Fluid Reasoning, Contextual Reasoning, and Culturally Diverse Students

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Opinions of IQ assessments?

Intelligence – Definition

- No one definition exists according to Wasserman (2012).
- A safe definition can be found in Merriam-Webster's Online Dictionary (2022):

"…the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (such as tests)."

Background on IQ measures

- First used in France, early 20th century.
- A measure of one's abilities related to problem solving, general intelligence (g)
- Helped predict academics and life success.
- Not free of controversy.
- Seem to favor some groups over others (High vs Low SES).
- Illegal for some populations in some states
- Used across the globe, present day, in schools and clinics.
- 99% of school psychologists surveyed reported IQ testing as the main part of their job in the past decade.

(American Psychological Association, 2004; Benjamin, 2009; Kaufman, 2009; Laundra, & Sutton, 2008; NASP, 2020; Powers & Hagens-Murillo, 2004 Wasserman, 2012; Wechsler, 2014)

Questions?

Reasoning

One’s ability to think about and understand information, discriminate between different types of information and execute a plan or strategy based on that same information.

(Salmon, 1991)

Is reasoning related to I.Q.?

Reasoning dictates how we think, interpret, and act on stimuli in front of us.

General Intelligence(g)/Fluid Intelligence (Gf) - One's ability to use deductive/mathematical logic, abstractly thinking, and generalize.

G and Gf have been affiliated with types of reasoning, vice versa.

G/Gf - Central to cognition and a fundamental element of virtually **every assessment of cognition/processing** available.

Gf and Gc have highest correlation to g.

(Ferrer, O'hare, & Bunge, 2009; Perkins, Farady, and Bushy, 1991)

Formal Reasoning

- Conceptual in nature, relying on abstract thinking.

- More deductive, in nature, used in seeking absolute or truth rather than contingent information…Belief mode.

- Mathematical, algorithmic, and reliant on symbolic logic.

(Ferrer, O'hare, & Bunge, 2009; Johnson and Blair, 1991; Miller-Jones, 1991; Perkins, Farady, and Bushy, 1991; Sadler, 2004; Schoenfeld, 1991; Voss, Perkins, & Segal,1991)

G/Gf = Formal Reasoning

General Intelligence/Fluid Intelligence - One's ability to use deductive/mathematical logic, abstractly thinking, and generalize.

Formal Reasoning - Conceptual and abstract in nature, Deductive, Mathematical, and reliant on symbolic logic.

(Ferrer, et al., 2009; Johnson and Blair, 1991; Miller-Jones, 1991; Perkins, et al., 1991; Sadler, 2004; Schoenfeld, 1991; Voss, et al.,1991)

Relational Abstraction

According to James Flynn, *relational abstraction* is a critical component of scientific thinking.

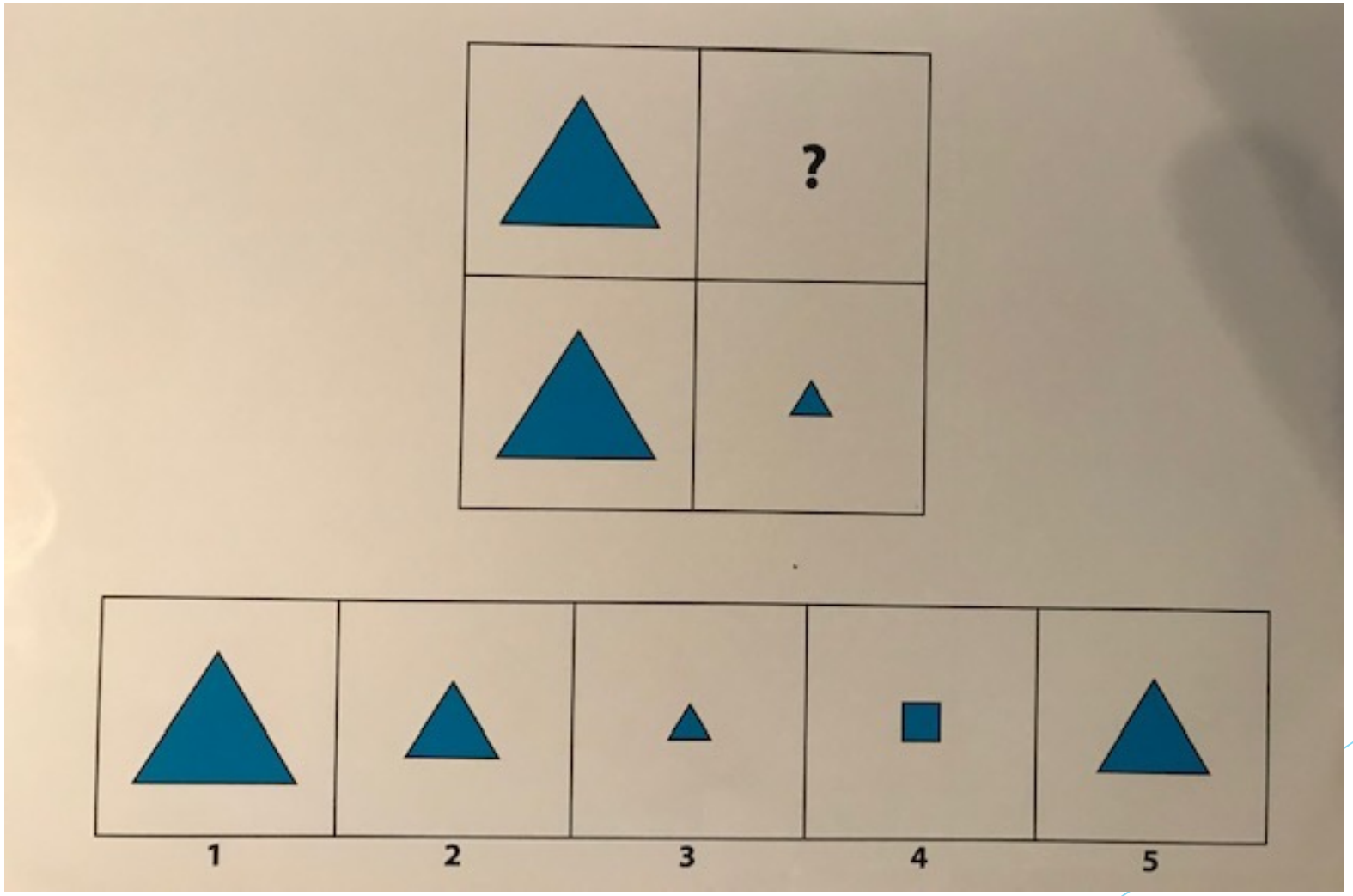
"…for analogical mapping when relations between objects are unrelated to the objects themselves" (Fox & Mitchum, 2013, p.88).

