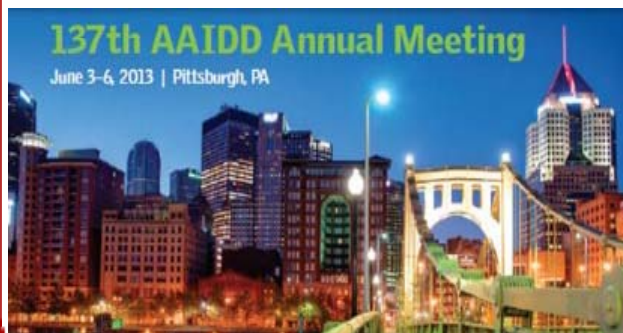


FINALLY... AN ADAPTIVE BEHAVIOR SCALE FOCUSED ON
PROVIDING PRECISION AT THE DIAGNOSTIC CUT-OFF.

How Item Response Theory Contributed to the Development of the DABS

Marc J. Tassé, PhD
Nisonger Center - UCEDD
The Ohio State University

Marc.Tasse@osumc.edu



June 4, 2013
Pittsburgh, PA



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Nisonger Center

Co-authors

David M. Thissen, PhD, University of North Carolina at Chapel Hill

Robert L. Schalock, PhD, Hastings College

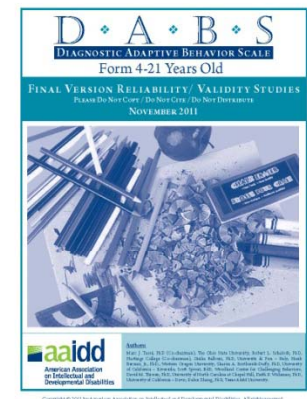
Giulia Balboni, PhD, Università di Pisa - Italy

Sharon A. Borthwick-Duffy, PhD, University of California - Riverside

Scott Spreat, EdD, Woodland Center for Challenging Behaviors

Keith F. Widaman, PhD, University of California - Davis

Dalun Zhang, PhD, Texas A&M University



Why Use IRT?

Items have their own properties.

Those item properties don't change.



Present items that inform our assessment.

Reliability is not the same across ability level.

Focus on reliability (information function) at the cut-off - not the mean.

Why Use IRT?

Using an IRT scoring system based on item response patterns, it is possible to compute comparable scores for individuals when some items are not scored (e.g., “no score” => treated as missing data).

“Missing data” will - logically - have an impact on the error estimate around the obtained standard score.

Item response theory (IRT) is a collection of mathematical models and statistical methods that were used in (1) the **item calibration**, (2) **item selection process** for the DABS, and (3) the **computation of DABS scores**.



Item Response Theory

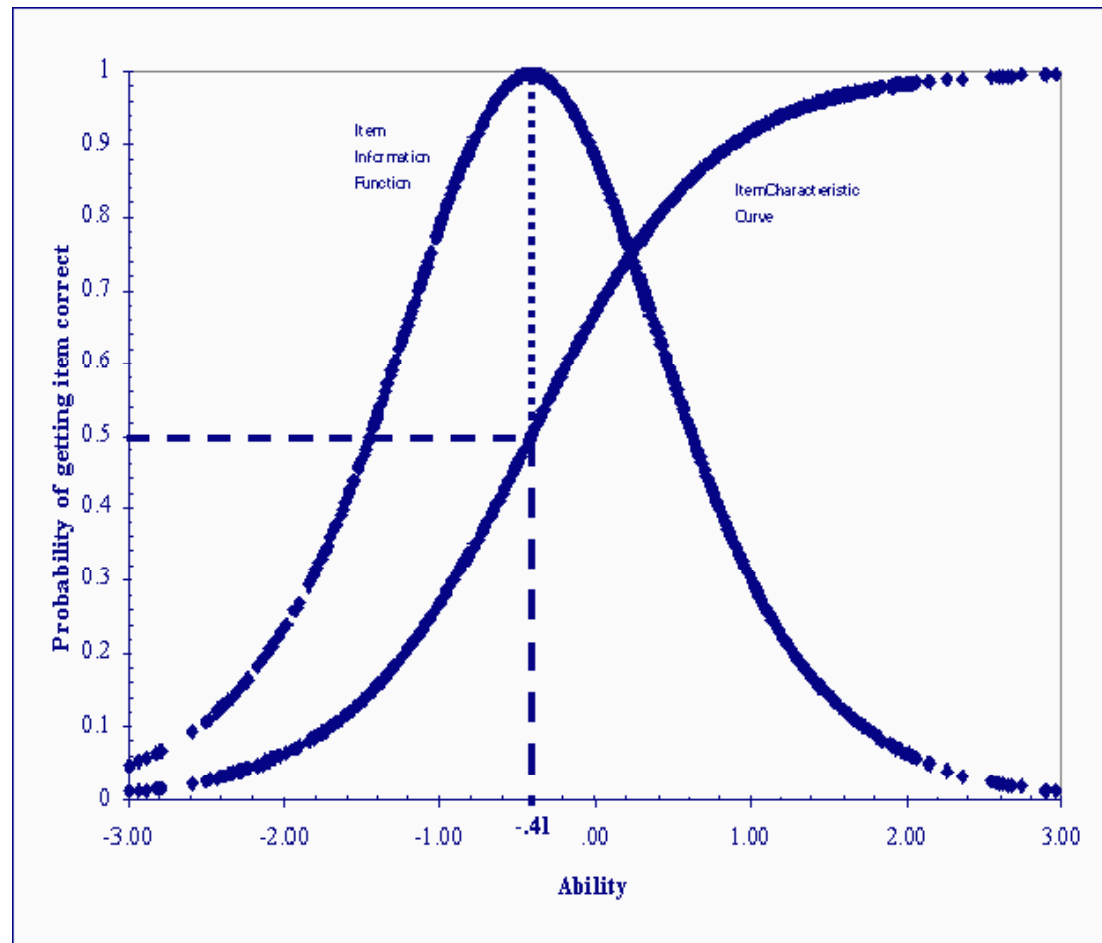
A test item is characterized by three distinct item parameters:

- **Item difficulty** parameter (e.g., higher the difficulty parameter - the more skill you must possess to achieve this item)
- **Item discrimination** parameter (i.e., how good is this item at differentiating between persons with high and low adaptive skills?)
- **Pseudo-guessing** parameter (i.e., what is the likelihood of someone succeeding this item by chance?)



