Carpe Cerebrum

What Neuroscience Can (and Cannot) Tell Us About Giftedness

Pamela R. Clinkenbeard, U. Wisconsin-Whitewater
Edward M. Hubbard, U. Wisconsin-Madison

The Wallace Research Symposium on Talent Development
Storrs, CT; May 21, 2024

Context

- Intrinsic: fascination
- Extrinsic: advocacy
- Role: “hybrid professional”
- Collaborator: neuroscientist

Why care about neuroscience?

- The research (especially on neuroplasticity) supports current models of gifted education, talent development, and motivation.
- Application (and misapplication) of neuroscience to education is growing rapidly.
- Neuroscience research provides useful information that can support advocacy for the gifted.
- It’s really cool.

Topics

- Terminology; quick history
- Types of “neuro & ed” research
- A few major theories re: intelligence and findings re: brain structure/function
- Three gifted education implications

Terminology: MBE? EN? Other?

- **MBE** = mind, brain, and education (Kurt Fischer, Harvard)
- **EN** = educational neuroscience (term used more in Europe & elsewhere outside U.S.)
- **Related terms**: cognitive neuroscience, cognitive science, cognitive science, "science of learning"

Partial History – Neuro in GT

- Roeper Review double issue 2008 (Kalbfleisch et al.)
- NAGC 2011(A. Robinson, Subotnik, N. Robinson, Clinkenbeard, Callahan); also Clinkenbeard & N. Robinson on EC
- Malleable Minds book 2012 (chapter)
- UWW Honors banquet 2016; EFs at WI counselors
- NAGC panel 2018 (Clinkenbeard, Miller, Foley-Nicpon, Assouline)
- WC Symposium 2019; several other recent GT conferences
- Miller & Clinkenbeard: 2020 in Critical Issues book, 2021 in PHP
- IMBES 2016, 2018; EARLI SIG 22/Wellcome Trust mtg. 2018
- Iowa B-B & INI Summit on Neuroscience of 2e 2021
- IMBES 2022 – “hybrid professional” talk

A Few Major Long-term Topics

- We know less that you might think: utility and limitations of neuroimaging studies
- Applications from special populations and creativity research
- Physiological definitions of intelligence: location (in brain) and speed (of processing)
- Emerging technologies (fMRI +)

A rough table of classification for Educational Neuroscience or MBE research

Name or type	Location	Methods	Purpose
Evidence-based teacher research (or ed practice based on research evidence)	Teacher's own classroom/school	Action research, quasi-experimental, other	To try out neuroscience principles in everyday practice
Larger-scale ed & ed psych research, including RCTs (Randomized Control Trials)	PK-12 (US ages 3-18) or university classrooms	Larger-scale behavioral observations or products	To test neuroscience principles in education settings with rigorous methodology
Cognitive science/ psychology; "science of learning"	Psychology labs	Behavioral observations of humans and animals	To test neuroscience principles beyond mapping brain activity
Neuroscience or neuropsychology	Neuroscience labs	More or less direct measures of brain activity (fMRI, EEG, etc.)	To discover new connections & to map neurological evidence & explanations for pedagogical knowns

Variables that correlate with “g”

(almost always using IQ or fluid intelligence measure of some kind, and sbs “r”)

- Brain volume (total, gray & white matter, other regions)
- Brain activity (pre-frontal and parietal; neural efficiency)
- Cognitive measures (working memory capacity, processing speed)

One major neuroscience-based theory of intelligence: P-FIT

- Parietal-frontal integration (P-FIT)
- Power: more volume of gray matter (cortex) in parts of frontal and parietal lobes
- Speed: better neural efficiency in white matter connecting brain areas

Additional areas of research

- Domain-specific studies (mostly in math)
- Neuroscience of creativity (see Society for the Neuroscience of Creativity)
- Motivation studies (think dopamine)
- Twice-exceptional, neurodiverse (see Belin-Blank collaboration with Iowa Neuroscience Institute) – neuroimaging, genomics

Does it really matter if their brains are different?

Should it affect how we teach or parent?

- Small sample sizes; mostly lab settings
- Over-interpretation (“brain research says…”)
- Application of neuromyths

Three implications for the field…

Neuroplasticity & Talent Development

- Neuroplasticity refers to the ability of the brain to adapt and improve. The brain affects learning, but learning also affects the brain.
- We all have malleable brains and we can all get "smarter," but young children's brains are the most malleable.
- There is research evidence that we can teach and nurture young students in ways that will raise the skills and performance of many more of them to "gifted" levels.

Research on development of Executive Functions (EFs)

- E.g. selective attention, cognitive flexibility, inhibitory control, working memory
- Recent CTD research on GT & EFs
- Children's and adolescents' EFs can be improved with training, and when tasks are appropriately challenging, there is evidence that they can affect later school success

Need for appropriate challenge

- Using neuroscience research on intelligence and motivation in GT advocacy (responsibly)
- Desirable difficulties research; productive struggle
- Neurogenesis: a bridge too far? (Neural substrate for Vygotsky)

Assertion

Optimal brain development requires appropriate challenge.

For more information or questions

clinkenp@uww.edu

Resources – MBE/EN

International Mind, Brain, and Education Society
https://www.imbes.org/

EARLI SIG 22 - Neuroscience and Education
https://www.sig22neuroeducation.com/

Centre for Educational Neuroscience (UK) -
http://www.educationalneuroscience.org.uk/

Annenberg Learner site: Neuroscience and the Classroom
https://www.learner.org/series/neuroscience-in-the-classroom/

- Belin-Blank Center – 2e research - https://belinblank.education.uiowa.edu/research/ini-collab.aspx
- The Society for the Neuroscience of Creativity - https://www.tsfnc.org/
- UW Center for Healthy Minds- https://centerhealthyminds.org/

Additional websites etc. (curriculum, brain facts, lessons for children, etc.)

- **https://developingchild.harvard.edu/resourcetag/brain-architecture/**
- https://www.natgeokids.com/uk/discover/science/general-science/human-brain/
- https://www.pewtrusts.org/en/trend/archive/spring-2020/putting-neuroscience-in-the-classroom-how-the-brain-changes-as-we-learn
- https://kids.frontiersin.org/articles/10.3389/frym.2020.00054
- https://www.sfn.org/sitecore/content/Home/BrainFacts2/For-Educators/For-the-Classroom/2019/The-Brain-Throughout-Life-Worksheet-040219
- https://cnlm.uci.edu/how-do-i-find-out-about-learning-and-memory-research/education/
- https://faculty.washington.edu/chudler/neurok.html