Neuroscience and Learning:
What the Research Says!

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**Simplicity is the Ultimate Sophistication**

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### The Decisive Dozen

*for Learning Design and Learning Measurement*

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<td>Exposure</td>
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<td>Feedback</td>
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<td>Baseline</td>
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<td>Engagement &amp; Understanding</td>
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<td>Remembering</td>
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<td>Application</td>
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Leonardo da Vinci

http://is.gd/ddResearch
The 22 Principles

Available at: is.gd/manifesto22
Quite simply, the BEST book on smile sheet creation and utilization, Period!

Karl M. Kapp
Professor of Instructional Technology
Bloomsburg University

Thoughtful and sensible advice for feedback tools that will provide valid and actionable data.

Robert O. Brinkerhoff
Professor Emeritus, Western Michigan University & Director, Brinkerhoff Evaluation Institute

Evidence-based practice at the master level.

Julie Dirksen
Author of Design For How People Learn
Today, which type of research offers the most critical information for learning design?

A. Research surveys of learner preferences.
B. Research examining learning methods and their outcomes.
C. Research on brain-based learning and neuroscience.
D. Training needs analysis, especially cognitive task analysis.
E. All of these together are important.

Have you seen vendors/consultants put forth the premise that YOU SHOULD BE USING NEUROSCIENCE to help your learning designs?

A. Not even a glimpse.
B. Once or twice.
C. Several times.
D. Many times.
E. Many, many, many, many times!!!
Glial Grandeur

From Researchers at the University of Edinburgh

http://is.gd/grandeur

Neuroscience Defined

“Neuroscience is the scientific study of the nervous system. It is a multidisciplinary branch of biology, that deals with the anatomy, biochemistry, molecular biology, and physiology of neurons and neural circuits.”

Wikipedia

Neuroimaging: fMRI, PET, SPECT
In your work as a learning professional, how do you use neuroscience research today?

A. Have SUCCESSFULLY designed learning based on neuroscience.
B. Have ATTEMPTED to design learning based on neuroscience.
C. AM PREPARING to design learning based on neuroscience.
D. WANT TO KNOW how to design learning based on neuroscience.
E. NOT ENGAGED or NOT REALLY INTERESTED in neuroscience.

Someday, neuroscience may have a ton to teach us about learning.
"I don't think brain science has anything to say for business practice."

"We still don't really know how the brain works."

"The state of our knowledge [of the brain] is childlike."

John Medina
Neuroscientist
June 2015

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November 2012:

“Neuroscience Applied to Education: Mostly Unimpressive”

January 2014:

“I’ve often written that it’s hard to bring neuroscientific data to bear on issues in education... Hard, but not impossible.”

Daniel Willingham
Research Psychologist
Daniel Busso & Courtney Pollock:

“There is little doubt that our knowledge of the developing brain is poised to make important contributions to the lives of parents, educators and policymakers…

Some have voiced concerns about the viability of educational neuroscience, suggesting that neuroscience can inform education only indirectly…

“Others insist that neuroscience is only one small component of a multi-pronged research strategy to address educational challenges, rather than a panacea…”


“In practice, at the moment it is only the insights of cognitive psychology that can be effectively used in education, but even here care needs to be taken. Neurology has the potential to add value to education, but in general there are only two real conclusions we can make at present:

• For the time being, we do not really understand all that much about the brain.

• More importantly, it is difficult to generalize what we do know into a set of concrete precepts of behavior, never mind devise methods of influencing that behavior.”
“There are no examples of novel and useful suggestions for teaching based on neuroscience thus far.”

“Behavioral and neural data can inform our understanding of learning and so, in turn, [inform] choices in educational practice and the design of educational contexts...

“Educational Neuroscience does not espouse a direct link from neural measurement to classroom practice.”
“Educational neuroscience may be especially pertinent for the many children with brain differences that make educational progress difficult in the standard curriculum.”

“It is less clear at present how educational neuroscience would translate for more typical students, with perhaps a contribution toward individualized learning.”

Reflections? Questions?
Found that the software used to do most neuroscience studies created 70% false positives, not 5% as it was supposed to.
Software faults raise questions about the validity of brain studies

Interpretation of functional MRI data called into question.

JOHN TIMMER  11/12/15, 2:15 PM

It's not an exaggeration to say that functional MRI has revolutionized the field of neuroscience. Neuroscientists use fMRI machines to pick up changes in blood flow that occur when different areas of the brain become more or less active. This allows them to noninvasively figure out which areas of the brain get used when performing different tasks, from playing economic games to reading words.
I have to say that I am incredibly pleased that this study won the IgNobel. Not just because it’s a really fun study, but also because it really is one of those studies that makes you laugh, and then makes you THINK. And in the case of this study in particular, it has changed a lot about how we think about making connections in fMRI, and may have actually really affected the way the data are published. And so, I present to you the dead salmon study.

Promising!

But neuroscience is not yet ready to inform learning practice!
Are we as learning professionals more susceptible to recommendations if they mention “neuroscience” or “brain science?”

