Cognitive & Socio-Emotional Resilience in Children with Dyslexia

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FUNDING
Dennis & Shannon Wong – DSEA ’88 Foundation
Toney & Potter Family

UCSF Dyslexia Center
OAK Foundation
CENTER for CHILDHOOD CREATIVITY
Liebe Patterson

NSF1540854 SL-CN (Gazzaley/Uncapher, UCSF)

R01HD078351 (Hoeft, UCSF)
R01HD086168 (Hoeft/Pugh, UCSF/Haskins)
R01HD065794 (Pugh, Haskins)
P01HD001994 (Rueckl, Haskins/UConn)
R01MH104438 (Nordahl, UCDavis/MIND)
R01MH103371 (Amaral, UCDavis/MIND)
Why is each child so different?
How can we ensure success in each child?

**KAITO**
“STORY MAN”
“3D MAN”

- Empathic
- Spiderman - Halloween
- Avoids reading

**TAIGA**
“INFORMATION SEEKER”

- Analytic
- Red/White blood cell - Halloween
- Avid reader
Jack Horner, a paleontologist from Jurassic Park/World

Importance of resilience

Importance of environment & community

Importance of looking at an individual as a whole (including literacy but also other cognitive and socio-emotional aspects)
Resilience

The ability to adapt to stressors in the environment (adversity) by “bending” but not “breaking”

(Karatsoreos & McEwen F1000Prime Reports 2013)

Socio-emotional resilience

Cognitive resilience
• IMPORTANCE OF AN INTEGRATIVE APPROACH
  - Reading & dyslexia are complex.
  - Multiple factors impact dyslexia & success.

• THE NEW NEUROSCIENCE OF DYSLEXIA

• COGNITIVE RESILIENCE

• SOCIO-EMOTIONAL RESILIENCE

• CONCLUSION
IMPORTANCE OF AN INTEGRATIVE APPROACH
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THE NEW NEUROSCIENCE OF DYSLEXIA

COGNITIVE RESILIENCE

SOCIO-EMOTIONAL RESILIENCE

CONCLUSION
Cost of Dyslexia

POOR OUTCOME: Reading Comprehension, Educational Attainment, Psychosocial Adjustment

Risks
1) There is no enjoyment in reading
2) Doesn’t get enough practice
3) Doesn’t develop automaticity
4) Reading becomes unpleasant
5) Poor vocabulary growth
6) Poor attitude toward school
7) Affects motivation to read

SUSCEPTABILITY GENES

PHONOLOGICAL

ORTHOGRAFULIC

Integrative Approach | New Neuroscience | Cognitive Resilience | Socio-Emotional Resilience | Conclusion
Cost of Dyslexia

Matthew Effect in Reading

- With Foundation Skills
- Without Foundation Skills

Pennington & Lefly. Child Develop 2001; Cosden JLD 2001; Wilson et al. JLD 2009; Foresight Mental Capital and Wellbeing Project. 2008; DuPaul et al. JLD 2012;
Resilience Model of LD: Promoting Resilience & Optimizing LD Outcome

Haft, Myers, Hoeft. Curr Opin Beh Sci 2016

**INTERNAL**
- Growth mindset
- Hopeful thinking
- Sense of coherence
- Locus of control
- Self determination

**FAMILY**
- Family cohesion
- Maternal affect
- Strong parental attachment
- Parental support & understanding of RD

**PEER/SCHOOL**
- Peer relationships
- Mentorship by teachers
- Teacher support
- Small class-size

**Cognitive Protective Factors**
- Oral language skills
- Motor skills
- Task-focused behavior
- Executive functions
- Interpersonal relationships

**Less Severe Dyslexia**

**Socio-Emotional Protective F.**

**Positive Outcome**

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Importance of an Integrative Approach to Maximizing Children’s Learning Potential

Weaknesses vs. Relative strengths

Risk vs. Protective factors

Vulnerability vs. Resilience

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Multiple Factors Contribute to Dyslexia

- Risk Gene1
- Risk Gene2
- Risk Gene3
- Protective Gene1
- Protective Gene2
- Environment1
- Environment2

Liability threshold model: Gottesman & Shields. PNAS ‘67


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POOR READERS & DYSLEXIA.
Reduced efficiency in brain networks related to speech & visual aspects of reading.