Relationships and values change with objects or symbols.

Needed to do well in I.Q assessments that are based on Gf/g.

(Flynn, 2016; Fox & Mitchum, 2013)

Example 1.



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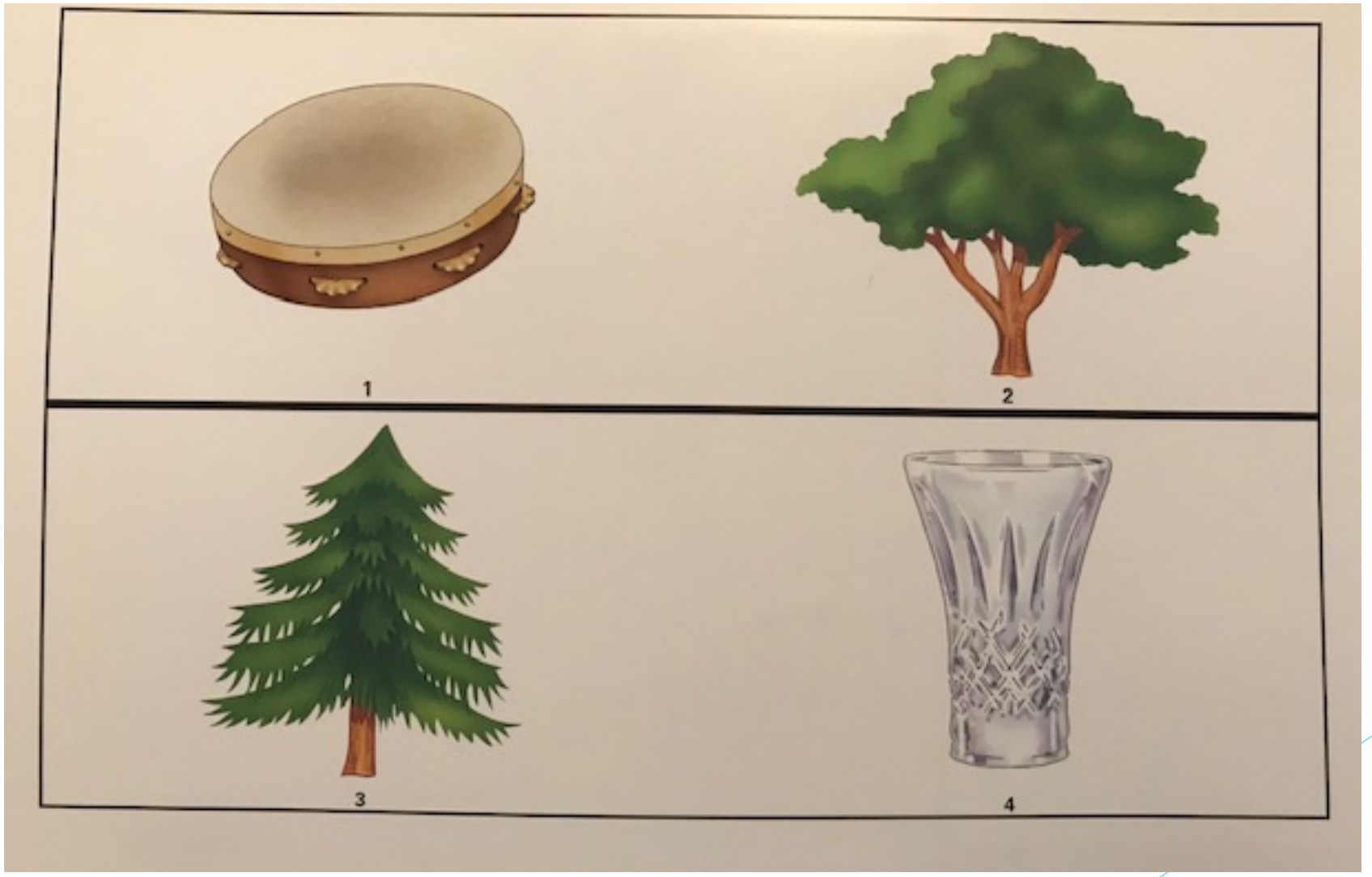

