Using the Battelle 3 Developmental Inventory in the Assessment of Young Children With Autism Spectrum Disorder

Sam Goldstein, PhD
Clinical Director, Neurology, Learning and Behavior Center
Assistant Clinical Professor of Psychiatry, University of Utah
Riverside Insights®

www.samgoldstein.com
info@samgoldstein.com
@drsamgoldstein
@doctorsamgoldstein
@CommonSenseScience
'TRUTH. @CommonSenseScience

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Relevant Disclosures

Co-author of:
- Comprehensive Executive Functioning Inventory
- Autism Spectrum Rating Scales
- Rating Scale of Impairment
- Cognitive Assessment System –Second Edition
- Handbook of Executive Functioning
- Handbook of Intelligence and Achievement Testing

Compensated Speaker by Riverside

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Sam obtained his Ph.D. in School Psychology from the University of Utah and is licensed as a Psychologist and Certified School Psychologist in the State of Utah. He is also board certified as a Pediatric Neuropsychologist and listed in the Council for the National Register of Health Service Providers in Psychology. He is a Fellow of the American Psychological Association and the National Academy of Neuropsychology. Sam is an Adjunct Assistant Professor in the Department of Psychiatry at the University of Utah School of Medicine. He has authored, co-edited, or co-authored over 50 clinical and trade publications, three dozen chapters, nearly three dozen peer-reviewed scientific articles, and eight psychological and neuropsychological tests. He is in development for a behavioral assessment tool to evaluate DMDD, a new interactive test for ASD, and is editing a clinical volume about DMDD. Sam is the Editor in Chief of the *Journal of Attention Disorders*. Since 1980, he has served as the Clinical Director of the Neurology, Learning, and Behavior Center in Salt Lake City, Utah.

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Presentation Objectives

1. This session will help participants develop an appreciation and insight to formulate an assessment battery to determine IDEIA and ADA eligibility for young children with ASD as well as complete a comprehensive assessment of a young child with suspected ASD.

2. Participants will acquire knowledge needed to understand the role the Battelle Developmental Inventory 3 can serve in a school-based or community assessment of young children with ASD.

3. This session will help participants gather data, make diagnoses, determine eligibility and formulate educational goals for young children presenting with ASD and accompanying developmental delays.

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NASP Domains

- *Domain 1: Data-Based Decision Making*
- *Domain 4: Mental and Behavior Health Services and Interventions*
- *Domain 9: Research and Evidence-Based Practice*

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Broadening the Spectrum

- Eleven meta-analyses published between 1966 and 2021.
- 27,723 total subjects from around the world.
- Five psychosocial dimensions: emotion recognition, theory of mind, cognitive flexibility, planning and inhibition.
- For all 5 dimensions group differences between normal and those with ASD have declined since 2000.
- This is generally attributed to differences in diagnostic criteria, assessment practices and community awareness.

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The Autism Spectrum by Cognition & Language

Levels of Cognitive Functioning

(~30-35%) ← → *(~65-70%)*

Cognitive Impairment	*Intact Cognition & Language*
Language Impairment	*Asperger Syndrome*
Seizures & Medical Co-Occurring Conditions	*Psychiatric Co-Occurring Conditions*
Severe/Profound Autism	*Neurodivergent*

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Current Statistics on Autism (CDC)

IN THE GENERAL POPULATION:

- 1 in 44 8-year-old children are identified with ASD
- Male-Female Ratio:
  - 4 times higher in boys
- Median Age of Diagnosis: 4-5 years
  - Much later for disadvantaged populations
- When ASD can be reliably diagnosed:
  - 18-24 months when diagnosed by experienced clinicians
- Co-Occurring Intellectual Disability:
  - 35% with ID

GENETIC LIABILITY:

- ASD in Subsequent Biological Siblings: 1 in 5 (~20% risk)
- Broader Autism Phenotype ("shadow symptoms*"): 1 in 5 Siblings*
- Non-ASD developmental delays: 1 in 10 Siblings

