

Just-in-Time Adaptive Interventions in Mobile Health

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advancing methods, improving health



JITAI: Just-in-Time Adaptive Interventions

- A JITAI is an adaptive intervention
- That is
 - delivered when needed
 - & where-ever needed



(Kaplan & Stone, 2013; Spruijt-Metz & Nilsen, 2014)

JITAI



Help People Quit Smoking

- Wearable bands measure activity, provide predictions of stress, cigarette smoking
- Smartphone provides four types of support 24/7
- Wearable band provides supportive “cue” and smartphone activates to highlight associated support when stress prediction reaches a criterion

JITAI

Help People be Active “HeartSteps”

- Wearable bands measure activity, phone sensors measure busyness of calendar...
- Smartphone pings and lockscreen is used to highlight activity messages when individual is not too busy and at the best time of the day



Just-in-Time Adaptive Intervention

5 Elements

The adaptation is guided by consideration of

(1) Proximal Response and Distal Outcome



In-the-Moment
Impact

The adaptation process is composed of

- (2) Tailoring Variables,
- (3) Decision Rules and
- (4) Intervention Options

The adaptation is triggered at

(5) Decision Points



Real-Time

Micro-Randomized Trial

Randomize between appropriate intervention options at decision times → Each person may be randomized 100's or 1000's of times.

Micro-Randomized Trial Elements

1. Record outcomes

- Distal (scientific/clinical goal) & Proximal Response

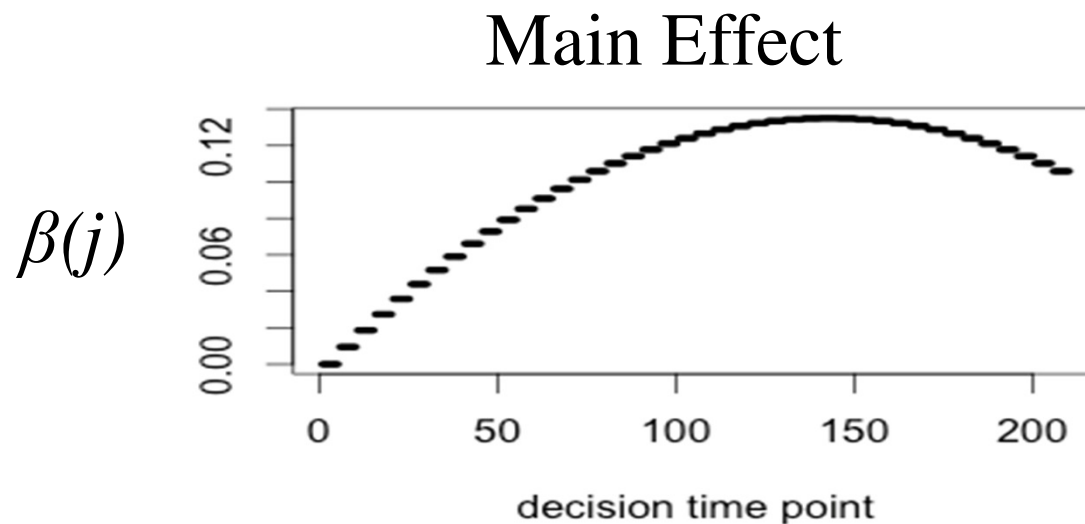
2. Record potential tailoring variables

3. Randomize among Intervention Options at decision points

4. At End of Trial use Resulting Data to assess moderation, construct decision rules

Proximal Main Effect

Main effect of HeartSteps lock-screen message on proximal response is likely time-varying $\beta(j)$, $j=1, \dots, J$



Micro-Randomized Trial

First Question to Address: Do the intervention options have an effect on the proximal response?

--Test for proximal *main effects* of the intervention

Availability

- Interventions can only be delivered at a decision time if an individual is *available*.
- The proximal main effect of treatment at a decision time is the difference in proximal response between *available* individuals assigned a lock-screen message and *available* individuals who are not assigned a lock-screen message.

EXTRA SLIDES FOLLOW

Distal Outcomes

The goal is to improve a longer-term, distal, outcome

- Substance use cessation; maintain increased activity level; maintain adherence to meds

To improve the distal outcome, the intervention options are formulated to target proximal responses

Proximal Responses

Mediators that may be critical to achieving the long-term goal

- 1) Short term targeted behavior
 - Substance use over x hours
 - Physical activity over x minutes
 - Adherence over next hour
- 2) Short term risk
 - Momentary craving, stress
- 3) Engagement in intervention/Intervention burden

Intervention options

- Intervention options:
 - Behavioral strategies, cognitive strategies, self-monitoring, social linkages, motivational,...
 - Whether to provide an intervention or whether to prompt self-monitoring
 - How to provide an intervention option
 - “Provide nothing” option
- Theoretically/scientifically driven (Klein et al., 2011)



Tailoring variables

Tailoring variables are moderators that inform which intervention option is best when, where and for whom.

- Often past proximal responses: stress, activity
- Risk & protective factors: busyness of calendar, momentary mood or craving, location, social context
- Adherence & burden

Decision Points

Typical decision points in JITAIs:

- Intervals in time (every x seconds, every x minutes, every x hours)
- When user requests help (presses “help” button”)

Frequency is guided by the dynamics of the tailoring variables and “in-the-moment nature” of the intervention effect.

Decision Rules

Link patient information to intervention options at decision points

- A decision rule is implemented at each decision point
- A JITAI often includes many different decision rules
- Development of decision rules is guided by an integration of empirical evidence, theory and clinical experience.

Momentary Lock Screen Recommendation

No Message or