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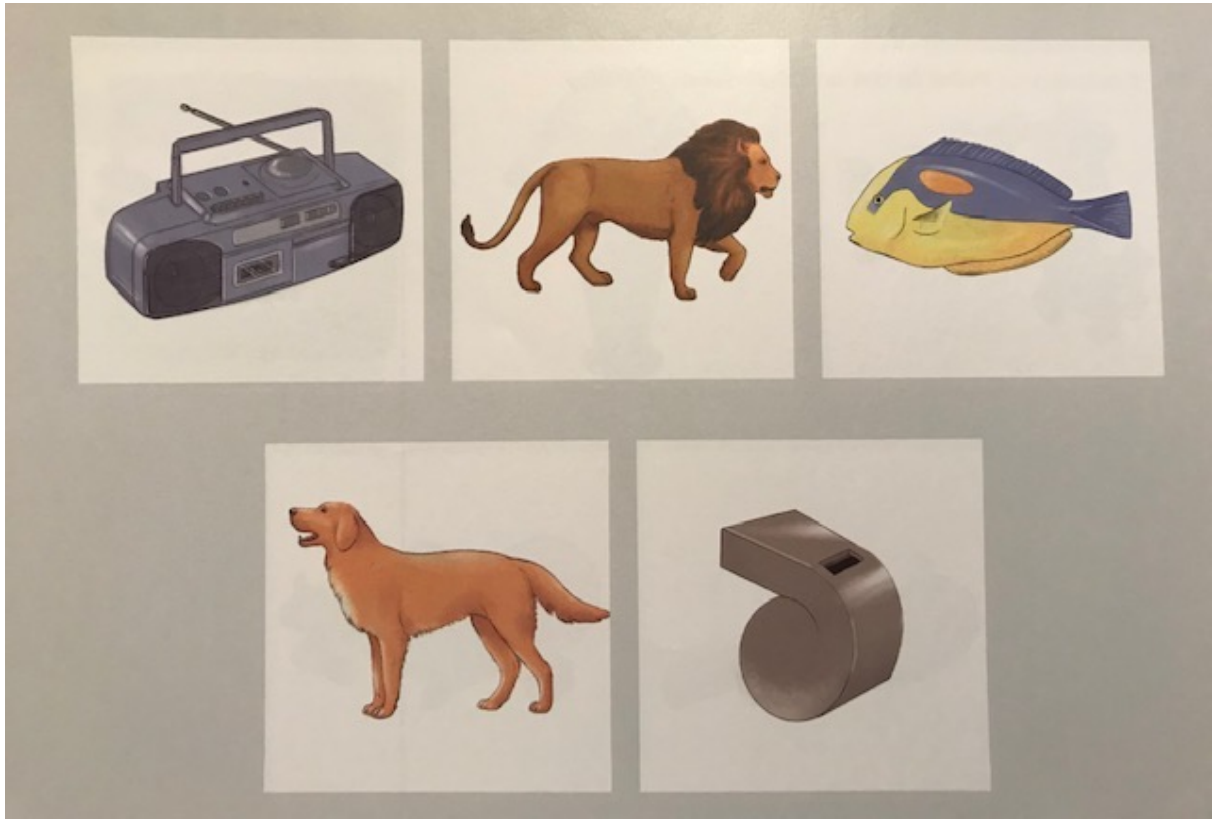

