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
<table>
<thead>
<tr>
<th>Study Authors</th>
<th>N</th>
<th>Duration (weeks)</th>
<th>Effect</th>
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<tr>
<td>Conroy</td>
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<tr>
<td>Sirriyeh</td>
<td>118</td>
<td>2</td>
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## Results – Outcome Measures

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<th>I²</th>
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<tbody>
<tr>
<td>Overall PA</td>
<td>9</td>
<td>.4170</td>
<td>26.92 (df=8, p=.0007)</td>
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<td>MVPA Duration</td>
<td>4</td>
<td>.3395</td>
<td>14.31 (df=3, p=.0025)</td>
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<td>Steps</td>
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<td>.3498</td>
<td>0.1826 (df=1, p=.6691)</td>
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</table>
## Results – Components

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<tbody>
<tr>
<td>Mobile Phone</td>
<td>7</td>
<td>.3905</td>
<td>8.85 (df=6, p=.1823)</td>
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<td>SMS</td>
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<td>8.6776 (df=5, p=.1226)</td>
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<td>Native Apps</td>
<td>3</td>
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<td>15.91 (df=2, p=.0004)</td>
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<td>PDA</td>
<td>2</td>
<td>.6826</td>
<td>15.43 (df=1, p=.0001)</td>
<td>93.52</td>
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</table>
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