The gap between neuroscience and education: Is it a bridge too far?

Jason M Lodge
School of Education
Science of Learning Research Centre, Queensland Brain Institute
The University of Queensland

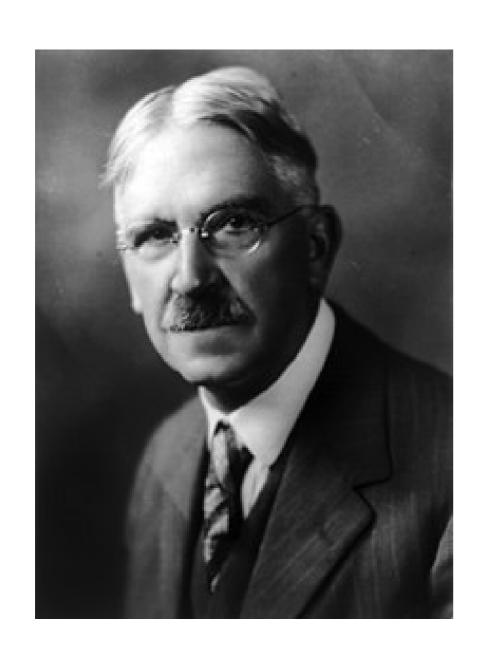
<u>jason.lodge@uq.edu.au</u>

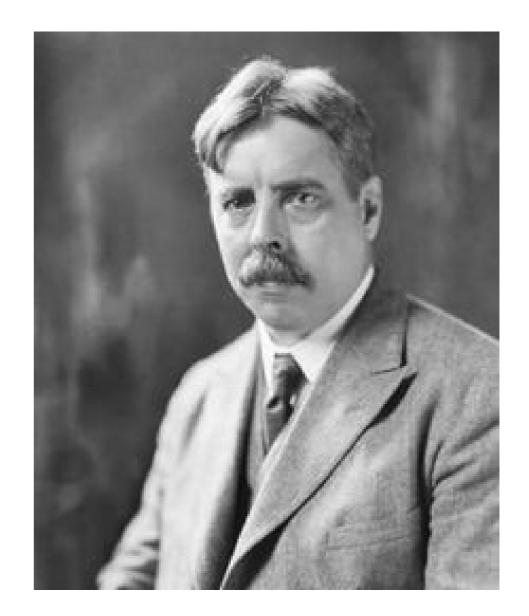






What does quality learning in education look like?





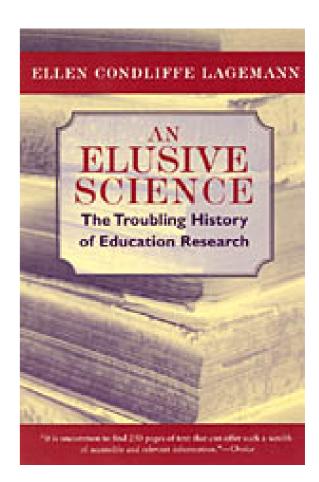


Audrey Watters @audreywatters · Jul 14

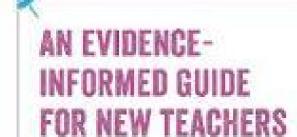
Dewey lost and Thorndike won (Ellen Condliffe Lagemann); and this is evident in almost all ed-tech

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#HistorianSignBunny



THE TRUTH ABOUT TEACHING



GREG ASHMAN



getting it
WRONG
from the
beginning



Our Progressivist Inheritance from Herbert Spencer, John Dewey, and Jean Piaget

kieran egan

Recipient of the Graventeyer Award in Education

Paul Smeyers
Marc Depage Editors

Educational Research:
The Attraction of Psychology

Springer

Chapter 2 Struggling with the Historical Attractiveness of Psychology for Educational Research Illustrated by the Case of Nazi Germany

Marc Depaepe

2.1 Far Too Easy Hypotheses?

La ciencia (...) consiste en un 'prurito' de plantear problemas¹
(José Ortega y Gasset, 1930/2001, p. 16)

A few years ago, when we determined the themes for the upcoming meetings of the Leuven *Research Community*, I thought that there could be no easier task than that which lays before me at the moment: reporting on the history of the attractiveness of psychology for educational research. On the basis of my work in the history of educational science on the development of the empirical-analytical paradigm (Depaepe, 1993), it seemed that one could quite easily formulate a number of hypotheses with regard to the increasing role of psychology in educational research.



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'In the endless war between trads and progs, my personal philosophy is that variety should be the spice of life'

Whether you're teaching in a Manchester classroom or a refugee camp in Northern France, all that matters is the teacher and the pupil. The rest is just about "what works", writes the TES education blogger of the year

By Natalie Scott

21 November 2016

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'Phallic' slur on teaching methods

EXCLUSIVE

By REBECCA URBAN
NATIONAL EDUCATION
CORRESPONDENT
Follow @RurbsOz

12:00AM APRIL 6, 2019

COMMENTS



Dr Lucinda McKnight from Deakin University.

A row has erupted in education circles over a push for rigorous scientific research to inform classroom teaching practices, after a prominent education academic described it as a "masculinist fantasy" that would create a workforce of "phallic teachers" obsessed with "data, tools and … probes".

Evidence

What works?

How do we translate it?

Expanded Edition

How People Learn



Brain,

Mind,



Experience,



and

School





Select topics to **Find What Works** based on the evidence



Literacy



Mathematics



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Path to Graduation



Postsecondary

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Charter Schools

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and Additional Conference

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Teaching methods go from lab to classroom

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People may have lived in Brazil more than 20,000 years ago

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SEPTEMBER OF YOU

SCREWCE THORIDS

Spiritual convictions and group identities inspire terrorist acts, study finds

MY BRUCK BOWER

SEPTEMBER D4.2017

SOCIETY LIFE-ATT

Innovative nonprofits receive \$20,000 in STEM Action Grants

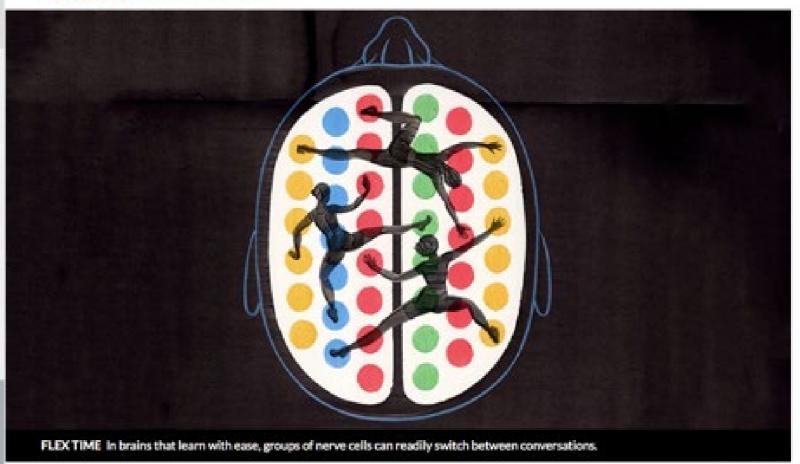
REVIEWS & PREVIEWS

North America's largest recorded earthquake helped confirm plate FEATURE NEUROSCIENCE

Learning takes brain acrobatics

When neural areas more easily switch communication partners, learning improves

BY LAURA SANDERS 11:00AM, SEPTEMBER 5, 2017



ALEXINABADM.

Peer inside the brain of someone learning. You might be lucky enough to spy a synapse pop into existence.

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Rewriting Life

How Machine Learning Is Helping Neuroscientists Crack Our Neural Code

A big challenge in neuroscience is understanding how the brain encodes information. Neural networks are turning out to be great code crackers.

by Emerging Technology from the arXiv August 10, 2017







Whenever you move your hand or finger or eyeball, the brain sends a signal

to the relevant muscles containing the information that makes this movement possible. This information is encoded in a special way that allows it to be transmitted through neurons and then actioned correctly by the relevant muscles.



Exactly how this code works is something of a mystery. Neuroscientists

What's the problem then?

The Seductive Allure of Neuroscience Explanations

Deena Skolnick Weisberg, Frank C. Keil, Joshua Goodstein, Elizabeth Rawson, and Jeremy R. Gray

Abstract

Explanations of psychological phenomena seem to generate more public interest when they contain neuroscientific information. Even irrelevant neuroscience information in an explanation of a psychological phenomenon may interfere with people's abilities to critically consider the underlying logic of this explanation. We tested this hypothesis by giving naïve adults, students in a neuroscience course, and neuroscience experts brief descriptions of psychological phenomena followed by one of four types of explanation, according to a 2 (good explanation vs. bad explanation) × 2 (without neuroscience

vs. with neuroscience) design. Crucially, the neuroscience information was irrelevant to the logic of the explanation, as confirmed by the expert subjects. Subjects in all three groups judged good explanations as more satisfying than bad ones. But subjects in the two nonexpert groups additionally judged that explanations with logically irrelevant neuroscience information were more satisfying than explanations without. The neuroscience information had a particularly striking effect on nonexperts' judgments of bad explanations, masking otherwise salient problems in these explanations.

THE CONVERSATION

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10 December 2012, 2.39pm AEST

Weird neuroscience: how education hijacked brain research

AUTHOR



Max Coltheart

Emeritus Professor, Department
of Cognitive Science at
Macquarie University

DISCLOSURE STATEMENT

Max Coltheart receives funding from the Australian Research Council

Macquarie University does not contribute to the cost of running The Conversation. Find



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So much talk about 'the brain' in education is meaningless

September 8, 2015 6.07am AEST



Authors



Jared Cooney Horvath PhD Student - Neuroscience, Psychology, and Education at University of Melbourne



Gregory Donoghue Learning Sciences Researcher & PhD Candidate at University of Melbourne

Disclosure statement

Jared Cooney Horvath works for the Science of Learning Research Centre (SLRC) at the University of Melbourne. The SLRC is funded through a Special Research Initiative of the Australian Research Council.

Gregory Donoghue is a student of, and works for, the Science of Learning Research Centre at the Melbourne University Graduate School of Education. The SoLRC is a Special Research Initiative of the Australian Research Council.