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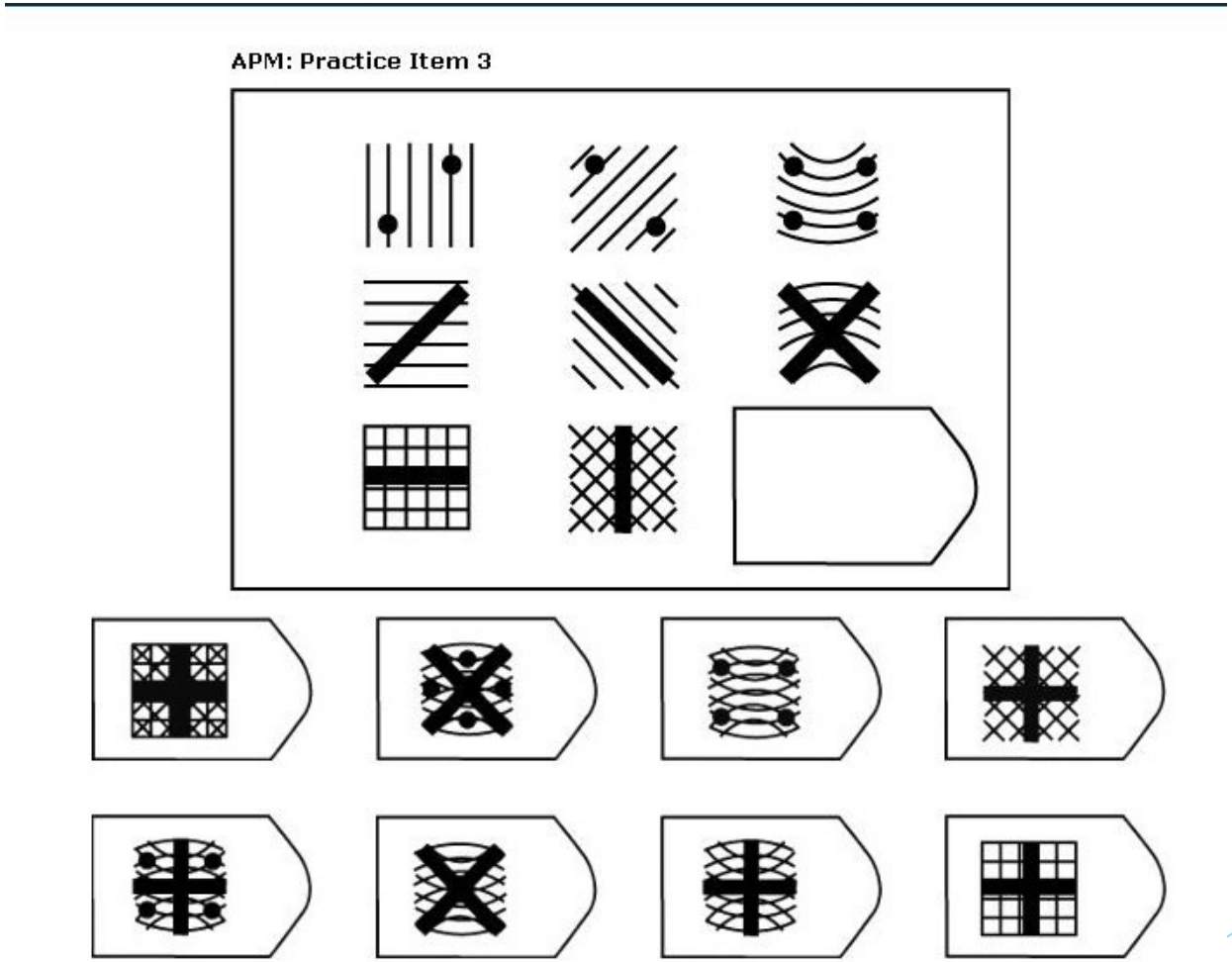

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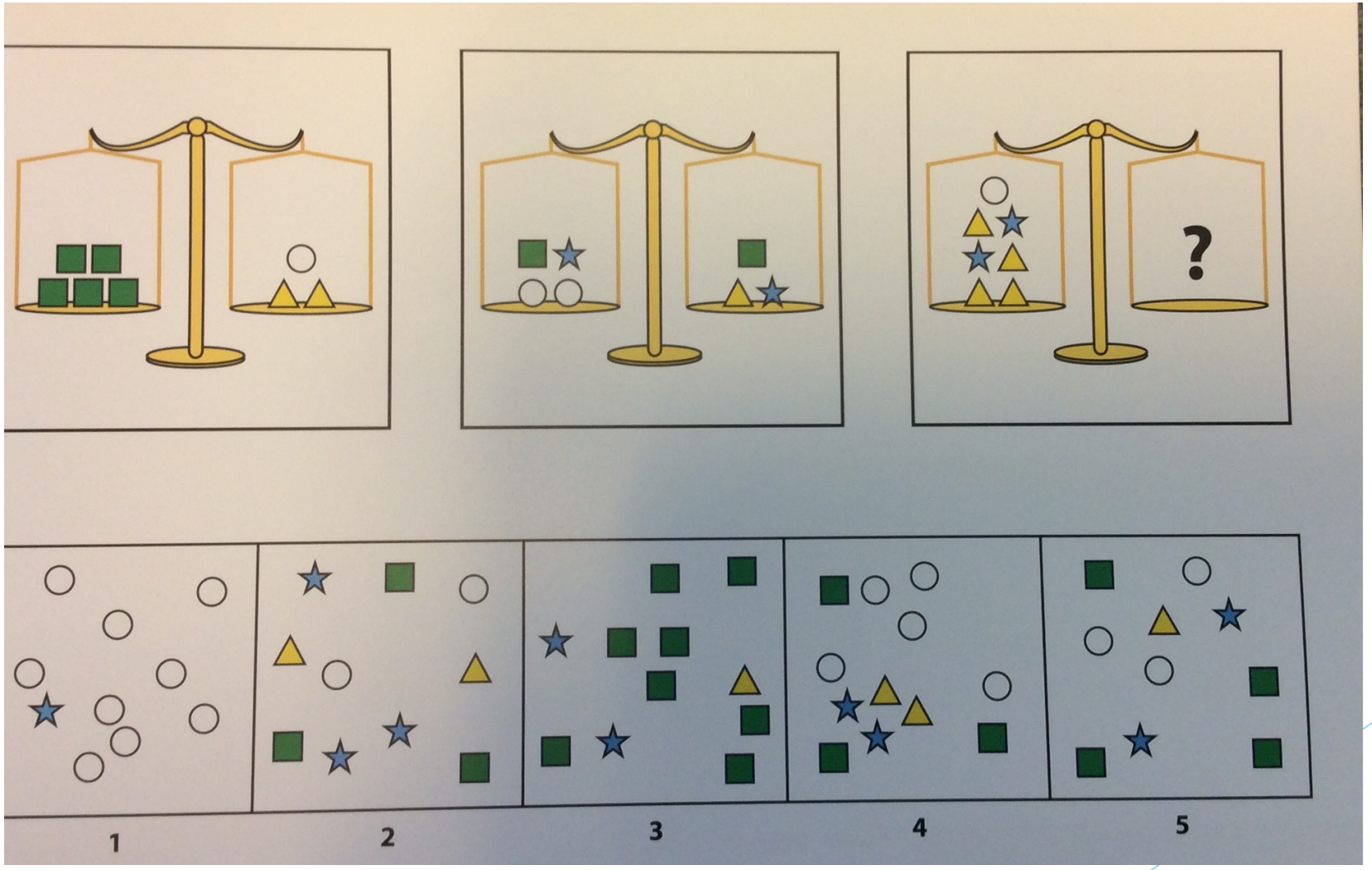


