Neuromyths and Neurofacts:
Information From Cognitive Neuroscience for Classroom and Learning Support Teachers.

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For

2013 Australian Association of Special Education National Conference, Adelaide
SESSION OUTLINE

- What is cognitive neuroscience & the science of learning?

- Neurofacts – some key findings from neuroscience
  - General information
  - Promising areas of neuroscience relevant to special education

- Neuromyths – watch out, there’s wolves about!

- Research about teacher knowledge of neurofacts & neuromyths

- Implications
We created a canvas of resources about this topic:

- [http://blnds.co/18c78Mf](http://blnds.co/18c78Mf)

**Cognitive Neuroscience Resources for Teachers**

1. Enter label
   Enter description/notes
   Understanding Working Memory.pdf

2. Podcast: Mind the Gap: Th...
   Enter description/notes
   ABC Radio All in the Mind - Synapses.mp3

3. Enter label
   Enter description/notes
   neuroscience for science educators.pdf
What is neuroscience?

- The study of the brain and the nervous system

- In the past two decades, neuroscience has made impressive progress in many of the field’s key areas
  - Technologies such as fMRI, PET scans, MRI, EEG
  - Enable insights into the brain systems underlying attention, memory, and emotions.

- Now, more than ever, neuroscience is on the cusp of important breakthroughs
  - Brain development & learning throughout the lifespan
  - Genetics & diseases
  - Gene / environment interactions, including biomarkers
  - New drug therapies

The human brain is more complex than the solar system
There are more neurons in a mm$^3$ of cortex than all the stars in this nebula
A Nerve Cell in the Brain
WHAT IS COGNITIVE NEUROSCIENCE?

- Neuroscience has a considerable contribution to make in exploring & explaining cognitive processes

- Cognitive neuroscience is the study of biological processes and interactions underlying cognition
  - what happens physiologically in the brain as we learn

- It is relevant to the profession of teaching and to understanding learning, and it will increasingly inform the work of special education and learning support teachers

- It is cognitive psychology that does the ‘heavy lifting’ for neuroscience, especially in education (Anderson & Della Sala, 2013)

- Increasingly, effective teachers in complex, contemporary learning environments will need sound knowledge of cognitive psychology concepts
COGNITIVE PROCESSES OF LEARNING

- Memory
  - long-term, short term, procedural, declarative etc.
- Working memory (see Blendspace: Understanding Working Memory)
  - Mental workbench for holding & manipulating information ‘in mind’
- Flexibility and adjusting to change
- Devising & modifying strategies for problem-solving
- Motivation
- Self-regulation
  - Sustaining and appropriately switching attention
  - Inhibiting responses
  - Implementing strategies and plans
  - Prioritising and modifying priorities
THE SCIENCE OF LEARNING

- A more scientific approach to teaching & learning
- Requires the use of evidence-based approaches
- Teacher as researcher
  - Action research approach to effective instruction
  - Data & assessment have an essential role
    - Does the evidence suggest that teaching results in effective, efficient student learning?
    - If so keep doing it & identify why it works; if not, why not?
- A multi-disciplinary approach
  - Educators, psychologists, neuroscientists & others
  - Building bridges between disciplines
- Increase teachers’ neuroscience literacy
NEUROFACTS – ANATOMY OF THE BRAIN

Figure 2.1 Key brain areas (image on right is from Anatomography maintained by Life Science Databases)

Blendspace: Transmission of Knowledge, PMSEIC
Brain Facts book
Blendspace: Neuroscience and Education: Issues and Opportunities
ABC Radio Podcast – Synapses - Mind the Gap
Synaptic Plasticity
**Neurofacts – Plasticity**

- A general term used to describe the adaptive changes in the structure or function of nerve cells or groups of nerve cells in response to injuries to the nervous system or alterations in patterns of their use and disuse.

- The structure and functions of parts of the brain are not fixed – the brain can modify itself.

- Synaptic plasticity enables learning and memory as the brain adapts to internal and external experiences.

