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An ARC funded
Special Research Initiative

SCIENCE OF LEARNING RESEARCH CENTRE

Supporting Attention for Self-Regulated Learning in Children and Adolescents

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Background

Aisling Mulvihill

Research Team

Prof Annemaree Carroll

Prof Jason Mattingly

Prof Paul Dux

Dr Natasha Matthews

Anica Newman

Dr Deberea Sherlock

Overview

Part 1 – Research Informed Intervention Approach

- The Attention Network Model
- Research Informed Skill Building
- A Metacognitive Approach

Part 2 – Investigation Into the Effectiveness of a Meta-Attention Program

Supporting Self-Regulated Learning

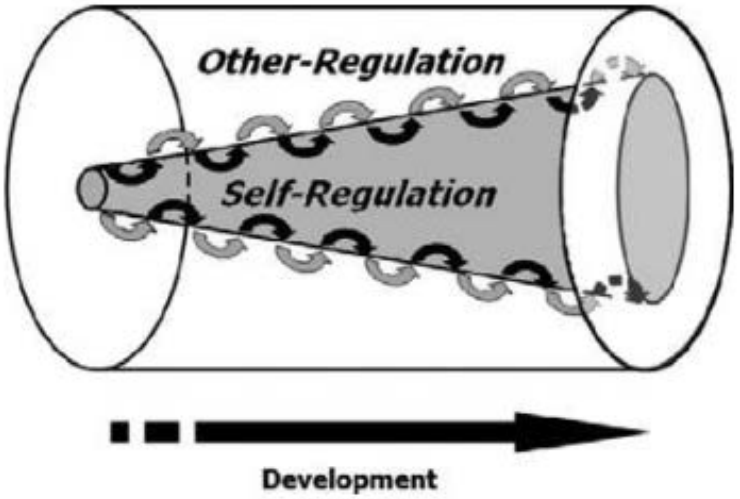


Figure 5. Transactional relations between self-regulation and other-regulation.

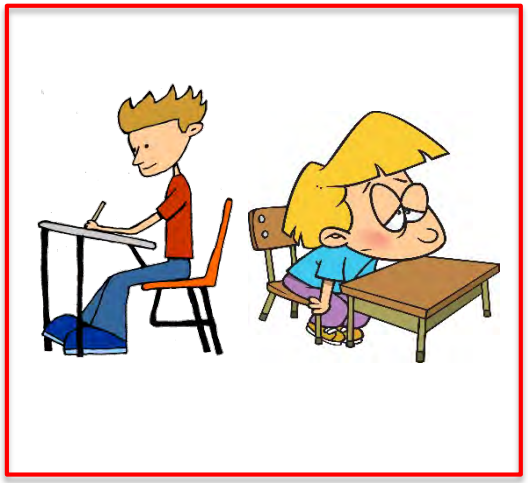
Sameroff & Fiese (2000)

The Attention Network Model

Attention Network Model

Posner & Rothbart (2007; 2014)

Alerting Network



Orienting Network

Executive Control Network

Attention Network Model

Alerting Network

- A state of attentional readiness
- Important state for learning
- Warning signals and predictability support attentional readiness

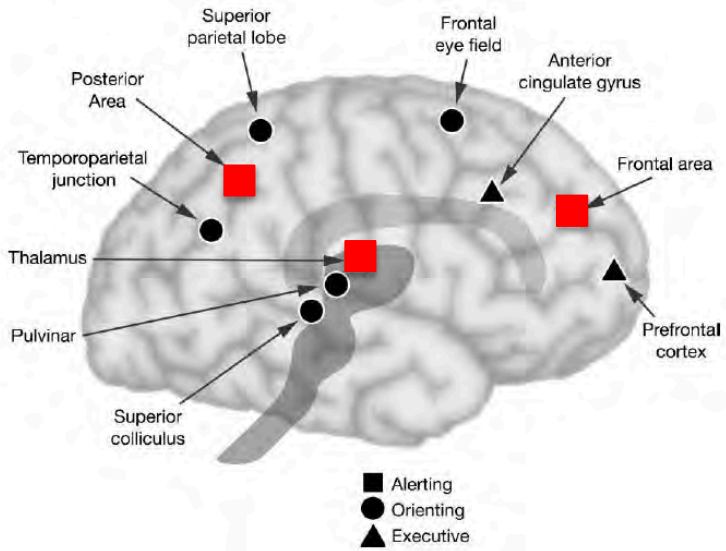


Figure 2
Anatomy of three attentional networks: alerting, orienting, and executive attention (from Posner &

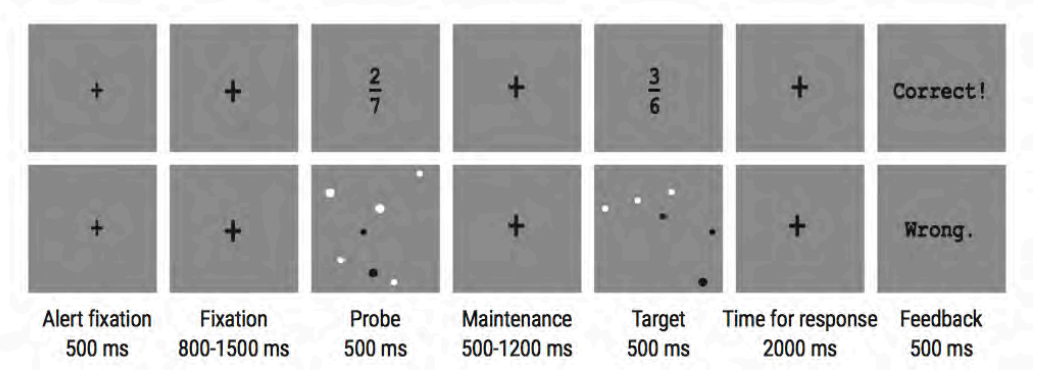
Function	Structures	Modulator
Alert	Locus coeruleus Right frontal Parietal Cortex	Norepinepherine

(Posner & Rothbart, 2014)

Attention Network Model

Alerting Network – Further Research

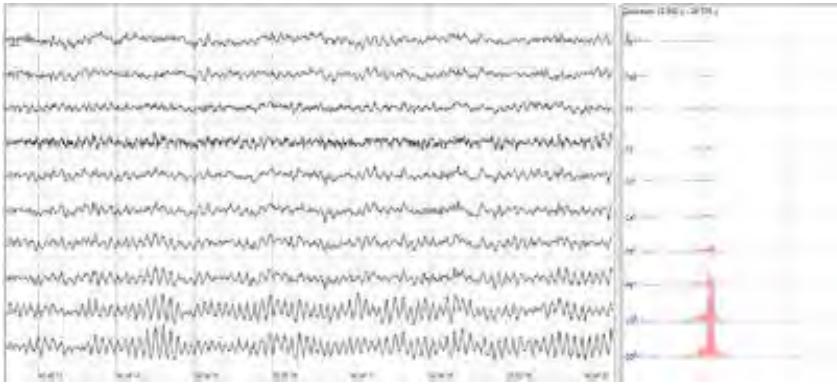
- SLRC Research led by Prof A. Carroll, Prof J. Mattingley, A/Prof P. Dux & Dr N Matthews
- Neural markers of attentional readiness and the impact on learning
- EEG records brain activity during mathematics task



