2021

01

leading brains Review

In this issue

Organisational Leadership

What You Don't See

The obvious may be in front of your eyes but the brain and attention is drawn in many directions and the seemingly obvious can lead to bad decisions – alternatively seeing the right things can lead to strokes of genius.

The Brain

The Mysterious Cerebellum

80% of your brain cells sit in this region of your brain – so some say that whatever the cerebellum does it must do a lot of it. This was long only considered a centre of coordination and refined motor control, but the functions of the cerebellum have now grown to include cognition, social, and emotional representations.

Team Leadership

The Average Performers that Enable High Performance

Many sports coaches know it – there are some team members, who may be unspectacular, but the whole team just functions better with them. But no one knows how to measure it and big data Is not helping – or is it?

The Green Brain

Our 2021 theme picture represents the organic nature of the brain, its ability to grow but also its ability to be damaged, like a plant with the wrong environment, or the chemicals we put into it.

Written by Andy Habermacher

Resident author, neuroleadership expert, passionate learner, masters athlete.

P.S. this photo is now 8 years old: despite ageing well a few wrinkles have been added, and a couple of grey (silver) hairs - and Andy hasn't worn a suit for a year now...

What's in store this month?

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Part 1

THE BRAIN

Contents:

Quick Hits

Here are some quick insights into what is coming out of the rich field of research into the brain.

How our brains track where we and others go

Published at the end of 2020, the University of California show findings into how the brain encodes how other people are in relation to others. This adds to the Nobel laureate winning work on place cells and grid cells but also on theory of mind and placing ourselves in other's shoes:

> *"Our results imply that our brains create a universal signature to place ourselves in someone else's shoes"*
> - Nanthia Suthana

https://www.uclahealth.org/how-our-brains-track-where-we-and-others-go

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The DNA regions in our brain that contribute to make us human

With only 1% difference, the human and chimpanzee protein-coding genomes are remarkably similar. Understanding the biological features that make us human is part of a fascinating and intensely debated line of research. Researchers at SIB and the University of Lausanne have developed a new approach to pinpoint, for the first time, adaptive human-specific changes in the way genes are regulated in the brain. These results open new perspectives in the study of human evolution, developmental biology and neurosciences. The paper is published in Science Advances.

> *"Gene expression, not gene sequence"*

https://www.sib.swiss/about-sib/news/10816-the-dna-regions-in-our-brain-that-contribute-to-make-us-human

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Researchers show what loneliness looks like in the brain

With covid still raging and many places back in lockdown this research gives an interesting perspective by showing the neural signatures of loneliness. This is not just relevant for lockdown but for many people, particularly some of our older inhabitants.

> *"We are just beginning to understand the impact of loneliness on the brain. Expanding our knowledge in this area will help us to better appreciate the urgency of reducing loneliness in today's society," says Danilo Bzdok*

https://www.mcgill.ca/neuro/channels/news/scientists-show-what-loneliness-looks-brain-325504

Research strongly suggests COVID-19 virus enters the brain

Sorry to focus on the bad news but here you have some, actually, unsurprising, evidence.

More and more evidence is coming out that people with COVID-19 are suffering from cognitive effects, such as brain fog and fatigue. And researchers are discovering why. The SARS-CoV-2 virus, like many viruses before it, is bad news for the brain. In a study published Dec.16 in **Nature Neuroscience**, researchers found that the spike protein, often depicted as the red arms of the virus, can cross the blood-brain barrier in mice.

"You do not want to mess with this virus," he (William A. Banks) said. "Many of the effects that the COVID virus has could be accentuated or perpetuated or even caused by virus getting in the brain and those effects could last for a very long time."

https://newsroom.uw.edu/news/research-strongly-suggests-covid-19-virus-enters-brain

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Compound protects myelin, nerve fibres

And good news for treatment of some neurodegenerative diseases such as multiple sclerosis: a compound developed at Oregon Health & Science University appears to protect nerve fibres and the fatty sheath, called myelin, that covers nerve cells in the brain and spinal cord.

"The drug could protect the nervous system from damage and reduce the severity of the disease," Bourdette said.

https://news.ohsu.edu/2021/01/13/study-suggests-compound-protects-myelin-nerve-fibers

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Brain Region in Focus

The Mysterious Cerebellum

Much, Much More than Coordination

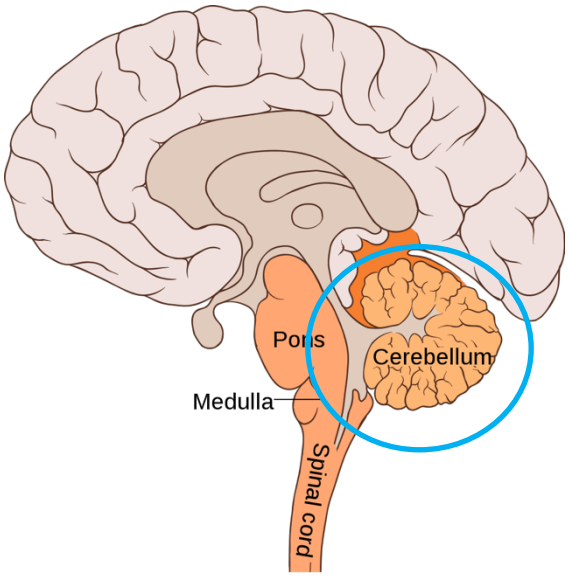
BY ANDY HABERMACHER

Reading time: about 10 minutes

The cerebellum hosts 80% of all our neurons. That is an astounding figure. It would suggest that $^4/_5$ of our brain processing sits in this small part of the brain - often called the small brain - at the back of our head. Not only that but considering that 80% of our neurons sit in this region, it is all the more surprising that this part of the brain does not get more publicity.

Generally, the cerebellum has been considered a centre of coordination and balance, but the cerebellum's role in much of cognition is generally ignored. Let us review this fascinating structure of the brain.

The cerebellum sits at the back of the head and has a surprisingly strong, and often underestimated, influence on all our cognitive processes - and incidentally houses 80% of all of our neurons. This figure of housing 80% of our neurons is a sobering and stunning figure and somewhat surprisingly hasn't caused as much head scratching as we would expect in the neurosciences. Let's put this into context – this is equivalent say, to 80% of the population of Britain living in a notable but unspectacular city in the UK, say Bristol. This would cause many researchers to wonder why Bristol with so many inhabitants weren't a more important city – then again can we imagine that a city housing 80% of the population wouldn't be a country's most important city?



Now this discrepancy has been known for a long time and recently supported by the innovative research of Suzana Herculano-Houzel who finally gave us solid answers to how many neurons and glial cells (supporting cells in the brain) we actually have. So, this has just been one of those curious facts about the brain that falls into the "fascinating information" category with nothing further to add. But this size has led others, such as Richard M. Bergland, to surmise that "…*whatever the cerebellum does, it does a lot of it.*"

This mystery thickens when we consider recent research mapping the surface area of the cerebellum. Looking at a picture of the cerebellum we can see that it is significantly smaller than the cerebrum, our outer cortex. However, we can also see that it is more wrinkled. It is indeed much more tightly folded. In 2020 researchers managed to calculate the surface area of the cerebellum and have shown that it reaches an amazing 80% of the size of the cerebrum. So much for small brain. It seems like we have a big brain complemented by another big brain. So, the cerebellum has the majority of neurons and almost equivalent surface area to our much-lauded cerebrum.

Why?

This becomes a difficult question to answer – nature does not tend to be wasteful of resources – there are some exceptions as the peacock's tail which seems to serve no evolutionary purpose, but it does it serve the purpose of sexual selection which continues to promote genes that are related to magnificent tails…as long as having a magnificent tail doesn't kill you, which it obviously hasn't. Yet this would not be able to explain our cerebellum. Females do not select mates on the basis of their magnificent cerebellum – not directly anyhow.

So, let's take a step back and look at what have traditionally been considered the functions of the cerebellum.

Traditionally the Cerebellum, which, it must be noted, is a well-researched brain region, has been considered a centre of motor control. Particularly refined motor control. This includes:

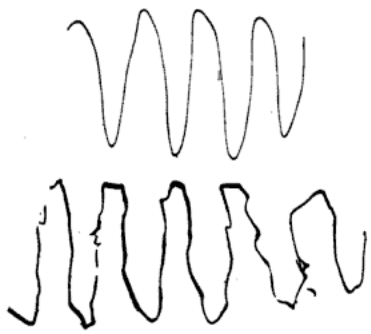
- Maintenance of balance and posture
- Coordination of voluntary movements
- Motor learning

In the above we noted specifically the refinement of fine motor control. Those with cerebellar damage can still walk and balance but lack the finesse of finely tuned balance similarly activities such as drawing or writing become shaky and inconsistent.

Indeed, damage to the cerebellum leads to

- **Decomposition of movement**: many of our movement are finely coordinated movements between multiple joints and muscles. Consider the seemingly simple task of touching one's nose with your finger. This however requires movement across multiple joints and using multiple muscles. Decomposition means the breaking down of movement into its constituent parts so those with cerebellar damage may initiate the shoulder movement, then the bending of the arm, then the clasping of fingers, separately to try to touch one's nose.

- **Intention Tremor**: what can be observed in patients is an involuntary tremor when getting close to an intentional movement, for example picking up a glass. As they approach the glass their hand begins to move back and forth as it approaches the glass and tries to grasp it.
- **Dysdiadochokinesia**: patients have difficulty performing rapidly alternating movements such as clapping your hands alternating between hitting with your palms and hitting the back of our hands.
- **Disruption in motor learning**: the above three would lead to no surprise that motor learning will be inhibited. But this can occur across all levels. Refined experiments for example show that something known as the vestibular ocular reflex also has disrupted learning patterns. This reflex is controlled by your eye muscles to keep your gaze steady when moving your head. So even largely unconscious automated motor reflexes are limited in learning and adaption with cerebellar damage.



Ataxia patient, bottom, attempting to draw the top line

The term generally used for these disorders with cerebellum damage is Ataxia and includes all the above symptoms and others including slurred speech, trouble eating and swallowing, and heart problems. Research into ataxia patients has led to a better understanding of the function of the cerebellum.

So far this is all very interesting but doesn't fully answer the question of why it takes up so much of the brain's resources with 80% of neurons and 80% of the surface areas of the cerebrum. One explanation would be that we as human beings underestimate the importance of motor control in our evolutionary past. When we research the brain, we like to think of "higher" functions such as language, cognitive reasoning, and abstraction, but our survival over eons has been mostly due to motor control. Not only that but refined motor control is what defines us in some way as human beings. Though other animal such as chimps can leap effortlessly through trees and show amazing feats of coordination our refined motor control apparent in our fantastic ability to make tools, clothes, and write, for example, far outstrips any animal on earth (also thanks to our opposable thumbs). Notable is that compared to chimps our cerebellum is almost triple the size, relatively that is. So, whatever the cerebellum is doing, it is also heavily involved in our uniquely human abilities.

This underestimation of motor refinement is certainly one explanation for our surprise at the size of the cerebellum. Moreover, this fine motor coordination, some have proposed, has also triggered large cognitive development that have led to our ability to abstract and develop more advanced cognitive abilities (see box at end of article).

When we look at the structure of the cerebellum some other things are striking. One is that it has only three layers of neurons compared to the six of the cerebral cortex, our folded outer layer of the brain (see following article). Also, that the functional units seem to be separated into self-dependent nuclei. This goes some way to explaining the differences to the cerebral cortex. The cerebral cortex, though having many fewer neurons, is more complex and more interconnected and therefore better suited to the complex processes of input and output and interrelations of these features such as integrating senses into a coherent whole. This is another way to resolve the paradox of the number of neurons in the cerebellum compared to the cerebrum.

But another interesting feature is that the cerebellum operates mostly in a feed forward manner rather than a feedback manner. That is, it predicts in advance the effects and movements necessary. Consider the example we gave above of moving to grasp a glass - to do this efficiently we need to be able to predict where to put the hand and control this in advance - a feedback mechanism makes it much slower and uncontrolled which is what happens with cerebellar damage.

But the cerebellum is involved in much, much more and there was also a slow realisation from the 1990s that the cerebellum is involved in much more than just fine motor control and coordination. This really moved into

the spotlight with the help of a prominent Ataxia researcher Schmahmann who in 1998 proposed "The cerebellar cognitive affective syndrome" because of his experiences with patients showing much more than motor dysfunction. He quotes cerebellar disruption leading to:

"...impairment of executive functions such as planning, set-shifting, verbal fluency, abstract reasoning and working memory; difficulties with spatial cognition including visual-spatial organization and memory; personality change with blunting of affect or disinhibited and inappropriate behaviour; and language deficits including agrammatism and dysprosodia"

And goes on to say:

"The constellation of deficits is suggestive of disruption of the cerebellar modulation of neural circuits that link prefrontal, posterior parietal, superior temporal and limbic cortices with the cerebellum."

In case you didn't understand that it means an interplay of neural circuits that include our executive, abstraction, and emotional centres of the brain.

In the meantime, the research and understanding of the cerebellum as a centre for coordinating other functions has included:

- Calming reactions linked to the parasympathetic nervous system and its proximity to the vagus nerve. For example, in infant calming responses
- Building cognitive hierarchies from concrete to abstract
- Emotion including emotion recognition, subjective feeling and elicitation, and reward valuation
- Social cognition including understanding mental states, intentions, beliefs, past behaviours, aspirations, and personality traits
- Post-Traumatic Stress Disorder: microlesions in the cerebellum shown to correlated with PTSD symptoms
- Integrating sensory information
- Autism related to above examples of integrating sensory information but also social cognition

Christopher Bergland who writes posts on Psychology Today, and retired ultra-athlete, has harboured pet theories of the cerebellum formulated with his father a neurosurgeon who himself wrote a controversial book on the brain in 1989. In Christopher Bergland's view the cerebellum functions as the automated seat of the brain controlling all automated functions. This would tie in neatly with the feedforward mechanisms outlined above and the widespread role of the cerebellum in large areas of human cognition.

Indeed, when we look to brain development something else is also striking. We noted that chimps' cerebellums are much smaller in comparison humans and indeed if we look at the development of the cerebellum it is precisely this part of the cerebellum, mapped to social and cognitive functions, that has expanded so much for human beings. So, despite the prefrontal cortex getting all the glory in being the biggest differentiator to chimps or early hominoids, it seems the cerebellum has a large part to play also.

And most major researchers would now agree. For example, a well-respected researcher, Doya proposes, the Cerebellum is best understood as predictive action selection based on "internal models" of the environment or a device for supervised learning, in contrast to the basal ganglia, which perform reinforcement learning, and the cerebral cortex, which performs unsupervised learning.