Partners

rain science fascinates teachers and educators, just as it fascinates all of us. When I speak to total applications of cognitive science in the classroom, there is always a question or two about the right brain versus the left brain and the educational promise of brainbased curricula. I answer that these ideas have been around for a decade, are often based on misconceptions and overgeneralizations of what we know about the brain, and have little to offer to educators (Chipman, 1986). Educational applications of brain science may come eventually, but as of now neuroscience has little to offer teachers in terms of informing classroom practice. There is, however, a science of mind, cognitive science, that can serve as a basic science for the development of an applied science of learning and instruction. Practical, well-founded examples of putting cognitive science into practice already exist in numerous schools and classrooms. Teachers would be better off looking at these examples than at speculative applications of neuroscience.

The teachers' questions arise out of the perennial interest in the brain and neuroscience that has always existed at the margin of educational research and reform discussions. Recently, however, interest in how neuroscience might improve education has moved from the margins to center place, that indirectly link brain function with educational practice. There is a well-established bridge, now nearly 50 years old, between education and cognitive psychology. There is a second bridge, only around 10 years old, between cognitive psychology and neuroscience. This newer bridge is allowing us to see how mental functions map onto brain structures. When neuroscience does begin to provide useful insights for educators about instruction and educational practice, those insights will be the result of extensive traffic over this second bridge. Cognitive psychology provides the only firm ground we have to anchor these bridges. It is the only way to go if we eventually want to move between education and the brain.

The Neuroscience and Education Argument

The neuroscience and education argument relies on and embellishes three important and reasonably well-established findings in developmental neurobiology. First, starting in infancy and continuing into later childhood, there is a dramatic increase in the number of synapses that connect neurons in the brain. This synaptic proliferation (synaptogenesis) is followed by a period of synaptic elimination. Second, there are experience-dependent critical periods in the development of sensory and motor systems. Third, in rats at least, complex, or enriched, environments cause new synapses to form.

The argument runs as follows. Starting in early infancy,





Cognitive Science 26 (2002) 85–112

http://www.elsevier.com/locate/cogsci

Spanning seven orders of magnitude: a challenge for cognitive modeling

John R. Anderson*

Psychology Department, Carnegie Mellon University, Pittsburgh, PA 15213, USA
Received 1 May 2001; received in revised form 25 September 2001; accepted 10 November 2001

Abstract

Much of cognitive psychology focuses on effects measured in tens of milliseconds while significant educational outcomes take tens of hours to achieve. The task of bridging this gap is analyzed in terms of Newell's (1990) bands of cognition—the Biological, Cognitive, Rational, and Social Bands. The 10 millisecond effects reside in his Biological Band while the significant learning outcomes reside in his Social Band. The paper assesses three theses: The Decomposition Thesis claims that learning occurring at the Social Band can be reduced to learning occurring at lower bands. The Relevance Thesis claims that instructional outcomes at the Social Band can be improved by paying attention to cognition at the lower bands. The Modeling Thesis claims that cognitive modeling provides a basis for bridging between events on the small scale and desired outcomes on the large scale. The unit-task level, at the boundary of the Cognitive and Rational Bands, is useful for assessing these theses. There is good evidence for all three theses in efforts that bridge from the unit-task level to educational applications. While there is evidence for the Decomposition Thesis all the way down to the 10 millisecond level, more work needs to be done to establish the Relevance Thesis and particularly the Modeling Thesis at the lower levels. © 2002 Cognitive Science Society, Inc. All rights reserved.

Keywords: Cognitive modeling; Cognitive architectures; Education; Intelligent tutoring

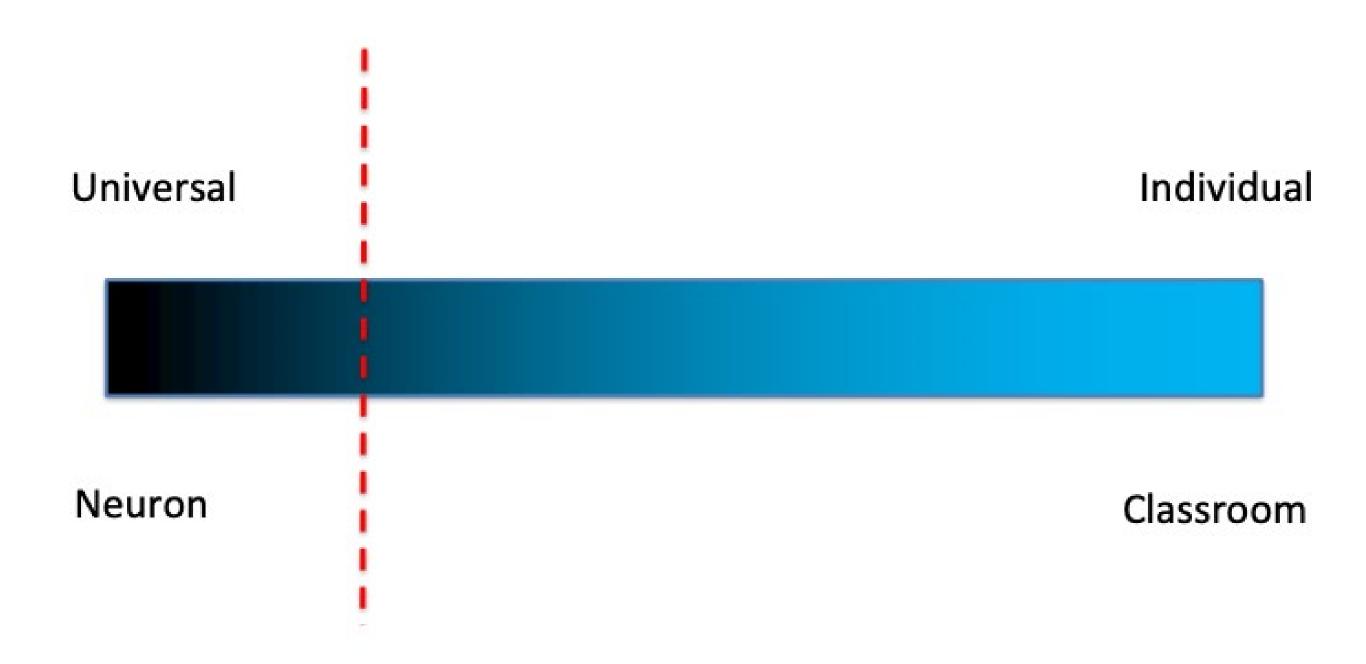
Table 1 Newell's Time Scales of Human Action

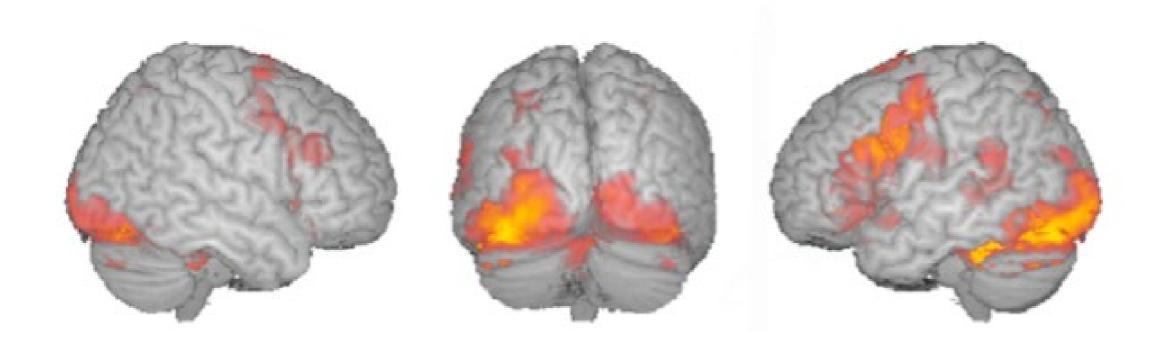
Scale (sec)	Time Units	System	World (theory)
$\overline{10^7}$	months		
10^{6}	weeks		Social Band
10^{5}	days		
10^{4}	hours	Task	
10^{3}	10 min	Task	Rational Band
10^{2}	minutes	Task	
10^{1}	10 sec	Unit task	
10^{0}	1 sec	Operations	Cognitive Band
10^{-1}	100 msec	Deliberate act	Ç
10^{-2}	10 msec	Neural circuit	
10^{-3}	1 msec	Neuron	Biological Band
10^{-4}	$100 \mu s$	Organelle	

