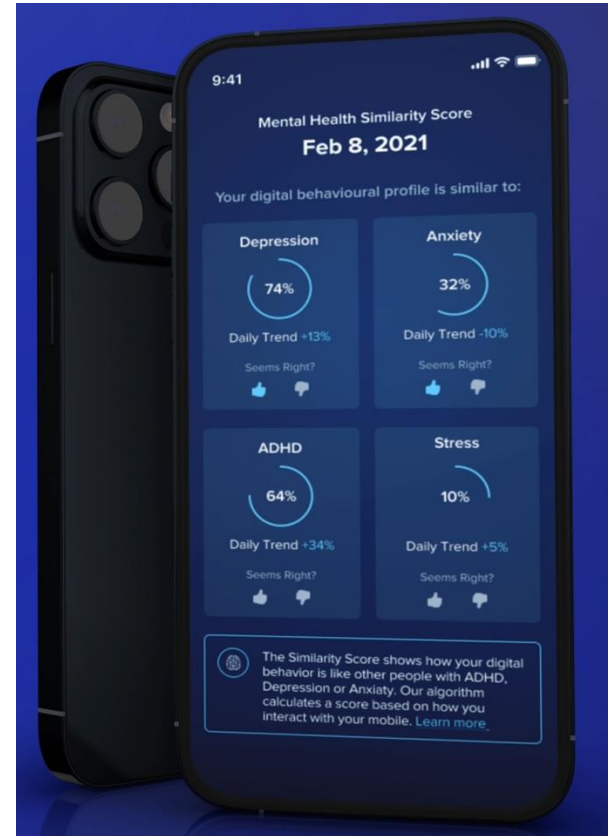# behavidence

The Most Accurate Tool to Measure Psychological and Mental Health Every Day

Girish Srinivasan
Co-Founder & CSO
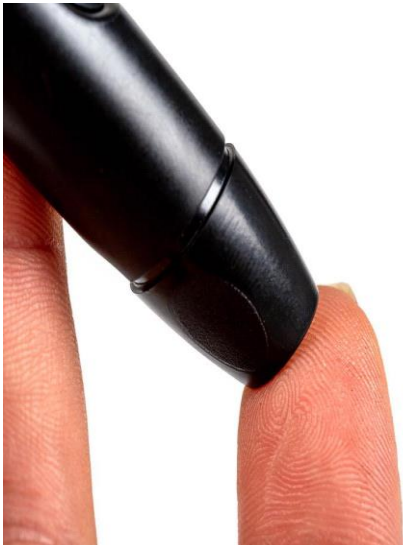girish@behvidence.com

Biomarkers?

- *Molecular* - Blood glucose : Normal value is 3.9-5.6 mmol/l
- *Histologic* - Cell microscopy for type of cancer - Squamous cell/ Basal Cell cancer.
- *Radiographic* - X-ray for Pneumonia which shows consolidation of an area on the lung.
- *Physiologic* - Blood Pressure - 120/80 mmHg

'Since the development of Modern Medicine, Biomarkers have been the leading player in assessing patients, evaluating diagnosis, treatment and prognosis"
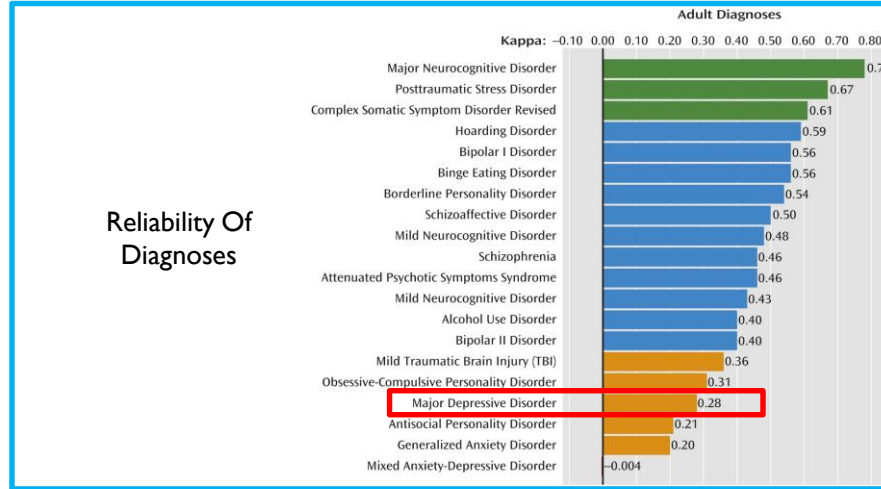
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Molecular Biomarker:

Blood glucose :

- Diagnostic biomarkers
- Screening
- Risk
- Treatment Response
- Prognostic (HBA1C)
- Predictive
- Susceptibility
- Monitoring

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No Behavioral or Bio Marker for Psychological & Mental Health

The Accuracy of Psychology/Psychiatry is Low

Reliability Of Diagnoses

Adult Diagnoses

Kappa: −0.10 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80

Diagnosis	Kappa
Major Neurocognitive Disorder	0.78
Posttraumatic Stress Disorder	0.67
Complex Somatic Symptom Disorder Revised	0.61
Hoarding Disorder	0.59
Bipolar I Disorder	0.56
Binge Eating Disorder	0.56
Borderline Personality Disorder	0.54
Schizoaffective Disorder	0.50
Mild Neurocognitive Disorder	0.48
Schizophrenia	0.46
Attenuated Psychotic Symptoms Syndrome	0.46
Mild Neurocognitive Disorder	0.43
Alcohol Use Disorder	0.40
Bipolar II Disorder	0.40
Mild Traumatic Brain Injury (TBI)	0.36
Obsessive-Compulsive Personality Disorder	0.31
Major Depressive Disorder	0.28
Antisocial Personality Disorder	0.21
Generalized Anxiety Disorder	0.20
Mixed Anxiety-Depressive Disorder	−0.004

Freedman et. al (2013) American Journal of Psychiatry

- Patient distrust

- Patient and therapist biases

- Lack of insurance or inadequate insurance

- Over 50% false positives

- Tech built on fuzzy constructs

- Stigma

- Switching diagnosis

- Low efficiency of therapies
(Medications, psychodynamic therapies)

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Digital Behavior Significance

Digital Behavior

What You're Going To Buy Next
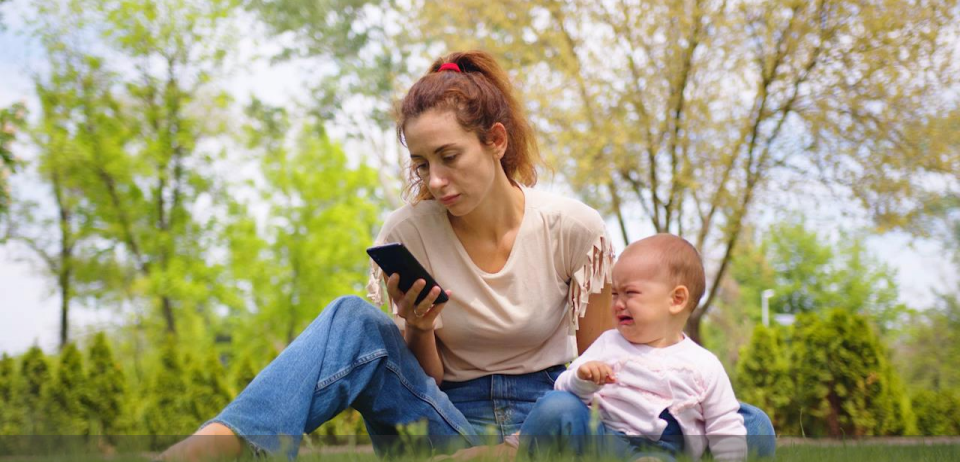

FACEBOOK

Digital Behavior

What You're Going To Watch Next

NETFLIX

Our Digital Behaviour Reflects Our Psychological and Mental Health With No Biases

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The Psychological Health Navigator

Collection

Digital anonymized behavioral data collected passively

ML/AI

Machine learning models Trained with thousands of patients

Accurate Psychological Marker

Daily similarity score with Anxiety, Depression and ADHD.

