

Lessons from the Norwegian Value of Time Study

EXTERNAL COSTS OF TRANSPORT: valuation of travel time and traffic noise

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Appraisal is central for transport policy: the importance of travel time savings (VTT)

- **For forecasting of demand:** VTT is the most important parameter that derives demand
- **For appraisal of transport policies:** VTT are often the main benefit of transport projects

Important issues:

- **Factors that contribute to VTT**
 - Observed and unobserved heterogeneity of travellers
 - Belief and values of the users (important for policies that aims at change in behaviour)
 - Perception of comfort & convenience of a mode
- **travel time has many components** (access/egress time, transfer time, etc)
- **Travel time variability**

Outline of presentation

- The Norwegian VTT study: a brief presentation
- Lessons from the Norwegian study
 - Design of the study
 - Extensions from utility maximisation paradigm to behavioural economic, specially prospect theory for looking at VTT and Cumulative prospect theory for reliability
 - Design of the SP experiments
 - Econometrics
- Conclusion

The purpose of the Norwegian study:

1. For evaluations of **operation, maintenance** and **new investments** of different transport infrastructures
2. For **pricing and new financing forms**
3. To provide detailed **values for different socio-economic segments** and **travel purpose** and **distribution of value of time**
4. For the evaluation of **distributional impacts**, equity
5. For the understanding of the **change in value of time over time**
6. For the analysis of nature of the **WTP and WTA** and **small values of saving time.**
7. The **differences between modes with respect to comfort and safety.**

The scope of the study:

- **Long distance modes of travel: Car, Rail, Air, and Bus**
(longer than 100 kilometres one-way)
- **Short distance travel: Car, Public Transport** (shorter than 100 kilometres one-way):
- **Walk and Cycle as main modes of transport** (not as access or egress modes)
- **Ferry and High Speed Boat**



The long distance study focus:

- In vehicle VTT
- Value of travel time variability
- Congestion (for car only)
- General “comfort” differences between modes

The short distance study focus:

- In vehicle VTT
 - Value of travel time variability
 - Congestion (for car only)
 - Seat availability (public transport)
 - General “comfort” differences between modes
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The Ferry/ High Speed Boat study focus:

- In vehicle VTT
- Value of travel time variability

The Walk/Cycle study focus:

- Walk/Cycle VTT
 - Number of stops at intersections
 - Provision of Cycle Path
 - Provision of separate Walk Path
 - Level of maintenance of Walk and Cycle paths
 - Removal of ice and snow
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Segmentation:

Socio-economic variable: Income (personal and household, Gender , Age, Occupation, Education, Household type (size, age, etc)

Travel purpose: Work, service (shopping, delivering children, etc.) and recreation and other leisure travels. Business travel is not covered

Other variables: travel distance, geographic coverage, travel company size (for car occupancy)



Design of the study

1. Stated choice study
 2. Self administered internet survey
 3. Recruitment by email
 4. Supplement data with choice based recruitments when necessary
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3 pilot studies  changes in parameters of design