Item Response Theory

A test item is characterized by three distinct item parameters (Item Characteristic Curve):



Item Response Theory

Item/Test Information Function:

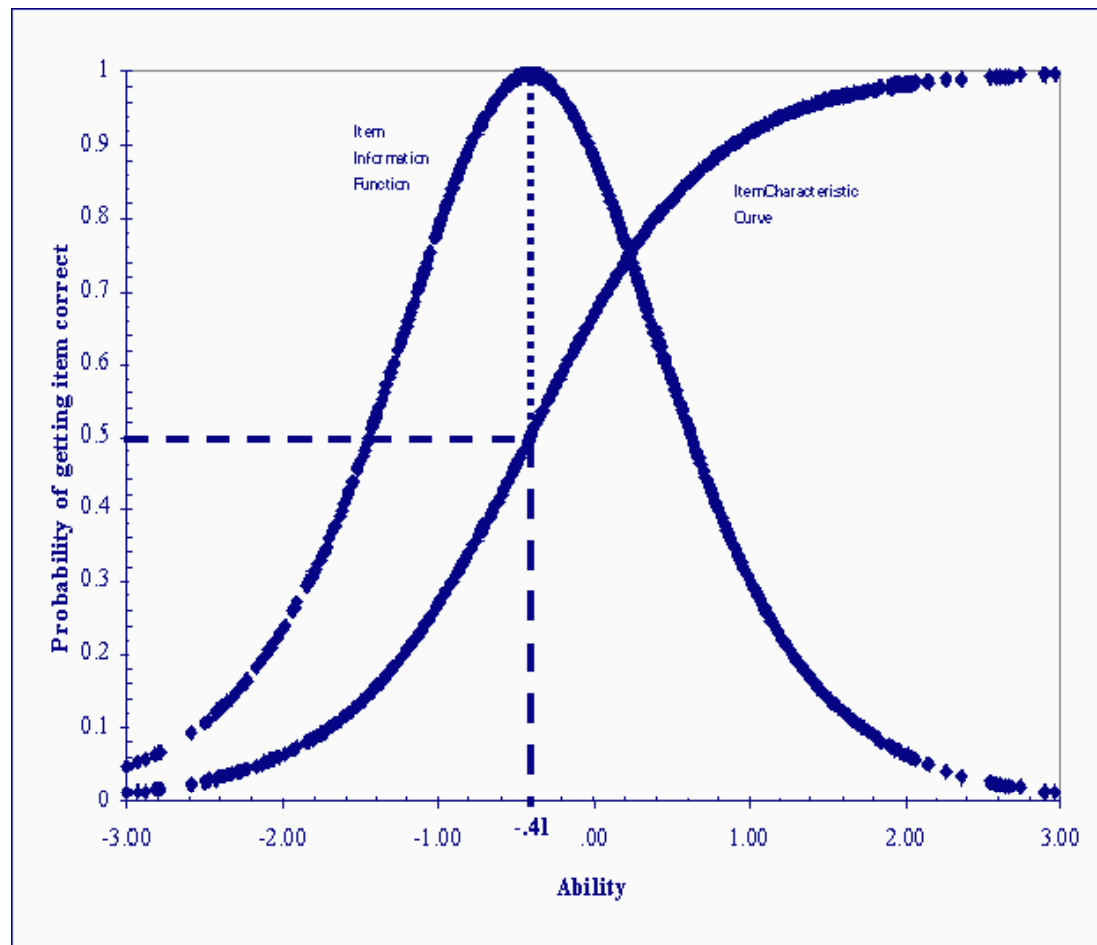
When you speak of having information, it implies that you know something about a particular subject or object. In psychometrics, the term *information conveys a similar, but somewhat more technical, meaning.*

In IRT the meaning of **information** is the “precision” (what we call in CTT = reliability) with which a parameter could be estimated. In IRT, the precision with which a parameter is estimated is measured by the variability of the estimates around the value of the parameter.



Item Response Theory

Item/Test Information Function:



Item Parameter Estimation

Samejima - "graded response model"

Samejima (1969, 1997) developed graded response models (GRM) for items with more than two ordered response alternatives (right/wrong); these models are widely used for items with categorical response scales like the Likert-type agree-disagree format. The logistic version of the GRM was used to calibrate the DABS items.

