

The promise of mobile technologies and single case designs for the study of individuals in their natural environment

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The promise of mobile technologies and single case designs for the study of individuals in their natural environment[☆]



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ABSTRACT

Mobile technologies are growing rapidly around the world to broad demographics of society. These technologies hold great promise for their integration with Single Case Designs (SCDs) and the study of individuals in their natural environment. This paper discusses the theoretical, methodological and analytic implications of these tools for the advancement of the contextual behavioral etiology of behavioral disorders, and their remediation. We hope this paper will highlight the scientific advantages of combining mobile technologies and SCDs and encourage their adoption among CBS scientists.

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Studying individuals in their natural environment is important and needed

- This strategy has proven successful (inductive and **Skinnerian tradition...**)
- Some populations are difficult to reach (**rare disorders** or problems)
- Basic science doesn't always **translate** into real world settings
- Group studies are **costly**, tedious, take a long time
- **CENT** guidelines for N=1 trials (equivalent to CONSORT)



Mobile technologies: a “dream come true” for behavioral scientists

- Access to **individual’s environment** was not feasible
- Clinical behavioral scientists resigned to **retrospective self-reports** and psychometric theory
- Had we had smartphones 50 years ago, the history of psychology would have been written differently
- Initial excitement is already translating into real change in how we approach research design, and measure outcomes and processes

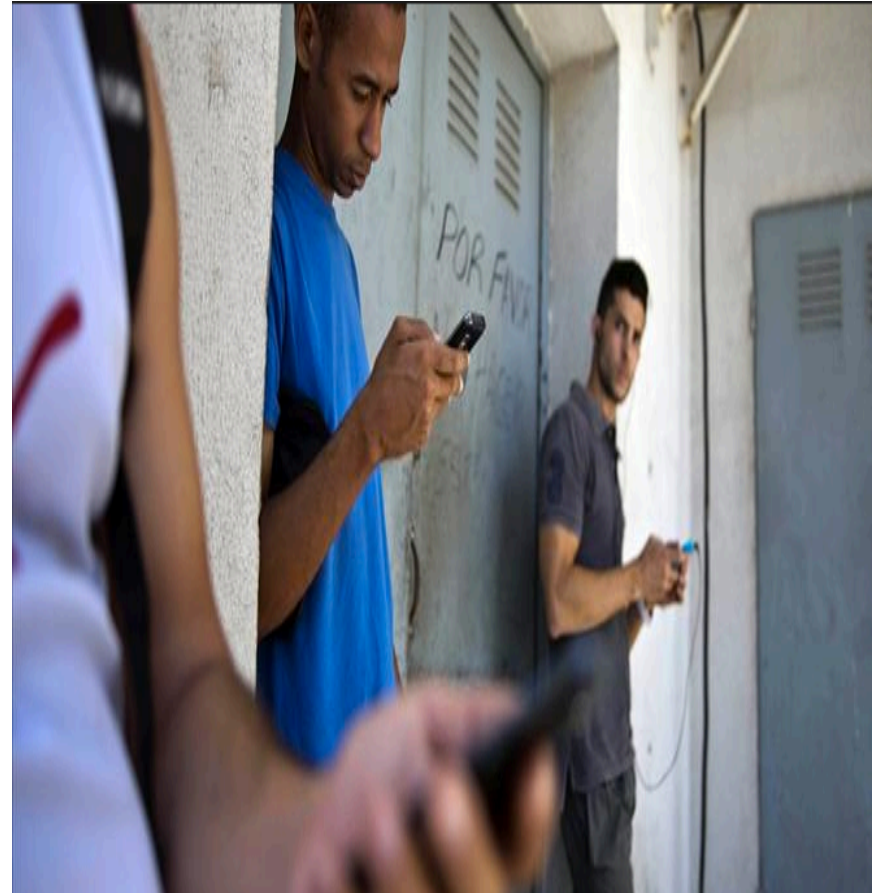


Theoretical advantages

Smartphones are already present in the **culture**.