Similar to what Christopher Bergland proposed more than a decade ago, the cerebellum can be seen as our predictive brain that integrates our models of the world and how to operate in it. This includes motor control,

obviously which is important, but notably all those other factors that make human beings human: in social cognition, emotional consolidation, and cognitive models of the world. It is our predictive brain, the brain that enables us to respond to the world with fluency and ease and that sixth sense that we ascribe to particularly talented individuals - in all areas of human behaviour and cognition.

In short, the small brain really is truly our second brain and is not to be underestimated in the forming and functioning of our human mind.

The strange case of the lady with the missing cerebellum

In 2014 a strange case appeared in the newspapers and academic journals. A lady in China had been admitted to hospital after a month of nausea, dizziness, and vomiting. After undergoing an MRI scan it was discovered that she had no cerebellum. Nothing, not a bit.

The lady is reported as being married and mother to one daughter the pregnancy which was described as being uneventful. The condition is very rare and is known as *cerebellar agenesis*- with only eight other cases reported.

It sounds amazing that a person can survive so well without 80% of the brain's neurons – however, on the counter side we know that children can survive and thrive and live almost normal lives after having undergone hemispherectomy – removing a full hemisphere of the brain (to cure severe and life-threatening seizures).

This lady did show some clear disruptions, she could not run or jump, for example. It was reported that she could not walk until she was seven. She was unsteady on her feet. Her language seemed normal, but she had slight voice tremor and slurred speech.

Generally, these cases are accompanied by cognitive disruptions and retardation but this was not noted in this case.

Academic reference and review:

Yu, F., Jiang, Q. J., Sun, X. Y., and Zhang, R. W. (2015). A new case of complete primary cerebellar agenesis: Clinical and imaging findings in a living patient. *Brain* 138, e353. doi:10.1093/brain/awu239.

https://academic.oup.com/brain/article/138/6/e353/269537

Another review link:

https://neuwritesd.org/2014/12/18/no-cerebellum-no-problem/

Did capping flint help our cognitive and linguistic abilities expand?

There has been great interest in the art of capping flint to make tools.

The making of tools is one obvious feature differentiates us from other animals, but the interest Is not just there but in the interplay with brain development. Research with brain scanning has shown that capping activates regions of the brain that are necessary for the fine motor control to speak and also with areas necessary for linguistic grammar.

So, could it be that millennia of capping helped drive the expansion of brain areas that were then co-opted into linguistic functions? And were these then driven further by transmission i.e., teaching of capping to offspring. New Scientist has an interesting article on this.

The Singing Ape Hypothesis

Originally proposed by Darwin this hypothesis suggest that sounds were strung together, and meanings added to them later. Research into hominoids shows that there was an enlarged trigeminal nerve on contrast to other apes suggesting refined motor control of the tongue and larynx also seen in birds for singing purposes.

Not only that but more recent research shows that fine voice control in apes is also reflected in fine motor control and therefore could give an evolutionary advantage through signalling better fitness and therefore sexual selection.

References:

Cells and area of Cerebellum:

Azevedo, F. A. C., Carvalho, L. R. B., Grinberg, L. T., Farfel, J. M., Ferretti, R. E. L., Leite, R. E. P., et al. (2009). Equal numbers of neuronal and nonneuronal cells make the human brain an isometrically scaled-up primate brain. *J. Comp. Neurol.* 513, 532–541.

Herculano-Houzel, S. (2010). Coordinated scaling of cortical and cerebellar numbers of neurons. *Front. Neuroanat.* doi:10.3389/fnana.2010.00012.

Sereno, M. I., Diedrichsen, J. rn, Tachrount, M., Testa-Silva, G., D Arceuil, H., and De Zeeuw, C. (2020). The human cerebellum has almost 80% of the surface area of the neocortex. *Proc. Natl. Acad. Sci. U. S. A.* 117. doi:10.1073/pnas.2002896117.

Cognitive, social, and emotional functions of cerebellum

D'Mello, A. M., Gabrieli, J. D. E., and Nee, D. E. (2020). Evidence for Hierarchical Cognitive Control in the Human Cerebellum. *Curr. Biol.* doi:10.1016/j.cub.2020.03.028.

Doya, K. (1999). What are the computations of the cerebellum, the basal ganglia and the cerebral cortex? Neural Networks. doi:10.1016/S0893-6080(99)00046-5.

Esposito, G., Yoshida, S., Ohnishi, R., Tsuneoka, Y., Del Carmen Rostagno, M., Yokota, S., et al. (2013). Infant calming responses during maternal carrying in humans and mice. *Curr. Biol.* doi:10.1016/j.cub.2013.03.041.

Kloth, A. D., Badura, A., Li, A., Cherskov, A., Connolly, S. G., Giovannucci, A., et al. (2015). Cerebellar associative sensory learning defects in five mouse autism models. *Elife*. doi:10.7554/eLife.06085.

Overwalle, F. Van, Ma, Q., and Heleven, E. (2020). The posterior crus II cerebellum is specialized for social mentalizing and emotional self-experiences: A meta-Analysis. *Soc. Cogn. Affect. Neurosci.* doi:10.1093/scan/nsaa124.

Pierce, J. E., and Péron, J. (2020). The basal ganglia and the cerebellum in human emotion. *Soc. Cogn. Affect. Neurosci.* doi:10.1093/scan/nsaa076.

Schmahmann, J. D., and Sherman, J. C. (1998). The cerebellar cognitive affective syndrome. *Brain* 121, 561–579. doi:10.1093/brain/121.4.561.

Terry, G., Meeker, K., Cline, M., Meabon, J., Raskind, M., Cook, D., et al. (2016). Phospho-tau and amyloid precursor protein are aberrantly elevated in mouse cerebellum following repetitive blast-induced mild traumatic brain injury. *Neuropsychopharmacology*.

Van Overwalle, F., Manto, M., Cattaneo, Z., Clausi, S., Ferrari, C., Gabrieli, J. D. E., et al. (2020). Consensus Paper: Cerebellum and Social Cognition. *Cerebellum*. doi:10.1007/s12311-020-01155-1.

Bergland's theories

Bergland, C. (2015) The Cerebellum Deeply Influences Our Thoughts and Emotions. Psychology Today https://www.psychologytoday.com/us/blog/the-athletes-way/201503/the-cerebellum-deeply-influences-our-thoughts-and-emotions

Bergland, R. (1989). The Fabric of Mind. Penguin Books.

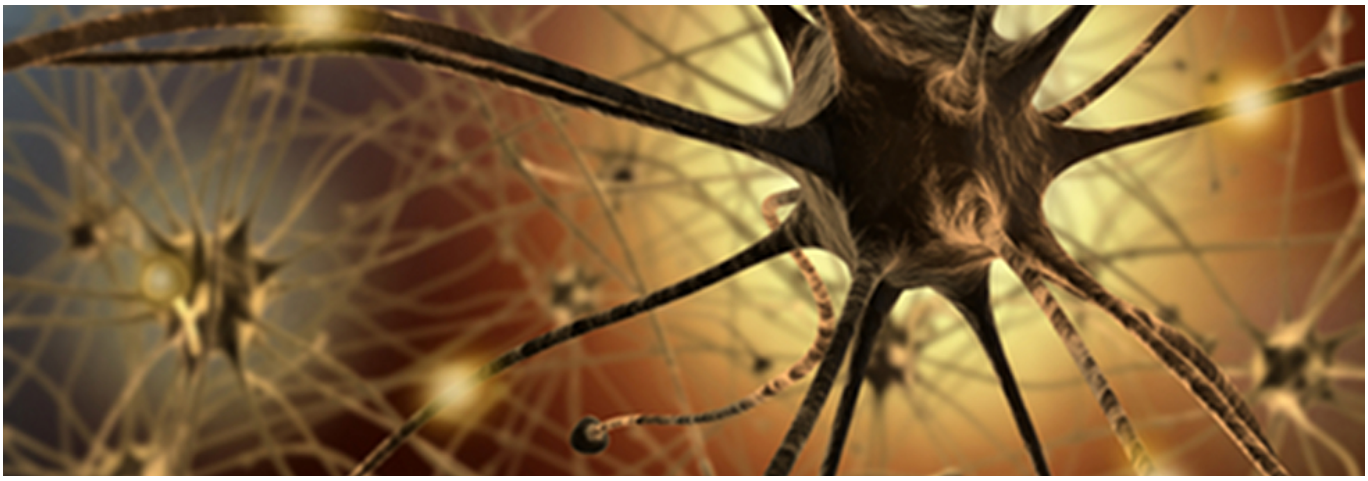
Bergland, C. (2007). The Athlete's Way. St. Martin's Press.

Case of missing cerebellum

Yu, F., Jiang, Q. J., Sun, X. Y., and Zhang, R. W. (2015). A new case of complete primary cerebellar agenesis: Clinical and imaging findings in a living patient. *Brain* 138, e353. doi:10.1093/brain/awu239.

More popular website (the above may be behind a paywall):

https://neuwritesd.org/2014/12/18/no-cerebellum-no-problem/



The Small Stuff in the Brain

The Six Layers of the Cortex

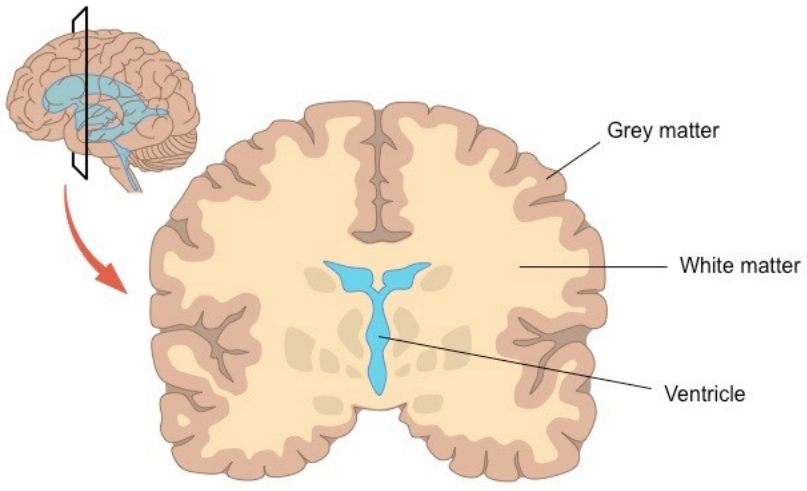
The surprisingly complex structure of our neocortex

BY ANDY HABERMACHER

Reading time: about 4 minutes

Novices to the brain may think that our brain is packed full of our magnificent brain cells, neurons. I can't remember how I used to think of the brain, but it was probably something along those lines. A mass of brain cells. This, however, is not how the brain is structured. First off, we have grey matter and white matter. The grey matter being where our neurons the functional units of our brain sit. The white matter basically making up a large volume of our brain being the connections between our neurons. Sobering to think that this outer layer, grey matter is only a few millimetres thick. What is more surprising is not only is this only a thin layer, but it is clearly structured into 6 discrete layers.

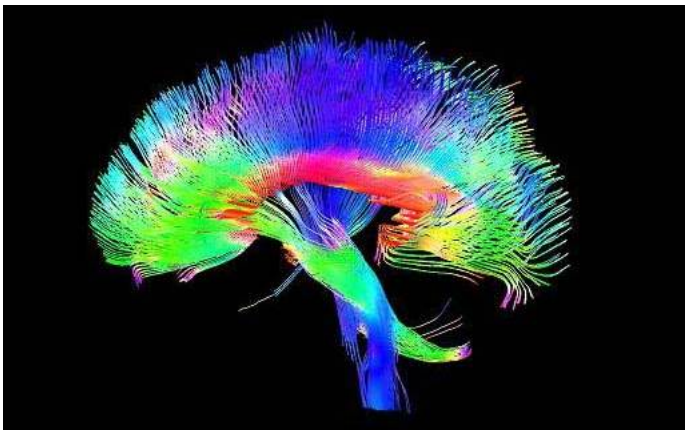
When first learning of neuroscience and behaviour we often get hooked on what brain regions "do". This is the localisation theory. There are many problems to this, but as a simplistic starting point there is probably no other way to do it. Neuroscientists themselves get hung up about other things, how these regions communicate and coordinate together. How the vast number of chemical interactions stimulate and moderate neuronal activity. How neurons operate in groups and what different types of neurons do in different location and regions.



This month's short deeper dive will look at the six layers – something I found fascinating when I first learnt of it. First off, we know that the brain is traditionally split into grey matter and white matter. The previous diagram left illustrates this. The outer folded layer of the brain is known as the grey matter. This is called grey matter because in conserved brains it appears greyish. In the living brain this

is light pink. This is where our neurons are densely packed. This is also sobering to think that our cognitions only sit in a thin layer of neurons spreading and folding over the brain. The internal area is known as white mater – because, well obviously, it is white. It is white because these are the myelinated axons of the neurons in the outer cortex and are therefore the communication pathways between different regions of the brain.

Mapping these pathways has also been part of a big brain project (but that is another story for another day). Diffusion Tensor Imaging (see below) has given us a good idea of these pathways and give impressive visual representations of the pathways in our brain which, as you can see, go from outer to inner and front to back.

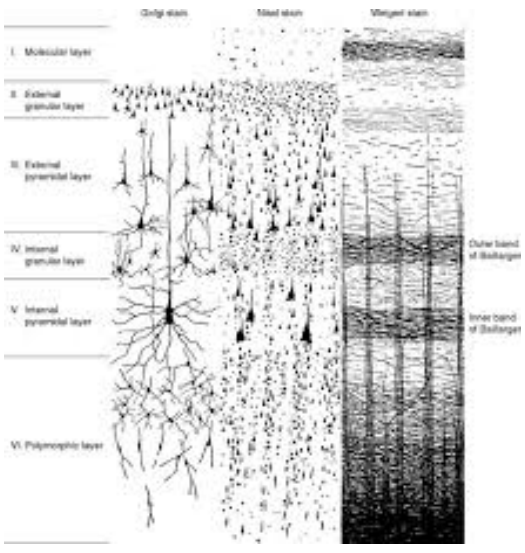


What is also interesting is the structure of the grey matter. This is not just a sheet of densely packed neurons but rather a clearly structured 6 layers of neurons. This structure is found in all mammals but not all parts of the brain have the 6 layers of the neo cortex some of the older regions such as the cerebellum we wrote about in the previous article have only three or four layers – suggesting an older evolutionary part of the brain.

The ins and outs of these layers will be going into too much technical detail but what we can clearly see is that in some regions we have densely packed cells and these then connected down to larger pyramidal cells which in turn connect across regions and across the brain. So, we can see a form of hierarchical processing with numbers of smaller cells connected closely in different regions and different layers communicating with different cells and parts of the brain.

The three outer layers receive inputs and give outputs to other cortical regions but in near proximity. The lower levels receive input and give output to the thalamus (often considered a relay station) and the brain stem.

