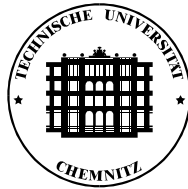


Torino, 12.11.2001



Evaluation of In-vehicle HMI using occlusion techniques: Experimental Results and Practical Implications



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J. F.

Funded by BMW AG Munich

Structure of the talk



- Summary of experimental results
 - » How valid is the occlusion technique?
 - » Costs and benefits

- Empirical constraints: on the road
- Nuggets and coals

What would be a valid method?



- A valid method for display-evaluation would separate HMI-designs with regard to
 - » Fast and exact apprehension of information
 - » Interruption and resumption of dialogues

What is the occlusion technique?



- Experimental control of viewing time and occlusion time
 - » Subject paced or fixed presentation times
 - Speed and accuracy of subjects task performance
- Two kinds of experiments so far:
 - » display complexity (visual search complexity)
 - » dialogue interruption (resuming after interruption)

The main question



- Is the occlusion technique a valid and reliable method for the evaluation of interfaces ?
- What about nuggets and coals?

Validation of the technique Research agenda



- **For a first step in validation, the technique**
 - » should distinguish displays of different complexity
 - » should give hints about dialogue interruption
- **Laboratory studies**
 - » better control of relevant variables
 - » cognitive oriented design of stimuli
 - » generalisation
- **Back on the road again...**

1. Occlusion technique and visual complexity

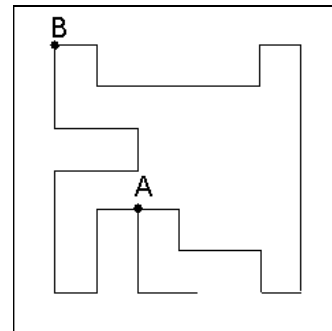
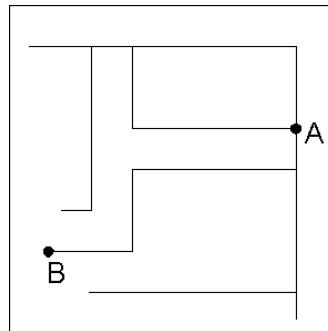


- **Display complexity**

- » visual search tasks of different complexity

- presentation times: from 200 ms to 1200 ms

- **Stimuli:**

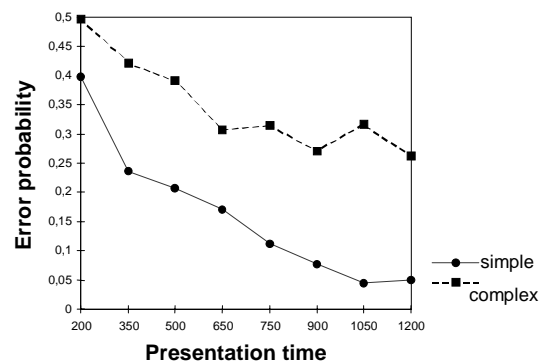


Results for fixed presentation times



- **IV: Stimulus complexity and presentation time**

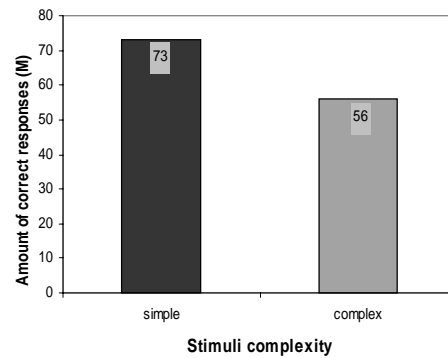
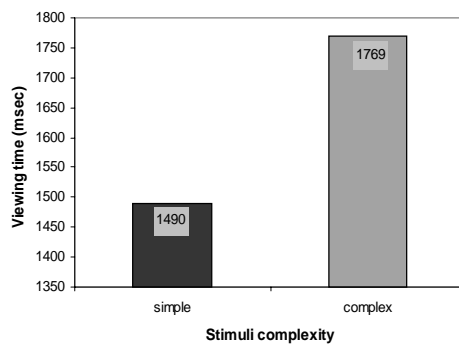
- **DV: Amount of errors**