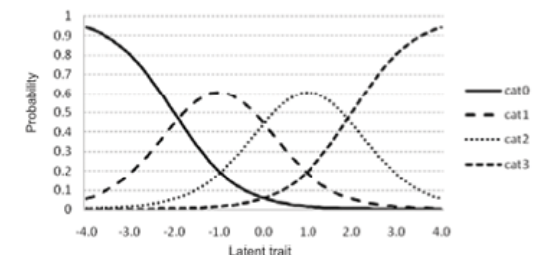
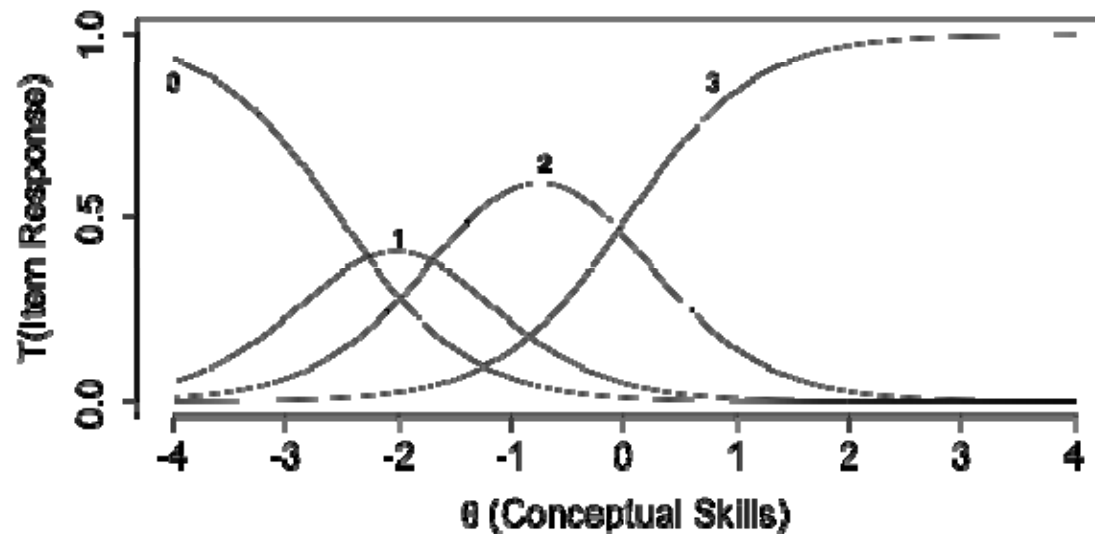


Figure 2 - CCI of the Graded Response Model of an item with $a=1.4$ and $b_1=-2.0$, $b_2=0.0$, $b_3=2.0$.

DABS Rating System

- 0 = No, rarely or never does it. (no ability)
- 1 = Yes, does it with reminders or assistance but rarely or never independently (partial ability)
- 2 = Yes, does it sometimes independently - but sometimes needs reminders or assistance (partial ability+)
- 3 = Yes - does it always or almost always independently - never or rarely needs reminders or assistance (full ability)
- NS = No Score (missing information / skip)



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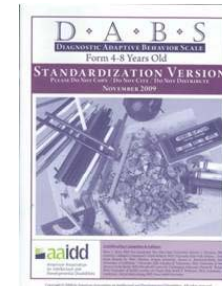
DABS Standardization - 3 Age Forms

DABS (4 - 8 year olds): 132 items

Conceptual Skills: 54 items

Social Skills: 49 items

Practical Skills: 29 items

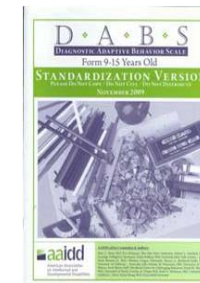


DABS (9 - 15 year olds): 192 items

Conceptual Skills: 81 items

Social Skills: 70 items

Practical Skills: 41 items

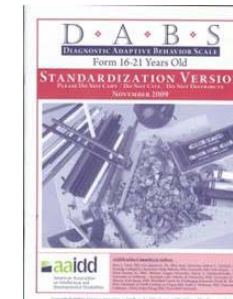


DABS (16 - 21 year olds): 128 items

Conceptual Skills: 40 items

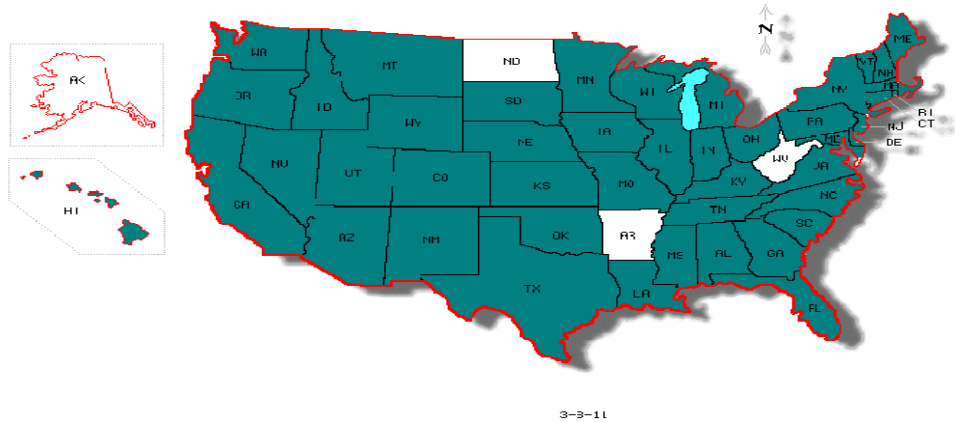
Social Skills: 37 items

Practical Skills: 51 items



Standardization (sample)

Standardization sample
recruited from 47 of 50
US states



CENSUS REGION	DABS (N = 1,058)	2000 US Census
West	22.1%	22.5%
Midwest	25.7%	22.9%
South	32.1%	35.6%
Northeast	20.2%	19.0%



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Standardization (sample)

Persons Assessed

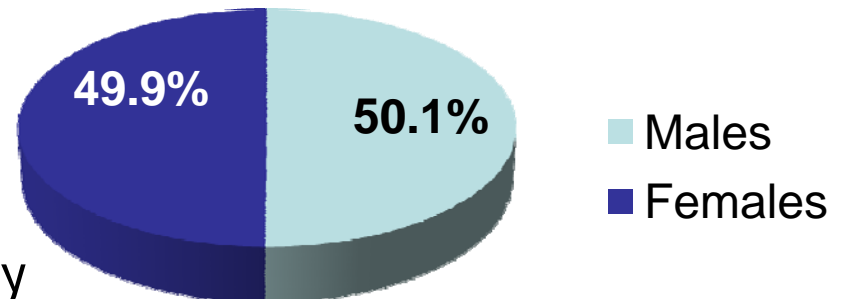
The standardization sample was composed of 1,058 individuals from the general population - between the ages of 4 and 21.