Shaywitz et al. NEJM ‘98; Hoeft et al. J Neurosci ‘06. Hoeft et al. PNAS ‘07
The Neuroscience of Dyslexia – Emerging View
Focus Also on Strengths, Protective Factors & Resilience

**RELATIVE STRENGTHS**
- phonological processing
- visuo-spatial
  - Holistic, 3d
- cognitive
  - explicit memory
  - comprehension
- IQ, reasoning, oral language ...
- character traits, socio-emotional

**RELATIVE WEAKNESSES**
- (visual/selective) attention
- cognitive
  - implicit procedural learning
  - short-term memory
- information processing

Grit, Resilience, Mindset, Empathy

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PROTECTIVE FACTORS & RESILIENCE
Which brain systems???

- Temporo-Parietal (TP)
  Phonological processing
- Occipito-Temporal (OT)
  Orthographic processing
Strengths, Protective Factors & Resilience: Coincidence, Compensatory or Meant to be?

- **Coincidence** Bryden MP. Laterality ‘87

- **Compensatory** Lansdell HJ. Comp Physio Psychol ‘69, Levy J. Nature ‘69

- **Causal** Kosslyn SM. Psychol Rev ‘87, Cai et al. PNAS ‘13 **Evolutionary advantage** Geschwind N. Annals of Dyslexia ‘84
Integrative Approach to Dyslexia Research

DEVELOPMENTAL STAGE:
- Preconception
- Prenatal
- Postnatal
- Child
- Adolescent
- Adult

TIME-SCALE:
- msec
- years

COGNITIVE PROCESSES:
- Perception
- Learning
- Cognition
- Reading, Math
- Socio-emotional

LEVEL:
- Neuroanatomy
- Physiology
- Behavior

New Neuroscience |
Cognitive Resilience |
Socio-Emotional Resilience |
Conclusion
Integrative Approach to Dyslexia Research

Brain electrical activity

EEG

EEG / MEG

Brain structure & function

fMRI

MEG

DTI

Genetics

Brain stimulation

NIRS

EEG

MRI

TMS / tDCS

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Our Work @ \textit{brainLENS}.

**Early school readiness & risk**

- Socio-emotional, Character traits
- Resilience
- Motivation, grit, resilience
- Stereotype threat
- Growth chart

**Mechanism of reading & learning**

- Protective factors
- Risk
- Compensatory factors
- LD/dyslexia
- Autism
- Oral & written language
- Emotional processing including reactivity & empathy
- Executive functioning & reasoning style
- Motor speech
- Visuospatial processing
- Structural & functional MRI imaging
- ADHD & anxiety
- Socio-emotional health & resilience
- Effects of dyslexia on aging

**Community**

- White House
- UNESCO
- US/CA Dept of Ed
- Brain imaging
- Prenatal environment
- Genetics
- Environment
- Underserved

**Brain LENS**

- Integrative Approach
- New Neuroscience
- Cognitive Resilience
- Socio-Emotional Resilience
- Conclusion
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COGNITIVE RESILIENCE

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Resilience Model of LD: COGNITIVE RESILIENCE

Haft, Myers, Hoeft. Curr Opin Beh Sci 2016

Risks

Less Severe Dyslexia

Cognitive Protective Factors

- Oral language skills
- Motor skills
- Task-focused behavior
- Executive functions
- Interpersonal relationships

Positive Outcome

Less Severe Dyslexia

Cognitive Protective Factors

- Morphological awareness
- Vocabulary
- Verbal reasoning
- Executive functions
- Grammar

Integrative Approach | New Neuroscience | Cognitive Resilience | Socio-Emotional Resilience | Conclusion
RESILIENT READERS: Those with good comprehension despite poor decoding.

Those with decoding difficulties rely more on contextual information to be able to read successfully.

INTERACTIVE COMPENSATORY MODEL OF DYSLEXIA (Stanovich, 1980)

Implications for intervention.
COGNITIVE RESILIENCE
Brain Mechanism?

Expected pattern related to:
RESILIENCE

Decoding
Comprehension

RESILIENT READERS
Typical Readers
Good comprehension but good decoding also

POOR READERS
Poor decoding but also poor decoding

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COGNITIVE RESILIENCE

Left Dorsolateral Prefrontal Cortex (DLPFC)

Resilient > Poor readers
Resilient > Typical readers

RESILIENCE

COMPREHENSION

DECODING

POOR READERS
RESILIENT READERS
TYPICAL READERS
COGNITIVE RESILIENCE
Not just dyslexics but anyone can have it.
COGNITIVE RESILIENCE

Chicken or egg? Show signs BEFORE reading failure.