A simple way to think of it, this is really simple, is that the densely packed middle and lower layers receive inputs from the thalamus and brain stem, and this are then processed in the higher levels and between cortical regions before being sent back through the thalamus and brain stem.



This is a fascinating part of the magic of the brain - the precise coordination is what researchers have been looking at and attempting to understand and map.

For me it is another example of the magical beauty of the brain and the impressive and exquisite complexity of the brain and how all these moving bits connect together to give us a complete whole and enable us to operate as human beings•

References

Adesnik, H., and Naka, A. (2018). Cracking the Function of Layers in the Sensory Cortex. *Neuron*. doi:10.1016/j.neuron.2018.10.032.

Grant, P. (2015). “Cerebral Cortex,” in *International Encyclopedia of the Social & Behavioral Sciences: Second Edition* doi:10.1016/B978-0-08-097086-8.55009-0.

Guy, J., and Staiger, J. F. (2017). The functioning of a cortex without layers. *Front. Neuroanat.* doi:10.3389/fnana.2017.00054.

Narayanan, R. T., Udvary, D., and Oberlaender, M. (2017). Cell type-specific structural organization of the six layers in rat barrel cortex. *Front. Neuroanat.* doi:10.3389/fnana.2017.00091.

Shepherd, G. M. (2011). The microcircuit concept applied to cortical evolution: From three-layer to six-layer cortex. *Front. Neuroanat.* doi:10.3389/fnana.2011.00030.

Shepherd, G. M., and Rowe, T. B. (2017). Neocortical lamination: Insights from neuron types and evolutionary precursors. *Front. Neuroanat.* doi:10.3389/fnana.2017.00100.

Part 2

BUSINESS BRAINS

Contents:

Organisational Leadership / Senior Leadership

The Things you Miss

How the brain can prioritize the obvious - but wrong - information

BY ANDY HABERMACHER

Reading time: about 8 minutes

The story of the statistician Abraham Wald goes that when World War II bomber planes returned with bullet holes, these parts of the planes were reinforced. Abraham Wald, however, made the counter-intuitive argument of reinforcing the areas that hadn't been damaged. The result was that losses decreased dramatically.

This is the story reported in an issue of Nautil.us (one of my favourite reading materials). The article is focused on systems thinking, which is a favourite topic of mine, but I would like to focus on the cognitive concept of attention and how this applies to business. This is because there are "logical" and obvious things to focus on. In the above story the bombers would return, and the obvious solution would be to armour or reinforce the areas of the plane that had bullet holes in. So far sounds logical – the planes are being hit – we can see where they're being hit - so let's reinforce those areas. This highlights a number of cognitive fallacies and of how the brain prioritises information – often the wrong information.

The logical leap that Abraham Wald managed was to understand that the planes that were returning, were hit in non-critical areas and the planes that weren't returning, were probably hit in other areas that were critical. It also highlights that there was some important information missing – namely that of the non-returning planes. It was only Abraham Wald who had this insight. The more interesting question is why did non-one else ask that question? And in the world of business this is the critical question. In a world of information and data and senior leaders making key decisions on this data and making strategic and key investment decisions not to mention more banal organisational decisions, how can they ensure that they don't reinforce the "bullet holes" in non-critical areas.

What's more this relatively simple insight of understanding that those planes that were not making it back were probably hit in other areas, can also be considered the root of "genius". I am not fan of the world genius – something we will approach in future issues and reviewing intelligence. But often genius insights are those that in retrospect seem so obvious. This is what makes them so genius-like: seeing the almost obvious and being able to operationalise this where others miss it.

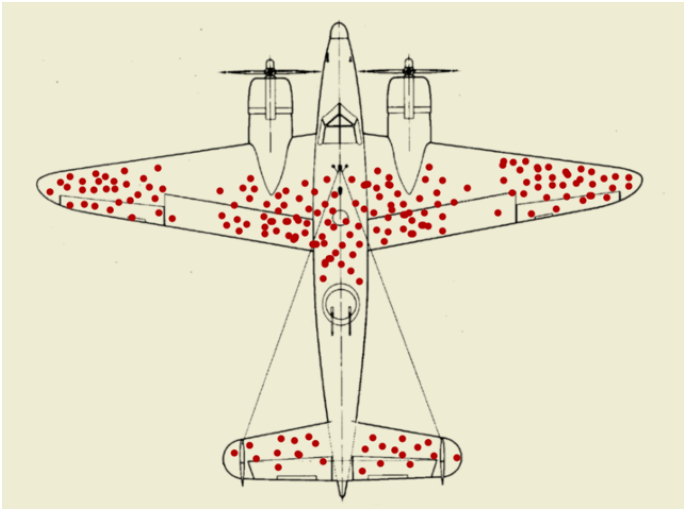
But what is interesting to us is what is happening in the brain, and the biases and shortcuts the brain uses that can lead us to miss the obvious and critical answer. Here are some which I will explore in more detail below.

- The brain **prioritises concrete** over abstract. The holes can be seen and touched.
- The brain also **prioritises dramatic and emotional**. Bullet holes and damage are dramatic and emotional – "phew close miss"
- The brain **prioritises simple closely related logical steps**. See hole, fix hole. Strengthen plane so no new holes in future (hopefully).
- The brain **works with information**. Non-present information is not processed (obviously, duh)

Let's explore a few of these in more detail:

Non-Information

Now this sounds like the most blatantly obvious thing to say. If the brain does not have the information, it does not process it. So far so good, but there are a number of twists to this and how the brain functions. But first back to the principle of no information – the problem is not so much the lack of information but the lack of searching for a complete picture. In the example of the bombers, we want a complete picture and that is what is taking the planes down as well as what is getting the planes back.



In the business world we are often faced with situations and given information and then need to decide on this. The first question to ask is: *what information do we not have*? This could lead to more insights.

Another aspect of this in business is we don't get answers to question we don't ask. A misunderstood aspect of data and surveys.

However, there are some areas where we may be able to spot the difference and missing information. These are situations that we already know well. If you are a chess player and you lay out a chess board and pieces are missing you notice this. This is because you have a map of how the chess board should be. We spoke about the cerebellum in an earlier article in this issue and how the cerebellum gives automated predictive information and works in collaboration with your cingulate cortex in the brain which activates to errors in the environment.

It is therefore no surprise that it was Abraham Wald who made the insightful proposal because he understood statistics and the nature of information (or not having it).

Predicative coding

The brain is a great predictive tool – Carl Friston a giant of neuroscience argues that the core function of the brain is surprise minimisation. Being able to predict what is going to happen in any number of situations. Using surprise minimisation as a core construct of AI in gaming situation rather than simple experience learning was proven to be more successful.

As we said our cerebellum operates in a feed forward manner and can be considered the predictive part of the brain, giving predictions in all areas of human endeavour. This predicative coding is however, built on past experiences. This is also corroborated by research into memory which shows that memory helps predict the future and those with memory deficits are also less able to predict the future.

In short, our brain is well-designed to make predictions and minimise surprise – part of the Orientation and Control system in SCOAP. When we do not have the experience, we therefore fail to make optimal predictions or when we assume the situation is known or predictable, often falsely. Similarly, when other evidence in present it can interfere with predictive coding. In the case of the planes, we didn't have enough information to make good predictions – once the mistake is known it becomes a part of our predictive coding – however, this may not be applied to other contexts such as busines predictions.

Emotional

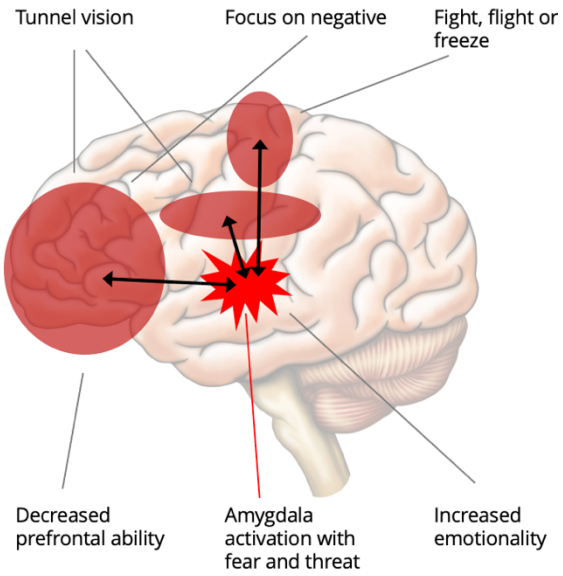
The research into emotional centres in the brain and attention is vast. Here a quick and simplified overview:

Our amygdalae, two almond-shaped structures sitting deep inside our brain are considered our emotional processing centres because of their well-documented high activation in emotional, particularly fear-based, contexts. To be more accurate they are emotional attention centres guiding attention of the brain to emotionally relevant stimuli. Remember emotional stimuli are there to guide behaviours and enable survival – good stuff that is good for us and so to be attended to, and the bad and threatening stuff, which may risk our survival and therefore activate emergency energy systems for fight or flight.

This is all good and right and in the "wild" and is a system which operates more than well enough to ensure survival. It just isn't very refined, and there are multiple problems when it comes to cognitive areas and areas requiring complex thought and creativity.

Activation of the amygdalae therefore drives attention - this has focusing impact on our cognitive resources. This focusing effect will therefore reduce cognitive functioning in other areas and reduce ability to think creatively or think in more connected ways. Our cognitive centre of the brain is designed to best operate at a distance to emotions and operation when everyday threats are not present. Therefore, we can think of high emotionality, particularly fear and threat, as focusing attention on the stimuli and simultaneously *reducing cognitive capacity*. In fearful or negative situations, it must also be noted that attention shifts to the negative i.e., more similar threats.

In the case of the planes this reduces our ability to think past the holes and the obvious threat that bullets going through planes pose. In everyday business this means that emotional or threating situations draw our attention – potential for loss will focus our attention on this – raise possibilities of this – "let's review how many of these risks we have in the company" - and reduce cognitive ability to resolve these problems, or think more creatively, or put the issues into context.



Concrete over abstract

The brain activates more to concrete situations - this is even true of words which themselves are abstract representations of contexts or situations. For example, action words like "walk" activate the brain more than more abstract words like "perambulate". Our brain is designed to work in a concrete environment – our abstraction abilities are built on top of our simple functional abilities. Though these

may be impressive, particularly when compared to other animals, concrete will always take priority over abstract. When something is see-able, and touch-able, it engages the brain more. The holes in the plane are very visible and represent a real threat so draw our attention – non-holes (pretty obviously, duh) in contrast, do not draw our attention. Why would they?

Simple and pragmatic over systematic

Another way the brain prioritises is by taking simple pragmatic approaches rather than more complex systemic approaches. There is a hole, so strengthen that part, is a simple logical step. The brain likes these types of logical steps. The more complex and more systemic, the harder the brain has to work, and the harder it is to comprehend, not to mention potentially harder and more complex to implement. Chances for success may also diminish with complexity. The article in Nautil.us that gave the plane example is focused on systemic thinking and complex systems theory. In the real world we often take, and prefer, the simple and pragmatic to the systemic and complex.

Improve your decision making

In short, the example of the bombers with bullet holes and the subsequent solution highlights a number of thinking and decision-making fallacies. Our brain's functioning highlights how these come about. This is critical for senior leaders in organisations not to mention leadership teams and boards of directors. My experience with these forums is that they fall into these fallacies very often. They do this because the brain is designed to fall into these traps and being higher in the organisation does not make one immune to this, even after numerous quality leadership courses or analysing decision making. The reason is that in the real world we all have to deal with the problems we face. Though one could argue that executive committees and boards of directors are distanced from operations and so should be able to make clear decisions, the problems they deal with are often big operational issues (such as potential major losses) which draw attention and therefore inhibit effective decision making.

So, in this example of the plane with the bullet holes, it highlights issues of:

- Information and non-information: the full picture
- Emotional focusing
- Concrete over abstract
- Simple over systemic

To improve decision making:

- Understand information and *non-information*
- Understand how emotional topics draw and focus attention
- Understand how concrete can override abstract
- Understand that complex systems may be the cause and solution rather than more simpler solutions
- Constantly ask: what is the root cause?
- Keep asking questions
- Review past decisions
- Self-reflection (see article in this issue "The Two Sides of Self-reflection")

Being smart increases your chances of falling into cognitive thinking traps!

It is important to note that intelligence per se is not an antidote. In fact, some research suggests that the more intelligent we are the more we fall into these biases and the less we are aware of them. Similarly, another review of the research noted that cognitive ability, thinking dispositions, and executive functioning were not helpful in reducing faulty decision making. What was a key differentiator was *cognitive reflection* – the ability to reflect on one's own decision and be open and honest and aware of one's decision-making processes.

We review the "The Two Sides of Self-Reflection" later in this issue.

In the meantime, take note of the above because I am sure your executive team is making sub-optimal decisions because of the above – and just reading this article is not enough to change that – you need to be constantly reflecting on your decisions to improve them. And that is free - and you can start now

References

Heuristics and thinking fallacies

Fox, C. R., and Tversky, A. (1995). Ambiguity Aversion and Comparative Ignorance. *Q. J. Econ.* 110, 585. doi:10.2307/2946693.

Hammond, J. S., Keeney, R. L., and Raiffa, H. (2006). The hidden traps in decision making. Harv. Bus. Rev. 84, 118

Kahneman, D., and Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica* 47, 263–291. doi:10.2307/1914185.

Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.

Susceptibility to heuristics and thinking fallacies

West, R. F., Meserve, R. J., and Stanovich, K. E. (2012). Cognitive sophistication does not attenuate the bias blind spot. J. Pers. Soc. Psychol. 103, 506–519. doi:10.1037/a0028857.

Toplak, M. E., West, R. F., and Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. Mem. Cogn. doi:10.3758/s13421-011-0104-1.

Predictive coding

Ellison, A. M. (1996). An introduction to bayesian inference for ecological research and environmental decision-making. Ecol. Appl. 6, 1036–1046.

Friston, K. (2012). Prediction, perception and agency. Int. J. Psychophysiol. 83, 248–252.

Kveraga, K., Ghuman, A. S., and Bar, M. (2007). Top-down predictions in the cognitive brain. Brain Cogn. 65, 145–168.

Marvin, C. B., and Shohamy, D. (2016). Curiosity and reward: Valence predicts choice and information prediction errors enhance learning. J. Exp. Psychol. Gen. 145. doi:10.1037/xge0000140.

Oldrati, V., Ferrari, E., Butti, N., Cattaneo, Z., Borgatti, R., Urgesi, C., et al. (2021). How social is the cerebellum? Exploring the effects of cerebellar transcranial direct current stimulation on the prediction of social and physical events. Brain Struct. Funct. doi:10.1007/s00429-020-02198-0.