Universal Individual

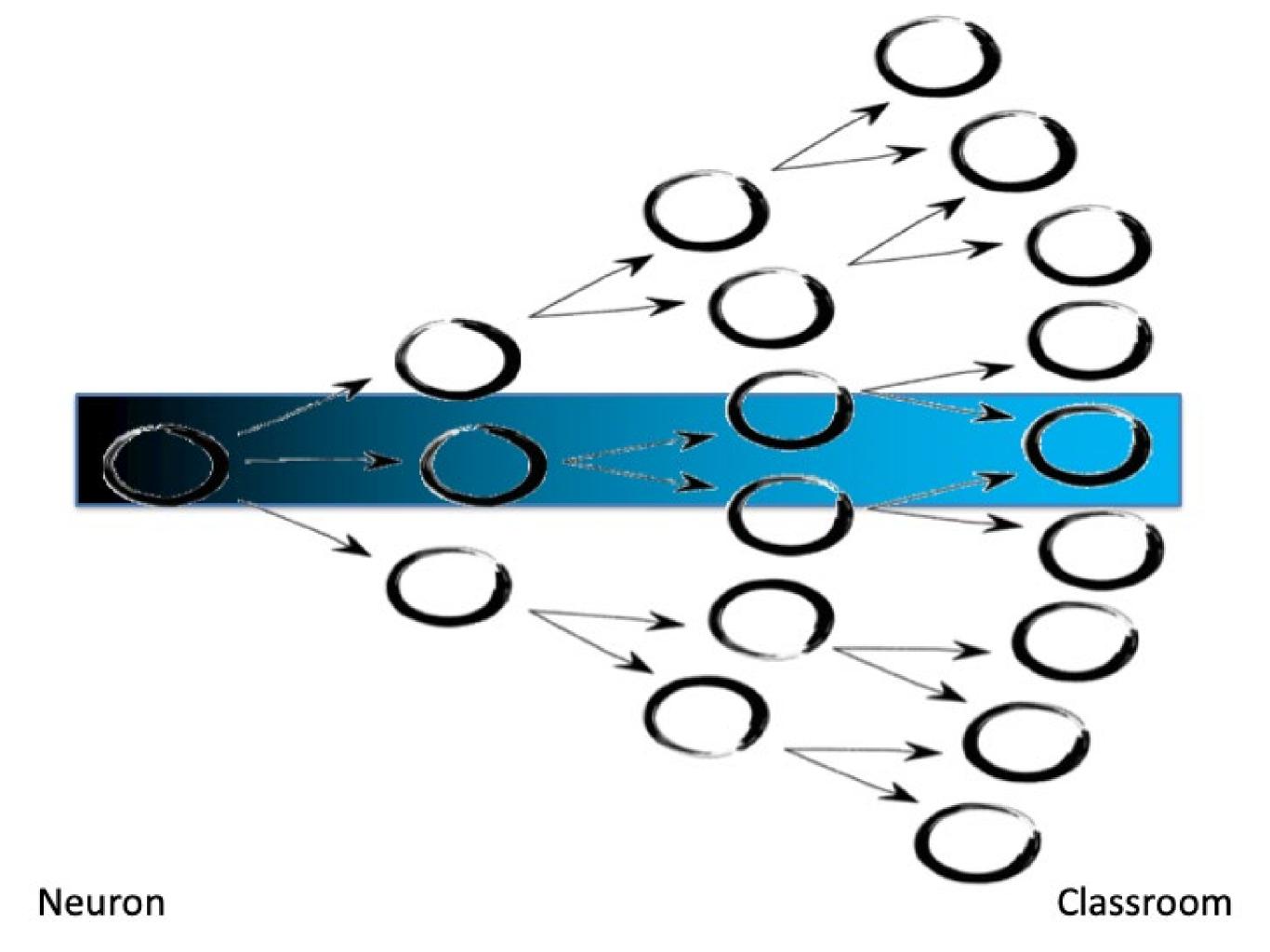


Neuron Classroom









Attempting to overcome the gap



Collaborating Organisations













Partner Organisations









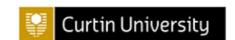










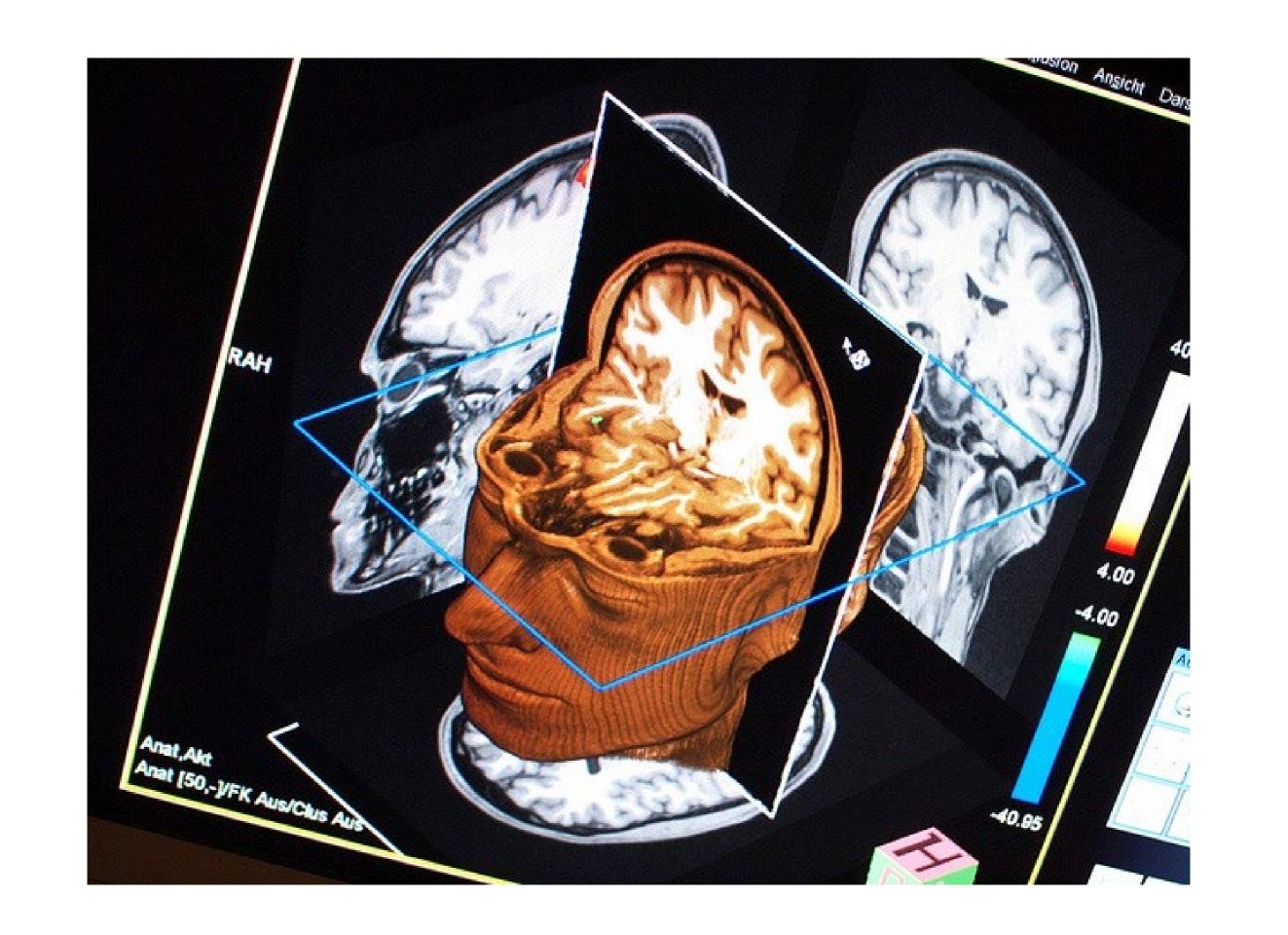


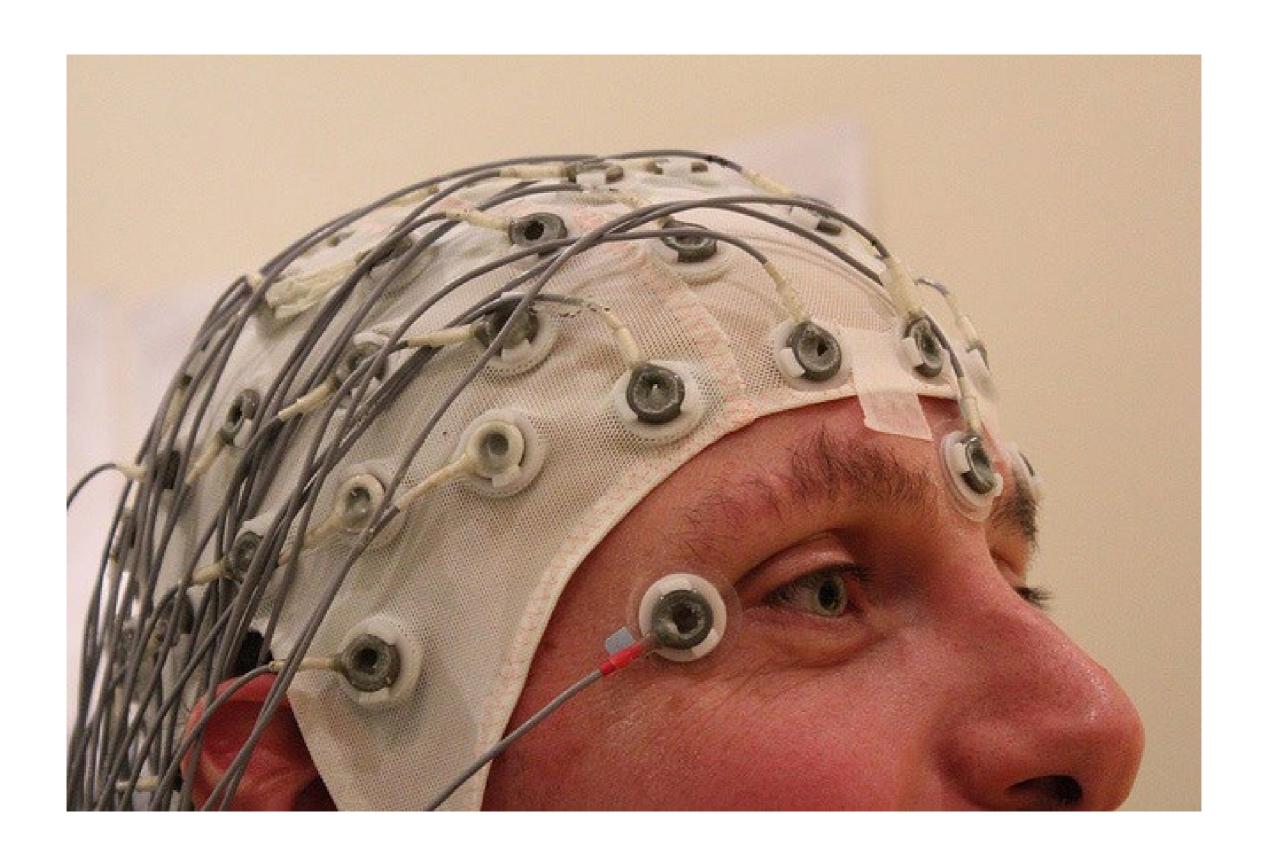






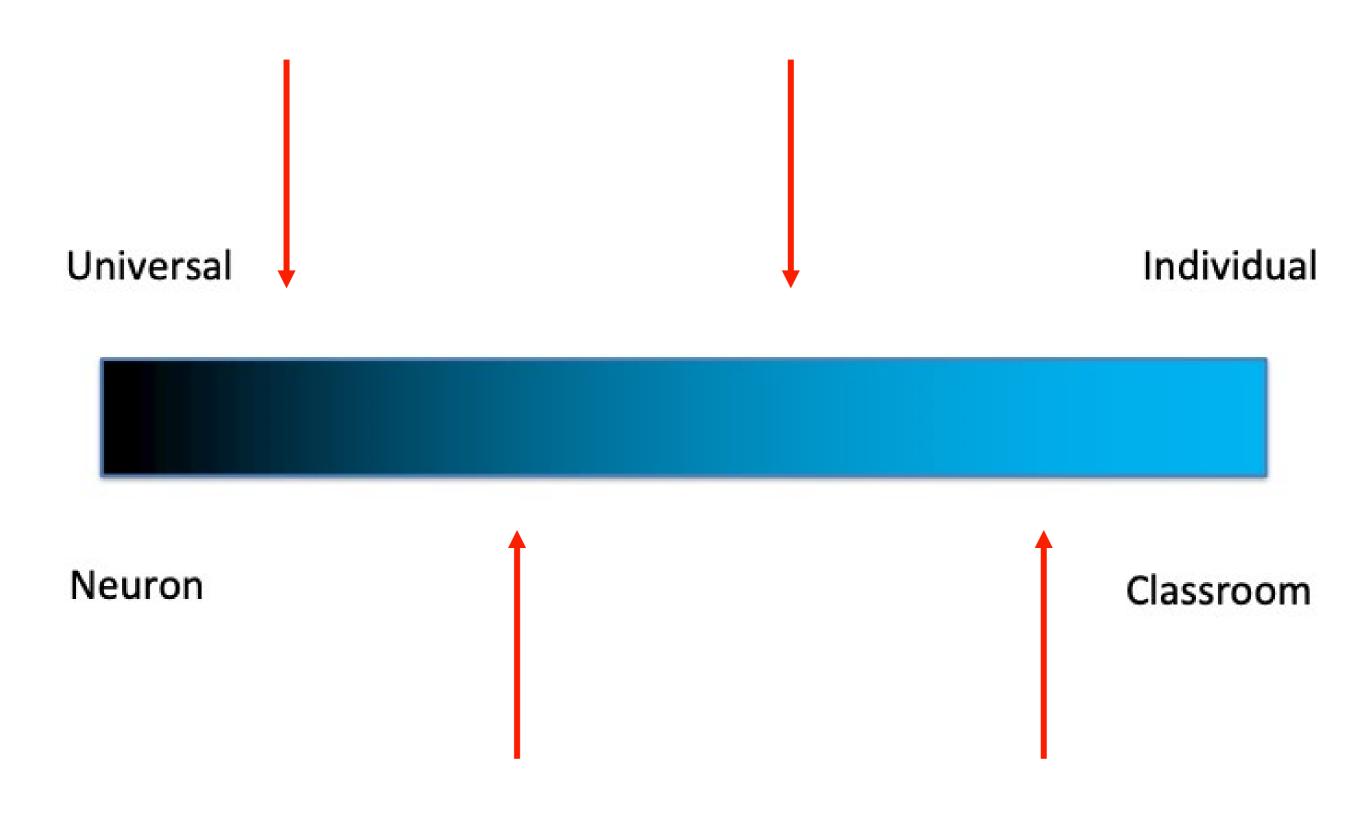








What to do about it?





Neuron Classroom

Errors/difficulties/confusion

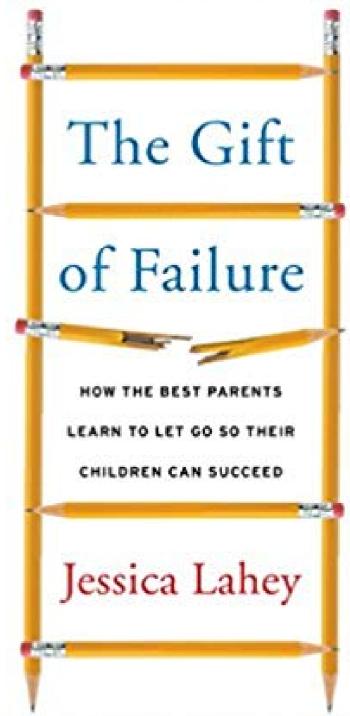


