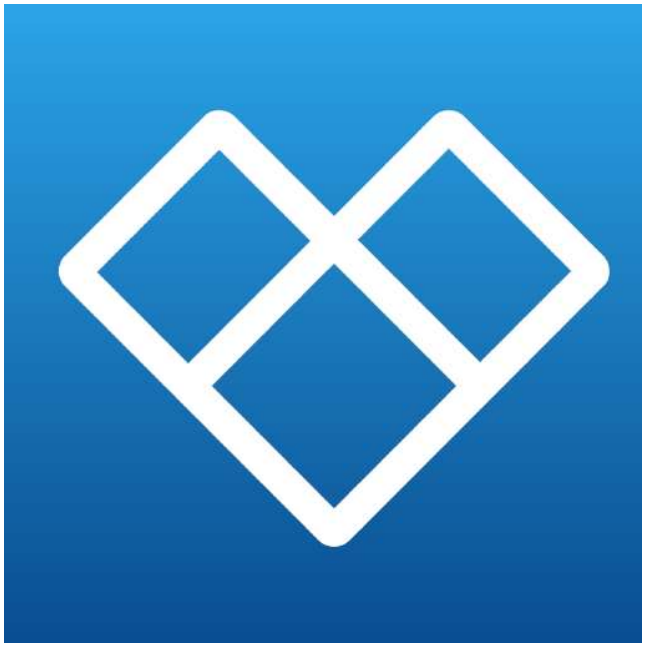

Pilot MRT of HeartSteps v1

Predrag “Pedja” Klasnja

Susan Murphy

JITAI Design Goals (A Reminder)

We should aim to develop JITAIs that…

- Contain effective intervention components
- For each person, deliver right components at the right times and in the right context
  - Deliver components when they are likely to be effective
  - Deliver components when the user is receptive
- Adapt to an individual's changing goals, capabilities, and circumstances

Optimization Questions for the HeartSteps Intervention Package

- Should we keep either of the two push components we designed for HeartSteps v. 1?
- If we were to keep a push component, how should we change it to make it better?
- How should we change the pull components to make them more useful to users?

Optimization Questions for the HeartSteps Intervention Package

- Should we keep either of the two push components we designed for HeartSteps v. 1?
- If we were to keep a push component, how should we change it to make it better?
- How should we change the pull components to make them more useful to users?

Informed by an MRT!

Questions About Activity Suggestions

- Do they work at all, in the sense of increasing activity shortly after they are delivered?
- Do their effects change over time (e.g., do people habituate to the messages)?
- Do walking suggestions and anti-sedentary suggestions have different effects on near-term activity?
- Do activity suggestions work differently when they are delivered in different contexts? (location, time of the day, day of the week, weather)?
- Does the dose of the suggestions matter (i.e., how many suggestions are sent in a short period of time)?
- Do activity suggestions have any delayed effects (e.g., by keeping activity on the person's mind)?

Questions About Planning

- Does asking people to plan do anything to increase activity on the next day?
- Does the effect of planning change over time?
- Does the interface used to plan (open-ended vs. choosing from a list) matter?
- Does the context when people are asked to plan matter (e.g., day of the week, weather next day)?

Choosing Proximal Outcome: Activity Suggestions

- Activity suggestions intended to act as cue to action—to help initiate activity soon after they are provided
- Proximal outcome needs to account for this immediacy of the intended effect
- Chosen outcome: step count in the 30 minutes right after the decision point
- Our rationale:
  - A much longer window may be too noisy, especially for anti-sedentary suggestions that may result in only a few steps
  - Users might not see the suggestion immediately, so a much shorter window would not capture acting on a suggestion seen late
- Limitation of the outcome: doesn't capture standing up, a plausible outcome of anti-sedentary suggestions

Choosing Proximal Outcome: Planning

- At first blush, ideal proximal outcome would be whether the person did the planned activity. But…
  - This very hard to passively sense
  - This outcome is meaningless if a person doesn't plan
  - Would not capture if the person did something else instead of the thing he/she initially planned
  - Doesn't address the central question about usefulness: does planning increase activity on the next day
- Chosen outcome: step count on the next day
  - Pro: captures changes in plans
  - Pro: More closely aligned with desired distal outcome
  - Con: Only captures step-based activities