Culture and Ethnicity

Culture:

a: the customary beliefs, social forms, and material traits of a racial, religious, or social group.

b: the set of shared attitudes, values, goals, and practices that characterizes an institution or organization.

In short elements of living, learning, and being specific to a group passed from one generation to the next.

Ethnicity:

a: **ethnic** quality or affiliation

Ethnic:

a: of or relating to large groups of people classed according to common racial, national, tribal, religious, linguistic, or cultural origin or background.

Ethnicity is commonly used when describing the physical and cultural aspects of a group.

(Merriam-Webster's Online Dictionary, 2023)

Formal Reasoning and Culture

"Cultural differences in cognition reside more in the situations to which particular cognitive processes are applied than in the existence of a process in one cultural group and its absence in another." (Glick & Sharp, 1971, p. 233)

-Luria emphasized the role of culture in neurological development and cognitive processing.

-Cultural experiences can impact and accelerate planning and self-regulation.

- The *Flynn Effect* – IQ gains over decades of exposure

- SES and accessibility

(Cole, 2005; Downer & Pianta, 2006; Flynn, 2016; Fox & Mitchum, 2013, Romstad & Xiong, 2017)

Common Responses to Accelerated Improved Formal Reasoning

Nutrition – **No.** Nutrition can raise intelligence scores; however, not one standard deviation over 5 decades.

- The impact of nutritional supplementation are relatively small, in reality.

Genetics – No. Sundet, Eriksen, Borren, and Tambs (2010) cite twin studies of Norwegian brother-pairs.

- A within sibling Flynn-effect took place when one sibling had formal exposer and one did not.

- This study was done on 69,000 kids.

Formal Reasoning Conditioning

- Meta analysis of 74 training experiments concluded that teaching of inductive reasoning strategies can help improve fluid reasoning abilities.
- Training for working memory has also showed gains in Gf and academic performance.
- Klauer and Phye (2008), reference a training program that yielded general success in teaching inductive problem-solving strategies.
- Program taught ways to discover similarities and differences with respect to relationships between objects.
- This strategy can be used and applied to problem solving.

(Barkl, Porter, & Ginns, 2012; Dehn, 2017; Klauer & Phye, 2008; Perrig, Hollenstein, & Oelhafen, 2009)

Current Disparities

- If a student being tested was not primarily exposed to a lifestyle that is more formal in nature, he or she may not do well.
- Lower SES (access to needs, child-care, pre-k, etc.).
- Refugee children (SLIFE)
- Immigrant children
- Collective cultures
- Oral vs Formal culture?

In summary

Formal/Fluid Reasoning abilities rely on abstract thinking, mathematical Logic, and conceptual thinking.

The base of nearly every assessment of intelligence or problem solving.

Especially relevant in nonverbal assessments (some are pure Gf).

Formal Reasoning/Gf are impacted by culture and experience.

A different form of problem solving

- An amalgamation of Informal Reasoning, and Sternberg's Practical/Contextual Intelligence.
- **Informal reasoning**: "The reasoning carried on outside the formal contexts of mathematics and symbolic logic."
- **Practical/Contextual Intelligence**: One's ability to processes information and solve problems in real-world contexts, through personal experience. Not just knowing how to do something, but what to do when variables change.
- Informal Reasoning and Practical/Contextual Intelligence overlap in definition.

(Johnson & Blair, 1991; Marshall & DeCapua, 2013; Sternberg et al., 1995, 2000)

Contextual Reasoning

- Intelligence is reasoning in motion (Sternberg, 1980).
- The application of *practical/contextual intelligence* could be referred to as *contextual reasoning*.
- Traits of Contextual Reasoning can be found in examinees if test performance on common IQ assessments is analyzed.

Contextual Reasoning Defined

A form of reasoning reliant on concrete, contextual, and practical thinking and problem solving, not bound by the rules of mathematical logic and abstract thinking.

How measuring Contextual Reasoning could help

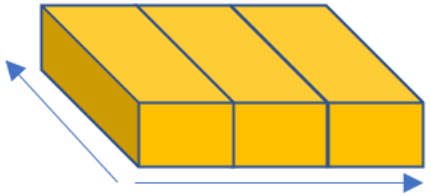
- Discrepancy model
- Gifted and Talented
- DCD identification
- ASD/EBD/OHD
- SLD Identification
- Comparison to Gf assessment of abilities
- Cross-battery approach
- What form of problem solving is favored?

“Point to the one that doesn’t belong.”

