



Multidimensional Assessment: Operationalizing the Socio-Emotional, Environmental, and experiential contexts in which development occurs

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Aims

- Identify contextual and individual difference factors that have the potential to deepen our understanding of individual differences in learning and academic outcomes
- Discuss ways of measuring these factors
- Highlight a few examples of the utility of these factors

“Big Data” Assessment

- ④ Understanding how to develop better strategies requires an understanding of the circumstances under which current approaches work and don't work (context)
- ④ However, this requires that these factors be operationalized and measured in a systematic way
- ④ Harmonization of these measures when possible allows for direct comparisons across studies (or sub-studies)

Understanding Context

- “Big data” initiatives afford the statistical power to test the effects of these contextual factors and build better models of academic and life skill development
 - Independent effects
 - Mediating effects
 - Moderating effects
- We can examine these effects at both the behavioral and biological level

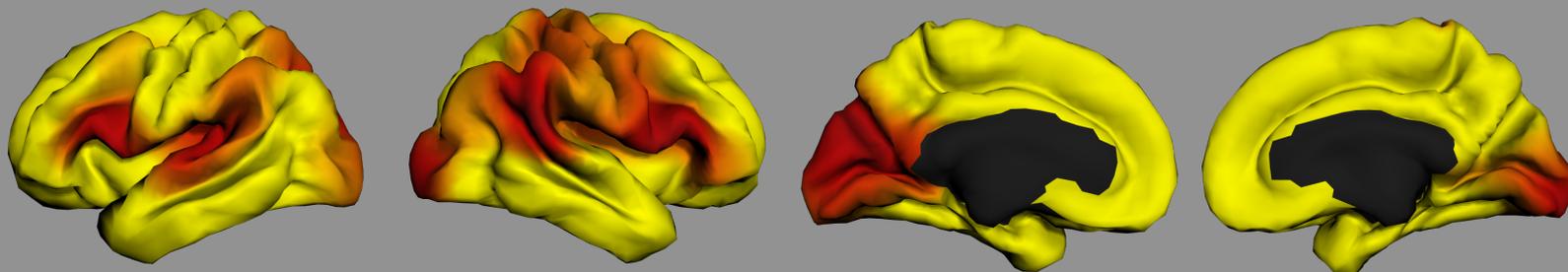
Biological Factors

- Genetic influences
 - Specific gene effects
 - Genetic ancestry
- Brain structure & function
 - Can influence behavior
 - Can be modified by experiences
- Family history
 - Can influence brain and behavior
 - Thru genetics
 - Thru family dynamics

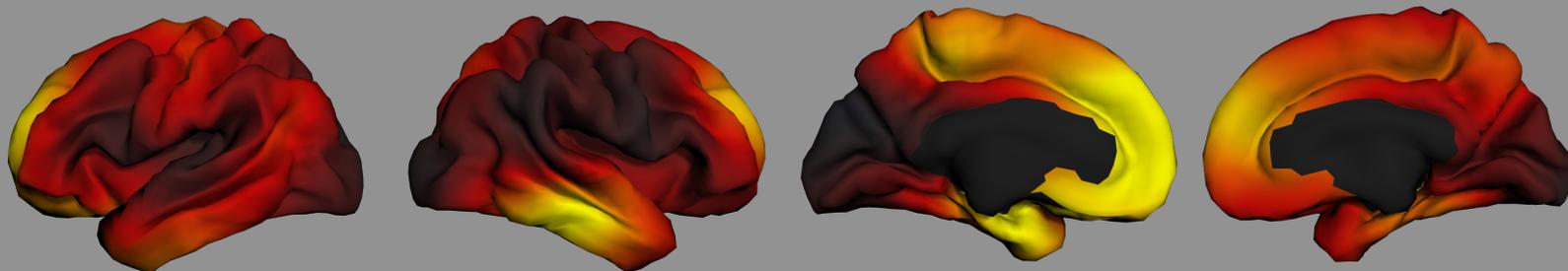
Genetic Ancestry Mediates Association Between Reading & Cortical Surface Area