Therefore these tools can be used to test RFT hypothesis:

- ***Relational cues*** can be deliberately manipulated in natural contexts
- Or used to ***enhance existing contexts*** (i.e., therapy session, classroom content)



Methodological advantages

Contextual behavioral precision: the effect of interventions can be gathered together with their antecedents and consequences

Scope: the effect of interventions can be measured across behavioral repertoires

Depth: the effect of interventions can be measured across different levels of analysis (i.e., social, physiological)

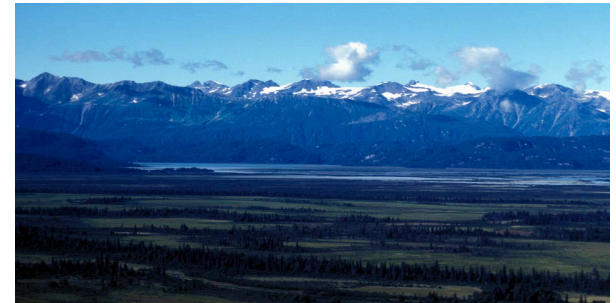
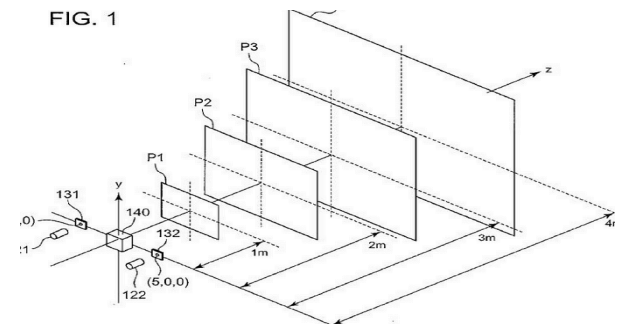


FIG. 1



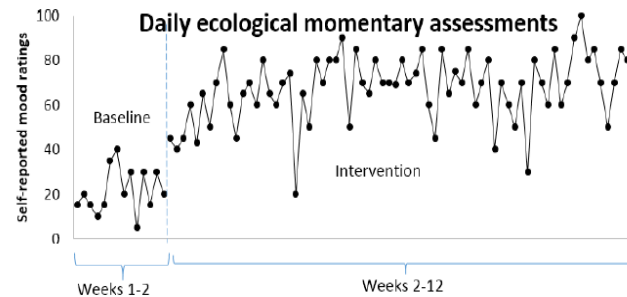
Analytic advantages:

Three enhancements

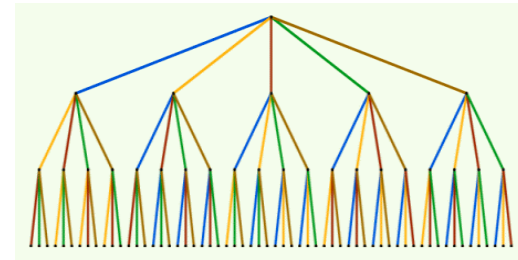
1. Ecological momentary assessments turned into ecological momentary experiments



2. Visual inspection gains “resolution:” more measurements per phase (“pixels x area”)



3. Randomization tests dramatically gain ***statistical power***



Randomization tests:

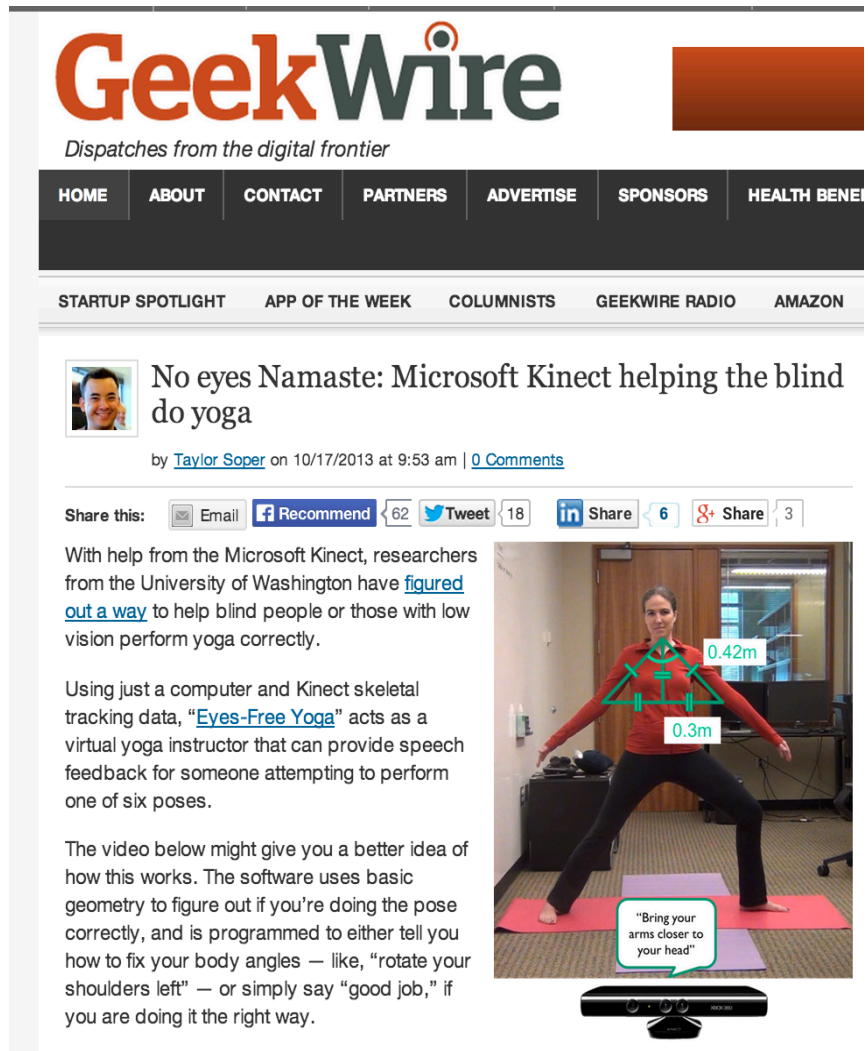
A new(old) way of extrapolating internal validity

- Group designs and **classic inferential statistics** were developed by Fisher as a “shortcut” to avoid tedious manual calculations and as a way to “approach” external validity
- However group designs are rarely “properly” done:
 - ***Participants are almost never randomly selected from a population***
 - “Normal” distributions are sometimes quite not normal
- In the end, ***replication*** (and induction) ends up being the way to infer external validity
- Further, group designs are so common that when we researchers hear “randomization” we tend to automatically think “individuals assigned to groups.” But *group randomization* is **just a *type*** of randomization

Example: Eyes Free Yoga Study

Rector, K., Kientz, J., ..., Vilardaga, R. (in prep)

- **Challenge:** blind individuals are difficult to recruit: Group design..., *not a great idea...*
- **Solution:** sequential single case experimental design
 - fast and simple to run
 - agile and adaptable
 - perfectly suited for multiple design iterations
- Frequent automated measurements will allow an ABAB design of 4 weeks (with at least 4 measurements per phase) with a **statistical power of:**
 - **455 permutations**
 - *Minimum possible p value* of **0.0022**