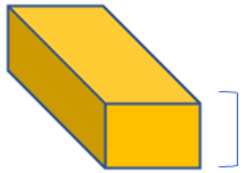
Demonstration Your Contextual Reasoning

- You have 10 colored blocks in front of you.
- 5 Orange and 5 Blue
- Orange Blocks are a third the weight of the Blue block which impacts how they interact with each other.
- Use **ALL** of the blocks in front of you to build a tower, 8 block units high with a base dimension of 3 x 3.
- You must use **ALL** of the blocks.

Specification Reminder



= 3 x 3 Base



= 1 Unit in Height

Which 3 options are the best for this situation?

A

B

C

D

E

F

B

E

F

Questions?

Reasoning types in academics

Formal Reasoning may favor:
- Individualized instruction
- Decontextualized material
- Literacy is key

Contextual Reasoning may favor:
- Collective instruction
- Pragmatic/contextualized material
- Oral in nature, less reliant on literacy

(Marshall & DeCapua, 2013; Miller Jones, 1989, 1991)

Contextual Reasoning in Professional Life

Science (Tweney, 1991)

Medicine (Christensen & Elstein, 1991)

Foreign Relations (Voss, 1991)

Law (Lawrence, 1991)

Nearly Every Profession (Voss, Perkins, & Segal, 1991)

Contextual Reasoning in action

Bricolage/Bricoleur:

- Contextual problem solving with only the resources immediately available.
- Commonly seen in developing systems and groups with limited access resources.
- Heavily reliant on improvisation, **NOT** abstraction.
- Not correlated with Gf.

(Benedekt, et al., 2014; Irvine & Berry, 1986)

Further Examples:

- Apollo 13 – CO2 Scrubber repair
- MacGyver television series
- The century old term *Jerry-Rigging*

Contextual Reasoning Case studies

-Populations in Eastern Europe - 1930's

-Inner-city AA Populations -1989

-Indigenous Mayan Populations - 2005

-Students in Australia - 2009

-Specific S.E. Asian populations - 2017

(Cole, 2005; Diamond, 1997;Luria, 1973; Miller-Jones, 1991; Naglieri et al., 2012; Romstad & Xiong, 2017; Trevelyan & Razali, 2009)

Where can we find Contextual Reasoning in current assessments?

More Contextual Less Formal				Most Formal Least Contextual
KABC-II Block Counting	KABC-II Rover	NEPSY-II Animal Sorting	KABC-II Conceptual Thinking	WISC-V Matrix Reasoning
KABC-II Triangles	KABC-II Story Completion		KABC-II Pattern Reasoning	WISC-V Figure Weights
KABC-II Face Recognition	WISC-V Visual Puzzles		D-KEFS Sorting	CAS-II Nonverbal Matrices
WISC-V Block Design	D-KEFS Tower			WAIS-IV Matrix Reasoning
NEPSY-II Arrows	WAIS-IV Visual Puzzles			WAIS-IV Figure Weights
WAIS-IV Block Design				

Example 1.
6 year old Hmong Male

Simultaneous/Gv	77	72-84	6	Low
Rover	7			
*Triangles	10			
*Story Completion	9			
Block Counting	10			
*Conceptual Thinking	3			
*Pattern Reasoning	6			

Example 2.
12 year old Hmong Male

Simultaneous/Gv	**105**	**95-115**	**63**	**Average**
Rover	11			
*Triangles	9			
*Block Counting	11			
Planning/Gf	**69**	**60-82**	**2**	**Very Low**
*Pattern Reasoning	1			
*Story Completion	8			

Example 3.
10 year old African American Male

Simultaneous/Gv	**100**	**94-106**	**50**	**Average**
*Triangles	10			
*Block Counting	9			
Rover	10			
Planning/Gf	**85**	**79-94**	**16**	**Average**
*Story Completion	9			
*Pattern Reasoning	6			

Example 4.
7 year old Africa American Female

Simultaneous/Gv	**97**	**90-104**	**42**	**Average**
*Triangles	9			
*Block Counting	10			
Rover	7			
Planning/Gf	**82**	**76-91**	**12**	**Below Average**
*Story Completion	9			
*Pattern Reasoning	5			

Example 5.
6 year old Caucasian Male

Simultaneous/Gv	**67**	**62-75**	**1**	**Very Low**
Rover	5			
Block Counting	11			
*Triangles	7			
*Pattern Reasoning	5			
*Story Completion	7			
*Conceptual Thinking	1			

What we know, so far…

- Gf and Formal Reasoning are virtually the same
- Both based on Abstract thinking
- The basis of virtually all IQ assessments
- Gf/Formal Reasoning is shaped by culture
- Contextual Reasoning, the opposite of the forementioned
- More common in everyday problem solving
- Contextual Reasoning seems to rely more on in-the-moment experience and learning.

Measuring Contextual Reasoning – Three Elements

-Main Stimuli and Problems Presented – Non-Abstract, Concrete

- Feedback when mistakes are made – Learn from mistakes.

- Allowance for partial credit – Not an All-or-None approach.

Just as we learn and process in real life problems.

Assessment of Nonverbal Contextual Reasoning (the ANCR).

ANCR was created and piloted in 2018/19.

Measurement of Contextual Reasoning abilities.

Three main attributes of the ANCR:

- The ANCR is not reliant on how well an examinee can abstractly think or solve complex puzzles. The ANCR is reliant on contextual reasoning to solve more real-world puzzles.
- The ANCR has a higher tolerance for error giving credit on items unless the examinee truly does not understand.
- The ANCR corrects mistakes and teaches during the session. Research based for those who learn contextually.

