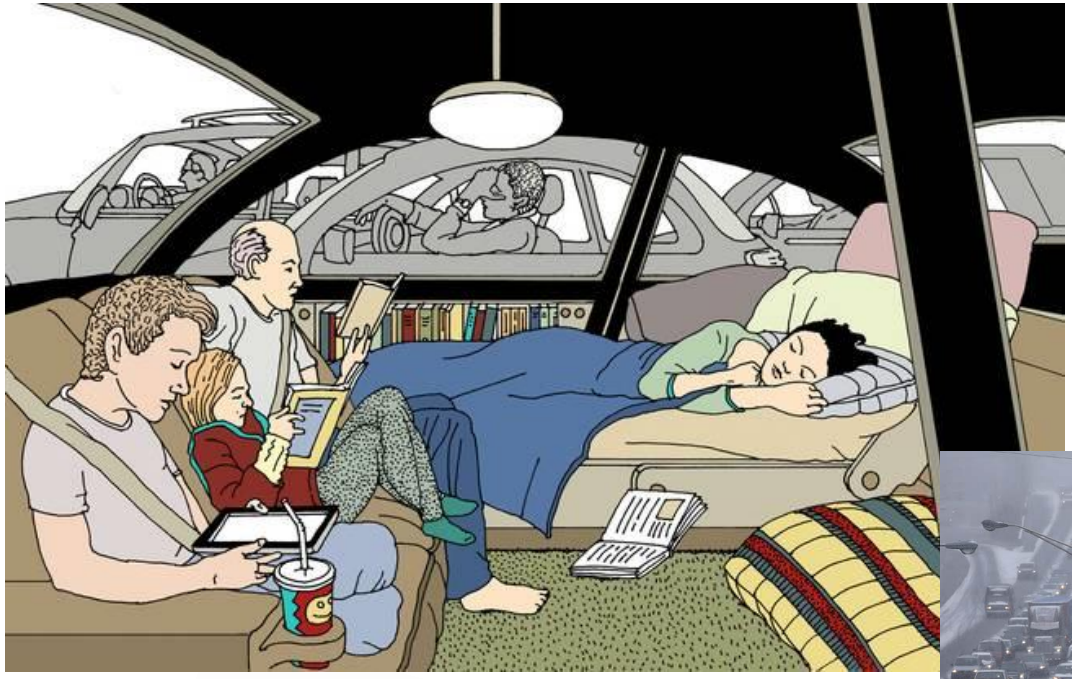
Behavioural Response to Automated Vehicles:

A Simple Formal Model

Baiba Pudāne

Caspar Chorus
Sander van Cranenburgh
Eric Molin
Theo Arentze
Yousef Maknoon

Automated vehicles …



https://www.treehugger.com/cars/why-should-self-driving-cars-look-cars.html

inside

outside?

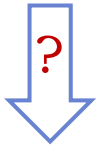
https://www.youtube.com/watch?v=kronjVz-lrc
(Atlanta, US)

Need a formal model…

to predict the travel behaviour
of future automated vehicle users.

Current approaches

Automated vehicles



Reduction in
Travel Time Penalty
(or Value of Travel Time)

Simulate & results
(more travel)

From an individual perspective

Wish-list:

1: Activity

2: Activity

From an individual perspective

Wish-list:

1:

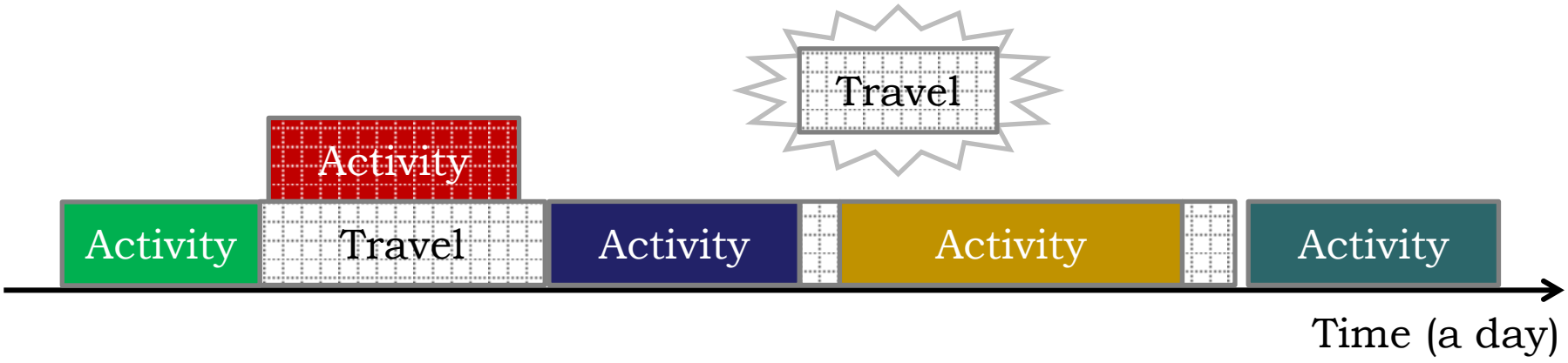
2: 