Age:

Mean = 11.1 years (SD = 4.9 years)

Min/Max = 4 - 21 years old

Gender

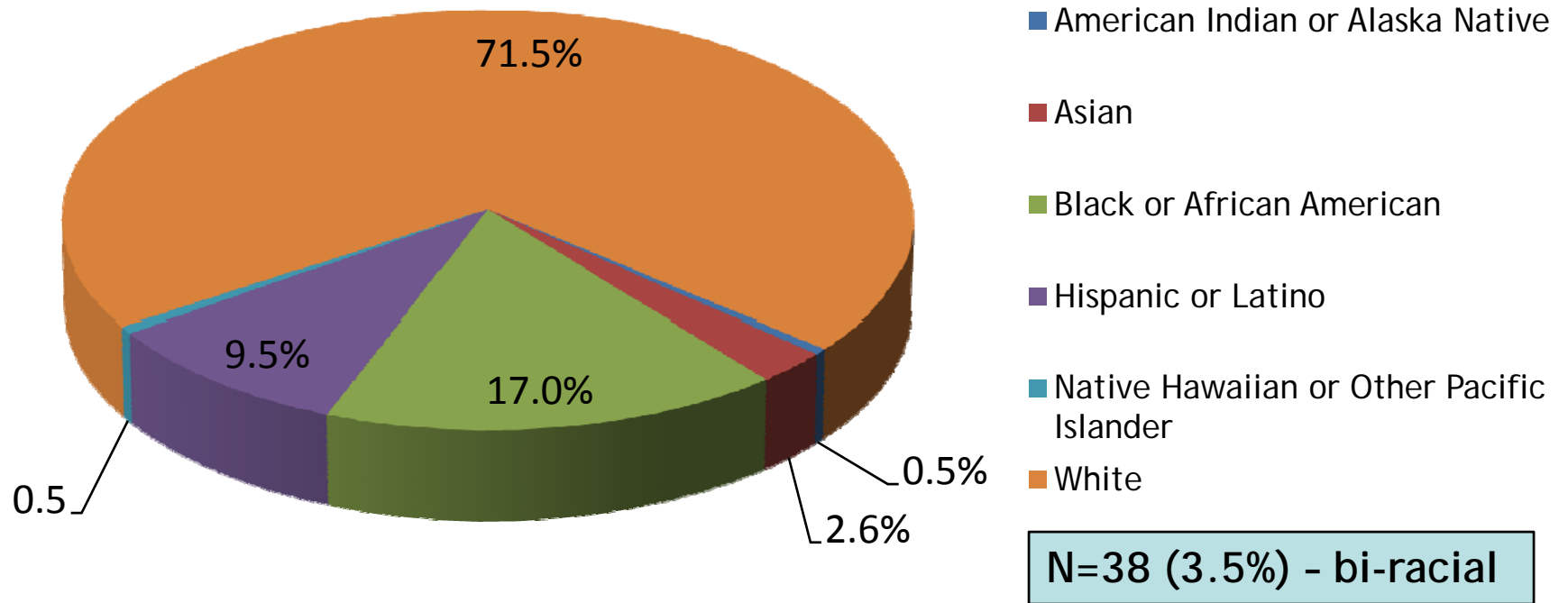


Intellectual Disability:

- 12% Dx of ID/Developmental Delay
- 88% no ID or DD

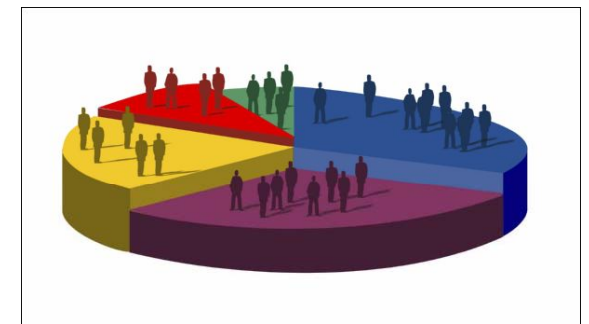
Standardization (sample)

Person-Assessed Race/Ethnicity



Standardization (sample)

Ethnicity	DABS (N = 1,058)	2000 US Census
American Indian or Alaska Native	0.5%	.9%
Asian	2.6%	3.6%
Black or African American	17.0%	12.3%
Hispanic or Latino	9.5%	12.5%
Native Hawaiian or other Pacific Islander	0.6%	.1%
White	71.5%	75.1%



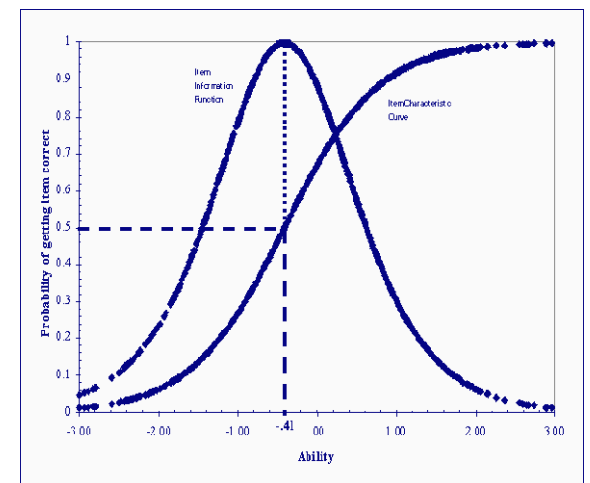
Refining the DABS Item Pool Using IRT

Four IRT-related criteria were used to select the final items composing each age-based DABS scale. These four criteria were employed within the authors' proscribed test length of 75 total items per age (4-8, 9-15, and 16-21) scale.



