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The social brain and education

There is a growing interest in the link between the developing brain and maximising outcomes in schools. Recent research outcomes in many western countries indicate that students are falling behind on global scales in terms of ranking. The most influential source for international rankings is the Programme for International Student Assessment (PISA), an international assessment measuring student performance in reading, mathematical and scientific literacy. Although not without significant levels of criticism (the small scope of the study, types of questioning, philosophical changes in reading, reasoning and the understanding of 'utilising' skills etc.), the impact of this study is significant for policy makers, educators and government systems. The effect of results like these can be significant – both positively as well as negatively significant.

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There is the factual reality that education demands commitment in terms of resources, energy, hardware and time. However education is also a science and an art – a science that needs to be well understood, constructed and executed and an art in terms of the student-teacher relationship, the nurturing school and socio-economic environment. The purpose of education needs to be well formulated, its essence clearly grasped and its outcomes identified.

If the purpose of education is to be the best in mathematics, the best in reading and/or the best in science then the obvious questions are: how does one define being the best in a discipline?; how do we measure these disciplines?, and what are we measuring?

On top of this there is an even more pressing question: what do we know about the learner? Is the student an eager learner keen to apply and explore his/her world with an open attitude to question and progress further than any of us, or is the student a reproducer who becomes unstuck when strict support networks discontinue and becomes anxious in the wake of challenging environments?

Reports like PISA are the outcome of an education philosophy based on the industrial model. The industrial model was (and still is in many respects) a commercially driven enterprise based on output. Although the model is commercially successful, it operates on production output like building model T Fords, washing machines or making chicken nuggets. When this model is applied to the education system we develop a benchmark of the product (gold standard), measure all results against the standard and produce a report of who produces output above or below the standard. The subtitle of the PISA report is: *What 15-year-olds know and what they can do with what they know* (OECD 2013). This is the Achilles heel of the report. It implies that by asking questions in regard to three disciplines, it can predict 'what they can do with what they know'. There are no assessments of the individual student's approach to life, support, sense of self and safety, happiness, social interactions. The monetary solution typically offered to enhance the outcomes is an even greater cause of concern.

Although the PISA reports have specific merit, they can by no means be the guide to address 'defects' in the education system. The principles of learning and memory formation, the developing brain and basic human needs for neural proliferation and wellness are much more fundamental and provide a clearer picture in the quest to enhance wellness and maximise capacity.

Neuroscience, the social brain and education

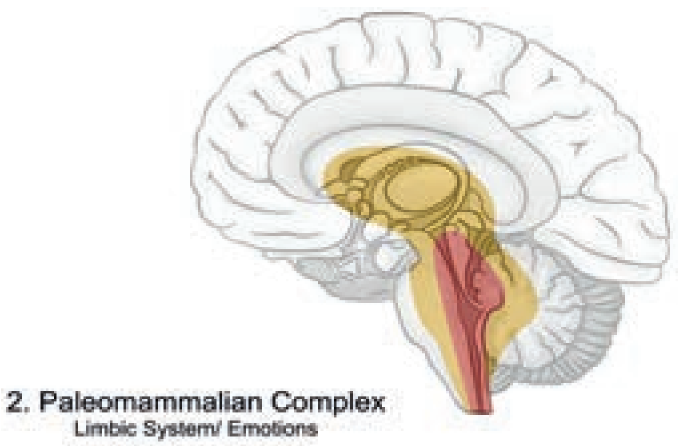
The brain is much more than an organ pre-scripted by its (fixed) genetic code. Neuroscientists have clearly demonstrated the role of the environment in shaping and moulding the brain. This process does not stop at any point – the brain continues to grow and change as a result of daily interactions with its environment. These daily interactions form the basis of what drives a human being to learn, integrate, explore and proliferate. Trauma, fear and risk of survival change these motivations (Rossouw 2013). These experiences do not stop development but alter development. This crucial point is often missed. Compromised environments alter the course of neural development and facilitate changes in memory systems. This does not indicate the absence of memory systems but a different direction. When performance is measured the results may seem comparable but the source (what drives the system) could be vastly different – especially in terms of long term outcomes.

