


**AACN Student Affairs Committee Student Series: Introduction to the PAI in Neuropsychology**

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### PAI Goals and Objectives

- 1. Review of general psychometric properties of PAI
- 2. Interpretation of PAI



### Helpful texts

- Morey, L.C. (2007). Personality Assessment Inventory Professional Manual, 2<sup>nd</sup> Edition. Lutz, FL: PAR.
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- Morey, L.C. (2003). Essentials of PAI Assessment. New York: John Wiley & Sons.
- Blais, M.A., Baity, M.R., & Hopwood, C.J. (Eds.). (2011). Clinical Applications of the Personality Assessment Inventory. New York: Routledge.

### Shameless Plug...

- University of Iowa Psychiatry Department Postdoctoral Residency Lifespan Clinical Neuropsychology
- Long name-Great Training!



### Critical Question


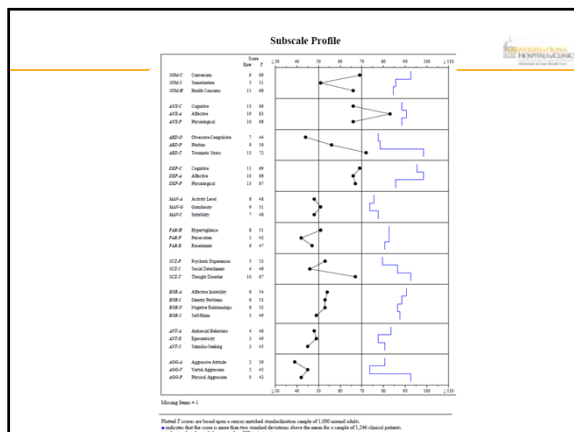
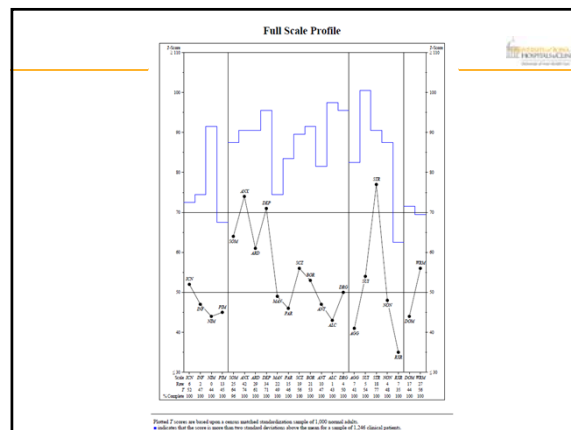
- How Familiar are you with the PAI?
  - Very much so
  - Reasonable familiar
  - I've heard of it
  - PA...what? I was just looking for the free breakfast...

### Test Construction

- PAI consists of:
  - 4 Validity Scales-ICN, INF, NIM, PIM
  - 11 Clinical Scales
    - SOM ANX ARD DEP MAN PAR
    - SCZ BOR ANT ALC DRG
  - 5 Treatment Indicator Scales
    - AGG SUI STR NON RXR
  - 2 Interpersonal Scales
    - WRM DOM
  - 9 Clinical and 1 Treatment Indicator scales have subscales

## Test Construction

- A bit of alphabet soup-but the scale names are intuitive!

## Test construction


- Wording was carefully screened to be unambiguous, non-colloquial, no double negatives, and not offensive to members of minority groups
- Requires only 4<sup>th</sup> grade reading level
  - Used a lot in prison, where reading levels are very low
- Uses a Likert-type response rather than True-False response framework, to reduce response set bias

## Reliability

- Most of the clinical scales have good test-retest reliability and internal consistency
- However, two of the validity scales (Infrequency and Inconsistency) have lower reliability.
  - May not be as strong for ruling in or out response bias
  - Other two validity scales have good reliability coefficients

## Validity

- The clinical scales do an excellent job of measuring the constructs involved
  - High correlations with other independently developed, consensus instruments for measuring specific diagnostic constructs such as depression, anxiety, psychopathy



## Some general issues about the PAI

- *Test relies heavily on the interpretation of subscales to arrive at good diagnostic hypotheses*
- When a construct is multidimensional (e.g., depressive disorders, which includes many possible diagnoses), the subscales can specify which aspect of the construct is prominent

