Using GPS data as auxiliary data.

Anne Elevelt, Wim Bernasco, Peter Lugtig,
Stijn Ruiter & Vera Toepoel.

BigSurv18 conference. Barcelona. 27 October.

Where you at? Using GPS Locations in an Electronic Time Use Diary Study to Derive Functional Locations.

Anne Elevelt, Wim Bernasco, Peter Lugtig,
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BigSurv18 conference. Barcelona. 27 October.

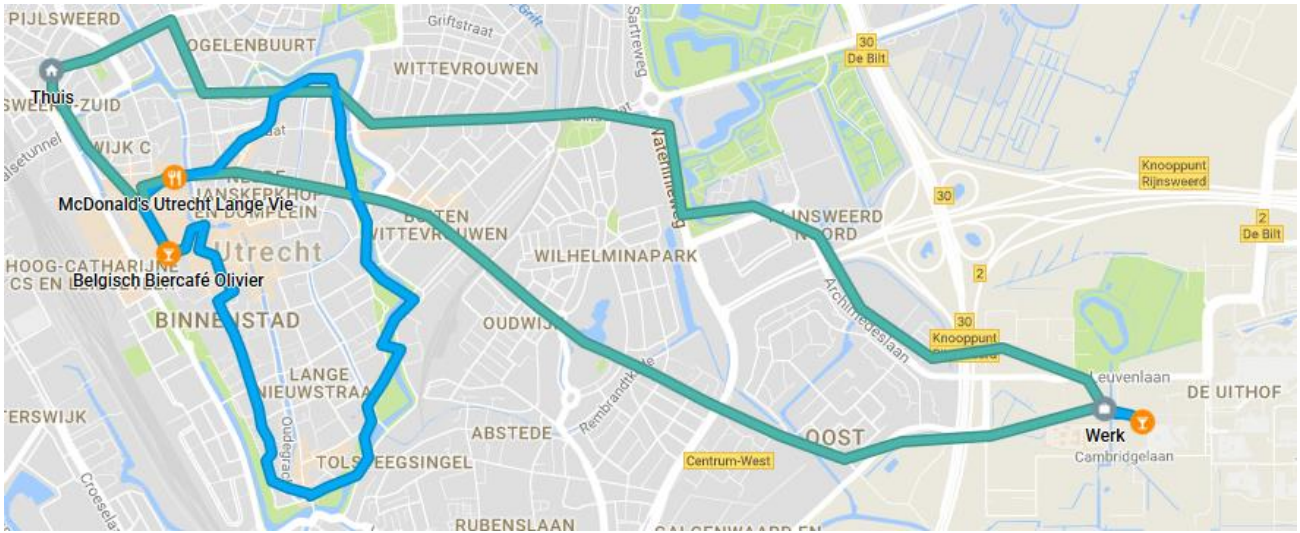
Diary studies

- Reliable and Accurate
- Different Domains
- But:
  - Burdensome

Time Use Survey App

For more information. see: Sonck & Fernee. 2013.

