USING ECOLOGICAL MOMENTARY ASSESSMENT TO IDENTIFY HOW AND FOR WHOM TREATMENTS WORK

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ECOLOGICAL MOMENTARY ASSESSMENT (EMA)

- Repeated collection of real-time data in the real-world environment
- Variable and infrequent effects in daily life

**Delivery Method**
- Smartphone
- Interactive voice response
- Text-based intervention

**Report Type**
- Visual analogue scales
- Check boxes
- Text or number entry
- Forced-choice responses

**Event-contingent**
- Happens
  - Begin
  - Behavior

**Signal-contingent**
- Random
  - Prompts
- Stratified
  - Prompts

**Time-based**
- Morning reports
- Evening reports

**Prized and Dangerous**

- Ecological validity
- Temporally sequenced data
- "Here and now" vs. "There and then"
- Lack of control
- Front end—design options
- Back end—analysis options

**Good things**
**Not-so-good Things**

**Visual analogue scales**
**Check boxes**
**Text or number entry**
**Forced-choice responses**
Options for nested data

- Generalized Estimating Equations (GEE)
- Multilevel Modeling (i.e., MLM, HLM, Mixed models)
- Structural Equation Modeling (SEM)
- Multilevel Structural Equation Modeling (MSEM)
EMA FOR MECHANISMS OF BEHAVIOR CHANGE

Using EMA to identify **HOW** and **FOR WHOM** treatments work

**FOR WHOM: MODERATION**

![Diagram showing the relationship between genetic moderator, mechanism, and outcome.](image)

- **GENETIC MODERATOR**
- **MECHANISM**
- **OUTCOME**

**HOW: MEDIATION**

**FOR WHOM: MODERATION**

- Genetic Moderator
- Mechanism
- Outcome

- e
- b
EMA FOR MECHANISMS EXAMPLE
EMA FOR MECHANISMS EXAMPLE

Prior study examined genetic moderators of naltrexone’s effects on drinking (Tidey, Rohsenow, Monti, et al., 2008)
METHOD

180 participants randomized to 3 weeks of daily naltrexone (50mg) or placebo

<table>
<thead>
<tr>
<th>Medication Status</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No medication</td>
<td>All placebo</td>
<td>Naltrexone (50mg) or placebo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMA status</td>
<td>EMA training</td>
<td>EMA baseline</td>
<td>EMA monitoring and weekly visits to lab</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EMA PROTOCOL

Handheld computers (PalmPilot) preloaded with software designed for this study

Report types
- Morning Reports
- Random Prompts (about 5 per day)
- Begin-drink Reports (before beginning each of up to 2 drinks)
- End-drink Reports (after each of up to 2 drinks)

Urge to drink, from 0 (no urge) to 10 (strongest ever)
SUBSET ANALYSIS

Alcohol Use Disorder Diagnoses
- No Diagnosis, \( n = 20 \) (19%)
- Abuse, \( n = 19 \) (18%)
- Dependence, \( n = 65 \) (63%)

Baseline average drinks per drinking day, 3 to 15 (\( M = 7, SD = 3 \))

Baseline percent drinking days, 31 to 100% (\( M = 65, SD = 17 \))

Baseline percent heavy drinking days, 10 to 100% (\( M = 44, SD = 17 \))
EMA FOR MECHANISMS EXAMPLE

1. Morning Reports
2. Random Prompts
3. Begin Drink Reports
4. End Drink Report 1
5. End Drink Report 2

Averaged over entire medication period
PRESENT ANALYSES

DRD4

Cue-elicited craving

Naltrexone

Total Drinks

DRD4

Naltrexone

Cue-elicited craving

Total Drinks
Unconflated Multilevel Model in Mplus

Between

- Naltrexone\(_j\)
- DRD4\(_j\)
- Craving person mean\(_j\)
- Drinking\(_j\)

