Westat®

An Employee-Owned
Research Corporation

Integrating Smartphone Apps into Small Regional Household Travel Surveys

and…

Into Large Ones as Well

April 2018

Marcelo Simas &

Laura Wilson

Outline

- Evolution of Smartphone Apps
- Implementation of DailyTravel Apps
- Field testing
  - Hickory, NC
- Real-world deployments
  - Billings, MT
- Lessons Learned

Background: GPS in HTS

- Traditional HTS methods collected 100% self-reported travel behavior information via paper travel diary reported by phone, mail, eventually web
- Early 2000s passive GPS loggers were introduced to provide an objective measurement of travel behavior and to detect potential under-reporting
- GPS sub-sample used to calculate trip rate correction factors for overall diary sample to address misreporting
  - Passive GPS compared to self-report
  - Use GPS-Prompted recall to improve reporting

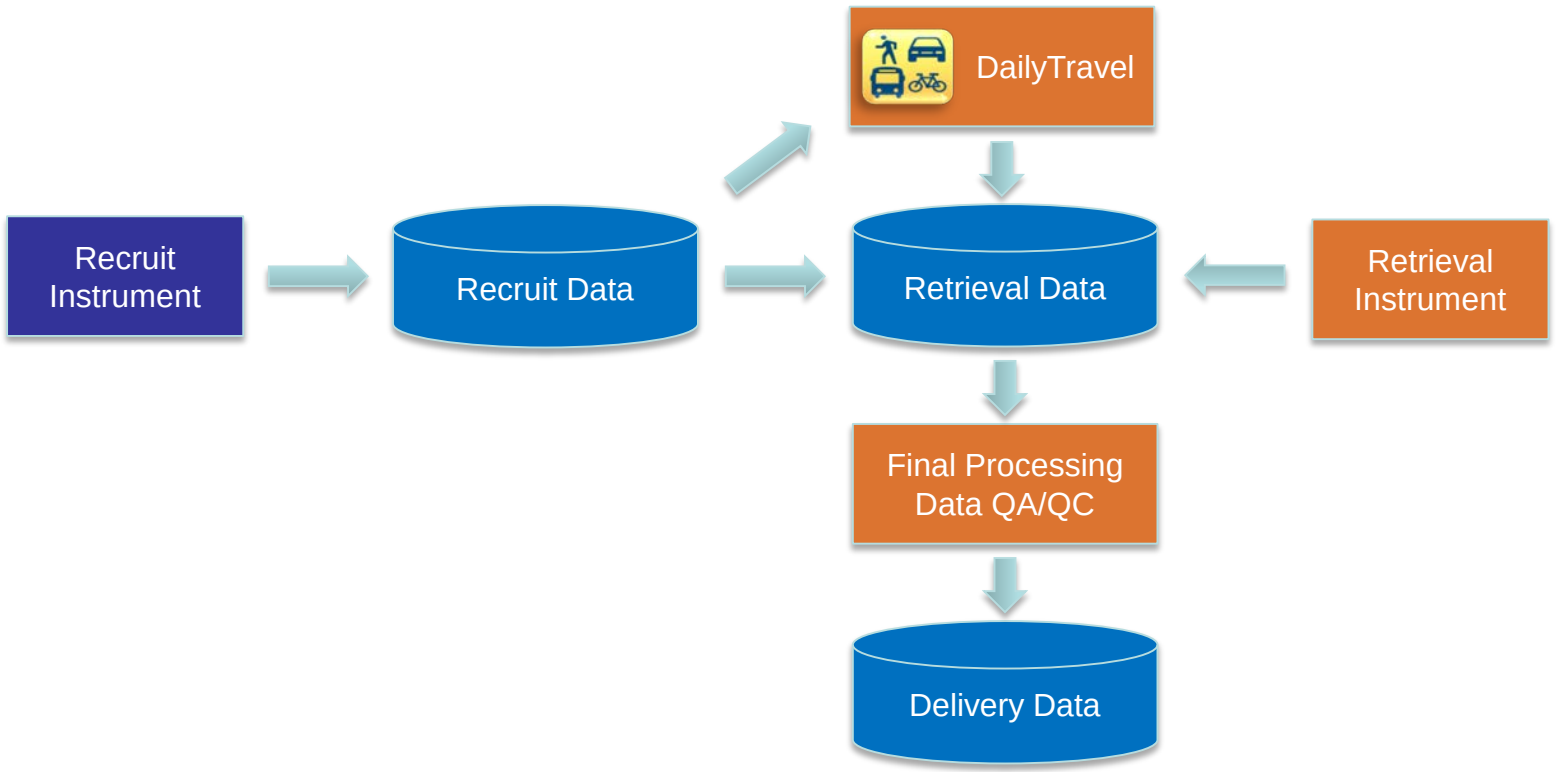
Evolution of Smartphone Apps

- Initially used as direct replacements of GPS loggers
  - NuStats adapted CycleTracks for Portland HTS (2010), captured limited attributes
- Connected to online instruments for prompted-recall
  - MIT – Future Mobility Survey in Singapore (2014)
- As a complete “in the moment” prompted-recall instrument
  - RSG – rMove smartphone apps

