Kaleidoscope

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Off-shore financial arrangements and Central American law firms have been proving paradoxically taxing for some politicians recently. Do the ethical habits of national leaders and the prevailing political culture cascade down to affect individuals' behaviour? Gachter & Schulz[1] test this by first deriving an index (the 'prevalence of rule violations' – PRV) to measure honesty and deception in 159 nations based upon their records of tax evasion, corruption and fraudulent politics. They then tested whether these national-derived indices predicted young individuals' behaviour from 23 of these countries, in a behavioural experiment where there was clear incentive to lie about a random result for personal gain. In a 'die in the cup' experiment the participant was instructed to roll a fair six-sided die twice and report *only the first roll*. The experimenter was blind to actual roll outcomes and the participant was told that they would get one monetary unit for a roll of 'one', two units for 'two' and so on, except, for rolling a six which earned *no money* at all. The average *honest* pay out should be 2.5 monetary units; conversely, a *fully-dishonest* pool would earn 5 monetary units on average. In a similar vein, if participants use the principle of 'justified dishonesty' (i.e. reporting the higher of the two rolls, since nobody would be able to tell) then we would expect a higher proportion of claims for 2, 3, 4 and 5 monetary units than predicted by chance: sure enough, across all 23 countries, participants show behaviour congruent with justified dishonesty, but not complete honesty or complete dishonesty. In countries where there was a higher prevalence of tax avoidance, political corruption, and a lower level of political freedom (high PRV), participants' mean claims were *higher*; 'fully honest' claims – reflected in the number of people reporting a zero claim on rolling a 6 – were greater in countries with low PRV. However, for the highest claim result – income maximisation by reporting a claim of 5 units – the association with high PRV did not hold, suggesting that *individual maximal cheating*, rather than 'bending' the truth, is not inherited from a country's prevailing culture of rule violation. The authors interpret these results as suggesting that intrinsic honesty levels are *not* the same around the world, and that corruption and exposure to rule violations corrodes individuals' practices. They conclude that:

> 'weak institutions and cultural legacies that generate rule violations not only have direct adverse economic consequences, but might also impair individual intrinsic honesty that is crucial for the smooth functioning of society.'

Body mass and types of food consumed by children are – appropriately – public and healthcare preoccupations. Critical questions include how early is the die cast, and what are the adverse long-term outcomes? Prevalence estimates on obesity offer few insights into *changes* in body habitus; utilising prospective cohort data Tran and colleagues[2] measured transitions between normal, overweight, and obese categories in US children. Strikingly, children who were normal weight or obese by *age 3* were unlikely to move into a different category by age 15, though overweight children did show considerable transitions to both of these categories. There were ethnic variations within this sample, with White and Asian children typically having lower BMIs than Black or Hispanic ones. How these data will map onto other countries is uncertain; however, the findings suggest obesity prevention work may have to begin at a very early life-stage.

The role of food type and childhood attentional difficulties and/or hyperactivity has been an area often fraught with more heat than light, with a focus on everything from sugar to various 'E numbers'. Peter et al[3] adopt a different approach, evaluating the effect of a *lack* of appropriate nutrition on attentional functioning in 188 participants across two generations (including 50 first-generation individuals hospitalised for moderate-to-severe protein energy malnutrition). Early childhood malnutrition was linked with long-lasting epigenetic signatures of differentially methylated genomic regions associated with liability for attention and cognitive deficits, and a (limited) potential for cross-generational transmission. Infancy malnutrition remains as enormous a public health challenge to the developing world as obesity is to the developed; in both instances, there are psychological as well as physical sequelae.

Cocaine dependent individuals have had no effective pharmacological replacement therapy, unlike those available for alcohol, opioids and tobacco. Writing in the *Lancet*, Nuijten and colleagues[4] evaluated sustained-release dexamfetamine in a multi-centre, double-blind placebo-controlled trial of dependent and treatment-refractory crack cocaine consumers who were also on methadone replacement therapy for heroin use. The active intervention was well tolerated in what is the largest such study to date, and it led to significantly fewer days of subsequent cocaine use. Comorbid use of heroin and crack cocaine is an important clinical and social issue, but it will also be vital to test dexamfetamine use in those exclusively consuming stimulants, especially those insufflating the more common cocaine hydrochloride. Effectiveness in more 'real-world' settings will also need to be assessed – without the daily supervision that an opioid-replacement programme involves.

Terry Pratchett remarked 'I'll be more enthusiastic about encouraging thinking outside the box when there's evidence of any thinking going on inside it'. That's why functional magnetic resonance imaging (fMRI) was invented. Typically, researchers design a task for the experimental participant to perform inside an MRI scanner while the blood-oxygenation-level dependent (BOLD) magnetic signature is collected across the brain; there is also a literature on the 'resting state' which measures brain activity while participants do nothing active in the scanner. With this information collected, each participant's data are subjected to a statistical procedure that identifies which regions of the brain are more active during one task relative to another; in the case of resting-state data correlations between areas of the brain where the respective BOLD signal fluctuates simultaneously are used to infer connectivity between these regions. For each participant, this results in a map of brain areas, but there are significant differences between participants, so these individual maps are subjected to further analyses to understand behaviour at the group level – that is, to remove individual variation by averaging and extracting only those regions *consistently* active across the group of participants.