Covariates

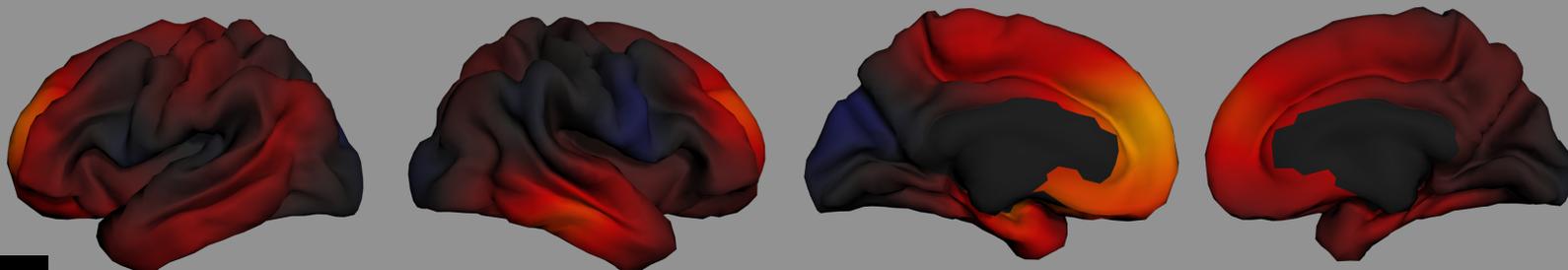
Age, Sex,
Scanner



+ SES

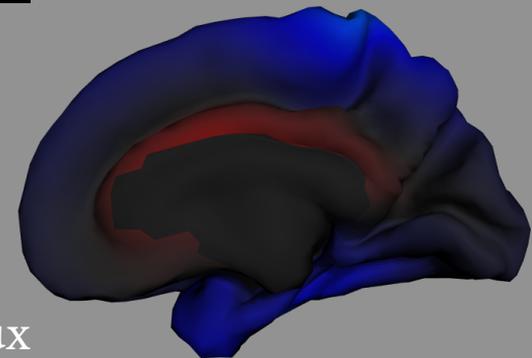
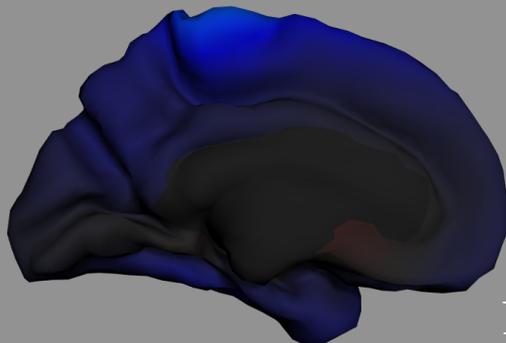
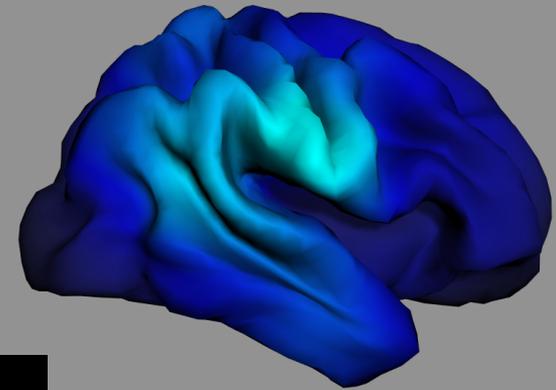
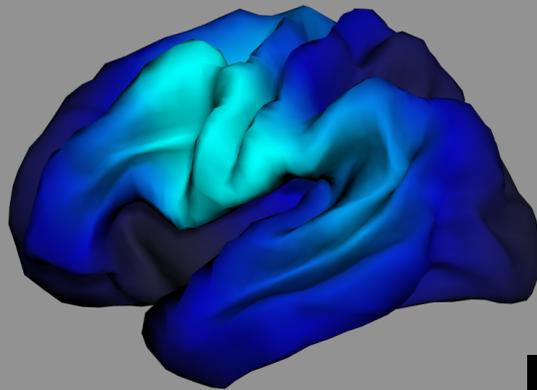


+ GAFs



Family History Effects on Brain Structure

- ⊗ Parental Hx of Substance Use → Cortical Thickness



Maddox et al., 2014 - Flux

Neuropsychological Functioning

- IQ
- Academic Skills
- Executive Functions
- Perceptual biases (basic processing thresholds)
 - Numerosity
 - Visual perception
 - Auditory discrimination
- Important to note that studies have generally found that cognitive factors account for no more than 50% of the variability in academic outcomes, leaving half the variance unaccounted for

Neuropsychological Functioning

NIH Toolbox Cognitive Domain (nihtoolbox.org)

Cognition

Cognition refers to the mental processes involved in gaining knowledge and comprehension, such as thinking, knowing, remembering, judging, and problem-solving. These higher-level functions of the brain encompass language, imagination, perception, and the planning and execution of complex behaviors.

Why Measure Cognition?

