Advantages of GPS in Transportation Studies

GPS technology is ideal for measuring personal mobility:

- Validate traditional diary data elements
  - Trip rates, travel times, origins and destinations
- Collect new data elements
  - Route, travel distances (VKT), instantaneous speeds
  - Details of trip chaining behaviors and mode choice
- Obtain highly accuracy spatial and temporal details
  - Accurate location data (origin and destination)
  - Accurate trip start and finish times
  - Accurate trip lengths, routes, and travel speeds
GPS-Enhanced Household Travel Surveys

**Purpose:** Audit CATI trip reporting accuracy

**Methodology:**
1) Study households are recruited, initial CATI data collected
2) GPS data is collected passively in each vehicle or for each person in a given household on assigned travel day(s)
3) CATI travel data is collected after travel day(s)
4) GPS data is processed within TIAS, with trips ends identified
5) CATI data is imported and matched to GPS trips, adjustments to GPS trips are made as justified
6) Summary statistics are generated, including trip rate correction factors

Recent GPS-enhanced Travel Surveys

- Use of in-vehicle GPS to validate diaries / CATI
  - 1998 Austin (200)
  - 2001 CA statewide (500)
  - 2001 Los Angeles (500)
  - 2001 Atlanta (750)
  - 2001 Pittsburgh (100)
  - 2001 Ohio statewide
  - 2002 Laredo (200)
  - 2002 St Louis (300)

**Notes:**
- GPS sample size in ( ) above
- Studies in red conducted by GeoStats
GeoStats GPS Trip Identification and Analysis System (TIAS)

Example of 6 trips reported and measured

GeoStats TIAS

Example of all 2 trips reported and 14 trips measured
In-Vehicle GPS Data Logger

- Powered via vehicle’s cigarette lighter socket
- Logs at 1-second or 5-second frequencies
- Records date, time, lat, long, speed, heading, altitude
- Logging & storage capacity options support data collection for up to 1 year
- Accuracy levels:
  - Date and time are exact
  - Position is within 5-15m
  - Speed is within 0.5 mph

California GPS Study Results

- 9.3 trips per household (adjusted GPS)
- 8.9 trips per household (GPS)
- 7.3 trips per household (CATI)

<table>
<thead>
<tr>
<th>County</th>
<th># HH</th>
<th># Veh</th>
<th># GPS trips</th>
<th># CATI trips</th>
<th># missed GPS</th>
<th>total missed</th>
<th>adj. % missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda</td>
<td>88</td>
<td>152</td>
<td>711</td>
<td>603</td>
<td>27</td>
<td>135</td>
<td>22.3%</td>
</tr>
<tr>
<td>Sacramento</td>
<td>93</td>
<td>171</td>
<td>853</td>
<td>635</td>
<td>45</td>
<td>263</td>
<td>41.4%</td>
</tr>
<tr>
<td>San Diego</td>
<td>111</td>
<td>200</td>
<td>1046</td>
<td>888</td>
<td>27</td>
<td>185</td>
<td>20.8%</td>
</tr>
<tr>
<td>Totals</td>
<td>292</td>
<td>523</td>
<td>2610</td>
<td>2126</td>
<td>99</td>
<td>583</td>
<td>27.4%</td>
</tr>
</tbody>
</table>
Other HHTS GPS Study Results

- Northeast city: final missed trip rate: 31.0% | 37.0%
  - 8.5 trips per household (GPS, unadjusted)
  - 6.5 trips per household (CATI)
- Southwest border city: final missed trip rate: 80.8% | NA
  - 11.3 trips per household (GPS, unadjusted)
  - 6.2 trips per household (CATI)
- Midwest city: final missed trip rate: 11.3% | 17.2%
  - 9.2 trips per household (GPS, unadjusted)
  - 8.3 trips per household (CATI)

Interpretation of Missed Trip Analysis Results

- Trip rate correction factors are not to be applied ‘across the board’ or random
- They should be applied based on correlates of underreporting
  - Household cultural or socio-demographic factors
  - Person-level characteristics
  - Trip-level characteristics
- Analyses are currently underway to identify and quantify these correlates
# GeoStats GPS Studies 2001-2002

