Ecological Momentary Assessment of Physical Activity

Genevieve F. Dunton, PhD, MPH
Department of Preventive Medicine
University of Southern California
Limitations of Recall and Observational Methods

Recall Instruments
• Memory errors and biases
• Not completed in the environment in which the behavior occurs

Observational Methods
• Often limited to a single setting
• Do not measure mood or subjective perceptions
Limitations of Objective Methods

Accelerometer

- Difficulty measuring activity type, load bearing, incline, bicycling, swimming

GPS

- Difficulty differentiating some modes of travel (scooter chair, wheel chair, stroller)
- Do not measure mood or subjective perceptions
Ecological Momentary Assessment (EMA)

• Real-time self-report responses in naturalistic settings
• Can simultaneously measure:
  1) Activity type (e.g., soccer, watching TV)
  2) Where (e.g., playground, trail, sidewalk)
  3) With whom (e.g., alone, friends, siblings)
  4) Perceived characteristics (e.g., safety, traffic)
  5) Mood (e.g., positive affect, negative affect, stress)
Electronic EMA
Equipment/Technology

- Mobile phone
- Personal Digital Assistant (PDA)
- Internet (Laptop, Desktop, iPad)
EMA Sampling Schedule

- **Event-contingent** - information recorded during or after a pre-determined behavior

- **Interval-contingent** - information recorded according to specific pre-set time frames (e.g., at 8am and 12noon everyday)

- **Signal-contingent** – information recorded when prompted, often at random times throughout the day

- **Context-contingent** – information recorded when a context or environment is sensed (GPS, heart rate, etc)
Example EMA Sampling Schedule
(Interval-Signal Contingent Hybrid)

- Monitoring occurred across 4 days (Fri-Mon) for each wave.

- No prompts during school hours on Friday or Monday.

<table>
<thead>
<tr>
<th>Day</th>
<th>8:30-10am</th>
<th>10am-12pm</th>
<th>12-2pm</th>
<th>2-4pm</th>
<th>4-6pm</th>
<th>6-8pm</th>
<th>8-8:30pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Saturday</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sunday</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Monday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Note: Question sequences were prompted at a random time within each interval.
Please stop what you are doing for a survey. Press the button under the word BEGIN to get started.

**Survey**

*What were you DOING right before the beep went off? (Choose your main activity)*

1. Reading, Computer, or Homework
2. Watching TV/Movies
3. Playing video games
4. Active Play, Sports, or Exercising
5. Other

**Survey**

*What was this OTHER activity?*

1. Eating/Drinking
2. Talking/On the phone
3. Chores
4. Riding in a car
5. Something else

**Survey**

*WHERE were you just before the beep went off?*

1. Home
2. School
3. Car/Van/Truck
4. Outdoors
5. Other

**Survey**

*How STRESSED were you feeling just before the beep went off?*

1. Not at all
2. A little
3. Quite a bit
4. Extremely

**Survey**

*Were you with your MOM or DAD just before the beep went off?*

1. Yes
2. No
Compliance  
(children ages 9-13 years)

- Children answered 80% (range 7% – 100%) of EMA surveys

- Unanswered surveys were more common among African-American (21%), Asian (22%), Mixed/Biracial (22%), and Other (25%) as compared with White/Caucasian children (11%)

- No differences by day of the week, time of day, sex, age, income or weight status

Physical Activity Levels During Answered and Unanswered Prompts
(Steps in the 30 minutes before the EMA prompt)

Adj. Wald F = 3.09, df = 1, p = .08
Adjusted for day of the week, time of day, sex, age, race/ethnicity, income, weight status.
Extent to Which EMA Surveys Disrupted Activity
(15 min. before/after the EMA prompt)

Adj. Wald $F = 2.29$, df = 1, $p = .13$
Adjusted for day of the week, time of day, sex, age, race/ethnicity, income, weight status.

Adj. Wald $F = 0.15$, df = 1, $p = .70$
Validity of EMA Activity Responses
(30 minutes before the EMA prompt)

Using EMA Describe the Contexts of PA and Sedentary Behavior

- Where?
- With whom?
- Do these patterns differ according to?
  - Demographic factors (sex, age, ethnic, income)
  - Temporal factors (time of day, day of the week, seasons)
Age and Income Differences in Physical Activity Contexts

Using EMA to Examine Differences in Physical Activity Across Contexts

• How do physical activity levels (e.g., intensity, duration) differ across physical and/or social contexts?

• How do physical activity experiences (e.g., enjoyment, positive and negative affect) differ across physical and/or social contexts?
Physical Activity Level by Social Context
(30-min. before EMA prompt)

Using EMA to Examine Antecedents, Concomitants, Consequences of PA Episodes

• Is the likelihood of participating in a physical activity bout related to prior or current mood, stress, pain, fatigue, etc?

• Does participating in a physical activity bout influence subsequent predict subsequent mood, stress, pain, fatigue, etc?
Conceptual Model of Temporal Relationships

7:45am
MVPA
SE
PA
NA
Energy
Fatigue
Demand
Control

11:45am
MVPA
SE
PA
NA
Energy
Fatigue
Demand
Control

3:45pm
MVPA
SE
PA
NA
Energy
Fatigue
Demand
Control

7:45pm
MVPA
SE
PA
NA
Energy
Fatigue
Demand
Control

Lagged Effects
### Associations with $\text{MVPA}_T$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group Avg. Coeff. (SE)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Efficacy</strong>$_{T-1}$</td>
<td>0.08 (0.02)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Positive Affect</strong>$_{T-1}$</td>
<td>0.06 (0.02)</td>
<td>.003</td>
</tr>
<tr>
<td><strong>Negative Affect</strong>$_{T-1}$</td>
<td>-0.11 (0.03)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Energy</strong>$_{T-1}$</td>
<td>0.04 (0.02)</td>
<td>.066</td>
</tr>
<tr>
<td><strong>Fatigue</strong>$_{T-1}$</td>
<td>-0.02 (0.01)</td>
<td>.135</td>
</tr>
<tr>
<td><strong>Control</strong>$_{T-1}$</td>
<td>0.05 (0.02)</td>
<td>.004</td>
</tr>
<tr>
<td><strong>Demand</strong>$_{T-1}$</td>
<td>-0.01 (0.01)</td>
<td>.978</td>
</tr>
<tr>
<td><strong>Pos. Soc. Inter.</strong>$_T$</td>
<td>0.17 (0.05)</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Prob. Soc. Inter.</strong>$_T$</td>
<td>0.02 (0.06)</td>
<td>.692</td>
</tr>
<tr>
<td><strong>Stressful Event</strong>$_T$</td>
<td>-0.01 (0.06)</td>
<td>.875</td>
</tr>
</tbody>
</table>

Using EMA to Examine Intraindividual Variability

- Do some people show stable patterns of physical activity self-efficacy across the day or from day to day whereas other people’s patterns are variable?

- Are between-person differences in degree of intraindividual variability in self-efficacy related to physical activity levels?
Intraindividual variability in self-efficacy was lower during weeks when brisk walking was higher ($\tau = -0.01$, SE = 0.002, $p < .01$).

Future Areas of Research

Context-Sensitive EMA with Environmental, Biological and Behavioral Triggers

-Integration of data from internal/external sensors (GPS, accelerometers, salivary amylase, air pollution monitors, instrumented asthma inhalers)
Challenges and Limitations

• Missing data
• Reactance
• Participant burden
• Costs
Acknowledgments

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