- Measurement of cognition is essential to any study of health and well-being, and should be included in large-scale epidemiologic studies and experimental studies of health and development, even if the target of the study is not cognition itself.
- Studies often assume normal cognition in volunteer participants. Objective measures provide information to further analyze results as they apply to individuals with a range of cognitive abilities. Cognition may be a hidden variable contributing to the success or failure of an intervention study.
- Cognition is essential to autonomy, academic achievement, and career accomplishments and can be a powerful modulator of risks in epidemiologic studies. Abnormalities of cognition are frequently an indicator of disease, and changes throughout the life span.
- Measurement is important in characterizing different target age groups, as well as longitudinal tracking of cohorts

Includes Measures of: **Executive Function** **Attention** **Episodic Memory** **Language** **Processing Speed** **Working Memory**

NIH Toolbox Cognition Battery

NIH Toolbox Early Childhood Cognition Battery

Emotional Functioning

- ⦿ Negative Affect
- ⦿ Stress
- ⦿ Positive Affect
- ⦿ Self-Efficacy
- ⦿ Life Satisfaction
- ⦿ Meaning and Purpose
- ⦿ Emotional Support

Math Anxiety

- ⦿ A widely studied phenomenon related to achievement
- ⦿ Has been shown to interact with working memory to predict math achievement (Ramirez et al., 2013)
- ⦿ Low WM, math anxiety was associated with achievement
- ⦿ High WM, math anxiety was associated with decreased achievement

NIH Toolbox Emotion Domain

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For the Assessment of Neurological and Behavioral Function

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Emotion

Emotion refers to any strong feelings, as of joy, sorrow, or fear. Emotion is an affective state of consciousness in which joy, sorrow, fear, hate, or the like is experienced, as distinguished from cognitive and volitional states of consciousness. Emotions can be negative and distressing, or positive emotions can be reflections of well-being in our lives, and positive social relationships can buffer stress and enhance health. The NIH Toolbox Emotion domain includes four major subdomains, described below. Measures include both self-report and, for certain ages, parent-report versions.

Why measure Emotion?

- It has important adaptive and communicative functions in a social species
- Emotional health has significant links to physical health
- It exerts a powerful effect upon perceptions of life quality
- Emotion measures are generally delivered as fixed-length forms or computer-adaptive tests, presenting developmentally appropriate items by age band (typically 8-12, 13-17 and 18+)

Includes measures of: [Psychological Well-Being](#) | [Social Relationships](#) | [Stress & Self Efficacy](#) | [Negative Affect](#)

[NIH Toolbox Emotion Battery](#) | [NIH Toolbox Parent Proxy Emotion Battery](#)

[Find a complete set of PDFs of Emotional Health measures here>>](#)