Scheidt, R. A., Zimbelman, J. L., Salowitz, N. M. G., Suminski, A. J., Mosier, K. M., Houk, J., et al. (2012). Remembering forward: Neural correlates of memory and prediction in human motor adaptation. Neuroimage. doi:10.1016/j.neuroimage.2011.07.072.

Emotional circuits and decision making

Heekeren, H. R., Schulreich, S., Mohr, P. N. C., and Morawetz, C. (2017). How incidental affect and emotion regulation modulate decision making under risk. in 5th International Winter Conference on Brain-Computer Interface, BCI 2017 doi:10.1109/IWW-BCI.2017.7858145.

Lerner, J. S., Li, Y., Valdesolo, P., and Kassam, K. S. (2015). Emotion and decision making. Annu. Rev. Psychol. doi:10.1146/annurev-psych-010213-115043.

Miu, A. C., Heilman, R. M., and Houser, D. (2008). Anxiety impairs decision-making: Psychophysiological evidence from an Iowa Gambling Task. Biol. Psychol. 77, 353–358.

Maitlis, S., and Ozcelik, H. (2004). Toxic Decision Processes: A Study of Emotion and Organizational Decision Making. Organ. Sci. 15, 375–393.

Seymour, B., and Dolan, R. (2008). Emotion, Decision Making, and the Amygdala. Neuron 58, 662–671.

Phelps, E. A., Lempert, K. M., and Sokol-Hessner, P. (2014). Emotion and Decision Making: Multiple Modulatory Neural Circuits. Annu. Rev. Neurosci. doi:10.1146/annurev-neuro-071013-014119.

Action words

Pulvermuller, F. (2005). Brain mechanisms linking language and action. Nat Rev Neurosci 6, 576–582.

Van Dam, W. O., Rueschemeyer, S.-A., and Bekkering, H. (2010). How specifically are action verbs represented in the neural motor system: an fMRI study. Neuroimage 53, 1318–1325.

Vigliocco, G., Kousta, S. T., Della Rosa, P. A., Vinson, D. P., Tettamanti, M., Devlin, J. T., et al. (2014). The neural representation of abstract words: The role of emotion. Cereb. Cortex. doi:10.1093/cercor/bht025.

Articles on Abraham Wald

https://nautil.us/issue/87/risk/the-damage-were-not-attending-to

https://www.dgsiegel.net/talks/the-bullet-hole-misconception

Team Leadership

The Average Performers Who Enable High Performance

BY ANDY HABERMACHER

Reading time: about 12 minutes

Many sports coaches know it – there are some team members, who may be unspectacular, but the whole team just functions better with them. But no one knows how to measure it and big data Is not helping – or is it?

The standard logic in business and sports is that to get high-performing teams you should hire a bunch of high-performing individuals or even stars. In the sports world we are fascinated by this with fantasy teams of the best-ever teams of the best-ever players. But the problem is that team performance is more than just the sum of the parts. For those who are familiar with rugby, which may not be many of you, every four years there is what is known as the British and Irish Lions tour. This is an old tradition and is considered one of the pinnacles of a rugby career - to play for and win with the Lions or play against and beat the Lions. In some ways more important and illustrious than the more recently introduced World Cup.

The fascinating thing is that logically the British and Irish Lions should thrash any team they come across. The players are selected from four of the biggest and most talented rugby nations on the planet (England, Scotland, Wales, and Ireland). So, picking the most talented players from a talent pool four times the size for any national team should provide an extremely talented team. And yet, despite this, the Lions winning against another national team is a big thing and far from a foregone conclusion. They selectively tour one of the southern hemisphere countries: South Africa, Australia, or New Zealand. On balance their chance of winning is only about 50/50 probability similar to if any one of the national teams were to independently tour. What's more, as part

of the Lions tour, they also play club or provincial teams – teams a step down on the pecking order of a national team and yet, surprisingly, maybe, they do not win all the time or rather lose regularly.

This shows that despite having rich pickings of talent from four elite national teams they do not necessarily perform better than any one national team and still fail to beat lowly club teams.

The question is why not, and what is the difference?

Another question is that of the unspectacular person on the team who somehow enables high team performance. In his insightful article 'The No-Stats All-Star' in *The New York Times Magazine* in 2009, Michael Lewis captured the essence of the problem. Writing about the US National Basketball Association (NBA) player Shane Battier, he notes:

> *Here we have a basketball mystery: a player is widely regarded inside the NBA as, at best, a replaceable cog in a machine driven by superstars. And yet every team he has ever played on has acquired some magical ability to win.*

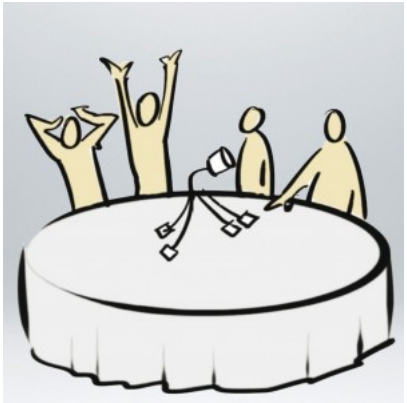
The above story of Battier is fascinating because he was consistently classed as an underperformer quoted as "at best a marginal N.B.A. player". His stats on the things that N.B.A. teams measure such as points and rebounds, were terrible. On paper he was a massive underperformer, but somehow when he was on the field everyone else performed better. The article that the above quote is taken from goes into a lot more depth on the refinement of statistical approaches and under some of these characteristics, or rather, better forms of statistical analysis, Battier does show up. For example, the greatest players all under perform when guarded by Battier. This may make good reading for another article on statistical analysis or what we quoted in the previous article of "*you don't get answers to questions you don't ask*" or my concept of *non-information*.

There are now a number of issues to approach in the above examples.

- Groups of higher performers do not necessarily (and often don't) make high performing teams.
- And that unspectacular performers, to the external eye, and to most statistical analysis, can enable teams to perform much better.

The question now in business is how can we identify these, and can we reward them also? Or simpler how can we put together high-performing teams. And more than that how do we define "talent".

Some of the clues may come in series of experiments on creativity. Tom Wujec is well known for his Ted talk on creativity using spaghetti and a marshmallow (a fun activity by the way) – the short video is well worth watching. The insights from these tasks are worth paying attention to. Notable is that kindergarten children were very effective but took a completely different approach to problem solving – worth saving for future articles on creativity – MBA graduates were terrible, and CEOs were also unspectacular.



Now let's assume for the sake of argument, and there could be a lot of argument, that CEO's and MBA graduates represent "talent". Now not strictly true as Tom noted, thankfully, architects and engineers performed best and so were the most "talented", giving thankful support, for the concept of being "an expert". THE CEOs and MBAs were ineffective because of using the wrong strategies – this is simply the problem of throwing a bunch of talented people together without thinking of team composition or what is known as **complementarity**. The insightful observation from Tom was that when he added an executive assistant to the teams of CEOs, their performance increased dramatically. Why?

He noted that communication and moderation increased. So, having a coordinator and communicator helped complementarity, and improved

synchrony, another important facet of team performance. The assistants effectively functioned as enablers - similar to what Battier was doing – not worrying about their statistical performance but enabling others to perform better through managing communication and presumably also conflict effectively.

This is also neatly complemented by research into intelligence and collective problem solving by Woolley and colleagues: in a set of structured experiments teams were given collective problems solving tasks – tasks that required the team to solve a problem collectively. The outcome was that the team with the average highest IQ i.e. team packed with "talent" did not perform best, nor did the team with the person with the highest IQ, the top performer condition. So, who came out on top? The team with the best communication abilities, ability to listen and complement and interact with other people's ideas. This again supports the concept of communication and enabling as being key factors to team performance. Women are more than interested to know that also simply having women in the team improved performance (of course you women knew that all along, didn't you)!

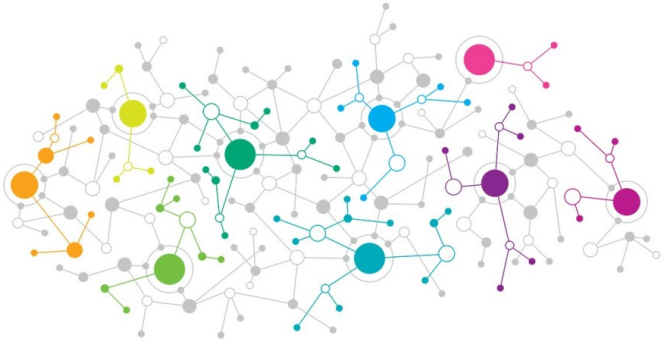
There is more to team performance, the above is in collective problem-solving scenarios, which is not necessarily what every team is mandated to do, though arguably will always be a part of any team's performance. Some of the other factors are not the focus of this article (see box at end). In summary team performance is very strongly influenced by other factors such as having a clear team, having clear roles, and clear goals. When I review teams in organisations, normally, this is the first thing I look at, and more often than not, the first thing that is wrong.

But in the case of Battier and the marshmallow exercise these were already given: the team was clear and the team goals also. But an important aspect of the research, often glossed over, is that individual competence was a predictor of *individual* productivity, but ***inter-team support*** was a better predictor of *team* productivity. Simply put, helping others in the team enables the team to perform better. This also points to a word of warning to those arrogant high performers. Though they may individually perform well, the question is how much do they diminish the performance of others? In sales teams, which are often loosely bundled teams, arrogant high performers may do little damage and create a lot of profit, but for interdisciplinary teams looking to create new solutions, the team damage is likely to override their individual ability.

This, however, doesn't lead us into any insights of how to actually identify these people or team dynamics – obviously the intuitive amongst us will already have identified this and may make better decisions on team fit and include this in hiring decisions. But some research (unpublished) we did on successful and failed teams in the startup space gives us some intriguing theories of team performance. This could also give us better analytics such as in the example of Battier that showed with standard analytics he was an underperformer but when using more refined methods he was an exceptional performer.

We only measured personality with a view in our first mandate to give some ideas of how well-matched startup teams were. The reason for our first piece of research into this was the acknowledged importance of the team in enabling startups to succeed but an inability or unwillingness to measure this. So, what did our research show?

First off, we looked at the concept of *homophily*. This is the concept that similar personalities get on well with each other. We set some cut-off points and first off, we could see that areas of conflict that we predicted with high variation in personality, was well-supported. However, there is a problem with this because of the two concepts I mentioned previously. Namely *synchrony* can be seen as how similar in personality, or mindset, individuals are, but *complementarity* is the concept of having differing but complementary skills or personality traits. These are seemingly contrasting aspects. Though many leaders proudly claim they have diverse teams our research shows they are not as diverse as they like to think, because they may be similar in multiple aspects of personality. Before I digress too far, I am sure you are keen to learn of what else we discovered in personality and effective teams.



Well, we found that:

- Similarity in personality predicted cohesion
- Differences in personality were well accepted best when only in limited areas. So, the larger the differences, and the larger the number of traits that differed, the worse the team cohesion.
- Extreme differences can cause conflict particularly when in multiple areas.
- **Polarisation** was an important aspect of team conflict i.e. when two members were high in a trait and another very low.
- Individualisation of polarisation - when a single person is an outlier it can lead to this person being left out, when it is multiple this person can be totally polarised.
- Large variations, if evenly distributed, can lead to cohesion but slow decision making. So, the opposite of homophily when there is wide but nicely distributed spread there may be some underlying conflict, but everyone balances each other out. *Complementarity* in short
- **Mindset** caused large disruptions. For example, we mapped team members to corporate mindset, based on traits that support classic corporate thinking, and startup mindset, and this was very predictive of conflict and team breakup in the startup scenarios.
- Some traits seemed more predictive than others e.g. multiple personalities high on dominance was a recipe for conflict
- "Typing" (such as classic humanistic vs. cognitive types) is too general and much less effective than summing multiple different single traits

From this we developed a coherence figure including the above multiple inputs – but this can only be understood as a rough guide to team cohesion because a team has many moving parts. Roles, as we said, play a key importance and being effective in roles is critical for cohesion and conflict minimisation – we don't measure this. Similarly, leadership and reporting structures will also guide potential for conflict.

What we also found, however, is that there are also moderating traits that minimise the risk of conflict. These includes, openness, and humour and those individuals who are high in intuition and high in cognition, helping to mitigate between these two contrasting viewpoints.

With the question of how to identify those average performers who enable high performance, let me show you what happens when we remove one person from a team.

Here you can see two teams along two separate personality traits (note that we measure up to 72 personality traits with our HBF tool – but normally only 28 for team cohesion). What you can see is a distribution of personalities along a scale. This team is therefore, based on this one trait, likely to differ significantly in how

they approach problems and see the world but there are a range of personalities so there are those in the middle who will moderate others and act as communicators between the two. Decision-making may be slow but could be effective.

However, if we move one person out of the team, in each case the middle person, we now suddenly have a polarized team with two groupings and high and low ends of the scale. Polarisation was one of the biggest predictors in our data for team conflict. So, by removing one person from the team we have now created the potential for more conflict. This could therefore be the unspectacular performer who unbeknownst to others helps moderate conflict.

The level of polarisation in the above is not extreme, here another example from the real world:

So where does this leave us? Let me summarise

1. A collection of talent or high performers **does not** make a high performing team
2. **Synchrony** and **complementarity** is critical to team performance
3. This can be **measured and mapped** but rarely is
4. **Communication skills** are critical
5. The team leader is responsible for **managing** this complementarity and synchrony
6. **Personality awareness** can improve synchrony and complementarity
7. Level of **inter-team support** is predictive of team performance
8. Don't forget the other obvious factors such as **clear roles and clear goals**

In short when looking to build high-performing teams look to high synchrony and high complementarity (over, and with, "high talent"), measure this, build awareness, encourage open communication. And, food for another article another day, you need a team leader who can manage and lead this effectively.

The corporate problem is that many organisations seem unaware of these team performance issues, still focusing on getting "talent" and measuring individual performance. A question to ask, is how to measure, and value team performers, and how do you reward those individuals who may be unspectacular but somehow keep the team rolling? A good start is to measure team cohesion but also identify those who are the enablers in the team and have high inter-team behaviours – they may be worth a lot more than you think.

Research into team performance

Research into team performance is long but notoriously difficult to research with so many moving parts in the real world. The military has provided the basis for a bunch of research because of their clear structure of teams and clear goals.

Some of the interesting and often underrated factors that come out of this research is: first off do you actually have a team? A team must be a coherent unit, stable overtime, have interdependences and have collective goals. Everyone agrees on that, but different researchers define them differently.