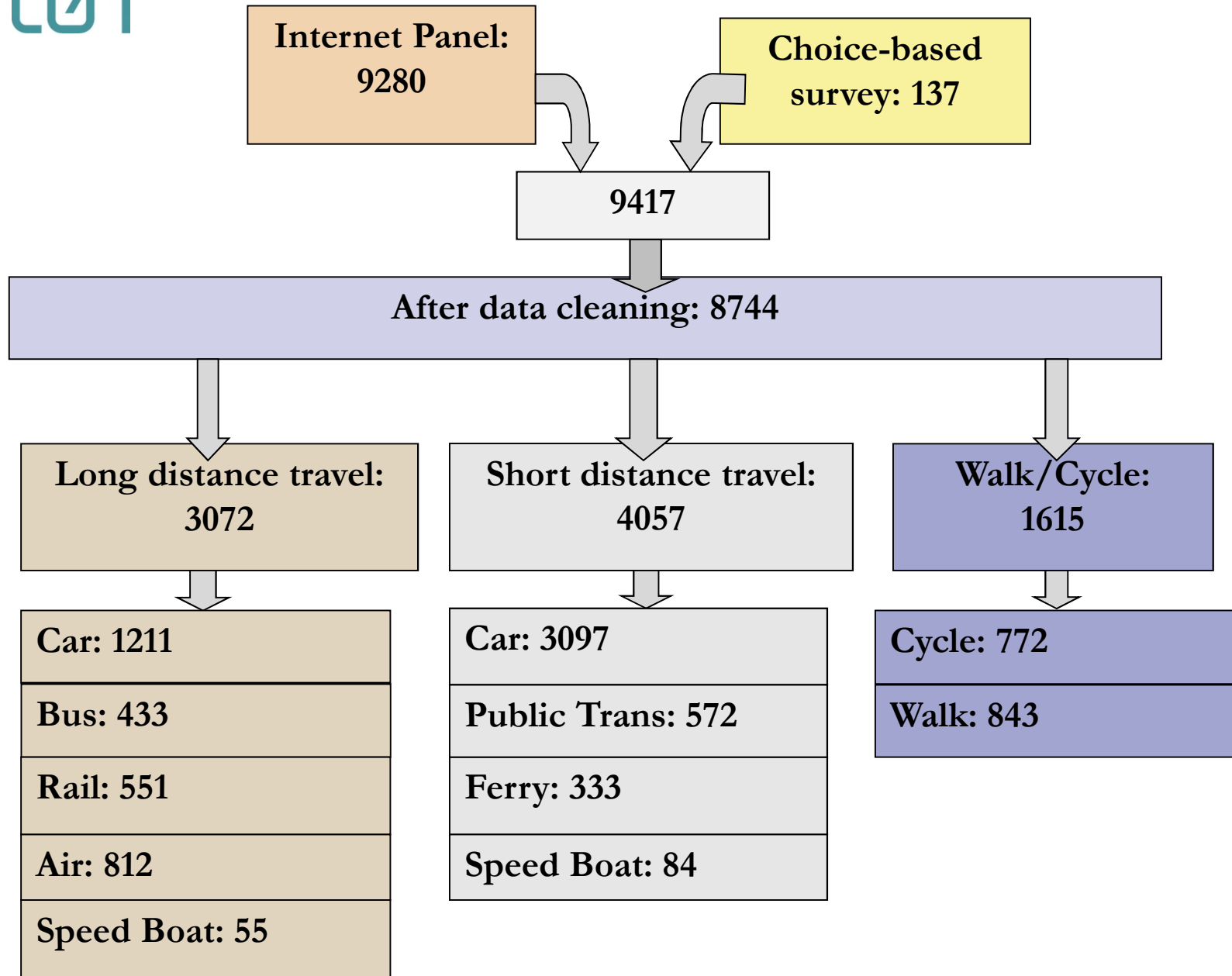
Main Study:

- Between 11 June-2 July 2009
- 2 reminders

47000 persons were contacted to participate.

9280 persons responded

Response rate among panel less than 20%



The structure of the questionnaire:

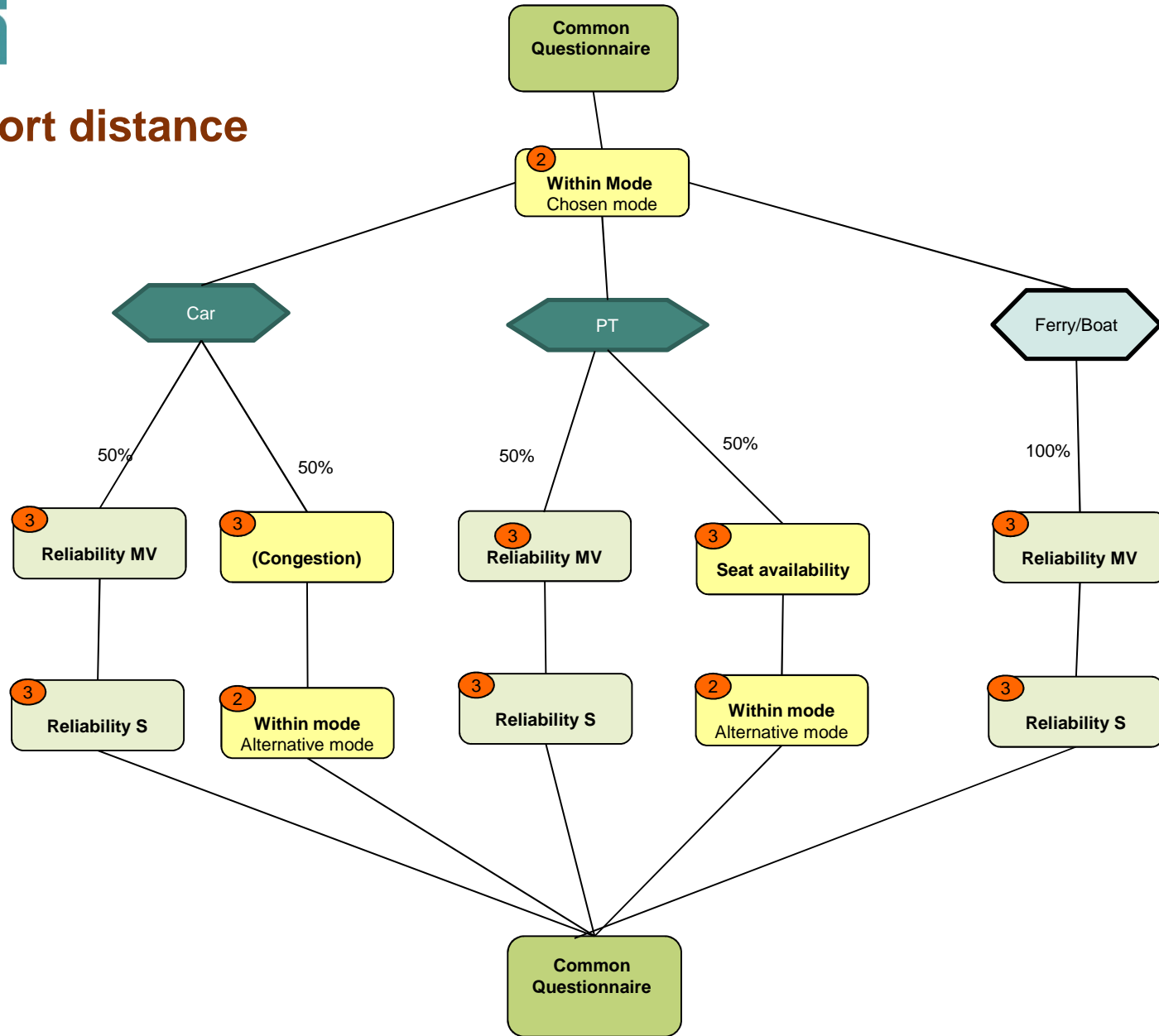
- Introductory questionnaire to collect **socio-economic** and **demographic data**
 - Questionnaire to collect data on the **reference trips** of the respondents
 - **Choice experiments** to collect data on the trade-offs that respondents make between different attributes
 - Final questionnaire to collect **further data** on respondents and **control questions**
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- The number of experiments were restricted to 3 per respondent
 - The number of attributes were restricted to 3 in each experiments
 - The number of choice sets were between 6 to 9 in the experiments
 - About 25 minutes to complete a questionnaire on the average