DailyTravel App – Background

- Objectives
  - Replace dedicated GPS logger devices (target iOS and Android devices)
  - Implement state-of-the art features
    - Support “in the moment” GPS-PR (limited place editing)
    - Support for adding missed trips
    - Multi-day support (week-long collection)
    - Customizable instruments, time zones and language
    - Connected to Google APIs for geocoding and place searching
    - Continuous data upload
  - Full integration with other retrieval modes (Web, CATI)
    - Possible to start on phone and end on Web or CATI

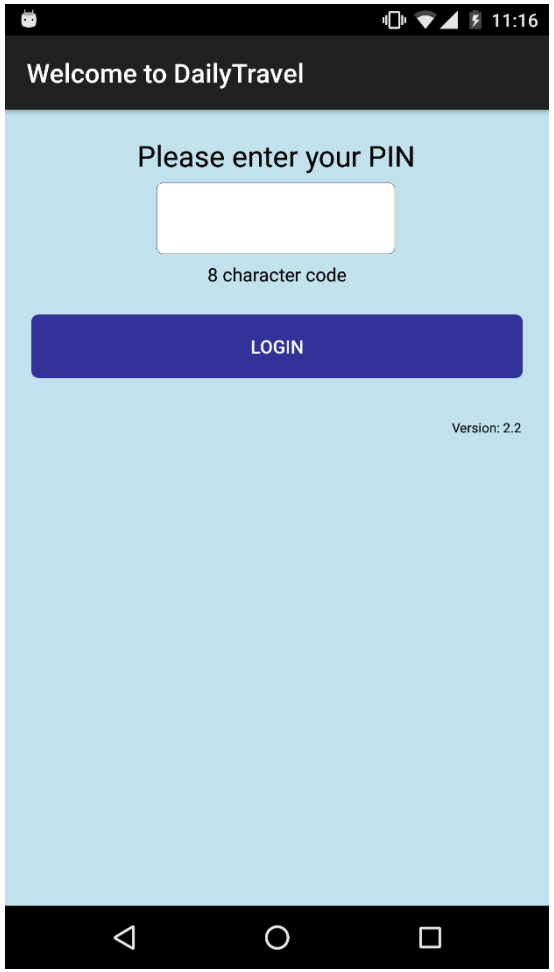
DailyTravel Data Flow

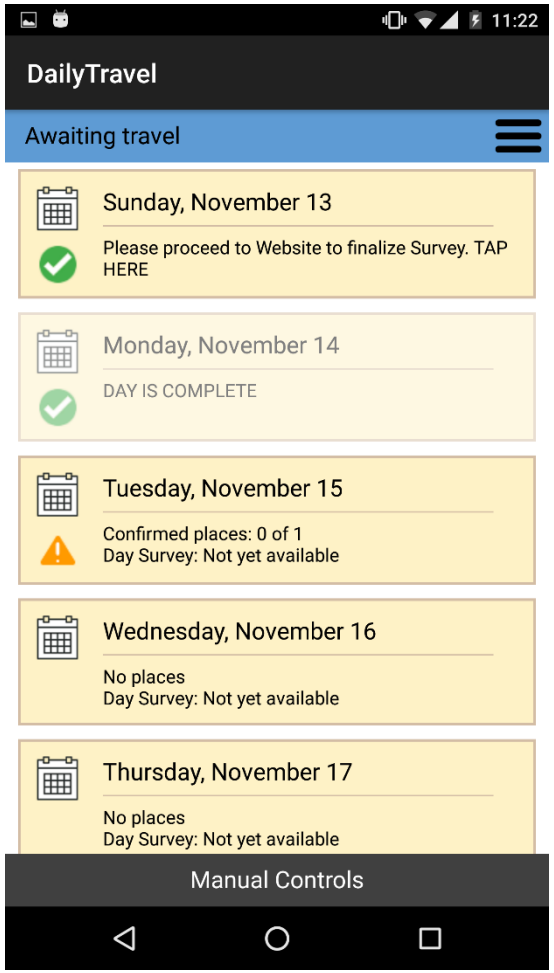


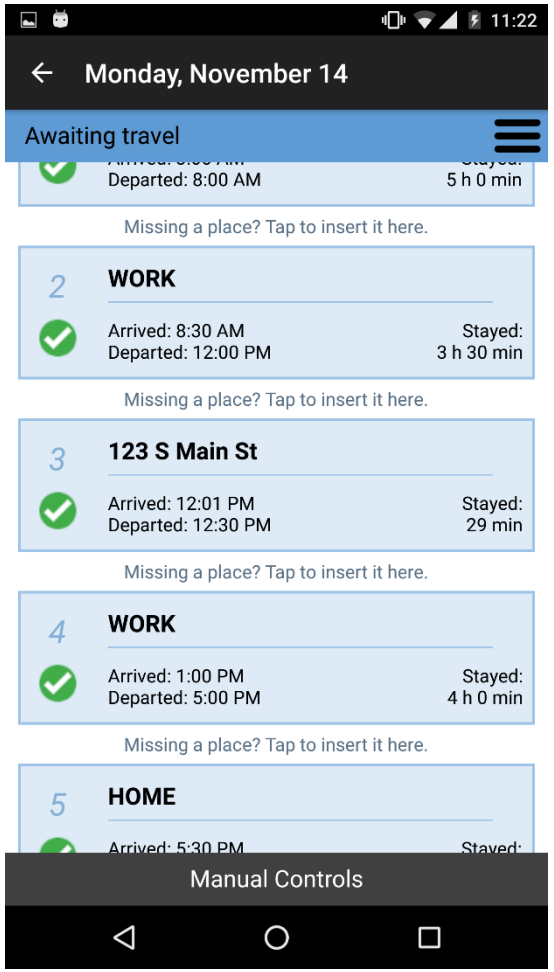
DailyTravel App - Overview

- Auto-detects trip start/stop using geofences
  - Downloads recruit locations
  - Controls GPS to minimize battery draw
  - Logs accelerometer data
  - Tuned to detect short stops, learns from travel to stop sooner
- Travel capture
  - Imputes attributes based on previous visits to a place
- Prompted Recall
  - Uses phone's notification system
  - Full customizable instrument – direct mapping to online Web / CATI questions
  - Can add GPS stops along the way to a place
- Add/Edit Non-GPS Places: input for places missed
  - Google Maps API geocoding