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Autism in Females

- Females often misdiagnosed or missed to diagnosis
- Females may present with stronger social skills (Kreiser & White, 2014):
  - Intact symbolic and imaginary play
  - Larger emotional vocabulary
  - Greater awareness and desire for social interaction
  - Ability to mimic others in social situations
  - May develop one or two close friends
- Restricted interests tend to be related to people/animals rather than inanimate objects (Lai & Baron-Cohen, 2015)
- Research points to a "protective effect" in females (Satterstrom et al., 2020)
- "Camouflaging Effect": Females are more likely to use coping strategies to hide ASD behaviors – likely due to social pressures (Hull et al., 2017)
- Higher rates of internalizing disorders (anxiety, depression, eating disorders)

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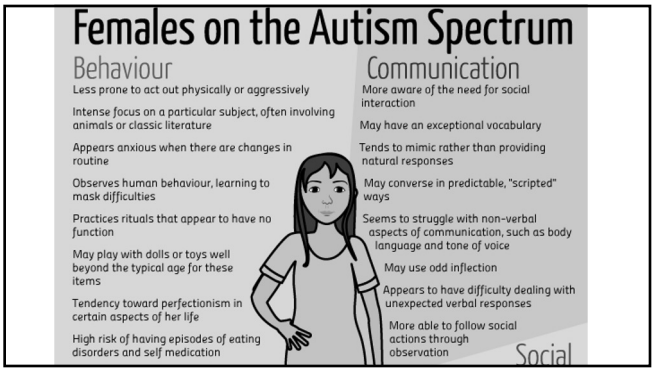

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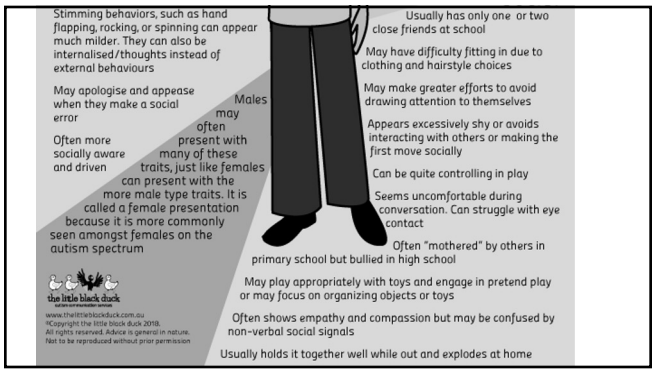

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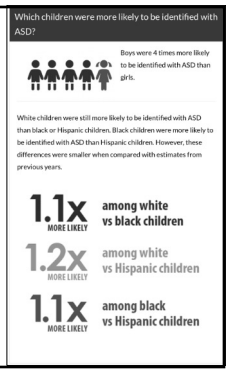
Racial & Ethnic Disparities

www.cdc.gov/ncbddd/autism/addm

- Prevalence rates are FINALLY identical for non-Hispanic white, non-Hispanic black, and Asian/Pacific Islander children but continue to be LOWER for Hispanic children
- 47% of Black children and 36% of Hispanic children are more likely to have Intellectual Disability with ASD compared to 27% of White children
- Black children with ASD are are less likely to have a first evaluation by age 3 than White children

CDC
Centers for Disease Control and Prevention



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Development of Play Skills in Autism

- Sensory-Exploratory Play – Pro-longed in ASD
  - Mouthing/dropping/manipulating objects
- Cause-and-Effect Play – Perseverative in ASD
  - Push-button & musical toys
- Functional Play – Impaired (e.g., lining up; visual peering; fixation on parts)
  - Using a toy for intended purpose (e.g., "driving" a car; "talking" on a phone; building with blocks; feeding a baby)
- Symbolic & Imaginary Play – delayed/prolongued (females) or absent in ASD
  - Using a toy for a novel purpose (e.g., using a block as a phone)
  - Using miniature figurines as agents (e.g., "mommy" feeding the baby)

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Use of Biomarkers to Detect Autism

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ASD Biologic/Genetic Identification

