two individuals,

23. Blackshaw, 2020

rather than groups; pathological rather than normal mental states; and aggression rather than cooperation. While autism, personality disorders, and schizophrenia are important and debilitating conditions, there is another place to understand normal human interactions.

Academia's emphasis on original publication also means that the conclusions of up to two-thirds of papers in psychology and other social sciences fail to be replicated by subsequent experiments instead of being peer-reviewed in terms of process.[24] Sweeping conclusions are often drawn from animal studies which may have little or no relevance to more complex human interactions. Scientific studies of the social interactions during the Second Track should balance these extremes and prove valuable as the issues under discussion.

Most mammals live in family groups, at least for a time, and other highly successful animals like bees, ants and termites are social to such an extreme extent that each colony effectively operate as a single mega-organism with thousands or even millions of members. Even bacteria and trees can recognise and effectively communicate with each other to some extent. Though millions of people may congregate in a city, we retain far more individuality than that. While we are inherently social on a small scale, such congregations are not natural to us. We find it difficult to remember and maintain more than 100 personal contacts, the size of a Stone Age tribe, regardless of the technology at our fingertips today.

Second Track groups tend to maintain around a dozen members, although individuals may join and leave over time. Just as we balance reason and emotion in our lives, our primitive social urges manage affiliation and aggression by establishing hierarchy and territoriality. Second Track taskforces break down existing affiliations, forcing us to reconsider our place and role in a new grouping.

Although they offer an alternative to current institutions and consultation methods, Second Track solutions tend to be rooted firmly within the current system. To remain practical within tight budgets, they tend to be evolutionary in nature and small in scale, at least as pilot measures. However, a Second Track body is an anarchist in nature, a self-organising group relying on a spirit of mutual aid to achieve common goals without authoritarian leadership. While meetings are organised for a particular date, and the chair may call the meeting to order and ensure the broad points on the agenda are addressed, members shape the discussion themselves, and the opportunity the Second Track groups give to participants to express themselves socially, as well as rationally, is part of their attraction and success.

Our social interactions are vital to every aspect of our lives, and a better understanding of the neural factors which shape our social behaviour could help address a range of social problems in itself, from crime and violence to racism and neglect of the most vulnerable. Understanding the brain chemistry that drives aggression has led to selective serotonin reuptake inhibitors (SSRIs) to curb impulsive, dangerous, and aggressive behaviour. Low levels of serotonin, for example, tend to increase the number and severity of bouts of aggression,[25] and supplements given to animals can make previous combatants make peace and groom.

These effects are complex, however. Increased serotonin levels make male monkeys more dominant in the hierarchy, and similar results are seen in human studies. For example, healthy participants who were given SSRIs proved to be both more dominant and cooperative during

24. Harris, 2018
25. Seo et al., 2008

mixed-motive games in one study.[26] Conversely, the depletion of serotonin led to less cooperation during a 'prisoner's dilemma' exercise, as participants rejected more offers that disadvantaged their fellow players, even when this potentially disadvantaged them.[27]

Real-life studies of social behaviour often employ the 'ecological momentary' method of assessment,[28] which plots behaviour on a graph with axes of agreeable–quarrelsome and dominant–submissive. When researchers gave different groups of people a placebo or two or three weeks of tryptophan,[29] a substance that supports serotonin production, the latter were duly found to be less quarrelsome and more dominant than their unmedicated peers.[30] Pleasurable human interactions can naturally boost serotonin, so participants in the Second Track may be more productive because they are both more agreeable in terms of the discussion and more dominant in implementation than in traditional and less enjoyable meetings.

Animal studies of the brain compound oxytocin[31] indicate its importance in forming close bonds between mates and mothers with offspring, as it increases each animal's willingness to defend others from a threat. Laboratory studies of healthy people show that it tends to increase our trust in others too. Oxytocin is another chemical that tends to be expressed due to positive interactions, again offering a mechanism by which positive Second Track interactions may prove more productive than their 'first track' equivalents.

One of the problems in studying the neurobiology of human social behaviour lies in the difficulty of objective measurement. Most studies in the past relied on people's assessment of their mood, actions and behaviour in real-life situations, a metric that is prone to misinterpretation. However, when assessing the results of behaviour rather than brain chemistry, bespoke studies involving different groups of similar individuals invited to consider a simple problem and – importantly – implement an effective solution could be more valuable.