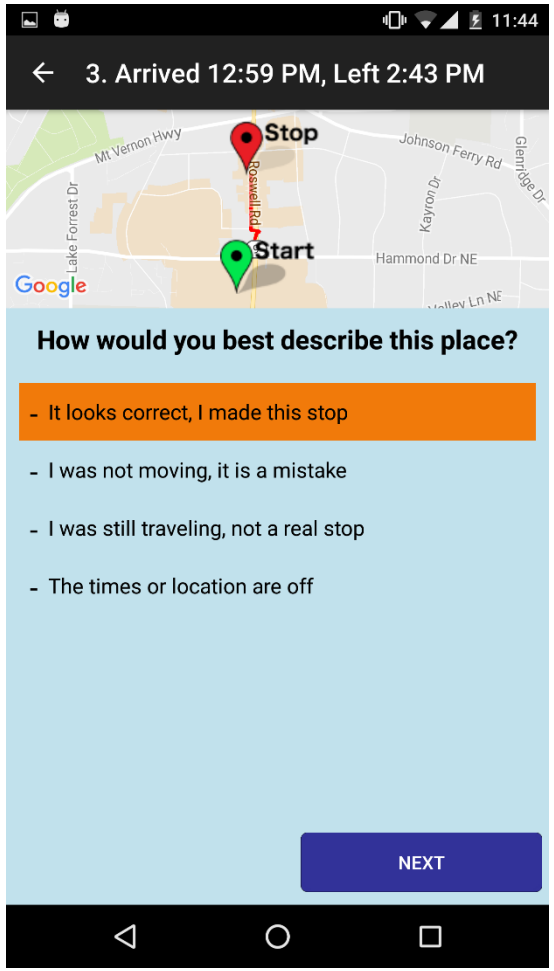
DailyTravel App

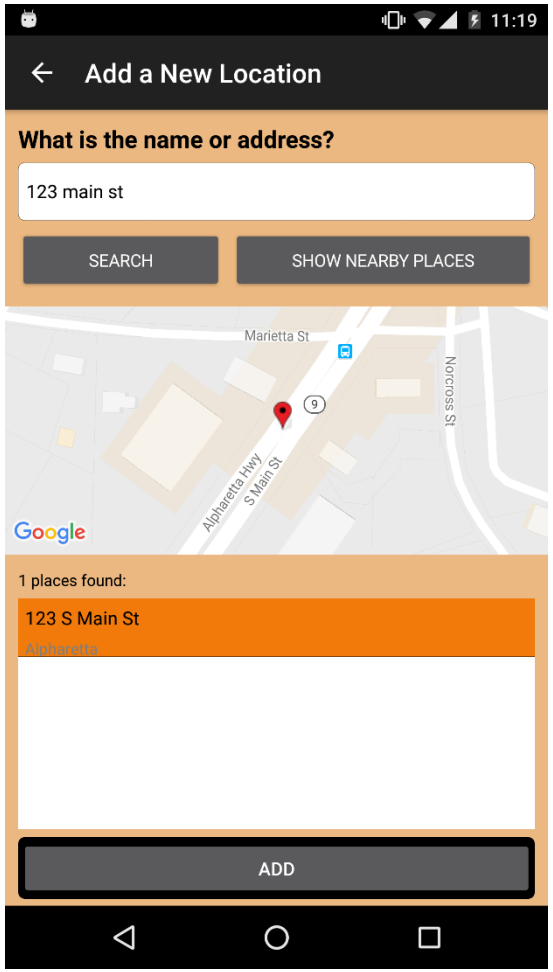


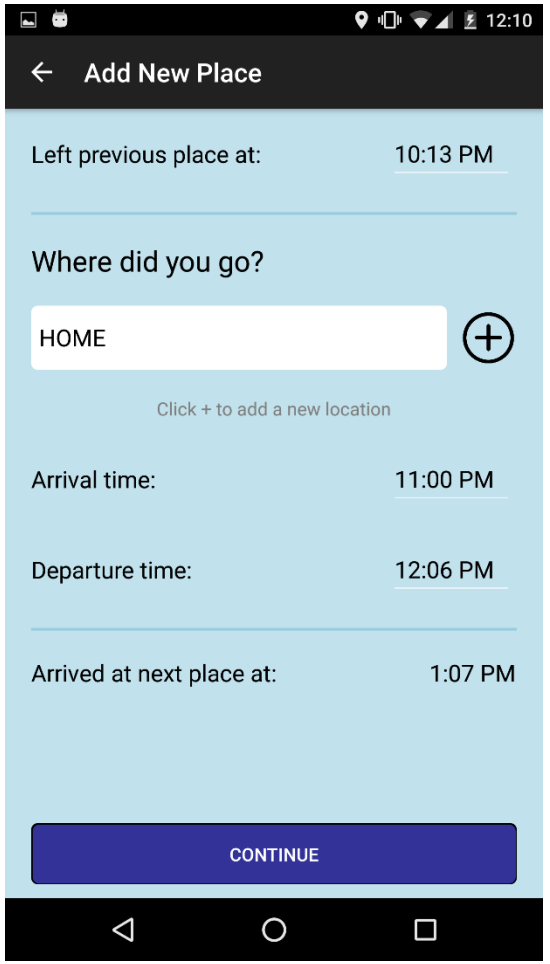




DailyTravel App

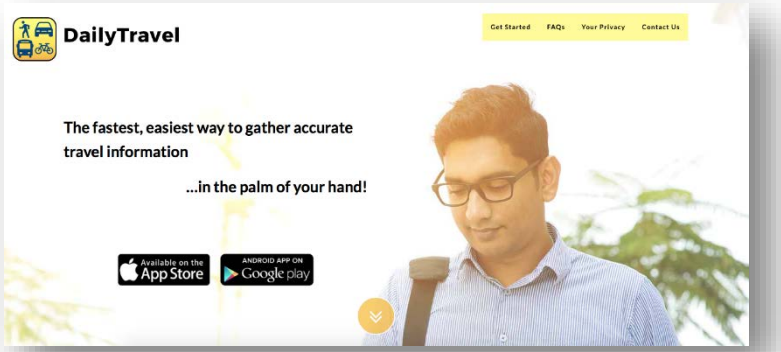






Field Testing – Hickory, NC

- Re-contacted households which had completed recent HTS in early 2016
  - Original used ABS sample
  - All electronic, no mail
  - Raffle for incentives
  - https://travelcatawbavalley.com
- Recruitment: 121 households (8.6% rec rate)