- Early detection for ASD is crucial for patients and their quality of life
- Data help researchers seek out commonalities, causes, and interventions.
- Behavioral tests limited to only diagnosing ASD will eventually be pushed out of the market in favor of tools (questionnaires and face to face measures) generating a profile of strengths and weaknesses to target in treatment.
- Profiles of strengths and vulnerabilities inform intervention programs, and areas of strength are used to build upon areas of weakness
- Measures that can identify these profiles can also track progress

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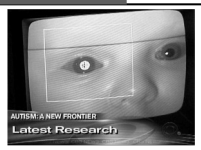
Infant Eye Tracking Studies



Patterns of Eye Gaze at monthly intervals

Birth through 36 months – data collected over 11 visits (2, 3, 4, 5, 6, 9, 12, 15, 18, 24, 36m)

Creating Growth Charts of Social Visual Engagement

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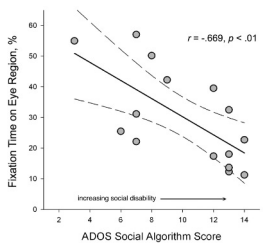
Predictors of Outcome

Jones, Carr, & Klin (2008; Arch Gen Psychiatry)



Less fixation time on eyes predicts more severe social disability.

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Key Assumption:

Children with ASD master a series of early social and related developmental tasks in a reliable sequence, corresponding to that seen in typically developing children.

But they are delayed, often requiring direct instruction to acquire a range of skill and behaviors others develop through experience alone.

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Key Assumptions

Sensory motor differences precede the unfolding of cognitive and adaptive deficits, as well as behavioral features of ASD across a six-to-twenty-four-month old interval.

The less severely affected group with ASD demonstrate later symptom onset in the second year of life with initial differences in the social communication domain.

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What are some measurable abnormalities of development that might demonstrate themselves in characteristic patterns of social and communicative behavior?

1. The ability to attribute mental states to one's self and others.
2. The ability to display an emotional reaction appropriate to another person's mental state (joint attention of emotion).
3. The ability to plan and attend to relevant details in the environment.

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What are some measurable abnormalities of development that might demonstrate themselves in characteristic patterns of social and communicative behavior ?

4. The ability to understand the communicative content of gaze.
5. The ability to work cooperatively with others (share joint attention of behavior).
6. The ability to understand, comprehend, analyze, synthesize, evaluate and differentiate in particular, social information in his environment.

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Diagnostic Evaluations for Autism are Comprehensive!

- Screeners for Risk and Need for Evaluation
- Developmental History
- Assessment of Developmental or Cognitive Skills
- Speech, Language, & Communication Assessment
- Adaptive Behavior Assessment
- Assessment of Autism Symptomatology
- Assessment of Executive Functioning
- Assessment of Emotional/Behavioral Regulation Skills

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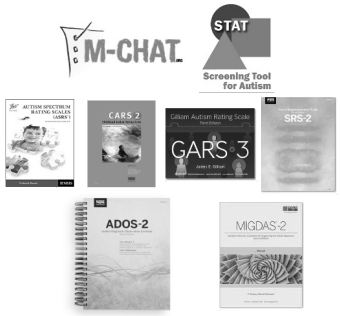
Assessing Autism Symptomatology

Screeners
- Identifying risk factors for ASD
- Detecting red flags that require further evaluation

Ratings
- Parent report / School Report
- Rating Scales/Questionnaires

Direct Assessment
- Direct observation of child with/without structure
- Probe language, social, play skills
- Observe atypical/stereotypical behaviors



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Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)

5 Modules based on age and language level
- Toddler Module: Between 12 and 30 months with no phrase speech
- Module 1: 31 months + with no phrase speech
- Module 2: 31 months + with phrase speech
- Module 3: Verbally fluent children & young adolescents
- Module 4: Verbally fluent older adolescents & adults

Items Coded on 4-point severity scale
- 0 = symptom not present
- 3 = symptom severe/atypical

Diagnostic Algorithm for Modules 1-4:
- Autism
- Autism Spectrum
- Non Autism Spectrum

ADOS-2
www.wpspublish.com
Lord et al., 2012

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Clinician Best Estimate (CBE)

- Most grants currently follow best-practices of using a CBE by 1 or 2 experienced clinicians that incorporates data from a variety of assessment sources (e.g., developmental history, ADOS-2, ADI-R, ASRS, cognitive findings, etc.)
- CBE typically trumps any single measure's algorithm/cut-offs, although some studies may still require minimum cut-offs
- No single measure diagnoses autism. Clinicians diagnose autism.

