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The Heterogeneity of Perceived Public Transport Reliability

ITEA Conference 2025, Evanston
June 27, 2025

1 Introduction & Motivation

- Joint work: Dr. Heike Link (DIW Berlin)
- Extensive dataset (survey & tracking) on travel behaviour, including experiences of delays, cancellations, replacement service, and shuttle service on public transport (PT) trips
- Descriptive analysis showed significant heterogeneity in (stated) experienced delays & cancellations
  - Partly explainable (e.g., longer trips, trips in rush hour)
  - Partly difficult to explain (e.g., gender, availability of alternative transport modes)

- **Do people of different groups perceive PT delays in different ways?**

2 Literature Overview

- Established literature on travel time perception (Clark, 1982)
  - PT travel times are consistently perceived as higher than they actually are (Peer et al., 2014)
  - Distorted mode choice due to biased travel time assessment (van Exel & Rietveld, 2010)
  - Perception differs between socio-economic groups (Meng et al., 2018)

- Travel time variability influences mode choice
  - Unreliable/fluctuating PT travel times lower commuting satisfaction (Cantwell et al., 2009)
  - Trade-off between absolute travel time and travel time reliability depends on the context (Soza-Parra et al., 2021; Ehreke et al., 2019)

- But: no existing research on perception of PT travel time variation/delays/irregularities (?)

3 Data & Approach

- Panel: nationwide, representative (>15 years), app-based, N=5000, 04-12/2023
- Survey data: 3 waves (June, September, December 2023)
  - Socio-demographics, mobility behavior, season ticket ownership, PT Experiences
  - **2547 reported last PT trips (Time, Duration, Mode, Purpose, Irregularities)**
- GPS tracking data: April-December 2023
  - Start & end time & location, mode, purpose of 4 million trips

- Idea: Find „last PT trips“ from surveys in GPS tracking data
  - Comparison between survey and tracking-> Identification of biases
  - Combination with Google Maps information -> Optimal travel times

- Matched dataset: 674 „last PT trips“ found, **567 used**

3 Data: Duration & Delay Measures

- **Multiple measures of travel times and delays:**
  - Stated travel time (Survey)
  - Stated delay (Survey)

  } Stated optimal travel time

  - Measured travel time (Tracking) -> Similar to stated travel time by definition
  - Calculated optimal travel time (Google Maps) -> Similar to stated optimal travel time?
  - Calculated delay: „real“ travel time (tracking) – calculated optimal travel time

- **Idea: Difference between stated delay and calculated delay = Delay Perception Bias (DPB)**
  - 2000 stated last trips (no LDPT): 22.1% with delay
  - 567 matched last trips: 16.4% with stated delay, 25.4% with calculated delay >10mins

4 Survey Data Findings: Delay Perception

Heckman model: Who experiences delays and how much?

- Explanatory: $D_{WE}, Time, Dur, UsedModes, Purpose, AvailModes, Status, Male, Age, HHSize, HHInc, Regtype$
- **Probit:** $P(D_D = 1|X) = f(Explanatory, NumModes)$ | **Linear:** $D = f(Explanatory, IMR)$

Trip characteristics results:

	Selection	Outcome
DayWE	-0.17	-6.10
Time.09-12	0.05	-3.13
Time.12-15	0.09	0.81
Time.15-19	-0.19	-4.42
Time.19-23	-0.00	5.17
Time.23-05	-0.42	-9.55
Time.NA	-0.18	-1.86
Duration	**0.01 *****	**0.31 ****

	Selection	Outcome
Mode_LocPT	-0.05	-0.06
Mode_RegTr	**0.33 *****	**12.07 ***
Mode_SBahn	0.11	2.27
Purpose_WorkEdu	**0.32 *****	2.38
Purpose_ShopErrand	-0.01	0.81
Purpose_Accomp	0.06	2.40
Purpose_FreeHoliday	-0.08	-2.25
NumModes	0.06	-