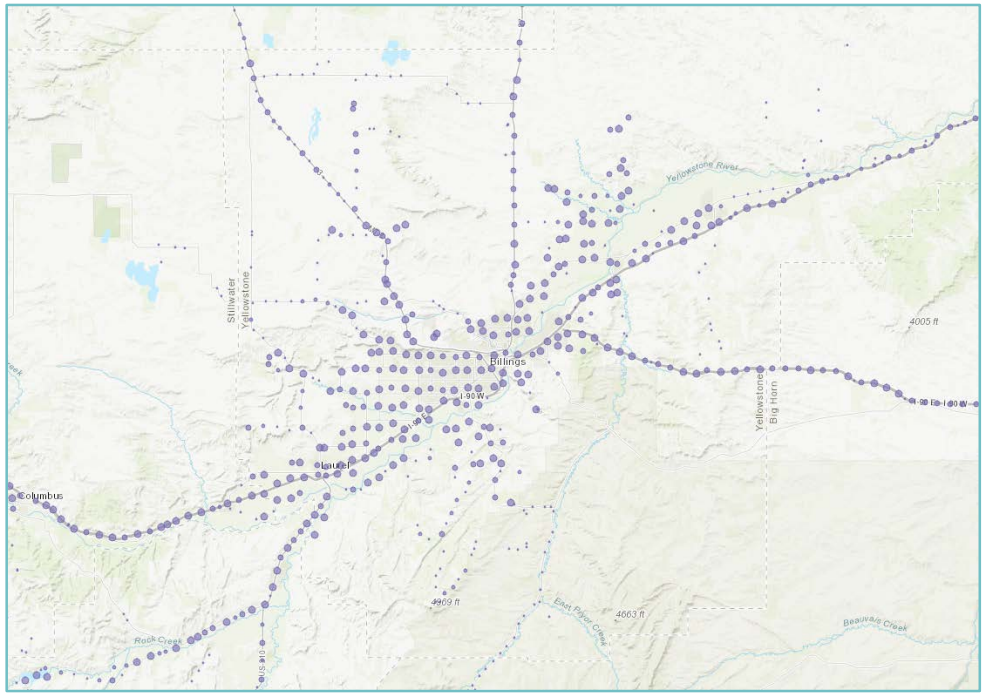
- Retrieval: 59 households (48.8% ret rate, 4.2% response rate)
- Phone breakdown
  - 91 persons (27%) used smartphones (102 agreed to use and 339 were eligible)
  - 75 persons (22%) confirmed trips using phones
  - 446k logged GPS points

Real-World – Billings, MT

- Traditional ABS sampling and mail-out recruitment
  - https://bigskydailytravel.com
- Two stage approach
  - Recruit (REC) -> Travel Date -> Retrieval (RET)
- Mostly Web with limited CATI support