## PAI Validity Scales

- Main Validity Scales:
- NIM, PIM, INC, INF
- Derived validity scales:
  - Rogers Discriminant Function (RDF)
  - Malingering Index (MAL)
  - Defensiveness Index (DEF)
  - Cashel Discriminant Function (CDF)
  - Negative Distortion Scale (NDS)

## PAI Validity Scales

- INC-Inconsistency. VRIN-like, but not as powerful as VRIN, reliability coefficients not as high
  - T=64-72: Moderately inconsistent
  - T>73=invalid profile, do not interpret
- INF Infrequency. Measures random, careless responding. Not a measure of malingering, since not evidence of pathology. Also not a strong validity indicator
  - T=60-74: inquire into response set
  - T>75=inattention to test, invalid profile
- INF also tap idiosyncratic response styles (e.g., if favorite hobbies actually are archery and stamp collecting, they'll get a point, since research suggests that generally these interests are inversely related)- may get high score if a somewhat eccentric individual

## PAI Validity Scales

- NIM (Negative Impression). F<sub>p</sub>-like, elevations are indicative of exaggerating the bad or malingering. Like the F scales, measure of response style as well as presence of pathology
  - T<73= no exaggeration (considered a "low" score by Morey)
  - T=73-91: Some exaggeration, cry for help, trauma
  - T>92=Possibly invalid, more likely as scores go up

## PAI Validity Scales

- PIM (Positive Impression). L/K-like, elevations suggest attempting to create favorable impression and/or unwillingness to admit to usual human flaws
  - T<57=open, honest
  - T=57-67: Some guardedness or exaggeration of self-worth
  - T>68=Questionable validity due to defensiveness
- DEF= Defensiveness Index
  - Like MAL, uses scale configurations to evaluate presence of invalidating defensiveness. DEF scores above 6 may indicate presence of "fake good" profile, although this index is not as sensitive as MAL (aka. "fake bad" profile).

## Malingering Index-MAL

- Refers to malingering of psychiatric disorders, not cognitive functioning
- Index of eight configural features of PAI observed when mental disorders are known to be faked.
  - NIM  $\geq$  110
  - NIM-INF  $\geq$  20T
  - INF-INC  $\geq$  15T
  - PAR-P-PAR-H, PAR-P-PAR-R, MAN-I-MAN-G  $\geq$  15T
  - DEP  $\geq$  85T AND RXR  $\geq$  45T
  - ANT-E – ANT-A  $\geq$  10T
- Will print out on computerized scoring if you have the software
- If below 3, probably not malingered, 3=possible malingering,  $\geq$ 5 usually is feigned severe mental disorder, malingered

### PAI Rogers Discriminant Function Index (RDF)

- Comes up on printout, not on hand score sheets, but designed to detect response bias and distortion
- Uses discriminant function analysis to distinguish faking bad profiles from those of actually distressed patients

### Missing Items

- No more than 17 unanswered items
- With less, should still look at what scales have missing items to see if they are interpretable.



## Factor Analysis in Neuropsychological Populations

### FACTOR ANALYSIS



### Factor Analysis in Neuropsychological Populations

- Most populations have similar factor structure to normative sample (Hoelzle & Meyer, 2009)
- Except for slight variations:
  - substance abuse (Schinka, 1995)
  - Psychiatric inpatients (Boone, 1998)
  - Eating disorders (Tasca et al., 2002)
  - University counseling center students (Cashel et al., 2003)
  - Chronic pain (Karlin et al., 2005)
  - Overall does not impact interpretation (Kurtz, 2007)

### Factor Analysis in Neuropsychological Populations

- In Neuropsychological Populations:
- (Frazier et al., 2006):
  - Similar internal consistency to normative sample on the clinical scales (subscales not studied)
  - Similar factor structure (4 factors for the 22 scales)
- Busse et al. (2014):
  - 5 factors best explained the data for 22 scales
  - Similar to normative sample except a "Random Responding" factor emerged (ICN, INF)
  - For the 11 clinical scales, 2 factors (internalizing and externalizing) emerged. Normative sample had 3 factors (egocentricity/exploitive factor emerged in normative sample)
    - More straightforward factor structure

### Factor Analysis in Neuropsychological Populations

- Generally factor analytic and reliability studies are similar in Neuropsychological samples and the normative sample
  - The first factor in both studies on previous slide was a "general distress" factor-very similar to MMPI research and PAI normative sample
- Busse et al. (all 22 scales):
  - Factor 2 was labeled "behavioral acting out"
  - Factor 3 was "social distancing" (NON and WRM loaded here rather than on factor 1)
  - Factor 4 was "substance use vulnerability"
  - Factor 5 was "random responding"