Attention Network Model

Alerting Network – Further Research

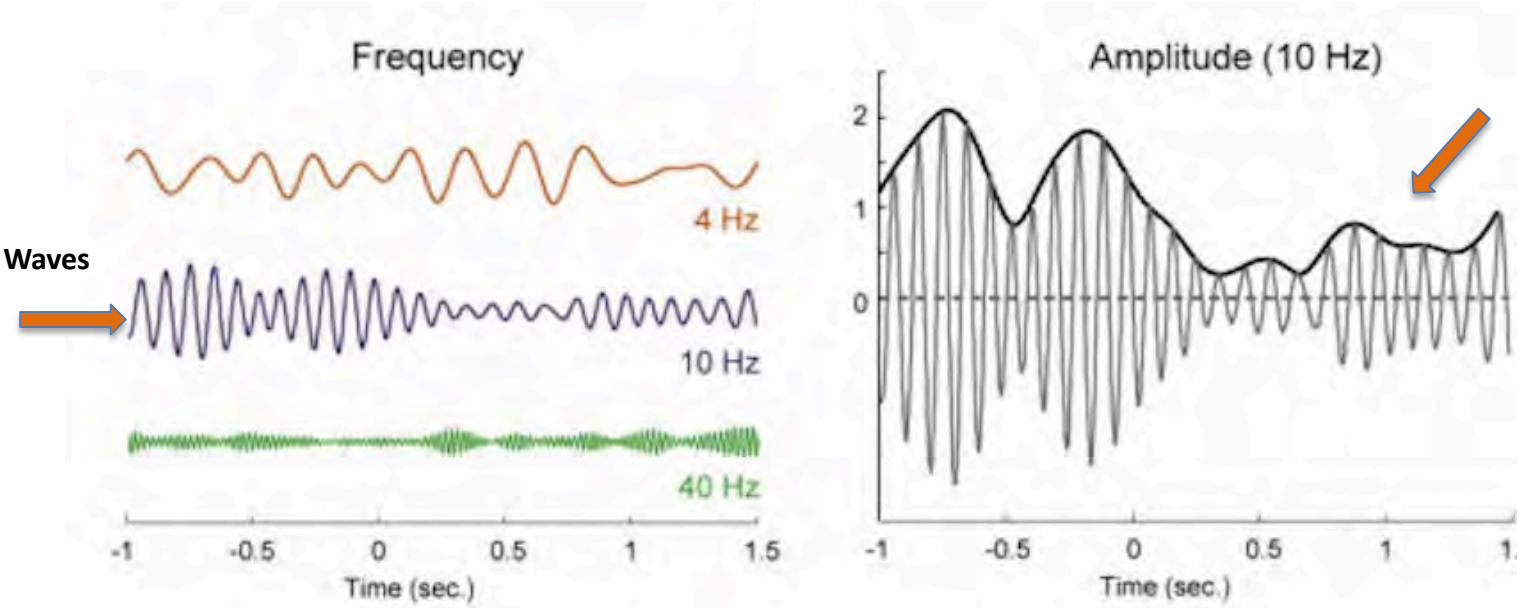
Continuous EEG Signal



Attention Network Model

Alerting Network – Further Research

Alpha Waves



Lower pre-trial alpha amplitude ➔ increased attentional readiness ➔ increased performance

Higher pre-trial alpha amplitude ➔ decreased attentional readiness ➔ decreased performance

Attention Network Model

Supports for the Alerting Network

- ✓ Monitor alertness
- ✓ Consider the impact of the environment/physical state
- ✓ Work for short focused periods
- ✓ Encourage student awareness and self-monitoring
- ✓ Use warning signals or cues

Attention Network Model

Orienting Network

- Aligning attention with sensory signals
- Selective, sustained attention is critical for explicit learning (Erikson et. al, 2015)
- Initially governed by novelty but increasingly controlled and selective (Ruff & Rothbart, 1996; Erikson et. al., 2015)