The Predictive Mind

COLOR DO COL

JAKOB HOHWY

NEW YORK TIMES BESTSELLER

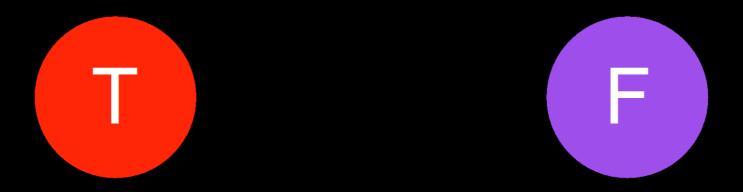


"Gripping. . . . How can teachers snatch back their critical role and give children the necessary space to fail? They could start by making parents read [this book]."

-Julie Lythcott-Haims, New York Times Bank Review

Misconceptions

Camels store water in their humps



Camels store water in their humps

T

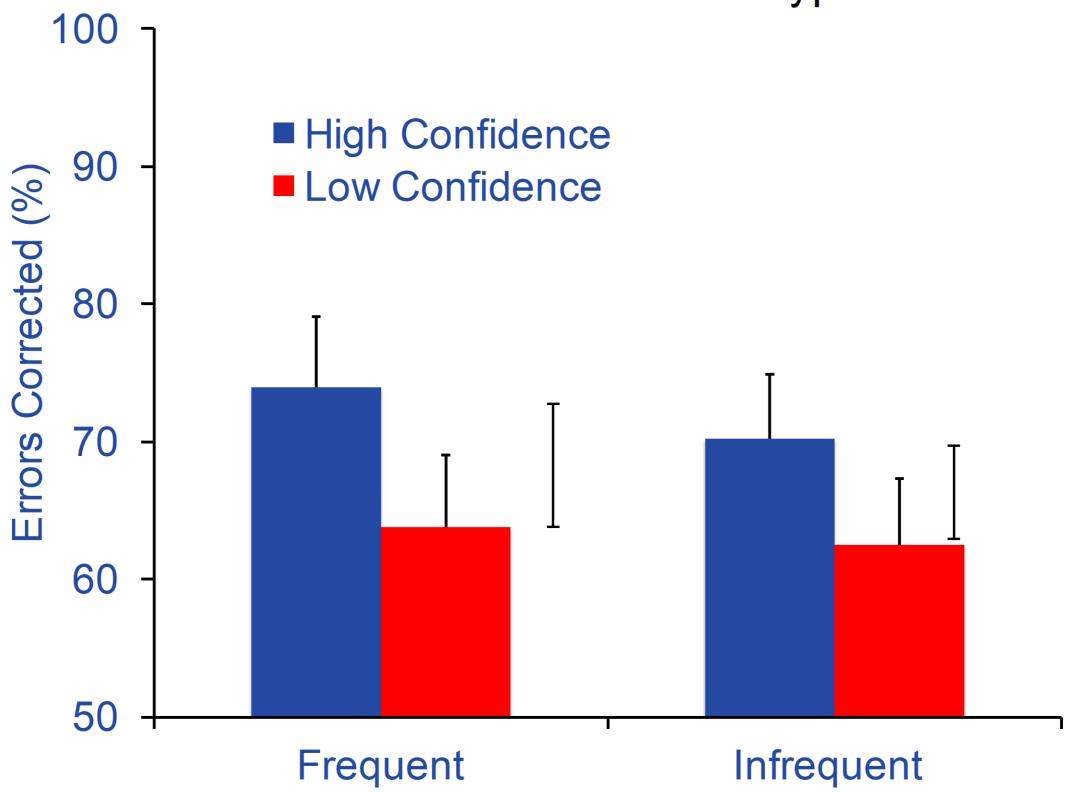
How confident are you in your answer?

