Increasing Physical Activity with Mobile Devices

A Meta-Analysis

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Background

- Physical activity (PA) is associated with reduced morbidity and mortality
- Despite endeavors to enhance participation, reduce attrition, and increase maintenance, PA rates remain low
- New consumer technologies offer a potential solution to these problems

The Mobile Device

- The Mobile Phone
  - Devices capable of communicating via voice and text
- Personal Digital Assistant (PDA)
  - Examples: Palm Pilot, Dell Axim
  - Offer organizational, basic word processing, internet, and entertainment features
- Smartphone
  - Combined PDA features with those of a mobile phone
  - Originally popular among businessmen, popularized by the 2007 release of the Apple iPhone

The Mobile Device

- Integrated into daily functioning for many individuals
- High levels of usage across demographic groups
  - 4 in 5 adults own mobile phones
  - 95% of young adults use mobile phones
  - In many western countries, mobile phones outnumber citizens
- An evolving technology
  - Many new features become less expensive and more widely used with time

Mobile Devices and Health

- Meta-analysis of mobile phone use for glucose control (Liang et. al., 2011)
  - 21 publications (n=1,657)
  - Overall reduction in HbA_{1c} ($p<.001$)
- Systematic review and meta-analysis of the effect of internet-based interventions on health-related behavior (Webb et. al., 2010)
  - 85 studies targeting health behavior (n=43,236)
    - $d = 0.16$
  - 20 studies targeted physical activity
    - $d = 0.24$
- Lack of review or meta-analysis addressing physical activity behavior change with a mobile device

Purpose

- Conduct a review and meta-analysis in order to:
  1. Determine the efficacy of mobile devices in previous physical activity research
  2. Examine common features of mobile devices in the research context
  3. Develop recommendations for future use

Methods

- Extensive Search through February, 2012
  - Online databases
  - Reference lists
  - Direct requests to experts
- Inclusion Criteria:
  - Implementation of mobile technologies
  - Target physical activity
  - Provide original data

Methods

- Quality assessed via the *Guide to Community Preventative Services* data extraction form
  - Concerned with "threats to validity"
    - Good – 0 - 1 limitations
    - Fair – 2 - 4 limitations
    - Poor – 4+ limitations
- Note – no "gold-standard"

Analysis

- Extracted:
  - Means (M)
  - Standard Deviation (SD)
- Calculated: Cohen's *d*
- Software: *Comprehensive Meta-Analysis*
  - *(Borenstein & Rothstein, 1999)*

Intervention Characteristics

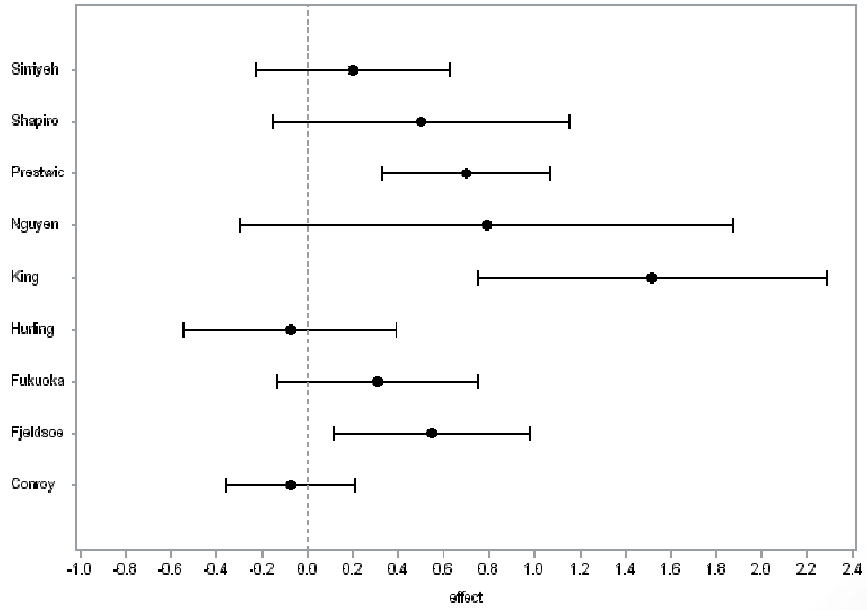
- 9 Unique Studies (n=743)
  - 7: Mobile Phone
  - 6: SMS
  - 3: Native Application
  - 2: PDA