Groups of people could be given the task of crossing a lake or other obstacle, for example, with a range of supplies at their disposal. One group could be 'chaired' but organised in a 'second track' manner without previous titles or formal hierarchy, while a more formal procedure could be outlined for another, with a third given no instructions at all. If the Second Track group consistently agreed on a practical solution and implemented it more efficiently than other groups, it would speak to the practical value of the approach.

Groups tend to exacerbate, rather than moderate, positive and negative traits that individuals might display in the same conditions.[32] Although any individual might run for the exit if caught alone in a building when a fire alarm goes off, for example,[33] people are more inclined to stay put – or panic completely – if surrounded by others doing the same. The bystander effect,[34] in which people in groups are less willing to help a stranger than they would be alone, is well known, as is people's

26. Tse and Bond, 2002
27. Wood et al., 2006
28. Ecological momentary assessment (EMA) involves the repeated sampling of the subjects' experience and behaviour in real time in their everyday environment. EMA eliminates recall bias, maximises ecological validity, and allows the study of microprocesses which influence behaviour in real-world situations which laboratory-based experiments may miss.
29. *Tryptophan is an essential amino acid which not only regulates infant growth and adult nitrogen balance but also creates niacin, a building block of the neurotransmitter serotonin.*
30. Jenkins et al., 2016
31. Oxytocin is a hormone secreted by the posterior lobe of the pituitary gland, a pea-sized structure at the base of the brain. It is popularly termed the 'love hormone' as it is produced when people cuddle or socially bond.
32. Radburn and Stott, 2009
33. Patrick, 2018
34. The bystander effect means people are less likely to help a distressed stranger if others are present. First proposed in 1968, it suggests that groups cohere into a state of shared and mutual denial through the diffusion of perceived responsibility.

propensity to riot if others around them give them social license by doing the same. Group dynamics, such as the Second Track, which have been honed over time to promote cooperation towards common ends, might also have the same effect on participants in a more beneficial direction, encouraging more positive behaviour and actions than would be the case if they were alone or in a more hostile or formal group setting.

The search for effective, practical ways to improve group dynamics is important. The infamous Milgram experiment[35] saw groups of students willing to deliver significantly more severe electric shocks to their playacting victims than individuals acting alone. Groups playing the Prisoner's Dilemma – a thought experiment that rewards trust and invites individual 'cheating' for personal advantage – also tend to be more cut-throat than individuals playing with each other. Discussions on social and political issues tend to include more 'fear and greed' statements if held in groups than if individuals are interviewed alone, and so it is vital for any group format to exacerbate positive rather than negative aspects of group behaviour.[36]

If the individuals within a group disagree on a common end and do not work cooperatively towards it, then they soon become less than the sum of their parts. The great success of Second Track groups is that they form a 'group brain' which is greater than the sum of its parts. While they generate ideas through discussions that no individual would produce due to greater exposure to the experience and ideas of others, a range of investigations into the nature of the 'social brain' outlined below offer more fundamental explanations of their effectiveness and appeal.

THE SOCIAL BRAIN[37]

> **'The proper study of mankind is man.'**[38]
> **– Alexander Pope**

For all but the last few decades of human history, the workings of our brains have remained a mystery. Indeed, our understanding of the universe around us developed far more quickly than our comprehension of the organ with which we understand the world. The brains' workings can be discussed in terms of metaphors,[39] given their innate complexity and the difficulty of studying something that we are studying. In the modern day, our brains are often seen as computers, for example, although the functioning of a living brain and a silicon chip has less in common than may first appear.

Neuroscience has traditionally focused on studying neurons or networks of neurons within individual brains by monitoring a subject asked to undertake a task alone in laboratory conditions. Monitors of various kinds then generate images of brain activity which indicate the complex neural processes that allow our brains to perceive, understand and act on sensory data.

While this has proved a helpful foundation in our modern quest to understand ourselves, simultaneous studies of humans interacting with each other in real-life situations are now coming to the fore. For example, there have been few studies that even attempt to explore the complex brain chemistry involved when two people talk to each other, let alone groups of ten or a dozen, in a roundtable discussion, and so the field is ripe for expansion.

35. McLeod, 2017
36. Massachusetts Institute of Technology, 2014
37. The social brain is defined as the complex network of areas in our brain that allow us recognize others and evaluate their mental state, intentions, feelings and actions.
38. Pope, 1733-34
39. Presentation on Metaphors and Historical Conceptions of the Brain, University of California San Diego, http://mechanism.ucsd.edu/~bill/teaching/w12/philneuro/metaphorsandconceptionsofbrain.key.pdf

'We spend our lives having a conversation with each other and forging these bonds,' says neuroscientist Thalia Wheatley of Dartmouth College, but 'we have very little understanding of how it is people actually connect. We know almost nothing about how minds couple.'