Prereading kids’ left DLPFC predicts future ‘resilience’

R² = 0.14004
R² = 0.12409

Prefrontal Volume

Cognitive Resilience

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COGNITIVE RESILIENCE
Role of DLPFC Network?

Related to learning, attention, & cognitive flexibility

Fronto-parietal network

1000 Functional Connectome. Neurosynth.org
Dynamically changes how it connects to other key networks based on current goals.

Critical for learning new skills and building mental rules.

Allows immediate & flexible transfer of skills.

Cole et al. Nat Neuroscience ’13
COGNITIVE RESILIENCE?
Other Frontal Mechanisms

Hoeft et al. PNAS ’07; Hancock Richlan Hoeft. Neurosci Beh Rev
Hoeft et al. PNAS ’11

Left Fronto-Striatal Network – Articulation
Right Inferior Frontal & Fronto-Parietal White Matter – Predict outcome

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COGNITIVE RESILIENCE: Summary

Prefrontal & fronto-parietal network

Cognitive flexibility, learning network

Importance of promoting activities to enhance cognitive flexibility & self-regulation early

The Reading Skills Pyramid

- Comprehension
- Fluency
  - Reading quickly and with expression
- Phonics
  - Connecting sounds to written letters/letter combinations for reading (decoding)
  - Connecting written letters to sounds for spelling (encoding)
- Phonemic Awareness
  - Hearing/manipulating beginning/ending sounds in words
  - Hearing/manipulating middle sounds in words
  - Hearing how many sounds are in a word
  - Hearing if sounds are same/different
- Phonological Awareness
  - Hearing individual words
  - Hearing individual syllables (beats)
  - Hearing whether words rhyme
- Other Foundational Skills

Created by Dic Bray, MSW in 2013  http://www.atlantarcads.org/
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Haft, Myers, Hoeft. Curr Opin Beh Sci 2016

**Risks**

**Dyslexia**

**Positive Outcome**

**INTERNAL**
- Growth mindset
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**FAMILY**
- Family cohesion
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**Integrative Approach | New Neuroscience | Cognitive Resilience | Socio-Emotional Resilience | Conclusion**
SOCIO-EMOTIONAL RESILIENCE
Character traits critical for success

Self discipline, more predictive than IQ (2x) & above and beyond achievement itself

(Duckworth & Seligman, Psychol Sci ‘05)

Above & beyond IQ & achievement
**SOCIO-EMOTIONAL RESILIENCE**

**Brain mechanisms**

*Myers et al. SCAN 2016*

Multiple targets – Multiple routes to enhance learning

**GROWTH MIND-SET:**
Belief that ability is effort based

**GRIT:**
Perseverance toward a long term goal

**GROWTH MINDSET**

**COGNITIVE REAPPRAISAL**
*(Doherty et al. Science ‘04)*

**INTRINSIC MOTIVATION**
*(Muyrayama et al. PNAS ‘10)*

**GRIT**

**PERSISTENCE**
*(Gusnard et al. PNAS ‘03)*

**FUTURE REWARD**
*(Doherty et al. Science ‘04)*

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Stereotype threat may put individuals at risk

“Stereotype threat is being at risk of confirming, as self-characteristic, a negative stereotype about one’s group.” – Steele and Aronson (1995)

“White men can’t jump.”

“Women are not good at math.”

reducingstereotypethreat.org, Whistling vivaldi by Claude Steele
Why might individuals with learning disabilities (including dyslexics, but also ADHD etc) experience stereotype threat?

- **Group identification** - low achievement
- **Aware of stereotype** (*Kelly and Norwich, 2004; Rashkind et al., 2006*)
- **Negative academic self-concept** (*Zeleke, 2004*)
- **Low self-esteem, negative affect, anxiety, and depression when faced with performance-avoidance goals** (the desire to perform less poorly than others) (*Sideridis, 2007; Aquino, 2011*)
Discordance leads to stereotype threat

Reduced attention
Stress & Anxiety
Fear & Threat
Reduced learning & memory, & performance

Everyone is prone.

“Girls are bad at math (and math is important to me)...”

“"I am a girl..."

“"I think I am good at math...”

SOCIIO-EMOTIONAL RESILIENCE
An Integrated Process Model of Stereotype Threat

Forbes et al., 2008
SOCIO-EMOTIONAL RESILIENCE
Brain mechanism of stereotype threat?