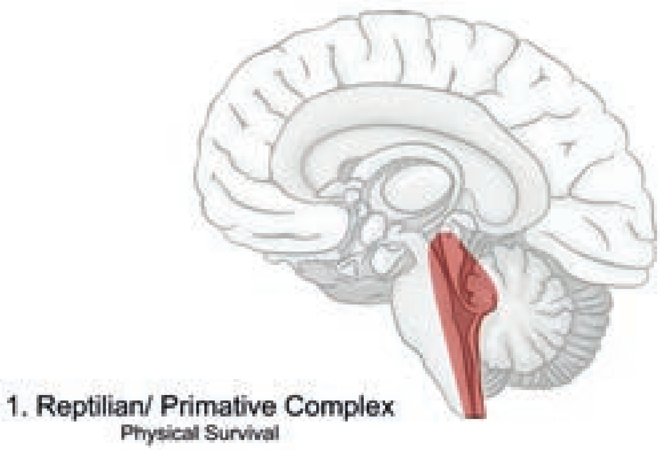
The primitive neural complex

The brain develops from the bottom to the top and from the inside out. The well-known model of neural development – the Triune Brain by neurologist Paul McLean (MacLean 1990) – demonstrated that the first areas of the brain that develop after conception are the very primitive systems, the systems that are responsible for survival (breathing, heart rate, the ability to procreate). He refers to these as the reptilian brain (brain stem, pons, medulla and part of the cerebellum). We share this with all living organisms. This part of the brain is fully developed at birth. It is also fully functional. If any of these systems are compromised the entire living unit is in grave danger of not surviving.

The Paleomammalian brain/cortex

The second part of the brain that develops is the mid-brain – structures below the corpus callossum. These structures – the thalamus, amygdala, hypothalamus, hippocampus (often referred to as the limbic system) and the basal ganglia – are jointly responsible for the





activation of the stress response. This neural section is fully developed at birth however not fully operational. The implications are significant and are closely linked to the interplay between the genetic make-up and environmental impact. When the external environment provides safe, secure and manageable cues, the stress response is limited and the neural activation develops open neural activations to frontal cortical areas. Compromised environmental cues enhance the risk of neural patterns of avoidance, to facilitate patterns of neural protection (MacLean 1990).

The impact is decreased social development that compromises frontal cortical activation. In both situations (enriched environments as well as compromised environments) memory systems are activated, however the nature of these networks is unique in nature. Memory systems linked to threat lead to fear-based (closed) reactions to enhance survival. Memory systems linked to enriched environments lead to open neural patterns, increased cortical blood flow to frontal cortical areas and enhanced, ongoing problem solving capacities.

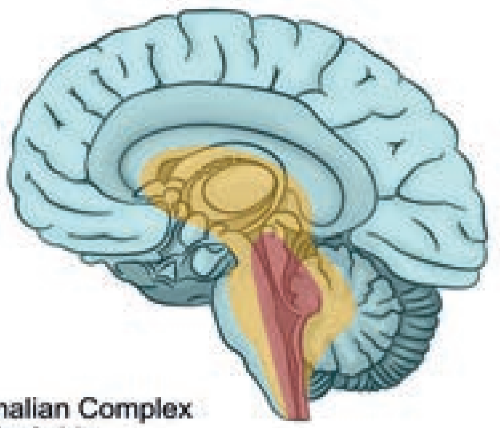
Fear-based learning is learning that focuses on limbic activation. The response is nearly immediate and learning is quick. The downside is it remains a survival response and the 'threat' will, as much as possible, be avoided (protective/survival learning). Consider a student who learns mathematics through a fear-based system – he/she may perform well in the subject due to fear but as soon as they are able to they drop the subject (the pattern of avoidance). On the other hand learning is facilitated from higher cortical regions when primitive (survival) regions are down-regulated (controlled) (Allison & Rossouw 2013).

Fear-based learning (memory systems) is much more powerful than open neural activation, driven by the basic human need to survive. The ongoing release of stress chemicals are detrimental though and long term performance deterioration results. Measuring performance (memory networks) without including neural patterns, neurochemical activations and long term performance and neural integration, means key variables to provide effective comparisons are missing.

The Neomammallian brain/cortex

Lastly the cortical regions of the brain develop. This is the largest part of the cortical mass that develops; most of its connections occur after birth. The brain continues to organise and reorganise itself as a result of information processing from the external environment and later from a complex interplay between environmental stimuli and frontal cortical processing. Processing of neural pathways to the cortical (especially frontal cortical) regions happens in close collaboration with the more primitive regions (Grawe 2007). When primitive (fear-based/survival) patterns are activated the memory systems respond according to the fear-based systems. When a soldier is trained to take cover as soon as he/she hears the sound of a gun then it is a survival memory system that kicks in automatically without activating the frontal cortical regions. This is a perfectly acceptable action for survival. However, when the same soldier sits in a shopping mall and dives for cover when a cleaner drops a bucket of water close by – everyone will be surprised by the behaviour. Instinctive (survival-based) responses are not all that helpful in enriched environments; consider people with phobias for lifts or having a panic attack because they need to cross a road. A pedagogical system that is based on fear may lead to short term good outcomes (immediate responses that are deeply ingrained) however effective applications are compromised as the response is survival focused (Grawe 2007).