This glaring gap in human understanding is beginning to be closed by a new generation of neuroscientists using sophisticated but portable and user-friendly technology to monitor and analyse the interactions of two individuals and larger groups. These studies have begun by looking at groups of people engaging in eye contact, storytelling or the joint consideration of an object or topic, but the unique dynamics of Second Track groups should offer a rich source of future studies, as the new field of interactive social neuroscience continues to develop.

Over and above the valuing of one method of committee organisation above another, such studies could help define the neural underpinnings of real-time real-life social interactions and improve our understanding of communication in the most fundamental terms. This might improve everything from education and training to the quality of political discourse – all issues that GAP Second Track taskforces have considered.

Previous generations of brain imaging machines required the subject to remain entirely still for long periods, and scientific rigour seemed to demand a strict level of environmental control which could only be maintained in the lab. Despite these practical barriers, the first successful attempt to study the functions of two brains interacting at the same time took place nearly 20 years ago.

Physicist Read Montague placed two subjects in different magnetic resonance imaging machines – more commonly used in hospitals – observe their brain activity as they played a competitive but straightforward game. Although they had to lie motionless in their respective machines, one person could send a signal to the other indicating whether they had just seen a red or green bulb light up, while the other had to guess whether or not they were telling the truth. In monitoring the differences and similarities of their brain functions simultaneously, he essentially invented the process he termed 'hyper-scanning'.[40]

Researchers soon adopted similar strategies, and the term now covers any brain imaging research involving more than one subject. Rather than place people in MRI scanners, today's researchers use various techniques, including electroencephalography (EEG) monitors,[41] magnetoencephalography[42] and functional near-infrared spectroscopy[43] to monitor activity in the brain. As the technology becomes less cumbersome and invasive, more people can be studied in more realistic situations, producing more practical results.

The hypothesis that Second Track groups become a *gestalt*[44] (collective brain) that can produce more robust results than other groups or individuals can now be tested in terms of brain function and practical outcomes. Participants might be monitored in Second Track and other types of group to see how well their brain waves synchronise, for example.

Several studies hint at ways that a Second Track group's 'social brain' might be investigated. One such piece of work, for example, appears to back one

40. Presentation by R. Montague, Professor, Department of Physics, Virginia Polytechnic Institute and State University, at TED, *YouTube*, 2012, https://www.youtube.com/watch?v=ufUkAQOQaXU
41. Electroencephalography (EEG) is a method of electro-physiological monitoring which records the electrical activity of the brain through non-invasive electrodes placed on the scalp.
42. Magnetoencephalography (MEG) maps brain activity by recording the magnetic fields produced by electricalcurrents occurring naturally in the brain, using highly sensitive magnetometers.
43. Functional near-infrared spectroscopy (fNIRS) indirectly measures neuronal activity in the cortex through neuro-vascular coupling.
44. 'Gestalt' is German for 'unified whole'. The initial Gestalt Principles were proposed a century ago by the German psychologists Max Wertheimer, Kurt Koffka and Wolfgang Kohler to explain how the human mind constructed order from myriad sensory perceptions. The concept of seeing individual elements as a whole and this being, in the words of Koffka, 'other than the sum of the parts.' has come to denote a group or hive mindin Science Fiction literature and the popular imagination.

of the driving tenets of the Second Track in finding that cooperation tends to be driven by self-interest rather than empathy for others. The Second Track has always emphasised the importance of self-interest in driving engagement in its processes. This pursuit of self-interest need not be at the expense of fellow participants – indeed, as Napolean Hill observed, 'it is literally true that you can succeed best and quickest by helping others to succeed'.[45]

From the University of Pennsylvania, the study offers a neurological explanation of the Second Track's rule of thumb that an appeal to self-interest can be more productive than pure altruism. It found that self-serving strategy, rather than empathy for other group members, seems to underlie much of the cooperative behaviour observed in most primates.[46] Several rhesus macaques were taught to play a computer game of 'chicken'[47] – no mean feat in itself – and soon learned ways to maximise results and rewards. Two monkeys playing against each other, for example, would cooperate to avoid crashing into each other and losing, but if just one monkey played against the computer while the other watched, then the watching monkey employed a different strategy to maximise rewards for itself at the expense of the other.