Characteristics

- Reported Outcomes
  - MVPA duration
  - MVPA frequency
  - % Active time spent in MVPA
  - Pedometer step counts
  - Number of days of exercise per week
  - Days per week walking for exercise

Results

Study Authors	N	Duration (weeks)	Effect
Conroy	198	24	-.075
Fjeldsoe	88	12	.548
Fukuoka	82	3	.311
Hurling	77	9	-.076
King	37	8	1.517
Nguyen	17	24	.788
Prestwich	134	4	.699
Shapiro	40	8	.501
Sirriyeh	118	2	.201



Results – Outcome Measures

	n	g	Q	I^2
Overall PA	9	.4170	26.92 (df=8, p=.0007)	70.28
MVPA Duration	4	.3395	14.31 (df=3, p=.0025)	79.04
Steps	2	.3498	0.1826 (df=1, p=.6691)	0

Results – Components

	n	g	Q	I^2
Mobile Phone	7	.3905	8.85 (df=6, p=.1823)	32.20
SMS	6	.4064	8.6776 (df=5, p=.1226)	42.38
Native Apps	3	.5078	15.91 (df=2, p=.0004)	87.43
PDA	2	.6826	15.43 (df=1, p=.0001)	93.52

Results

- Quality:
  - Three studies of “good” quality
  - Five studies of “fair” quality
  - One study of “poor” quality

Discussion

- Results indicate that the mobile platform is effective for increasing physical activity behavior
- There is significant heterogeneity among studies
- Understanding common design issues is an important first step when considering design of future interventions

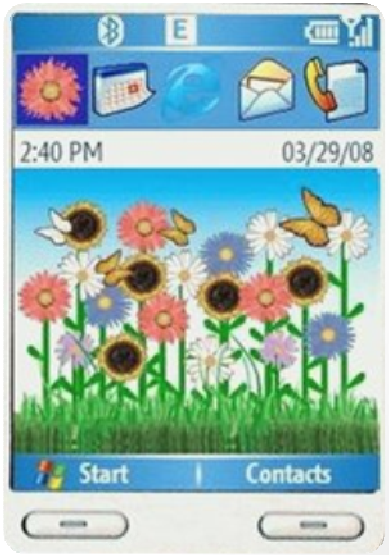
Discussion: Design Characteristics

- The role of SMS
  - Supplement data collection
  - An alternate means of communication
  - May assess behavior in real time
  - Must be recognized as one of many tools

- Lacking Automation
  - The mobile environment is flexible and conducive to immersive tailoring and automation
- Theoretical frameworks must be adapted and developed which assess unique aspects of the mobile platform

Discussion: Native Applications

- Popularity of widespread app development is a unique and key feature to mobile devices
  - Reside on the device
  - More complex, more flexible than web applications
  - Reach a diverse population
- Previous work has been successful
  - Interesting examples
    - UbiFit (Consolvo, 2008)
    - Neat-o-Games (Fujuki, 2008)



Discussion: Ubiquity

- Most important advantage of mobile devices
  - Availability of diverse applications have led many to integrate their mobile device into their daily lives.
  - We can deliver materials and collect data with little additional burden
- Components which might hinder the usability for the participant should be minimized

Conclusion

- This research indicates that mobile devices are effective in increasing physical activity behavior.
- Much of the potential of the device is unexplored in the research setting.
  - Integral in daily functioning
  - Exchange rich multimedia information
  - Collection of data and distribution of materials in real time
- There is significant heterogeneity in study design and outcomes measured
- Future researchers must address new, popular technologies in a methodical, theoretically grounded fashion.

Thank You