### Factor Analysis in Neuropsychological Populations

Table 4. Varimax rotated component loadings of all full scales

Scales	Study sample components					Morey's (1991) clinical sample factors			
	1	2	3	4	5	1	2	3	4
Inconsistency	-.01	-.01	-.45	.47	-.01	-.01	-.01	-.41	-.01
Infrequency	-.79	-.01	-.01	-.73	-.01	-.79	-.01	-.81	-.01
Negative Depression	-.59	-.42	-.01	-.41	-.68	-.01	-.01	-.01	-.01
Positive Depression	.81	-.01	-.01	-.01	-.78	-.01	-.01	-.01	-.01
Somatic Complaints	.82	-.01	-.01	-.01	-.90	-.01	-.01	-.01	-.01
Anxiety	.80	-.01	-.01	-.01	-.85	-.01	-.01	-.01	-.01
Anxiety Related Disorders	.83	-.01	-.01	-.01	-.89	-.01	-.01	-.01	-.01
Depression	.56	.82	-.01	-.01	-.68	-.78	-.01	-.01	-.01
Mania	.73	-.42	-.01	-.01	-.84	-.01	-.01	-.01	-.01
Paranoia	.67	.41	-.01	-.01	-.81	.41	-.01	-.01	-.01
Schizophrenia	.67	.41	-.01	-.01	-.81	.41	-.01	-.01	-.01
Borderline Features	-.01	-.68	-.47	-.01	-.73	-.01	-.01	-.01	-.01
Antisocial Features	-.01	-.78	-.01	-.01	-.77	-.01	-.01	-.01	-.01
Alcohol Problems	-.01	-.79	-.01	-.01	-.79	-.01	-.01	-.01	-.01
Drug Problems	-.01	-.69	-.01	-.01	-.70	.48	.45	-.01	-.01
Aggression	.61	-.01	-.01	-.01	-.61	-.01	-.01	-.01	-.01
Stress	.44	-.56	-.01	-.01	-.63	-.01	-.01	-.01	-.01
Nonsupport	-.61	-.01	-.01	-.01	-.59	-.42	-.01	-.01	-.01
Treatment Refusal	-.64	-.48	-.01	-.01	-.40	-.72	-.01	-.01	-.01
Distraction	-.01	-.82	-.01	-.01	-.49	-.40	-.01	-.01	-.01
Worship	40.13	10.73	7.49	5.29	4.91	41.2	11.2	6.9	5.9
% of variance	8.83	2.56	1.85	1.16	1.08				
Factor eigenvalues									

\* Within the study sample, Component 1 = General Distress; Component 2 = Behavioral Acting Out; Component 3 = Social Detaching; Component 4 = Substance Abuse Vulnerability; Component 5 = Random Responding.


### Factor Analysis in Neuropsychological Populations

Table 5. Varimax rotated component loadings of clinical scales only


Scales	Study sample components		Morey's (1991) clinical sample factors		
	1	2	1	2	3
Somatic Complaints	.75	-.01	.75	-.01	-.01
Anxiety	.88	-.01	.91	-.01	-.01
Anxiety Related Disorders	.83	-.01	.87	-.01	-.01
Depression	.88	-.01	.89	-.01	-.01
Mania	-.01	.59	-.01	.50	.90
Paranoia	.65	.42	.67	.40	-.01
Schizophrenia	.81	-.01	.84	-.01	-.01
Borderline Features	.73	.52	.77	.45	.48
Antisocial Features	-.01	.84	-.01	.86	.51
Alcohol Problems	-.01	.74	-.01	.73	-.01
Drug Problems	-.01	.70	-.01	.82	-.01
% of Variance	49.1%	16.4%	49.7%	18.0%	9.5%
Factor Eigenvalues	5.40	1.81			

Within the study sample, Component 1 = Internalizing Behaviors; Component 2 = Externalizing Behaviors.