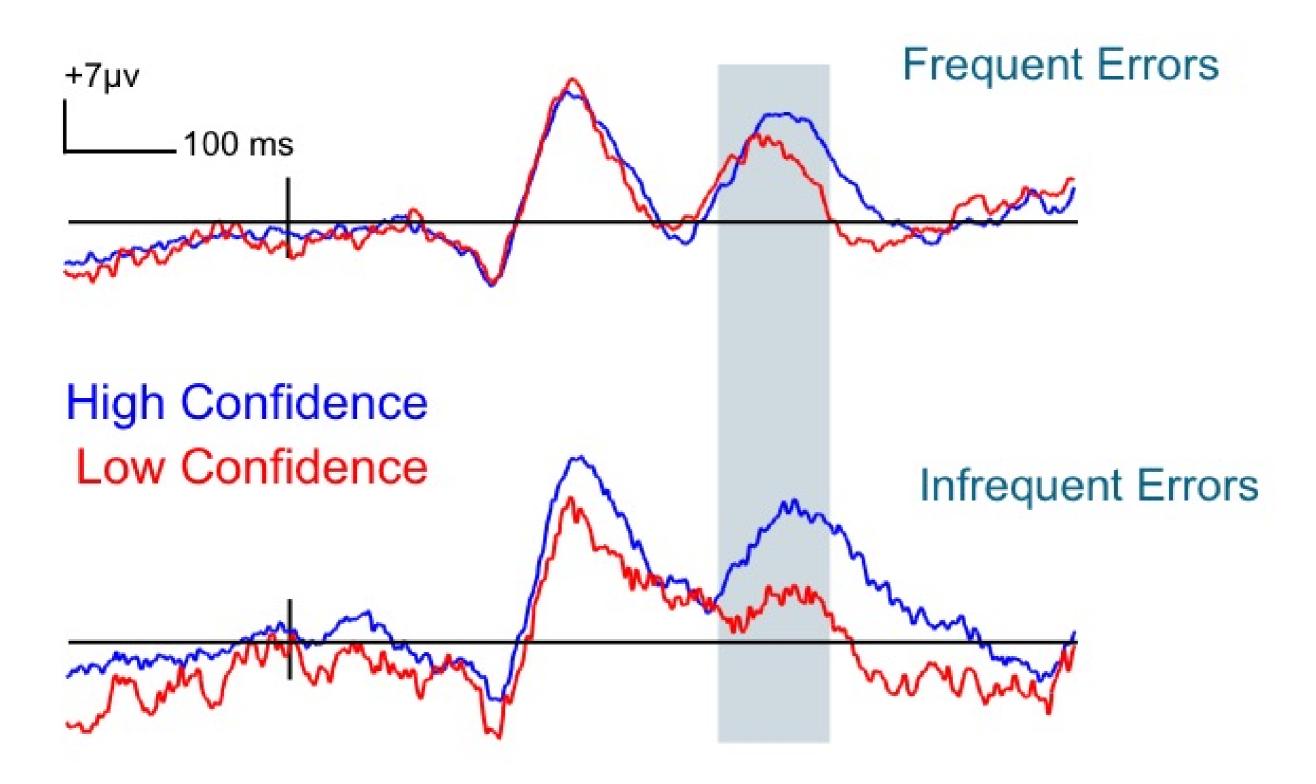
Not at all confident

Very confident



Hypercorrection Effect





Surprise

Universal Individual

Neuron Classroom

Confident

Wrong

Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments

Justin Kruger and David Dunning Cornell University

People tend to hold overly favorable views of their abilities in many social and intellectual domains. The authors suggest that this overestimation occurs, in part, because people who are unskilled in these domains suffer a dual burden: Not only do these people reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the metacognitive ability to realize it. Across 4 studies, the authors found that participants scoring in the bottom quartile on tests of humor, grammar, and logic grossly overestimated their test performance and ability. Although their test scores put them in the 12th percentile, they estimated themselves to be in the 62nd. Several analyses linked this miscalibration to deficits in metacognitive skill, or the capacity to distinguish accuracy from error. Paradoxically, improving the skills of participants, and thus increasing their metacognitive competence, helped them recognize the limitations of their abilities.

The Golden Gate Bridge in San Francisco is orange

Searing meat seals in the moisture

After hydrogen, oxygen is the second most plentiful element in the universe

Storing batteries in the freezer will not improve their performance

Elephants have two knees

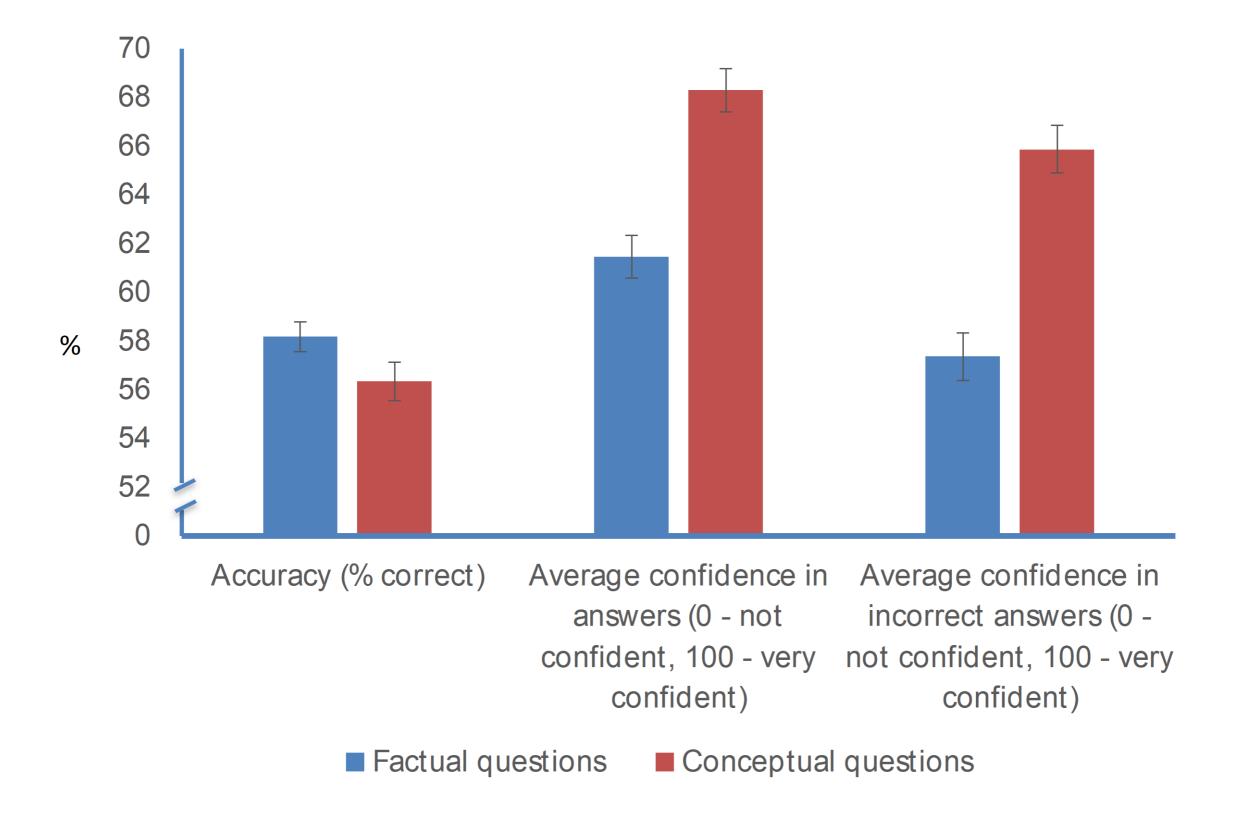
The word Sunday is named after the moon

Sitting too close to the TV will damage your eyes

Blood pressure is measured by a thermometer

A horse can run faster than an ostrich

The Golden Gate Bridge in San Francisco is orange	Т
Searing meat seals in the moisture	F
After hydrogen, oxygen is the second most plentiful element in the universe	F
Storing batteries in the freezer will not improve their performance	Т
Elephants have two knees	Т
The word Sunday is named after the moon	F
Sitting too close to the TV will damage your eyes	F
Blood pressure is measured by a thermometer	F
A horse can run faster than an ostrich	F



