Current Technologies in Physical Activity Assessment & Intervention

YOUTH

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Settings for physical activity in youth

• School
• Active transportation
• Sports teams
• Home
Stewart, T., Duncan, S., & Schipperijn, J. (2017). Adolescents who engage in active school transport are also more active in other contexts: A space-time investigation. Health & Place, 43, 25-32.
What proportion of time is spent physically active?

- At home: 5.3% of 226 min/day
- Near home: 9.5% of 103 min/day
- At school: 4.8% of 344 min/day
- Near school: 9.7% of 28 min/day
- Other locations: 7.1% of 115 min/day
NPR 2013: “In More Cities, A Camera On Every Corner, Park And Sidewalk”
Temporal Synchronicity: Joint Parent-Child Physical Activity

Measured through 7 days of accelerometer and GPS monitoring.

Time-varying Effects of Intentions on Physical Activity Across the Day

Note: Analyses conducted using Time-Varying Effects Modeling (TVEM). Y-axis represents the magnitude of the time-varying associations between intentions at any given EMA prompt and subsequent physical activity across the next two hours.

R21HL113810

- Jay Mendoza
- Cycling not in train
- Total MVPA
  - Assign MET values to cycling
- Reviewers perspective

Children and researchers participate in the bike train
Riding in a car
Sitting
Walking
Jogging
Cycling
(a) Ankle
(a) Waist

factor (behavior)
- CarRiding
- Cycling
- Jogging
- Sitting
- Walking

CPM

Riding in a car
### Balanced accuracy* of machine learned classifiers using leave-one-participant-out cross-validation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Waist</th>
<th>Ankle</th>
<th>GPS</th>
<th>Waist + GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>0.97</td>
<td>0.97</td>
<td>0.96</td>
<td>0.99</td>
</tr>
<tr>
<td>Walking</td>
<td>0.98</td>
<td>1.00</td>
<td>0.94</td>
<td>1.00</td>
</tr>
<tr>
<td>Jogging</td>
<td>1.00</td>
<td>1.00</td>
<td>0.81</td>
<td>1.00</td>
</tr>
<tr>
<td>Cycling</td>
<td>0.98</td>
<td>1.00</td>
<td>0.81</td>
<td>1.00</td>
</tr>
<tr>
<td>Riding in car</td>
<td>0.98</td>
<td>0.96</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.98</td>
<td>0.99</td>
<td>0.90</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Comparison of kids protocol to freeliving adults

<table>
<thead>
<tr>
<th>Activity</th>
<th>Waist accelerometer+ GPS data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>0.92</td>
</tr>
<tr>
<td>Walking/Running</td>
<td>0.76</td>
</tr>
<tr>
<td>Cycling</td>
<td>0.92</td>
</tr>
<tr>
<td>Riding in car</td>
<td>0.90</td>
</tr>
<tr>
<td>Average</td>
<td>0.92</td>
</tr>
</tbody>
</table>

iWatch study will provide freeliving data in kids (& matched parents) but still challenging
- Not all settings
- Harder to annotate
- Annotation browser development

• Used adult sample to provide HMM probabilities
• Playing in place was not included in protocol so decision rules added on moving from GPS.
Use of time and frequency domain features in the raw signal (VM) improves recognition using a shorter time window.

Hagenbuechner, Cliff, Trost et al. JSAMS 2015;18(4):426-31
Comparison with Cut-Points: Wt. Kappa
Sample (PHASE study)
199 youth
8-12 years old
Mean daily wear hours = 11.9 (SD = 2.0)
Mean wear days = 5.0 (SD = 1.9)
Growing Up in New Zealand Activity Tracking – Compliance Assessment

• 75 children ~8yo
• Axivity AX3 sensors (Accelerometer, Temperature Sensor)
• Worn for 7 full days on thigh and back (sensors record for 14 days and begin recording prior to expected usage time)
• Using temperature sensor to measure compliance and to improve activity processing efficiency (only process data while sensor is in use)
Wearables in the literature

• Fitbits & sleep tested against PSG
  • FitbitChargeHR™ in adolescents
  • Fitbit Ultra in adolescents & children
• Fitbit Zip compared to Actigraph in adolescents
INTERVENTIONS
What’s in the literature?

- Review of 5 studies
- Pilot of Fitbit & Facebook
- Fitbit at recess

- 9 mobile phone app studies
  - Mixed findings
  - Peer component may help
Exergames

• When played as designed can induce moderate EE
  • 2 studies report vigorous EE
• 11 RCTs show no impact on Total PA, MVPA, fitness
  • But other studies show impacts
• 2 RCTs show impact on BMI
  • Maddison et al, Trost et al
• Displacement of entertainment games by 10 min/day
• School based (M Simons) – niche activity
  • A percentage of children use intensively, some moderately, some not at all
• Family (A Maloney): parents key in starting, siblings key in maintaining
Mobile games
Key discussion points

• Fun is key element that technology can deliver, in all places
• Role of both parents & children
• Correlations with other devices is not sufficient
  • Need ground truth validation
  • Kids more challenging than other groups
• Free living validation of algorithms is important
  • Computer science publication standards of ‘solving the problem’ are insufficient
  • Generalizability is often lacking
• Behaviors (+ sleep) vs EE
  • Protocols vs freeliving (including ActivPAL)
    • ISCOLE
    • Combine datasets?
• Challenges include
  • Developing & testing scalable annotation system: is it faster/better?
  • Changing models of devices
  • Reviewers misperceptions