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Developed in 1973 at the Battelle Memorial Institute Columbus Laboratories by Jean Newborg.

Project was initiated by the U.S. Department of Education to provide a uniform measure of developmental progress and to evaluate effectiveness of federally funded Early Childhood Education Programs

Currently, practitioners across all 50 states use the BDI for special services eligibility. Sixteen states use the BDI as a preferred state assessment and anchor tool

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Battelle Developmental Inventory 3

The new Battelle Developmental Inventory (BDI 3) is a comprehensive assessment that measures 6 areas of developmental milestones including:

- Social Emotional (Personal-Social)
- Communication
- Adaptive
- Motor
- Cognitive
- Battelle Early Academic Survey

Battelle 3 is the only assessment on the market that measures these domains from birth to 7 years 11 months. It is the most comprehensive assessment on the market for early childhood and is widely used by early childhood evaluators.

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Standardization and Norms of BDI-3

2500 children completed the Adaptive, Cognitive, Communication, Motor and Social-Emotional domains from 20 age groups with 100 children in each group

Special Group Studies were performed for BDI 3 Standardization

- Autism
- Cognitive Delay
- Motor Delay
- Premature Birth
- Speech and Language Delay
- Broad Developmental Delay

1000 children completed the Spanish Developmental Battery assessment in 20 age groups.

1000 children completed the Battelle Early Academic Survey assessment in 9 age groups.

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BDI-3 Domains and Subdomains

Social-Emotional Domain
- Adult Interaction
- Peer Interaction
- Self- Concept and Social Role

Adaptive Domain
- Self Care
- Personal Responsibility

Motor Domain
- Gross
- Fine
- Perceptual

Communication Domain
- Receptive
- Expressive

Cognitive Domain
- Attention and Memory
- Reasoning and Academic Skills
- Perception and Concepts

Battelle Early Academic Survey
- Literacy
- Mathematics

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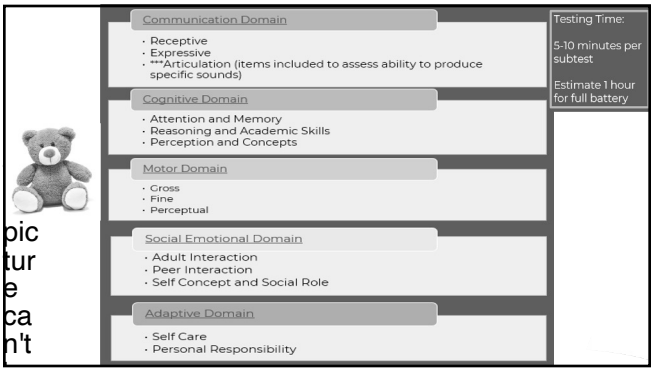

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The BDI-3 Developmental Screening Test

- Allows you to quickly screen and evaluate early developmental milestones to identify children at risk for developmental delays or disabilities.
- Requires no more than 30 minutes for a full administration.
- Consists of a subset of test items from each of the 5 BDI-3 domains.
- Requires only 1 Easel book.
- Quickly screen for school readiness.

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BDI-3 Key Features

Comprehensive measurement of all developmental areas

Conceptualization of *developmental milestones*

Age range of birth through 7 years, 11 months

Complete assessment and screening test

Flexible administration options

Multiple point scoring

Easy to score

Norm, curriculum, and criterion reference base

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Broad Applications and Purposes of the BDI-3

Identify the developmental strengths and opportunities for learning of typically developing infants and children.	Identify the developmental strengths and opportunities for learning of children with disabilities in infant intervention, preschool, kindergarten and primary education programs.	Assessing children as part of a comprehensive evaluation considered to be "at risk" in any developmental area such as ASD.
General screening of preschool and kindergarten children.	Monitoring child progress.	Assessing and developing IEP's and Treatment Plans.