Short distance

CE1

CE2

CE3

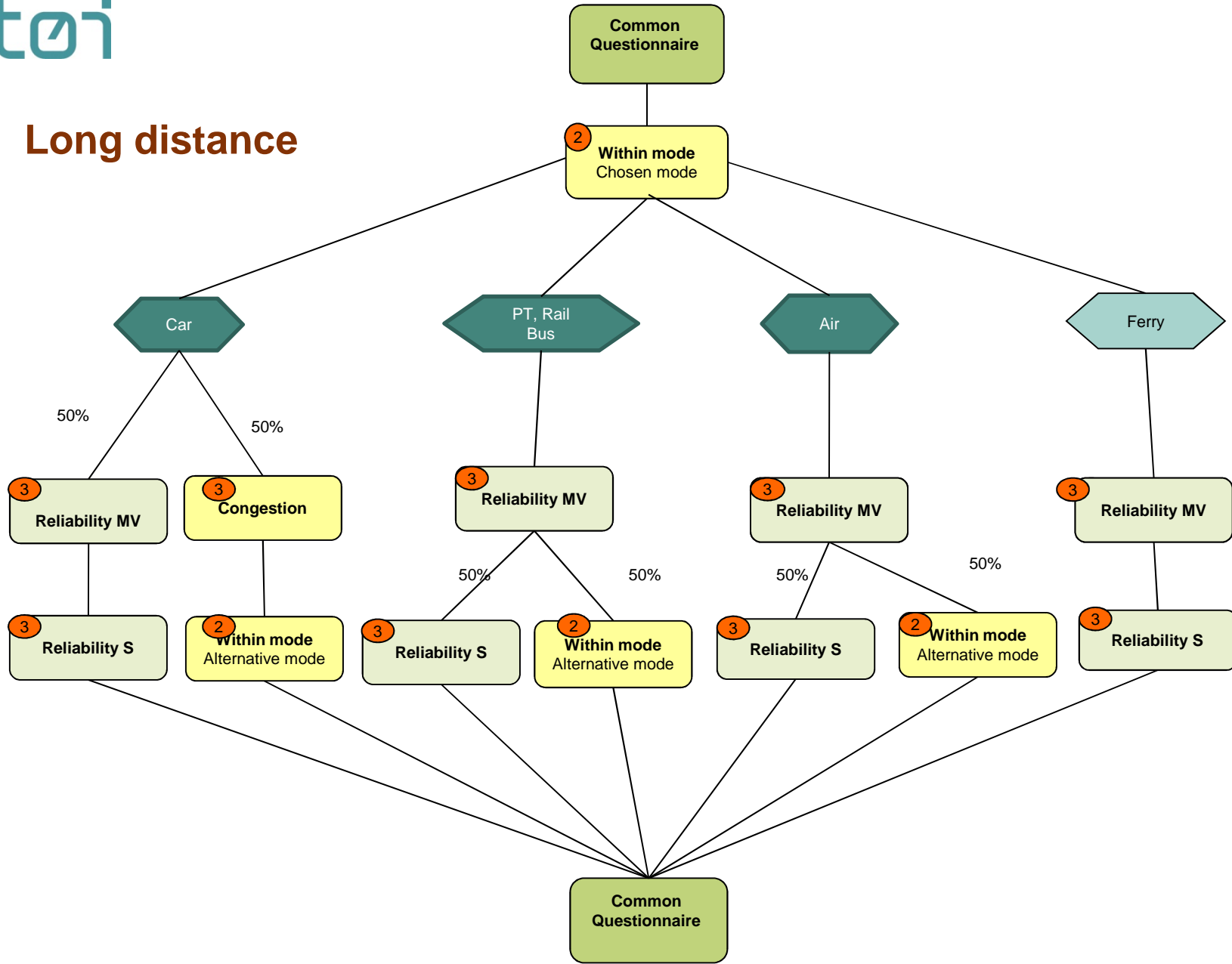


Long distance

CE1

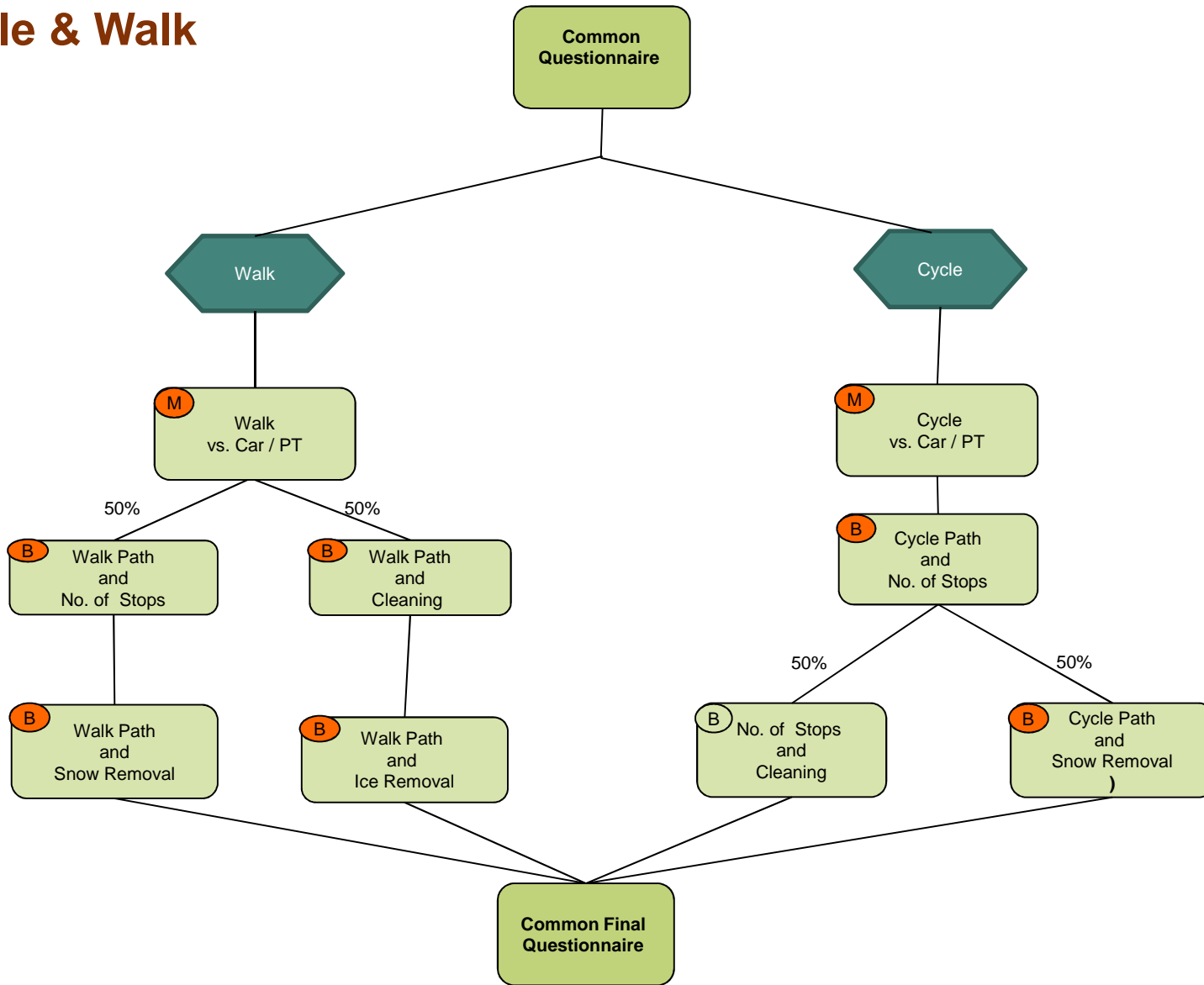
CE2

CE3



Cycle & Walk

CE1
CE2
CE3



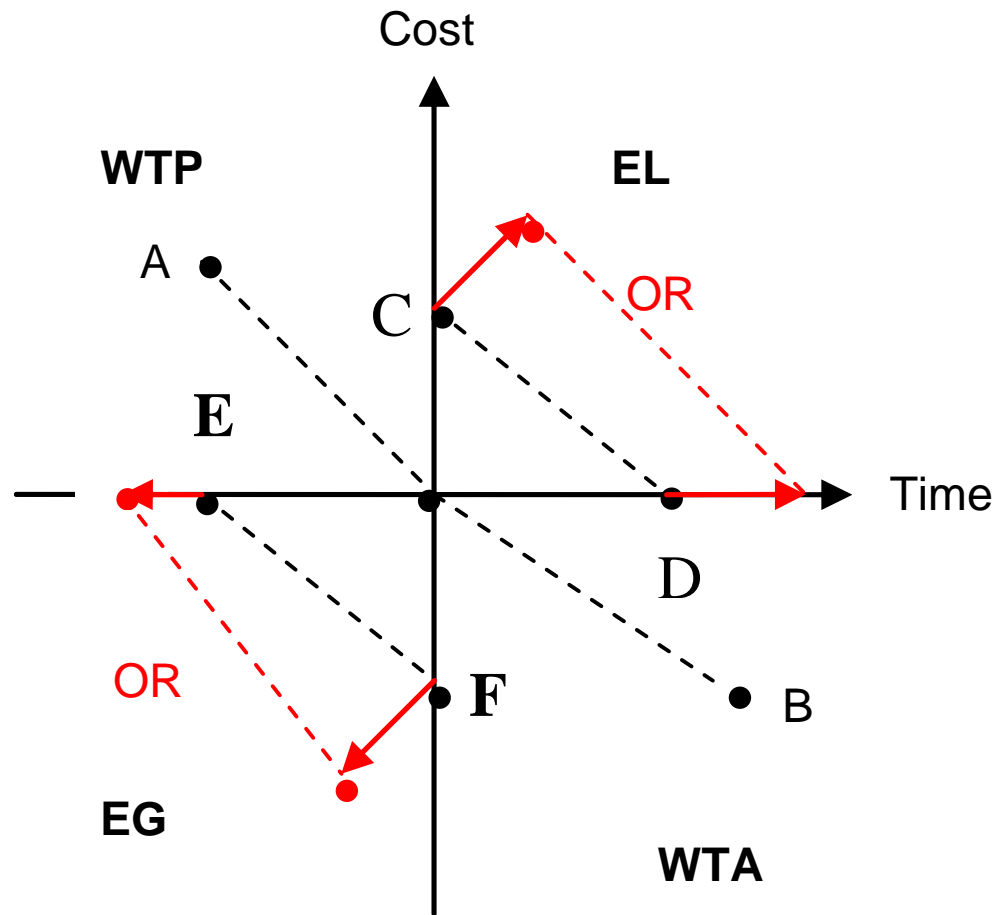
Choice Experiment CE1

Two attributes, time and cost and 9 choice sets.

Assume everything else is the same, which trip do you choose?

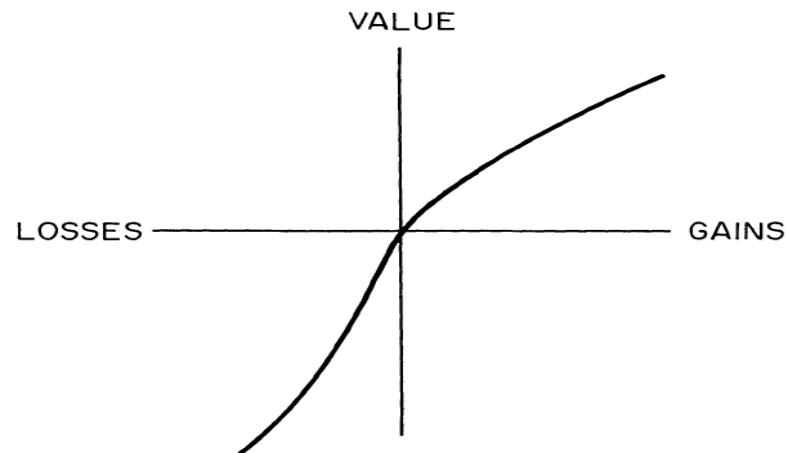
<u>Trip A</u>	<u>Trip B</u>
Travel time: 25 min.	Travel time: 30 min.
Cost: 27 NOK	Cost: 19 NOK
<input type="radio"/>	<input type="radio"/>

Four Types of Valuation



The design of CE1 allows

- direct estimation of the distribution of value of travel time
- to incorporate prospect theory
- to address the WTA and WTP gaps
- to address the value of small time savings



Travel time variability: two choice experiments

1. Mean-variance approach

$$U = \delta C + \alpha ET + \rho \sigma_T$$

2. Scheduling approach

$$U = \delta C + \alpha T + \beta SDE + \gamma SDL + \theta D_L$$

C is travel cost

ET is expected travel time

σ_T is the standard deviation of travel time

SDE & SDL are scheduled early or late arrival compared to preferred arrival time

D_L is a dummy for late arrival

$\alpha, \beta, \gamma, \delta$ and θ are parameters (marginal utility)



Choice set: mean variance approach

Consider the following two #transport_mode# trips.