'We found that neurons in a part of the brain [previously] linked to strategic thinking, but not in a part of the brain linked to empathy and shared experience, respond selectively when rhesus macaques cooperate,' commented Wei Song Ong, the postdoctoral neuroscience researcher at the University of Pennsylvania, who led the study.

While this does not mean that cooperation cannot be motivated by empathy or consideration for others, it does tend to indicate that, at its root, much of our ostensibly sophisticated cooperation with each other is driven by primitive instincts of self-interest. By acknowledging this reality, rather than obfuscating or ignoring it as other multidisciplinary groups tend to do, the Second Track may free people to pursue their interests more honestly and openly, increasing their commitment to tangible outcomes. This acknowledgement may increase trust between participating individuals, as there is no hidden agenda to be suspicious of.

Like those of the Second Track, the cooperation generated in successful groups could also have a neurological source in the mirroring or synchronisation of brain function. Indeed, the unconscious mirroring of brain activity may be a part of how animals, including humans, interact to form social bonds. A group led by Dr Miguel Nicolelis, a professor of neuroscience at Duke University School of Medicine in North Carolina, investigated this notion fascinatingly. He invented a rhesus monkey to remotely drive a vehicle to gain a piece of fruit while being watched by another monkey.[48] Every time the monkey driving the cart won a piece of fruit, the watching primate was similarly rewarded.

The scientists found that the brains of the two monkeys became synchronised as one carried out, and the other watched the activity. Indeed, Nicolelis reported that up to 60% of the neurons in the motor cortexes of both monkeys fired simultaneously.[49] Significantly, this synchronisation

45. American educator, author, orator, and Presidential adviser Booker T. Washington perhaps phrased the same idea with a little more grace in saying 'If you want to lift yourself up, lift up someone else.'
46. Platt et al., 2016
47. Wilson, 2017
48. Nicolelis, 2013
49. Ramakrishnan et al., 2017

grew as the first monkey drove closer to its reward or, in a follow-up experiment, as the second monkey control the vehicle remotely. This 'group brain' effect may help explain how animals of all kinds manage to undertake group tasks of apparently great complexity, as well as the 'group brain' effect of Second Track groups, while Nicolelis suggested that antisocial neurological disorders such as autism may be the result of an individual's inability to establish such inter-brain synchronisation.

'We can no longer think of brains in isolation,' Nicolelis said. 'The 'social brain' idea that we are talking about supersedes the notions that (scientists) have developed for brains in isolation because the brain is not just a passive device alone in the world. […] The action on one animal involves the actions of other animals.'

Neuroscientist Uri Hasson of Princeton University also explored the capacity of brains to synchronise by scanning a person who was asked to tell a story and noticing that another individual produced similar results when listening to a recording of the tale.[50] 'The brain of the listener becomes similar to the brain of the speaker,' Hasson observed, and further work proved that the more aligned the brains of speaker and listener were in terms of brainwave responses, the greater the listener's reported comprehension. Hasson concluded that 'Your brain as an individual is really determined by the brains you're connected to.'

Hasson is now partnering with Professor Wheatley at Dartmouth in the USA to measure the 'coupling' of brains during a conversation.[51] A good conversation, notes Wheatley, involves 'creating new ideas together and experiences you could not have gotten to alone'.[52] Second Track groups multiply that effect by involving 10 or 12 people in the same conversation, and this network effect may significantly increase its potential for the generation of new ideas.

Their work involves subjects in scanners in each institution connected online. The subjects take turns to construct a story together, making it up a few lines at a time, and a workable hypothesis might be that the creativity and fluidity of the story will vary with the synchronicity of the brains involved. The use of portable EEG machines to monitor the synchronicity produced by individuals in Second Track meetings might also show a relationship between brain synchronicity and agreed and productive outcomes.

Several studies conducted on humans in real-life situations have been performed with portable EEG machines. They also show that people's brainwaves become synchronised in the audience of concerts, films or other shared mass experiences. A series of studies in New York City high schools,[53] performed by a team of New York University researchers including Suzanne Dikker and Ido Davidesco, has produced even more exciting results. Repeated EEG readings from every student in a biology class over a term showed that the students' brainwaves became more synchronised in direct relation to their engagement in their lesson. Furthermore, this synchronicity increased concerning the amount the students liked each other and their teacher. In short, closer relationships and more engaging lessons lead to more synchronisation. An ongoing study is currently examining whether these levels of brain synchrony during class predict the retention of material learned.

