Assessing Mental Health in Under Six Minutes

Using Cutting-Edge Technology to Diagnose and Report on Behavioral Health Challenges Facing Foster Youth

February 14th, 2018

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PART I
CAT-MH™ - The Science

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What the CAT-MH™ Can Do

In less than 6 minutes the CAT-MH™ can:

• Identify the presence of mental health pathology
  • Depression
  • Anxiety
  • Mania/hypomania
  • Suicidality
  • Substance Abuse

• And measure the severity of these disorders

• Determine the need for treatment and type of treatment required

• Provide measurement-based treatment in or out of the clinic
Classical vs. IRT Measurement

Classical Measurement Model
Classical vs. IRT Measurement
What is CAT?

Arithmetic  Algebra  Calculus

Imagine a 1000 Item Math Test
The Bifactor Model

\[ \alpha = \begin{bmatrix} \alpha_{11} & \alpha_{12} & 0 \\ \alpha_{21} & \alpha_{22} & 0 \\ \alpha_{31} & 0 & \alpha_{33} \\ \alpha_{41} & 0 & \alpha_{43} \end{bmatrix} \]

\[ P = \int_{-\infty}^{\infty} \left\{ \prod_{i=2}^{d} \int_{-\infty}^{\infty} \prod_{j=1}^{n} \left( \Phi \left[ \frac{\gamma_j - \alpha_{ij} \theta_1 - \alpha_{jv} \theta_v}{\sqrt{1 - \alpha_{ij}^2 - \alpha_{jv}^2}} \right] \right) \right\}^{u_jv} g(\theta_v) d\theta_v g(\theta_1) d\theta_1, \]

\[ \hat{\theta}_{li} = E(\theta_{li} | u_i, \theta_{2i}, K, \theta_{di}) = \frac{1}{P_i} \int_{\theta_1}^{\theta_{li}} \left\{ \prod_{i=2}^{d} \int_{\theta_v}^{\infty} L_{iv} (\theta_v^*) g(\theta_v) d\theta_v \right\} g(\theta_1) d\theta_1 . \]

\[ V(\theta_{li} | u_i, \theta_{2i}, K, \theta_{di}) = \frac{1}{P_i} \int_{\theta_1}^{\theta_{li}} (\theta_{li} - \hat{\theta}_{li}) \left\{ \prod_{i=2}^{d} \int_{\theta_v}^{\infty} L_{iv} (\theta_v^*) g(\theta_v) d\theta_v \right\} g(\theta_1) d\theta_1 . \]

Gibbons and Hedeker, 1992, *Psychometrika*
Gibbons et al., 2007, *Applied Psychological Measurement*
What is the CAT-MH™?

• The CAT-MH™ represents a computerized adaptive test (CAT) based on a multidimensional item response theory (MIRT).

• This means that we can, for example, extract the information from 400 depression symptom-items using an average of 10 adaptively administered items, yet maintain a correlation of \( r \geq 0.95 \) with the 400 item test score.

• As such we can dramatically increase precision while eliminating clinician burden and minimize patient burden.
CAD-MDD: Computerized Adaptive Diagnosis

Diagnosis and Measurement are fundamentally different things

Sensitivity = 0.95
Specificity = 0.87

Gibbons et.al. *JCP*, 2013
How Does the CAT-MH™ Work?

• We administer a question with medium severity.

• We estimate severity based on the response to the question (symptom).

• We select the next most informative question out of the remaining symptoms-item questions.

• We stop when we reach the desired precision of measurement (e.g. 5 points on a 100 point scale)
What are the Advantages of the CAT-MH™?

• After adaptive administration of approximately 10 items in 2 minutes, we have attained the same level of precision that we would have from the administration of hundreds of items for that person.

• Different people get different items, targeted to their severity.

• The same person gets different items upon repeat testing eliminating response bias and permitting high frequency measurement.

• The CAT-MH™ is cloud-based and can be used anywhere.
What can the CAT-MH™ Measure?