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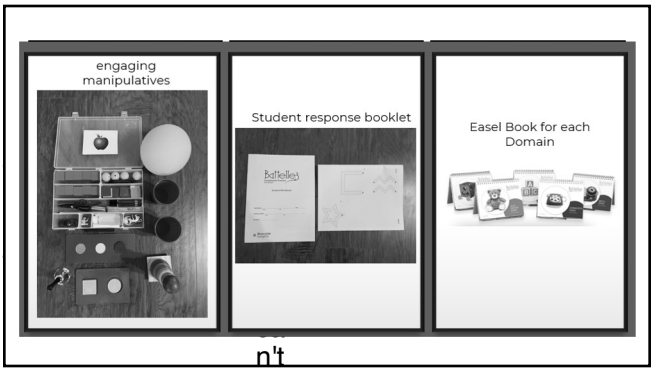

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BEAS Domains and Subdomains

Battelle3 Developmental Inventory 3rd Edition

Literacy
- Print Concepts
- Rhyming
- Phonological Awareness
- Phonics and Word Recognition
- Listening Comprehension
- Fluency

Mathematics
- Numbers Counting and Sets
- Geometry
- Measurement and Data
- Operations and Algebraic Thinking

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Testing time: 35-40 minutes

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Sample Reports- Battelle Developmental

Domain/Subdomain	RS	SS	PR	AE	CSS	CSS 90% CI	Z-Score	T-Score	NCE
Adaptive	**61**	**83**	**13**	**-**	**496**	**490-501**	**-1.13**	**39**	**26**
Self-Care	52	8	25	38	503	496-510	-0.67	43	36
Personal Responsibility	9	5	5	28	488	479-497	-1.67	33	15
Social Emotional	**54**	**63**	**1**	**-**	**408**	**399-417**	**-2.47**	**25**	**<1**
Adult Interaction	0	1	<1	0	280	255-305	-3.00	20	<1
Peer Interaction	9	2	<1	<24	451	442-460	-2.67	23	<1
Self-Concept and Social Role	45	5	5	33	493	487-499	-1.67	33	15
Communication	**61**	**83**	**13**	**-**	**496**	**490-501**	**-1.13**	**39**	**26**
Receptive Communication	52	8	25	38	503	496-510	-0.67	43	36
Expressive Communication	9	5	5	28	488	479-497	-1.67	33	15
Motor	**54**	**63**	**1**	**-**	**408**	**399-417**	**-2.47**	**25**	**<1**
Gross Motor	0	1	<1	0	280	255-305	-3.00	20	<1
Fine Motor	9	2	<1	<24	451	442-460	-2.67	23	<1
Perceptual Motor	61	83	13	-	496	490-501	-1.13	39	26
Cognitive	**52**	**8**	**25**	**38**	**503**	**496-510**	**-0.67**	**43**	**36**
Attention and Memory	9	5	5	28	488	479-497	-1.67	33	15
Reasoning and Academic Skills	0	1	<1	0	280	255-305	-3.00	20	<1
Perception and Concepts	9	2	<1	<24	451	442-460	-2.67	23	<1
BDI-2 Total	**52**	**8**	**25**	**38**	**503**	**496-510**	**-0.67**	**43**	**36**

NCE - The Normal Curve Equivalent is another commonly reported type of standard score that has a mean of 50 and a standard deviation of 21.06.

The CSS scale is centered so that a score of 500 on each subdomain represents the developmental level of a typical 36-month-old.