Again, this may have direct relevance to the Second Track, as its free-flowing format and the other ways it drives engagement may similarly increase this brain synchronisation effect.

50. Lerner et al., 2011
51. Hasson et al., 2012
52. Denworth, 2019
53. Dikker et al., 2017

INTER-PERSONAL ENGAGEMENT

> **'Alone we can do so little; together we can do so much.'**[54] **– Helen Keller**

The Second Track allows experts, practitioners and decision-makers from different spheres to engage with each other in a safe shared space without the hierarchical and organisational boundaries which normally divide them. The new research introduced above is helping to reveal why this personal approach is so critical in building social links, encouraging personal engagement and generating personal satisfaction, which keeps members coming back and pursuing work together.

Psychiatrist and social neuroscientist Leonhard Schilbach of the Max Planck Institute of Psychiatry in Munich argue that 'social cognition is fundamentally different when you are directly engaged with another person as opposed to observing another person'.[55]

In 2010, for example, psychologist Elizabeth Redcay and Rebecca Saxe of the Massachusetts Institute of Technology[56] placed a subject inside an MRI scanner which then interacted with a researcher sitting by the scanner or through a video feed. Their experiment showed that the live interaction activated the areas of the brain associated with social cognition and rewarded far more than the recorded session.

Redcay's subsequent studies have shown that children's brains engage more of the regions associated with empathy – thinking about the mental states of others, or mentalising as it is called – when they believe they are communicating with peers rather than others.[57] The Second Track, by stripping participants of their prior job titles, although not their expertise, explicitly makes everyone a peer on the same level in the meeting. Adults also have more empathy with others when they see them as peers and are more willing to adjust their attitudes, increasing the chance of cooperation towards a common goal.

Redcay's studies of joint attention also suggest that the mentalising regions of the brain, such as the temporal-parietal junction,[58] respond differently when people concentrate on something as a group, rather than an individual, again perhaps strengthening the 'group brain' of Second Track processes.

Schilbach has found in his studies of 'second-person neuroscience'[59] that even simulations of attention are enough to trigger a positive response. The perception that one's behaviour affects another person, even in as trivial a way as returning a gaze, is enough to trigger the brain's reward circuitry in the ventral striatum.[60]

54. In the early 1920s, Helen Keller and her teacher Anne Sullivan eased their precarious finances by performing on the vaudeville circuit. According to the joint biography *Helen and Teacher: The Story of Helen Keller and Anne Sullivan Macy* by Joseph P. Lash, published in 1980, their 20 minute 'act' saw Keller deliver a short speech which included these lines: 'My Teacher has told you how a word from her hand touched the darkness of mymind and I awoke to the gladness of life. I was dumb; now I speak. I owe this to the hands and hearts of others. Through their love I found my soul and God and happiness. Don't you see what it means? We live by each other and for each other. Alone we can do so little. Together we can do so much. Only love can break down the walls that stand between us and our happiness.'
55. Denworth, 2019
56. Redcay et al., 2010
57. Alkire and Redcay, 2019
58. The temporal and parietal lobes of the brain meet at temporoparietal junction, situated at the posterior of the lateral sulcus (Sylvian fissure). The TPJ incorporates information from the thalamus and the limbic system as well as the body's visual, auditory and somatosensory systems.
59. Schilbach et al., 2013
60. The ventral striatum forms part of the brain's basal ganglia and limbic system and appears to be a vital part of the human brain's 'circuitry' for decision making and reward-related behaviour.

'The so-called mentalising network and the action-observation network seem to be much more closely connected (than previously supposed)', says Schilbach. 'They influence each other, sometimes in a complementary and sometimes in an inhibitory fashion.'[61] Formal meetings which inhibit the free flow of interpersonal interaction in favour of rigid bureaucratic procedures are not only less rewarding than second track interactions, but dampening natural human interactions in favour of bureaucratic procedures may have a repulsive effect.

As with Track II diplomacy,[62] the agreement and implementation of policy on complex or 'wicked' problems that cross departmental boundaries and involve a range of stakeholders depend greatly on strong personal relationships to overcome institutional divides. The importance of 'looking people in the eye' during potentially fraught discussions or tense negotiations found more validation in the work of Norihiro Sadato of Japan's National Institute for Physiological Sciences in 2019. He used hyper-scanning to prove that eye contact prepares the 'social brain' to empathise with the other person by activating the same areas of each person's brain simultaneously.