Results for subject paced inspection times



- IV: Stimulus complexity
- DV: inspection time, amount of correct responses



Summary on visual complexity



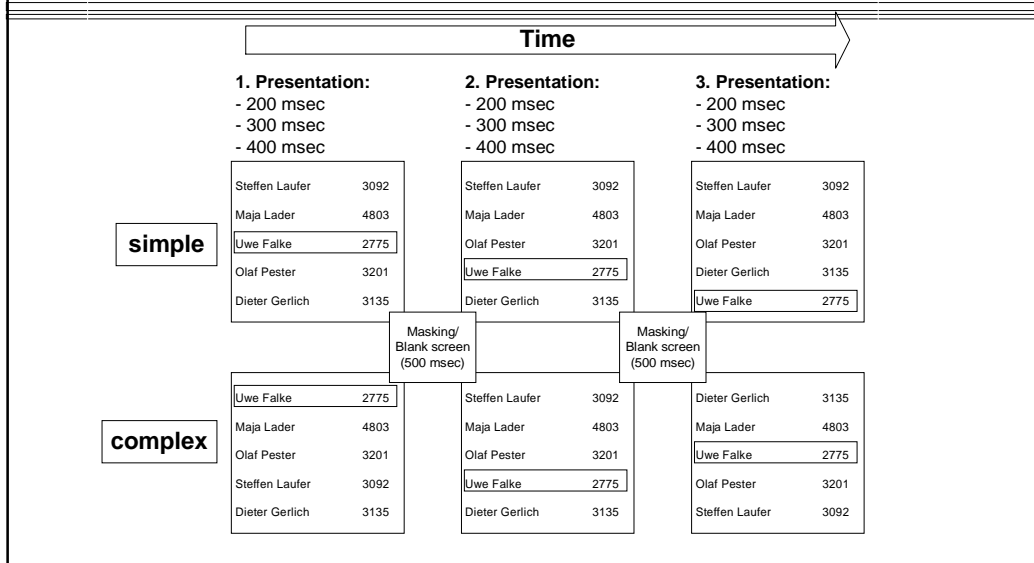
- **The occlusion technique separates displays of different visual complexity**
 - » with fixed presentation times
 - » with subject paced inspection times
- if the criterion used for display evaluation is fast and reliable interpretation of the presented information

2. Dialogue interruption and resumption

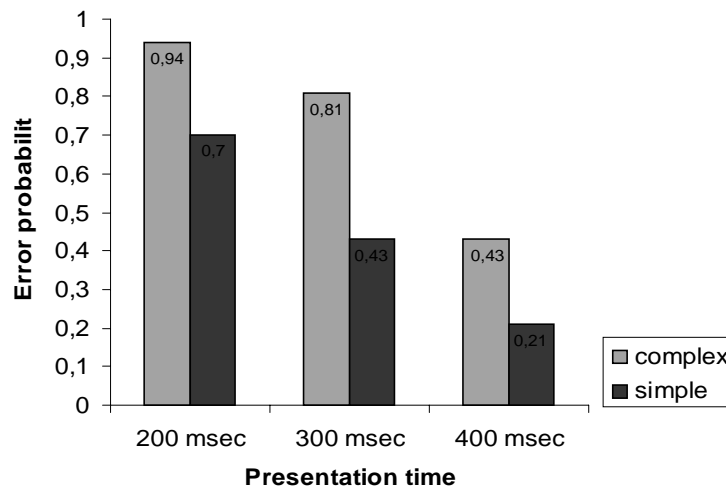


- Ease of dialogue resumption as a measure of ease of dialogue interruption
 - » Interruption and graphical stimulus coding
 - » Interruption and pattern matching with secondary task

