Healthy Cognitive Development in Deaf Children

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• Executive Functions and Sustained Attention
• Sustained Attention and Deaf Children
• Theoretical Approaches
• A Unified Framework for Intervention
Executive Functions and Sustained Attention
EXECUTIVE FUNCTIONS

- Staying on Task
- Avoiding Distraction
- Goal-Directed Behavior

WORKING MEMORY
PLANNING
INHIBITION
SHIFTING
SUSTAINING ATTENTION
From Zahr & Sullivan, 2008

Conflict network

Fan et al., 2001
Piaget’s A not B Task (Diamond, 1990)

- EF develops rapidly in first 24 months
- Can be measured using tasks like A-not-B
- Predicts effortful control at later age
Delayed Gratification ("Marshmallow" Test) (Mischel & Metzner, 1962)

- More verbally fluent
- Use and respond to reason
- Attentive and able to concentrate
- Planful and think ahead
- Curious, exploring and eager to learn

(Mischel, Shoda, & Peake, 1988)
Cognitive Assessment System

WORKING MEMORY
PLANNING
INHIBITION
SHIFTING

MATCHING NUMBERS
PLANNED CODES
PLANNED CONNECTIONS

0.18 – 0.59 correlation coefficients
0.12 – 0.60

(Best, Miller, & Naglieri, 2011)

WJ-R Reading

READING
LETTER-WORD IDENTIFICATION
PASSAGE COMPREHENSION
WORD ATTACK
READING VOCABULARY
QUANTITATIVE CONCEPTS
APPLIED PROBLEMS
CALCULATION

WJ-R Math

MATH

ACADEMIC ACHIEVEMENT

Rochester Institute of Technology
Interim Summary – Executive Functions

- Executive Functions include several cognitive abilities
- They are underpinned by networks of brain areas
- EFs improve as children get older
- They predict future EF abilities and academic achievement
SUSTAINING ATTENTION

Resource Control Theory (Thomson et al., 2015)

(Esterman et al., 2014)
Intelligence predicts academic grades better for children with high sustained attention

(Steinmayr et al., 2010)

(Fortenbaugh et al., 2015)
Continuous Performance Tests (CPTs)

540 digits over 9 minutes

Only 45 “targets” = 1-9 sequence

(Gordon & Mettelman, 1988)
Sensitivity = ratio of hits to false alarms

Impulsivity = count of impulsive false alarms
Interim Summary – Sustained Attention

- Sustained attention fluctuates over time
- Fluctuations are linked to prefrontal cortex
- Sustained attention improves rapidly up until age 16 years, and declines after age 45 years
- Has been shown to moderate effects of intelligence on academic achievement
- Can be measured using CPTs
Sustained Attention and Deaf Children
- Deaf kids do worse
- HAs help
- CIs help more

Cross sectional!

(Quittner et al., 1994)
• Deaf kids do worse
• HAs help
• CIs help more
• Still cross sectional!

(Smith et al., 1998)
- Longitudinal
- Improve after CI
- Not by much
- Performance still poor

(Horn et al., 2005)
• Deafness or language?
• What about deaf kids who use ASL?
  • Deaf parents
  • Hearing parents (< 3 yrs)

(Dye & Hauser, 2014)
(Terhune-Cotter & Dye, in prep)
Interim Summary – Deaf Kids’ Attention

- Early research suggested sustained attention deficits in deaf children
- Issues with sampling – no ASL signers included
- Deaf kids with early ASL perform like hearing kids
- Language factors drive better sustained attention and decreased impulsivity
Theoretical Approaches
SENSORY THEORIES

DIVISION OF LABOR HYPOTHESIS
(Smith et al., 1998)

AUDITORY SCAFFOLDING HYPOTHESIS
(Conway et al., 2009)

NEUROLOGICAL THEORIES

DEAF CONNECTOME
(Kral et al., 2016)

LANGUAGE THEORIES

LANGUAGE SCAFFOLDING HYPOTHESIS
(Hall, 2020)

INTERSUBJECTIVITY HYPOTHESIS
(Dye & Morgan, 2020)
SENSORY THEORIES

(Conway et al., 2009)

(Smith et al., 1998)
NEUROLOGICAL THEORIES

(Kral et al., 2016)
(Dye & Morgan, 2020)
Interim Summary – Theoretical Approaches

- Different theories are grounded in how they see deafness
  - Sensory loss ("hearing loss")
  - Neurological disorder ("connectome disease")
  - Atypical language ("deaf")

- Each theory has data to support it
  - But those data come very different kinds of deaf child
A Unified Framework for Intervention
Biopsychosocial Systems Theory

(Engel, 1977)

(Kronenberger & Pisoni, 2020)
Question and Answer Period
References Cited

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