A Personalized Modular Therapy for Depression and Anxiety: Design and Initial Implementation

Aaron J. Fisher, Ph.D.
Assistant Professor
Department of Psychology
University of California, Berkeley
GAD and MDD

- Generalized anxiety disorder (GAD) is the most commonly occurring anxiety disorder
- Major depressive disorder (MDD) is likewise the most common of the mood disorders
- One-year comorbidity = .62 (Kessler et al., 2005)
- 255 possible ‘versions’ of MDD, 42 of GAD
  - 793 different possible comorbid presentations
Procedure

• Structured Clinical Interview
  – GAD and/or MDD

• Web-based smartphone assessment
  – 4x/day for ~ 30 days

• Factor analysis of individual data (P-Technique)

• Dynamic Factor Modeling

• Dynamic Assessment Treatment Algorithm (DATA)

• Targeted, modular treatment delivery (UP)
<table>
<thead>
<tr>
<th>Item</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
<th>Module 5</th>
<th>Module 6</th>
<th>Module 7</th>
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Participants

- 122 individuals given structured clinical interviews (ADIS)
- 50 invited to participate
- 40 enrolled
- 32 Survey Completers
  - 4 MDD (12%)
  - 15 GAD (47%)
  - 13 GAD + MDD (41%)
- 20 treatment completers (5 in therapy)
  - 3 MDD (15%)
  - 8 GAD (40%)
  - 9 GAD + MDD (45%)
Participants

- 32 Survey Completers
  - 24 Women (75%), 8 Men (25%)
  - Mean age = 33.91 (13.26)
  - 44% White (14), 25% Asian/Asian–American (8), 19% Latino (6), 6% African–American (2)

- 20 treatment completers
  - 15 women (75%), 5 men (25%)
  - Mean age = 32.9 years (13.22)
  - 55% White (11), 25% Asian/Asian–American (5), 15% Latino (3), 5% African–American (1)
To what degree have you:

1. Felt down or depressed
2. Felt hopeless
3. Experienced loss of interest or pleasure
4. Felt worthless or guilty
5. Felt worried
6. Felt restless
7. Felt irritable
8. Had difficulty concentrating
9. Experienced muscle tension
10. Felt fatigued
11. Avoided activities
12. Procrastinated
13. Sought reassurance
UP Modules

M1: Motivation Enhancement for Treatment Engagement
M2: Psychoeducation & Tracking of Emotional Experiences
M3: Emotion Awareness Training
M4: Cognitive Appraisal and Reappraisal
M5: Emotion Avoidance and Emotion–Driven Behaviors
M6: Awareness and Tolerance of Physical Sensations
M7: Interoceptive and Situation–Based Emotion Exposures
M8: Relapse Prevention
## Treatment Outcome

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Tx Performance

- Pre/Post Cohen’s $d = 2.21$ over 9.75 sessions
- Average effect per session = .23
- Johnsen & Friborg (2015)
  - Analyzed 70 RCTs from 1977 to 2014
  - Pre/Post HAM–D Cohen’s $d = 1.69$
  - Over an average of 14.61 sessions
  - $d = .12$/session
DATA: Raw Factor Score

\[
\left( \% \text{ CFA Variance} \right) \times \left( \text{Autoregression} \uparrow 2 + \sum \uparrow \text{Cross Predictions} \uparrow 2 \right) / N \downarrow \text{Factors} \]

Contribution of each factor to symptom variation

- Within time
  - % Variance in the confirmatory model

- Across time
  - % Variance in the time-lagged parameters of the dynamic model
DATA: Normalized Factor Score

\((\text{FS}_N) = \frac{\text{Raw Factor Score}}{\text{Max Factor Score}}\)

The FS\(_N\) sets the scale for all Factor Scores between 0 and 1, with a fixed maximum of 1.
DATA: Raw Item Score

\[ \text{Item Mean/Max Mean} \times \sum (\text{Factor Score} \times |\text{Standardized Factor Loading}|) \]

- Average symptom severity relative to other symptoms
- Factor Score for the factor the symptom corresponds to
- Degree to which the symptom relates to the factor
DATA: Normalized Item Score

\((IS_N) = \frac{\text{Raw Item Score}}{\text{Max Item Score}}\)

The IS\(_N\) sets the scale for all Item Scores between 0 and 1, with a fixed maximum of 1.
DATA: Module Score

Item–Average Module Score:
\[ \Sigma \frac{IS \downarrow N}{ /N \downarrow Items} \]

Raw Sum Module Score:
\[ \Sigma \uparrow IS \downarrow N \]

Final Module Score:
\[ \text{Normalized} \left( \frac{\Sigma \uparrow IS \downarrow N}{ /N \downarrow Items} \right) + \text{Normalized} \left( \Sigma \uparrow IS \downarrow N \right) /2 \]
Module Score

• The raw sum preferentially weights modules with a greater number of items
  – A module with a greater number of treatment targets will address a wider range of psychopathology

• More narrowly defined interventions might be penalized for being relatively underrepresented in the matching matrix.