2.1 Interruption and graphical stimulus coding



Results of interruption and graphical stimulus coding

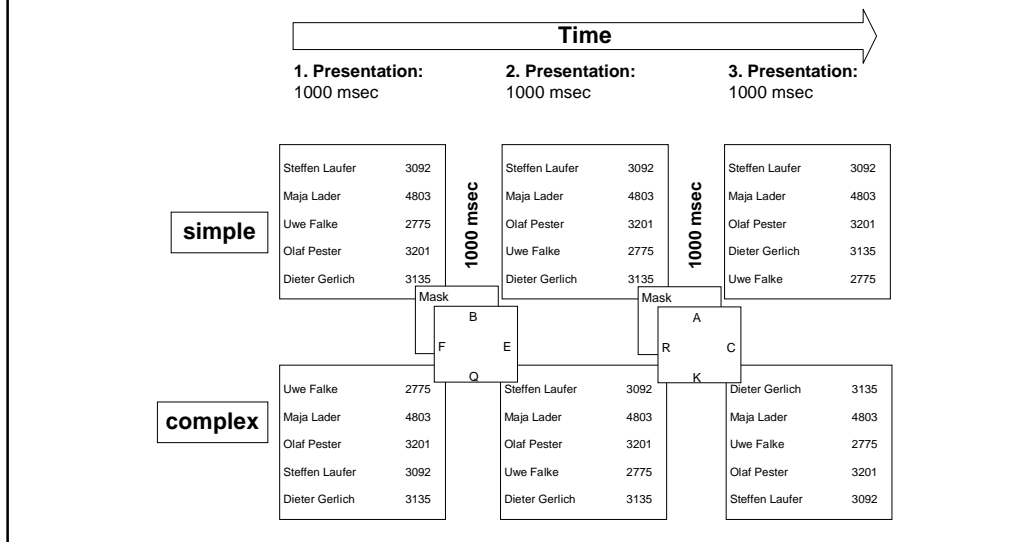


Summary of interruption and graphical stimulus coding

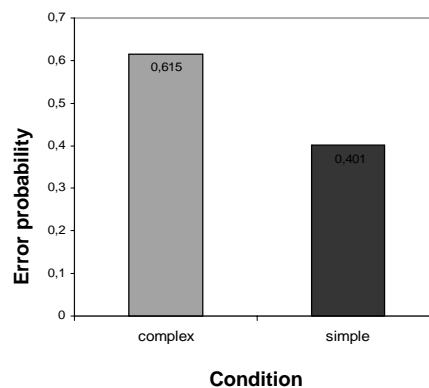
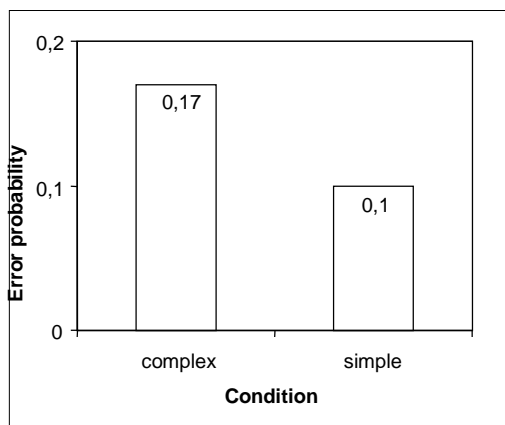


- The occlusion method separates
 - » between dialogues that ease resumption after interruption and those that do not
- Restriction
 - » no secondary task
 - » only graphical coding, no semantic coding
 - » information predictable/unpredictable as the only aspect that influences dialogue resumption

2.2 Interruption and pattern matching with secondary task



Results of pattern matching



Summary of pattern matching with secondary task

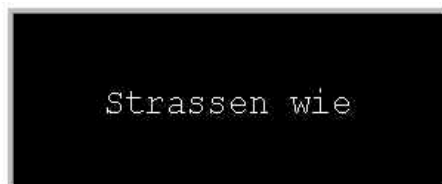


- With pattern matching the occlusion technique separates
 - » between dialogues that ease resumption after interruption and those that do not
- The performance in secondary task also decreases in the complex condition, significant more errors are made contrary to the simple condition
 - » no trade-off between primary & secondary task

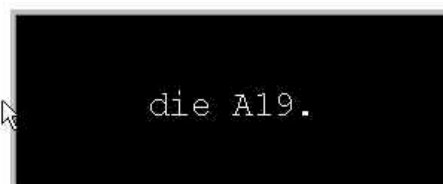
2.3 Interruption – dynamic displays



- The problem: dynamic changes....
- Stimuli: short texts (max. 40 words), presented within a frame of 2-3 words for 0.7 secs