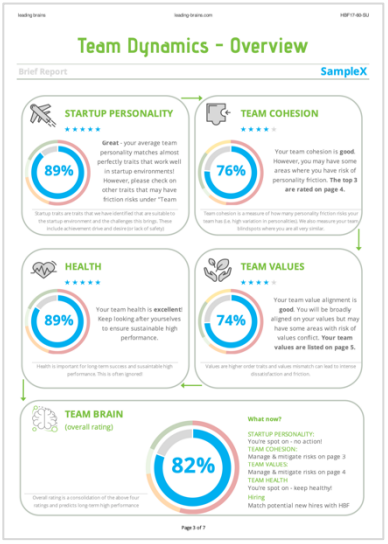
Similarly, the boring stuff is very important – clear roles and clear goals and the skills to perform the tasks. Nothing spectacular there but in modern matrixed global organisations, roles and responsibilities can become diffuse and large, with people wearing many hats.

Other more recent work that has become a main stock of team workshops has been the well-known work done by Google internally finding, to their surprise, but not to any psychologist or sociologist, that psychological safety was a key factor, as was leadership and particularly coaching by the team leader.

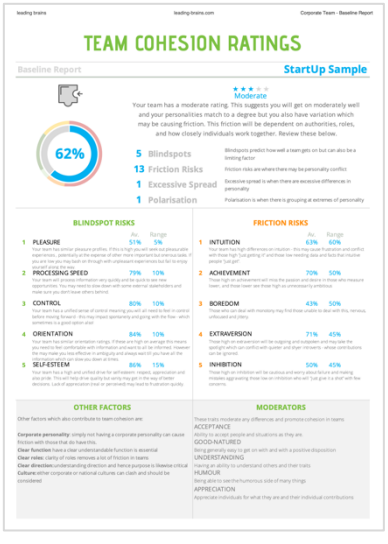
Context plays a role and the synchrony effect we speak about in the article is highest when teams have less well-defined roles and high interdependencies, but with less interdependencies and very structured roles, is less important. Similarly, synchrony has been shown to predict short-term success in entrepreneurial settings but complementarity, diversity, has been shown to be better for long-term success.

Using HBF to measure team cohesion

We specifically developed the HBF to measure team cohesion. Our report shows cohesion factors, blindspot risks where synchrony is high, but also friction risk where personality diversity is high. These are only potential risks, and managing them is up to the team. The report therefore provides a valuable way to frame this information and provide a basis to build awareness and discussions around how to improve team efficacy.



Team Dynamics Overview:
summarized ratings on five factors



Detailed Team Cohesion Ratings:
top five blindspots, and top five friction risks highlighted

Detailed Mapping:
Overview of how all team members map on each personality trait. You can identify moderators and enablers here.

References

Referenced articles

https://www.nytimes.com/2009/02/15/magazine/15Battier-t.html

https://aeon.co/essays/what-complexity-science-says-about-what-makes-a-winning-team

Team performance

Burke, C.S. et al., 2006. What type of leadership behaviors are functional in teams? A meta-analysis. Leadership Quarterly.

Ceri-Booms, M., Curşeu, P.L. & Oerlemans, L.A.G., 2017. Task and person-focused leadership behaviors and team performance: A meta-analysis. Human Resource Management Review.

Charan, R., Drotter, S. & Noel, J., 2011. The Leadership Pipeline: How to build the leadership powered company 2nd ed., San Francisco: Jossey-Boss.

Coutu, D., 2009. Why Teams Don't Work--An Interview with J. Richard Hackman. Harvard Business Review.

Google (2019). Guide: Understand Team Effectiveness. re:Work https://rework.withgoogle.com. doi:.1037//0033-2909.l26.1.78.

Gully, S.M. et al., 2002. A meta-analysis of team-efficacy, potency, and performance: Interdependence and level of analysis as moderators of observed relationships. Journal of Applied Psychology, 87(5), pp.819–832.

Hackman, J.R., 2002. A Real Team. In Harvard Business School Press.

Hackman, J.R. & Connor, M.O., 2004. What Makes for a Great Analytic Team? Individual vs. Team Approaches to Intelligence Analysis. Intelligence.

Kozlowski, S.W.J. & Bell, B.S., 2012. Work Groups and Teams in Organizations. In Handbook of Psychology, Second Edition. pp. 412–460.

Morgeson, F.P., DeRue, D.S. & Karam, E.P., 2010. Leadership in Teams: A Functional Approach to Understanding Leadership Structures and Processes. Journal of Management.

Creativity and Intelligence

Somech, A., and Drach-Zahavy, A. (2013). Translating Team Creativity to Innovation Implementation: The Role of Team Composition and Climate for Innovation. J. Manage. doi:10.1177/0149206310394187.

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., and Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. Science 330, 686–688. doi:10.1126/science.1193147.

Wujec, T. (2010). The Marshmallow Challenge. Marshmallow Challenge- TED TALK.

Homophily, Synchrony, and Complementarity

Antonenko, P. D., Davis, R., Wang, J., and Celepkolu, M. (2019). On the Same Wavelength: Exploring Team Neurosynchrony in Undergraduate Dyads Solving a Cyberlearning Problem With Collaborative Scripts. Mind, Brain, Educ. doi:10.1111/mbe.12187.

Aven, B., and Hillmann, H. (2018). Structural role complementarity in entrepreneurial teams. Manage. Sci. doi:10.1287/mnsc.2017.2874.

Gompers, P. A., Huang, K., and Wang, S. Q. (2017). Homophily in Entrepreneurial Team Formation. SSRN Electron. J. doi:10.2139/ssrn.2973329.

Hu, J., and Judge, T. A. (2017). Leader-team complementarity: Exploring the interactive effects of leader personality traits and team power distance values on team processes and performance. J. Appl. Psychol. doi:10.1037/apl0000203.

McPherson, M., Smith-Lovin, L., and Cook, J. M. (2001). Birds of a feather: Homophily in social networks. Annu. Rev. Sociol. doi:10.1146/annurev.soc.27.1.415.

Mønster, D., Håkonsson, D. D., Eskildsen, J. K., and Wallot, S. (2016). Physiological evidence of interpersonal dynamics in a cooperative production task. Physiol. Behav. doi:10.1016/j.physbeh.2016.01.004.

Reinero, D. A., Dikker, S., and Van Bavel, J. J. (2021). Inter-brain synchrony in teams predicts collective performance. Soc. Cogn. Affect. Neurosci. doi:10.1093/scan/nsaa135.

Ruef, M., Aldrich, H. E., and Carter, N. M. (2003). The structure of founding teams: Homophily, strong ties, and isolation among U.S. entrepreneurs. Am. Sociol. Rev. doi:10.2307/1519766.

Smith, D. M. (2018). Collective Synchrony in Team Sports. ProQuest Diss. Theses.

Steffens, P., Terjesen, S., and Davidsson, P. (2012). Birds of a feather get lost together: New venture team composition and performance. Small Bus. Econ. doi:10.1007/s11187-011-9358-z.

Individual Performance

The Two Sides of Self-Reflection

BY ANDY HABERMACHER

Reading time: about 6 minutes

Self-reflection has currently been going through a revival and is seen as a gateway to all things good and great. But beware the distinction between cognitive reflection, self-reflection, and rumination.

Self-reflection has been promoted as a means to increasing personal performance and constant improvement. Though some may associate this with the current wave of mindfulness, this has been in the leadership literature for a long time. In 1987 Gene Hall reported that reflective practices were more predictive of more effective School Principals, corelating with strategic sense and initiation, these descriptions related to still current buzzwords in leadership literature.

Indeed, in the HBF model of the evolution of human behaviour, self-reflection can be considered one of the latest additions to our arsenal of cognitive skills. It is therefore a particularly human ability. This ability should also enable us to improve competence and skills and this is likely how it developed in human beings as a cognitive ability to improve abilities be that in fighting, strategizing, gathering food, or making flint for hunting.

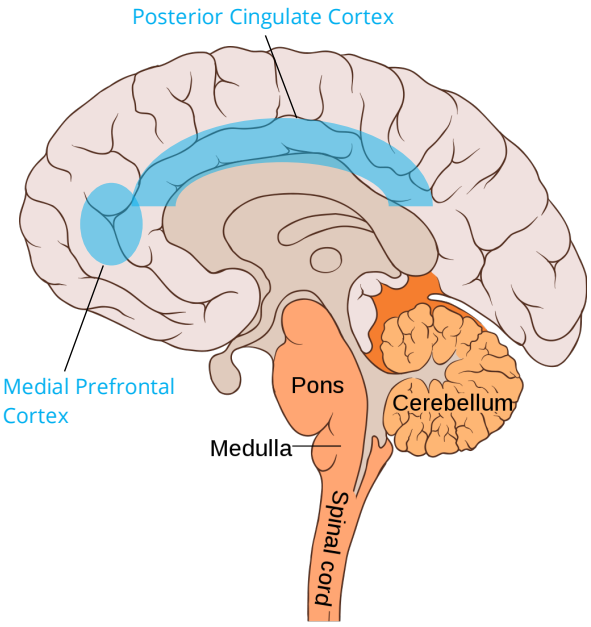
So, all in, it sounds like a good thing and good thing to promote in business and for individuals looking to get the best out of themselves. The only problem is that the research paints a muddled pictures and I'd also like to focus on the downsides – so that we can get more of the upsides.

I started proposing reflection as a method for continuous improvement from the mid 1990s, more related to concepts of sports performance which are constantly analysing and reflecting on ways and methods of improvement. In the 2005 the Cognitive Reflection Test (CRT) was developed by Fredericks (see box below). Research from this show promising results and that cognitive reflection could be more instructive than general intelligence. We noted in an earlier article that those who scored higher on the test were less susceptible to falling into classic thinking fallacies and traps, and better able to deal with bias. In fact, there are a bunch of

benefits to cognitive reflection. However, cognitive reflection is not the same as self-reflection because it is not just thinking about oneself but cognitively engaging with problem solving and self.

When we turn to the brain, we can see that research points to the medial prefrontal cortex and posterior anterior cingulate cortex as being heavily involved in self-reflection. Research also points to the insula being involved which we discuss in the next issue – the insula is a region that integrates bodily feelings. This is in line with the well-known functions of the brain's regions: prefrontal regions activating thought processes, the cingulate cortex which is involved in attention and error detection, complemented by the insula for integrating bodily feelings.

So far so good – an interesting digression is that of political viewpoints with some research in the USA showing that conservatives are more intuitive, following instinctive gut feelings, particularly in social contexts, and liberals are more reflective. What was more worrying about one study documenting this, is that they commented that these are more resistant to manipulation, i.e. change, than previously assumed.



This also falls in line with our proposal that self-reflection is as much a personality trait as an ability, with some people having more propensity or natural reflective abilities than others. Obviously, this can be worked on, and reflective practices built into one's workday.

This concept of self-refection being as much a personality trait as an activity to be developed is supported by other factors and the downside to self-reflection. We spoke about the medial prefrontal cortex as being involved in self-reflection, but this area is also strongly associated with depression. The medial prefrontal cortex was shown to exert more influence on other parts of the brain in those with depressive symptoms by researchers in 2017. This in turn is related to self-appraisal and also *rumination* that can be considered the negative sibling of self-reflection. The same circuits therefore that enable insight and self-improvement also activate self-critical thoughts and rumination - sitting with these and playing them over again and again.

This in turn brings us back to the more recent movement of self-reflection, positive psychology and strategies such as gratitude. Notable is also that though many positive effects have been documented with mediation, precisely these negative responses have also been recorded in research into mediation. Namely that negative rumination can increase, therefore leading to depressive symptoms (this depends on the context and mediation methods used). This downside to mediation is rarely reported in the popular literature.

This concept of gratitude and writing gratitude diaries, things we are thankful for, has been shown to be effective for those who are susceptible to negative self-rumination.

It should be noted that these processes are interrelated, but that self-reflection and cognitive refection are slightly different beasts. Self-reflection is the natural self-reflective process whereas cognitive reflection is a conscious activity to reflect on what has happened and manage intuitive and reflexive cognitive responses which improves decision making and business processes. There are strong overlaps and those who are high on self-reflection will be able to engage easily in cognitive reflection but may drift into critical self-appraisal and rumination.

So, to summarise the differences because these are important

- **Self-reflection**, also called *metacognitive reflection*, ability to reflect on oneself and introspect
- **Cognitive reflection**, ability to manage and inhibit impulsive intuitive thought processes
- **Reflective leadership**, practice of reflecting on leadership practices and keep focused on how practices are effective or not and particularly of larger strategic initiatives
- **Rumination**, the act of dwelling on negative self-referential thoughts

So where does this leave us. Cognitive reflection and reflective leadership have a bunch of research to back them up showing generally positive outcomes and therefore are of interest to anyone looking to improve their effectiveness and performance on the job (and in all areas of life).

So top tips are:

- Take time each day to reflect on what has happened and what you need to do to achieve your big goals
- Make sure you align your actions to your bigger strategic goals
- Practice unbiased self-reflection
- Note when you are ruminating and revert to unbiased reasoning
- If you are susceptible to self-criticism, consider a gratitude diary

We do know that these will in part be guided by natural propensity, personality, to engage in self-reflection and cognitive reflection. But we do all have a prefrontal cortex and can exert control over our behaviours and thought processes. The prefrontal cortex is fresh first thing in the morning before the day's activities have tired you out, so the final tip is to engage in strategic reflection first thing in the morning before you roll your sleeves up and get stuck into your day's work•

The Cognitive Reflection Test

The first cognitive reflection test is a short three-item test.

(1) A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents

(2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes

(3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days

These items have quick intuitive response that are incorrect. Therefore, to get the right answer one must first be able to identify and reject the intuitive response. What's more, confidence in having given the correct response was similar between those answering correctly and incorrectly. By the way, less that 20% of participants get all responses correct – this testing is often done with university students in the US. Note also that increased time pressure and disturbances dramatically reduced correct responses.

A longer version of the CRT has been developed by Toplak et al. (2014)

Overconfidently underthinking: narcissism negatively predicts cognitive reflection

This is the title of a 2020 paper relating cognitive reflection to other personality traits. This is well worth a read, but they measure multiple forms of cognition, reflection, various forms of narcissism, impulsiveness, and overconfidence. The big take away though was that those high in grandiose narcissism, claim to enjoy engaging in cognitive tasks, but are massively high on overconfidence, and show lower reflective abilities and insight.

So those arrogant individuals who have a high regard for themselves and their superiority will tend to fall into thinking traps more often but be overconfident in their abilities to avoid them and be unable to acknowledge and think through how they could have made a better decision. Many people in business reading this will be slowly nodding their heads having come across many people like this...

Littrell, S., Fugelsang, J., and Risko, E. F. (2020). Overconfidently underthinking: narcissism negatively predicts cognitive reflection. *Think. Reason.* doi:10.1080/13546783.2019.1633404.

References

Education

Hall, G. E. (1987). Strategic Sense: The Key to Reflective Leadership in School Principals. *ERIC*.