• The average of the 2 item scores within each module reflects the central tendency of the module, without penalizing modules with fewer items
  – Taking the average of the item-average and raw sum thus provides a balance between a more overtly model-oriented or item-oriented scoring system
# Matching Matrix

<table>
<thead>
<tr>
<th>Item</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
<th>Module 5</th>
<th>Module 6</th>
<th>Module 7</th>
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<td>1</td>
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<td>Felt restless</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Felt worried</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Felt worthless or guilty</td>
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<td>0</td>
<td>1</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Experienced loss of interest or pleasure</td>
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<td>0</td>
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<tr>
<td>Felt hopeless</td>
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<tr>
<td>Felt down or depressed</td>
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<td>0</td>
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<td>0</td>
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<tr>
<td>Felt fatigued</td>
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<td>0</td>
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<tr>
<td>Experienced muscle tension</td>
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<td>0</td>
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<tr>
<td>Had difficulty concentrating</td>
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<tr>
<td>Avoided activities</td>
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<td>Sought reassurance</td>
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<tr>
<td>Procrastinated</td>
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<td>0</td>
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Network Models

• Latent factors reflect disease model
  – Single underlying cause
• Requires conditional independence
  – Symptoms/behaviors (likely) causally-related
• Network models provide an alternative
• May allow a superior application of algorithm
Po48 Network Model
Expected Force

- Centrality measures are poorly equipped for flow characteristics of weighted networks (Borgatti, 2005)
  - Not designed to quantify spreading power
  - Underestimate influence of non-hub nodes

- **Expected Force** quantifies the spreading power of each node in a network (Lawyer, 2015, Nature)
  - Spreading power is determined by the influence of the node and the influence of its neighbors
  - Provides a normal, continuous metric
To what degree have you:

1. Felt down or depressed
2. Felt hopeless
3. Experienced loss of interest or pleasure
4. Felt worthless or guilty
5. Felt worried
6. Felt restless
7. Felt irritable
8. Felt angry
9. Felt afraid
10. Had difficulty concentrating
11. Experienced muscle tension
12. Felt fatigued
13. Avoided people
14. Avoided activities
15. Procrastinated
16. Sought reassurance
17. Dwelled on the past
18. Felt positive
19. Felt content
20. Felt enthusiastic
21. Felt energetic
Po48 Network Model
P117 Network Model
Predicted Effects (& Observed)

• Direct Effects
  – Down → Positive: −.21 (−.22)
  – Down → Hopeless: .18 (.32)
  – Down → Afraid: .13 (.14)

• Indirect Effects
  – Down → Positive → Afraid:
    • −.21 x −.23 = .05 (−.22 x −.15 = .03)
  – Down → Hopeless → Enthusiastic
    • .18 x −.31 = .06 (.32 x −.19 = .06)
Predicted Effects (& Observed)

• Direct Effects
  – Down → Positive: −.21 (−.22)
  – Down → Hopeless: .18 (.32)
  – Down → Afraid: .13 (.14)

• Indirect Effects
  – Down → Positive → Afraid:
    • −.21 × −.23 = .05 (−.22 × −.15 = .03)
  – Down → Enthusiastic: −.05 (−.26)
ExF across Mood & Anxiety

- Lost Interest of Pleasure
- Down
- Content
- Worried
- Hopeless
- Positive
- Guilty
- Afraid
- Irritable
- Fatigued
- Difficulty Concentrating
- Restless
- Energetic
- Enthusiastic
- Dwelled on the Past
- Avoided Activities
- Procrastinated
- Angry
- Avoided People
- Sought Reassurance
- Muscle Tension
ExF across Mood & Anxiety

![Graph showing ExF across Mood & Anxiety with different conditions: GAD Only, MDD Only, GAD+MDD.](attachment:image.png)
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<td>Experienced muscle tension</td>
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<td>Had difficulty concentrating</td>
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<td>Avoided activities</td>
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<td>Sought reassurance</td>
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<td>Procrastinated</td>
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<td>Felt fatigued</td>
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<td>Had difficulty falling or staying asleep</td>
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<td>Had restless or unsatisfying sleep</td>
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</table>

CBT-I = cognitive behavioral therapy for insomnia; ERP = exposure and response prevention; (-) = negatively scored items.
Conclusions

• Proof of concept
• Strong overall effects ($d = 2.20$)
• Evidence for shorter time-to-effect
  – $d = .23$/session versus $.12$/session (Johnsen & Friborg, 2015)
• Good support for factor analytic approach
  – Possibly not the most parsimonious design
• Network approach may be superior
  – Expected force a promising metric
  – Evidence for accuracy of predictions
• Both the factor- and network-based approaches easily accommodate comorbidity
Thank You

• Jonathan Barkin
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• Sheryl FitzGerald

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• Alyssa Parker
• Jennifer Paul
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