Refining the DABS Using IRT

1. Choose items to make up a relatively unidimensional set within each of the three skills areas (conceptual, social, and practical). “Unidimensional” was defined operationally as a relatively high value of explained common variance attributable to the general factor in a bi-factor IRT model fitted to the data. In the IRT analysis results, larger values of ‘common variance explained’ (near 1.0) are good; smaller values are not so good. Item selection was on retaining items with larger values.



Refining the DABS Using IRT

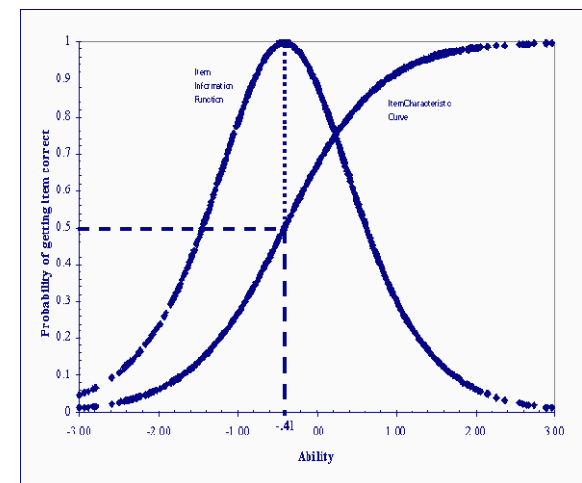
2. Retain balance among the sub-domains. In both the Field Test Manual and the Standardization Study Assessment Manual sub-domains within each skill area were included. For example, conceptual skills (as a skill area) included a number of sub-domain skills such as language, reading and writing, money use, self-direction, etc. Social skills similarly included skills such as interpersonal, responsibility, gullibility, etc. Practical skills included activities of daily living, occupational skills, use of money, etc.

In the process of making the scales unidimensional, we also wanted to make each scale unidimensional, but retaining to the extent possible a balance among the sub-domains. This was done by ensuring that each of the skill areas contained one or more of the age-specific sub-domain items.

Refining the DABS Using IRT

3. Choose items that have lower missing data proportions. Thus, those items with high missing data proportions (operationally defined as ‘NS-no score’) were excluded from the item pool.
4. Choose the items that have relatively **high information value**. In the IRT analysis, these items were identified as having “high Fisher information.”

Items were selected, within the parameters of the above three criteria, that are informative, especially in the lower range of adaptive skills where the cutoff score falls.



Refining the DABS Using IRT

Summary of Unique & Linked Items on the DABS

DABS Forms

<i>Domain</i>	<i>4-8 y.o.</i> <i>(Ni=132)</i>	<i>(4-8 & 9-15)</i>	<i>9-15 y.o.</i> <i>(Ni=192)</i>	<i>(9-15 & 16-21)</i>	<i>16-21 y.o.</i> <i>(Ni=128)</i>
Conceptual Skills	25 items 16 unique	9 link	25 items 7 unique	9 link	25 items 16 unique
Social Skills	25 items 14 unique	11 link	25 items 5 unique	9 link	25 items 16 unique
Practical Skills	25 items 7 unique	18 link	25 items 0 unique	7 link	25 items 18 unique

DABS Item Parameters

Table. Graded Model Parameter Estimates for the Conceptual Skills Items, Ages 16-21

Items		a	b ₁	b ₂	b ₃
1	Completes job applications.	2.08	-1.19	-0.52	0.26
2	Looks up needed information in dictionary, encyclopedia, or computer.	3.47	-1.72	-1.07	-0.36
3	Reads important documents (e.g., class registration, school/work policies, credit card application).	2.27	-1.43	-0.81	0.37
4	Reads tags to find clothing of the correct size in a store.	2.28	-1.79	-1.34	-0.74
5	Makes a list (e.g., things to do, things to buy).	1.40	-1.74	-1.06	-0.19
6	Writes clear complex sentences such as in letters, E-mails, or other notes.	3.47	-1.40	-1.01	-0.41
7	Can tell the value of monetary bills of different denominations.	3.31	-2.01	-1.54	-1.14
8	Checks for correct change after buying an item.	2.29	-1.36	-0.83	0.01
9	Gives clerk the correct amount of money to buy an item.	3.32	-1.68	-0.99	-0.37
10	Makes purchases after comparing similar products to determine the better value.	2.66	-1.30	-0.63	0.16

Refining the DABS Using IRT

D ♦ A ♦ B ♦ S DIAGNOSTIC ADAPTIVE BEHAVIOR SCALE Form 4-21 Years Old

FINAL VERSION RELIABILITY/ VALIDITY STUDIES
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NOVEMBER 2011



Authors:
Marc J. Tassé, PhD (Co-chairman), The Ohio State University, Robert L. Schalock, PhD, Hastings College (Co-chairman), Giulia Balboni, PhD, Università di Pisa - Italy, Hank Bersani, Jr., PhD, Western Oregon University, Sharon A. Northwilde-Duffy, PhD, University of California - Riverside, Scott Sprent, EdD, Woodland Center for Challenging Behaviors, David M. Thissen, PhD, University of North Carolina at Chapel Hill, Keith F. Widaman, PhD, University of California - Davis, Dahn Zhang, PhD, Texas A&M University.

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4-8 Years Old => START HERE

CONCEPTUAL SKILLS

Conceptual skills encompass receptive and expressive language, reading and writing, self-direction, time, numbers/measures, and problem solving.