From an individual perspective

Wish-list:

1: Activity

2:



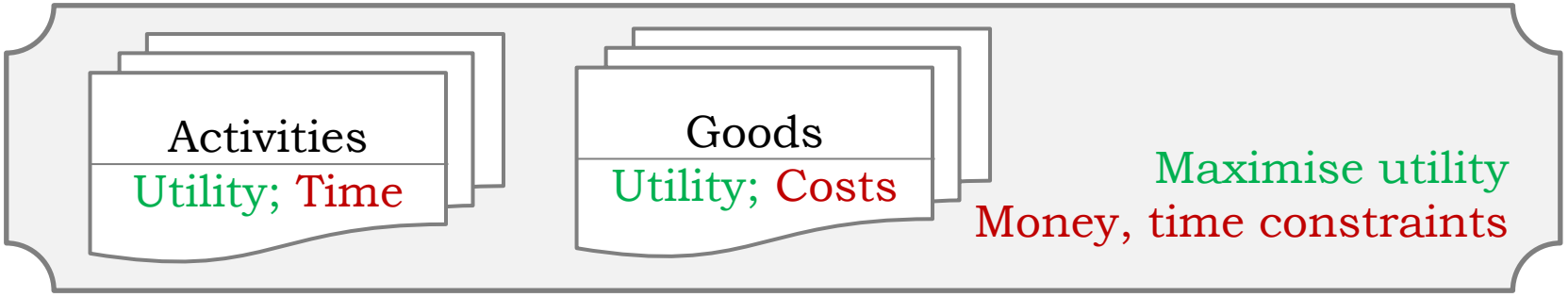
What did we see?

1. 'Transferred' activities to the automated vehicle
2. Freed time for new (or longer) activities
3. New schedule with sometimes more, sometimes less travel

Need to adopt an activity-based, instead of trip-based, perspective.

Activity-based perspective

Time-use theory:



Becker, Gary (1965): A Theory of the Allocation of Time. In The Economic Journal 75 (299), pp. 493–517.

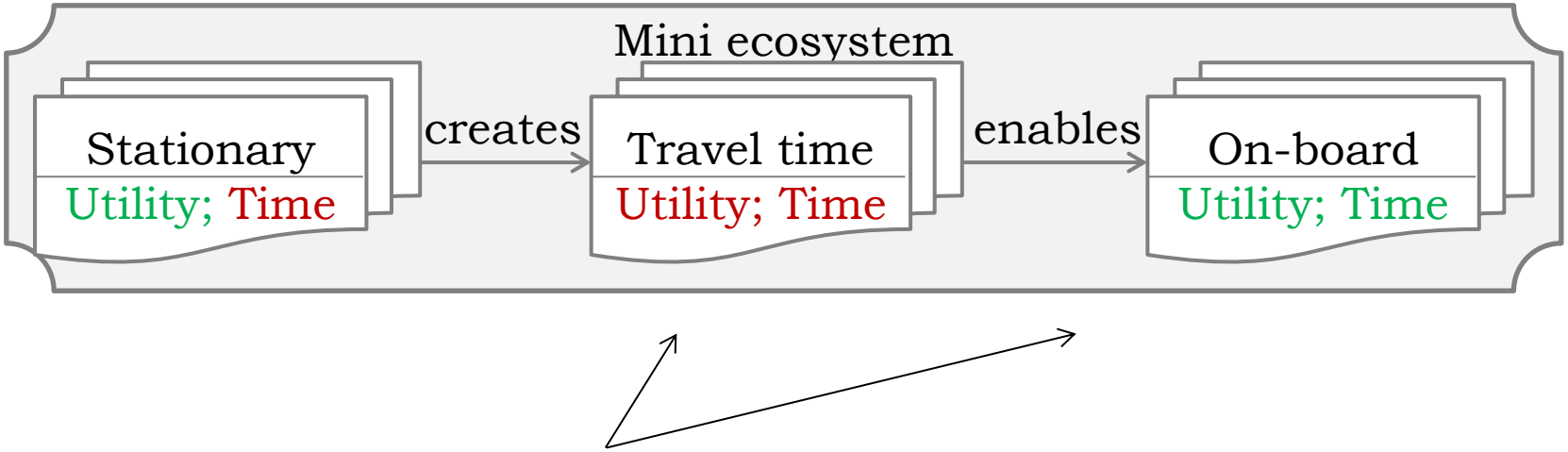
DeSerpa, Allan (1971): A theory of the economics of time. In The Economic Journal 81 (324), 828–846.