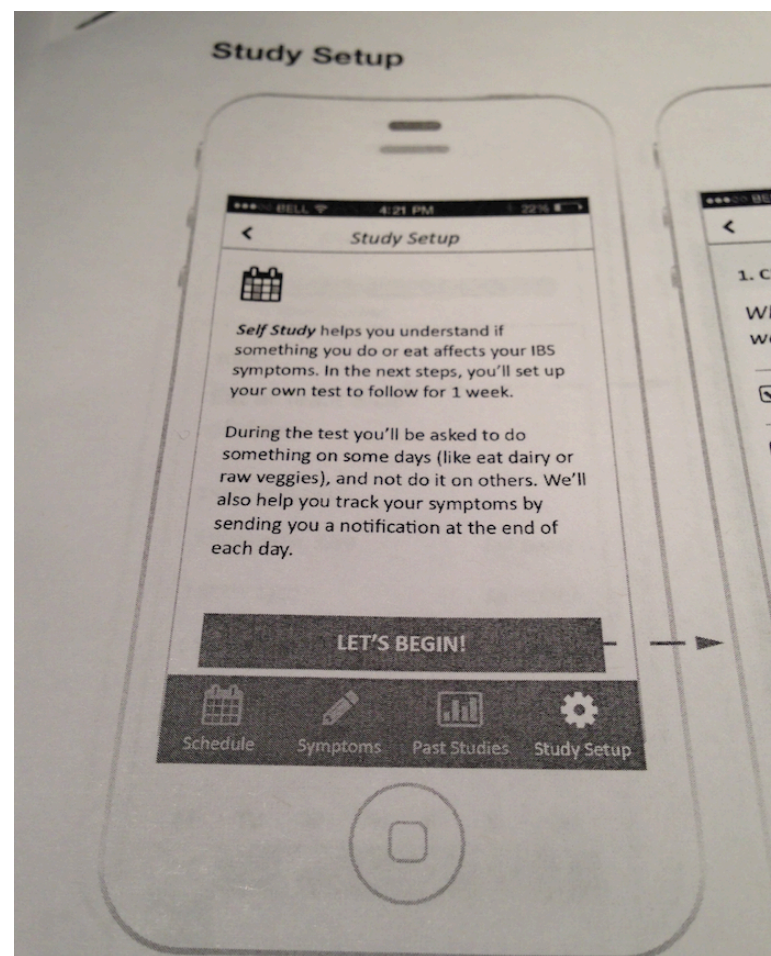


The image is a screenshot of a GeekWire article. At the top, the GeekWire logo is displayed in orange and green, with the tagline "Dispatches from the digital frontier" below it. A navigation bar contains links for HOME, ABOUT, CONTACT, PARTNERS, ADVERTISE, SPONSORS, and HEALTH BENEFITS. Below this is another navigation bar with links for STARTUP SPOTLIGHT, APP OF THE WEEK, COLUMNISTS, GEEKWIRE RADIO, and AMAZON. The article title is "No eyes Namaste: Microsoft Kinect helping the blind do yoga" by Taylor Soper, dated 10/17/2013 at 9:53 am, with 0 comments. Social sharing buttons for Email, Recommend (62), Tweet (18), Share (6), and Share (3) are visible. The article text states: "With help from the Microsoft Kinect, researchers from the University of Washington have figured out a way to help blind people or those with low vision perform yoga correctly." It continues: "Using just a computer and Kinect skeletal tracking data, 'Eyes-Free Yoga' acts as a virtual yoga instructor that can provide speech feedback for someone attempting to perform one of six poses." A video player shows a woman in a red top and black pants performing a yoga pose on a red mat. A Kinect sensor is positioned in front of her. On-screen measurements show 0.42m for the distance between her arms and 0.3m for the distance between her arms and her head. A speech bubble from the Kinect says "Bring your arms closer to your head".

Physical Health Detective (PHD)

Kientz, J., Cook, J., ..., Vilaradaga, R. (in prep)

- **Challenge:** helping individuals with irritable bowel syndrome identify food that exacerbates their symptoms.
- **Solution:** sequential SCD experiments (“self-experiments”)
- Measurement frequency and minimal carry over effects allow for a completely randomized SCD (or alternating treatments design) with a maximum of 4 consecutive measurements per phase with a statistical power of:
 - **2940 permutations**
 - *Minimum possible p value* of 3.4014×10^{-4}
- *“Personalized behavioral health”*



Summary and conclusions

RCTs can become **giants with feet of clay**. They are very valuable, but we need to find ways to harness RCTs with solid feet

Arguing that our studies are grounded on **basic behavioral research** is not enough

Robust principles of change do **not always translate** into effective real world interventions

We need to use ***agile and ecologically valid methods***

CBS needs to expand the ***diversity of methods*** to use

The synergy between single case designs, mobile technology and randomization tests holds great promise for contextual behavioral scientists