Osterman, K. F. (1990). Reflective Practice: A New Agenda for Education. *Educ. Urban Soc.* doi:10.1177/0013124590022002002.

Cognitive Reflection

Biaaek, M. (2016). What Color are the Lilies? Forced Reflection Boosts Performance in the Cognitive Reflection Test. SSRN Electron. J. doi:10.2139/ssrn.2832142.

Deppe, K. D., Gonzalez, F. J., Neiman, J. L., Jacobs, C., Pahlke, J., Smith, K. B., et al. (2015). Reflective liberals and intuitive conservatives: A look at the cognitive reflection test and ideology. Judgm. Decis. Mak.

Frederick, S. (2005). Cognitive Reflection and Decision Making. J. Econ. Perspect. 19, 25–42.

Hoppe, E. I., and Kusterer, D. J. (2011). Behavioral biases and cognitive reflection. Econ. Lett. doi:10.1016/j.econlet.2010.11.015.

Salgado, Otero, and Moscoso (2019). Cognitive Reflection and General Mental Ability as Predictors of Job Performance. Sustainability 11, 6498. doi:10.3390/su11226498.

Primi, C., Morsanyi, K., Chiesi, F., Donati, M. A., and Hamilton, J. (2016). The Development and Testing of a New Version of the Cognitive Reflection Test Applying Item Response Theory (IRT). J. Behav. Decis. Mak. doi:10.1002/bdm.1883.

Szaszi, B., Szollosi, A., Palfi, B., and Aczel, B. (2017). The cognitive reflection test revisited: exploring the ways individuals solve the test. Think. Reason. doi:10.1080/13546783.2017.1292954.

Toplak, M. E., West, R. F., and Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. Mem. Cogn. doi:10.3758/s13421-011-0104-1.

Toplak, M. E., West, R. F., and Stanovich, K. E. (2014). Assessing miserly information processing: An expansion of the Cognitive Reflection Test. Think. Reason. doi:10.1080/13546783.2013.844729.

Neural correlates of reflection

Herwig, U., Kaffenberger, T., Schell, C., Jäncke, L., and Brühl, A. B. (2012). Neural activity associated with self-reflection. BMC Neurosci. 13, 52.

Johnson, S. C., Baxter, L. C., Wilder, L. S., Pipe, J. G., Heiserman, J. E., and Prigatano, G. P. (2002). Neural correlates of self-reflection. Brain. doi:10.1093/brain/awf181.

Modinos, G., Ormel, J., and Aleman, A. (2009). Activation of anterior insula during self-reflection. PLoS One. doi:10.1371/journal.pone.0004618.

Zelazo, P. D. (2015). Executive function: Reflection, iterative reprocessing, complexity, and the developing brain. Dev. Rev. doi:10.1016/j.dr.2015.07.001.

Rumination / depression

Cooney, R. E., Joormann, J., Eugène, F., Dennis, E. L., and Gotlib, I. H. (2010). Neural correlates of rumination in depression. Cogn. Affect. Behav. Neurosci. doi:10.3758/CABN.10.4.470.

Johnson, M. K., Nolen-Hoeksema, S., Mitchell, K. J., and Levin, Y. (2009). Medial cortex activity, self-reflection and depression. Soc. Cogn. Affect. Neurosci. 4, 313–327.

Modinos, G., Renken, R., Ormel, J., and Aleman, A. (2011). Self-reflection and the psychosis-prone brain: an fMRI study. Neuropsychology 25, 295–305.

Part 3

SOCIETY BRAINS

Contents:

Mental Health

The Third Wave - Mental Health

BY ANDY HABERMACHER

Reading time: about 7 minutes

The second wave was predicted by the experts – and so far the pandemic has played out pretty much as the experts warned. There may be a third wave but with vaccinations underway, this should be largely minimised. However, health experts have been warning for months now of the mental health issues that are arising and set to continue post pandemic. On review this is not hard to see why this is the case.

At the time of writing, we are still heavily in the grasps of the second wave of the COVID-19 pandemic. With mass and rapid vaccination programmes underway the end is in sight - but when that end is, nobody can say for sure. Will there be a third wave? Maybe. But what most people do seem to be certain of is an increase in mental health issues. Now I do have to say that's this has been predicted from the start and the mass of burnout and mental degeneration has not quite materialised as predicted. In fact, some people seemed to be thriving, with some reports showing that 10% of the population is in better shape now then pre-pandemic. That shouldn't be as surprising as we might expect, after all the pandemic affects different people in different ways and particularly with the rise of home working, we could expect a decrease in stress. Why? The reason being research has consistently shown that commuting is some of the most wasteful and miserable time of a worker's day - so reducing or completely wiping out commuting is having a positive benefit on many people's lives.

However, despite some positive news, the negative news is that the pandemic has on average had a negative impact on mental health and this is likely to increase and will become apparent over the next months. The reason is that the current situation can have dramatic impacts on emotional needs, and we can illustrate this nicely with our SCOAP model.

For those who are not initiated in our SCOAP model you might want to read this academic review published at the end of 2020 - in summary SCOAP is a robust academic model and summarises and consolidates needs and well-being models proposed over the last century or so. It is in simple a meta-model of human needs and well-

being. Klaus Grawe whose work we drew strongly on when developing the SCOAP model, indeed it was the inspiration, stated in his book neuropsychotherapy that:

"This suggests that well-being depends almost entirely on the degree to which individuals manage to attain their motivational goals"

This was based on his findings of his research, and research with colleagues that showed extremely high correlations to needs satisfaction (i.e. motivational goals) and violations. Without going into the details, if you sign up for a Brain and Behaviour course you can learn a lot more of the background into this, we can see that needs violation is critical to mental health. With that in mind we can then analyse, with our SCOAP model, in a structured way the likely and almost certain impacts that pandemic will be having on the individuals in and out of the workplace.

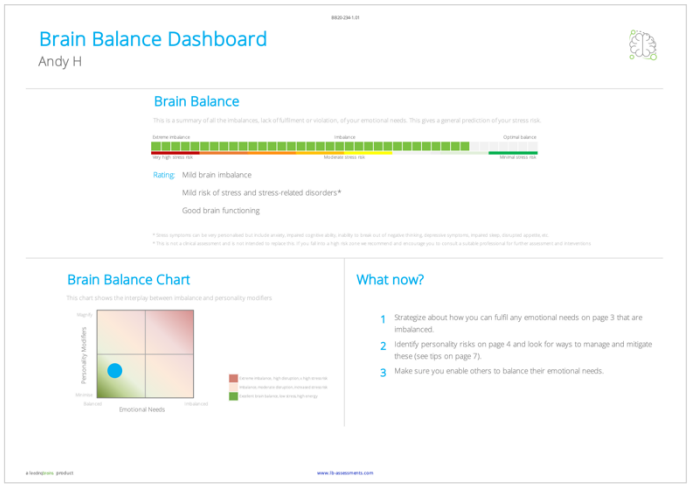
Now it is important to note that these needs are personal. That means different individuals will have different levels of needs motivation. For example, some people will require high Attachment with high affiliation and high contact to people, other people will require much less social contact to be happy. This is why if we want to measure well-being of an individual, we can only do this at the individualised level. We need to match need satisfaction to a personalised ideal level, and fulfilment above this ideal level will no longer lead to an increase in well-being Fulfilment below this level will lead to a decrease in well-being. What we also noticed in our research was that intensity of needs plays a role i.e. needs that were rated as very important caused more satisfaction or disruption in individuals.

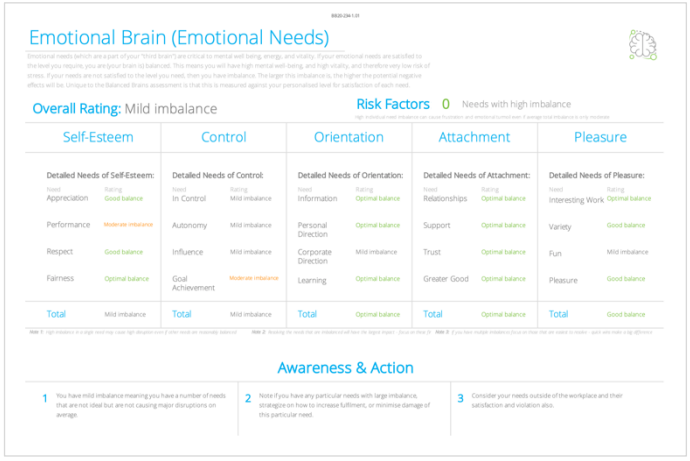
The table below shows the potential impacts on the individuals during the pandemic and in workplaces and we can see that there are many potential threats and negative outcomes. This will be balanced by an increase for certain individuals in certain contexts. For example, those people living in cities with other people, and have space to work from home, may find home working increases their well-being. Alternatively, those living in cramped spaces with families who are not at school may find this could increase the stress during the workday and lead them to being less effective. Similarly, those who live alone and are experiencing strict lockdowns may

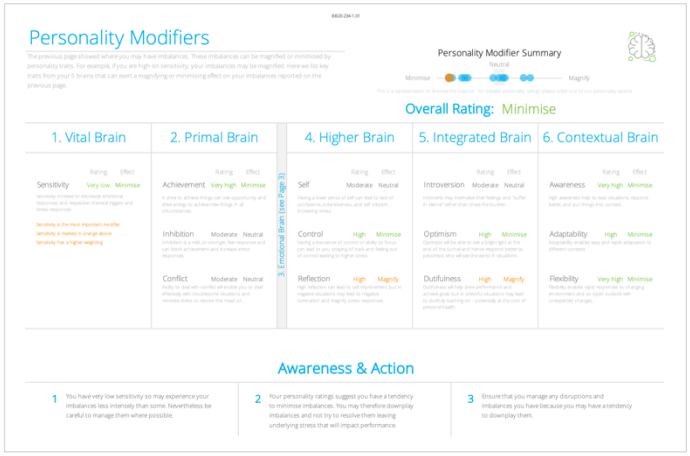
	Self-Esteem	Control	Orientation	Attachment	Pleasure
Potential Negative Impacts (increase risk of mental health issues)	- Threat to survival - Inability to fulfil self-esteem	- Lack of control - Lack of ability to do things one wants such as travel, go out. - Lack of control over busienss factors impacted by pandemic	- Lack of information - No idea when this will end - Continual uncertainty - Lack of communication with others	- Lack of physical contact - Loneliness - Lack of social events - Lack of "soft" social events such as eating in restaruant or going to a bar even if alone	- Lack of ability to engage in multitude of pleasurable events - Lack of exercise - Lack of events to visit: sports, concerts, theatre - Lack of socialising and the fun aspects of this
Job Loss	- Threat to survival	- Lack of control - Certain industries impacted very hard reducing chance of getting something here	- Lack of infomration - No idea when this will end - Furture uncertainty - Inability to plan for future - Potential loss of purpose	- Loss of colleagues - Loss of daily human contact even if not close	- Increase in stress - Inability to engage in pleasurebale activites
Potential Positive	- For those who can take advantage of this, success may increase e.g. certain software organisations	- Control can increase with more structured day (less time wasted on commuting or other annoying factors)	- Control can increase with more structured day (less time wasted on commuting or other annoying factors)	- Building support structures for those close - Helping in the community - Close to family	- Removal of negatives such as commuting and waling to other meeting rooms - More time - Comfortable home environment - Close to family

feel the lack of social contact as oppressive and lead to acute and chronic feelings of loneliness which can have dramatic impacts on the brain and brain function.

What is therefore clear is that a potential third wave of mental health issues is going to be very varied and diverse and very dependent on individuals and context. This is why many classic measures of well-being may fail to capture this effectively. Our Balanced Brains Assessment (key pages to left), however, measures firstly needs as outlined in SCOAP to a personalised level and therefore shows imbalances in need satisfaction at a personalised level. This means we can measure individualised brain imbalance. We know from our previous research that this matches strongly to vitality, well-being and mental health issues, as Grawe proved previously. We can therefore give a prediction of how balanced the brain is and therefore also gave a prediction of risk of mental health issues from mild too severe.







However, the risk of mental health issues is tightly connected to many other factors but some of these factors we can measure. For example, we know that personality plays an influence. Research, for example, has shown that sensitivity plays a large role in mental disturbances. This is because sensitivity actually measures the amount the system, the body, responds to stimuli. In the case of needs imbalance, this is a large negative stimuli and sensitive people will respond stronger which will lead to larger hormonal and emotional responses and therefore impact well-being much more so than a less sensitive individual. We noticed this, and some research my collaborator Argang Ghadiri published in 2017 showed that taking into consideration sensitivity, we could increase the accuracy of our model in predicting mental health and vitality in the workspace.

Therefore, by taking both of these factors into account, personality and brain imbalance, we can provide more accurate measures and predictions of mental health in daily life or in the workplace. As we know, and as we can see, the pandemic has had multiple impacts on large parts of the population, it would be irresponsible to ignore this. We do know this can have different impacts positive and negative but there is an overriding level of negative impacts and this will have an impact on brains, brain function, emotional responses, and therefore mental and physical health. This may be a long tail event with imbalances building up over time and increasing stress in the body and brain and leading to a slow increase of mental health issues over a longer period of time. This will also be dependent on how long-term many of the

impacts of the pandemic will be: economic situation, recovery of jobs, effective vaccination programmes, and so on and so forth.

There have been some people who have predicted that the 20s will become a time for partying and celebration similar to the swinging 30s that followed the Great Recession at the end of the 1920s. Seemingly this bottled-up repression across society could lead to a releasing of this in a period of wildness - only time will tell.

In summary, based on our work into needs and the brain, we can be sure that there will be a whole host of negative impacts complemented and balanced by a number of positive impacts but overall, we predict a negative trend, and we encourage you to be proactive in managing this for yourselves and your business. If you are in an organisational leadership position, we would strongly encourage you to take this very seriously in your organisation because this will impact your people, your productivity and the health of your organisation•

References

Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., and Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. *Psychol. Aging*. doi:10.1037/0882-7974.21.1.140.

CIGNA (2018). New Cigna Study Reveals Loneliness at Epidemic Levels in America. Available at: https://cigna.newshq.businesswire.com/press-release/new-cigna-study-reveals-loneliness-epidemic-levels-america.

Grawe, K. (2007). *Neuropsychotherapy: How the Neurosciences Inform Effective Psychotherapy*. Lawrence Erlbaum Associates.

Grosse Holtforth, M., and Grawe, K. (2004). Inkongruenz und Fallkonzeption in der Psychologischen Therapie. *Verhal. Psychosoz. Prax.*

Grosse Holtforth, M., Pincus, A. L., Grawe, K., Mauler, B., and Castonguay, L. G. (2007). When What You Want is Not What You Get: Motivational Correlates of Interpersonal Problems in Clinical and Nonclinical Samples. *J. Soc. Clin. Psychol.* 26, 1095–1119.