Blendspace: Norman Doidge Book
NEUROFACTS – PLASTICITY
NEUROFACTS — MIRROR NEURONS

- A special class of brain cells that fire not only when an individual performs an action, but also when the individual observes someone else make the same movement.

- A defect in this system may underlie autism spectrum disorders.

- Further research from cognitive neuroscience about mirror neuron systems may lead to enhanced understandings about learning through imaginative play, social learning through imitation, and the role of demonstration and explicit instruction in learning new skills (Geake, 2009).
NEUROFACTS FOR SPECIAL EDUCATION

- **Dyslexia**
  - Findings from neuroscience confirm & expand existing knowledge, and provide new knowledge about the critical roles phonological processing and language development play in reading acquisition.

- **Dyscalculia**
  - Critical role of number sense, importance of early development of number sense concepts.
  - Brain imaging shows that more than one neural system is used for representing numbers.
  - Number facts are stored in the language system.
  - More complex calculations seem to involve visuo-spatial regions of the brain.

- **ADHD & Autism**

Blendspace: Neuroscience and Education: Issues and Opportunities
In Forum: Neuroscience & Special Education
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Neuroscience is developing new knowledge about many different fields relevant to education:

- Sleep
- Stress and its impact on learning and memory
- Addiction
- Disorders
- Ageing
- Music
- Recovering from trauma
- Biomarkers for disease & disability
- Gene / environment interactions
**Quiz: Neuromyth or Neurofact?**

1. You only use 10% of your brain
2. Listening to classical music makes you smarter
3. Brain damage is always permanent
4. Your brain can’t make new cells
5. Drinking alcoholic drinks always kills brain cells
6. Drug use makes holes in your brain
7. There are critical times when certain learning must occur
8. Playing games keeps your brain young

Blendspace: *Neuromyths PowerPoint Presentation*
MYTHBUSTING FOR SAVVY EDUCATORS

- ‘Brain-based’ learning
  - Where else would it take place? Elbow-based learning?

- People are either “right-brained” or “left-brained”
  - Regardless of personality or skill set, you use both the right and left hemispheres of your brain to perform everyday tasks

- Male and female brains are radically different.
  - Though there may be subtle differences between male and female brains, there is absolutely no significant evidence to suggest that the genders learn or should be taught differently

- If pupils do not drink sufficient amounts of water (6–8 glasses a day) their brains shrink
  - Encourage children to drink if they are thirsty; some extra monitoring in hot weather
Learning Styles

- **Myth**: Learning can be improved if children are classified and taught according to their preferred learning style.

- **Fact**: These separate structures in the brain are highly interconnected and there is profound cross-modal activation and transfer of information between sensory modalities.
NEUROMYTHS IN YOUR CLASSROOM?

- **Brain Gym**

- **Myth:** these exercises can benefit anyone by improving concentration, memory, reading, writing, organizing, listening........

- **Fact:** based on unfounded claims that exercise will help improve inter-hemispheric information transfer. There appear to be no experimental studies published in peer-reviewed research journals that support the effectiveness of Brain Gym in improving academic performance.
Multiple Intelligences

Gardner's multiple intelligence theory has been very influential in education worldwide. It was also made to measure for the commercial educational solutions industry, eight intelligences to improve and make money from!

The human brain is unlikely to function via Gardner’s multiple intelligences .... it is unlikely that each of Gardner’s intelligences could operate ‘via a different set of neural mechanisms’ [as Gardner claims]. Waterhouse, 2006 in Geake, 2008
NEUROMYTHS IMPLICATIONS

- Commercial programs are developed based on neuromyths
  - Teachers and schools buy them
  - Vulnerable parents buy them

- Uncritical acceptance of neuromyths is
  - A threat to the validity of evidence-based knowledge about cognitive neuroscience
  - A lost opportunity as limited resources are wasted on approaches which do not have an evidence base for their rationale or efficacy

