# Development and Validation of an E-diary System for Assessing PA and Travel Behaviors

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# Examples of Physical Activity Measures

# Advantages and Disadvantages of Commonly Used Physical Activity Measures

| | Advantages | Disadvantages |
|---|---|---|
| uestionnaires | Cheap, mass data collection, activity patterns | High subjectivity, a relative measure, recall difficulty, overestimations |
| ctivity Monitors | Objective and absolute measures | High cost, difficulty for data collection for certain activities; no activity patterns |
| eart Rate Monitors | Objective and absolute measures | Possible impact by psychologica factors; no activity patterns |
| oubly Labeled Water | The most accurate energy expenditure measure | Very expensive; no activity patterns |

# Diary: Another Useful Method

- Participants are asked to recall their activity or behaviors in a predetermined interval (e.g., every 30 minutes)
- Diaries potentially provide highly accurate information regarding people's activity patterns
- Diaries have been employed in various research areas, such as assessing time usage, travel behavior, diet and physical activity

# Challenges/Barriers in Usage of Diaries for PA Assessment

- Scoring such diaries is very labor-intensive activity and, as such is very expensive
- Raters' objectivity is also sometimes a concern when raters are not carefully trained (Montoye et al., 1996)
- Little is known about the best time interval for an accurate recall
- Diary, therefore, is used mainly as a criterion measure in physical activity research, and its advantage of providing rich information about physical activity patterns has never been taken

# Measure Activities Using Diaries

- Way to collect data

| Time | Activities |
| --- | --- |
| 5:00 am – 6:00 am | Sleeping |
| 6:00 am – 7:00 am | Got up for 5 min; walking outside 35 min; eating breakfast for 15 min; dress up for 5 min |

- Various formats: Time to recall, format to record
- Various areas: Time usage; travel behaviors

# New Technology to Address Challenges:

## Speech Recognition

- A process of automatically extracting and determining linguistic information conveyed by a speech wave suing computers or electronic circuits

- 1952, first digit recognizer Audrey by Davis et al.
- 1992, AT&T introduced its voice-recognition call-processing system
- 1995, voice-activated dialing services offered by most phone companies
- Now, applications in every field

# New Technology to Address Challenges:
## Automatic Scoring Technique

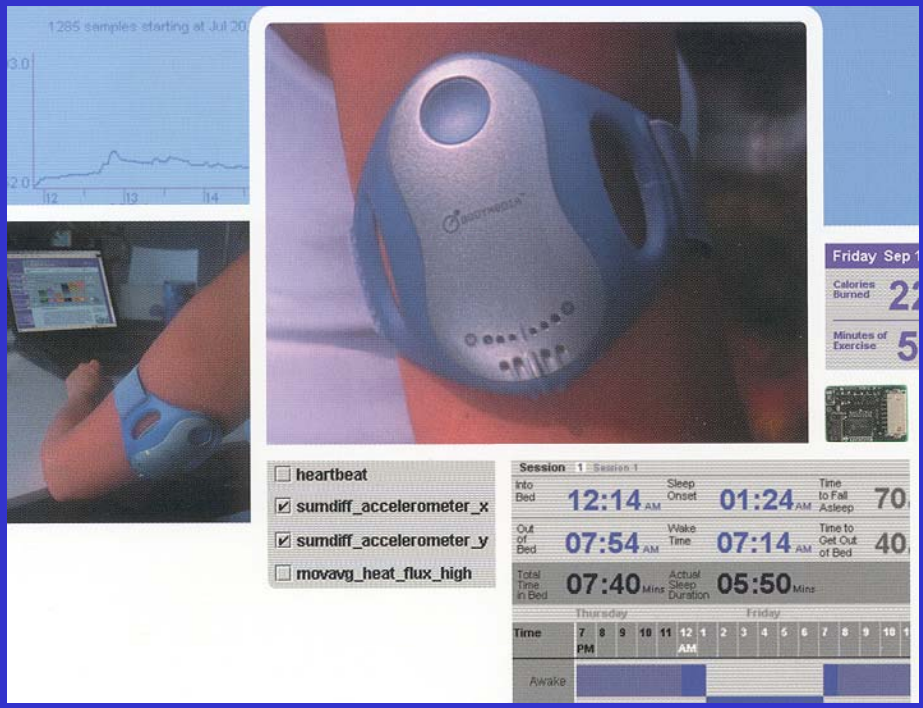
- A computerized, artificial intelligence-based information retrieval system