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PhenX Toolkit

NHGRI Initiative – www.phenxtoolkit.org



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Psychiatric Symptoms



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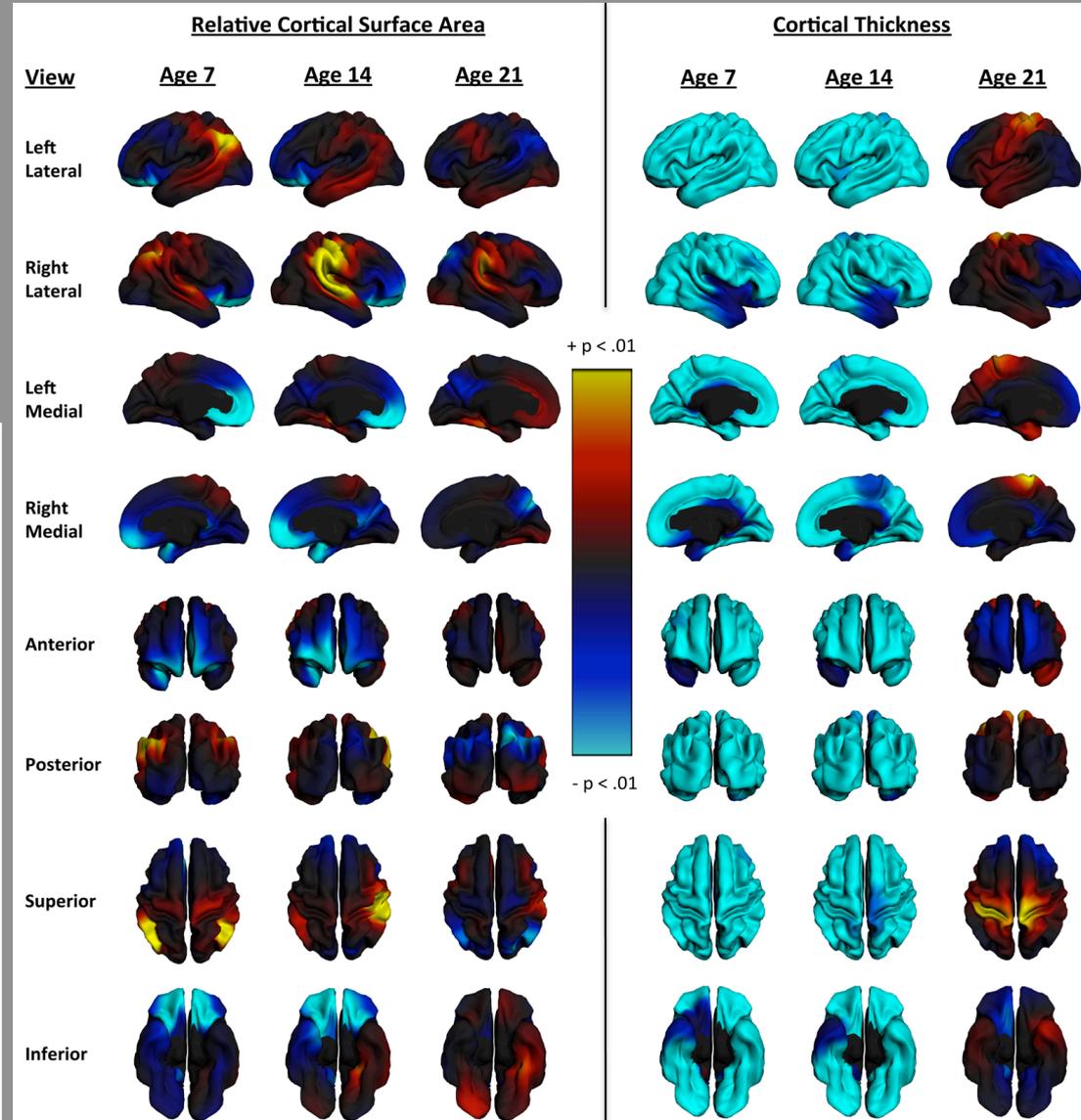
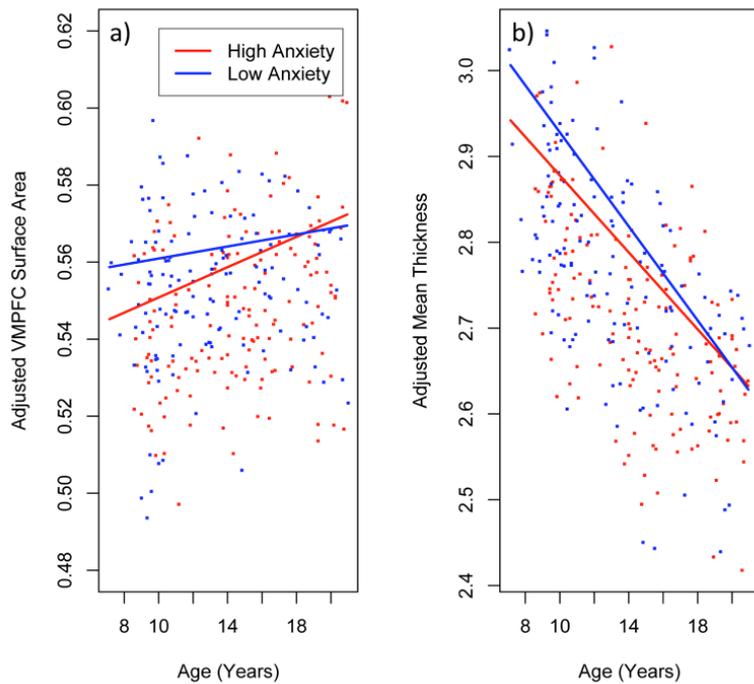
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Anxiety Moderates Apparent Trajectories of Brain Development

Using the PhenX measure of anxiety (SCARED-R; Muris, 1999)



Child Mental Health

- Learning Disabilities
- ADHD
 - Associated with many poor academic and life outcomes (Loe & Feldman, 2007)
- Anxiety Disorders
 - Severe anxiety has been associated with poor peer relations, attention, and school performance in children (Strauss et al., 1987), as well as with later school dropout (Van Ameringen et al., 2001)
- Depression
 - Early study found association with academic achievement in both genders at ages 8-9, but only in girls ages 10-11 (Feshbach & Feshbach, 1987)