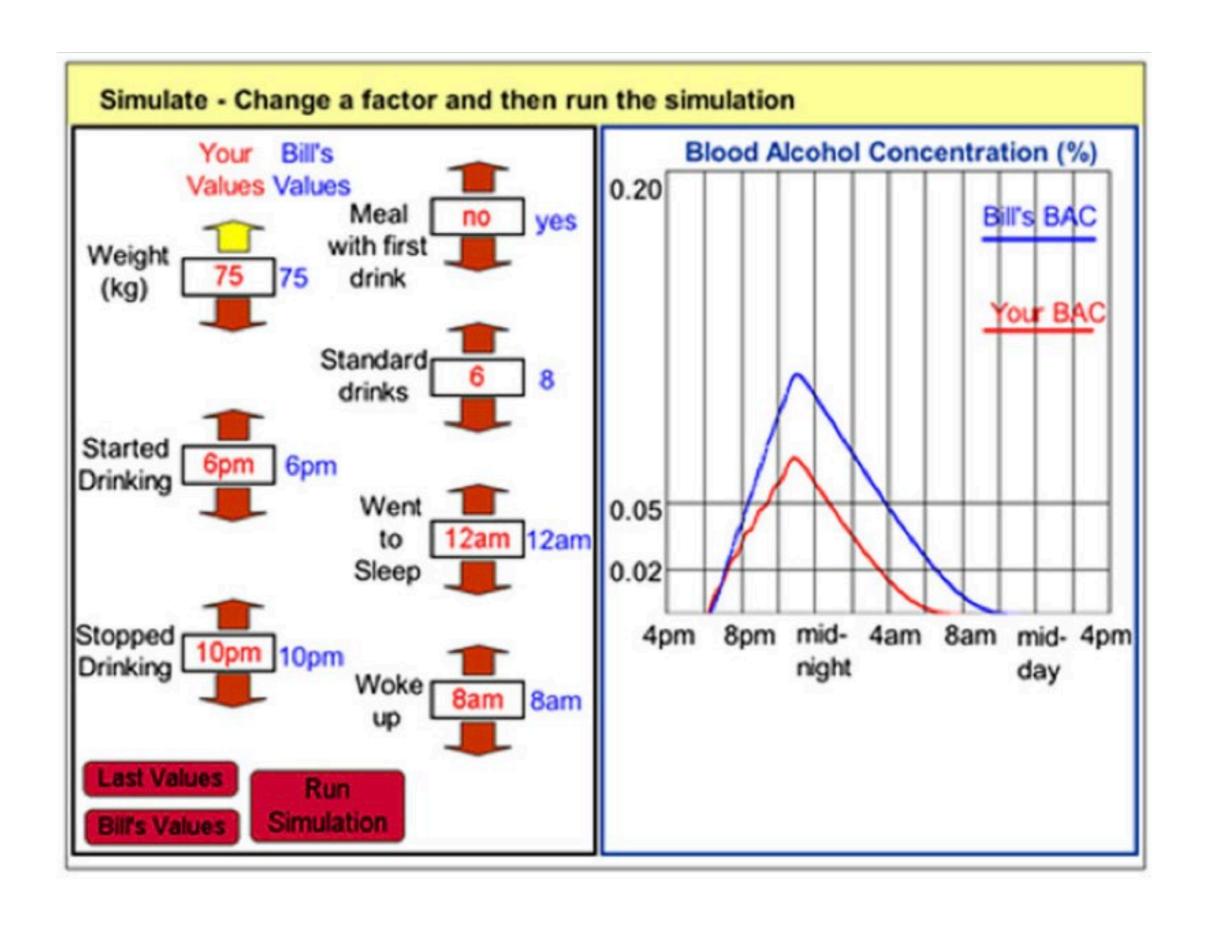
Confident

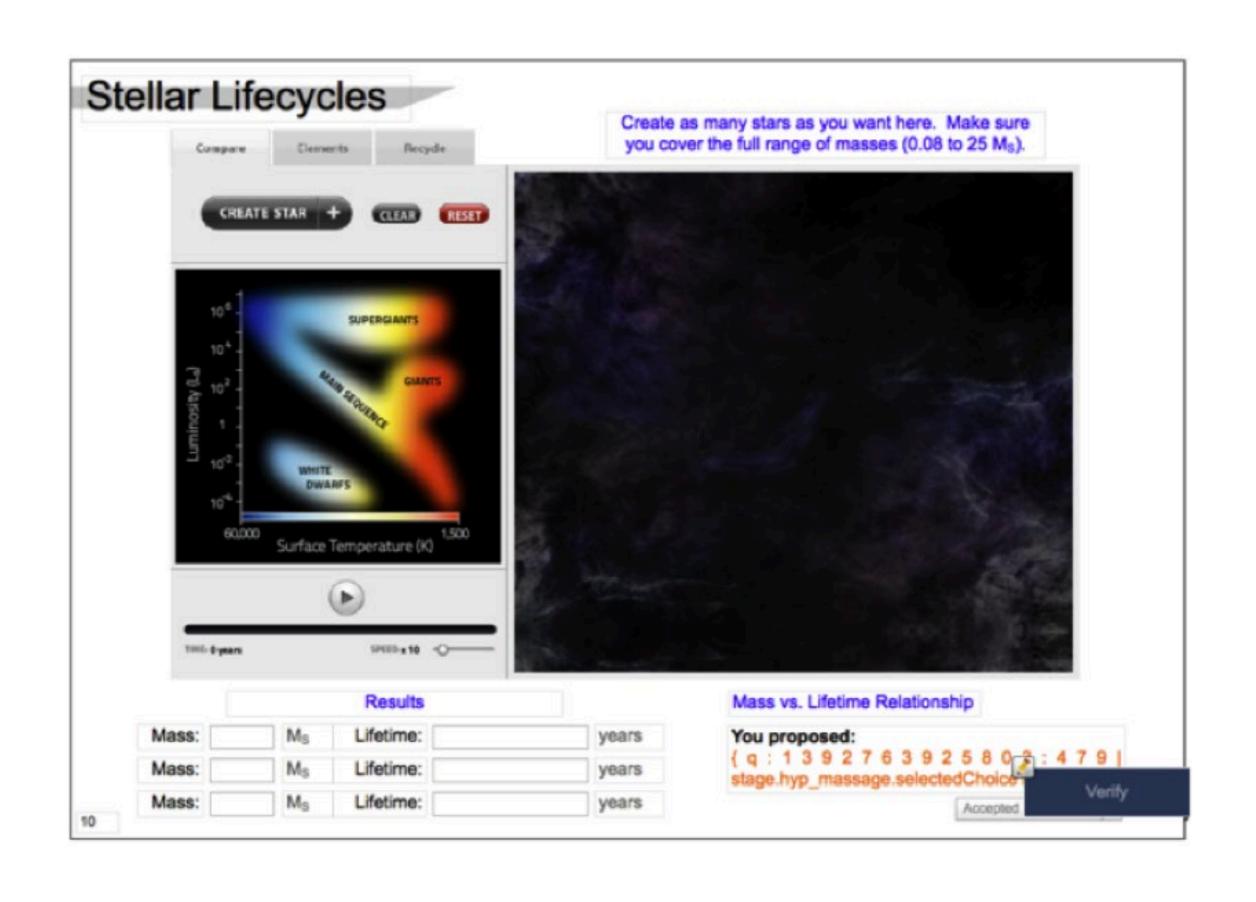
Wrong

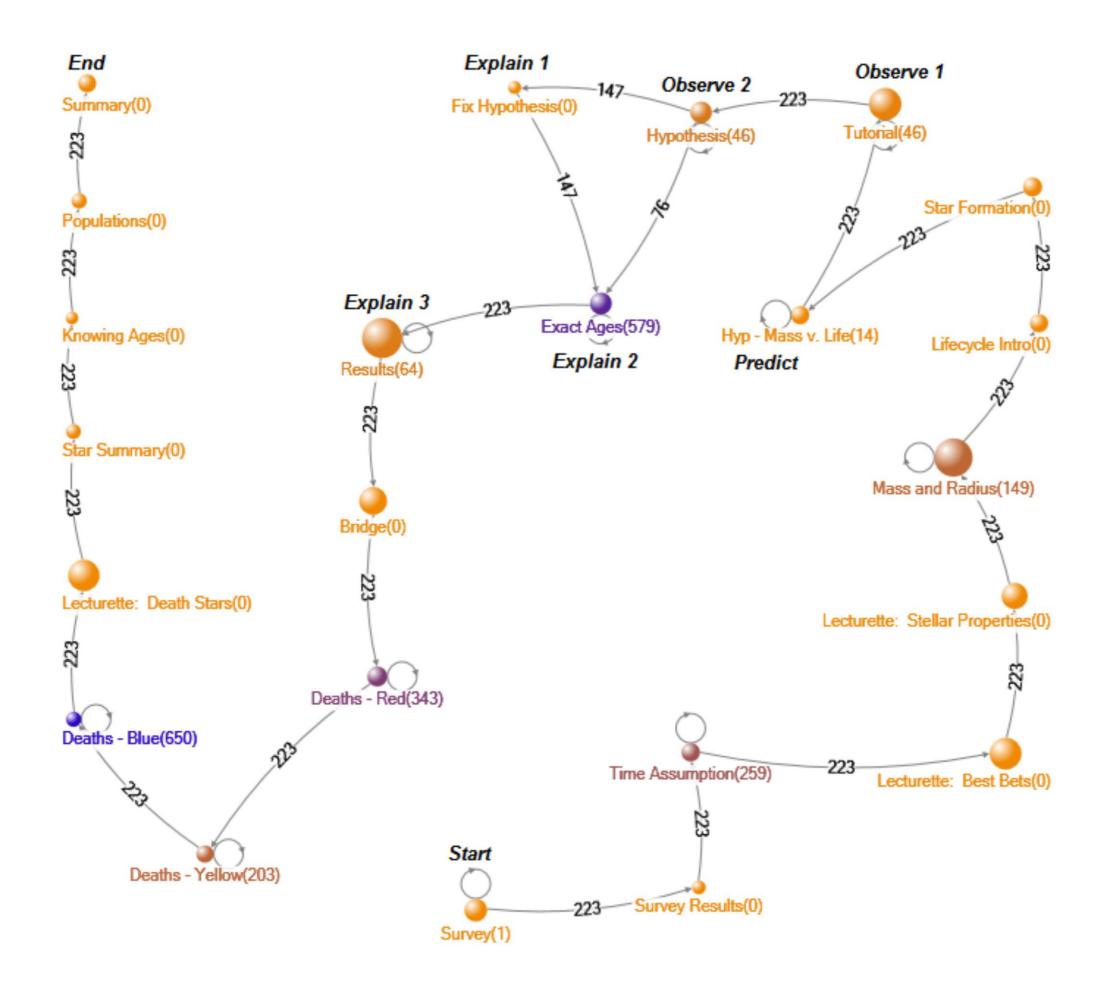


Neuron Classroom

What does this mean in practice?











How does this help teachers?

Universal Individual



Neuron

Classroom

Higher Education Learning Framework (HELF)

Aim:

To develop an evidence-informed framework for university learning that has the potential to be implemented widely across tertiary institutions

The Interviews

24 interviews with international and national experts in the learning sciences and higher education.

Broad research questions:

- What are the principles for effective learning in the 21st century?
- How can the principles be translated for effective university teaching?
- How does the emerging science of learning research and literature influence these principles?

Relative weight of nodes in dataset





Themes and Principles

Deep and meaningful learning

Learning is built on prior knowledge and engages students in deep thinking

Contextualised learning

Context can be leveraged to enhance the learning experience and outcomes

Learning to learn

If students understand how they learn, they can improve the way they learn

Challenges & difficulty

Difficulties and safe failure can be used to promote student learning

Learning as becoming

Learning is a process of becoming

Interactive learning

Interactive experiences strengthen student learning

Emotions and learning

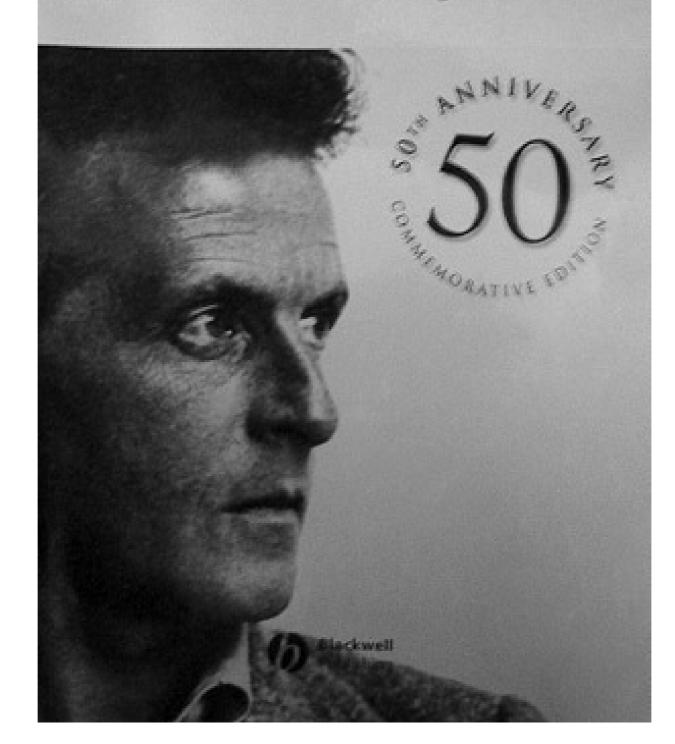
Emotions play a role in how and why students learn

Errors Challenge Difficulties Confusion Confidence Surprise

What have we learned?