Recall Accuracy: 75-94%

Psychological & Mental Health Similarity Score

MHSS

- Detect and screen mental health disorders

- Fully reimbursable (CPT 96172)

- 0% Respondent burden

- No identifiable data collected

- 100% Safe and secure

- White label app or embedded SDK

- HIPAA and GDPR compliant

- 75%-94% recall accuracy

Our proprietary MHSS models

	Anxiety	Depression	ADHD	Stress	PPD
Ground Truth	GAD-7	PHQ9 / Clinical	ASRS/Snap4	PSS	EPDS/Clinical/PHQ9
Training Cohort	$n = 4,622$	$n = 2,400$	$n = 1,364$	$n = 2,324$	$n = 2,038$
Top Recall Accuracy	94%	89%	75%	92%	91%

We developed a capability to develop new digital phenotype in 30 days
Current pipeline: OUD, ASD, Burnout, ADHD 2.0

Scientifically validated in a peer reviewed study

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Tailored to your needs

https://care.behavidence.com/

- Customized Metrics
- Branding and Look
- Central Analytics
- Plug and Play Platform
- Individual or Population Level
- Alerts and Intervention Triggers
- Seamless Integration
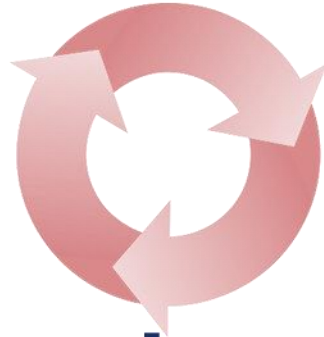- Easy PMPM Licensing Packages