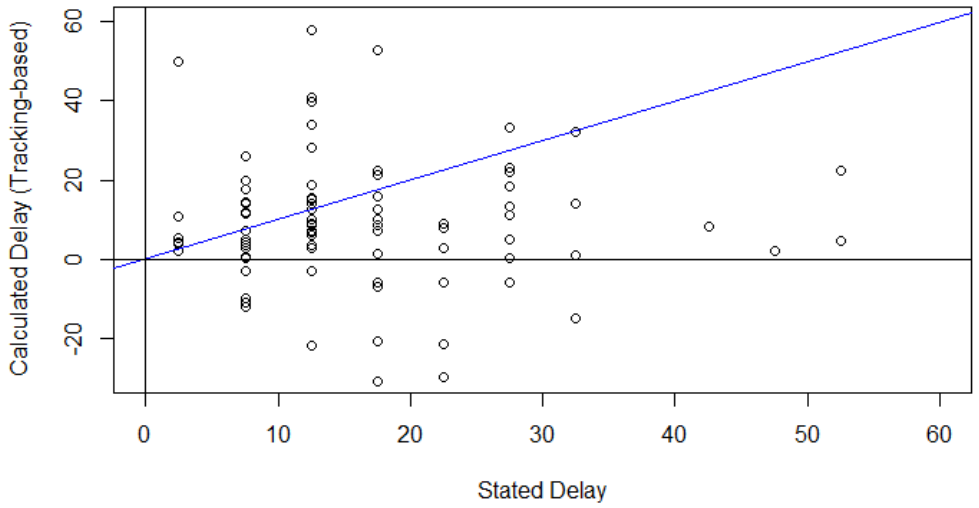
4 Survey Data Findings: Delay Perception

Personal characteristics results:

	Selection	Outcome
AvailBike	0.11	-1.05
AvailCar.None	-	-
AvailCar.Passenger	0.09	-3.00
AvailCar.Driver	-0.02	-3.87
AvailCar.Company	0.05	-3.50
Status.Working	-	-
Status.NotWorking	0.02	0.90
Status.Education	0.07	1.35
Status.Retired	-0.11	-2.96
Male	-0.26 ***	-1.63
Age	**-0.01 ****	-0.09
HHSize	-0.01	0.90

	Selection	Outcome
HHInc.<1000	-	-
HHInc.1000-2000	-0.17	-9.75 **
HHInc.2000-3000	-0.14	-4.55
HHInc.3000-4000	-0.00	-3.68
HHInc.>4000	0.12	0.71
HHInc.NA	-0.09	-3.58
Regtype.M	-	-
Regtype.R	-0.03	-2.08
Regtype.U	0.20 *	5.42
IMR	-	25.15
N	1606	344
(Pseudo-)R2	0.18	0.68

5 Tracking Data Findings: Delay Perception Bias



- 25% of stated optimal travel times & 20% of measured travel times faster than Google Maps (-> „negative delay“)
- Correlation between stated and calculated delay: 0.20

Heckman model: Does stated delay differ from calculated delay and how much?

- Explanatory: $Purpose$, $AvailModes$, $Status$, $Male$, Age, $HHSize$, $HHInc$, $Regtype$, $PTShare$
- **Probit:** $P(D_{DPB} = 1|X) = f(Explanatory, NumModes)$ | **Linear:** $DPB = f(Explanatory, IMR)$
- $D_{DPB} = 1$ if DPB is more than 5 minutes or 10% of calculated delay
- *DPB* measured as % deviation of stated delay from calculated delay

5 Tracking Data Findings: Delay Perception Bias

	Selection	Outcome
Purpose_WorkEdu	-0.24	0.42
Purpose_ShopErrand	-0.18	1.47 **
Purpose_Accomp	0.35	0.61
Purpose_FreeHol	-0.25	-0.05
AvailBike	0.21	-0.29
AvailCar.None	-	-
AvailCar.Passenger	**0.11**	**0.63**
AvailCar.Driver	**-0.02**	**1.45**
AvailCar.Company	**-0.12**	**1.20**
Status.Working	-	-
Status.NotWorking	0.22	0.06
Status.Education	0.03	2.10
Status.Retired	-0.04	-1.03
Male	0.21	**-1.66 ** **
Age	0.00	0.01

	Selection	Outcome
HHSize	-0.08	0.31
HHInc.<1000	-	-
HHInc.1000-2000	0.24	**-3.63 ** **
HHInc.2000-3000	0.52	**-4.47 ** **
HHInc.3000-4000	0.39	**-4.28 ** **
HHInc.>4000	0.66	**-5.26 ** **
HHInc.NA	0.67	-6.09 **
Regtype.M	-	-
Regtype.R	-0.01	-1.17
Regtype.U	-0.05	-1.00
PTShare	0.14	1.12
NumModes	**0.16 ** **	-
IMR	-	-4.17
N	322	223
(Pseudo-)R2	0.07	0.17

6 Next Steps & Further Work

- Wrap up conclusions on survey model
- No conclusions on bias model yet

- Further work on matching algorithm & measure calculation (focus on cases with delay)
- Revisit Google Maps travel times -> How are people consistently faster than Google?
- Disentangle actual PT delay and deviation from Google Maps travel times

- **A lot to do!** Work in progress, to be continued

Thank you for your attention!

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