Habermacher, A., Ghadiri, A., and Peters, T. (2020). Describing the elephant: a foundational model of human needs, motivation, behaviour, and wellbeing. doi:10.31234/osf.io/dkbqa.

Hawkley, L. C., and Cacioppo, J. T. (2010). Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Ann. Behav. Med.* doi:10.1007/s12160-010-9210-8.

Holtforth, M. G., Bents, H., Mauler, B., and Grawe, K. (2006). Interpersonal distress as a mediator between avoidance goals and goal satisfaction in psychotherapy inpatients. *Clin. Psychol. Psychother.* 13, 172–182. doi:10.1002/cpp.486.

Holtforth, M. G., Grawe, K., Fries, A., and Znoj, H. (2008). Inkonsistenz als Differenzielles Indikationskriterium in der Psychotherapie - Eine Randomisierte Kontrollierte Studie. *Z. Klin. Psychol. Psychother.* doi:10.1026/1616-3443.37.2.103.

Matias, T., Dominski, F. H., and Marks, D. F. (2020). Human needs in COVID-19 isolation. J. Health Psychol. doi:10.1177/1359105320925149.

Ong, A. D., Uchino, B. N., and Wethington, E. (2016). Loneliness and Health in Older Adults: A Mini-Review and Synthesis. *Gerontology*. doi:10.1159/000441651.

Rajkumar, R. P. (2020). COVID-19 and mental health: A review of the existing literature. Asian J. Psychiatr. doi:10.1016/j.ajp.2020.102066.

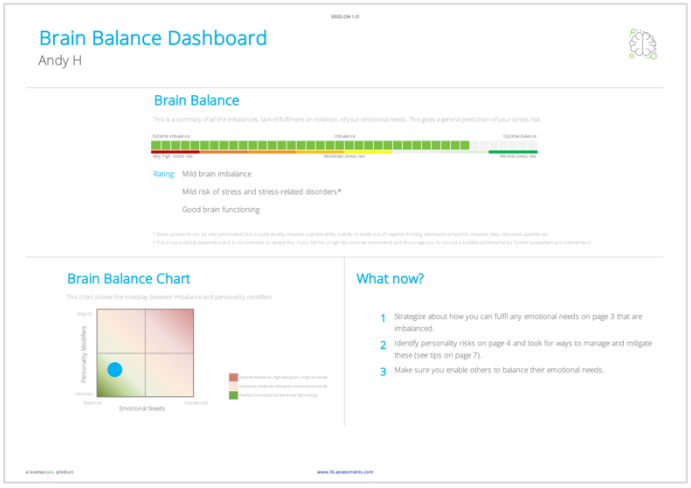
Vindegaard, N., and Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. Brain. Behav. Immun. doi:10.1016/j.bbi.2020.05.048.

leading brains Products

Balanced Brains Assessment

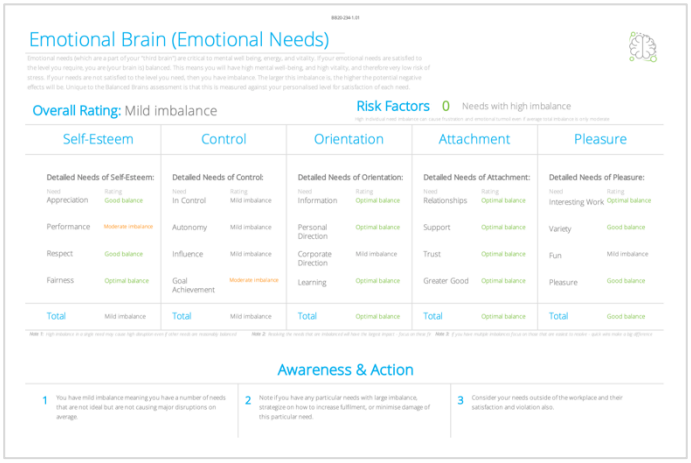
The Balanced brains Assessment is designed as a quick, effective, robust, and accurate way to predict brain balance. This therefore helps individuals identify areas for improvement, build awareness, and encourage self-management of issues. For corporations this is rapid way to identify stress, burnout, and mental health risk in an organisation.

Learn more here: https://leading-brains.bit.ai/docs/view/kZFSEYgdosfkv0pL



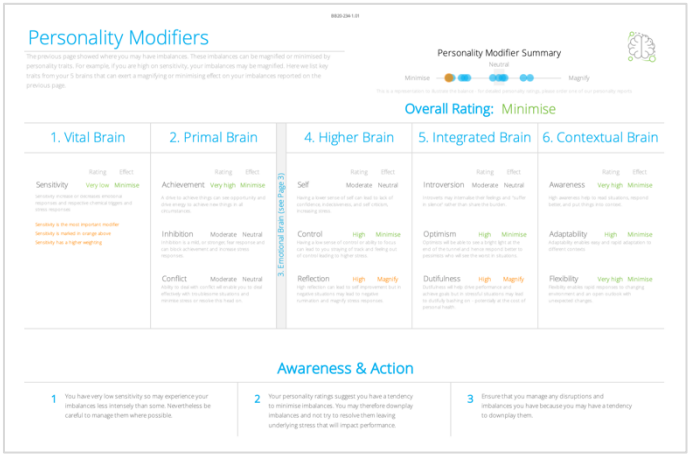
Brain Balance Dashboard

The dashboard gives a quick view with our unique single brain balance figure. In addition, the brain balance chart matches imbalance with personality modifiers - a truly unique approach to measuring stress risk.



Brain Imbalances

- *Emotional needs listed as SCOAP Overall balance rated*
- *Individual needs separately rated with simple descriptive rating*
- *Action points*



Personality Modifiers

- *Unique approach of matching personality modifiers that magnify or minimize stress*
- *Sensitivity is highlighted as this is the single most important modifier*
- *Gives an overall rating of magnify, neutral or minimize*

Part 4

LEARNING BRAINS

Contents:

Learning Brains

The Underestimated Role of Worldviews

BY ANDY HABERMACHER

Reading time: about 6 minutes

Many educational paradigms have look at the brain and learning, and also have considered mindsets. But these are all summed up in the way the brain builds a worldview which exerts a continual pull on all aspects of life and learning. Understanding this can lead to better educational interventions.

The marshmallow experiment is one of psychology's most famous experiments. The marshmallow experiment, as a reminder, is designed to show cognitive control, or rather, delayed reward gratification. The experiment goes as this: a child is placed in a room with a marshmallow in front of them, they are then instructed by an adult that the adult is going to leave the room, and the child can choose to eat the marshmallow now, or not eat the marshmallow, and if the marshmallow is still there when the adult returns, they will get another marshmallow as a reward. This gives the child *two* marshmallows, double their original circumstance, if they manage to exert the cognitive control to resist the temptation of eating the juicy marshmallow placed in front of them.

There have been many variations of this experiment and many amusing YouTube videos to back them up. For example, see this one. The videos are amusing because we see sweet children struggling to control their desire and impulse to eat the marshmallow and employ a number of amusing strategies. So far so good. Where the experiments become more interesting is correlating them to later academic or life success. The original experiments showed that those children who could resist the marshmallow, or sweet, enjoy much more later

life success, such as higher income, higher academic achievements, better professions. The relatively simple logic, based on brain functioning, is that the cognitive control required to resist immediate gratification, is similar to the cognitive control required for many aspects of life such as studying, and waiting and working for a bigger reward later. There is a whole bunch of truth in this hypothesis.

However, a new twist to this experiment has raised some other issues and this is relevant for education and schooling. It also neatly highlights the extremely powerful pull of worldviews on many aspects of our lives. What the new variation of this experiment did, was to manipulate the perceived trustworthiness of the adult giving the instructions. To do this the study designers allowed the children to see the adult break a promise to another child. In this case the adult promised to bring the other child a set of colouring crayons but forgot or failed to do so. In the cases where the child had seen the adult instructor failing to fulfil a prior promise their completion of the marshmallow task plummeted in contrast to the trusted situation where the completion of the marshmallow task was in line with previous experiments.

This now adds a piece of real-world information to the task i.e. a trusted partner. What we can see is that in the case of an untrustworthy partner it is probably better to dig into the marshmallow right off because there is no guarantee of a second marshmallow, so why bother going through all that effort of resisting temptation. Why not just enjoy the marshmallow while you can. Therefore, we can see that's the seemingly logical concept of reward gratification is modified by the concept of the reward expectation and these two, in part, fight it out.

This is interesting because previously the concept of cognitive control or reward gratification was seen as a simple logical step. It is better to wait for more reward. But in the real world there are many other influencing factors such as the above example of trust, expectation, and change in the future. In differing circumstances scoffing the marshmallow immediately and not waiting for a potential second one, may be the strategic, logical, or better decision. What's more, we can see with the above experiment is that perception plays a large part in this. Indeed, we have no idea of how much perception played a role in the original experiments. Were those children who exhibited high cognitive control trusting individuals who trusted the institutions, the teachers, and society, and so were more willing and able to engage in delayed reward gratification?

This now becomes important when we look at education and particularly at education in deprived areas. There is a whole separate discussion on the impacts on the brain of poverty and the underlying stress this has been shown to exert on brain development, but we will leave that for another article on another day. In this article I would like to focus on the worldviews because these are, I believe, massively underrated in educational contexts. In this example we can see a simplified worldview of trusting teachers and institutions and not trusting teachers and institutions. It seems that some of the factors influencing education in deprived areas derives from worldviews as much as, or rather than, ability, or other deficits.

First off though what is a worldview:

> *A worldview is a way of describing the universe and life within it, both in terms of what is and what ought to be. A given worldview is a set of beliefs that includes limiting statements and assumptions regarding what exists and what does not (either in actuality, or in principle), what objects or experiences are good or bad, and what objectives, behaviors, and relationships are desirable or undesirable. A worldview defines what can be known or done in the world, and how it can be known or done. In addition to defining what goals can be sought in life, a worldview defines what goals should be pursued. Worldviews include assumptions that may be unproven, and even unprovable, but these assumptions are superordinate, in that they provide the epistemic and ontological foundations for other beliefs within a belief system.*
>
> *(from Koltko-Rivera 2004)*

That indeed is a pretty comprehensive description, and we may now begin to understand why worldviews are so powerful. One way to think of the brain is that it builds an operating model of the world and then applies this to all subsequent behaviours. Obviously early experiences in life will have strong influences on this operating model. Therefore, all our subsequent behaviours, intentions, and thoughts pass through this and are filtered by and squeezed into this operating model.

Consider the concept of mindset that Dweck proposed and gained immense popularity and was considered an epiphany by many people. Growth mindset being a mindset exhibited by those people who believe in growing and development and see the world as adaptive and changing and themselves also. These people are more likely to engage in positive educational behaviours and keep learning in life. In contrast the fixed mindset as seeing the world as fixed, as good/bad and right/wrong leading to inhibited growth. This is a good model (though research has shown it is not as impressive as initially claimed) but also another story for another day. The problem with this is that this mindset is a part of a worldview which is whole larger operating model of the world – who to trust, concept of right and wrong, future expectations, where do I fit in the world?

We will explore some of the concepts of worldviews in later issues - it is a big area – the review by Kolko-Rivera dig into the complexities and details of this (it is the best review I have found to date). But for now, it is important for educators, particularly those in deprived areas to understand the concept of worldviews, how we and children develop a view of how the world operates. This raise the stakes in these areas of first and foremost being a trusted person as well as focusing on educational issues. In fact, by being a trusted person, and building this worldview, teachers are trusted individuals, you may be doing some kids a bigger benefit than improving their maths grades•

References

Worldviews

Koltko-Rivera, M. E. (2004). The Psychology of Worldviews. Rev. Gen. Psychol. 8, 3–58.

Major, B., Kaiser, C. R., O'Brien, L. T., and McCoy, S. K. (2007). Perceived Discrimination as Worldview Threat or Worldview Confirmation: Implications for Self-Esteem. J. Pers. Soc. Psychol. doi:10.1037/0022-3514.92.6.1068.

Mancini, A. D., Prati, G., and Bonanno, G. A. (2011). Do Shattered Worldviews Lead to Complicated Grief? Prospective and Longitudinal Analyses. J. Soc. Clin. Psychol. 30, 184–215.

Matthews, M. R. (2009). Science, worldviews and education. Springer Netherlands.

The legendary first marshmallow experiment

Mischel, W., and Ebbesen, E. B. (1970). Attention in delay of gratification. J. Pers. Soc. Psychol. doi:10.1037/h0029815.

Delayed gratification

Bembenutty, H., and Karabenick, S. A. (2004). Inherent association between academic delay of gratification, future time perspective, and self-regulated learning. Educ. Psychol. Rev. doi:10.1023/B:EDPR.0000012344.34008.5c.

Berman, M. G., Yourganov, G., Askren, M. K., Ayduk, O., Casey, B. J., Gotlib, I. H., et al. (2013). Dimensionality of brain networks linked to life-long individual differences in self-control. Nat. Commun. 4. doi:10.1038/ncomms2374.

Casey, B. J., Somerville, L. H., Gotlib, I. H., Ayduk, O., Franklin, N. T., Askren, M. K., et al. (2011). Behavioral and neural correlates of delay of gratification 40 years later. Proc. Natl. Acad. Sci. U. S. A. doi:10.1073/pnas.1108561108.

McGuire, J. T., and Kable, J. W. (2013). Rational temporal predictions can underlie apparent failures to delay gratification. Psychol. Rev. doi:10.1037/a0031910.

Mischel, W., Ebbesen, E. B., and Raskoff Zeiss, A. (1972). Cognitive and attentional mechanisms in delay of gratification. J. Pers. Soc. Psychol. doi:10.1037/h0032198.

Mischel, W., Shoda, Y., and Rodriguez, M. L. (1989). Delay of gratification in children. Science (80-.). doi:10.1126/science.2658056.

Mischel, W., Shoda, Y., and Peake, P. K. (1988). The Nature of Adolescent Competencies Predicted by Preschool Delay of Gratification. J. Pers. Soc. Psychol. doi:10.1037/0022-3514.54.4.687.

Schlam, T. R., Wilson, N. L., Shoda, Y., Mischel, W., and Ayduk, O. (2013). Preschoolers' delay of gratification predicts their body mass 30 years later. J. Pediatr. doi:10.1016/j.jpeds.2012.06.049.

Wood, M. (1998). Socio-economic status, delay of gratification, and impulse buying. J. Econ. Psychol. doi:10.1016/S0167-4870(98)00009-9.

Marshmallow replayed

Kidd, C., Palmeri, H., and Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability. Cognition. doi:10.1016/j.cognition.2012.08.004.