- Smartphone apps offered to all households
  - Recruitment: 1,633 households (8.5% rec rate)
  - Retrieval: 1,078 households (66% ret rate)

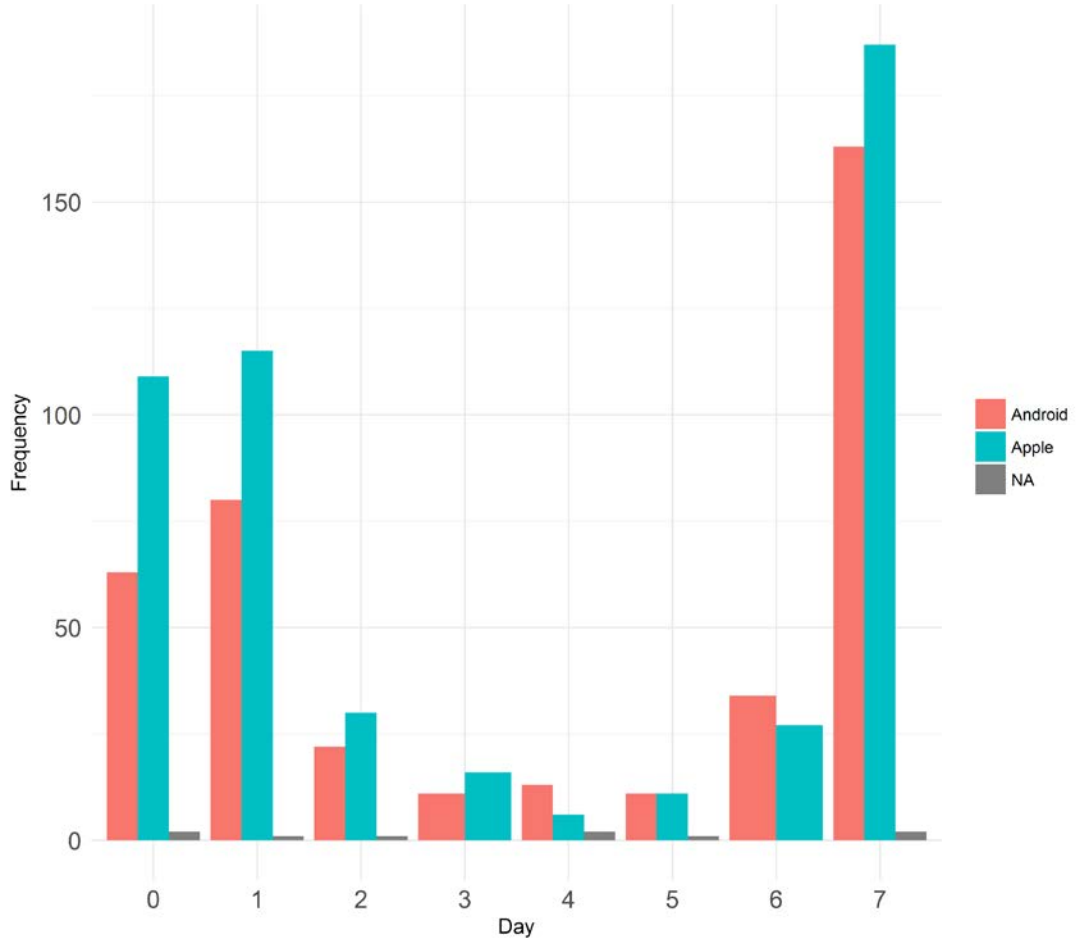
Real-World – Billings, MT

- 932 participants downloaded and initialized the app,
  - 546 collected travel data for seven days
  - 352 confirmed all details on all captured places for the week
- The majority used iPhones (57%)
  - iPhone users showed higher retrieval
- The apps collected…
  - 6 million GPS points
  - 87,511 places