ANCR piloting version is comprised of 5 subtests.

ANCR Pilot Demographic Data

Caucasian - 35

Ages 5 – 16 years of age

- 19 males
- 16 females

Non-Caucasian – 60

Ages 5 – 16 years of age

- 38 males
- 22 females

Ethnic categories

- 26 African American
- 13 Latino
- 21 Asian/Other

Results of piloting

-Between Non-white and White examinees, the mean raw total score showed no difference in performance.

- No overall performance difference between different racial categories and white examinees (demographically matched cases).

- No overall performance difference between higher and lower SES.

Further information

- Asian Sample size, so far, is predominantly 2nd generation S.E. Asian immigrant/refugees (Hmong, Laotian, Thai).

- African American Population is comprised of half Somali-American examinees.

- Performance between African-American and Somali-American indicates, overall, equivalent performance when appropriately matched.

- Latino sample includes Mexican-American and Colombian-American children.

ANCR present day - Standardization

-Five different subtests

-True to its original form and method of testing. Three elements mentioned earlier are still its foundation.

- Can be done in person or remotely.

- One of few assessments standardized for remote sessions.

-For standardization, a sum of the sessions have been done in person, also, to mimic the school and/or clinic environment.

- Can be given in English and Spanish

Examinee Response Options

For all five subtests, answers can be done by pointing to answers.

If a verbal response is the preferred option of the examinee, it will not impact the score if the child responds in English, their home language, urban slang, or American sign language as long as the response can be defended as correct.

Being familiar with the child's language and culture is preferred but use of an interpreter is permitted for response purposes.

“Nonverbal”

“In nonverbal testing, the aim is to appreciably reduce the role of language, not to eliminate it all together, a goal that might not be possible when the persons begin testing are proficient speakers of a language.”

“…language cannot be eliminated entirely from any assessment.”

– Hammill, Pearson, & Wiederholt, 2009

The Nonverbal element of the ANCR

The ANCR is a language reduced assessment.

”Language reduced tests (also called “performance” tests) require the examinee to respond by pointing, manipulating blocks, solving puzzles, reproducing designs, and arranging picture sequences, among many other examples. Most nonverbal tests available are language reduced formats. Language reduced tests that use the pointing response (e.g. CTONI-2) have an added bonus because they are relatively motor free.”

Current Data Gathering Process

Short training session for all those who are administering the instrument.

Licensed diagnostician and school psychologists from: **Minnesota, New York, Texas, West Virginia, & Wisconsin.**

Participants were from: **Alabama, California, Georgia, Louisiana, Minnesota, New York, Texas, & West Virginia, Wisconsin.**

Administration done in person and via telecommunication.

Done in both English and Spanish

Several ethnic groups and SES were assessed.

Performance by Racial/Ethnic Groups

	All subjects	White	Nonwhite	Af.American	Asian/Oth.*	Hisp/Lat
Missing Pieces	16	16	16	16	15	16
Toads Adv.	15	15	14	14	15	14
Block Towers	19	19	19	18	18	20
A.Thinking. P.S.	20	21	20	21	20	20
A.Thinking. O.C	25	25	24	25	24	23
Standard Score	**100**	**100**	**99**	**99**	**99**	**100**
N	400	232	168	48	52	68

SES – Overall Performance

	Some college or lower	College or Higher
Missing Pieces	17	16
Toads Adv.	15	15
Block Towers	21	18
A.Thinking. P.S.	21	20
A.Thinking. O.C	24	25
Standard Score	102	100
N	70	330

AA SES – Overall Performance

	Some college or lower	College or Higher
Missing Pieces	17	16
Toads Adv.	16	14
Block Towers	24	16
A.Thinking. P.S.	21	20
A.Thinking. O.C	24	24
Standard Score	**106**	**99**
N	12	36

Asian SES – Overall Performance

	Some college or lower	College or Higher
Missing Pieces	17	14
Toads Adv.	17	14
Block Towers	22	16
A.Thinking. P.S.	22	19
A.Thinking. O.C	28	22
Standard Score	107	**98**
N	14	38

Latino SES – Overall Performance

	Some college or lower	College or Higher
Missing Pieces	16	16
Toads Adv.	13	15
Block Towers	29	20
A.Thinking. P.S.	19	21
A.Thinking. O.C	21	24
Standard Score	**98**	**101**
N	34	34

Spanish Speaking vs. Total Sample

	Spanish Speaking	Total Sample
Missing P	17	16
Toads Adv	14	15
Block T.	22	18
Analytical T. P.S.	20	20
Analytical T. O.C	22	25
Standard Score	**101**	**100**
N	37	400

Spanish -Low SES vs. Total Sample

	Spanish Lower SES	Total Sample
Missing P	16	16
Toads Adv	13	15
Block T.	20	18
Analytical T. P.S.	19	20
Analytical T. O.C	20	25
Standard Score	**99**	**100**
N	20	400

Gender Performance

	Male	Female
Missing Pieces	16	16
Toads Adv.	15	14
Block Towers	20	17
A.Thinking. P.S.	21	21
A.Thinking. O.C	25	25
Standard Scores	**101**	**99**
N	200	200