This synchronised response includes the cerebellum, the reasoning part of our brains which helps us predict the sensory consequences of actions, and our limbic mirror system, a set of brain regions that activate when we move our body – or our eyes – and when we observe another person's movements. The limbic system allows us to recognise emotions and share them with others, creating our capacity for empathy.

CONCLUSION

> **'Everything we do, every thought we've ever had, is produced by the human brain. But exactly how it operates remains one of the biggest unsolved mysteries, and it seems the more we probe its secrets, the more surprises we find.' – Neil deGrasse Tyson**

One of these surprises may be that probing the mysterious brain chemistry that drives and shapes our social interactions could lead to a fundamental reappraisal of how we organise groups and joint activities. This research shows that individual neurological reactions in social interactions are crucial in human communication and cooperation,[63] and rigorous, independent scientific studies of interactions in Second Track and other types of groups would seem a logical next step.

Such studies – which might combine behavioural observation, psychophysiological investigations and computational approaches in line with the Second Track's multidisciplinary approach – could explore interactions in real-life situations from the participants' point of view, rather than 'offline' studies shaped by the perceptions of observers. Investigating and understanding the Second Track's effect on emotional engagement might offer clues to its capacity to improve participant engagement and project outcomes in a wide range of applications.

Results from a range of objective tests and monitoring equipment could generate the complex data required to test the hypothesis that the Second Track tends to produce more favourable results for individuals, and therefore more productive results for groups than more formal 'first track' approaches. However, the parallels between this research and GAP methods, as well as the demonstrable success of Second Track groups and GAP itself, already suggest a positive result.

61. Denworth, 2019
62. Track II or backchannel diplomacy involves the interaction of non-state actors, or sometimes diplomatic discussions in informal settings, with a view to conflict resolution.
63. Hari et al., 2015

REFERENCES

Alkire, D. and Redcay, E. (2019), Understanding Other Minds; What happens in our brains when we interact with people?, retrieved from ResearchGate Online https://www.researchgate.net/publication/334618961

Blackshaw, B. (2020), The Second Track and Talanoa: Implementation of the Pacific Connect programme in the Pacific Islands, *BESS*™, vol. 2, no. 1, June 2020, https://www.globalaccesspartners.org/publications/Blackshaw_GAP_Journal_BESS2020.pdf

Denworth, L. (2019), 'Hyperscans' Show How Brains Sync as People Interact, *Scientific American*; https://www.scientificamerican.com/article/hyperscans-show-how-brains-sync-as-people-interact/

Dikker. S., Davidesco, I., Wan, L. and Kaggen, L. (2017), Brain-to-Brain Synchrony Track Real-World Dynamic Group Interactions in the Classroom, *Current Biology* 27 (9), https://www.researchgate.net/publication/316530998_Brain-to-Brain_Synchrony_Tracks_Real-World_Dynamic_Group_Interactions_in_the_Classroom

Donne, J. (1988), No Man Is an Island, Souvenir Press Limited

Fritz, P. (2019), Second Track to Success, *BESS*™, vol. 1, no. 1, August 2019, https://www.globalaccesspartners.org/publications/Fritz_GAP_Journal_BESS2019.pdf

Fritz-Kalish, C. (2019), Twenty years on the Second Track: GAP case studies, *BESS*™, vol. 1, no. 1, August 2019, https://www.globalaccesspartners.org/publications/FritzKalish_GAP_Journal_BESS2019.pdf

Global Access Partners (2021), Initiatives, https://www.globalaccesspartners.org/think-tanks

Hari, R., Henriksson, L., Malinen, S. and Parkkonen, L. (2015), Centrality of Social Interaction in Human Brain Function, *Neuron* 88 (1)

Harris, R. (2018), In Psychology and Other Social Sciences, Many Studies Fail the Reproducibility Test, retrieved from National Public Radio; https://www.npr.org/sections/health-shots/2018/08/27/642218377/in-psychology-and-other-social-sciences-many-studies-fail-the-reproducibility-te

Hasson, U., Ghazanfar, A. A., Galantucci, B., Garrod, S. and Keysers, C. (2012), Brain-to-brain coupling: a mechanism for creating and sharing a social world, *Trends in cognitive sciences* 16 (2): 114–121

Holt, J. (2011), Two Brains Running, *The NY Times*, https://www.nytimes.com/2011/11/27/books/review/thinking-fast-and-slow-by-daniel-kahneman-book-review.html