GPS tracks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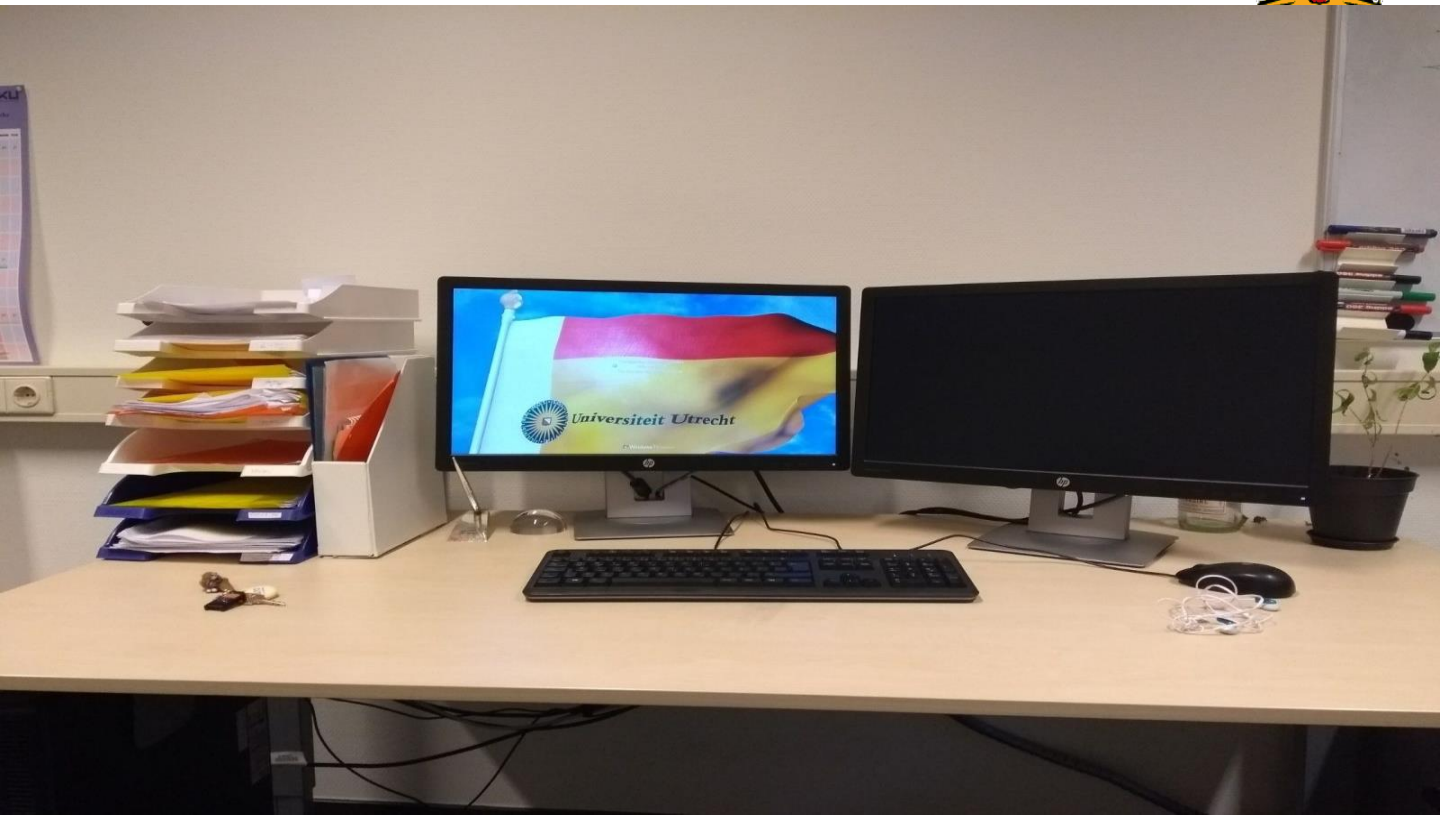
ABSTEDE
Rembrandtkade
OOST
Werk
Cambridgelaan
TOLSTEEGSINGEL
Centrum-West
Croeselaan
RUBENSLAAN

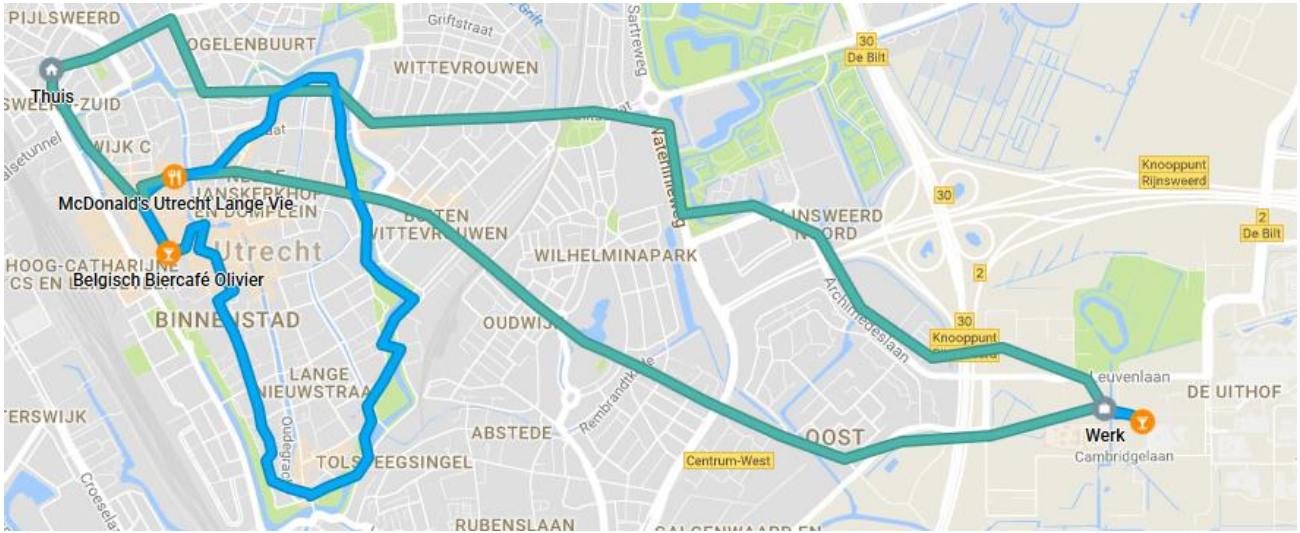

Without data, you're
just another person
with an opinion.