Trip A

Cost: C NOK

Variations in travel time:

$$T - \Delta t_1$$

$$T - \Delta t_2$$

$$T$$

$$T - \Delta t_3$$

$$T - \Delta t_4$$

Trip B

Cost: $C - \Delta C$ NOK

Variations in travel time

$$T - \Delta t_5$$

$$T$$

$$T$$

$$T - \Delta t_6$$

$$T - \Delta t_7$$

Which one do you prefer?

Trip A

Trip B

Choice set: scheduling approach

Consider the following two #transport_mode# trips

Trip A:

Total travel time: T minutes

Arrival time: $[-\Delta X] \Delta X$ minutes **early**

Total Cost: C NOK

Trip B:

Total travel time: $T + \Delta T$ minutes

Arrival time: $[0]$ **On time**

Total Cost: $C - \Delta C$ NOK

Which one do you prefer?

Trip A

Trip B



Choice set: congestion and seat availability:

Consider the following two car trips

Trip A	Trip B
Total trip time: T min	Total trip time: $T + \Delta T$ min
Congested driving time: $X - \Delta X$ min	Congested driving time: X min
Total Cost: C NOK	Total Cost: $C - \Delta C$ NOK

Which one do you prefer?

Trip A Trip B

Consider the following two public transport trip

Trip A	Trip B
Total travel time: T minutes	Total travel time: $T + \Delta T$ minutes
Sitting available: $X - \Delta X$	Sitting available: X
Total Cost: C NOK	Total Cost: $C - \Delta C$ NOK

Given everything else the same, which one do you prefer?

Trip A Trip B

Walk and Cycle as main mode of transport

- Payment vehicle
- Mode choice between Walk/Cycle and Car/Public Transport

Choice set:

Consider two alternative trips Walk and by Public Transport	
Trip A: Walk Total time: T minutes Separate walk way	Trip B: Public Transport Total time: T minutes Total cost: C NOK
Which one do you prefer?	
<input type="checkbox"/> Trip A	<input type="checkbox"/> Trip B



Model choice model: (Trade-off between time and cost)

$$U_{ni_C/W} = ASC_n + \alpha T_{C/W_M} + \beta T_{C/W_P} + \varepsilon_{1ni}$$

$$U_{ni_Alt} = \delta T_{Alt} + \gamma C_{Alt} + \varepsilon_{2ni}$$

Where:

ASC is the alternative specific constant

T_{C/W_M} is the Cycle/Walk time in mixed traffic

T_{C/W_P} is the Cycle/Walk time on Cycle/Walk Path

T_{Alt} is the time with Alternative Mode

C_{Alt} is the cost with Alternative mode

ε is the error term

$\alpha, \beta, \delta, \gamma$ are the corresponding coefficients

n, i stand for respondent n and choice set i

Presentation of other attributes:

Given everything else the same, which alternative do you prefer?

Trip A	Trip B
Total walk time: T minutes	Total walk time: $T + \Delta T$ minutes
Time on separate walk path: x % of T	Time on separate walk path: y % of $T + \Delta T$
No. of stops at intersections: S	No. of stops at intersections: $S - \Delta S$