Multi-Day Reporting – Billings, MT

- Participants were asked to use app for a week
  - 1st day matched Web/CATI reporting
- Once participants confirmed a day they were more likely to confirm all days



Smartphone Participants – Billings, MT

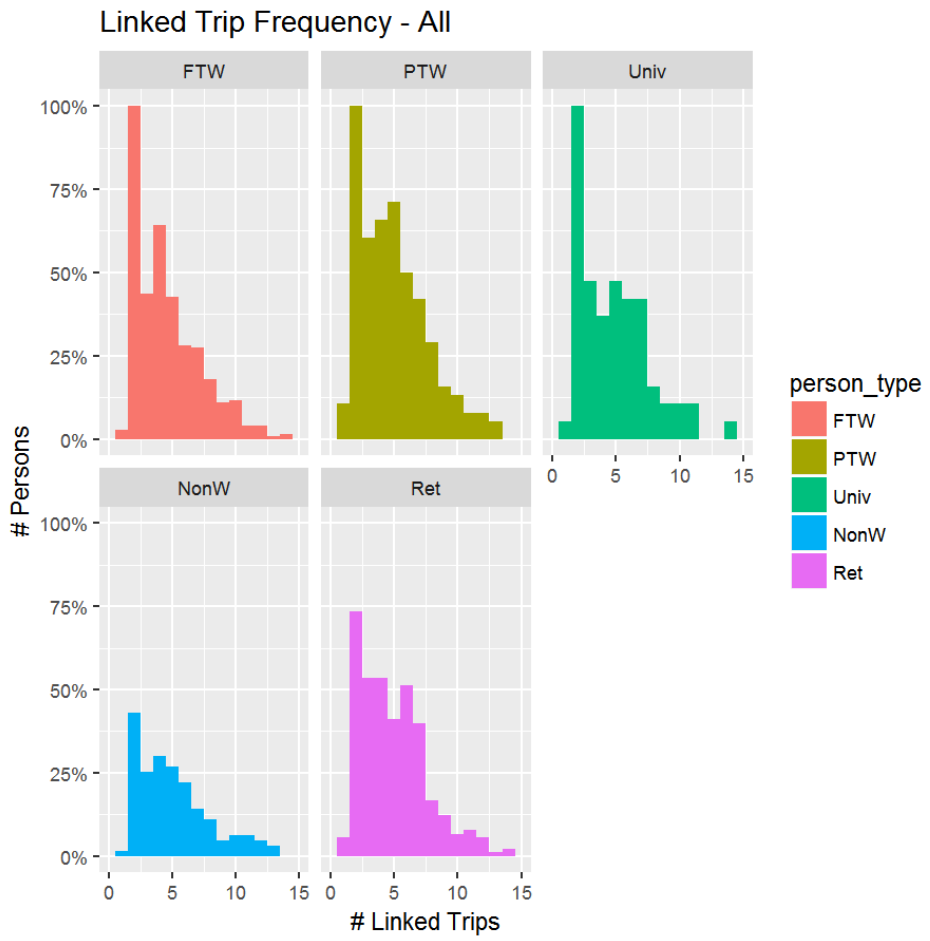
Complete persons by phone and person type