Universiteit Utrecht

Potential problems

- Battery life
- Data quality of GPS measurements
- Rule-based algorithms needed

GPS tracks.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GPS coordinates.

date	longitude	latitude
2018-02-23 17:44:14	5.124597	52.09303
2018-02-23 17:43:11	5.128350	52.09254
2018-02-23 17:42:09	5.130846	52.09203
2018-02-23 17:41:04	5.134006	52.09042
2018-02-23 17:40:03	5.136958	52.08891
2018-02-23 17:38:59	5.139979	52.08749
2018-02-23 17:37:56	5.143923	52.08639
2018-02-23 17:36:53	5.147190	52.08532

date	longitude	latitude
2018-02-23 08:21:42	5.170318	52.08520
2018-02-23 08:20:39	5.170312	52.08520
2018-02-23 08:19:30	5.170323	52.08520
2018-02-23 08:18:28	5.170312	52.08520
2018-02-23 08:17:26	5.170333	52.08523
2018-02-23 08:16:24	5.170320	52.08520
2018-02-23 08:15:22	5.170316	52.08520
2018-02-23 08:14:21	5.170304	52.08520
2018-02-23 08:13:17	5.170253	52.08519
2018-02-23 08:12:18	5.170216	52.08521
2018-02-23 08:10:57	5.170545	52.08503
2018-02-23 08:10:29	5.170417	52.08477
2018-02-23 08:09:16	5.169474	52.08611
2018-02-23 08:08:13	5.164519	52.08726
2018-02-23 08:07:12	5.160384	52.08687
2018-02-23 08:06:08	5.156182	52.08869
2018-02-23 08:05:07	5.153705	52.09132
2018-02-23 08:04:02	5.149904	52.09237
2018-02-23 08:03:00	5.145754	52.09208
2018-02-23 08:01:57	5.144957	52.09527
2018-02-23 08:00:54	5.140605	52.09573
2018-02-23 07:59:52	5.135603	52.09555
2018-02-23 07:58:49	5.130910	52.09543
2018-02-23 07:57:48	5.127493	52.09532
2018-02-23 07:56:45	5.125550	52.09649
2018-02-23 07:55:39	5.121906	52.09648
2018-02-23 07:54:36	5.117634	52.09642
2018-02-23 07:53:34	5.115756	52.09906
2018-02-23 07:52:02	5.111302	52.09772
2018-02-23 07:51:01	5.108787	52.09730
2018-02-23 07:49:59	5.108909	52.09726

Aims

- Propose a method for analyzing the GPS data
- Integrate the location and survey data
- Explain variability
- Understand how to use location data
  - Sufficient quality? -> Automatically record functional locations in the future

Functional Locations

- Home
- School / Work
- In Transit
- Everywhere
- Other

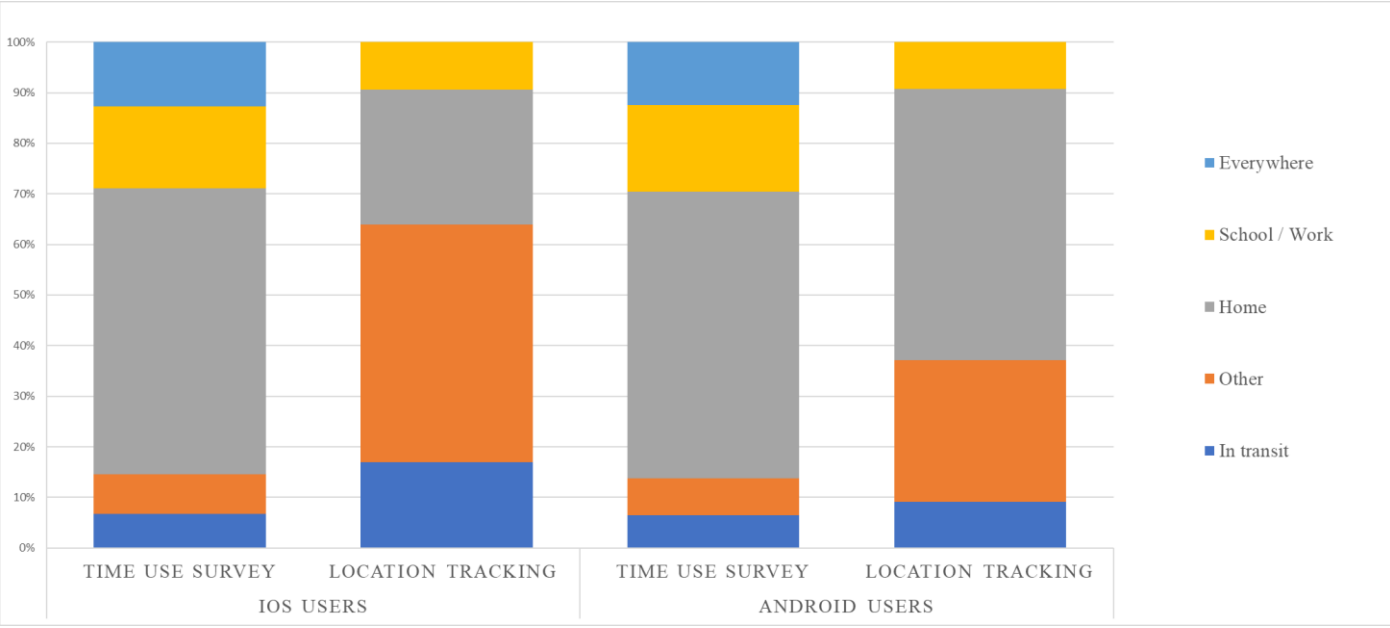
Do the two sources match?