PHILOSOPHICAL INVESTIGATIONS

The German Text, with a Revised English Translation



Edited by Jared Cooney Horvath, Jason M. Lodge and John Hattie





FROM THE LABORATORY TO THE CLASSROOM



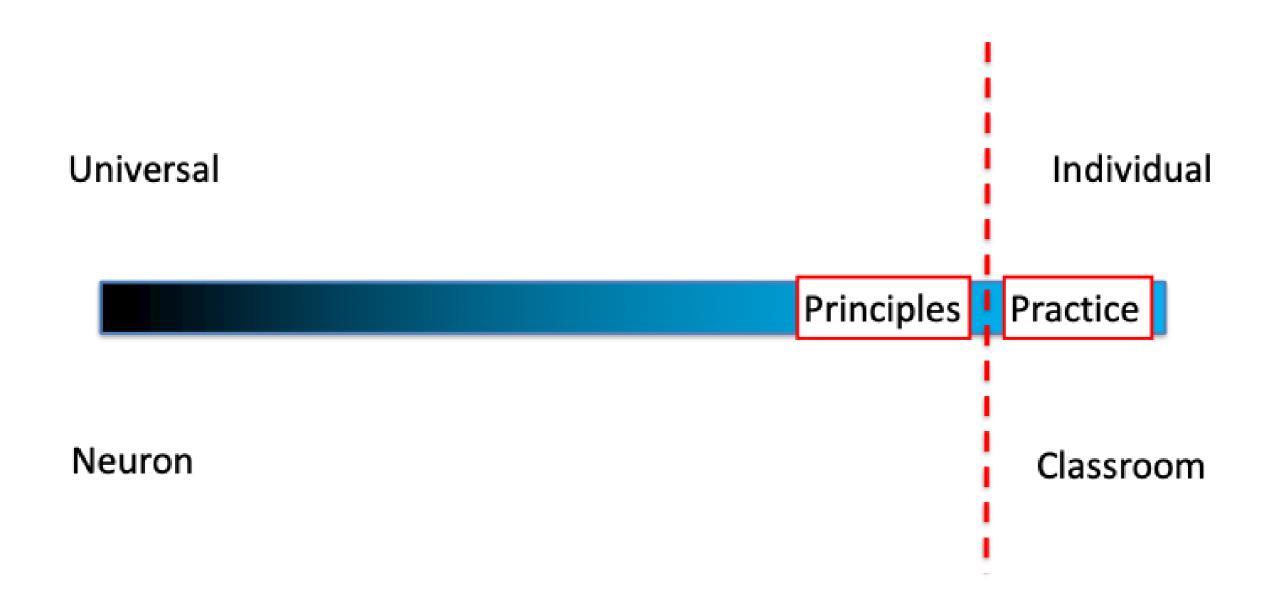
TRANSLATING SCIENCE OF LEARNING FOR TEACHERS

Functional

Diagnostic

Conceptual

Prescriptive



HOW LEARNING WORKS

Research-Based Principles for Smart Teaching

Susan A. Ambrose Michael W. Bridges Michele DiPietro Marsha C. Lovett Marie K. Norman

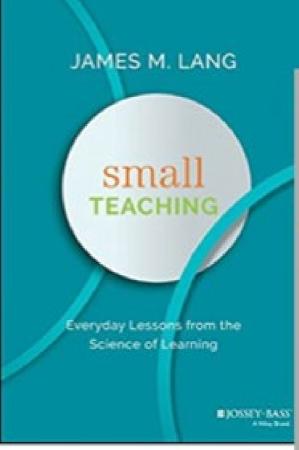
FOREWORD BY RICHARD E. MAYER

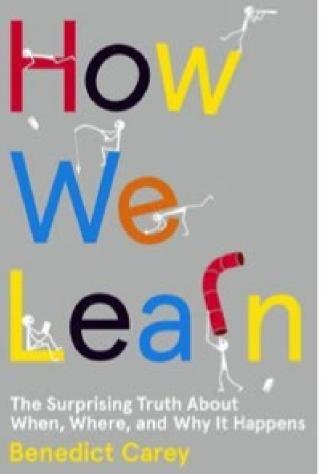
make it stick



The Science of Successful Learning

Peter C. Brown Henry L. Roediger III Mark A. McDaniel









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Trends in Neuroscience and Education

journal homepage: www.elsevier.com/locate/tine



The hard problem of 'educational neuroscience'

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- ^b Melbourne Graduate School of Education, University of Melbourne, Australia
- ^c Melbourne Centre for the Study of Higher Education, University of Melbourne, Australia
- d ARC-SRI Science of Learning Research Centre, Australia

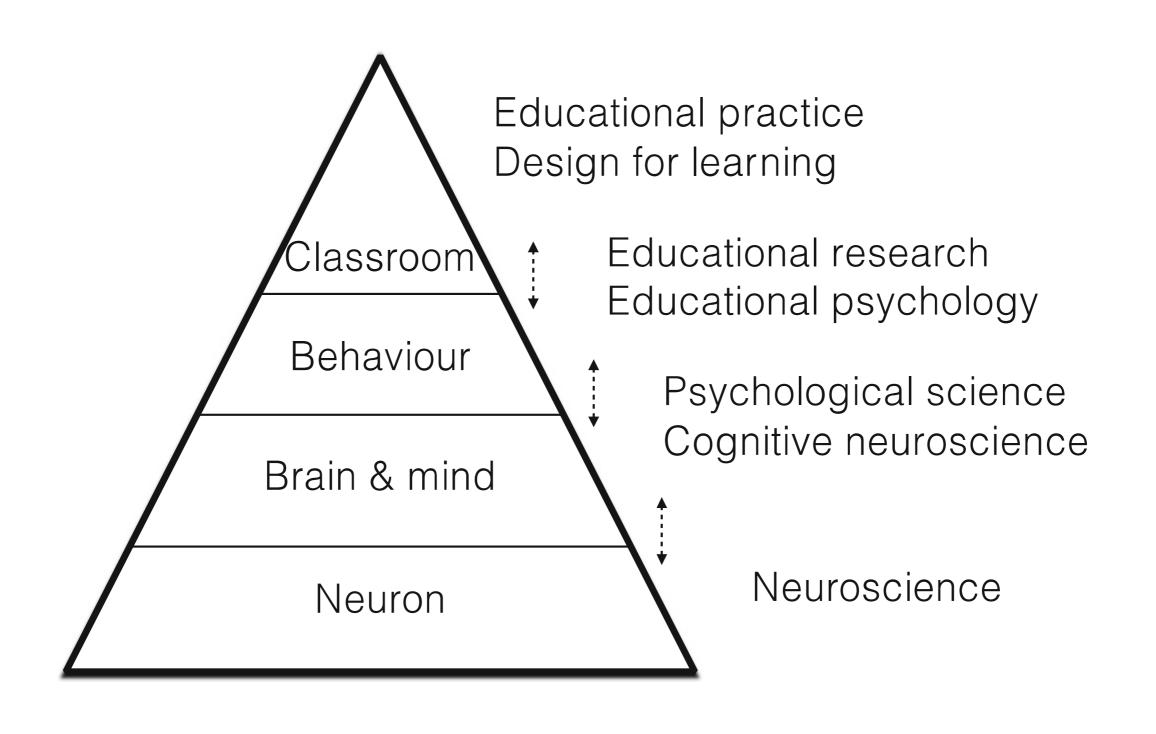


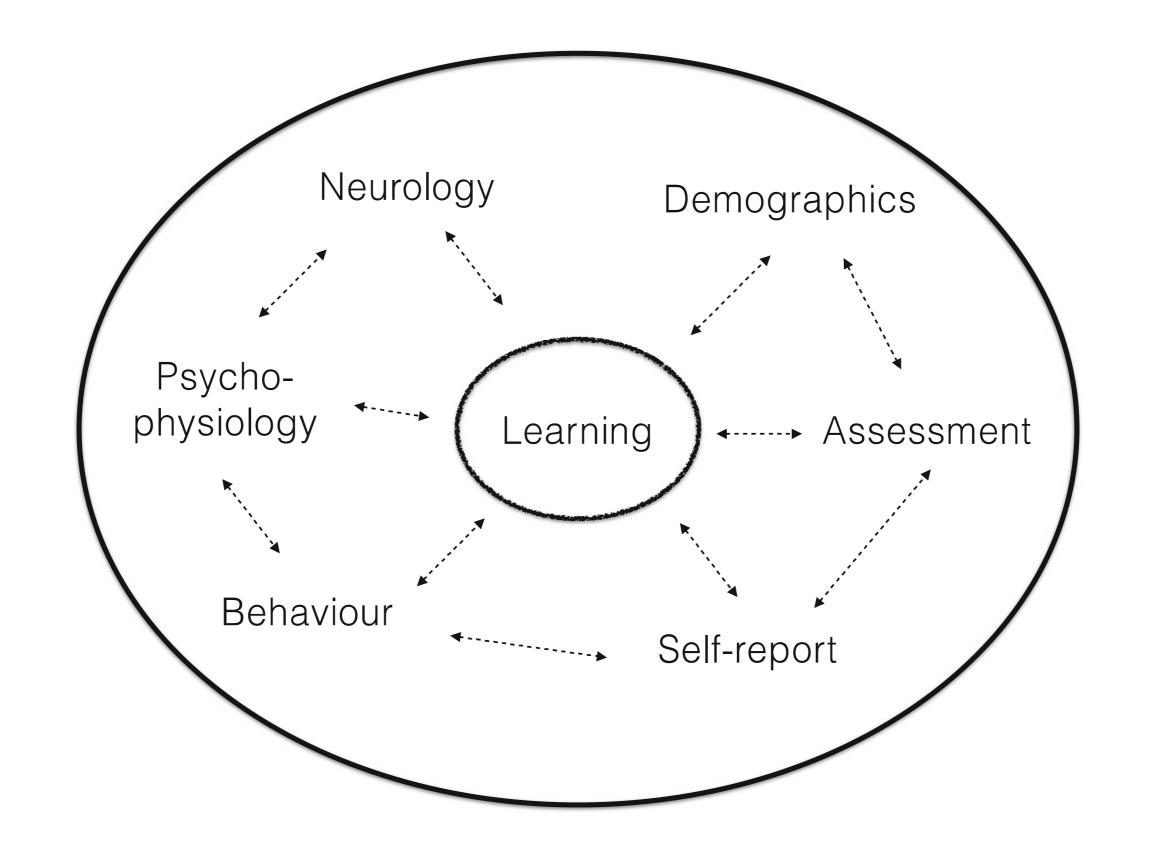
ARTICLE INFO

Keywords:
Interdisciplinary
Philosophy
Science of learning
Mind-body
Translation

ABSTRACT

Differing worldviews give interdisciplinary work value. However, these same differences are the primary hurdle to productive communication between disciplines. Here, we argue that philosophical issues of metaphysics and epistemology subserve many of the differences in language, methods and motivation that plague interdisciplinary fields like educational neuroscience. Researchers attempting interdisciplinary work may be unaware that issues of philosophy are intimately tied to the way research is performed and evaluated in different fields. As such, a lack of explicit discussion about these assumptions leads to many conflicts in interdisciplinary work that masquerade as more superficial issues. To illustrate, we investigate how philosophical assumptions about the mind (specifically the hard problem of consciousness and mind-body problem) may influence researchers in educational neuroscience. The methods employed by researchers in this field are shaped by their metaphysical beliefs, and arguments around these issues can threaten accepted disciplinary ontologies. Additionally, how a researcher understands reduction in the special sciences and how they place their colleagues in this ontology constrains the scope of interdisciplinary projects. In encouraging researchers to explicitly discuss the philosophical assumptions underlying their research we hope to alleviate some of the conflict and establish realistic expectations for collaborative projects.