Evans, Alan W. (1972): On the theory of the valuation and allocation of time. In Scottish Journal of Political Economy 19 (1), 1–17.

Our contribution

Modified time-use theory:

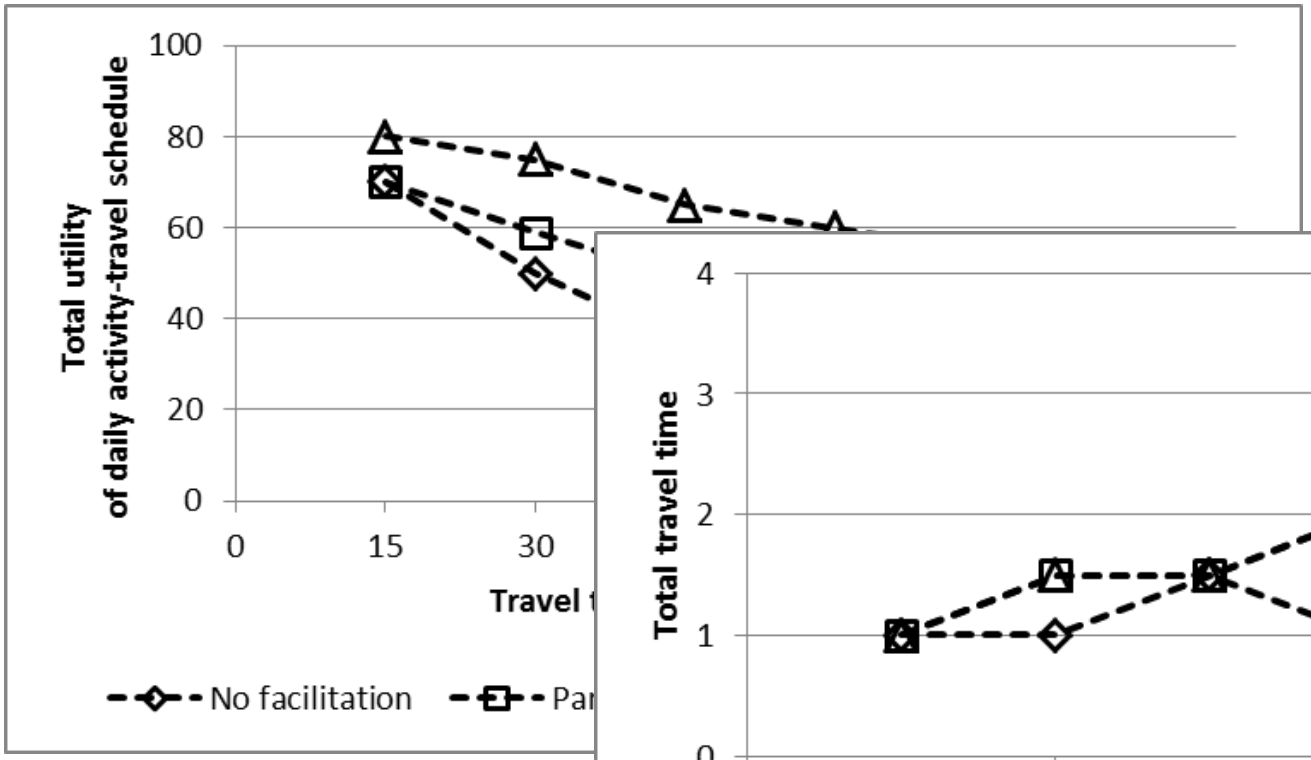
Consider activity locations: stationary vs on board