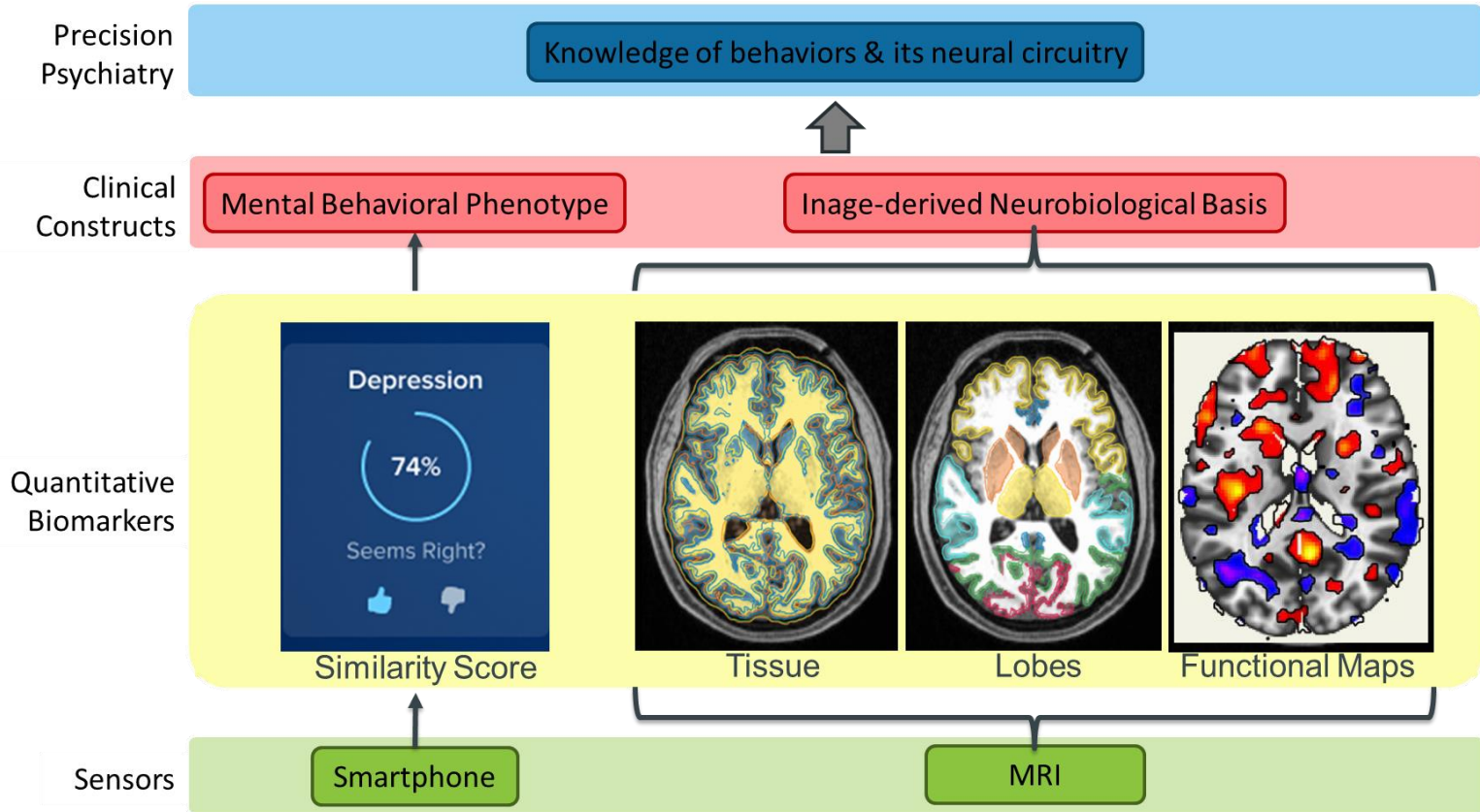behavidence

Benefits
Clinicians

- An early screening tool with the opportunity for timeous interventions

- Continuous remote monitoring tool

- Ability to identify correct or incorrect therapeutic interventions early on - avoid trial and error therapy

- Avoid unnecessary lengthy treatment

- Advancing Precision Medicine in Psychology & Psychiatry

- Alert notifications within the app if needed

- Improved self-awareness and self-management.

A Sneak Peek into the next steps!

Substance Abuse Disorder – Characteristics

Behavioral Phenotypes

- Coordination
- Impulsivity
- Reaction
- Concentration
- Activity level
- Sleep
- Social dynamics
- Connectivity

Imaging Phenotypes

Structural

- Volumetric changes in frontal cortex
- Enlargement of basal ganglia
- Severe grey matter deficits in the cingulate, limbic, and paralimbic cortices
- Smaller hippocampi
- Smaller amygdala

Functional

- Higher levels of activity in the caudate, cingulate, lateral PFC
- Correlation between craving and NAc activity

Ref: 1) Fowler, Joanna S., et al. "Imaging the addicted human brain." Science & practice perspectives 3.2 (2007)
2) Hsu, M, Ahern, DK, Suzuki, J. Digital phenotyping to enhance substance use treatment during the COVID-19 pandemic. JMIR Ment Health. 2020;7(10):e21814.