Child Mental Health

- www.dsm5.org has a number of experimental measures to probe symptom dimensions
 - Cross-cutting symptoms
 - Level 1: Broadband
 - Level 2: Narrow-band
 - Diagnosis-focused severity ratings
 - Personality

Level 1 Cross-Cutting Symptom Measures

[DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure—Adult](#) (also available in print book)

[DSM-5 Parent/Guardian-Rated Level 1 Cross-Cutting Symptom Measure—Child Age 6–17](#) (also available in print book)

[DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure—Child Age 11–17](#)

Child Mental Health

For Parents of Children Ages 6–17

LEVEL 2—Somatic Symptom—Parent/Guardian of Child Age 6–17 (Patient Health Questionnaire 15 Somatic Symptom Severity Scale [PHQ-15])

LEVEL 2—Sleep Disturbance—Parent/Guardian of Child Age 6–17 (PROMIS—Sleep Disturbance—Short Form)

LEVEL 2—Inattention—Parent/Guardian of Child Age 6–17 (Swanson, Nolan, and Pelham, version IV [SNAP-IV])

LEVEL 2—Depression—Parent/Guardian of Child Age 6–17 (PROMIS Emotional Distress—Depression—Parent Item Bank)

LEVEL 2—Anger—Parent/Guardian of Child Age 6–17 (PROMIS Emotional Distress—Calibrated Anger Measure—Parent)

LEVEL 2—Irritability—Parent/Guardian of Child Age 6–17 (Affective Reactivity Index [ARI])

LEVEL 2—Mania—Parent/Guardian of Child Age 6–17 (Adapted from the Altman Self-Rating Mania Scale [ASRM])

LEVEL 2—Anxiety—Parent/Guardian of Child Age 6–17 (Adapted from PROMIS Emotional Distress—Anxiety—Parent Item Bank)

LEVEL 2—Substance Use—Parent/Guardian of Child Age 6–17 (Adapted from the NIDA-Modified ASSIST)

For Children Ages 11–17

LEVEL 2—Somatic Symptom—Child Age 11–17 (Patient Health Questionnaire 15 Somatic Symptom Severity Scale [PHQ-15])

LEVEL 2—Sleep Disturbance—Child Age 11–17 (PROMIS—Sleep Disturbance—Short Form)

LEVEL 2—Depression—Child Age 11–17 (PROMIS Emotional Distress—Depression—Pediatric Item Bank)

LEVEL 2—Anger—Child Age 11–17 (PROMIS Emotional Distress—Calibrated Anger Measure—Pediatric)

LEVEL 2—Irritability—Child Age 11–17 (Affective Reactivity Index [ARI])

LEVEL 2—Mania—Child Age 11–17 (Altman Self-Rating Mania Scale [ASRM])

LEVEL 2—Anxiety—Child Age 11–17 (PROMIS Emotional Distress—Anxiety—Pediatric Item Bank)

LEVEL 2—Repetitive Thoughts and Behaviors—Child Age 11–17 (Adapted from the Children's Florida Obsessive Compulsive Inventory [C-FOCI] Severity Scale)

LEVEL 2—Substance Use—Child Age 11–17 (Adapted from the NIDA-Modified ASSIST)

Child Mental Health

For Children Ages 11–17

Severity Measure for Depression—Child Age 11–17 (PHQ-9 modified for Adolescents [PHQ-A]—Adapted)

Severity Measure for Separation Anxiety Disorder—Child Age 11–17

Severity Measure for Specific Phobia—Child Age 11–17

Severity Measure for Social Anxiety Disorder (Social Phobia)—Child Age 11–17

Severity Measure for Panic Disorder—Child Age 11–17

Severity Measure for Agoraphobia—Child Age 11–17

Severity Measure for Generalized Anxiety Disorder—Child Age 11–17

Severity of Posttraumatic Stress Symptoms—Child Age 11–17 (National Stressful Events Survey PTSD Short Scale [NSESS])

Severity of Acute Stress Symptoms—Child Age 11–17 (National Stressful Events Survey Acute Stress Disorder Short Scale [NSESS])

Severity of Dissociative Symptoms—Child Age 11–17 (Brief Dissociative Experiences Scale [DES-B])