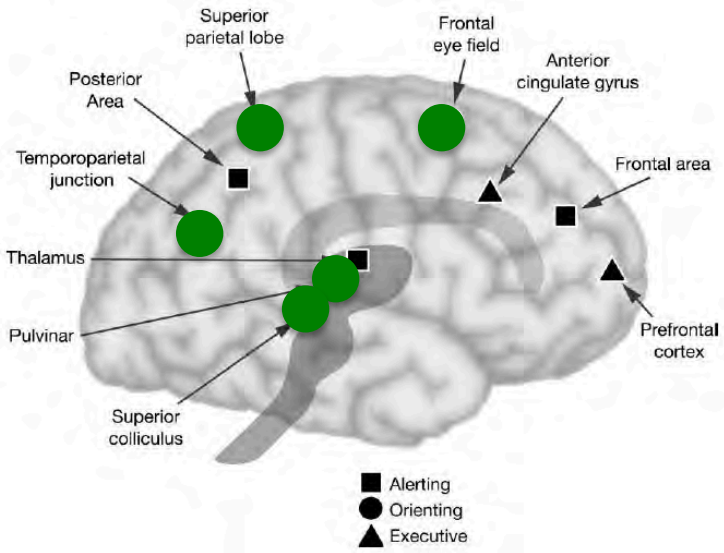


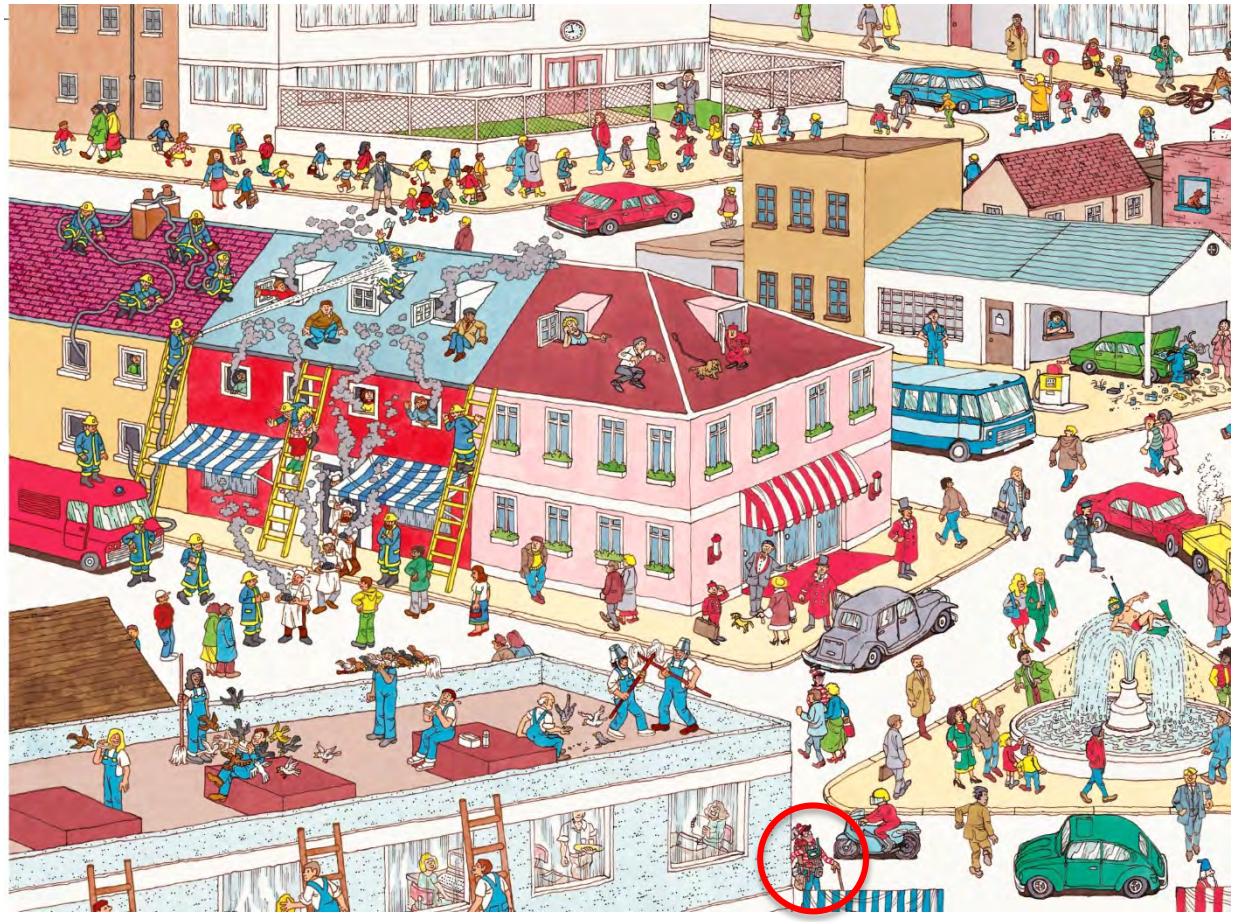
Figure 2
Anatomy of three attentional networks: alerting, orienting, and executive attention (from Posner & Rothbart 2007).

Function	Structures	Modulator
Orient	Superior parietal Temporal parietal junction Frontal eye fields Superior colliculus	Acetylcholine

(Posner & Rothbart, 2014)

Attention Network Model

Orienting Network



Attention Network Model

Orienting Network – Further Research

Orienting attention can be influenced by:

- Saliency of stimuli (Ruff & Rothbart, 1996)
- Prior knowledge and learning (Kim & Rehder, 2011)
- Motivation and reward (Bourgeois, Chelazzi & Vuilleumier, 2016)
- Emotion (Pine et. al., 2005; Shackman, Shackman, & Pollak, 2007)

Attention Network Model

Supports for the Orienting Network

- ✓ Create interest in the material
- ✓ Reduce environmental distractors
- ✓ Make learning goals clear and explicit
- ✓ Link new learning to prior learning
- ✓ Single focus where possible – multitasking does not support performance

Attention Network Model

Executive Attention Network

- Control of attention
- Important for goal directed actions
- Control of attention in young children tends to be reactive and becomes more proactive with maturation (Chevalier et. al, 2015)

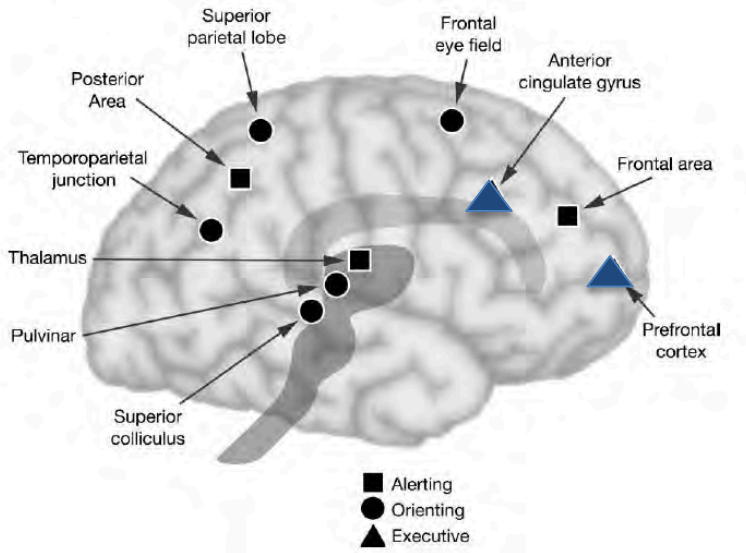


Figure 2
Anatomy of three attentional networks: alerting, orienting, and executive attention (from Posner & Rothbart 2007).

Function	Structures	Modulator
Executive Attention	Anterior cingulate Lateral ventral Prefrontal Basal ganglia	Dopamine

(Posner & Rothbart, 2014)

Attention Network Model

Executive Attention Network

- Typically explored in research that involves conflict towards attainment of a goal

BLUE, RED, YELLOW, GREEN, BROWN, BROWN, BLUE, ORANGE,

GREEN, RED, BLUE, WHITE, BLACK, GREEN, YELLOW, ORANGE

Attention Network Model

Supports for the Executive Attention Network

- **Help students develop goals and prioritise actions**
  - ✓ Make learning goals explicit
  - ✓ Use feedback effectively
  - ✓ Use planning tools

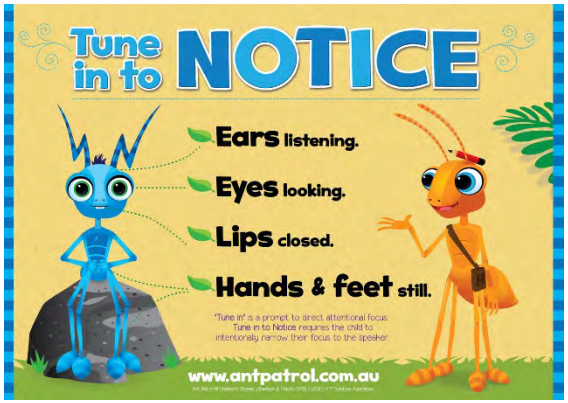
- **Encourage self-reflection**
  - ✓ Encourage students to stop and think before they act
  - ✓ Provide replacement for impulsive actions
  - ✓ Explore outcomes and visualise helpful prior to demanding situations