Women & under-performance in math

*Lack of improvement in math performance over time under ST (interaction: p<.005)*


Lack of MATH related activation under ST
Increase in EMOTIONal response under ST

Stereotype threat impacts key cognitive networks and emotion-related networks negatively
SOCIO-EMOTIONAL RESILIENCE
Building Resilience Against Stereotype Threat

- Reframing the task (e.g. Quinn & Spencer, 2001)
- De-emphasizing threatened social identities (e.g. Stricker and Ward, 2004)
- Role models (e.g. Blanton et al., 2000)
- External attributions for difficulty (e.g. Good et al, 2003)
- Self-affirmations (e.g. Schimel et al., 2004)
- Growth mindset (e.g. Aronson et al., 2002)
SOCIO-EMOTIONAL RESILIENCE
Strength-based approach may build resilience

Diehl ... Hoeft ... Pugh. NeuroImage ‘14

Visuo-spatial processing show yin-yang relationship with reading

Poorer the reading, better the visuo-spatial (configural) abilities (von Károlyi et al., ‘01; ‘03).

$r = .42$

Integrative Approach  |  New Neuroscience  |  Cognitive Resilience  |  Socio-Emotional Resilience  |  Conclusion
Socio-emotional resilience mentoring may build resilience

**Improvement in:**

- Self Esteem (12%)
- Grit (value) (8-36%)
- Growth Mindset (14%)
- LD Identity (comfort, bond, importance) (24-52%)
- Reading Self-concept (19%)
- etc...

**Response to failure**

- 26.7%
- ***P<0.0001

**Depression**

- 12.5%
- ~*P=0.05

**Display more positive emotions and effort-based strategies in the face of failure.**

**Integrative Approach | New Neuroscience | Cognitive Resilience | Socio-Emotional Resilience | Conclusion**
Mentoring may build resilience

Self-Esteem (Fall to Spring % increase)

Mentee-Rated Mentorship Quality (1-low to 3-high)

$R^2 = 0.13$ (r=0.36)
P=0.025

N=39
• Stereotype threat & fixed mindset could be potential mechanisms underlying underperformance in those with learning challenges.
• Others such as anxiety, motivation and reduced grit likely interact with stereotype threat and fixed mindset, and result in further underperformance.
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CONCLUSION
CONCLUSION: Promoting Resilience

Haft, Myers, Hoeft. Curr Opin Beh Sci 2016

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PEER/SCHOOL
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- Mentorship by teachers
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SOCIO-EMOTIONAL LEARNING (mentoring)

Cognitive Protective Factors
- Oral language skills
- Motor skills
- Task-focused behavior
- Executive functions

LITERACY INTERVENTIONS
- Morphological awareness
- Vocabulary
- Verbal reasoning
- Executive functions
- Grammar

COGNITIVE TRAINING

Positive Outcome

Integrative Approach | New Neuroscience | Cognitive Resilience | Socio-Emotional Resilience | Conclusion
CONCLUSION: Promoting Resilience

• Cognitive control, self-regulation – Cognitive reappraisal & positive reframing, Promotes grit

• Strength based approach – Confidence, Optimism

• Growth mindset – Active coping (sense of control), Optimism

• Social support, role model, mentoring – Connection to community

• Reduce stereotype threat – Optimize learning environment & enhanced performance

• Stress inoculation (exposure to tolerable levels of stress & challenges)

Bay Area
UCSF (NC White, R Hendren, K LeWinn, L Pasch, M Gorno-Tempini, B Miller);
UC Berkeley (S Bunge);
UC Davis (Y Uchikoshi, D Amaral, C Wu Nordahl);
U of SF (G Leung);

USA/Canada
Boston College (J Black);
Georgia State U (R Morris);
Harvard U, Boston Children’s Hospital (L Prock Albers);
MIT (J Gabrieli);
U of British Columbia (L Siegel);
U of Michigan (I Kovelman, R Marks);
Vanderbilt U (L Cutting);

Asia
Beijing Normal U, China (H Shu);
Hebrew U, Israel (R Frost);
Keio U, Tokyo, Japan (B Yamagata, M Mimura);
Nat’l Cntrl U, Inst of Cog Neurosci, Taiwan (D Wu, O Tseng)
U Hong Kong, China (C McBride);

Europe
BCBL, Spain (M Carreiras);
U College London, UK (C Hulme);
U of Jyvaskyla, Finland (H Lyytinen, P Leppannen, U Richardson);
U of Salzburg, Austria (F Richlan);

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POSTDOC & RESEARCH ASSISTANT WANTED!

Thank you...