- 1960s, Page's works on grading essays using computers
- 1995, introduction of modern computer power and artificial intelligence
- New generation scorers: LSA (Landauer & Foltz, 1997); *E*-rater at ETS (Burstein, 1998); BETSY (Rudner, 2001)

# New Technology to Address Challenges:
## GPS and Practical Energy Measures

- Global position system
- GeoLogger by GeoStats

- Armband: Practical energy measure



# *E*-diary: An Ongoing Project

## (Funded by ALPESP, Robert Wood Johnson Foundation)

- To develop an *E*-diary system to measure physical activity and travel behaviors using voice-recognition and automatic scoring technologies
- To determine the validity of the *E*-diary system by correlating it with two criterion measures: (a) Armbend (a field energy expenditure measure) and (b) GeoLoggers, a new GPS device of travel movements
- To determine its reliability by asking participants to record their physical activity and travel behaviors using *E*-diary system for 21 consecutive days

# A Multi-Disciplinary Research Team

- Dr. Weimo Zhu (Measurement)
- Dr. Mark A. Hasegawa-Johnson (Voice recognition)
- Dr. Lawrence M. Rudner (Automatic Scoring)
- Dr. Cesar A. Quiroga (Travel behavior; consultant)
- Dr. Richard A. Washburn (PA assessment; Consultant)
- Dr. John Robinson (Diary assessment, Consultant)
- Dr. Jean Wolf (GPS assessment, Consultant)

# Components of *E*-Diary System

- **Voice Recognition**

  An application developed based on Dragon Naturally Speaking software and an interface programmed by Visual Basic

- **Automatic Scoring**

  A program modified from BETSY, a Bayesian essay scoring software developed by Rudner (2002)

# How it works? – We hoped

- Participants are reminded to record their physical activities by a programmed “beep” (from a digital recorder);
- They then talk into the digital recorder to record their physical activities during the previous half-hour or 15 minutes, which are then automatically transferred into electronic text.
- Finally, the downloaded electronic text can be analyzed automatically using an *E*-coder so that an individualized report of physical activity assessment, evaluation and prescription can be generated

# Data Collection Using *E*-diary, Armband and Geologger


# How is the progress?

- Tried to build our own recorder with a beeper system – too complex and long ☹; so use a watch with beeper and a Sony Memory Stick recorder;
- Developed a voice recognition application using the Dragon Naturally Speaking software ☺
- Examined the error rates for PA assessment in both lab (*n* = 43; 258 records; C%: M = 92.54, SD=5.88) and field settings (*n*=3; 85.6%) and the results have been satisfactory ☺
- A combination of GPS technique and objective measure will provide an accurate, objective criterion measure for the *E*-diary validation ☺

# More about Error Rate

- The speech recognition output was organized in the format of "label" file, which are compared with corresponding "reference" files;
- % Correctness = 100 x $H$ / $N$; $H = N - S - D$

  where $H$ = the number of correct labels, $N$ = the total number of labels, $D$ = deletions, and $S$ = Substitutions

- I uh…walk for 15 minutes

  ↓

  I went and walk 15 minutes
- The analyses were completed using Hresults, a Hidden Marko Model Toolkit (HTK) performance analysis tool.