- ### Factor Analysis in Neuropsychological Populations
- Busse et al. concluded that:
  - Neuropsychological sample was similar to eating disordered and alcohol-dependent samples on factor analysis
  - Small differences with normative sample-no egocentricity factor for the 11 scales, random responding broke out as separate factor
  - Overall PAI can be interpreted similarly with NP populations



## Application of the PAI in Clinical and Forensic Neuropsychology




- ### PAI and Mixed Neuropsychological Samples
- Significant relationship between somatic complaints/preoccupation and non-credible performance
- SOM and SOM-C are negatively correlated with TOMM scores (e.g. higher SOM/SOM-C correlated with poorer TOMM performance)<sup>1</sup>
  - Modest correlations with SOM, ANX, ARD, DEP, SCZ and Dot Counting/Rey 15 Item<sup>2</sup>
- <sup>1</sup> Whiteside et al., 2010; <sup>2</sup> Sumanti et al., 2002

- ### Psychiatric Patients
- PAI scales and neuropsychological test results do not overlap
  - Memory subscale of RBANS correlated with SOM
  - Trails A negatively correlated with SOM, ANX, DEP, and BOR
  - PVTs and the validity scales were not examined
- Aikman & Souheaver (2008)

### TBI

- Demakis et al (2007) found SOM, DEP, BOR, PAR, & SCZ elevations
- But they did not distinguish between mild, moderate, and severe TBI



### TBI

- Another mixed TBI sample (sample not well defined in terms of severity) cluster analysis based on PAI scales
  - Depression and Somatic concerns most prevalent in TBI
  - Males tended to have more borderline and antisocial personality features
  - Females tended to have more borderline features
  - BUT half the sample had a "normal" profile

Velikonja et al., 2010

### MTBI

- MTBI patients had elevations on SOM and DEP compared to moderate to severe TBI, but not a paradoxical pattern of generally higher elevations with milder TBI
- Moderate to severe TBI had higher elevations on ANT and ALC (e.g. higher risk taking and impulsive behavior)
- However, they did not distinguish compensation seeking from other TBI patients

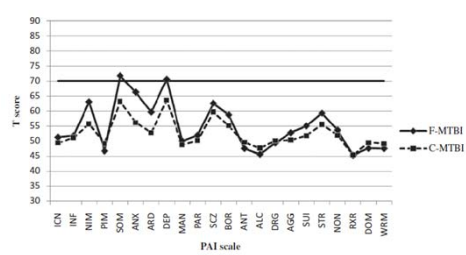
Kurtz et al., 2007

### Compensation Seeking MTBI

- Compensation seeking MTBI participants scored higher on NIM, SOM, ANX, ARD, DEP, all SOM and ANX subscales, and ARD-P.
- Large effect sizes: SOM-S, ANX, ANX-C, ANX-A
- Medium effect sizes: SOM, SOM-C, SOM-S
- Compensation seeking MTBI also had higher mean scale elevations
- Compensation seeking MTBI had mean scale elevations in the clinically significant range on SOM and DEP

Whiteside et al., 2012

### Compensation Seeking MTBI



Whiteside et al., 2012


### ADHD and Learning Disorders

- Rates of non-credible performance similar to forensic contexts (estimates range up to 47.6% for noncredible performance in ADHD and 24.5% in combined LD/ADHD)
- PAI validity scales were insensitive to noncredible performance because "a general, indiscriminant tendency (toward negative response bias) might not be the norm."
- Similar to later research showing SVT and PVTs assess different domains (more later!)

Sullivan et al. 2007

### ADHD and LD

- Musso et al. (2016) found similar results
  - NIM, MAL and RDF have "excellent specificity" but relatively low sensitivity (.20 to .33) to invalid responding.



### ADHD-Musso et al. cut offs

Table 3. Examination of Recommended and Alternative Cutoff Scores for PAI Validity Indices.