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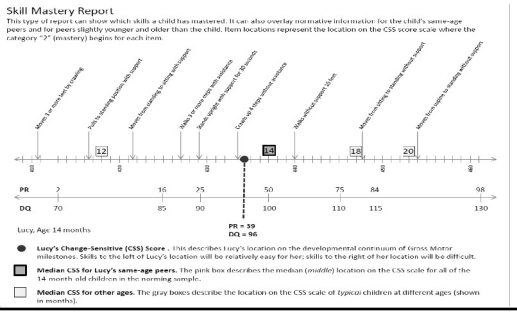
Battelle Developmental Skill Mastery Report



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Battelle Early Academic Survey Sample Reports- Table of Scores- Literacy

Domain/Subdomain/Area	Raw Score	Scaled Score	Standard Score	Percentile Rank	<25%ile Support	25th-49%ile Monitor	>=50%ile On Track
Literacy			100	75	x		
Print Concepts	8	8		25		x	
Phonological Awareness		5		5			x
Syllables	6				x		
Onset Rime	7					x	
Phoneme Identification	8						x
Phoneme Blending and Segmenting	4				x		
Phoneme Manipulation	3					x	
Phonics And Word Recognition		5		5			x
Letter Identification	8				x		
Letter Sound Correspondence	7					x	
Early Decoding	5						x
Sight Words	2				x		
Nonsense Words	3					x	
Long Vowel Patterns	8						x
Inflectional Endings	7				x		
Listening Comprehension	8	8		25		x	
Fluency	7	5		5			x

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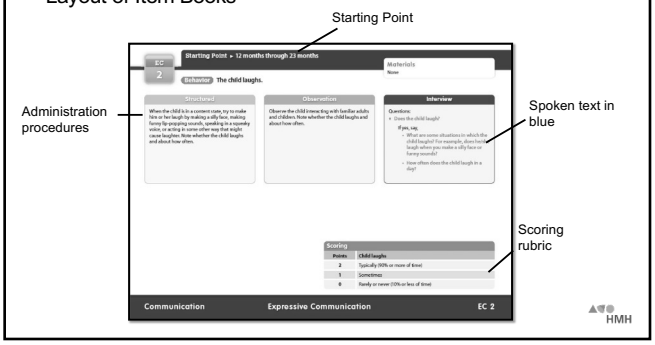
Layout of Item Books



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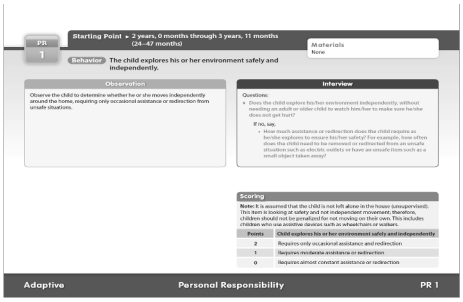
Sample New Item- Adaptive Domain



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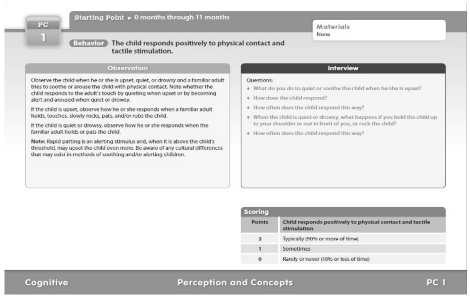
Sample New Item- Cognitive Domain



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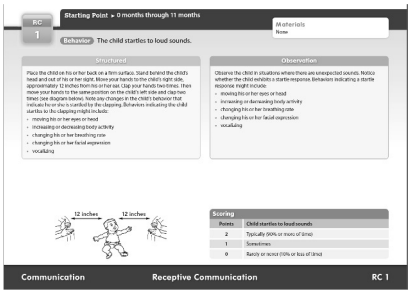
Sample New Item- Communication Domain



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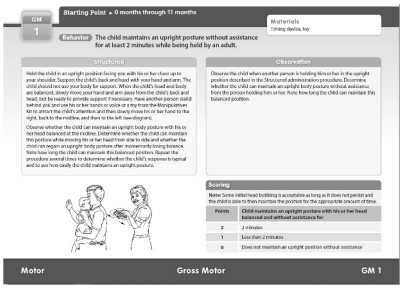
Sample New Item- Motor Domain



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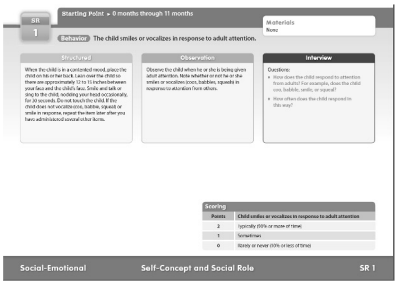
Sample New Item- Social-Emotional Domain