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A practical study protocol

Aim

- Exploring digital phenotyping to inform brain structure and/or function
- Establish a meaningful hypothesis to bridge the domains of neural circuitry with behaviors
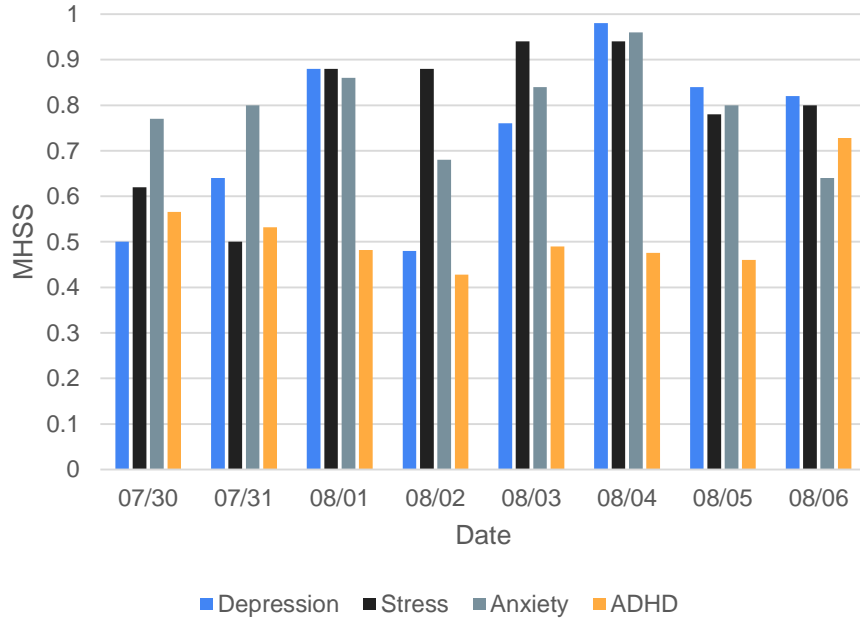
Study Subjects

- Individuals active diagnosis or treatment in the last 3 months
- Healthy volunteers

Method

- Behavidence smartphone app with an associated cloud-based analytics solution to compute a daily metric (Mental Health Similarity Score - MHSS) representing digital behavioral similarity to addiction
  - » Minimum of 30 days of passive data collection
- MRI examination consisting of at least 2 acquisitions
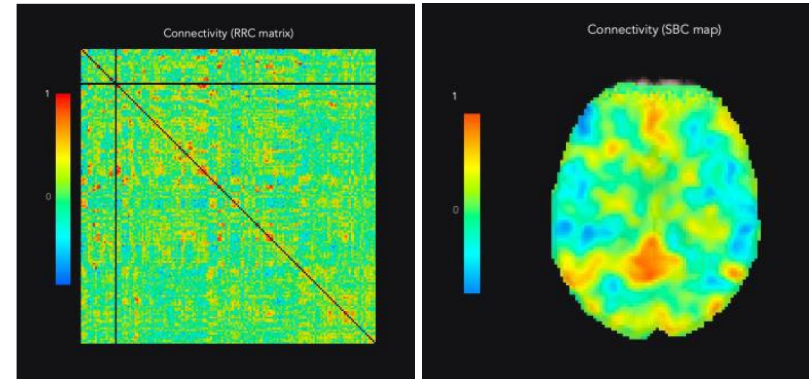 - » 3D T1
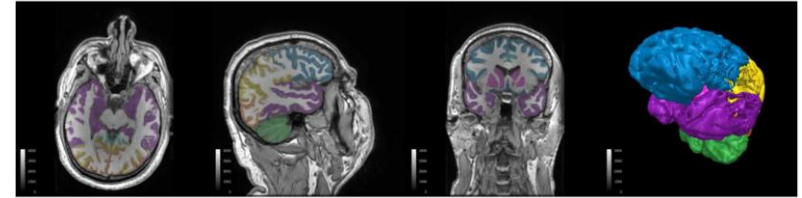 - » resting-state functional MRI

Sample Subject Result

Longitudinal MHSS (severe depression on PHQ-9)

Legend: ■ Depression ■ Stress ■ Anxiety ■ ADHD

Data Courtesy: Dr. Naveen Chitkara, Neurosurgeon, NHS Hospital, Jalandhar

Lobes

Region	Volume [cm³]	% ICV	Ref*
Cerebellum	141.62	10.42	9.22-10.26
Parietal	77.32	5.69	7.10-7.83
Frontal	138.22	10.17	11.42-12.58
Occipital	44.98	3.31	3.29-3.86
Temporal	111.14	8.17	8.50-9.28
Limbic	17.55	1.29	1.56-1.75
Basal ganglia	38.34	2.82	2.51-2.76

Connectivity (RRC matrix)

Connectivity (SBC map)

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Thank You!