Weiter



Weiter

Equipment

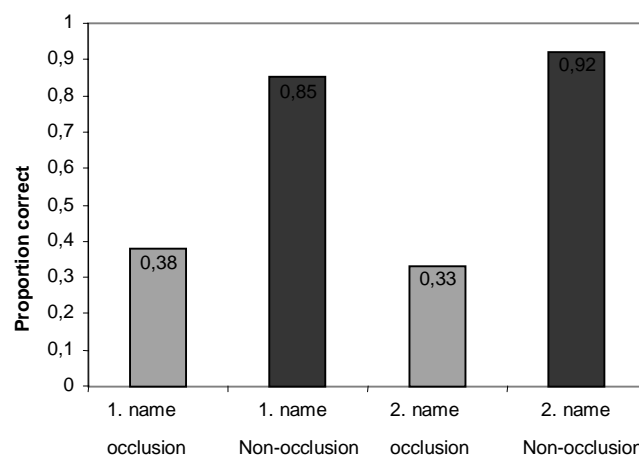


- Psion handheld computer for in-car use
 - » Stimuli-presentation with java-applet on a web-browser
- Shutter glasses
 - » 1500msec open, 3500msec closed
- Task
 - » read the texts, understand their meaning, memorize the abbreviations for motorways

Results



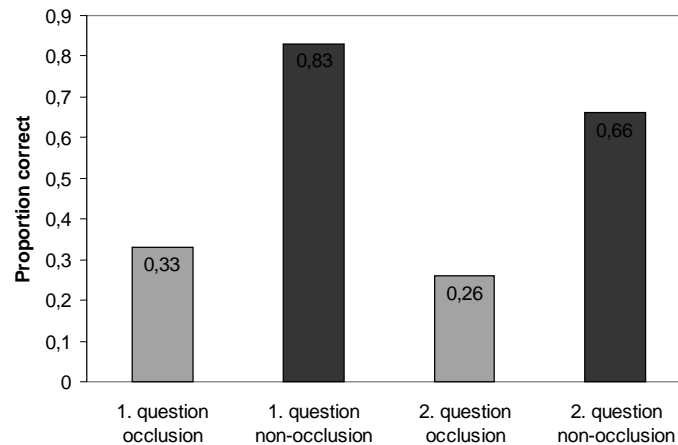
Mean relative frequencies of correct recall of motorways



Results



Mean relative frequencies of correct answers to content questions



Summary – from the lab



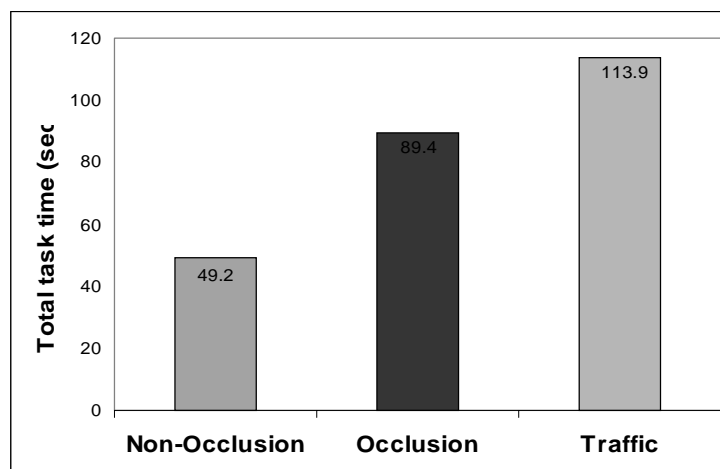
- The various results show that the occlusion technique
 - » Separates reliable between displays of diverse complexity
 - » Supplies with evidence about how easily displays can be resumed after an interruption
 - » Identifies HMI-designs not suitable while driving

II. Back on the road again...

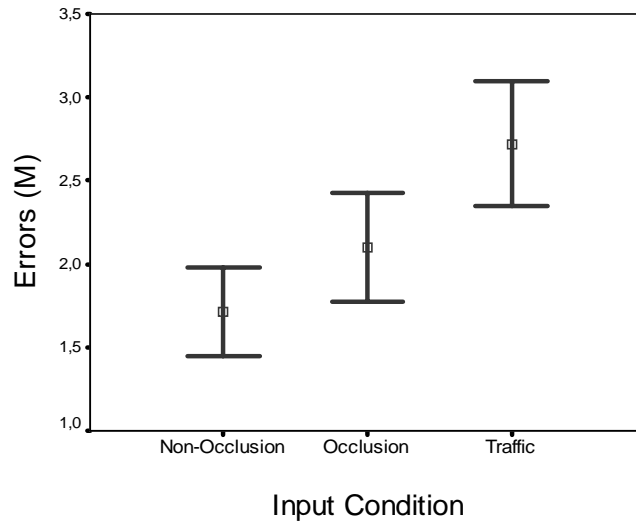


- How efficient is the occlusion method in simulating „real“ traffic? Will the results from the lab scale up?
- Field experiment:
 - » a) parking lot, without occlusion
 - » b) parking lot, with occlusion
 - » c) on the road
- Task: Entering destinations (Carin)