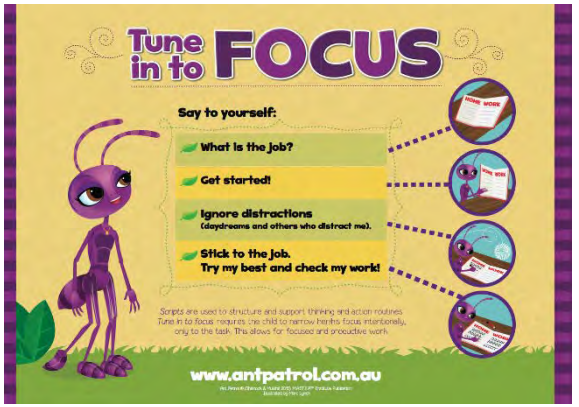
Skill Building Resources

The Ant Patrol
(Sherlock & Mulvihill, 2013)

The MASTER Focus Program
(Sherlock & Mulvihill, 2015)

Skill Building Resources





Skill Building Resources

Meta-attention Intervention
Session 1: Introduction to Impulse and Attention Control Psycho-education of Attention
Session 2: The Energy Network Attentional Readiness
Session 3: Control your Energy Inhibitory Control (Activation and Inhibition)
Session 4: Tune in to Your Thinking Motivation for Effort & Sustained Attention
Session 5: The Energy Network Continued Motivation, Attentional Readiness & Sustained Attention
Session 6: The Focus Network Selective Attention
Session 7: The Control Network Executive Control & Motivation for effort
Session 8: The Control Network – Stay Focused Executive Control & Motivation for effort

A Metacognitive Intervention Approach

Metacognitive Vs Brain Training Interventions

- Typically laboratory and computer based
- Training effects typically limited with little evidence of transfer
- Lack functional application to traditional education settings

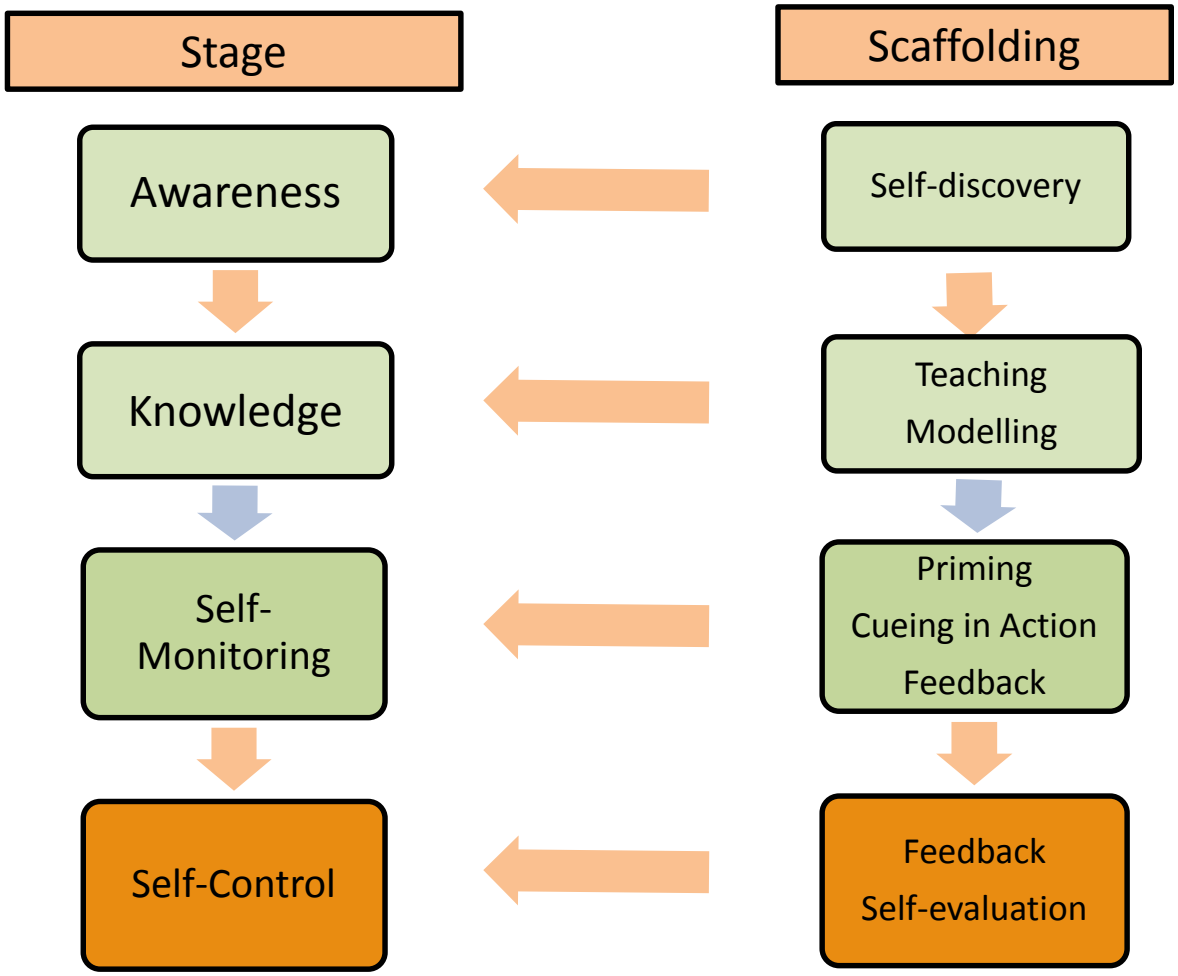
(Redick et al., 2013)

Metacognitive Intervention

- A mental activity that regulates cognition
- Reflects ‘top-down’ regulatory control
- Targets task approach (knowledge and control)
- Potential for translation to applied educational context

(Marulis et al., 2016; Schneider & Lockl, 2008; Kuhn & Dean, 2004)