	ADHD			LD			College Controls		
	Simulators	Support efforts	No Diagnosis	ADHD	LD	Controls	Simulators	Support efforts	No Diagnosis
<b>Personality Index</b>									
Cutoff 67	0.14	0.02	0.93	0.96	0.94	0.97	0.89	0.93	0.97
Cutoff 70	0.10	0.02	0.94	0.98	0.97	0.97	0.93	0.97	0.97
Cutoff 75	0.06	0.00	0.98	0.99	1.00	0.98	0.95	0.97	0.97
<b>Infrequency scale</b>									
Cutoff 67	0.30	0.12	0.86	0.85	0.91	0.91	0.81	0.82	0.92
Cutoff 71	0.20	0.08	0.92	0.89	0.93	0.93	0.88	0.90	0.90
Cutoff 75	0.11	0.04	0.95	0.95	0.97	0.97	0.93	0.99	0.99
<b>Positive Impression Management</b>									
Cutoff 75	0.28	0.16	0.99	0.97	0.82	0.85	0.95	0.91	0.91
Cutoff 77	0.22	0.10	0.99	0.98	0.72	0.76	0.95	0.93	0.93
Cutoff 81	0.24	0.06	0.99	0.98	0.74	0.71	0.99	0.95	0.95
Cutoff 85	0.18	0.00	0.99	1.00	0.98	0.99	1.00	0.99	0.99
<b>Repetitive/Disruptive Function</b>									
Cutoff 85	0.44	0.26	0.82	0.79	0.74	0.68	0.68	0.71	0.71
Cutoff 87.5	0.39	0.10	0.76	0.74	0.66	0.67	0.69	0.72	0.72
Cutoff 91	0.30	0.00	0.76	0.76	0.71	0.69	0.74	0.77	0.77
Cutoff 1.25	0.23	0.06	0.99	0.99	0.95	0.94	0.94	0.97	0.97
<b>Malingered Index</b>									
Cutoff 2	0.22	0.06	0.98	0.96	0.95	0.93	0.99	0.98	0.98
Cutoff 3	0.14	0.04	0.89	0.75	0.77	0.75	0.86	0.86	0.86
<b>Positive Impression Management</b>									
Cutoff 27	0.28	0.06	0.98	0.96	0.82	0.84	1.00	0.94	0.94
Cutoff 35	0.18	0.00	0.99	0.98	0.91	0.88	1.00	0.94	0.94

Note: PAI = Personality Assessment Inventory

### Symptom and Performance Validity Assessment with the PAI

### Performance Validity and PAI

- 2 general types of profiles in individuals who fail PVTs:
  - Global complaints group-broad over reporting across many symptoms
  - Cognitive/Somatic complaint group-over reporting limited to these types of symptoms accompanied by underreporting (e.g. defensive) of psychological symptoms.

Patrick & Horner, 2014, Temple et al., 2003, Larrabee 2007

### Performance Validity and PAI

- SOM often elevates when patients fail PVTs (Whiteside et al., 2012, Lange et al., 2012, Sumanti et al., 2006)
- NIM is the validity scale most often associated with PVT failure (Haggerty et al., 2007, Keiski et al., 2015)
- BUT in a simulator study, Keiski et al. also found that PIM elevates in the defensive simulating group with lower NIM scores

### Performance Validity and PAI

- NIM was related to PVT performance in a mixed neuropsychological sample
- Exaggerated cognitive dysfunction tended to be present when NIM is very high
- Evidence also exists for a defensive response style on the PAI in the context of PVT failure (replicating the Keiski et al. simulator study in a clinical population)
- Results suggest more than one pattern of response bias on PAI in PVT failure cases

Gaasedelen et al., 2017

### Classification Accuracy of PAI Validity Scales

- NIM had best classification accuracy to PVT failure (AUC=.65).
  - BUT still low sensitivity (0.16 with specificity =.92) and below "acceptable" AUC level (.70).
  - MAL (T=64), SN= .18, SP=.86
  - NDS (Raw score=28), SN= .20, SP=.91
  - Doesn't knock your socks off...

Gaasedelen et al, 2017

### Classification Accuracy of PAI Validity Scales

- Only NIM was significantly different between PVT pass and PVT fail groups in a mixed neuropsychological sample (with conservative correction for multiple comparisons)
- Without correction for multiple comparisons, MAL and NDS were also significantly different ( $p < .05$ )
- No other validity scales were different

Gaasedelen et al, 2017

### Classification Accuracy of PAI Validity Scales

- RDF has not been supported in detecting exaggerated cognitive dysfunction (Gaasedelen et al, 2017; Armistead-Jehle & Buican, 2012).
- NDF-smaller effect than initial validation study (Mogge et al., 2010) and cross validation simulation study (Rogers et al, 2013).
- Overall, existing validity scales (with possible exception of NIM) are not terribly sensitive to noncredible cognitive performance.

Gaasedelen et al, 2017

### Classification Accuracy of PAI Validity Scales

- Cluster analysis-on patients in the PVT FAIL group
  - 2 response styles on PAI-Global Style (elevations on NIM, MAL-with low PIM scores)
  - Defensive style-no scale elevations
  - Suggests those who fail PVTs will fall into two types of response sets.
- This is a civilian MTBI sample, so future research could compare civilian and veteran samples to explore these different response patterns further.