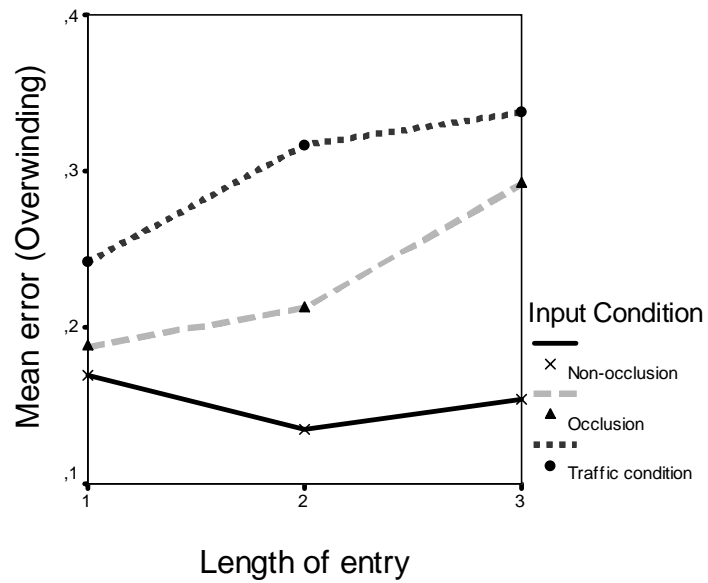
Results - Total task time



Results



Results - Errors



Summary - Traffic



- The occlusion method produces cognitive load comparable to a real traffic situation
 - » suitable for the simulation of real-world conditions
 - » but less in intensity
- Possible consequences:
 - » Use a secondary-task procedure

III. Nuggets



- Direct assessment of relevant variables
 - » accuracy
 - » time of information acquisition
- Various aspects of a system can be studied
 - » resumption after interruption
 - » visual complexity
 - » impact of additional cognitive load
 - » visual control

III. Coals



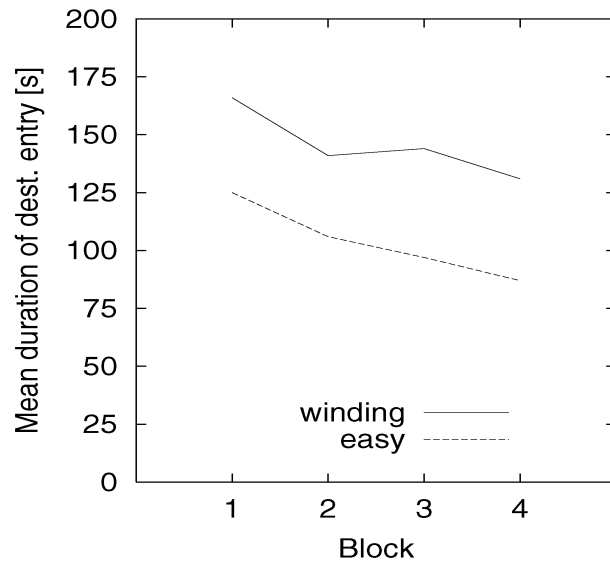
- Relatively high number of subjects needed
- Different system aspects not testable all at once
- It gets on your nerves...
- values of occlusion parameters not empirically validated so far

How to estimate the parameters?