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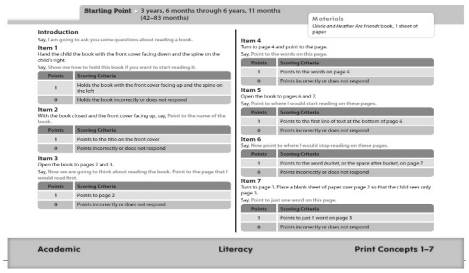
Sample New Item- Early Academic Domain



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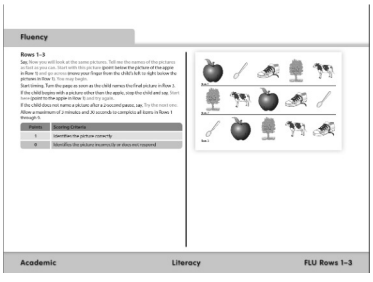
Sample New Item- Early Academic Domain



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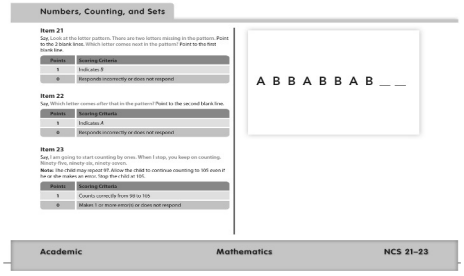
Sample New Item- Early Academic Domain



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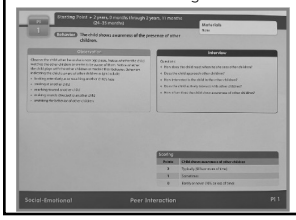
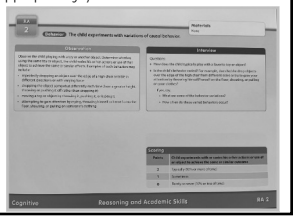
Using the BDI-3 as Part of an ASD Assessment Focused on ASD Behaviors

30+ items on the BDI-3 complete have been aligned with the DSM-5 criteria for ASD

Example : **Persistent deficits in social communication and social interaction**
→ Cross validate ASRS (i.e., smile appropriately? look at others when interacting with them?



Example : **Restricted, Repetitive Patterns of Behavior, interests and/or activities**
→ Cross validate ASRS (i.e., play with toys appropriately?)



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BDI-3 Scoring & Reporting

- BDI-3 scoring can be completed through the web-based **Riverside Score** system - a secure, web-based environment where examiners can easily enter raw scores, assessment data, and test session observations.
- BDI-3 Developmental Complete Sample Report

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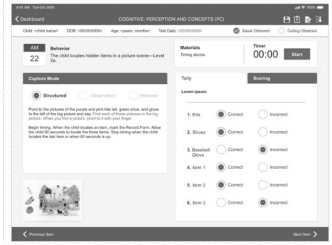
Mobile data solution (BDI-3 MDS)

- Administer the BDI-3 on-the-go using a compatible Windows Device or tablet.
- Use it with any combination of the complete test, screening test or BEAS
- Timer capability
- In-the-moment scoring
- Combines examiner test easel instructions and examiner test record forms
- Reduce human error with basal and ceiling indicators
- Can also use offline & synch back to Riverside Score once internet connection is available



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Conclusions

- Our focus in ASD definition, diagnosis and treatment is shifting to a disorder of primarily social functioning.
- ASD is a lifespan condition.
- The identification of ASD is shifting to a technology driven assessment of critical biological variables (e.g. eye gaze)
- Children with ASD demonstrate measurable abnormalities in development that can be reliably and validly measured to design individualized treatment.
- The Battelle 3 offers a viable means to assess key developmental areas as part of a comprehensive evaluation for young children with ASD.

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www.samgoldstein.com
info@samgoldstein.com
@drsamgoldstein
@doctorsamgoldstein
@CommonSenseScience
TRUTH. @CommonSenseScience

TEDx
Sam Goldstein, Ph.D.
sam@samgoldstein.com
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