Physical Activity

- Any bodily movement that results in energy expenditure
- Unlike fitness, an outcome measure, physical activity is a process measure
- PA has health benefits independent of fitness
- Only recently measured

Physical Activity Measures

- Accelerometers
  - CALTRAC, CSA/Actigraph
- Self-reports
  - Interviews or questionnaires
    - (e.g., PAR, SAPAC)
- Proxy measures
  - (e.g., heart rate monitors; doubly labeled water)
- Direct observation
  - BEACHES, SOFIT, SOPLAY, SOPARC

Ecological Approach to Activity Promotion

- Identifies times and places for PA
- Identifies social & physical resources/barriers
- Identifies policies that hinder/facilitate PA
- Modifies environmental factors to attract people and promote PA opportunities

(Sallis)

Systematic Observation

- Direct method for assessing physical activity
- Permits simultaneous examination of physical and social environment
  - (location, presence of others, prompts, consequences)
- History
  - (Bullen '64; Hovell '78)
- Method, not an instrument

Systematic Observation

- Advantages
  - Direct and objective measure
  - High internal validity
  - Assesses contextual variables
    - (e.g., social and physical environment)
  - Suitable for aquatic environments
  - Low participant (i.e., subject) burden
  - Results understood by practitioners
Systematic Observation

- Disadvantages
  - Expense (observer time)
  - Accessibility to all locations
  - Potential subject reactivity

Feasibility of Direct Observation

- Training required
  - Depends upon complexity of system (number of activity and contextual codes)
- Time for measurement
  - Real time plus travel
  - Data entry
  - Recording and playback if video is used

Observer Training

- Memorize codes
- Directed practice using video segments
- Assessments using ‘gold standard’
- Field practice
- Field reliabilities with certified assessor
- Additional training to prevent observer drift

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Observation Techniques

- Frequency
- Duration (including latency)
- Time sampling/interval recording
  - Momentary time sampling—SOPLAY & SOPARC
  - Partial interval recording
  - Whole interval recording

Interval Recording

- Typically short observe/record intervals (6-10 seconds)
- Codes entered during ‘record’ intervals
- Activity codes vary among systems
  - 5 codes; BEACHES and CARS
  - 14 posture codes with 3 levels each (Bailey, ’95)

Pacing Observations Entering Data

- Duration (Computer; each key is toggle switch)
- Interval
  - Computer
  - Audiotape tape/CD/MP3/IPod
- Data entry
  - Computer
  - Hand score
    - Form
    - Scantron
Observation Systems

- Designed for specific purpose
  - (BEACHES, SOFIT, SOPLAY, SOPARC, SOCARP)

- Key ingredients
  - Behavior categories
  - Observation protocols (e.g., pacing)
  - Coding conventions

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Observation Systems

- Individuals and Facilities

  - SOPLAY
    - Group behavior at leisure at school
  - SOPARC
    - Group behavior in parks and communities
    - Includes age and race/ethnicity groupings
  - SOPARNA
    - Group behavior in wilderness areas
    - Includes group size, activity modes

**Methodological Considerations (1)**
- Validity of codes
- Observer training
- Reliability measures
- Observer drift/instrument decay
- Recalibration
  - “Gold-standard” videotapes
Methodological Considerations (2)

- **Sampling Adequacy**
  - Time periods (e.g., seasonality)
  - More than weather and temperature
  - Time of day
  - Week days vs. week ends
  - Enough teachers, students, parks

Methodological Considerations (3)

- **Time Frame**
  - Varies upon setting (home, park, recess, PE lesson)
  - Adequacy of sampling weighed against cost and observer and subject burden
  - Number of observations needed to classify behavior depends upon setting and system used

System Validation (1)

- Activity codes:
  - Heart rates, VO2max, accelerometers

- Example:
  - SOFIT/SOPLAY Activity Codes
  - Heart rates (lab and field; ages 4-17)
  - Accelerometer (PE and recess)

System Validation (2)