Jenkins, T.A., Nguyen, J.C.D., Polglaze, K.E. and Bertrand, P.P. (2016), Influence of Tryptophan and Serotonin on Mood and Cognition with a Possible Role of the Gut-Brain Axis, *Nutrients* 8 (1): 56

Kahneman, D. (2013), Thinking, Fast and Slow, Farrar, Straus and Giroux, reprint edition

Kahneman, D. and Tversky, A. (1979), Prospect Theory: An Analysis of Decision under Risk, *Econometrica*, Vol. 47, No. 2 (Mar 1979), pp. 263-291

Kaku, M. (2014), The Future of the Mind: The Scientific Quest to Understand, Enhance, and Empower the Mind, *Doubleday*

Kolko, J. (2021), Wicked Problems: Problems Worth Solving: A Handbook and Call to Action

Lencioni, P. (2002), The Dysfunction of a Team: A Leadership Fable

Lerner, Y., Honey, C.J., Silbert, L.J. and Hasson, U. (2011), Topographic mapping of a hierarchy of temporal receptive windows using a narrated story, *Journal of Neuroscience* 31 (8):2906–2915

Massachusetts Institute of Technology (2014), When Good People do Bad Things: Being in a group makes some people lose touch with their personal moral beliefs, *Science Daily*, https://www.sciencedaily.com/releases/2014/06/140612104950.htm

Massingham, P., Fritz-Kalish, C. and McAuley, I. (2020), Emergent Communities of Practice: A complexity theory lens, *BESS™*, vol. 2, no. 1, June 2020, https://www.globalaccesspartners.org/publications/Massingham_etal_GAP_Journal_BESS2020.pdf

MayoClinic (2021), Selective serotonin reuptake inhibitors (SSRIs), retrieved from https://www.mayoclinic.org/diseases-conditions/depression/in-depth/ssris/art-20044825

McLeod, S. (2017), The Milgram Shock Experiment, *Simply Psychology*, https://www.simplypsychology.org/milgram.html

Montague, R. (2021), What we're learning from 5,000 Brains, TED presentation, retrieved from YouTube, https://www.youtube.com/watch?v=ufUkAQOQaXU

Nicolelis, M. (2013), A monkey that controls a robot with its thoughts. No, really; TED presentation, retrieved from YouTube, https://www.youtube.com/watch?v=CR_LBcZg_84

Patrick, N. (2018), The Reasons People Ignore Fire Alarms, retrieved from FireCo, https://www.fireco.uk/3-reasons-people-ignore-fire-alarms/

Pfieffer, U.J., Timmermans, B., Vogeley, K., Frith, C.D. and Schilbach, L. (2003), Towards a Neuroscience of Social Interaction, *Frontiers in Human Neuroscience*, https://doi.org/10.3389/fnhum.2013.00022

Platt, M.L., Seyfarth, R.M. and Cheney, D.L. (2016), Adaptations for social cognition in the primate brain, *Philosophical transactions of the Royal Society of London*, Series B, Biological sciences 371 (1687)

Pope, A. (1733-34), An Essay on Man: Epistle II, retrieved from The Poetry Foundation https://www.poetryfoundation.org/poems/44900/an-essay-on-man-epistle-ii

Radburn, M. and Stott, C. (2009), The Psychology of Riots – and Why it's Never just Mindless Violence, *The Conversation*, https://theconversation.com/the-psychology-of-riots-and-why-its-never-just-mindless-violence-125676

Ramakrishnan, A., Byun, Y.W., Pedersen, C.E., Lebedev, M.A. and Nicolelis, M. (2017), Cortical neurons multiplex reward-related signals along with sensory and motor information, *Proceedings of the National Academy of Sciences of the United States of America* 114 (24): E4841–E485

Redcay, E., Dodell-Feder, D., Pearrow, M.K., Mavros, P.L., Kleiner, M., Gabrieli, J.D. and Saxe, R. (2010), Live face-to-face interaction during fMRI: a new tool for social cognitive neuroscience, *NeuroImage* 50(4): 1639–1647

Satterfield, D. (2013), The Origin of Species – Charles Darwin, *The Leader Maker*, https://www.theleadermaker.com/the-origin-of-species-charles-darwin/

Schilbach. L., Timmermans, B., Reddy, V., Costall, A., Bente, G., Schlicht, T. and Vogeley, K. (2013), Toward a second-person neuroscience, Cambridge University Press