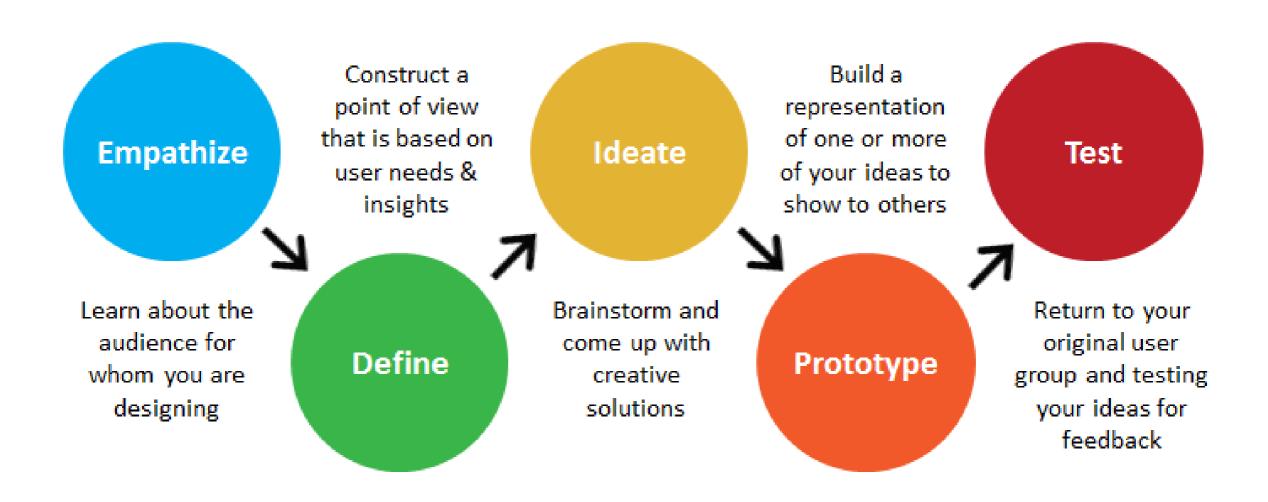


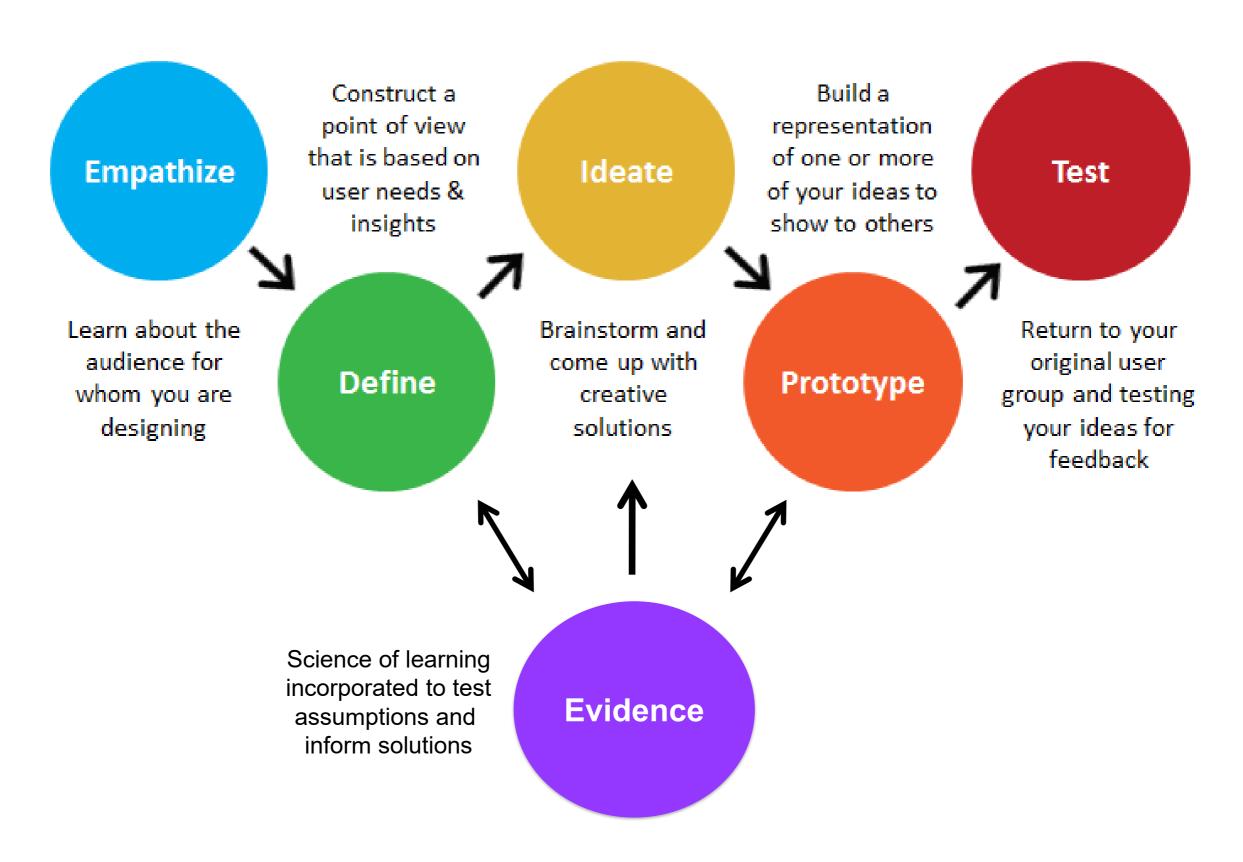


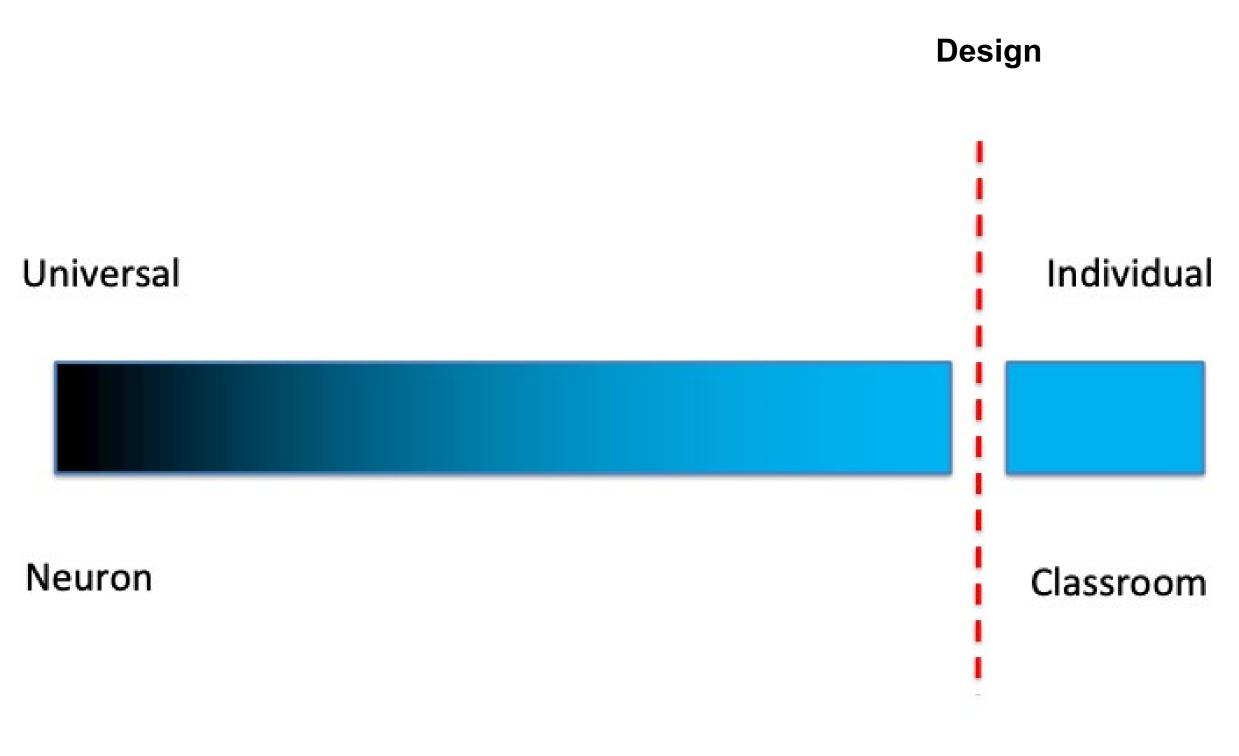


HANDBOOK OF Implementation Science for Psychology in Education

BARBARA KELLY
DANIEL F. PERKINS







Implementation science

The gap between neuroscience and education: Is it a bridge too far?

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Science of Learning Research Centre, Queensland Brain Institute
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