Observed

- Craving
- Drinking

Within

- Person-mean centered craving\(_{ij}\)
- Drinking\(_{ij}\)
# RESULTS: DRINKDAY

<table>
<thead>
<tr>
<th></th>
<th>Est.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WITHIN LEVEL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craving $\rightarrow$ Drink day</td>
<td>0.23</td>
<td>0.05</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>BETWEEN LEVEL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naltrexone $\rightarrow$ Drink day</td>
<td>-0.53</td>
<td>0.38</td>
<td>.161</td>
</tr>
<tr>
<td>Naltrexone (Placebo ref.) $\rightarrow$ Craving person mean</td>
<td>0.30</td>
<td>0.46</td>
<td>.522</td>
</tr>
<tr>
<td>DRD4L (DRD4S ref.) $\rightarrow$ Craving person mean</td>
<td>0.78</td>
<td>0.53</td>
<td>.139</td>
</tr>
<tr>
<td>Naltrexone $\times$ DRD4L $\rightarrow$ Craving person mean</td>
<td>-1.85</td>
<td>0.72</td>
<td>.010</td>
</tr>
<tr>
<td>Craving person mean $\rightarrow$ Drink day</td>
<td>0.25</td>
<td>0.10</td>
<td>.008</td>
</tr>
<tr>
<td><strong>Naltrexone $\times$ DRD4L</strong> $\rightarrow$ Drink day</td>
<td>-0.57</td>
<td>0.51</td>
<td>.266</td>
</tr>
<tr>
<td>Naltrexone $\times$ DRD4L $\rightarrow$ Drink Day</td>
<td>0.68</td>
<td>0.65</td>
<td>.292</td>
</tr>
</tbody>
</table>
### INDIRECT EFFECTS: DRINK DAY

<table>
<thead>
<tr>
<th>Effect</th>
<th>Est.</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect: $a_1 \times b$</td>
<td>0.07</td>
<td>(-0.15, 0.30)</td>
<td>.519</td>
</tr>
<tr>
<td>Moderated indirect effect: $(a_1 + a_3) \times b$</td>
<td>-0.39</td>
<td>(-0.75, -0.03)</td>
<td>.034</td>
</tr>
</tbody>
</table>
## RESULTS: DRINKDAY

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<tr>
<td><strong>WITHIN LEVEL</strong></td>
<td></td>
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</tr>
<tr>
<td>Craving → Total drinks</td>
<td>0.30</td>
<td>0.06</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>BETWEEN LEVEL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naltrexone (Placebo ref.) → Total drinks</td>
<td>1.46</td>
<td>0.82</td>
<td>.073</td>
</tr>
<tr>
<td>Naltrexone → Craving person mean</td>
<td>-0.54</td>
<td>0.37</td>
<td>.143</td>
</tr>
<tr>
<td>DRD4L (DRD4S ref.) → Craving person mean</td>
<td>0.02</td>
<td>0.43</td>
<td>.957</td>
</tr>
<tr>
<td>Naltrexone × DRD4L → Craving person mean</td>
<td>-0.41</td>
<td>0.66</td>
<td>.532</td>
</tr>
<tr>
<td>Craving person mean → Total drinks</td>
<td>0.79</td>
<td>0.18</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>DRD4L → Total drinks</td>
<td>0.35</td>
<td>0.76</td>
<td>.640</td>
</tr>
<tr>
<td>Naltrexone × DRD4L → Total Drinks</td>
<td>-2.46</td>
<td>1.08</td>
<td>.022</td>
</tr>
</tbody>
</table>
## Indirect Effects: Total Drinks

<table>
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<th>Effect</th>
<th>Est.</th>
<th>95% CI</th>
<th>p</th>
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<tbody>
<tr>
<td>Indirect effect: $a_1 \times b$</td>
<td>-0.43</td>
<td>0.32</td>
<td>0.185</td>
</tr>
<tr>
<td>Moderated indirect effect: $(a_1 + a_3) \times b$</td>
<td>-0.75</td>
<td>0.47</td>
<td>0.110</td>
</tr>
</tbody>
</table>
Unconflated multilevel moderated mediation models have an advantage over traditional MLM in that they disaggregate between and within effects. However, in some situations, using the person mean as a proxy for the person’s latent standing can result in biased estimates (Preacher, Zyphur, & Zhang, 2010). But bias is greater when there are fewer level 1 units. Decisions about study design and analytic approach can restrict or expand the inferences one may draw from the data.
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