- **Face validity**
- Environmental variables
  - Area type; Activity type

- People variables
  - Gender, Age group; Ethnicity group

- Theoretical implications

Observer Variability

- **Within Observer**
  - Examined using video technology during training and recalibration

- **Between observers**
  - Called interobserver agreement or reliability
  - Reported in different ways:
    - Kappa (controls for chance agreement)
    - Interval by Interval (I-I)
    - Intraclass correlations

Physical Activity Data

- Typically summarized as:
  - Activity time in levels (minutes, hours)
  - Proportion of time (% of lesson or practice)
  - Estimated energy expenditure (kilocalories, METS)
  - Counts (e.g., steps taken)
Estimated Energy Expenditure

Physical Activity Occurs within Specific Environments
- In transport
- At home (play, work)
- Recreation (structured, unstructured)
- Sports (youth, senior)
- Schools
  - PE Classes; Intramurals; Inter-scholastics;
  - Clubs; Free Play

Home Settings

BEACHES Contexts (New version)
- 1. Activity Level
  - (lie down, sit, stand, walk, vigorous)
- 2. Physical Location
  - (e.g., inside home, outside)
- 3. People Present
  - (e.g., parents, sibling, others)
- 4. Behavior Motivated
  - PA; Sedentary
- 5. Motivator
  - (Adult; Child)
- 6. Views Media
  - (No; Yes)
- 7. Eats
  - (No; Yes)

RESULTS: Physical Activity at Home
- OVERALL: Children were
  - Indoors 78% of the time
  - Sedentary 74% of the time
  - Vigorous only 11% of the time
- REDUCED ACTIVITY ASSOCIATED WITH:
  - Being indoors (p<.001)
  - Parents being present (p<.004)
  - Time viewing media (p<.001)
  - Time ingesting food (p<.05)

McKenzie et al., 2008, AJPH

MVPA of Prechoolers at Recess and Home

(A= 351; McKenzie et al., 1992, JBDT)
Activity Facilitating Toys at Home

Prompts for Physical Activity at Home

School Settings

1. Physical Education
2. Recess/free play

SOFIT Categories

- Physical Activity
  - Lying Down, Sitting, Standing, Walking, Vigorous
- Lesson Context
  - Management, Knowledge, Fitness, Skill Drills, Game Play, Other
- Instructor Behavior

SOFIT Entry Form

Abbreviated

<table>
<thead>
<tr>
<th>Int</th>
<th>Activity</th>
<th>Context</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 2 3 4 5</td>
<td>M K F S G O I O N</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 2 3 4 5</td>
<td>M K F S G O I O N</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1 2 3 4 5</td>
<td>M K F S G O I O N</td>
<td></td>
</tr>
</tbody>
</table>

M-SPAN PE: Effects on Student MVPA Minutes

<table>
<thead>
<tr>
<th>MVPA Min Per Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
</tr>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

N=24 Schools; 214 Teachers; 1847 Lessons
MVPA by Gender and Context

N=24 M-BPAN schools; 430 lessons
(McKenzie et al., 2006, ESCHS)

Instructor Behavior
Physical Activity Promotion in PE

(McKenzie et al., 2006, MSSE; 241 Lessons; 36 schools)

Time in Physical Activity:
US Goals vs. Girls' PE Classes

McKenzie et al., 2006, MSSE
TAAG Baseline; N=36 middle schools, 6 states

SOPLAY Categories

- Physical Activity
  - (Sedentary, Walking, Vigorous)
- Area Contexts
  - (Accessible, Usable, Equipped, Supervised, Organized)
- Other Contexts
  - (Time, Temperature, Predominant Activity/Sport)

SOPLAY
(McKenzie et al., 2000, Preventive Medicine)

- Observers scan target areas and record activity intensity of each person
- Three levels: sedentary, walking, and vigorous
- Levels validated via heart rates enable energy expenditure in area to be estimated
- Simultaneous entries for relevant environmental characteristics

McKenzie School-7 Activity Areas
**Percent of School Population in Activity Areas**

- Before School: 4.2%
- Lunch Time: 19.1%
- After School: 1.9%

N=24 M-SPAN schools, 151 areas

(McKenzie et al., 2000, Preventive Medicine)