Metacognitive Intervention



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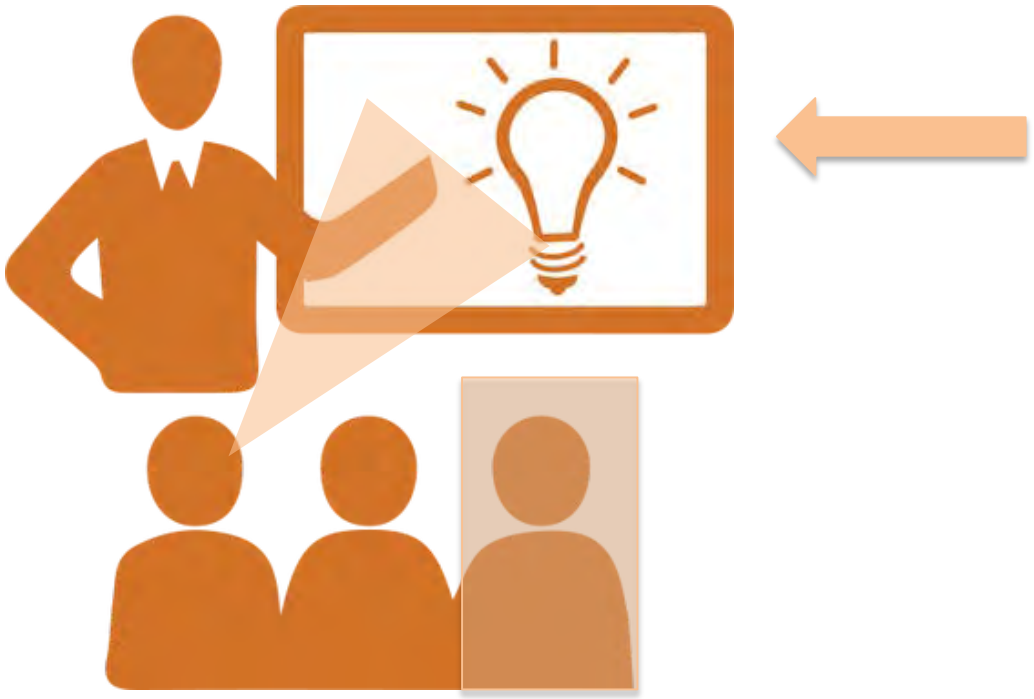
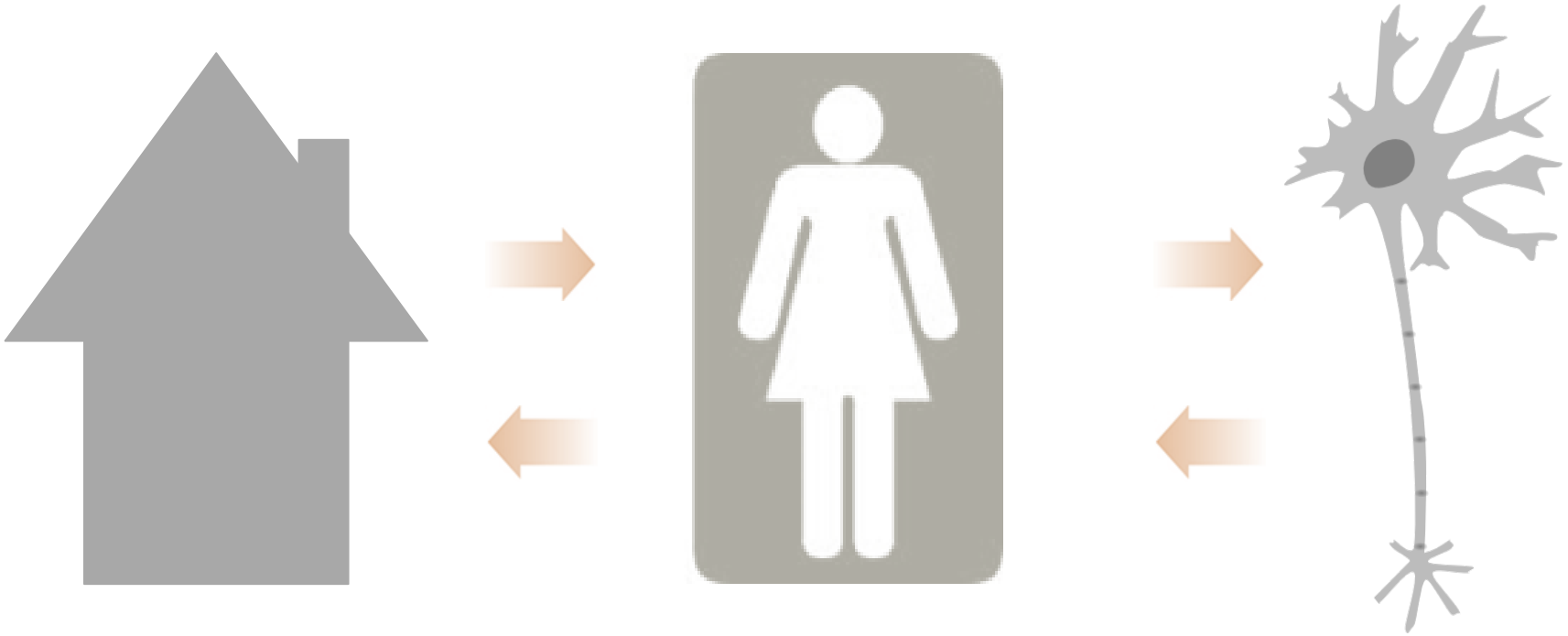
Research Snapshot:
Investigation into the Effectiveness of Meta-Attention Training

Learning to Focus
A Metacognitive Intervention Study



Bringing Researchers Together



EDUCATION RESEARCH

COGNITIVE NEUROSCIENCE (PSYCHOLOGY)