For Children Ages 11–17

The Personality Inventory for DSM-5—Brief Form (PID-5-BF)—Child Age 11–17

The Personality Inventory for DSM-5 (PID-5)—Child Age 11–17

Early Development and Home Background

For Parents of Children Ages 6–17

Early Development and Home Background (EDHB) Form—Parent/Guardian

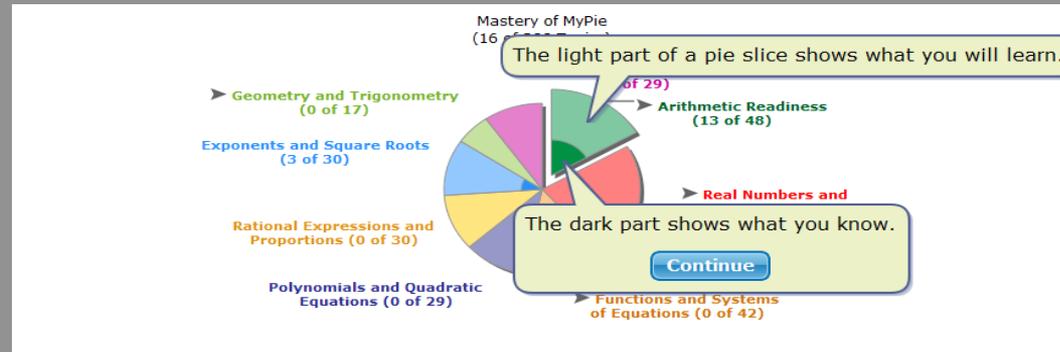
Temperament/Personality

- Temperamental attention, activity (Rudasill et al., 2009), and effortful control (Zhou et al., 2010) have been linked to academic outcomes
- Openness, Agreeableness, & Conscientiousness are positively associated with academic outcomes, while Neuroticism is negatively associated (Laidra et al., 2007)

Engagement & Motivation

- 10-week computerized training program in algebra (ALEKS)

- 41 8th graders



- Skills going into the program predicted the amount learned
- However, how much they engaged in the program was more important
- Attitudes toward math, self-efficacy, and school stress predicted level of engagement

Domain Preference: Thresholding

- It may be important to know what types of academic stimuli children are averse to and drawn to
- Self-reported preferences alone may not be the best way to measure this

Level	Auditory/Linguistic	Visuospatial/Quantitative
Symbolic	Reading	Math
Non-symbolic	Phoneme Discrimination	Quantity Discrimination
General	Auditory Discrimination	Spatial Location

Domain Preference: Symbolic/Reading



up

of



up

of

Domain Preference: Non-symbolic/Linguistic



(Phoneme String)



Domain Preference: Auditory Discrimination



(Tone Sequence)