<table>
<thead>
<tr>
<th>Study Name</th>
<th>Dates of study</th>
<th>Unit of Analysis</th>
<th>Equipment Used</th>
<th>Length of Study (all projects were 3AM-3AM)</th>
<th>Total days in study period</th>
<th># Deployed (HH or person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Statewide HHTS</td>
<td>2/12/01-10/3/01</td>
<td>Vehicle</td>
<td>In-vehicle</td>
<td>1-day</td>
<td>79</td>
<td>517</td>
</tr>
<tr>
<td>Pittsburgh HHTS</td>
<td>9/11/01-12/10/01</td>
<td>Vehicle</td>
<td>In-vehicle</td>
<td>1-day</td>
<td>38</td>
<td>74</td>
</tr>
<tr>
<td>Laredo HHTS</td>
<td>3/25/02-3/31/02</td>
<td>Vehicle</td>
<td>In-vehicle</td>
<td>1-day</td>
<td>46</td>
<td>187</td>
</tr>
<tr>
<td>St. Louis HHTS</td>
<td>9/5/02-11/7/02</td>
<td>Vehicle</td>
<td>In-vehicle</td>
<td>1-day</td>
<td>46</td>
<td>313</td>
</tr>
<tr>
<td>SCAG Vehicle Activity</td>
<td>7/12/02-8/19/02</td>
<td>Vehicle</td>
<td>In-vehicle</td>
<td>10-day</td>
<td>30</td>
<td>67</td>
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<tr>
<td>Atlanta Route Study</td>
<td>11/12/02-11/18/02</td>
<td>Person</td>
<td>Wearable</td>
<td>7-day</td>
<td>14</td>
<td>57</td>
</tr>
<tr>
<td>London GPS Pilot</td>
<td>9/02-11/02</td>
<td>Person</td>
<td>Wearable</td>
<td>3-day</td>
<td>67</td>
<td>143</td>
</tr>
<tr>
<td>Atlanta HHTS Physical Activity Study (ETD)</td>
<td>Spring 2001 (5/6-7/13) Fall 2001 (8/19-12/15) Spring 2002 (1/6-4/20)</td>
<td>Person</td>
<td>Wearable</td>
<td>245 travel day pairs</td>
<td>542</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study Name</th>
<th># Deployed (HH)</th>
<th># Deployed (Per/Veh)</th>
<th>Max # of GPS days</th>
<th>GPS Completes (Per/Veh)</th>
<th>HH Completes (all parts)</th>
<th>Actual # of GPS days (CM HHs)</th>
<th>Actual # of GPS days (All HHs)</th>
<th>GPS CM %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Statewide HHTS</td>
<td>517</td>
<td>776</td>
<td>776</td>
<td>NA</td>
<td>292</td>
<td>523</td>
<td>67.4%</td>
<td></td>
</tr>
<tr>
<td>Pittsburgh HHTS</td>
<td>74</td>
<td>149</td>
<td>149</td>
<td>46</td>
<td>85</td>
<td>101</td>
<td>67.8%</td>
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</tr>
<tr>
<td>Laredo HHTS</td>
<td>187</td>
<td>348</td>
<td>348</td>
<td>234</td>
<td>87</td>
<td>156</td>
<td>67.2%</td>
<td></td>
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<tr>
<td>St. Louis HHTS</td>
<td>313</td>
<td>656</td>
<td>656</td>
<td>428</td>
<td>150</td>
<td>300</td>
<td>67.3%</td>
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</tr>
<tr>
<td>SCAG Vehicle Activity</td>
<td>87</td>
<td>111</td>
<td>111</td>
<td>87</td>
<td>NA</td>
<td>NA</td>
<td>102.3%</td>
<td></td>
</tr>
<tr>
<td>Atlanta Route Study</td>
<td>57</td>
<td>37</td>
<td>358</td>
<td>46</td>
<td>NA</td>
<td>NA</td>
<td>102.3%</td>
<td></td>
</tr>
<tr>
<td>London GPS Pilot</td>
<td>143</td>
<td>143</td>
<td>420</td>
<td>134</td>
<td>NA</td>
<td>NA</td>
<td>102.3%</td>
<td></td>
</tr>
<tr>
<td>Atlanta HHTS Physical Activity Study (ETD)</td>
<td>542</td>
<td>542</td>
<td>1084</td>
<td>295</td>
<td>235</td>
<td>470</td>
<td>92.2%</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1900</td>
<td>2792</td>
<td>4961</td>
<td>1305</td>
<td>1534</td>
<td>2953</td>
<td>59.5%</td>
<td></td>
</tr>
</tbody>
</table>

Notes: GPS days totals include non-travel days - need to investigate closer
Max # of GPS days calculate = # deployed (per/veh)*Length of study period

Technology for a Mobile World
GeoStats
Personal GPS Data Loggers (passive wearable logger)

Applications
- Can be used with household travel surveys as paper diary augment for all modes of travel
- Can be used for multi-day data collection – no user interface lessens respondent burden

Projects
- 2002 London Area Travel Survey (150)
- 2002 Atlanta Route Study (57)
- 2003 Sydney Household Travel Survey
- 2003 Canada Studies

One week activity space of Atlanta participant
GPS-based Prompted Recall

**Purpose:** Reduce / replace CATI retrieval

**Methodology:**

1) Study households are recruited, initial CATI data collected
2) GPS data is collected passively in each vehicle or for each person in a given household on assigned travel day(s)
3) Within 2-3 days after travel day(s), GPS data is processed within TIAS referencing CATI recruitment data (ie habitual locations), with trips ends and trip characteristics (such as purpose) identified
4) GPS-based trips are presented back to participants via prompted recall website for travel confirmation and completion
5) Summary statistics are generated
Interactive Survey with GPS (wearable with user interface)

Benefits
- User interface is electronic travel diary – eliminates paper diary & CATI retrieval
- GPS records date, time, lat, long, speed, heading, altitude for every trip, every mode
- Powered via 3 D-cell batteries for up to three days of logging

Projects to Date
- 1996 Lexington (100): in-vehicle
- 1999 the Netherlands (150): all modes
- 2001-2002 Atlanta (600): all modes (physical activity study)
All GPS trips recorded by Atlanta Physical Activity Study participants

Bicycle trips recorded by Atlanta Physical Activity Study participants