- Adult (English and Spanish) – valid for ages 12 and older
  - Depression*
  - Anxiety*
  - Mania/Hypomania*
  - Suicidality*
  - Psychosis
  - Substance Abuse*
  - Functional Impairment
  - Quality of Life
  - PTSD
  - Functional status and well being (Thyroid Cancer Survivors)

- Perinatal (English and Spanish)
  - Depression*
  - Anxiety*
  - Mania/Hypomania*

- Child and adolescent (child and parent ratings) Ages 7-12
  - Depression
  - Anxiety
  - Mania/Hypomania
  - ADHD
  - Conduct disorder
  - Oppositional defiant disorder
  - Suicidality

* Completed, validated and available now
Why is this So Important?

• Emergency Department U of Chicago (n=1000)
  • 22% MDD positive screens (>90% confidence)
  • 7% MDD Positive + moderate or severe CAT-DI
  • 3% suicide screen positive
  • 3-fold increase in ED visits in moderate/severe
  • 4-fold increase in hospitalizations in moderate/severe
  • None of these patients had a psychiatric indication

• Primary Care Spain and US Latino Samples (n=1000)
  • 25% MDD positive screens (>90% confidence)
  • 9% MDD Positive + moderate or severe CAT-DI
What if you Could Assess Youth at Any Interval in Time?

Daily measurement of a Deep Brain Stimulation patient for 6 months in her home.

Sani et.al. *Translational Psychiatry*, 2017
Select Uses/Users of the CAT-MH™

- State of Tennessee
  - Foster Care, Juvenile Justice, Detention Centers – 300 case workers trained
- Cook County Jail
  - Screening in Bond Court and the Cook County Jail
- UCLA Depression Grand Challenge
  - Screen all undergraduates at UCLA and triage to iCBT
  - Screen 1.8 million to develop a Registry of 100,000 patients
- Indiana University Substance Abuse Grand Challenge
  - State-wide Survey
  - State-wide health care system integration
- NorthShore University Health Systems
  - Perinatal depression screening and follow-up
- Veteran’s Administration/Department of Defense
  - Develop new PTSD scale and further validate suicidality scale
Scientific Literature


PART II
Linking the CAT-MH™ to the SACWIS Data

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Linking CAT-MH™ to SACWIS

• The following data show the advantages of linking the CAT™ to SACWIS data (e.g., placement data)

• These data are illustrative of the benefits and are NOT indicative of any particular finding, set of findings, or conclusions.
Positive for Depression by Age

![Bar Graph showing percent positive for depression by age]

Age at Placement

Percent Positive for Depression

- 13
- 14
- 15
- 16
- 17
- 18
Average Anxiety Level by Depression
Anxiety Level by Discharge Reason

- Reunified: Anxiety Level
- Still in Care: Anxiety Level
Average Level of Anxiety by Depression Status and Placement Type
PART III
Use of the CAT-MH™ in Tennessee

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Tennessee Department of Children’s Services
Use of the CAT-MH™ in Tennessee

• Initial pilot with 2 regions of TN Department of Children’s Services

• Expanded to statewide rollout for youth in state’s custody who are in detention centers

• Why did TN choose CAT-MH™?
  – Administration by front line workers is possible
  – Able to make immediate determination about need for referral
  – Good for temporary placement situation because can’t afford to wait a week or more for a clinician to come assess
Use of the CAT-MH™ in Tennessee

- TN uses CAT-MH™ to test for anxiety, depression, and suicidal ideation
- Results are emailed to front line staff and clinician
- TN uses cutoffs established in the literature
- TN Family Service Workers (case managers) note whether youth has flagged for suicide
- TN Licensed Clinician is a consultant who emails worker about recommended referrals
- TN has contracted with a local provider to deliver services in detention centers
PART IV
Implementation successes and challenges

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Implementation Successes

Easy, convenient interface

Email notification structure

Immediate clinical information

Training response
Implementation Challenges

Use of temporary ID’s

Wifi availability

Email notification structure

Concern over youth’s responses
For further information about the CAT-MH™, please contact:
Adaptive Testing Technologies
info@adaptivetestingtechnologies.com

For general questions about The Center for State Child Welfare Data:
analytics@chapinhall.org

Read more about the use of the CAT-MH™ to diagnose and report on behavioral health challenges facing foster youth:
https://fcda.chapinhall.org/data-center-news/under-six-minutes/