A. Yes, there is scientific evidence that people are more likely to believe arguments if they use scientific terminology.

B. Yes, there is scientific evidence that people are more likely to believe arguments if they use the term “neuroscience.”

C. No, this is an urban legend.

Superfluous neuroscience information is biasing
But scientific information in general is biasing.
NOT just neuroscience info
Neuroscience can be exploited by unscrupulous [vendors]

From a well-known elearning vendor.

Gives impression that their products are based on neuroscience.

But in fact, the spacing effect and retrieval practice findings are NOT based on neuroscience!
Perceptions of Past Research

Bruce and Bahrick counted up all the articles related to the SPACING EFFECT and found 321.

First mention of fMRI in PsycINFO.

10th article that mentions fMRI.
1974
First Mention of Retrieval Practice.

1988
Seminal research review of Retrieval Practice by Robert Bjork.


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**Behavioral**

![Behavioral Graph](image)

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**The Guardian**

Teaching

Teachers must ditch 'neuromyth' of learning styles, say scientists

Eminent academics from worlds of neuroscience, education and psychology voice concern over popularity of method

Teaching children according to their individual ‘learning style’ does not achieve better results and should be ditched by schools in favour of evidence-based practice, according to leading scientists.

Thirty eminent academics from the worlds of neuroscience, education and psychology have signed a letter to the Guardian voicing their concern about the popularity of the learning style approach among some teachers.

They say it is ineffective, a waste of resources and potentially even damaging as it...
Facts about neuroscience that you need to know...

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<th>Human attention span</th>
<th>Goldfish attention span</th>
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| 8.25 seconds         | 9 seconds               

The speed that the brain can process information is as follows:
- 0.5 meters/sec
- 120 meters/sec (that's about 43 miles/hour)

You can commit about 3-4 things to short-term memory. After 20 seconds they will disappear from memory unless you repeat them over and over.

The human mind wanders 30% of the time.

Based on these facts alone, you can see why...

25% of L&D professionals are integrating neuroscience.

Neuroscience helps us to explore the question: What makes L&D effective?

NEUROSCIENCE ENABLES:
- More engagement for learners
- Cost savings
- Higher staff retention
- Increased credibility as a practitioner

Why are games good for learning?
Knowing About the Brain Helps L&D People Train

We've looked into the latest research on the neuroscience of learning. This exciting new field has created a wealth of great tips to make L&D more effective, but you can relax understanding neuroscience isn't brain surgery.

- How Neuroscience Can Boost L&D:
  - More Engaged
  - Better Retention
  - Cost Savings
  - Fewer Start Stalls
  - Improved Decision-Making
  - Increases Credibility

Training Impacts

You Can Increase Your Confidence and Credibility as a Facilitator

The Field Opens Up Other Perspectives and Creates Discussion

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Read Why Diverse Teams Are Smarter in Harvard Business Review

Neuroscience shows why striving to increase workplace diversity is not an empty slogan

Read the Article
A strong case can be made that the integration of behavior analysis and neuroscience portends a biobehavioral science whose implications for understanding complex behavior, including human behavior, are as profound as the earlier integration of the sciences of heredity and genetics for understanding complex structure.

Skinner explicitly acknowledged “the spatial gap between behavior and the variables of which it is a function” and argued that this gap “can be filled only by neuroscience, and the sooner... the better” (Skinner, 1938, p. 470).

http://neurocritic.blogspot.ca/2013/03/what-is-this-thing-called-neuroscience.html
The very notion of a ‘neurological correlate’ implies what I am here contending—that there are two independent subject matters (behavior and the nervous system) which must have their own techniques and methods and yield their own respective data. No amount of information about the second will ‘explain’ the first or bring order into it without the direct analytical treatment represented by a science of behavior.

I am asserting, then, not only that a science of behavior is independent of neurology but that it must be established as a separate discipline whether or not a rapprochement with neurology is ever attempted.

B. F. Skinner (1938)

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D. Training needs analysis, especially cognitive task analysis.
Will’s Article on Neuroscience and Learning

https://is.gd/brainlearning

Questions?
What Research-Based Factors Should We be Using to Guide Our Learning Designs?
### The Decisive Dozen

for Learning Design and Learning Measurement

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**Baseline**

- Engagement & Understanding
- Remembering
- Application

[http://is.gd/ddResearch](http://is.gd/ddResearch)

www.Debunker.Club

*Helping to Clean Up The Learning Field*
• Research on Learner Control in eLearning — https://is.gd/learnercontrol
• Measuring eLearning — https://is.gd/measureelearning
• Test Your Learner Feedback Questions — https://is.gd/smilecheck
• Five Reasons for the Spacing Effect — https://is.gd/5reasons4
• List of Subscription Learning Providers — https://is.gd/slproviders
• New Definition of Microlearning — https://is.gd/microlearning
• eLearning Manifesto 22 Principles — http://is.gd/manifesto22
• Neuroscience & Learning: Not Yet! — http://is.gd/brainlearning

Smile Sheet Question Challenge
Neuroscience and Learning: What the Research Says!

Slides available at: www.is.gd/willstuff

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