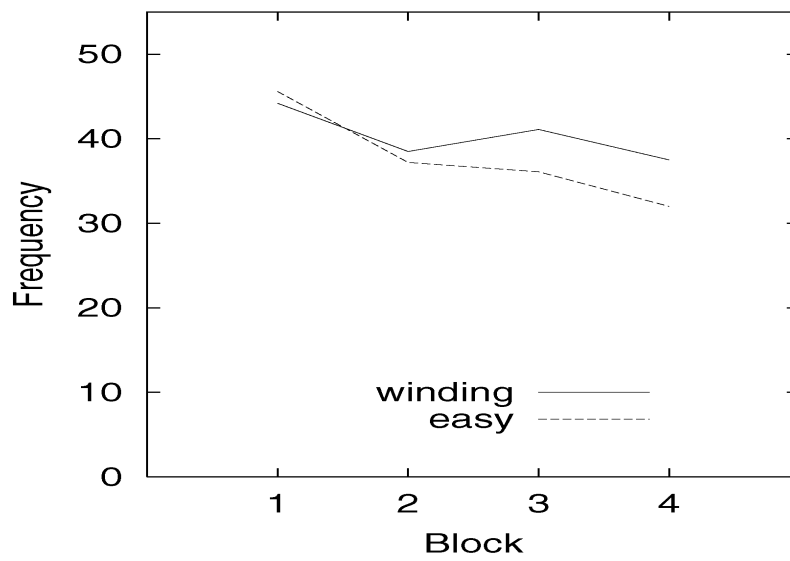


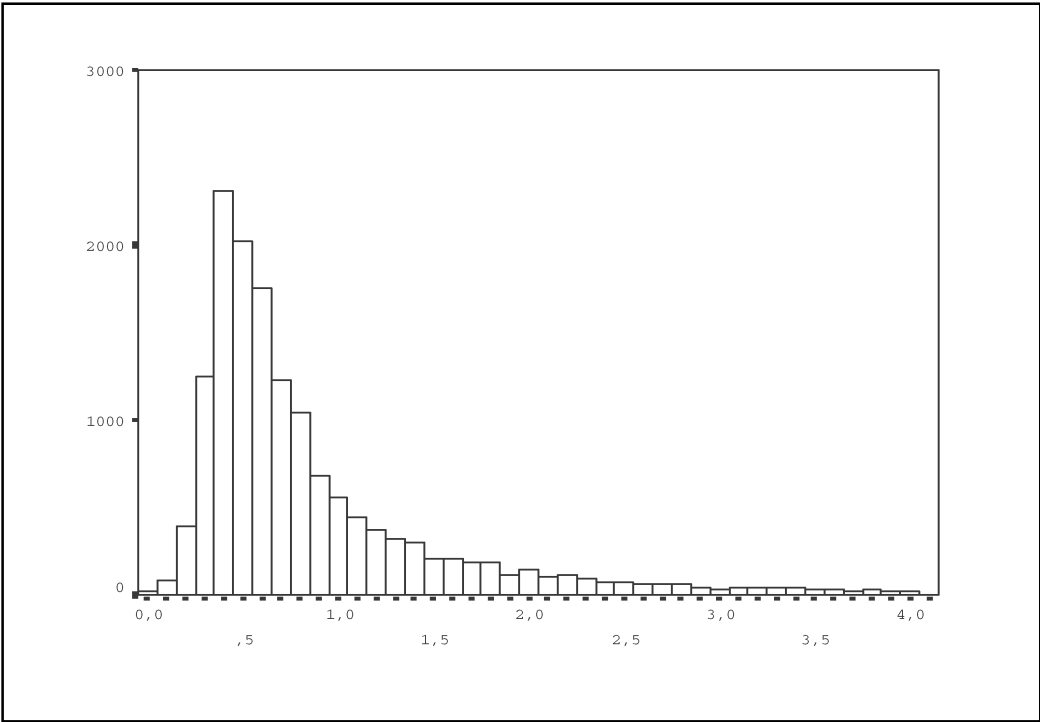
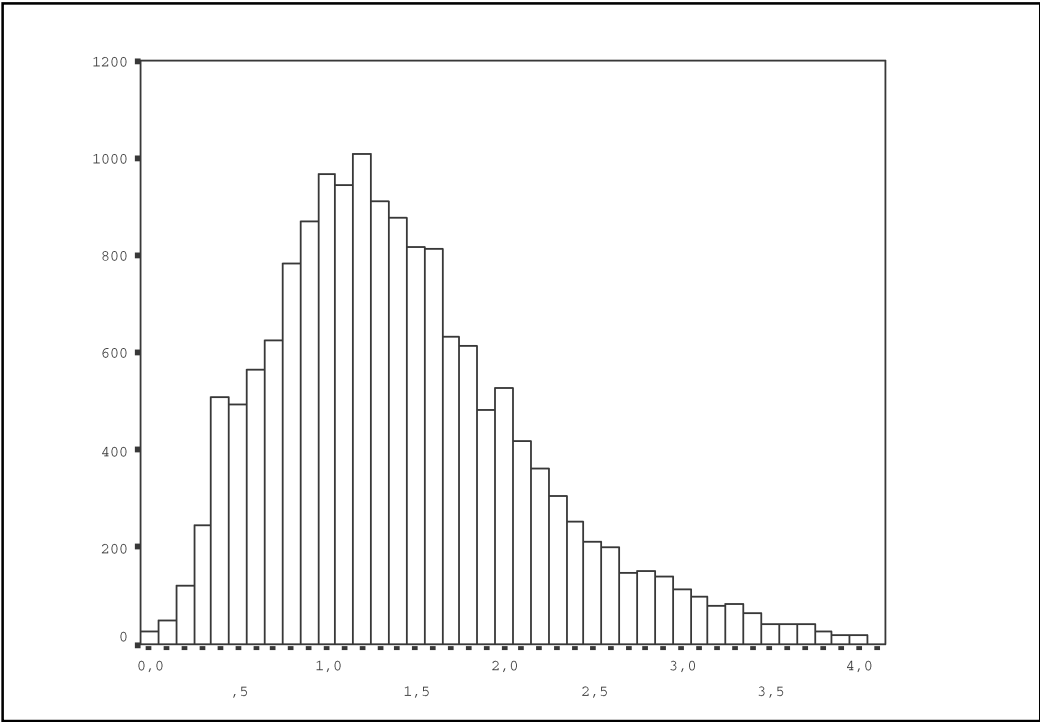
- Gaze duration and eye movement strategies while driving
- A training study on behalf of the *Federal Highway Research Institute, Bonn*
- Participants enter up to 100 destinations within 5.5 hours

