Does conducting activities while traveling reduce the Value of Time?

Evidence from a within-subjects designed choice experiment

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Introduction

background

- hypothesis
    - conducting activities while traveling reduces the Value of Time (VoT)

- limited empirical evidence
    - Ettema and Verschuren, 2007
    - Malokin et al., 2017
    - Kouwenhoven and de Jong, 2018
    - Varghese and Jana, 2018

measurement problem

- unexpected findings:
  - those who work while traveling or bring an ICT device have a higher VoT
- explanation: self-selection
  - those most time-pressured come equipped
- thus: comparing between individuals is problematic
  - a within-subjects design is required

within-subjects design

- observe choices of same persons in two contexts (Wardman and Lyons, 2016):
    1. able to conduct preferred activity
    2. not able to conduct preferred activity

- $VoT_{non\ activity}$ - $VoT_{activity}$ = VoA (Value of Activity)

- avoid confoundment with unpleasant travel conditions
    - ‘you forgot to bring equipment’

objectives

1. test the proposed within-subject design approach

2. add to evidence for hypothesis that conducting activities while traveling reduces the VoT

3. provide VoA estimates:
    - for policy making: appraising investments that aim to reduce the disutility of travel
    - e.g. Internet, electricity, silence wagons

Experiment & data

reference trip

- trip purpose of most often made train trip
    - focus: commuters and leisure travelers
- preferred activity (spend most time on)
    - working/studying / reading / listening to music
- required equipment

stated choice experiment

- observe time & cost tradeoffs for reference trip
    - for both activity & non-activity context

- 3 time duration classes:
    1. short: 10, 20, 30 minutes, €3, €4.5, €6
    2. middle: 35, 50, 65 minutes, €6, €8, €10
    3. long: 80, 100, 120 minutes, €8, €12, €16

- D-efficient designs, priors from pilot

measurement

- two sets of six choices:
    - to avoid memory effects:
        - different time classes per context
        - randomized
    - randomized order for (non-)activity context

non-activity context choice task

My personal profile

Purpose of my trip: Commute
Preferred activity: Reading
Requirements: Book/paper/something to read

Make a choice between the travel options below

Your travel time amounts:	20 minutes	30 minutes
Your travel costs amounts:	€ 6.00	€ 4.50
Possibility to read:	No, you forgot to bring your book/paper/something to read	No, you forgot to bring your book/paper/something to read
	☐	☐

sample

- 6000 invited from Netherlands Railways (NS) panel
    - 1580 responses

- of which 820:
    (1) commuters or leisure travelers
    (2) conduct any of the 3 selected activities
    (3) bring equipment

Model

Value of Time (VoT) space

$$V_i = \beta_T \bullet T_i + \beta_C \bullet C_i \qquad \text{(T=time, C=Costs)}$$

$$VoT = \frac{\beta_T}{\beta_C} \Rightarrow \beta_T = \beta_C \bullet VoT$$

$$V_i = \beta_C \bullet \beta_{VoT} \bullet T_i + \beta_C \bullet C_i$$

Value of Activity (VoA)

$$\text{VoA} = \beta_{VoT_{NAC}} - \beta_{VoT_{AC}} = \Delta\beta_{VoT}$$

$$\beta_{VoT_{AC}} + \Delta\beta_{VoT} = \beta_{VoT_{NAC}}$$

$$V_i = \beta_C \bullet C_i + \beta_C \bullet \beta_{VoT_{AC}} \bullet T_i + \beta_C \bullet \Delta\beta_{VoT} \bullet T_i \bullet NAC$$

estimated from pooled data of both conditions

NAC: 1= Non Activity Condition; 0=Activity condition

Results

MNL model per group

	Commuters					
	Working/studying		Reading		Listening to music	
	Est.	*t-value*	*Est.*	*t-value*	*Est.*	*t-value*
VoT_{AC} #	12.42	13.59	11.22	19.04	10.26	10.56
VoA	6.36	4.37	4.98	5.60	3.63	2.25
VoT_{NAC}	18.78		16.20		13.89	
β_C	-0.263	-9.51	-0.305	-14.25	-0.333	-7.66
*% Reduction VoT**	-33.9%		-30.7%		-26.1%	

	Leisure travelers					
	Working/studying		Reading		Listening to music	
	Est.	*t-value*	*Est.*	*t-value*	*Est.*	*t-value*
VoT_{ac} #	6.54	8.99	3.77	10.53	5.74	7.49
VoA	1.16	1.05	3.39	7.31	0.69	0.66
VoT_{nac}	7.70		7.16		6.43	
β_C	-0.616	-6.12	-0.425	-20.91	-0.430	-7.57
% Reduction VoT	-15.1%		-47.1%		-10.7%	

$VoT_{AC} = \beta_{VoT_{AC}} \bullet 60$; $VoA = \Delta\beta_{VoT} \bullet 60$; $VoT_{NAC} = VoT_{AC} + VoA$

* Reduction VoT = VoA / VoT_{NAC} * 100%

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exploring relationships

- single pooled model
    - including the 6 groups
    - effects coding

- interactions of VoA, VoT and β_C with:
    - socio-demographics
    - trip characteristics
    - activity context order

findings

- socio-demographics
    - none for gender, age, income, education
    - impact only indirect via 6 distinguished groups
- trip characteristics
    - none for frequency, seat, transfer, part activity
    - significant effects for trip duration & who pays
- activity order: significant

activity order effect

within-person comparison

between person comparison

VoA=0.43

first context	second context	difference	
activity	**no-activity**		
VoT_{AC}	VoT_{NAC}	VoA	
9.22	13.06	3.84	loss
no-activity	**activity**		
VoT_{NAC}	VoT_{AC}	VoA	
9.65	7.10	2.54	gain

endowment effect

- first context = reference
- activity first → travelers ‘owns’ activity condition
    - taking away activity (= loss) has more impact
- cost parameter is not affected: adds to validity

Conclusions

conclusion within-subject approach

- proposed approach
    - observe choices for same persons…
    - … in both activity and non-activity context

- approach ‘works’
    - statistically significant & plausible results
    - within-subject comparison is important

conclusion VoT reduction

- evidence found for the hypothesis that conducting activities while traveling reduces VoT

- % reduction VoT
  - commuters: work 33.9; read 30.7; music 26.1
  - leisure work 15.1; read 47.1; music 10.7

- commuter results comparable to previous findings

conclusions VoA

- VoA estimates higher for commuters
  - commuters: work 6.36; read 4.98; music 3.63
  - leisure: work *1.16*; read 3.39; music *0.69*

- effects:
  - none for socio-demographics
  - lower for travelers who pay themselves
  - activity order - activity first (loss): VoA higher

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policy implications

- VoA allows appraisal of investments that improve conducting activities
    - Internet, silence wagons, electricity
    - speed train vs. reliable Internet in China
    - e.g. Tang et al. (2017)

- automated vehicles allow conducting activities
    - decrease VoT expected in future
    - reduced benefits in infrastructure appraisal

Related work in our group

- PhD. Thesis work of Baiba Pudane who focuses on time use in automated vehicles

- Pudāne, B., Molin E., Arentze, T., Maknoon, Y., Chorus, C. (2018), A Time-use model for the automated vehicle area, Transportation Research, part C, 93, 102-114.

- Pudāne, B., Rataj, M., Molin E., Mouter, N., Cranenburgh, S., Chorus, C., Activity travel behavior in the automated vehicle area: Results from a focus group study, *under review Transportation Research, part D.*

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Thank you for your attention