Rating System:

- "0" No – rarely or never does it.
- "1" Yes – does it with reminders or assistance but rarely or never independently.
- "2" Yes – does it sometimes independently – but sometimes needs reminders or assistance.
- "3" Yes – does it always or almost always independently – never or rarely needs reminders or assistance.
- "NS" No Score – has a physical impairment that impedes performance of this skill. / No Score – lacks opportunity due to cultural, gender, and/or geographic/regional factors / No Score – lacks opportunity due to environmental constraints. / No Score – the respondent has no direct knowledge of the individual's typical performance.

1	Communicates complex ideas through oral, sign, or written language (including assistive technology).	0	1	2	3	NS
2	Uses verb tenses (e.g., past, present, future).	0	1	2	3	NS
3	Relates experiences in narrative form (i.e., tells stories).	0	1	2	3	NS
4	Uses factual information to defend a position during a discussion.	0	1	2	3	NS
5	Arranges words alphabetically.	0	1	2	3	NS
6	Reads newspapers, books, or other materials.	0	1	2	3	NS
7	Writes first name, copying from an example.	0	1	2	3	NS
8	Writes at least 10 words from memory.	0	1	2	3	NS
9	Writes first and last name correctly without an example.	0	1	2	3	NS
10	Writes short notes or messages.	0	1	2	3	NS
11	Follows written classroom or work schedule.	0	1	2	3	NS
12	Reads at least 10 words.	0	1	2	3	NS
13	Recognizes all letters of the alphabet. (Letters may be out of sequence.)	0	1	2	3	NS
14	Weighs possible consequences before making a decision.	0	1	2	3	NS
15	States complete home address (including zip code).	0	1	2	3	NS
16	Adapts activities to coincide with the current season or weather conditions.	0	1	2	3	NS
17	Refers to things he/she has done or will do within a specified time, such as last week or next month.	0	1	2	3	NS
18	Shows an understanding of the difference between day-week, minute-hour, month-year, etc.	0	1	2	3	NS
19	States correct day, month, and year of birth.	0	1	2	3	NS
20	Refers correctly to "morning," "afternoon," "evening," and "night."	0	1	2	3	NS
21	Locates important dates on a calendar (e.g., birthdays or holidays).	0	1	2	3	NS
22	Demonstrates knowledge of days of the week, in the correct order.	0	1	2	3	NS
23	Demonstrates knowledge of months of the year, in the correct order.	0	1	2	3	NS
24	Counts at least 10 objects, one by one.	0	1	2	3	NS
25	Can identify when there is a problem.	0	1	2	3	NS

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Refining the DABS Using IRT

4-8 Years Old

SOCIAL SKILLS

Social skills encompass interpersonal relations, responsibility, self-esteem, follows rules/obeys laws, manners, and social problem solving.

Rating System:

- "0" No – rarely or never does it.
 "1" Yes – does it with reminders or assistance but rarely or never independently.
 "2" Yes – does it sometimes independently – but sometimes needs reminders or assistance.
 "3" Yes – does it always or almost always independently – never or rarely needs reminders or assistance.
 "NS" No Score – has a physical impairment that impedes performance of this skill. / No Score – lacks opportunity due to cultural, gender, and/or geographic/regional factors / No Score – lacks opportunity due to environmental constraints. / No Score – the respondent has no direct knowledge of the individual's typical performance.

1	Reaches mutual agreement with others when in disagreement.	0	1	2	3	NS
2	Identifies relationships between people when asked (e.g., "That's Fred's mother," "He's John's brother," etc.).	0	1	2	3	NS
3	Contributes as a constructive member of his/her social group.	0	1	2	3	NS
4	Places reasonable demands on friends (e.g., does not become upset when a friend goes out with others and doesn't invite him/her).	0	1	2	3	NS
5	Stays on the topic in group conversations.	0	1	2	3	NS
6	Recognizes/anticipates the likely consequences of another person's plan/proposal.	0	1	2	3	NS
7	Asks for help when needed.	0	1	2	3	NS
8	Tries to help others when a legitimate request is made.	0	1	2	3	NS
9	Avoids saying things or asking questions that embarrass or hurt others.	0	1	2	3	NS
10	Offers help before needing to be asked.	0	1	2	3	NS
11	Acts upon instructions given.	0	1	2	3	NS
12	Accurately evaluates own abilities (i.e., doesn't over/under estimate).	0	1	2	3	NS
13	Accepts compliments.	0	1	2	3	NS
14	Follows rules and regulations when playing games (e.g., board games, sports, etc.).	0	1	2	3	NS
15	Responds to hints or indirect social cues in conversation (e.g., yawning, looking at their watch, etc.).	0	1	2	3	NS
16	Says "Thank you," "I'm sorry," "Excuse me," etc. when appropriate.	0	1	2	3	NS
17	Says "hello" or "hi" and "good-bye" or "bye" when coming and going.	0	1	2	3	NS
18	Shows concern for the feelings of others.	0	1	2	3	NS
19	Stands a comfortable distance from others during conversations, as appropriate for culture.	0	1	2	3	NS
20	Waits for appropriate moment in a conversation to speak.	0	1	2	3	NS
21	Shows emotions/feelings appropriately.	0	1	2	3	NS
22	Makes compromises to resolve conflicts.	0	1	2	3	NS
23	Appropriately responds to social cues from others used to express their emotional state (e.g., anger, difference of opinion, etc.).	0	1	2	3	NS
24	Identifies problems when they occur.	0	1	2	3	NS
25	Responds appropriately to humor.	0	1	2	3	NS

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4-8 Years Old

PRACTICAL SKILLS

Practical skills encompass activities of daily living, maintaining a safe environment/safety, health care, and schedules/routines.