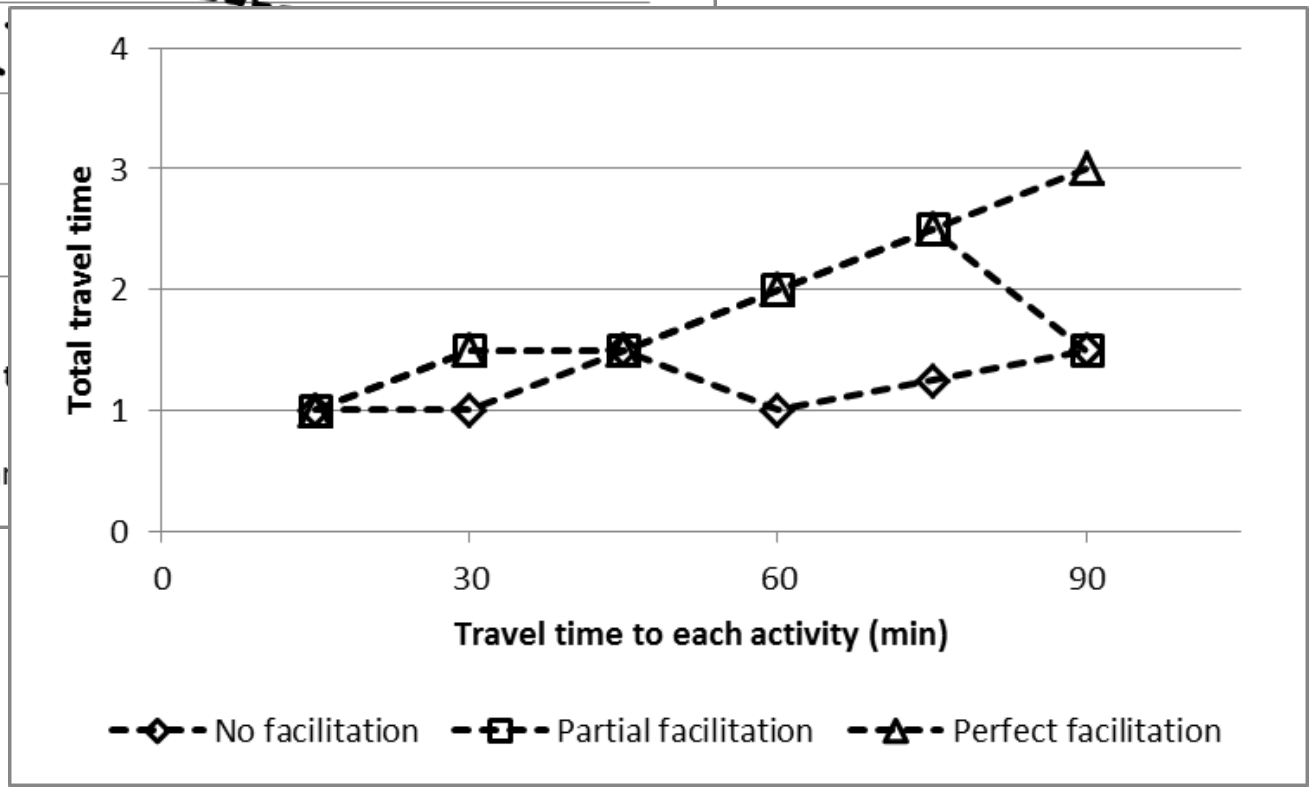


The formal model

$max \sum_{i \in I} \left(y_i^l U_i^l + \sum_{m \in M} (z_i^m V_i^m + y_i^m U_i^m) \right),$		Maximise utility of on-board, stationary activities and travel
$\sum_{i \in I} \left(y_i^l T_i^l + \sum_{m \in M} z_i^m H_i^m \right) \leq T,$		Limit total time of stationary activites and travel to T
$\sum_{i \in I} y_i^m T_i^m \leq \sum_{i \in I} z_i^m H_i^m$	$\forall m \in M,$	Limit time spent in on-board activities to the travel time
$y_i^l + \sum_{m \in M} y_i^m = x_i$	$\forall i \in I,$	Each selected activity is completed (possibly in different locations)
$y_i^l \leq r_i$	$\forall i \in I,$	Each travel is completed (possibly in different modes)
$r_i \leq G y_i^l$	$\forall i \in I,$	
$\sum_{m \in M} z_i^m = r_i$	$\forall i \in I,$	

Simulate various scenarios





Current work

1. Focus groups on ‘impact of automated vehicles on daily activities’ – validate the model and generate new insights
2. Deterministic formal model → stochastic model and a compatible data collection instrument

TRAIL

Spatial and Transport Impacts of Automated Driving

Thank you!