When a stressor is manageable, it leads to cortical activation and the formation of memory networks toward the frontal cortical systems (especially the pre-frontal cortex). This process is referred to as *controllable incongruence* (Allison & Rossouw 2013). When the stressor impact is significant it shifts cortical blood flow toward limbic areas, down regulates activation to frontal areas and memory systems are enhanced in fear based regions. Patterns of survival (avoidance behaviours) then emerge. This is the result of *uncontrollable incongruence*. Learning takes place in both cases but the processes and long term outcomes are very different.



3. Neomammalian Complex
Executive Activity

Indicators for wellness and capacity maximisation

Let's explore the key indicators for wellness and the maximisation of capacity in education from a neuroscientific perspective:

1. The need for a supportive teacher student relationship

This is the essential hallmark of effective education. Without the facilitation of an effective relationship (addressing the basic need for attachment in the educational environment) primitive fear-based systems are not effectively down-regulated and cortical sprouting inhibited (Schenck 2011).

2. The need to increase latency periods when engaging with students

Latency is described as the period of time that lapses between when a student is given a response opportunity and when the opportunity is interrupted. This phenomenon has been around for decades. Research indicates that smarter/more liked students are given more latency periods than less smart/liked students (Schenck 2011).

3. Ask open questions rather than direct questions

Direct questions up-regulate a sense of distress. Even when a teacher asks a particular student a question and the teacher is quite certain that particular student can effectively address the question, the fear response increases for other students less comfortable with the answer. Open questions, with hints and clues, increase interest, collaboration and safety (Allison & Rossouw 2013).

4. Encouragement

Encouragement has significant neurobiological effects. It enhances the student teacher relationship (down regulating the primitive responses and up-regulating cortical sprouting); it increases motivation which leads to more neural activation (rather than to give up and discontinue neural firing); motivation also increases the release of endorphins and dopamine (key neurotransmitters to assist with completion of tasks and enhance plasticity through ongoing engagement (strengthening neural patterns) (Rossouw 2013b).

5. Respect

Demonstration of respect has significant neural effects. It enhances a sense of survival (being accepted) and inhibits fear. It also encourages patterns of engagement and as a result facilitates neural activation to the frontal cortical areas – key to social and cognitive development (Allison & Rossouw 2013).

6. Enthusiasm and passion

Studies on mirror neurons have demonstrated that humans learn many skills by observation. This can be helpful or detrimental depending on the environment. In education settings the role of the teacher is pivotal to facilitate the learning environment. A teacher that demonstrates enthusiasm and teaches with passion facilitates similar responses in the student and enhances learning outcomes (Rizolatti & Craighero 2004). Conversely the opposite is also true.

7. An enriched environment

The ultimate need for enhanced learning environments is to provide an enriched environment. This is much more than a physical environment that provides access to all possible (electronic) media. An enriched environment means (on physical and emotional levels) that safety needs to be present (Cozolino 2013). This means first and foremost the need for a trustworthy environment (absence of fear – bullying, violence, and the presence of emotional warmth, acceptance and a sense of belonging) (Espinoza 2011). An enriched environment is an environment where the child can develop, laugh, play, and proliferate. It is an environment where there is a seamless collaboration between home and school (Grawe 2007)

'What students know and what they can do with it' is more than a measure of information retention. The development of the brain is a social (environment experience driven) interaction that requires a close (holistic) look at the social system to be able to make predictions like 'what they can do …' (Cozolino 2013). This is most likely the reason why simple solutions like 'more money is needed' are doomed to fail if they are not driven by a socially responsible agenda with a clear understanding of the challenges and potential of the interactive developing brain.

PISA

Every three years since 2000 the Organization for Economic Co-Operation and Development has provided a report on the rankings of knowledge of 15-year-olds. Demographic information is collected through questions to students and their school principals regarding the student's background, the school, the learning environment and school systems.

The PISA report has significant benefits:

- It provides a snapshot of what 15-year-olds know in terms of a fixed subset of items for reading, mathematics and science.
- It provides a snapshot of what 15-year-olds know in terms of this fixed subset of items in comparison to each other within countries and economies and between countries and economies.
- It provides a snapshot of what 15-year-olds know in terms of this fixed subset of items in comparison to another fixed subset of items every three years (within and between economies and countries).

The report fails to address:

- how this information will translate to applications of the current information basis ('knowledge');
- whether the learner has obtained the information through fear based activation or an enriched environment;
- the wellness factor of neural development.

For more information go to: https://www.acer.org/ozpisa/key-findings and http://www.oecd.org/australia/pisa-2015-australia.htm

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