Electronic Supplementary Material

SYSTEMATICS REVIEW OF THE INTERDISCIPLINARY EXCHANGE AMONG MATHEMATICS EDUCATION AND NEUROSCIENCE

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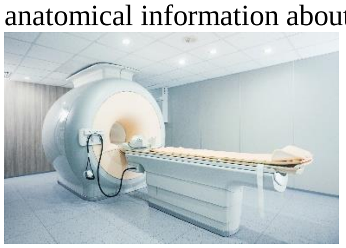
Dictionary of neurocognitive techniques and abbreviations

Neuroimaging Methods visualize and analyze brain structure and function, enabling researchers to study brain activity, connectivity, and anatomy. These techniques help understand neurological disorders and cognitive processes through structural and functional imaging approaches.	
MRI	**Magnetic Resonance Imaging** measures the behavior of hydrogen atoms in water molecules when exposed to strong magnetic fields and radio waves. It detects differences in water content and properties across tissues, creating detailed anatomical images based on these variations. It provides detailed anatomical information about gray/white matter structure.  Picture borrowed from iStock-946845536
fMRI	**Functional Magnetic Resonance Imaging** measures brain activity by detecting changes in blood oxygenation and flow. It provides excellent spatial resolution, allowing researchers to identify which brain regions are active during specific cognitive tasks. However, it has relatively poor temporal resolution, as the blood flow changes occur several seconds after neural activity
EEG	**ElectroEncephaloGraphy** records electrical activity directly from the scalp using electrodes. It offers outstanding temporal resolution (milliseconds), making it ideal for studying rapid cognitive processes and brain wave patterns. While its spatial resolution is limited, it's particularly valuable for studying sleep, attention, and real-time cognitive processing.

	 Picture borrowed from iStock-47328314
ERPs	**Event-Related Potentials** is time-locked EEG responses to specific sensory, cognitive, or motor events. ERP has excellent temporal resolution for studying cognitive processing stages. Widely used in language, attention, and memory research, ADD
ERD	**Event-Related Desynchronization** is frequency-specific increase in EEG power reflecting increased cortical activity in response to sensory, cognitive, or motor events. ERD is analyzed in the frequency domain, meaning it examines ongoing brain rhythms instead of discrete time-locked responses. ERD is widely used for assessing movement, attention, and brain-computer interfaces (BCI).
MEG	**MagnetoEncephaloGraphy** measures magnetic fields produced by neural activity. It combines good temporal resolution with better spatial resolution than EEG, though not as precise as fMRI. It's especially useful for studying language processing and sensory responses.
fNIRS	**Functional Near-Infrared Spectroscopy** measures hemodynamic responses in cortical areas by optical methods. It allows researchers to monitor brain activity in naturalistic settings like learning and attention in real-world educational contexts. fNIRS is particularly useful for studying cognitive development in infants.
Physiological measures are objective assessments of bodily functions that provide insights into the interplay between physiological and cognitive processes. These measures are widely used in psychophysiology, neuroscience, and psychology research.	
HRV	**Heart Rate Variability** assesses autonomic nervous system function HRV provides insights into stress response and emotional regulation. Often combined with GSR for broader psychophysiological assessment
GSR	**Galvanic Skin Response** measures changes in skin conductance related to autonomic nervous system arousal. GSR Particularly valuable for studying emotional responses, stress, and attention. Provides insights into implicit processing and autonomic responses that may not be consciously accessible

<table>
<tr><td>Eye-tracking</td><td>Eye-tracking methodology records eye movements and gaze patterns during tasks using infrared cameras or video.

It is providing insights into visual attention, reading processes, and decision-making and particularly valuable for studying information processing and visual cognition.</td></tr>
<tr><td>fEMG</td><td>Facial Electromyography records electrical activity from facial muscles.