NEUROSCIENCE

Learning to Focus Study – At a Glance

Recruitment

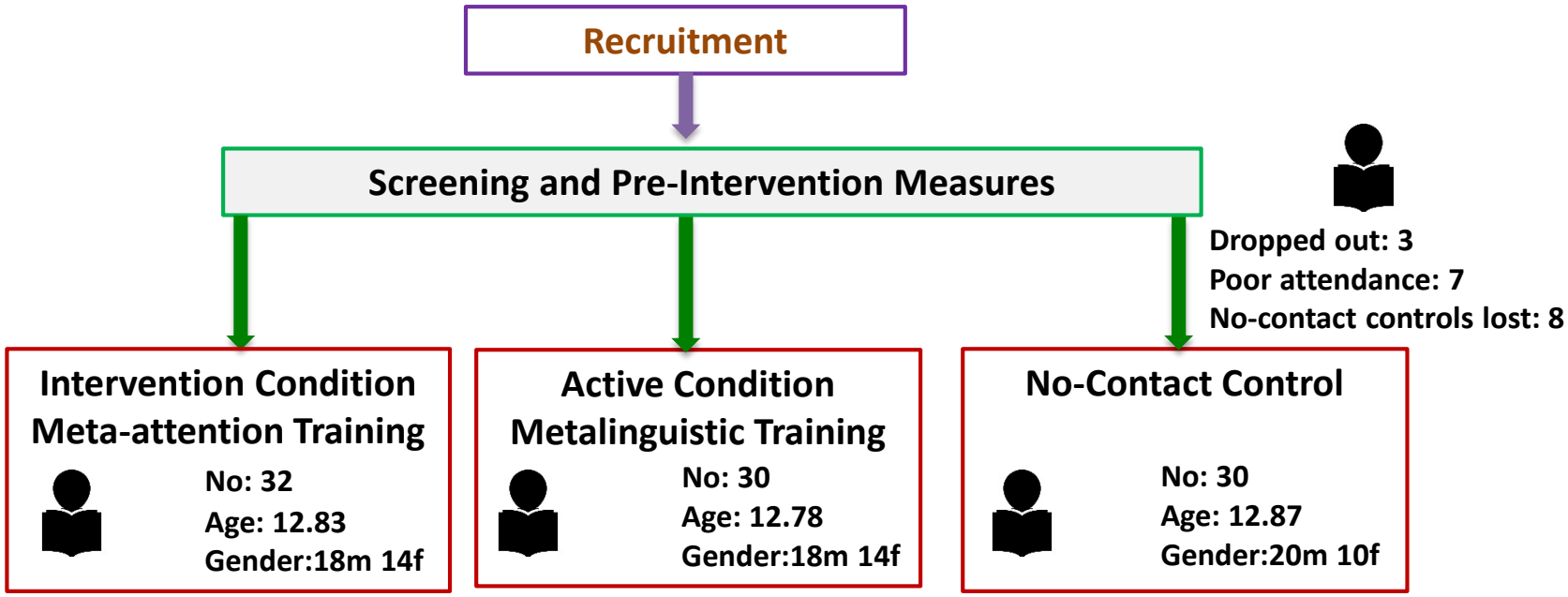
Learning to Focus Study – At a Glance

Recruitment

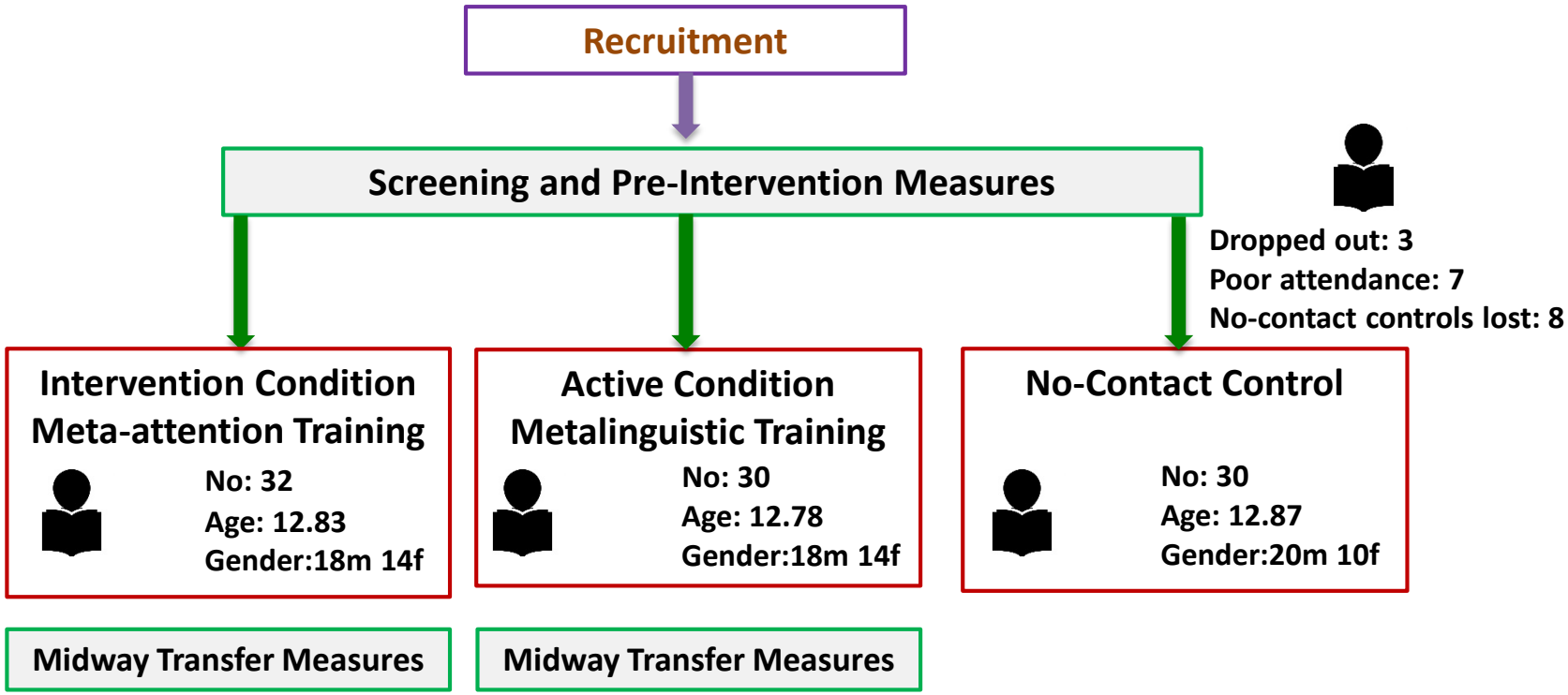
Screening and Pre-Intervention Measures

110 Students
15 Schools

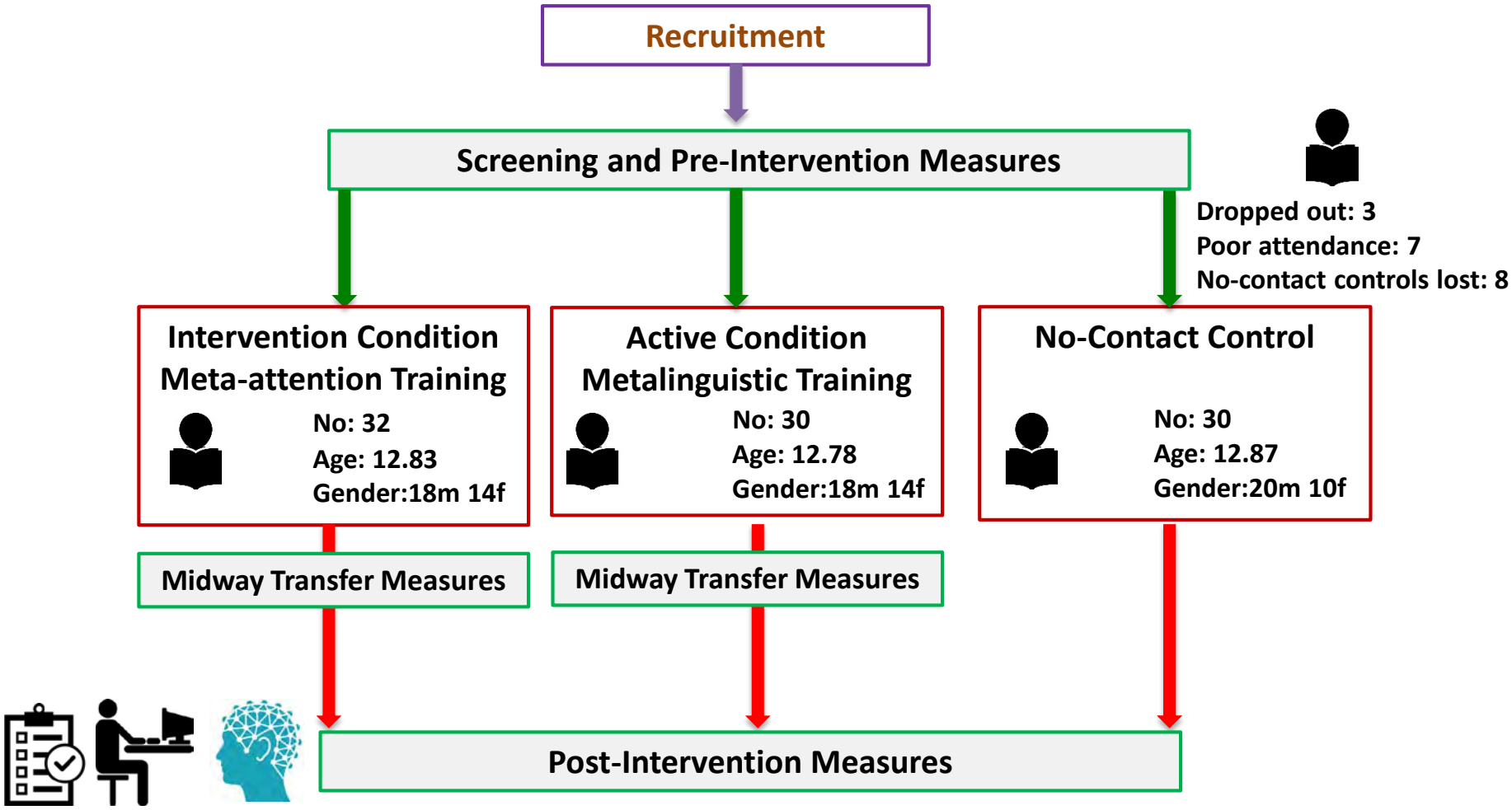
Learning to Focus Study – At a Glance



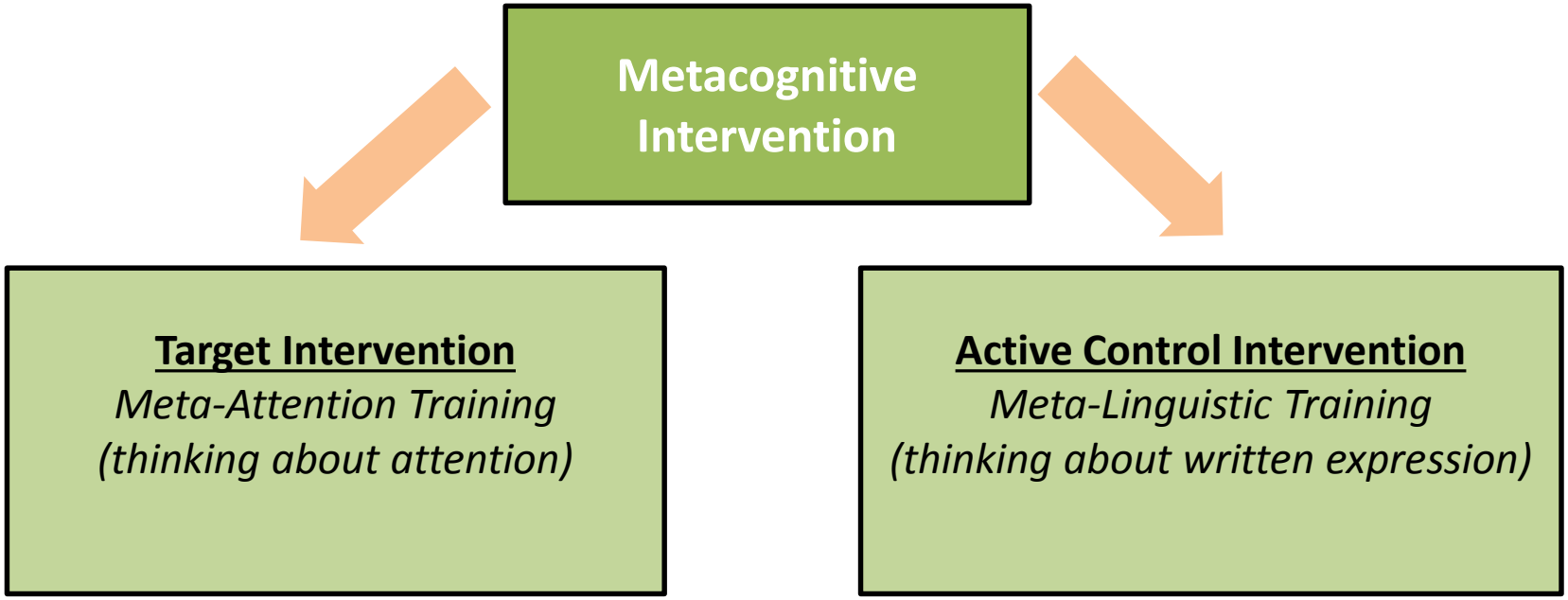
Learning to Focus Study – At a Glance



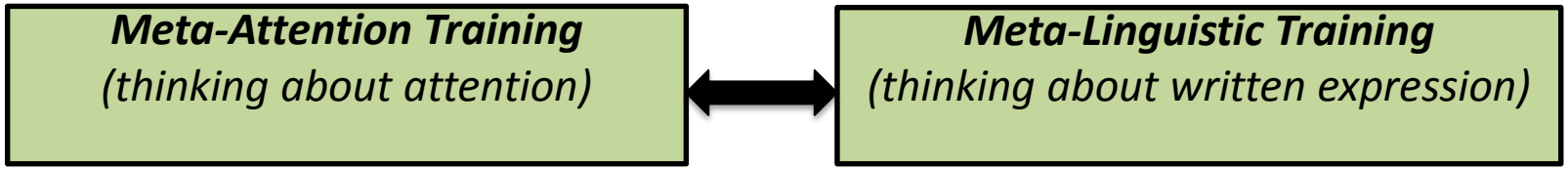
Learning to Focus Study – At a Glance



Learning to Focus Study – Training Programs



Learning to Focus Study – Training Programs



- ✓ 8 weekly sessions
- ✓ 1.5hour session time
- ✓ Group based instructional format
- ✓ Targets metacognition
- ✓ Weekday reflection tasks
- ✓ Cascade of skill development

Learning to Focus Study – Training Programs

Meta-Attention Training
(thinking about attention)

- Knowledge of attention
- Strategies for proactive control that target:
  - Arousal levels
  - Inhibition
  - Selective attention
  - Motivation
  - Goal setting and planning

Meta-Linguistic Training
(thinking about written expression)

- Knowledge of writing genres and structures
- Strategies for written expression that target:
  - Idea generation
  - Written plans and structures
  - Use of writing templates
  - Elaboration
  - Monitoring and review

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Learning to Focus Study – Training Programs

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Session 8: The Control Network – Stay Focused Executive Control & Motivation for effort

Meta-Linguistic Intervention
Session 1: Psycho-education of Written Expression Awareness of Written Expression
Session 2: Growing Narratives – The Big Ideas Generating Relevant Content – Flow of Ideas
Session 3: Growing Narratives – Organise Ideas Planning Written Structures
Session 4: Growing Narratives – Describing Ideas Knowledge and Use of Word Types
Session 5: Recount/Account Self-monitoring - Awareness of Specific Writing Genre
Session 6: Procedural Text Awareness of Specific Writing Genre
Session 7: Persuasive Text Awareness of Specific Writing Genre
Session 8: Fictional Narrative Awareness of Specific Writing Genre