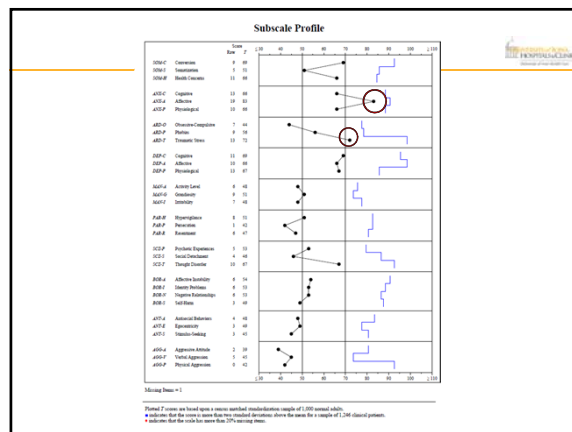
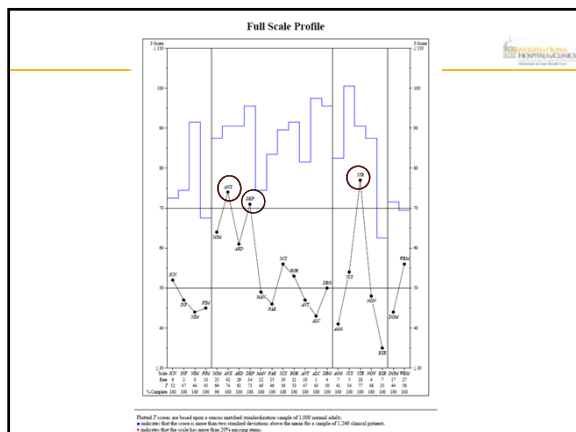
Gaasedelen et al, 2017

## Interpretation Examples

### PAI Example #1

- 32 year old female with 18 years of education
- Referred secondary to Multiple Sclerosis
- Has also had treatment for depression
- Poor sustained attention and mildly slowed processing speed, otherwise WNL performance

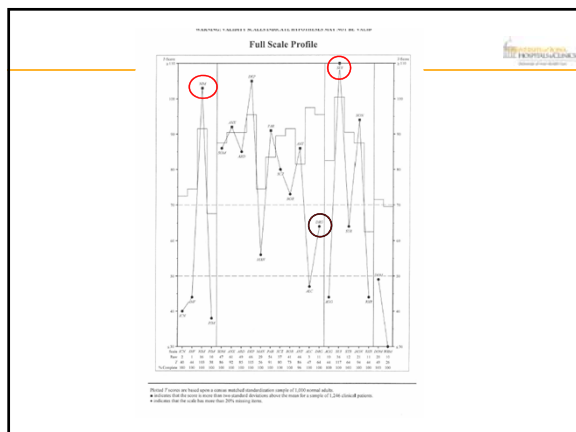




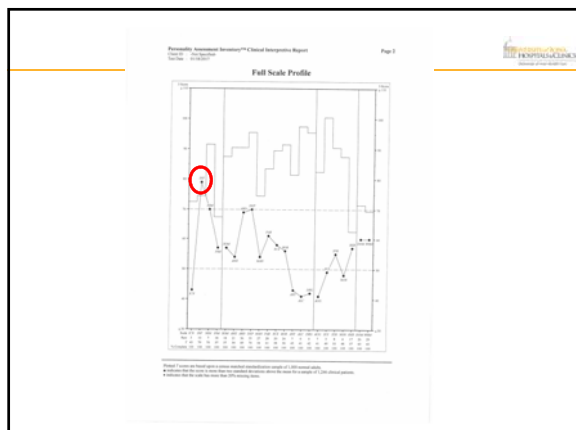
**Supplemental PAI Indexes**

Index	Value	T Score
Defensiveness Index	1	38
Cashef Discriminant Function	113.72	34
Malingering Index	0	44
Rogers Discriminant Function	-2.32	38
Suicide Potential Index	8	65
Violence Potential Index	1	47
Treatment Process Index	2	55
ALC Estimated Score	---	52 (9F higher than ALC)
DRG Estimated Score	---	50 (Equal to DRG)
Mean Clinical Elevation	---	56

- ### PAI Example #2 Invalid-High NIM
- 26 year old male with 10 years of education
  - Referred secondary to vague memory complaints
  - Has also had treatment for depression, personality disorder (unspecified), and polysubstance dependence
  - Variable attention, encoding, language, with poor organizational ability and slow processing speed.