**Percent in Activity Areas**

- Before School: 1.5%
- Lunch Time: 10.6%
- After School: 7.9%

N=24 M-SPAN schools, 151 areas

(McKenzie et al., 2000, Preventive Medicine)

**MVPA by Gender**

- Boys: 31.4%
- Girls: 48.5%

N=24 M-SPAN schools, 151 areas

(McKenzie et al., 2000, Preventive Medicine)

**Activity Area Characteristics**

- Useable
- Accessible
- Supervised
- Equipped
- Organized

N=24 middle schools, 151 areas X 3 days

(McKenzie et al., 2000, Preventive Medicine)

**Community Settings**

Parks and Recreation Centers

**System for Observing Play and Recreation in Communities (SOPARC)**

- Developed in 2003
- Validated (2 NIH grants)
- Widely used (translated into four languages)
- Numerous published papers
**BACKGROUND**
- Community parks are viable, but rarely studied locations for physical activity
- PA research in parks relies mostly on self-reports by individuals
- Validated instruments to assess PA of groups and associated variables do not exist
- Little is known about park area features and user characteristics, including PA levels
- Minority populations are at health risk, and their PA in parks is rarely studied

**PURPOSES**
- Develop and assess an objective, direct observation tool for studying PA and associated variables in community settings
- Employ the system in multi-ethnic communities to study park areas and characteristics of users, including their PA

---

**Contribution of Public Parks to Physical Activity: Analysis of Park and User Characteristics**
Cohen, McKenzie, Sehgal, Lurie, Golinelli, & Williamson
Supported by NIEHS

**Methods**
- **LOCATION**
  - 8 neighborhoods in Los Angeles with:
    - High household poverty (X=35%; range=16-55%)
    - High % of minority groups (2000 census)
      - Latino, range=16-55%
      - African-American, range =0-88%

---

**Data Sources**
- **Direct Observation (SOPARC)**
  - (System For Observing Play and Active Recreation in Communities)
  - N=16,224 park users
- **Interviews of Park Users**
  - N=713 adults
- **Interviews of Area Residents**
  - N=605 adults from randomly selected homes >2 miles
- **US 2000 Census**

---

**Observation Methods**
- **PARKS**
  - 8 parks in multi-ethnic communities
  - Size: Range=3.4-16.0 acres; Mean = 7.8 acres
  - 165 Target Areas: Range/park =17-27; Mean =20.6
- **DATA COLLECTION**
  - 8 assessors trained systematically
  - 56 clement days (7 in each park)
  - 4 one-hour periods/day (7:30AM; 11:30AM; 3:30PM; 6:30PM)
  - 4511 area visits
SOPARC Categories

- User Physical Activity Levels
  - (Sedentary, Walking, Vigorous)
- User Characteristics
  - (Gender, Age, Race/Ethnicity)
- User Activity Modes
  - (e.g., soccer, picnicking)
- Area Contexts
  - (Accessible, Usable, Equipped, Supervised, Organized)
- Other Contexts
  - (Day, Time, Temperature)

(McKenzie et al., 2006)

Reliability Measures

BACKGROUND
- Observer-pairs conducted 472 simultaneous measures in 125 activity areas in 6 parks

AREA CHARACTERISTICS
- Accessibility, 98%; Usability: 94%; Supervised, 97%; Organized, 97%; Equipped, 99%

NUMBER COUNT FOR AREA
- Correlation=.99 for both females and males
- % Agreement= 92% females, 89% males

PEOPLE CHARACTERISTICS (Overall)
- Age Grouping: Females, 95%; Males, 97%
- Ethnic/Race Grouping: Females, 99%; Males, 99%
- Physical Activity Level: Females, 90%; Males, 88%

Characteristics of Activity Areas

Proportion of Observations Activity Areas Occupied

Areas with Most VPA

Park Users: Age Categories

N=8 Parks; 165 Activity Areas; 4511 Visits
Proportion Walking and in Vigorous Activity in 8 Parks