Rating System:

- "0" No – rarely or never does it.
 "1" Yes – does it with reminders or assistance but rarely or never independently.
 "2" Yes – does it sometimes independently – but sometimes needs reminders or assistance.
 "3" Yes – does it always or almost always independently – never or rarely needs reminders or assistance.
 "NS" No Score – has a physical impairment that impedes performance of this skill. / No Score – lacks opportunity due to cultural, gender, and/or geographic/regional factors / No Score – lacks opportunity due to environmental constraints. / No Score – the respondent has no direct knowledge of the individual's typical performance.

1	Adjusts the water flow at the faucet.	0	1	2	3	NS
2	Adjusts the water temperature at the faucet.	0	1	2	3	NS
3	Cares for toileting needs.	0	1	2	3	NS
4	Controls bowels and bladder during the day.	0	1	2	3	NS
5	Uses the restroom.	0	1	2	3	NS
6	Controls bladder at night time.	0	1	2	3	NS
7	Fastens/straightens clothing after using the restroom.	0	1	2	3	NS
8	Uses the restroom in familiar settings.	0	1	2	3	NS
9	Uses the restroom in unfamiliar settings.	0	1	2	3	NS
10	Puts on shoes.	0	1	2	3	NS
11	Adjusts shirt/sweater if in-side is out.	0	1	2	3	NS
12	Puts on clothing.	0	1	2	3	NS
13	Dresses appropriately depending on occasion.	0	1	2	3	NS
14	Selects clothing that is appropriate for weather/season.	0	1	2	3	NS
15	Takes bites of food that are of appropriate size.	0	1	2	3	NS
16	Chooses appropriate utensils.	0	1	2	3	NS
17	Drinks from cup or glass with no spilling.	0	1	2	3	NS
18	Eats without making a mess.	0	1	2	3	NS
19	Tests hot liquids/foods before drinking/eating.	0	1	2	3	NS
20	Discriminates between potentially dangerous items from safe ones.	0	1	2	3	NS
21	Shows safety awareness when crossing streets (e.g., checks for traffic before crossing streets, driveways, and parking lots).	0	1	2	3	NS
22	Stays with group during group activities without wandering away.	0	1	2	3	NS
23	Communicates to others when not feeling well.	0	1	2	3	NS
24	Regulates body temperature by finding shade when hot or going indoors when cold.	0	1	2	3	NS
25	Follows a daily schedule.	0	1	2	3	NS

4-8 Years Old => STOP HERE

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DABS Scores

IRT Response Pattern Scoring - using Samejima - "graded response model".

Samejima models are widely used for items with categorical response scales like the Likert-type agree-disagree format.

The logistic version of the GRM is used in scoring the DABS protocols.

We use a 2-parameter model for estimating the person's level of adaptive behavior: (1) Item Difficulty & (2) Item Discrimination



DABS Scores

IRT Response Pattern Scoring - using Samejima -
“graded response model” .

0 = no ability

1 = partial ability

2 = partial ability+

3 = full ability

NS = no score / missing information / skip



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DABS Online Scoring

This is a prototype web scoring system for the DABS, using a preliminary Java applet. If Java is not installed on your computer, you will need to install it.

Usage:

Enter the person's age in the box below, using values 4-21; for persons over 21, enter 21.

Then enter the item responses for the CS, SS, and PS scales in the designated boxes, in the order in which the items are presented in the booklet, using numbers:

- 0: No - rarely or never does it
- 1: Yes - does it with reminders or assistance but rarely or never independently
- 2: Yes - does it sometimes independently - but sometimes needs reminders or assistance
- 3: Yes - does it always or almost always independently - never or rarely needs reminders or assistance

Enter a single space for any item with No Score:

- No Score - has a physical impairment that impedes performance of this skill.
- No Score - lacks opportunity due to cultural, gender, and/or geographic/regional factors
- No Score - lacks opportunity due to environmental constraints.
- No Score - the respondent has no direct knowledge of the individual's typical performance.

Then click the Compute Scores button to see the scores in the lower box.

Enter age in years:

Enter CS responses (0-3, blank for No Score):

Enter SS responses (0-3, blank for No Score):

Enter PS responses (0-3, blank for No Score):

Scores:

Technical output:

DABS Online Scoring

Then click the Compute Scores button to see the scores in the lower box.

Enter age in years:

Enter CS responses (0-3, blank for No Score):

Enter SS responses (0-3, blank for No Score):

Enter PS responses (0-3, blank for No Score):

Scores:

Technical output:





DESCRIPTION AND SUMMARY RESULTS

PERSON ASSESSED

Unique ID: SAMPLE
 Age: 12
 Gender: Male
 Date of Evaluation: 7/25/2012

INTERVIEWER

Name: John Doe

RESPONDENT

Relationship to Person Assessed: Parent

The Diagnostic Adaptive Behavior Scale (DABS) is an individually administered standardized measure of adaptive behavior. The DABS is unique in that was specifically designed and developed to ensure congruence with the AAIDD definition of Intellectual Disability. For the purpose of this assessment instrument, adaptive behavior is defined as the collection of conceptual, social, and practical skills that have been learned and are performed by people in their everyday lives (Schalock et al., 2010). The DABS is composed of 75 items, broken up into the three primary domains of adaptive behavior. Typical administration time is between 20-30 minutes. The DABS was developed to be administered via interview with a parent, grandparent, caregiver, teacher, or other respondent who knows well the person whose adaptive behavior is being assessed.