Part 5

HEALTHY BRAINS

Contents:

Healthy Brains

Take a Walk on the Wild Side

BY ANDY HABERMACHER

Reading time: about 6 minutes

Walking has been shown to be one of the most effective ways to get exercise and when we look at the neurological impacts, they are pretty impressive. Combine this with exposure to nature and we have an even more potent tool for boosting health.

When I speak at public events there are always guaranteed to be two types of questions that I get. One will be on certain mental disorders, normally from a member of the audience who has a family member with a specific disorder. Two will be something to do with healthy brains. This second one may be guided by current trends which may vary from eating nuts, omega-3 fats, meditation, or any number of other trends or recent news reports. Many of these trends or news stories are based on research and therefore have some element of truth in them. But as many of you know I always like to take a step back and look at the big picture - I think of what the actual biggest impact is on an individual and an individual's brain.

One of the most striking things is that often simple things have large impacts. Apologies this is sometimes a bit "boring", no hype here. And the simplest of them all is probably walking. This is probably nothing new to many of you readers, but let's review the research anyhow just so you understand how powerful and how impactful this is, and the dramatic benefits for your brain. I also claim that by taking a few adjustments and combining a couple of other elements, such as nature, we can boost the positive benefits even more and this has well documented and powerful impacts on your brain.

Shane O'Mara is an Irish neuroscientist who has written book on the power of walking "In Praise of Walking". Many of the benefits are the benefits we can see from physical exercise in general. The most dramatic of which is an increase in something known as Brain-Derived Neurotrophic Factor (BDNF). It is a mouthful to say but when neuroscientists talk about BDNF it means brain growth. BDNF is the brain's growth hormone so when more of this is released it means bits of your brain are growing. Similarly, neurogenesis in the hippocampus is shown to be promoted by exercise. Why is the hippocampus important - well this is often considered our memory centre – or at least a part of the brain that is critically involved in memory consolidation. But more than that the hippocampus and closely related regions are involved in spatial orientation and positioning.

Walking is uniquely coordinated in human beings because of our bipedal gait, walking and balancing on two legs, which we do effortlessly but requires immense brain control and coordination. Another aspect of walking is that it activates theta waves – these are brain waves which are also strongly correlated with learning and memory consolidation – but also creativity. It is no surprise that many people colloquially report having their best ideas when walking the dog (or under the shower). Research has indeed shown that low level activity is indeed best for creativity. Just the right level of stimulus.

There are other obvious benefits such as increased blood circulation but also release of Vascular Endothelial Growth Factor (VEGF), another mouthful, that helps to grow the blood vessels to supply the brain with blood and nutrients. Not to mention the role of exercise in increasing immune responses and strengthening the immune system.

Though a lot of the research into the brain has been with exercise such as running and cycling. There has been a bunch of research that specifically shows the benefits of walking. Not only that but walking has been shown to be an effective form of exercise matching many other forms and it can be as little as six miles a week to have an effect reports Kirk Erickson who has done substantial research into exercise – including into the ageing brain for those of you like me who are pushing along in the years! More than that, brisk walking is considered, by some, such as Praet, to be one of the most effective fat burning exercises and may be a better prescription for those trying to lose weight because of its ease. And finally, and this is good news, accumulating short bouts e.g. in 3-minute blocks in one study by Miyashita et al., is just as effective as going for a longer walk of 30 mins. In fact, more recent research into fat metabolism showed that getting 8'500 steps a day throughout the day

increased fat metabolism on a subsequent 1-hour block of jogging. Maybe no surprise but the real surprise is that those who got 5'000 steps a day or less had muted fat metabolism when doing the 1-hour jog. This is important because it means that exercise itself may not be enough but that constantly getting one's steps and being active is just as, or more important.

So, the simple tip is walk often, and regularly throughout the day even if as short as 3 minutes at a time.

Now to add an additional twist, we can add coordination. This activates the brain more so than walking on flat and stable surfaces. So, walking in the countryside and on uneven surfaces has also been shown to be more stimulating and has higher health and cognitive benefits.

The benefits of being exposed to nature and green environments is also compelling. Longer times spent in nature is strongly associated with well-being. What may be more surprising is that short walks in environments exposed to more nature vs. more urban environments also stimulated an effect – an additional surprise is that this was not predicted by the study participants themselves, reported by Nisbet and Zelenski in 2011. These benefits can be reaped after as little as five minutes according to a 2018 study. A large-scale study in England by Garrett et al. also showed that living near the sea had large benefits irrespective of wealth or education.

The benefits of nature are more than just elevating mood though the impacts of reducing stress (yes, a reduction in cortisol has also been measured) and related hormonal pathways and shouldn't be underestimated. The benefits extend to improved cognition, attention, creativity, and problem solving – a short walk in nature therefore has a restorative effect – resetting cognitive function. Other benefits seem to include improved vision in children with constant exposure to outdoor environments, not to mention doing outdoor activity at recess.

A further benefit is improved immune system functioning. There are a number of mechanisms at play here. One study of Japanese forest bathing reported increased activity in Human Natural Killer Cells, key cells in immune function but also notably in combatting cancer. An additional factor is that of the microbiome of soil and the beneficial impacts of this – most research has singled out children and the benefits they gain from

exposure to nature's microbiome. Admittedly, being in nature and rolling around in the soil are not one and the same thing and we adults may be less inclined to do that – come on oldies, let yourself go and have a good roll in the dirt. New Scientist also reported in 2015 that the country air might be good for us because it is slightly poisonous!

This all points to walking in nature given you a double whammy in terms, of health, wellbeing, and cognitive function. Now for those with office jobs in the city, long walks in the countryside during the day are not an option (but maybe from the home office). But just getting some exposure to green environments such as a local park has surprising benefits not to be underestimated. The other big take away is that small bouts of walking regularly through the day have surprisingly large benefits irrespective of environment.

So, to summarise:

- Walk regularly and often (really regularly, and really often)
- Walking can easily replace other forms of more strenuous exercise such as running or cycling (but keep doing them if you enjoy them!)
- Small bouts, as much as feasibly possible
- Aim to get at least 8'000 steps a day but preferably upwards of 12'000
- Walk on uneven surfaces if possible
- Get exposure to nature and green environments (or waterscapes)

It must be noted that walking is the easiest and cheapest form of exercise. You can do it almost anywhere, almost anytime, dressed in almost any clothes, and still reap the benefits.

Hopefully this has convinced you to take a walk on the wild side. Your brain and health will thank you.

References

Walking and exercise

Burton, H. M., and Coyle, E. F. (2021). Daily Step Count and Postprandial Fat Metabolism. Med. Sci. Sport. Exerc. 53, 333–340. doi:10.1249/MSS.0000000000002486.

Erickson, K. I., Leckie, R. L., and Weinstein, A. M. (2014). Physical activity, fitness, and gray matter volume. Neurobiol. Aging 35.

Erickson, K. I., Gildengers, A. G., and Butters, M. A. (2013). Physical activity and brain plasticity in late adulthood. Dialogues Clin. Neurosci. 15, 99–108.

Guardian article on Shane O'Mara: https://www.theguardian.com/lifeandstyle/2019/jul/28/its-a-superpower-how-walking-makes-us-healthier-happier-and-brainier

Griffin, É. W., Mullally, S., Foley, C., Warmington, S. A., O'Mara, S. M., and Kelly, Á. M. (2011). Aerobic exercise improves hippocampal function and increases BDNF in the serum of young adult males. Physiol. Behav. doi:10.1016/j.physbeh.2011.06.005.

Kramer, A. F., Erickson, K. I., and Colcombe, S. J. (2006). Exercise, cognition, and the aging brain. J Appl Physiol 101, 1237–1242.

Praet, S. F. E., Van Rooij, E. S. J., Wijtvliet, A., Boonman-De Winter, L. J. M., Enneking, T., Kuipers, H., et al. (2008). Brisk walking compared with an individualised medical fitness programme for patients with type 2 diabetes: A randomised controlled trial. Diabetologia 51, 736–746.

Miyashita, M., Burns, S. F., and Stensel, D. J. (2008). Accumulating short bouts of brisk walking reduces postprandial plasma triacylglycerol concentrations and resting blood pressure in healthy young men. Am. J. Clin. Nutr. 88, 1225–1231.

Sellers, C. E., Grant, P. M., Ryan, C. G., O'Kane, C., Raw, K., and Conn, D. (2012). Take a walk in the park? A cross-over pilot trial comparing brisk walking in two different environments: Park and urban. Prev. Med. (Baltim). 55, 438–443.

Nature

Bragg, R. (2014). Nature-based interventions for mental wellbeing and sustainable behaviour: the potential for green care in the UK. Nature-based Interv. Ment. wellbeing Sustain. Behav. potential green care UK.

Garrett, J. K., Clitherow, T. J., White, M. P., Wheeler, B. W., and Fleming, L. E. (2019). Coastal proximity and mental health among urban adults in England: The moderating effect of household income. Health Place. doi:10.1016/j.healthplace.2019.102200.

Li, Q., Kobayashi, M., Wakayama, Y., Inagaki, H., Katsumata, M., Hirata, Y., et al. (2009). Effect of phytoncide from trees on human natural killer cell function. Int. J. Immunopathol. Pharmacol. doi:10.1177/039463200902200410.

MacKerron, G., and Mourato, S. (2013). Happiness is greater in natural environments. Glob. Environ. Chang. doi:10.1016/j.gloenvcha.2013.03.010.

Neill, C., Gerard, J., and Arbuthnott, K. D. (2018). Nature contact and mood benefits: contact duration and mood type. J. Posit. Psychol. doi:10.1080/17439760.2018.1557242.

New scientist article: https://www.newscientist.com/article/mg22630270-200-country-air-could-be-good-for-us-because-its-slightly-poisonous/

Nisbet, E. K., and Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. Psychol. Sci. doi:10.1177/0956797611418527.

Olszak, T., An, D., Zeissig, S., Vera, M. P., Richter, J., Franke, A., et al. (2012). Microbial exposure during early life has persistent effects on natural killer T cell function. Science (80-.). doi:10.1126/science.1219328.

Rose, K. A., Morgan, I. G., Ip, J., Kifley, A., Huynh, S., Smith, W., et al. (2008). Outdoor Activity Reduces the Prevalence of Myopia in Children. Ophthalmology. doi:10.1016/j.ophtha.2007.12.019.

Wu, P. C., Tsai, C. L., Wu, H. L., Yang, Y. H., and Kuo, H. K. (2013). Outdoor activity during class recess reduces myopia onset and progression in school children. Ophthalmology. doi:10.1016/j.ophtha.2012.11.009.

Part 6

HBF Updates

Updates and information on SCOAP and HBF products and services.

Contents:

Revising SCOAP Needs

With the publication of our preprint end of 2020, we have formulated a detailed and updated version of SCOAP and given more rationale and analysis behind this.

You can access the Preprint here: https://psyarxiv.com/dkbqa

leading brains Review

Well, you are and have been reading it. See my rationale in FAQ section. In short this is a way for those interested in applying neuroscience, and neuropsychology in business and real-world contexts, this is the place to be informed. It ties in strongly to SCOAP and other research I have been, and am working on.

Updates and latest research will be announced here first.

Online Courses

For 2021 all course on HBF and SCOAP will be put into a new online format. At the time of writing the **Brain + Behaviour Module 1** is currently online, and I plan to completely review, and update, all modules at the rate of one per month.

SCOAP Coach 1: end of February 2021

Neuroleadership 1: end of March 2021

HBF Assessments: end of April 2021

Brain + Behaviour 2: end of April 2021

SCOAP Coach 2: end of May 2021

Neuroleadership 2: end of June 2021

Brain + Learning: end of July 2021

Brain + Behaviour 3: end of August 2021

SCOAP Coach 3: end of September 2021

Neuroleadership 3: end of October 2021

Current prices are set at $170 per course with and additional $70 for those who want certification.

Assessments

We released the **Balanced Brains Assessment** at the end of 2020 which measures brain balance in the workplace. This uses SCOAP theory to match emotional needs imbalance but uniquely also matches this to personality modifiers. You can learn more here:

Our current Assessments Portfolio

HBF Individual Personality

Assessments and reports using the HBF personality framework (probably the world's most comprehensive personality assessment) – detailed, and including third-person ratings, stability ratings, and leadership levels (in full report).

Reports can be ordered in 3 levels of detail:

- Brief
- Baseline
- Full

Two contexts can be chosen for reports

- Corporate
- Education

Team Cohesion Reports

Reports can be ordered in 2 levels of detail:

- Brief
- Baseline

Two contexts can be chosen for reports

- Corporate
- Start-up

Balanced Brains

Reporting on individual brain balance. For details see: https://leading-brains.bit.ai/docs/kZFSEYgdosfkv0pL

Collective anonymised reports available for corporations

Agile Mindset

Reporting on different types of agile mindset.

Content Expertise

As part of my 2021 strategic focus, I will be focused on delivering content expertise to corporations and other training, development, coaching, consulting organisations.

My unique and deep knowledge in the brain, behaviour, cognition and, importantly, how this fits together can help individuals and organisations refine their knowledge, know-how, products, and services.

You can learn more here: https://leading-brains.bit.ai/docs/view/E0UPDODYfTn5elPn

FAQ

What's special about leading brain Review?

It provides uniquely focused content combining neuroscience, cognitive neuroscience, neuropsychology, and psychology, in organisational and society contexts, consolidated into one coherent issue and interlinked issues. Based on rigorous science but readable for the average educated person.

Can I share this information?

These articles are for you the subscriber – this is designed as limited, special information to give you value. However, you may want to share this with others particularly to guide and influence on themes that may be relevant (such as your boss or team at work) and the rules of engagement are: you can share one article with up to 5 people who you may think are interested. You cannot share the *issue* - it's a small outlay to buy it for those who are really interested. Do not share with large groups of people. And obviously don't post these articles in public forums (I publish one article each month in Medium as a freebie to the world).

Why are subscriptions limited?

A long story but the short answer is I believe this information is best suited to a small group of people with the right mindset and focus. I want to focus on providing great content and not on marketing, managing social media, and trying to sell myself or my ideas. I decided the best way to do this is to limit it to a smaller group of people who value the information and content. The nature of this is also closely related to my work on the HBF and this is naturally suited to a small group of "insiders" who can fully appreciate this.

Thanks for being a part of this

Can I write an article for leading brains Review?

The rationale for this publication is that the themes are neatly linked together and matched to the latest science and balanced reviews of content. It is therefore a personal project and baby, and linked to the knowledge sitting in my head, my writings, research, and musings. I am not averse to other authors, but it must fit in seamlessly with the themes, the science, and standards.

When is it published?

It is published once a month, but dates may vary slightly: normally from 20th-28th each month.

Can I have this in hard form

This is only published in electronic form, but you should be able to download this to PDF and print if you so wish. Remember not to distribute to others (see article sharing guidelines above).

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