<table>
<thead>
<tr>
<th>Park</th>
<th>% Walking</th>
<th>% Vigorous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algin</td>
<td>20.3</td>
<td>11.2</td>
</tr>
<tr>
<td>Green</td>
<td>22.5</td>
<td>17.2</td>
</tr>
<tr>
<td>Costello</td>
<td>18.5</td>
<td>30</td>
</tr>
<tr>
<td>Pecan</td>
<td>18.5</td>
<td>12.2</td>
</tr>
<tr>
<td>Andrews</td>
<td>22.9</td>
<td>13.2</td>
</tr>
<tr>
<td>Van Ness</td>
<td>24.8</td>
<td>16.6</td>
</tr>
<tr>
<td>Evergreen</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wilmington</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

N=16,048 people; 165 activity areas; 56 days

METS Expended Per Resident Within One Mile of Park

<table>
<thead>
<tr>
<th>Park</th>
<th>METS Expended Per Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algin</td>
<td>0.28</td>
</tr>
<tr>
<td>Green</td>
<td>0.10</td>
</tr>
<tr>
<td>Costello</td>
<td>0.26</td>
</tr>
<tr>
<td>Pecan</td>
<td>0.14</td>
</tr>
<tr>
<td>Andrews</td>
<td>0.29</td>
</tr>
<tr>
<td>Van Ness</td>
<td>0.49</td>
</tr>
<tr>
<td>Evergreen</td>
<td>0.12</td>
</tr>
<tr>
<td>Wilmington</td>
<td>0.31</td>
</tr>
</tbody>
</table>

N=16,048 people; 165 activity areas; 56 days

METS Expended in Park Per Resident Within One Mile

Interview Results
(N=1318 adults; mean age=38 years; range=18-90)

- Safety
  - Most park users (75%) and residents (71%) felt safe using the park (related to poverty levels)
  - Perceptions of safety did not predict park use

- Exercise
  - Both groups identified the park as their most common exercise location
  - Only 3% of users and 6% of residents used a health club for exercise

Interview Results (2)

- Park size not related to user activity levels
- Park users:
  - Primarily lived within ¼ mile (43%) or ¼ to ½ mile (21%) of park
  - Only 13% lived more than a mile from park

Interview Results (3)

- Gender (being male), age (adult), and proximity predicted frequency of park use
- Proximity to park was the only predictor of frequency of exercise
Conclusions
These parks:
- Served a large proportion of the local population
- Were used more often and differently by males than females
- Did not serve seniors well
- Park use and vigorous activity were related to onsite, organized sports

Conclusions (2)
- Community parks are important locations for PA, particularly for low SES populations
- Not used to capacity
- Increased programming and supervision would likely attract more users
- Special efforts/programs needed to attract specific populations (e.g., seniors, female adolescents)

Methods
- 274 activity areas in 10 urban/suburban parks: 2 each in:
  - Los Angeles, CA
  - Albuquerque, NM
  - Columbus, OH
  - Chapel Hill/Durham, NC
  - Philadelphia, PA
- Each area observed hourly for 14 hr/day for two weeks
- One week in summer and one in fall
  - In Los Angeles, one park was observed for 2 weeks in the fall, second park was observed in the fall.

Example of Park Use Over 1 Week
TIQUEX (NM) August 6-12, 2008

Predicts park use, including:
Number, gender, PA levels, & age and race/ethnicity groupings
Hourly Pattern of Park Use, Two Consecutive Weeks
QUEEN ANNE: May 2008
Number Observed in Each Time Period
Week 1 vs Week 2

Differences Between Days
- Weekday data were different from weekend data
- When all the parks were combined, Sunday data were very different from the Saturday (Cronbach alpha < 0.7)

Conclusions
- Number of observation days may be reduced to 4 days per week from the original 7
- Using SOPARC 4 times per day provides reliable and valid estimates of total daily park use

Percent in Each Activity Area by Gender

Seeing is Believing: Observing Physical Activity and Its Contexts Systematically
Summary
- Physical activity: context matters
- Theoretical and practical research issues
- Examples:
  - Home, School, & Community Environments