- Overall distribution
- Timeslot level
- For what activities?
- Explore variability

Methodology

- Youth in Europe Study (YES!) panellists.
  - Around 19 years old
    - » Netherlands Institute for the Study of Crime and Law Enforcement [NSCR]
- Time Use Diary on Smartphones
  - GPS data
    - » Originally developed by CentERData and Netherlands Institude for Social Research [SCP].
    - » Sonck & Fernee. 2013.
- IOS (Iphone) versus Android users
  - Measurement Frequency

Overall Distribution



Timeslot level (Android)

		Based on Time Use Survey				
		In transit	Everywhere	Other	Home	Work
Based on GPS	In transit	**42.38**	10.23	15.73	3.76	10.17
	Other	33.08	33.37	**42.45**	22.04	35.46
	Home	20.05	49.40	34.71	**70.46**	22.39
	Work	4.49	7.00	7.11	3.75	**31.98**

Accuracy: 58.5%

Timeslot level (iOS Users)

		Based on Time Use Survey				
		In transit	Everywhere	Other	Home	Work
Based on GPS	In transit	**23.74**	19.89	22.93	12.79	24.07
	Other	53.91	52.44	**50.20**	46.03	41.23
	Home	11.20	18.26	16.60	**35.56**	13.40
	Work	11.16	9.41	10.27	5.61	**21.30**

Accuracy: 33.3%

Potential Problems *(and tested solutions)*

- Coding errors in location data
  - *Code over days*
- Coding errors in TUS data
- Data sources out of sync
  - *Allow small temporal inconsistencies*
- Not enough information in isolation
  - *Use information from TUS*

Time Use Categories

- No large differences within category
- iOS < Android
  - Sleeping: 41.3% vs 74.2%
  - Watching TV 19.6% vs 59.3%

Explore variability

Multilevel model, Android & iOS separately

MATCH <- Time of day + Weekend + times filled out

ICC: 0.121

Explore variability

Multilevel model, Complete sample

MATCH <- Android + Time of day + Weekend + times filled out

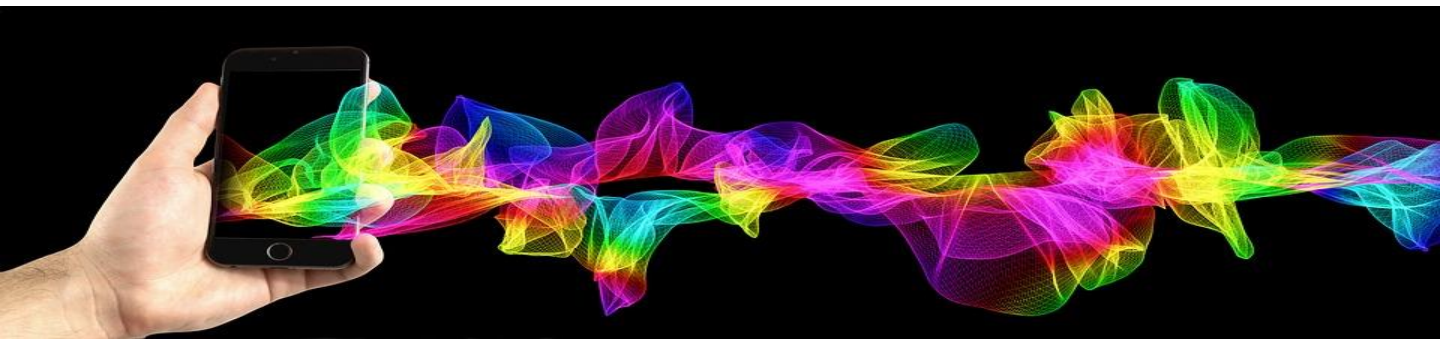
ICC: 0.142

Conclusions

- Many positioning errors.
- Differences in matching success are largely intrapersonal.
- Measurement frequency intertwined with phone type.

Next step

- Combine sensor and survey data!
- Experiment
- Positioning errors: Use better filter



Thank you!

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