In the journal *Science*, Tavor et al[5] pose the question: what if these individual variations are *useful* signal rather than noise? Using 98 participants from the human connectome project, they first extracted resting state and structural data that were completely free of any task-related signal, resulting in 107 variables. Then, for seven cognitive domains (including language, theory-of-mind, motor and gambling tasks) they extracted the familiar task-dependent maps, resulting in 47 maps for each

participant showing regions activated by the respective task conditions. They then trained a regression-based model which would take the 107 resting-state/structural data variables as input and produce a predicted map for one of the individual's 47 task-dependent maps as output. The training method meant that for a given participant, the model was trained on all other participant's input resting-state/structural and output task-dependent data *but not* that participant – this ensured that the model could generalise rather than simply encode the associations on any given participant.

Remarkably, the correlations between the model's predicted output (that is, the task-dependent map predicted from the resting-state/structural data) and the participant's *actual* task-dependent map, was very high for each participant, and tailed-off for other participants. The model appeared to be able to predict differences in task-related activity (in terms of shape, anatomical position and size) using only a participant's resting-state data. The authors note how we all differ in how we perceive, think and act; as such, our brains must also vary, and accepting and understanding this difference rather than 'averaging out' individual differences may be vital to a better understanding of brain function.

Individual factors are important – albeit poorly understood – indices for developing post-traumatic stress disorder (PTSD), but what about *external* **social factors?** Hikichi *et al*[6] had been exploring social cohesion in an older community of Japanese locals ($n = 3567$) some months before the 2011 magnitude 9 earthquake and tsunami in Tōhoku. This was the most powerful earthquake to hit that country in modern record-keeping, displacing a quarter of a million people, with over 15 000 deaths; it is perhaps best remembered in the West for leading to the meltdown of the three Fukushima nuclear reactors. These unique 'pre-disaster' data allowed the team to follow-up this community and their progress 2.5 years later. Older individuals are more susceptible to natural disasters and their aftermath, and overall, just over 11% of this sample reported severe PTSD secondary to these horrific events. However, higher community-level social cohesion was significantly associated with lower rates of occurrence. The finding held even accounting for experiences during the disaster, such as interruption to healthcare, the loss of housing, and the death of loved ones. The authors argue that good communities offer reassuring 'informal insurance' of information and support during crises, and are better at voicing their unmet needs and cohesively mobilising for necessary subsequent action. Social cohesion can be measured – this study utilised a simple 3-item scale – and may assist disaster forecast planning.

As neuroscientists we trek the partially explored hills and valleys of the brain, trying to better understand the terrain and the paths between regions. Reasoning by analogy allows inferential abstractions and permits generalisations between situations. Despite this, its neurological underpinnings have not previously been well demarcated. Urbanski *et al*[7] examined such

functioning in 27 patients with focal frontal lobe damage. The left rostrolateral prefrontal cortex (PFC) was crucial to analogical reasoning, appearing to play a role in relational matching and integration; such neuropsychological functioning has been proposed to sit atop a hierarchical PFC model of reasoning, problem solving, behavioural adaption, and abstraction. However analogical reasoning is *not* associated with global executive functioning, and is thus not captured by standard cognitive batteries. Indeed the authors argue that functioning of this region is poorly assessed in usual clinical practice, but should form part of routine neuropsychological assessment.

If one external process such as a traumatic injury can hinder analogical reasoning, could another type help? Green and colleagues[8] tested the neuromodulatory technique of transcranial direct current stimulation (tDCS) on the frontopolar cortices of healthy individuals and found that it enhanced conscious augmentation and state creativity. So-called 'creativity cuing' has previously been demonstrated through cognitive interventions, and the authors combined this with neuromodulation. They note how the greater analogical creativity was not due to decreased accuracy in determining valid analogies, which they argue confirms an enhancement in real creativity rather than inappropriate divergence. Through electrodes placed on the skull, tDCS applies a small direct current to the brain, facilitating neuronal transmission; perhaps the analogy is putting on one's thinking cap and having a creative spark.

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3 Peter CJ, Fischer LK, Kundakovic M, Garg P, Jakovcevski M, Dincer A, et al. DNA methylation signatures of early childhood malnutrition associated with impairments in attention and cognition. *Biol Psychiatry* 26 Mar 2016 (doi: 10.1016/j.biopsych.2016.03.2100).

4 Nuijten M, Blanken P, van de Wetering B, Nuijen B, van den Brink W, Hendriks VM. Sustained-release dexamfetamine in the treatment of chronic cocaine-dependent patients on heroin-assisted treatment: a randomised, double-blind, placebo-controlled trial. *Lancet* 22 Mar 2016 (doi: 10.1016/S0140-6736(16)00205-1).

5 Tavor I, Parker Jones O, Mars RB, Smith SM, Behrens TE, Jbabdi S. Task-free MRI predicts individual differences in brain activity during task performance. *Science* 2016; **352**: 216–20.

6 Hikichi H, Aida J, Tsuboya T, Kondo K, Kawachi I. Can community social cohesion prevent posttraumatic stress disorder in the aftermath of a disaster? A natural experiment from the 2011 Tohoku earthquake and tsunami. *Am J Epidemiol* 29 Mar 2016 (doi: 10.1093/aje/kwv335).

7 Urbanski M, Brechemier M-L, Garcin B, Bendetowicz D, de Schotten MT, Foulon C, et al. Reasoning by analogy requires the left frontal pole: lesion-deficit mapping and clinical implications. *Brain* 13 Apr 2016 (doi:10.1093/brain/aww072).

8 Green AE, Spiegel KA, Giangrande EJ, Weinberger AB, Gallagher NM, Turkeltaub PE. Thinking cap plus thinking zap: tDCS of frontopolar cortex improves creative analogical reasoning and facilitates conscious augmentation of state creativity in verb generation. *Cereb Cortex* 13 Apr 2016 (doi: 10.1093/cercor/bhw080).