Domain Preference: Symbolic/Math

$$3 + 2$$

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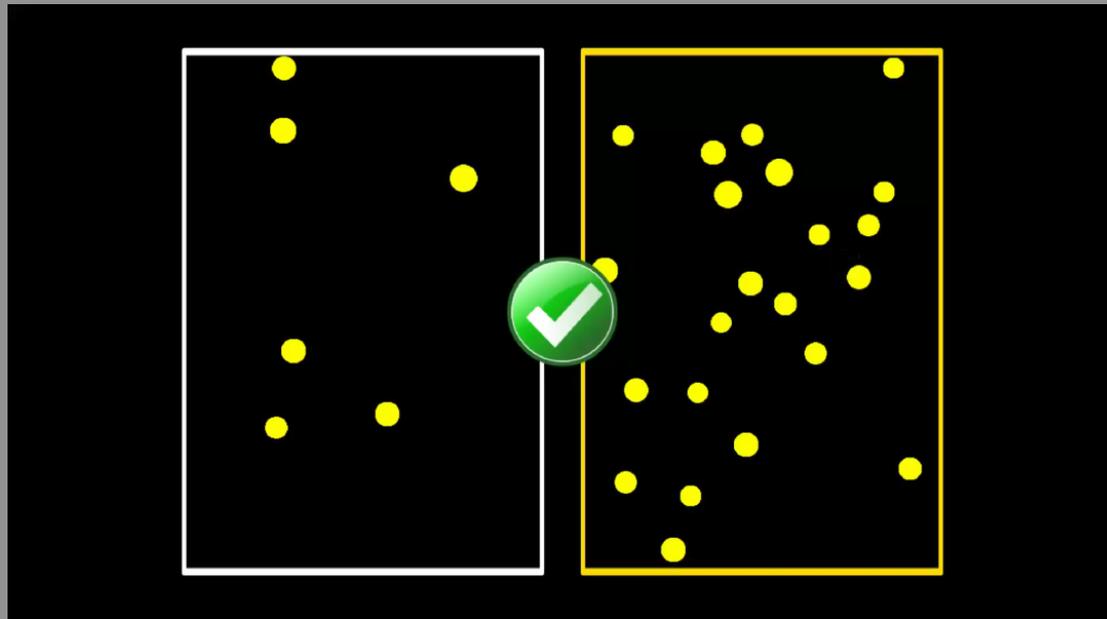
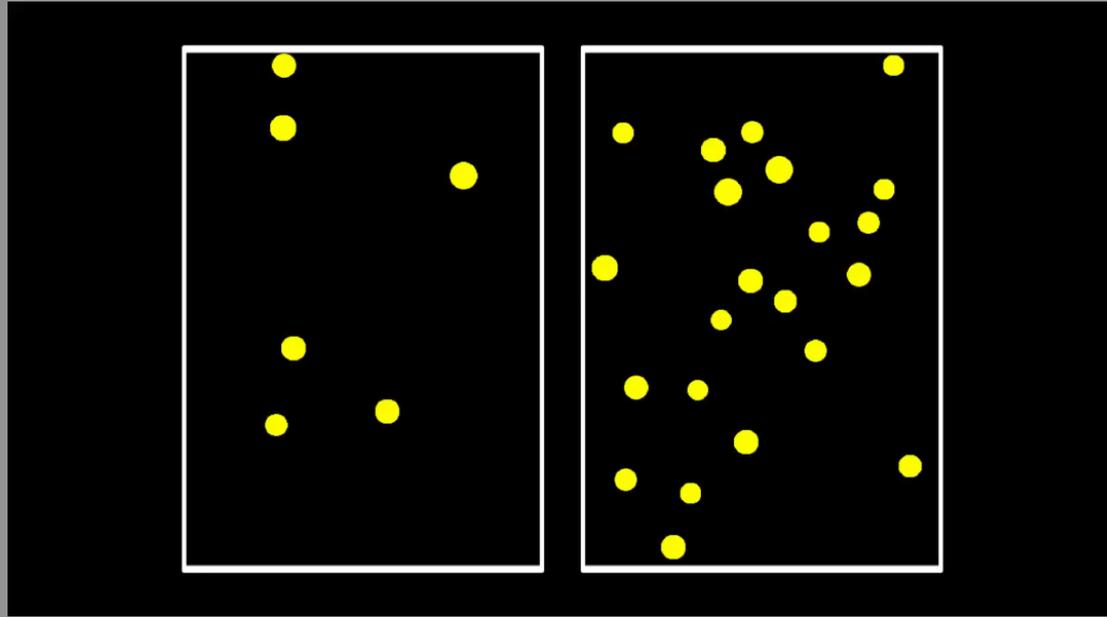
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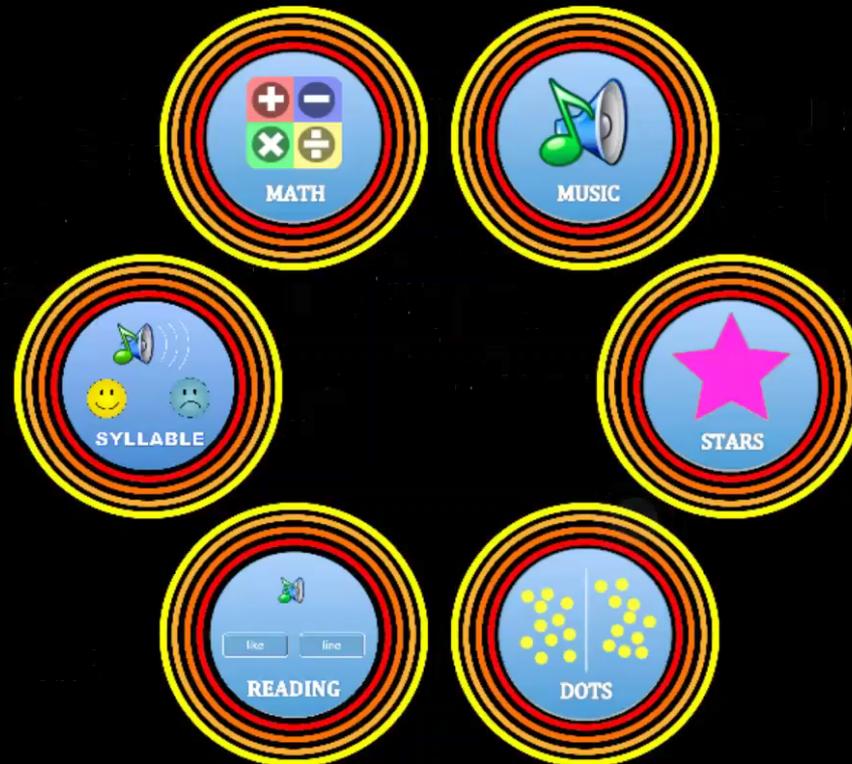
Domain Preference: Non-symbolic/Quantitative