Used to study emotional expressions and affective responses. Can detect subtle emotional reactions not visible to observers</td></tr>
<tr><td colspan="2">Brain stimulation techniques modulate neural activity through electrical, magnetic, or other energy forms to study causal links between brain regions and cognition.</td></tr>
<tr><td>TMS</td><td>Transcranial Magnetic Stimulation uses magnetic pulses to temporarily activate or inhibit specific brain regions.

This allows researchers to study causal relationships between brain activity and behavior.</td></tr>
<tr><td>rTMS</td><td>Repetitive Transcranial Magnetic Stimulation, delivers repeated pulses over time to produce longer-lasting changes in cortical excitability.</td></tr>
<tr><td>tDCS</td><td>Transcranial Direct Current Stimulation applies weak electrical currents to modulate brain activity. It's used to study brain plasticity and potentially enhance cognitive function.</td></tr>
<tr><td>tACS</td><td>Transcranial Alternating Current Stimulation delivers oscillating electrical currents at specific frequencies to interact with and modulate endogenous brain rhythms.</td></tr>
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Complete list of the search terms in the Survey

Cognitive neuroscience

- Cognitive neuroscience
- Neurocognition
- Neuroimaging,
- EEG
  - ✓ ERD / ERS
- ERP
  - ✓ Peak amplitude
  - ✓ Mean amplitude
  - ✓ Latency
  - ✓ laterality
- MRI
- sMRI
- fMRI
- fNIRS
- GSR
- Brain stimulation
  - ✓ TMS
  - ✓ rTMS
  - ✓ tDCS
  - ✓ tACS
- Eye tracking,
- Eye movements
  - ✓ Fixations
  - ✓ Entropy
  - ✓ Fixation times
  - ✓ Fixation duration
  - ✓ Gaze
  - ✓ Gaze-path
  - ✓ Eye gaze
  - ✓ Saccade
  - ✓ Transitions

Mathematics education

Numerical skills
- Enumeration
- Subitising
- Arithmetic operations
- Counting
- Comparison

Advanced skills
- Problem solving
  - ✓ Solution
  - ✓ Algorithms
  - ✓ Strategies
  - ✓ Heuristic
  - ✓ Creativity
  - ✓ Insight
- Problem posing
- Modeling
  - ✓ Literacy
- Thinking
- Reasoning
  - ✓ Symmetry considerations
  - ✓ Equivalence
- Proving
- Logical inference
- Defining
- Solving (in)equations

Statements / questions
  - ✓ Axiom
  - ✓ Theorem
  - ✓ Lemma
  - ✓ Definition

Tasks / activities
  - ✓ Problem
  - ✓ Equation
  - ✓ System of equations
  - ✓ Inequation
  - ✓ Construction
  - ✓ Investigation
  - ✓ Discovery

Relationship
  - ✓ Equivalence
  - ✓ Inference
  - ✓ Symmetry
- Representations
- Number line
- Symbols
- Sign

- Quantity
  - ✓ Whole / negative number
  - ✓ Fraction / Decimal / Integer/ Complex number
- Change and relationships
- Algebra
- Calculus
  - ✓ Variable
  - ✓ Equation / equality
  - ✓ Inequation / inequality
  - ✓ Function
  - ✓ Graph
  - ✓ Tangent line
  - ✓ Inflexion point
  - ✓ Minimum
  - ✓ Maximum
  - ✓ Extremum
  - ✓ Interval
  - ✓ Diagram
  - ✓ Derivative
  - ✓ Integral
- Statistics
  - ✓ Average / Mean value / Median
  - ✓ Standard deviation
  - ✓ Sample
  - ✓ Correlation / Regression
- Uncertainty and data
- Probability

- Geometry / Space /Shape
- Figure
  - ✓ Straight line
  - ✓ Segment / side
  - ✓ Point / vertex / center
  - ✓ Intersection
  - ✓ Triangle
  - ✓ Quadrilateral / rectangle / square/ parallelogram / trapezoid/ kite / rhombus
  - ✓ Circle / radius / diameter / center / arc / chord
  - ✓ Area
  - ✓ Perimeter

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