Seo, D., Patrick, C.J., and Kennealy, P.J. (2008), Role of Serotonin and Dopamine System Interactions in the Neurobiology of Impulsive Aggression and its Comorbidity with other Clinical Disorders. *Aggression and violent behaviour*, 13 (5): 383–395

The Cooperative Human (2018), *Nature Human Behaviour*, Issue 2, https://www.nature.com/articles/s41562-018-0389-1

Tse. V. and Bond, A. (2002), Serotonergic intervention affects both social dominance and affiliative behavior, *Psychopharmacology,* 161 (3): 324–30

University of California San Diego, presentation on Metaphors and Historical Conceptions of the Brain, http://mechanism.ucsd.edu/~bill/teaching/w12/philneuro/metaphorsandconceptionsofbrain.key.pdf

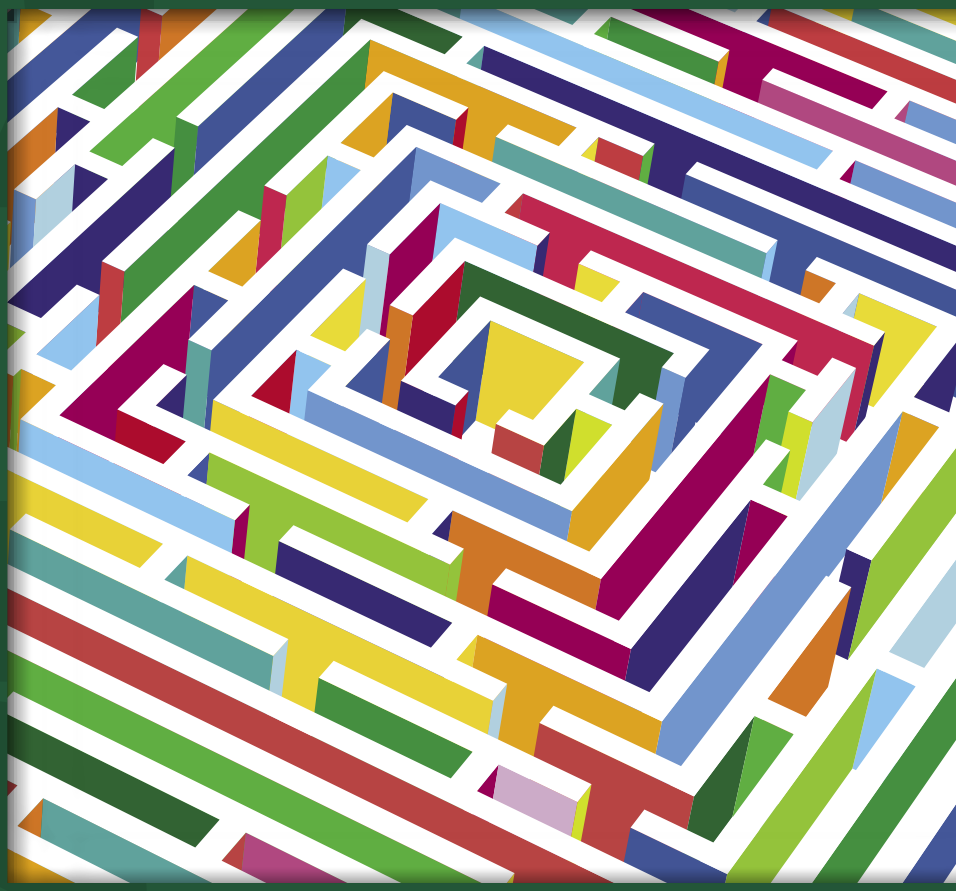
Wilson, C. (2017), Monkeys learn to play 'chicken' in a virtual driving game, *The News Scientist*, https://www.newscientist.com/article/monkeys-learn-play-chicken-virtual-driving-game/

Wilson, R. (2018), What is Homo Economicus?, *Investopedia*, https://www.investopedia.com/ask/answers/08/homo-economicus.asp

Wood R.M., Rilling J. K., Sanfey, A.G., Bhagwagar, Z. and Rogers, R.D. (2006), Effects of tryptophan depletion on the performance of an iterated Prisoner's Dilemma game in healthy adults, *Neuropsychopharmacology* 31 (5): 1075–84

JOURNAL OF BEHAVIOURAL ECONOMICS AND SOCIAL SYSTEMS

Volume 3, Number 1, 2021



gap | TCG