Domain Preference: Spatial Location



Domain Preference: Choice



Parenting & Peer Influences

- Often studied in low SES communities and cross-culturally
- Authoritative/non-authoritarian parenting is associated with better performance through greater parental involvement in school (Steinberg et al., 1992)
- Parental harshness is associated with poorer academic and behavioral outcomes (Shumow et al., 1998)
- Maternal and peer support are associated with better academic outcomes in low SES communities (Gonzales et al., 1996)

PhenX Social Environment Measures



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DOMAIN: Social Environments #210000

Release Date: October 8, 2010

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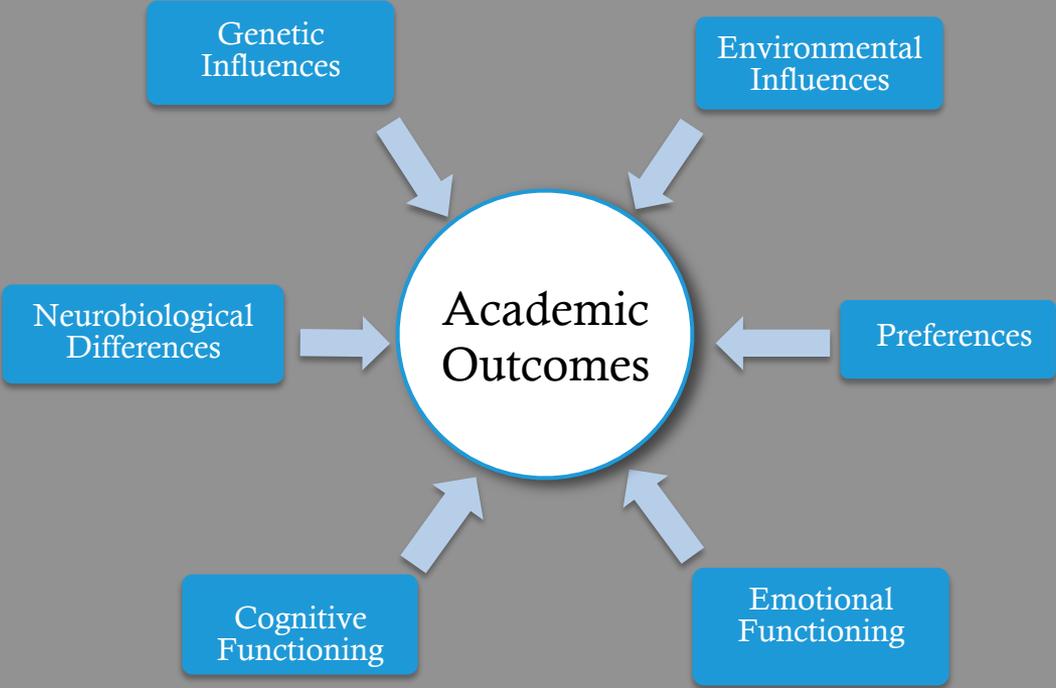
Life Experiences

- Martial arts appears to promote executive function development (Lakes & Hoyt, 2004)
- Music involvement is associated with better academic performance (Southgate & Roscigno, 2009)
- Music may improve auditory skills via neuroplastic mechanisms (Kraus & Chandrasekaran, 2010)
- Other extracurricular activities appear to enhance academic functioning thru strengthening ties between child, parent, and community (Broh, 2002)

Life Experiences

- Exposure in the home
 - Words & Reading
 - Music
 - Art
 - Television
 - Pets
- Participation in activities
 - Art
 - Athletics
- Adverse life events
 - Frequency
 - Intensity
 - Duration
 - Enjoyment
 - Skill
 - Self-efficacy
 - Consequences
 - Negative
 - Positive

Summary



Challenges to “Big Data” Assessment

- Finding measures that span your age of interest (particularly for longitudinal studies)
- Finding developmentally appropriate measures
- How to collect data that is both useful and brief

Conclusion

- The contextual factors addressed here represent just some of the potential influences on learning, but this list is by no means exhaustive
- Teacher involvement in this approach could inform research on new and important factors that have yet to be studied
- Even if our brief measures don't answer our questions fully, they help to guide future research