Trip A Trip B



Trade-off between time and other attributes



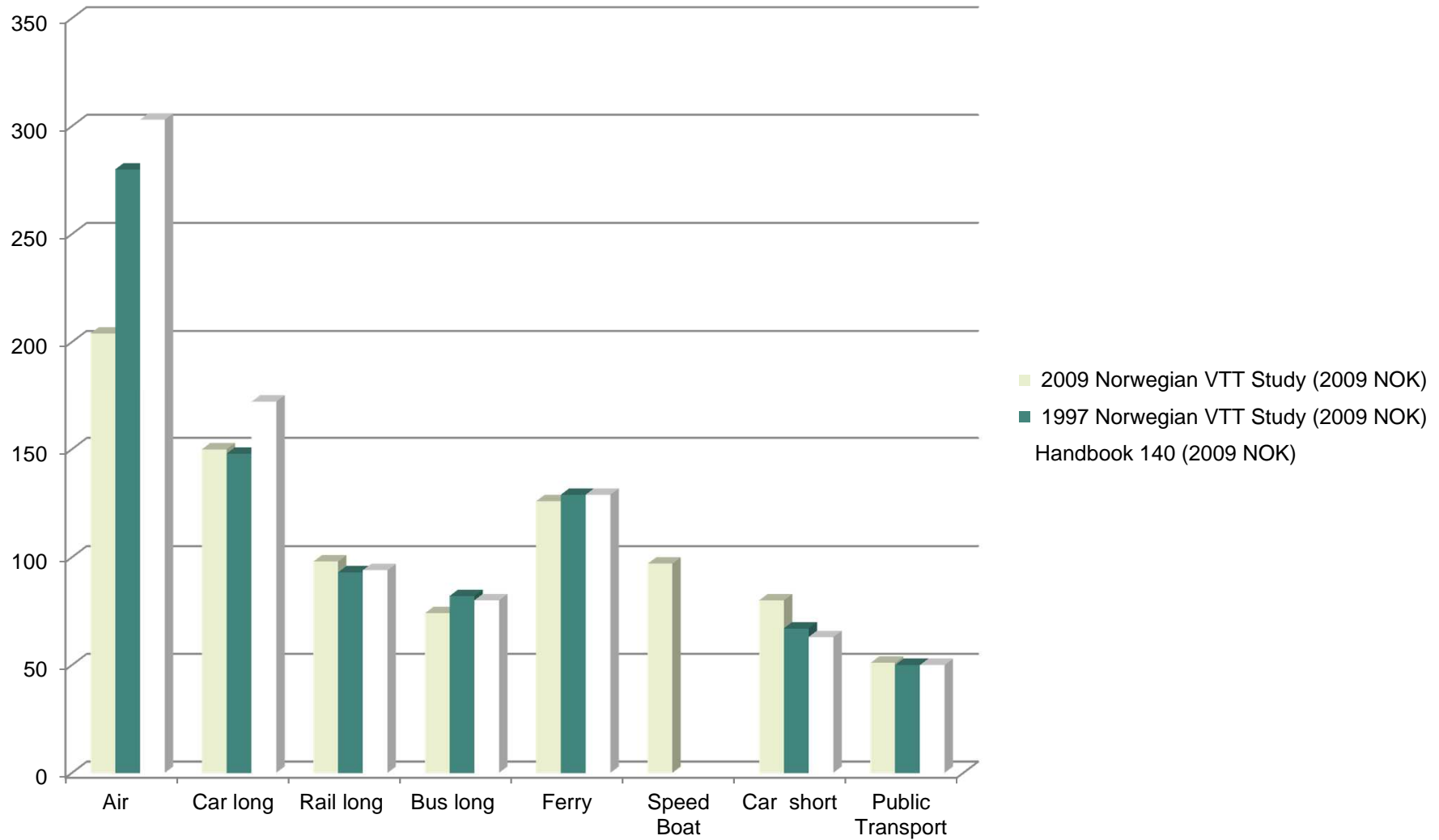
Monetary value of other attributes by using the trade-off between time and cost

The differences between VTT between modes

- **User type effect**
 - Users differ in observed (e.g. income) and unobserved (e.g. attitude) characteristics
 - People with higher VTT use faster transport modes
- **Mode effect**
 - VTT differs because comfort and other attributes of transport modes differ
- **Strategic response**

We can separate these effects by investigating two choice experiments, one for the chosen mode and another for alternative mode, jointly

Value of time over time



Lessons:

Presentations of attributes

Congestion, seat availability, etc.

Design of the experiments (optimal design!)

Role of income

Personal income, equivalent household income, relative income
theory of consumption

Value of time over time

Equity issues

Econometrics

Lessons:

Design of the study:

Internet survey (low response rate and representatively)

Behavioural Economics:

Extensions from utility maximisation paradigm to behavioural economic, specially prospect theory essential for looking at VTT & Cumulative prospect theory (CPT) for reliability and other factors associated with risk. CPT is a descriptive theory of decision making under risk

Data on belief and values (latent variables)

Some policies are now aiming at changing perceptions and behaviour or travelers

Conclusion

Nils Bruzelius was amazed by the continued interest in value of travel time in 1997. His PhD thesis on value of time was published in 1979.

The interest only has increased with better understanding of behaviour, improvements in data collection, and econometrics



Thank you for your attention