# Preliminary Results

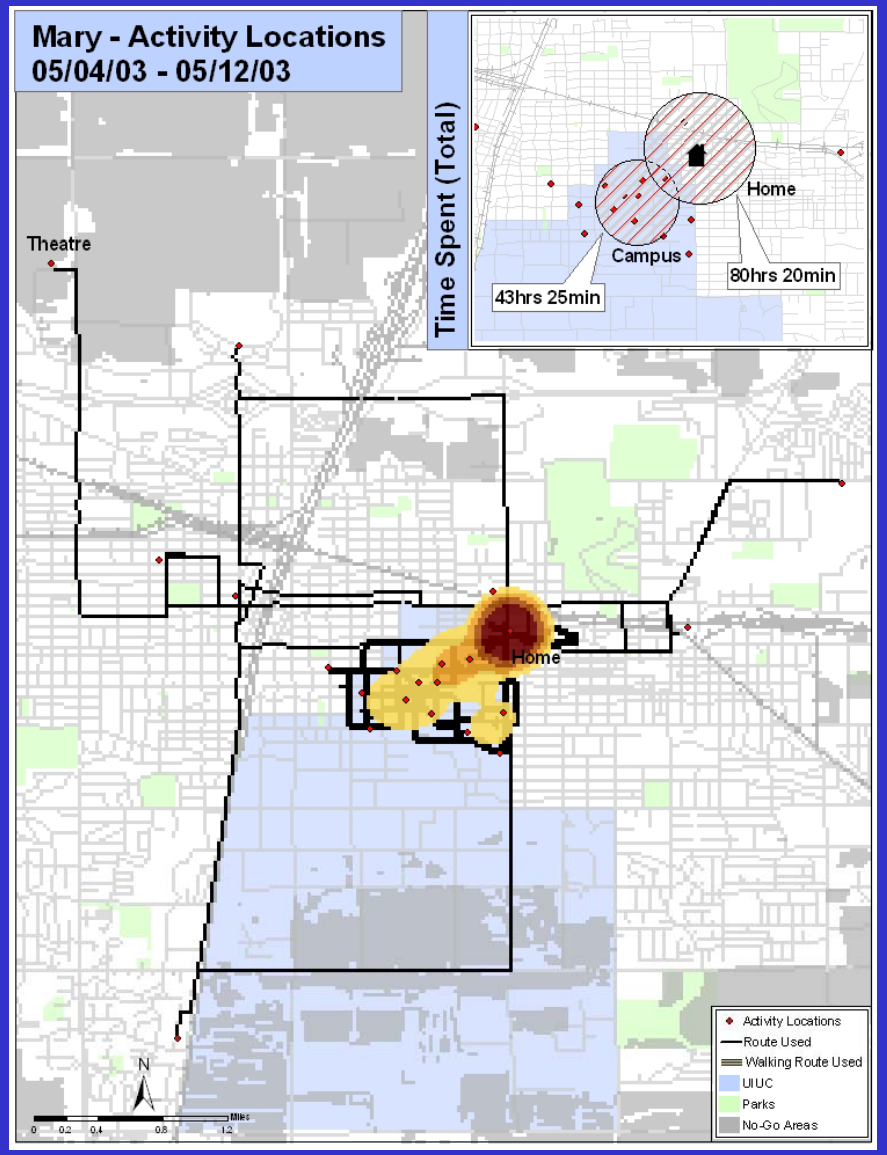
A segment of recently collected pilot data
(the beep interval = 30 min, but the recall intervals were flexible)

| Record Time | Apparent Start Time | Activity Time | Activity |
|---|---|---|---|
| 13:29 | 12:59 | 30 | I ate lunch for 30 minutes |
| 14:29 | 13:29 | 20 | I work on my homework for 20 minutes |
| | | 10 | I rode on the bus for 10 minutes |
| | | 20 | I walked for 20 minutes |
| | | 10 | I packed for 10 minutes |
| 14:59 | 14:29 | 30 | I packed for 30 minutes |
| 15:30 | 15:00 | 30 | Driving home in a car for 30 minutes |

# Physical Activity Space (Zhu, 2003)

*Physical activity space (PAS) is the area or space where an individual spends time And engages in physical activities;*

*PAS is a measure that can integrate both The measurements of physical activity behavior and its interaction with surrounding environment;*



# Challenges and Next Step

- 30-min interval is “Too Much” ☹; so we use 60 min now;
- Travel behavior data collection “from xx to xx” did not work well (Correctness % ranged from 5% to 90%);
- Reexamine the training process and look for travel experts’ help now …
- Just start automatic scoring data analysis
- More data with PA and travel behaviors are need!!!

# Thank You!