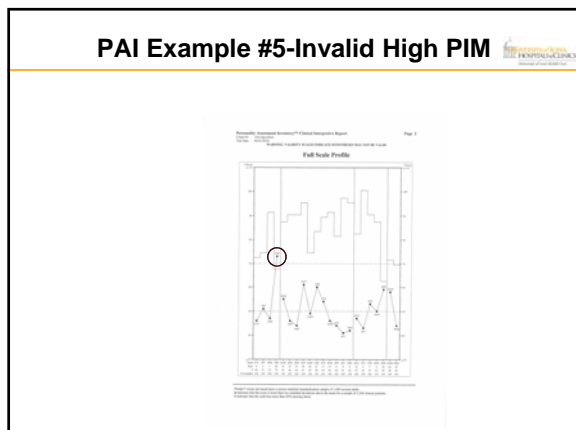


- ### PAI Example #3 Invalid High INF
- 21 year old female referred for suspected learning disorder. Special education in HS, wanting to pursue some type of post HS training.
  - Diagnosed with severe Reading Disorder (WIAT Reading and Written Language standard scores in 70's).



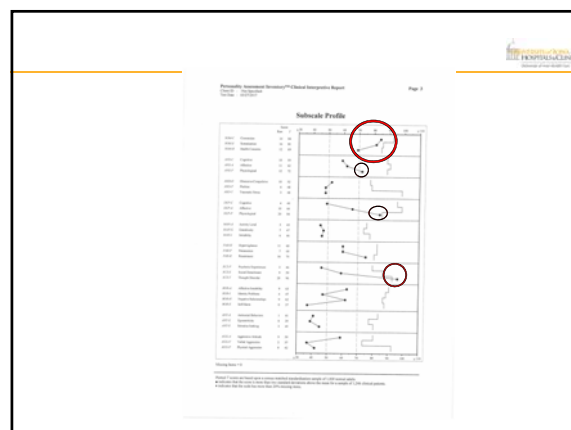
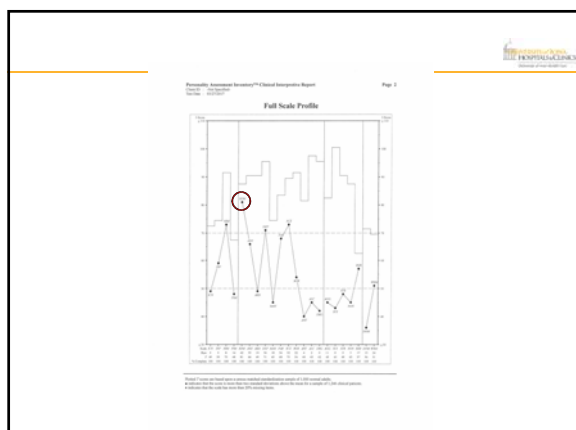
**PAI Example #5-Invalid High PIM**

- 20 year old male student-athlete
- Referred secondary to concussion sustained while playing football 4 weeks earlier
- Grades: Cs mostly, a few Bs
- Denies any cognitive complaints, says he's "Good to go" and wants to return to play.
- Cognitive profile was basically WNL-with low average VCI.



**PAI example #6-Somatization**

- 29 year old woman with 12 years of education
- Referred due to pain complaints, fatigue, variety of vague medical complaints, and memory complaints.
- Previous medical evaluations were negative.



## Recommendations for Use

- Cases with a known or suspected psychiatric component
- Particularly cases with complex psychiatric/substance use issues
- When patients can tolerate the measure
- When concerns with response bias are present
- Has a suicide screen that can be helpful

## Contraindications

- Low Functioning patients-intellectual disability, some ASD cases
- Dementia and serious neurologically impaired cases
- The “degrees of freedom” is wider due to lower reading level and simpler language, but if patient is below about 5<sup>th</sup> grade reading, PAI likely will not be helpful (e.g. will likely be invalid even if patient is able to finish it)



## Conclusions

- Growing body of research supports the reliability and validity of the PAI in neuropsychological populations.
- Low reading level of items is advantageous in neuropsychological evaluation
- Validity scales are useful for evaluating response bias
- Interpretation of scales is reasonably straightforward.

## Thank you

- Thank you for your attention.
- Special thanks to my collaborators on PAI research:
- Owen Gaasedelen, PhD
- Michelle Busse, PsyD
- Michael Basso, PhD, ABPP
- Jared Helling, PsyD

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