Tracing people and cars with GPS and diaries: Current experience and tools

Jean Wolf, PhD
GeoStats
Atlanta, USA

ETH Hönggerberg, Zürich
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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

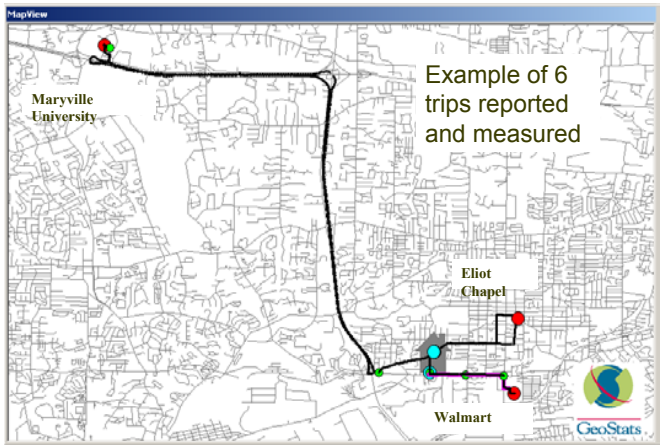
Methodology:

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

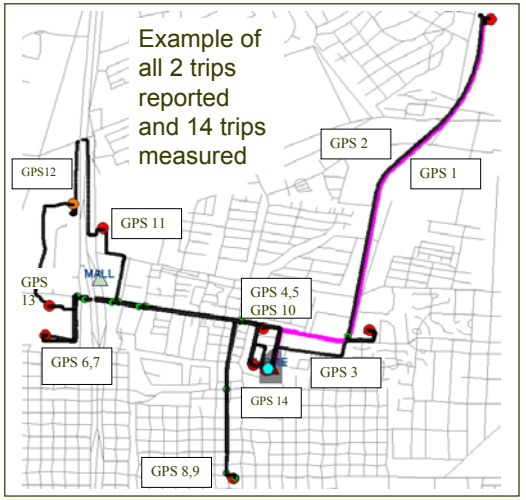
Recent GPS-enhanced Travel Surveys

- 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)



GeoStats TIAS



In-Vehicle GPS Data Logger

The GeoStats GeoLogger

- 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

County	# HH	# Veh	# GPS trips	# CATI trips	# missed GPS	total missed	adjusted % missed
Alameda	88	152	711	603	27	135	22.3%
Sacramento	93	171	853	635	45	263	41.4%
San Diego	111	200	1046	888	27	185	20.8%
Totals	**292**	**523**	**2610**	**2126**	**99**	**583**	**27.4%**

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

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

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

GeoStats GPS Studies 2001-2002

Study Name	# Deployed (HH)	# Deployed (Per/Veh)	Max # of GPS days	GPS Completes (Per/Veh)	HH Completes (all parts)	Actual # of GPS days (CM HHs)	Actual # of GPS days (All HHs)	GPS CM %
CA Statewide HHTS	517	776	776	NA	292	523	NA	67.4%
Pittsburgh HHTS	74	149	149	101	46	85	101	67.8%
Laredo HHTS	187	348	348	234	87	156	234	67.2%
St. Louis HHTS	313	666	666	428	150	300	428	64.3%
SCAG Vehicle Activity	67	111	1110	67	NA	NA	1023	92.2%
Atlanta Route Study	57	57	399	46	NA	NA	278	69.7%
London GPS Pilot	143	143	429	134	NA	NA	299	69.7%
Atlanta HHTS Physical Activity Study (ETD)	542	542	1084	295	235	470	590	54.4%
TOTAL	**1900**	**2792**	**4961**	**1305**	**810**	**1534**	**2953**	**59.5%**
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)

Personal GeoLogger

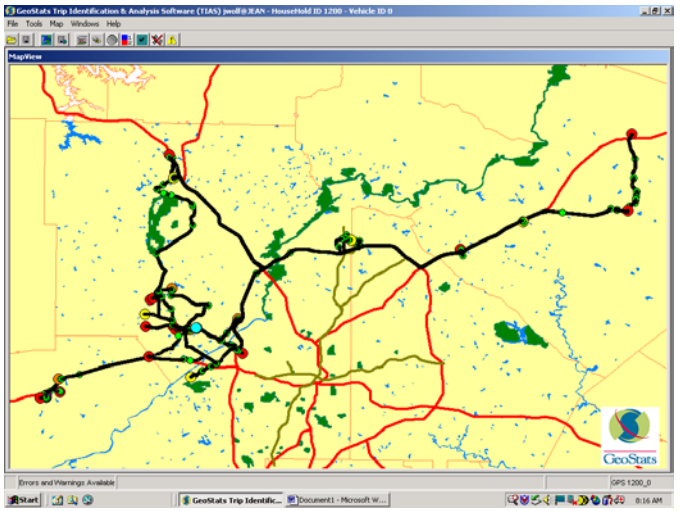
Applications

- 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

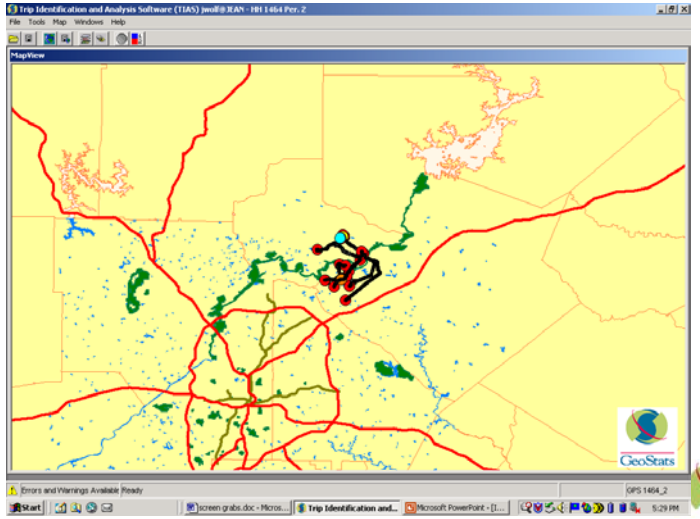
Projects

- 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



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

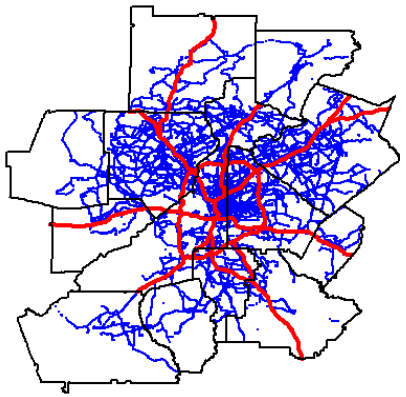
Projects to Date

- 1996 Lexington (100): in-vehicle
- 1999 the Netherlands (150): all modes
- 2001-2002 Atlanta (600): all modes

(physical activity study)

Atlanta multi-modal trip

All GPS trips recorded by Atlanta Physical Activity Study participants



Bicycle trips recorded by Atlanta Physical Activity Study participants