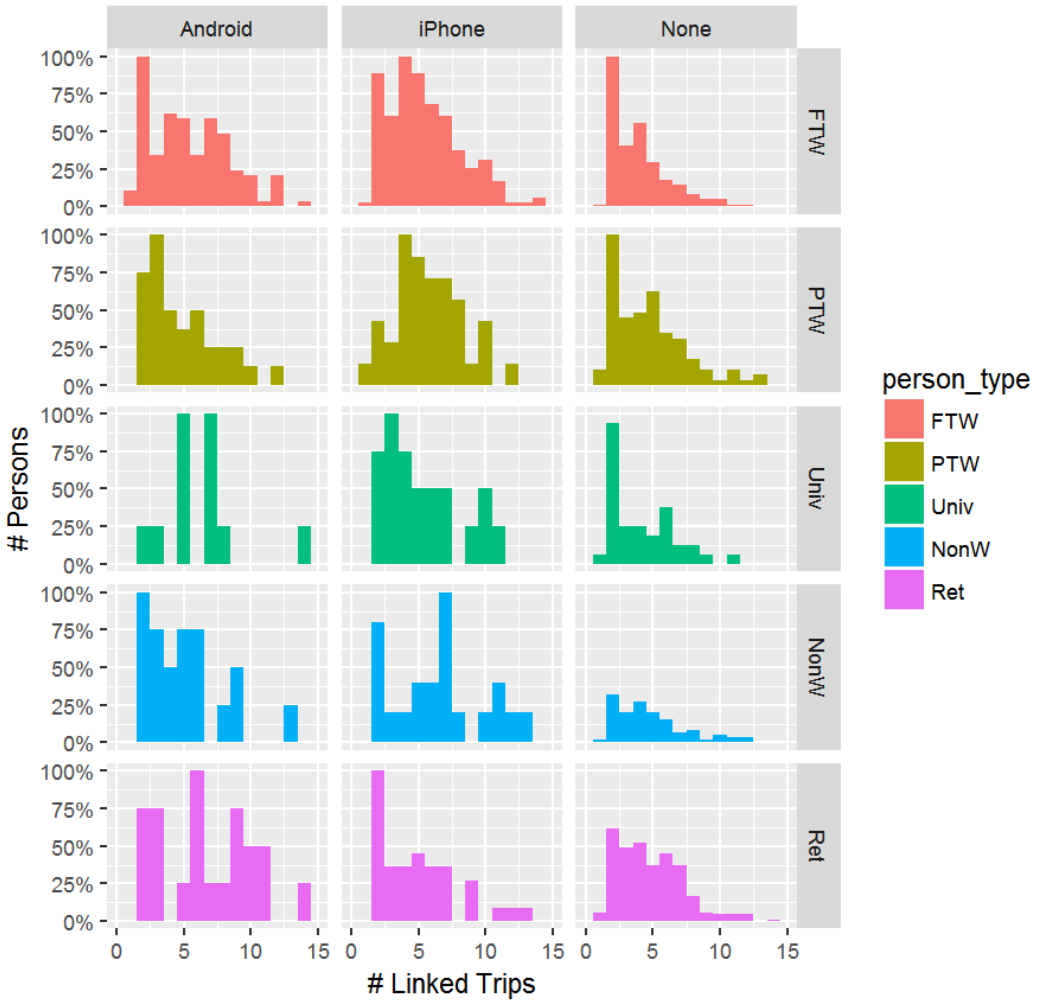
Person Type	*Android*	*iPhone*	*None*
Full Time Worker	146 (61%)	209 (63%)	548 (45%)
Part Time Worker	38 (16%)	39 (12%)	124 (10%)
University Student	11 (05%)	20 (06%)	55 (04%)
Non-Worker	20 (08%)	22 (07%)	142 (12%)
Retiree	24 (10%)	41 (12%)	354 (29%)

Complete persons by phone type and income level

Aggregate Income	*Android*	*iPhone*	*None*
< $30k	49 (21%)	41 (12%)	329 (27%)
$30 - $59k	70 (29%)	72 (22%)	297 (24%)
$60k - $99k	106 (44%)	167 (50%)	490 (40%)
> $99k	14 (06%)	51 (15%)	107 (9%)