5-6 Years of Age

	Nonwhite	White
Missing P	11	12
Toads Adv	10	8
Block T.	12	11
Analytical T. P.S.	14	14
Analytical T. O.C	17	17
Standard Score	**101**	**99**
N	30	49

7-8 Years of Age

	Nonwhite	White
Missing P	15	15
Toads Adv	11	11
Block T.	17	17
Analytical T. P.S.	18	17
Analytical T. O.C	22	22
Standard Score	101	99
N	42	39

9-11 Years of Age

	Nonwhite	White
Missing P	16	17
Toads Adv	15	16
Block T.	21	21
Analytical T. P.S.	21	21
Analytical T. O.C	24	26
Standard Score	**99**	**101**
N	53	56

12-14 Years of Age

	Nonwhite	White
Missing P	19	19
Toads Adv	18	19
Block T.	22	22
Analytical T. P.S.	24	25
Analytical T. O.C	30	31
Standard Score	**98**	**101**
N	22	50

15-19 Years of Age

	Nonwhite	White
Missing P	19	19
Toads Adv	20	21
Block T.	24	21
Analytical T. P.S.	27	28
Analytical T. O.C	31	32
Standard Score	101	100
N	19	38

How does performance correlate with achievement?

WJ-IV W Score	WJ-IV
	Partial-Corr.
Reading	.69**
Broad Reading	.73**
Math	.62**
Broad Math	.60**
Math Calc Skills	.53**
Written Lang	.60**
Broad Written Lang	.63**
Written Exp	.55**
Academic Skills	.70**
Academic Flu	.68**
Academic App	.63**
Brief Ach	.74**
Broad Ach	.71**
Age-in-Year	na
N	23

Performance compared to Raven's

	Raven's	
ANCR	Partial-Corr	
MP Total Raw Score	0.48	*
TC Total Raw Score	0.21	
BT Total Raw Scores	0.56	**
AT.PS Total Raw Score	0.19	
AT.OC Total Raw Score	0.65	**
ANCR Total Raw Score	0.60	**
Raven's AS	1.00	
N		22

Overall

- Contextual Reasoning, by the current definition, is measurable.
- Contextual Reasoning abilities were found to be **equal and balanced** across groups assessed.
- Contextual Reasoning does not directly correlate with Gf in two separate smaller studies, through use of the ANCR.
- Contextual Reasoning does correlate with Achievement in one smaller study, through us of the ANCR.

General Feedback From Examiners and Parents

- Examinees enjoy it.
- The computer-based system for administration is easy to use.
- Tool is easy to learn for novice psychologists and diagnosticians to veteran practitioners.
- Subtests keep kids engaged at all age and ability levels.

Moving Forward – For Academics and Practitioners

-Higher ed. Classes specific to:

Anthropology of Disability

Anthropology of Cognition

Anthropology of Psychology

-Understanding of the fundamental difference in reasoning styles and how they impact learning

-Identifying reasoning and learning style of students in class

- Modification of school work to fit the reasoning and learning style of student

In School or Clinics-

- We still do not have a measure, available now, for Contextual Reasoning
- For struggling students, consider the method used to measure their academics
- Curriculum is important – (CRA based for Math)
- Allowing room to learn – **People learn little from success but so much from making errors.**
- Collective instruction and learning

Analyze trends in assessment performance (Abstract loading)

More Contextual Less Formal				Most Formal Least Contextual
KABC-II Block Counting	KABC-II Rover	NEPSY-II Animal Sorting	KABC-II Conceptual Thinking	WISC-V Matrix Reasoning
KABC-II Triangles	KABC-II Story Completion		KABC-II Pattern Reasoning	WISC-V Figure Weights
KABC-II Face Recognition	WISC-V Visual Puzzles		D-KEFS Sorting	CAS-II Nonverbal Matrices
WISC-V Block Design	D-KEFS Tower			WAIS-IV Matrix Reasoning
NEPSY-II Arrows	WAIS-IV Visual Puzzles			WAIS-IV Figure Weights
WAIS-IV Block Design				

For Instruction and Academic Supports, Consider the Three Schemata

- Linguistic – The language in which one must use
- Content – The subject matter that is being addressed
- Formal – The type of task that must be performed

Schemata	Description	Example
Linguistic	The language in which the activity is presented and the student must respond	First language; second/ dialect language
Content	The subject matter the activity is asking the student to address	Schools subjects at grade level; basic education competencies; Vocational/technical knowledge; culture-based information
Formal	The type of task that the activity requires the student to perform	Assessment formats; true/false, matching, multiple choice; critical thinking skills: defining, summarizing

(Marshall & DeCapua, 2013, p.35)

Adding info on Contextual Reasoning to an evaluation report.

- This will fluctuate depending on the tools used.
- Not stating formal reasoning scores are invalid.
- Simply stating the child's/examinee's reasoning has not been fully measured, only partially.
- Remark only on what appears to be more contextual abilities.
- Cannot yet measure CR to directly say we've identified it in an eval.

Final Thoughts

"If the Flynn effect is a testament to the capacity of humans to adapt to their environments, then it is also a statement about the vastness and irregularity of human diversity. The need to accommodate this irregularity will become increasingly apparent as cross-cultural, cross-geographical findings accumulate in the coming years…Establishing a psychology that can cope with diversity and change will require looking beneath the surface features of human variation for principles that transcend both culture and time."

-Fox & Mitchum, 2013

This was written 10 years ago and our assessments have not changed…

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