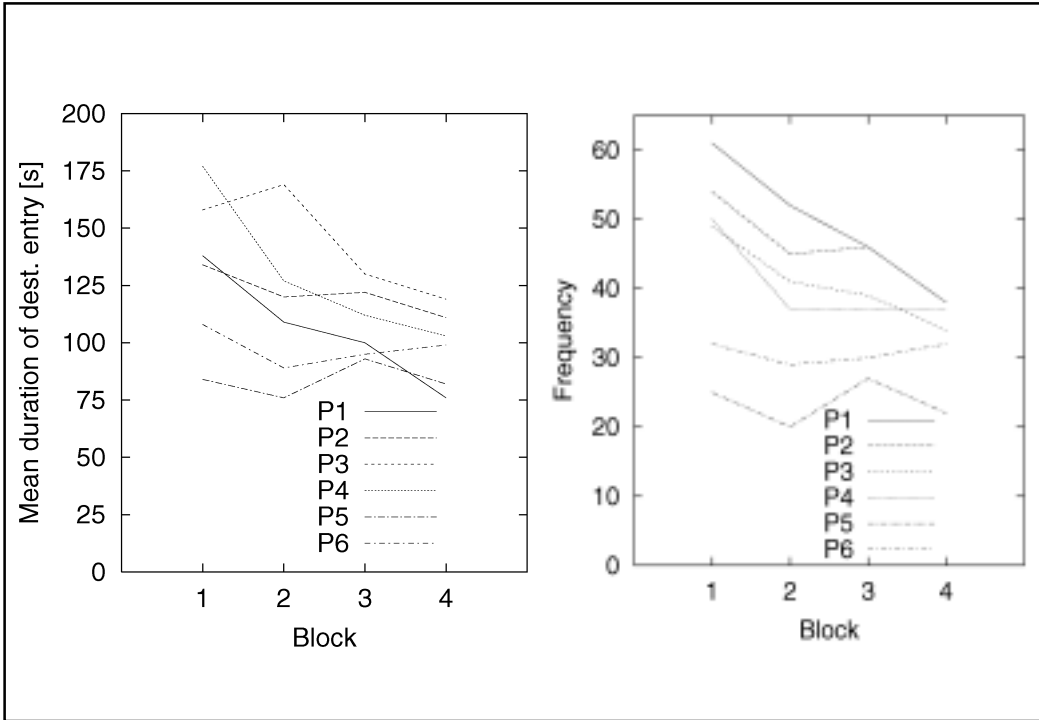
Preliminary Results



Preliminary Results







Thank you very much for your attention