The primary purpose of the DABS is diagnostic and it has been standardized to assess the adaptive behavior of persons between the ages of 4 and 21 years old, inclusively. The DABS was developed using Item Response Theory methodology to provide precise diagnostic information around the point where an individual presents significant limitations in adaptive behavior. A significant limitation in adaptive behavior is one of the three criteria needed to make a diagnosis of intellectual disability (the other two being significant limitations in intellectual functioning and age of onset before 18 years). The DABS is intended to examine adaptive skills across different age ranges that most often distinguish between persons who do and do not have an intellectual disability. The standard scores are presented on a population-referenced metric where the mean score is 100 and the standard deviation is 15.

IMPORTANT

These DABS results must be interpreted with caution. Although the DABS was developed using a rigorous methodology and national standardization, the current study is the first to examine the reliability and validity of this instrument.

DABS Results

	Standard Score	Standard Error of Measurement
Conceptual Skills	76	± 2
Social Skills	86	± 3
Practical Skills	69	± 3
Composite Score	74	± 2



AAIDD DABS Co-authors:

Marc J. Tassé, PhD (Chairman), The Ohio State University; Robert L. Schalock, PhD (Co-Chairman), Hastings College; Giulia Balboni, PhD, Università di Pisa- Italy; Hank Bersani, Jr., PhD., Western Oregon University; Sharon A. Borthwick-Duffy, PhD ; University of California – Riverside; Scott Spreat, EdD, Woodland Center for Challenging Behaviors; David M. Thissen, PhD, University of North Carolina at Chapel Hill; Keith F. Widaman, PhD, University of

D ♦ A ♦ B ♦ S

DIAGNOSTIC ADAPTIVE BEHAVIOR SCALE

DESCRIPTION AND SUMMARY RESULTS

PERSON ASSESSED

Unique ID: SAMPLE
 Age: 12
 Gender: Male
 Date of Evaluation: 7/25/2012

INTERVIEWER

Name: John Doe

RESPONDENT

Relationship to Person Assessed: Parent

The Diagnostic Adaptive Behavior Scale (DABS) is an individually administered standardized measure of adaptive behavior. The DABS is unique in that was specifically designed and developed to ensure congruence with the AAIDD definition of Intellectual Disability. For the purpose of this assessment instrument, adaptive behavior is defined as the collection of conceptual, social, and practical skills that have been learned and are performed by people in their everyday lives (Schalock et al., 2010). The DABS is composed of 75 items, broken up into the three primary domains of adaptive behavior. Typical administration time is between 20-30 minutes. The DABS was developed to be administered via interview with a parent, grandparent, caregiver, teacher, or other respondent who knows well the person whose adaptive behavior is being assessed.

The primary purpose of the DABS is diagnostic and it has been standardized to assess the adaptive behavior of persons between the ages of 4 and 21 years old, inclusively. The DABS was developed using Item Response Theory methodology to provide precise diagnostic information around the point where an individual presents significant limitations in adaptive behavior. A significant limitation in adaptive behavior is one of the three criteria needed to make a diagnosis of intellectual disability (the other two being significant limitations in intellectual functioning and age of onset before 18 years). The DABS is intended to examine adaptive skills across different age ranges that most often distinguish between persons who do and do not have an intellectual disability. The standard scores are presented on a population-referenced metric where the mean score is 100 and the standard deviation is 15.

IMPORTANT

These DABS results must be interpreted with caution. Although the DABS was developed using a rigorous methodology and

DABS Results

	Standard Score	Standard Error of Measurement
Conceptual Skills	76	± 2
Social Skills	86	± 3
Practical Skills	69	± 3
Composite Score	74	± 2

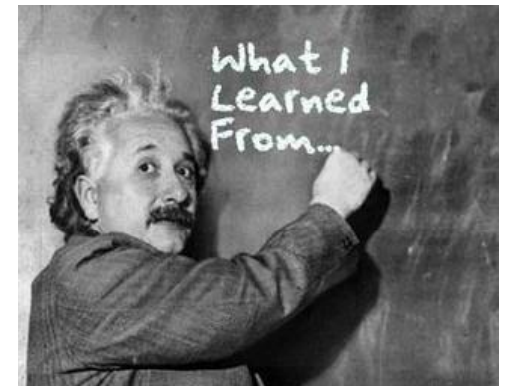
DABS Standard Scores

Standard Scores (Mean = 100, SD = 15)

<u>DABS Results</u>		
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Composite Score	74	± 2

Concluding Remarks

- ✓ Focused on providing information of “significant limitations” in adaptive behavior => for rule-in/out of diagnosis;
- ✓ Recent norms based on general population;
- ✓ Items selection based on IRT;
- ✓ Use of item difficulty and item discrimination;
- ✓ Scoring of DABS based on IRT;
- ✓ Reliability/Information Function focused at “cut-off”.



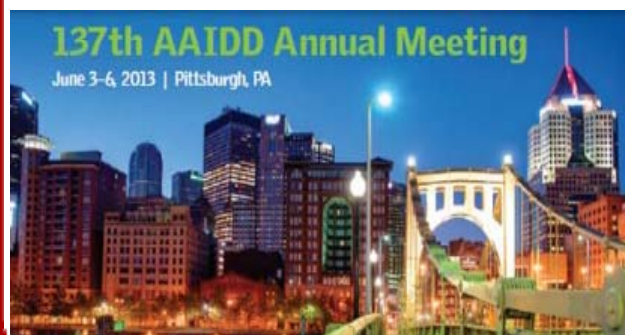


FINALLY... AN ADAPTIVE BEHAVIOR SCALE FOCUSED ON
PROVIDING PRECISION AT THE DIAGNOSTIC CUT-OFF.

How Item Response Theory Contributed to the Development of the DABS

Marc J. Tassé, PhD
Nisonger Center - UCEDD
The Ohio State University

Marc.Tasse@osumc.edu



June 4, 2013
Pittsburgh, PA



THE OHIO STATE UNIVERSITY

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