- A need for further pre-service and in-service teacher education about the facts and myths of cognitive neuroscience and education
http://www.brainfacts.org/about-neuroscience/
Research about Teacher Knowledge of Neuroscience & Neuromyths

- International researchers include:
  - Pickering & Howard-Jones, 2007
  - Rato, Abreu & Castro-Caldas, 2011

- Focus of the research:
  - teacher perceptions of the relevance and utility of neuroscience to education,
  - acceptance of neuromyths
  - teacher understandings of neuroscience research and how these understandings influence their practice.
INTERNATIONAL RESEARCH FINDINGS

- Teachers think neuroscience is interesting and relevant to education

- A concerning percentage of teachers cannot consistently identify neuromyths

- Problematic levels of acceptance of non-scientific information among teachers,
  - For example, a concerning belief that genetic factors are a key determinant of student educational outcomes

- Teachers recognise the need for further training and are eager to increase their neuroscience literacy
Our Research about Australian Teacher Knowledge of Neuroscience & Neuromyths

Bellert & Graham, 2013 (under review)
- First research about Australian teachers

A survey of 16 statements
- Teacher attitude
- Teacher knowledge
- Recent teacher learning / reading about neuroscience
- Neuromyths

87 respondents, primary and high school teachers (mostly learning support and special education teachers and consultants)

Responses descriptively analysed
OUR RESEARCH ABOUT AUSTRALIAN TEACHER KNOWLEDGE OF NEUROSCIENCE & NEUROMYTHS

- Positive statements about teacher attitude to the potential role of cognitive neuroscience in education were answered as ‘true’ by the great majority of respondents.

- True statements about cognitive processes, brain functioning and education were also recognised as ‘true’ by a large majority of respondents.
  - but a false statement about factors impacting on student motivation was only recognised as false by 57.5% of respondents.
### Percentage of Respondents Who Identified the Neuromyth Statement as ‘False’

<table>
<thead>
<tr>
<th>Neuromyth</th>
<th>All respondents (%)</th>
<th>Respondents recently accessed relevant professional learning (%)</th>
<th>Respondents not recently accessed relevant professional learning (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching to ‘multiple Intelligences’ has been validated as a sound approach to use for effective teaching and improved student learning</td>
<td>33</td>
<td>41.02</td>
<td>27.08</td>
</tr>
<tr>
<td>The years from 0 to 3 are more important than any other age for learning</td>
<td>21.84</td>
<td>28.2</td>
<td>14.58</td>
</tr>
<tr>
<td>Brain Gym is a well-researched program with demonstrated outcomes for improved student learning</td>
<td>65.52</td>
<td>66.67</td>
<td>64.58</td>
</tr>
<tr>
<td>We only use 10% of our brains</td>
<td>35.63</td>
<td>33.32</td>
<td>37.5</td>
</tr>
<tr>
<td>The different hemispheres of the brain have different functions. For example, creative thinking happens in the right hemisphere of the brain</td>
<td>9.19</td>
<td>7.69</td>
<td>10.42</td>
</tr>
<tr>
<td>Individual differences in academic abilities can be partly attributed to individual learning styles (e.g. Visual, Auditory, Kinaesthetic)</td>
<td>35.63</td>
<td>41.02</td>
<td>31.25</td>
</tr>
<tr>
<td>We are born with a fixed number of brain cells and are unable to manufacture more brain cells as we grow older</td>
<td>64.37</td>
<td>69.23</td>
<td>60.42</td>
</tr>
</tbody>
</table>
CONCLUSION: IMPLICATIONS FOR PRACTICE

- Listen up!
  - Neuroscience is providing interesting information of relevance to special education & disability
  - It is becoming increasingly influential
    - Evidence-based confirming & disproving

- Look Out!
  - Teacher professional learning (& healthy scepticism) is needed to discern brain-based non-science from useful information

- Turn the soil to build the bridges - collaboration
  - Teacher understanding of cognitive psychology
  - Teacher awareness of neuromyths
  - Reliance on evidence-based / evidence informed practices
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For questions or further information, email me:

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