Trip Frequencies – Billings, MT





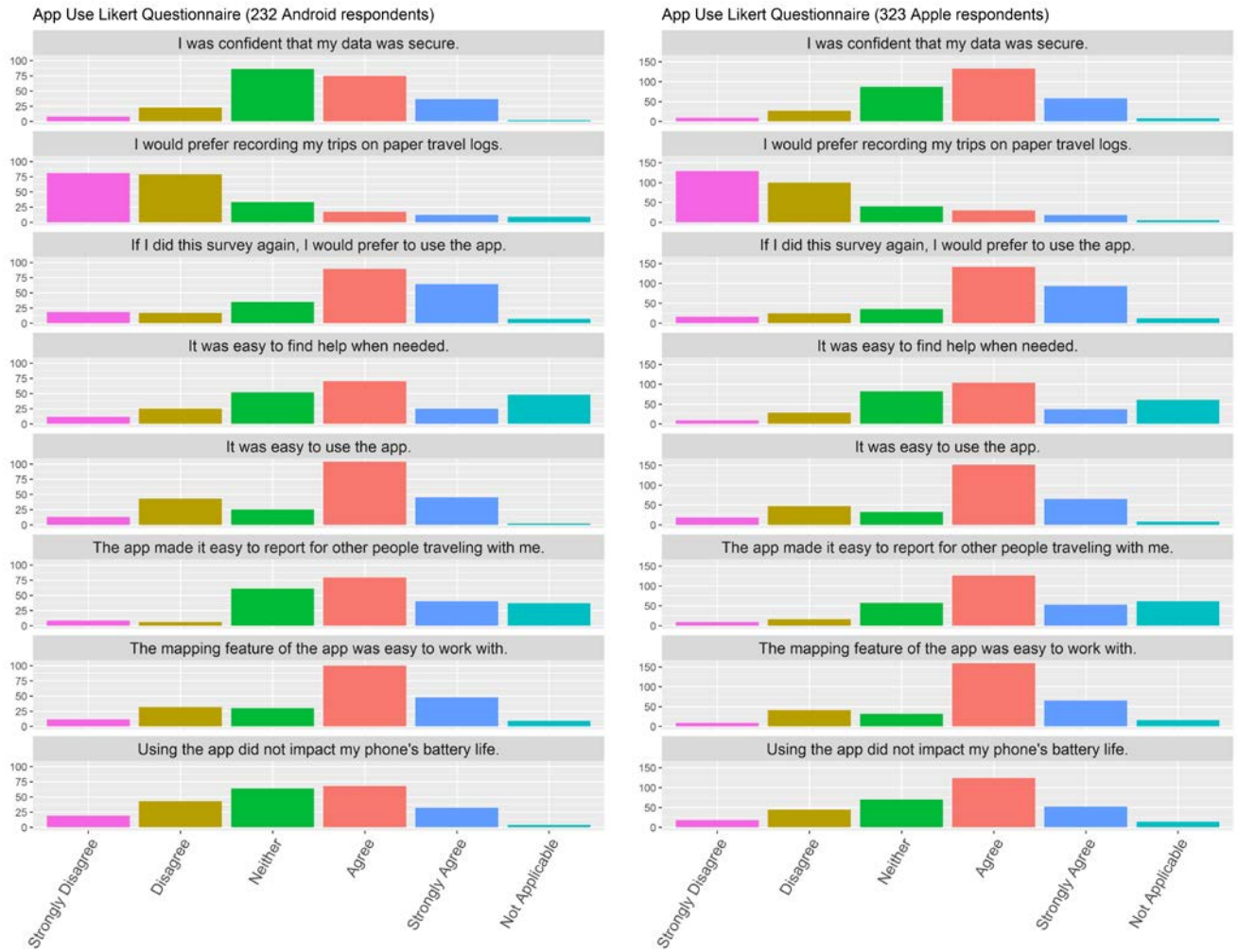
Trip Rates – Billings, MT

	Android	iPhone	None
FTW	5.1	5.3	3.3
PTW	4.5	5.0	4.2
Univ	6.2	4.8	2.9
NonW	4.4	6.2	2.8
Ret	5.7	5.0	3.7

N			
FTW	121	153	383
Univ	11	14	28
NonW	11	13	77
Ret	17	23	205

	FALSE	TRUE
FTW	3.3	5.2
PTW	4.2	4.7
Univ	2.9	5.3
NonW	2.8	5.3
Ret	3.7	5.3

Billings Attitudinal Questions – Billings, MT



Other Efforts

- Vancouver HTS (TransLink)
  - 4 days of travel with a ‘Practice Day’
  - Custom Localized Version
  - Collected data from over 10,000 phones
- Chicago HTS (CMAP)
  - 12,000 goal
  - 7 days of GPS travel capture
  - Support for Spanish
  - Google Transit
- Maryland Statewide HTS
  - Target of 7,500 completes
  - Main study starting in April 2018
- Laredo HTS
  - Target of 2,000 completes
  - Pilot scheduled for May 2018

Lessons So Far

- When inviting participants to use app in REC it is best to get emails and leverage reminders
  - It is OK to decide to use the app later
- Once confirming participants tend to confirm all days
- Offering multiple report modes impacted response
  - Participants were confused by references to the app on the public website
- Households with more smartphone users have higher ret rates
  - iPhone users have higher ret rates also
- Shared travel consistency is harder to ensure
  - Instruments are disconnected (smartphones + online)
  - Location inconsistencies can be introduced (phone GPS data inaccuracies)
  - Working on algorithmic solutions
- Higher trip rates for smartphone users (more analysis needed)

Final Remarks

- Smartphones have come a long as a GPS data collection and electronic diary platform
  - Large market penetration (77% of Americans – Pew Study)
  - High participation rates (50% of households in Billings)
  - Lower cost per household when compared to GPS loggers
- Benefits to HTS
  - Reduced burden when reporting travel for multiple days
  - Addresses under-reporting (higher trip rates)
- However…
  - Can impact overall response rates
  - Pose new challenges to data cleaning (shared travel)
  - Harder to test “end-to-end”
  - Add cost for processing extra days

Questions?

Thank you!

Laura Wilson
laurawilson@westat.com
404-596-8155

Marcelo Simas
marcelosimas@westat.com
404-596-8151