Learning to Focus Study – Measures

Learning to Focus Study – Measures

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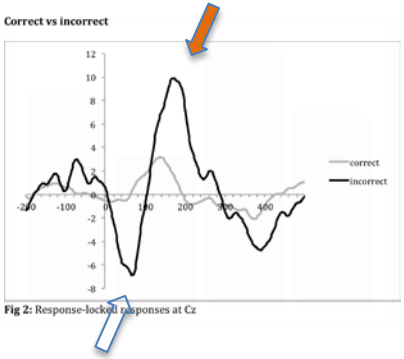

Fig 2: Response-locked responses at Cz

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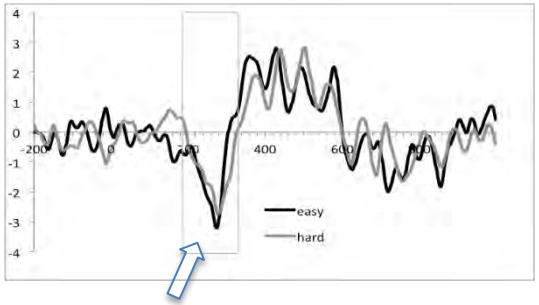
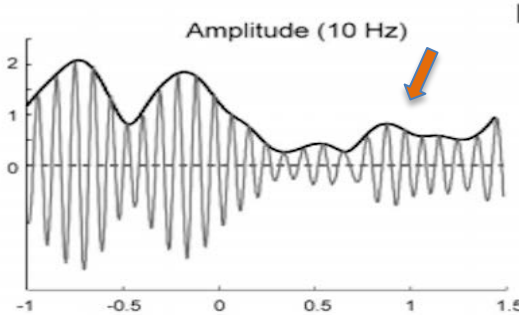


N2Pc

Pre-Trial Alpha



Learning to Focus Study – Measures

Flanker Task

Psychological Refractory Period

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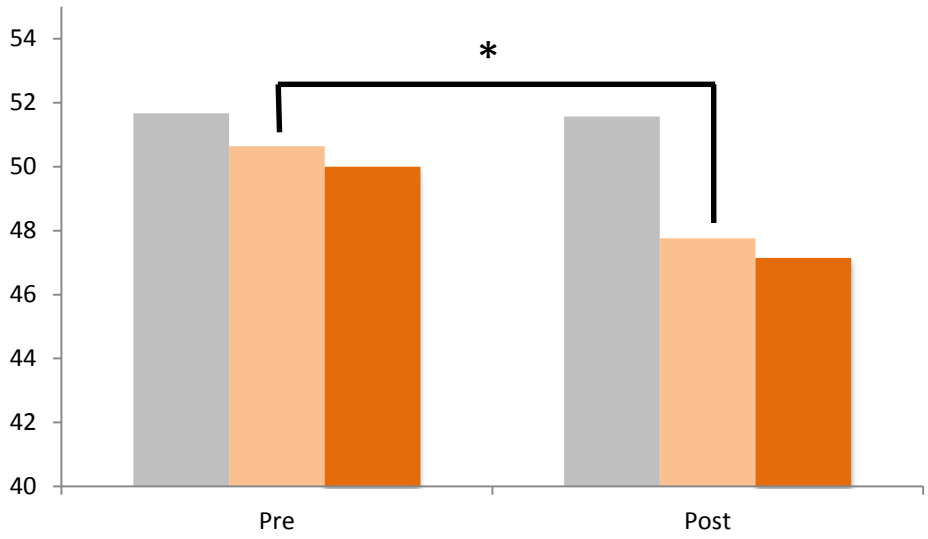
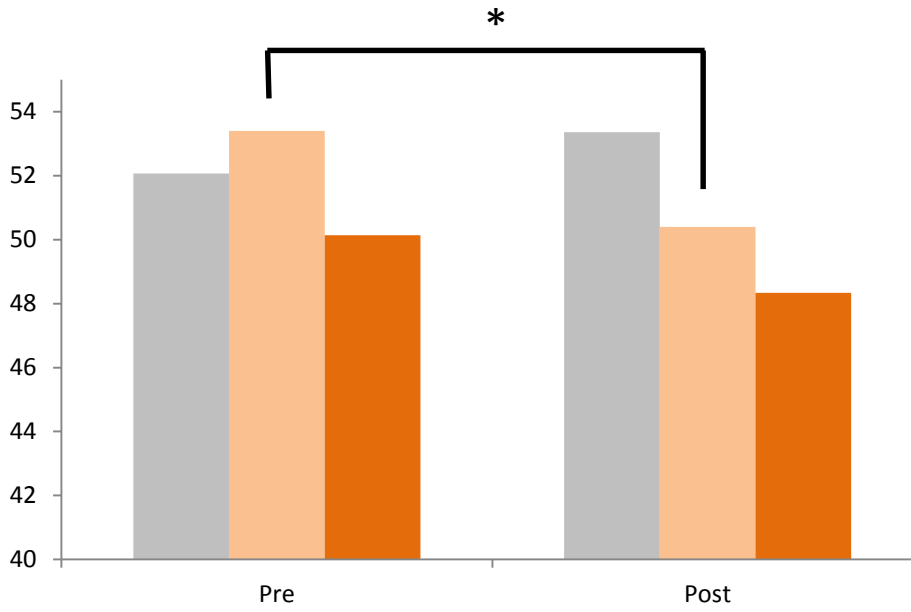
Learning to Focus Study – Measures

Learning to Focus Study - Preliminary results

Global Executive Composition

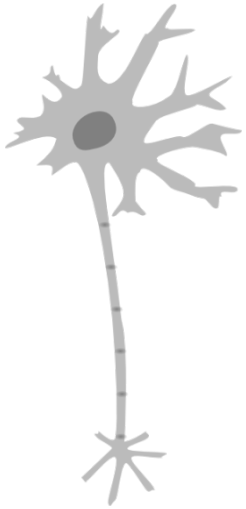


Meta-cognitive index



Control Meta-attention Meta-linguistic

Learning to Focus Study – Bringing Researchers Together



NEUROSCIENCE

COGNITIVE NEUROSCIENCE
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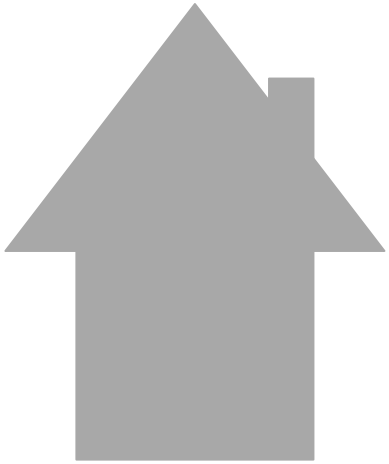

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SCIENCE OF LEARNING RESEARCH CENTRE

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