Proximal Outcome Considerations

- You may not be able to capture the ideal proximal outcome
- Most proximal outcomes will have trade-offs
- You could identify multiple proximal outcomes for the same intervention component
  - e.g., MVPA minutes for planning
- Proximal outcomes can be physiological (e.g., stress) or psychological (e.g., self-efficacy) mediators of distal outcome, in addition to behaviors (e.g., steps)

HeartSteps MRT Design

- 6-week study with sedentary adults (N=42)
- Both activity suggestions and planning micro-randomized
  - Suggestions randomized 5 times a day:
    - No-suggestion (40%), active suggestion (30%), sedentary suggestions (30%)
  - Planning randomized every night:
    - No-planning (50%), new plan (25%), pick-a-plan (25%)
- Data captured during the study:
  - Minute-level steps, location, weather, calendar, HS app use, answers to daily questionnaires

Randomization of Activity Suggestions

- Activity suggestions randomized 5 times a day for each person on each day of the study
- Randomization scheme:
  - No suggestion at p = .4
  - Walking suggestion at p = .3
  - Anti-sedentary suggestion at p = .3
- Randomization results in the average of 3 suggestions per day (since we assume some would be missed)
- Activity suggestions randomized only if the person is available for treatment (e.g., not walking, not in vehicle)

INS2
PK [3]1

Slide 11

INS2 can you give an example of what a decision rule would look like? Bonnie did this -- it looks very nice.
Billie, 3/18/2016

PK [3]1 I wrote the decision rule for current version in Slide 17. I can talk here how to augment it with contextual information once we do the analyses. If you prefer, though, I can come up with a fake example and add another slide. Just let me know
Pedja Klasnja, 3/28/2016

Data Captured at Decision Points for Activity Suggestions

- Step count in 30 minutes following randomization (our proximal outcome!)
- Step count in 30 minutes prior to randomization
- Response to suggestion (if present): thumbs-up, thumbs-down, no response
- Location
- Weather
- Time of day
- Day of the week
- Day in study

Randomization of Planning

- Planning randomized every evening for each participant each day of the study
- Randomization scheme:
  - No planning at p= .5
  - Open-ended planning at p = .25
  - Choose from a list at p = .25
- Participants asked to plan on average every other day

Data Captured for Planning

- Next day's step count (proximal outcome)
- Current day's step count
- Weather for the next day
- Day of the week
- Day in study
- Amount of time spent on the planning screen

Pre-specified Primary Analyses for Activity Suggestions

$$Y_{t+1} \sim \alpha_0 + \alpha_1 Z_t + \beta_0 (A_t - 0.6)$$

$$Y_{t+1} \sim \alpha_0 + \alpha_1 d(t) + \alpha_2 Z_t + \beta_0 (A_t - 0.6) + \beta_1 d(t)(A_t - 0.6)$$

- A_t: Indicator if suggestion delivered at occasion t
- Y_{t+1}: Log of 30-min step count after occasion t
- Z_t: Log of 30-min step count prior to occasion t
- *d(t)*: Day in the study for occasion t

Some Activity Suggestion Findings

- Averaging over time, activity suggestions marginally significant, add about 35 extra steps
- At start of study, activity suggestions add 167 steps, but effect decreases with time
- Walking suggestions add 60 steps averaged over time, and 271 steps at the start of study
- Anti-sedentary suggestions didn't have any effect on the proximal outcome we looked at
- Suggestions don't work when sent at "Other" locations
- Effect of suggestions is negatively impacted by the dose of suggestions in the recent days (habituation)
- Qualitatively, sedentary suggestions were better liked and were found to be more interesting

Optimization Decisions for Activity Suggestions

- Keep the component
  - Walking suggestion initially very effective
  - Anti-sedentary suggestions really well liked
- Only provide walking suggestions at pre-specified decision times
- Provide anti-sedentary suggestions based on real-time data (i.e., redefine decision points)
- Minimize probability of sending suggestions when the person is at “other” location, since we can’t tailor as well
- Manage habituation by reducing probability of providing suggestions based on number of recently provided suggestions

Back to You

- Specify the questions your optimization study should be able to answer
- Define your experimental design
  - What are you randomizing?
  - When are you randomizing (at baseline vs. over time)?
  - What options are you randomizing for each factor?
- What should be your primary and secondary analyses?
- What decisions would you want to be able to make when you are done?