



Research knows best, but how to communicate distraction measures practically in an industrial context

Claudia Geitner

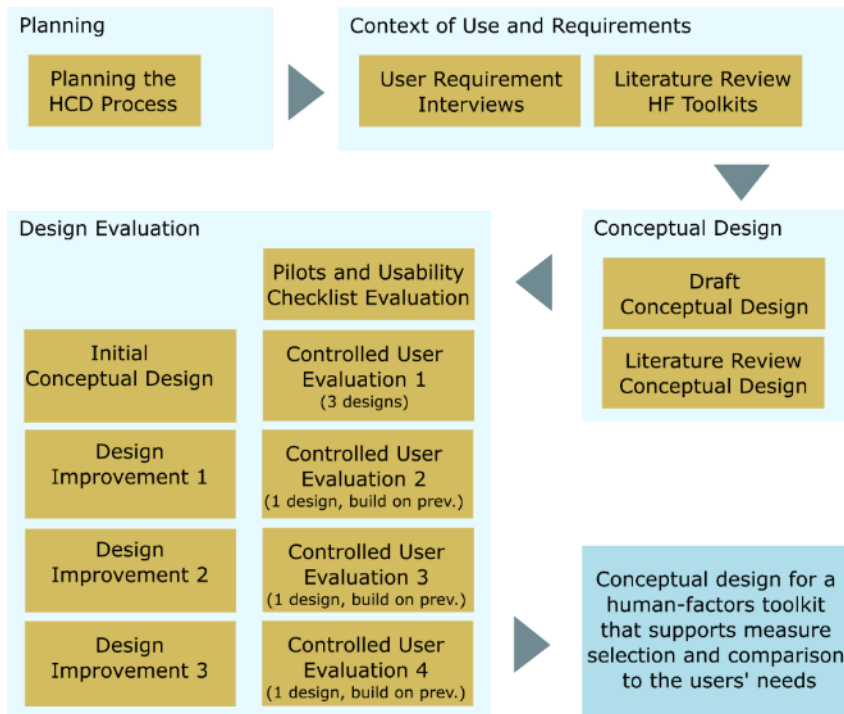
Experiential Engineering Research Group
University of Warwick (UK)

Co-Authors: Stewart Birrell, Lee Skrypchuk, Francesco Biondi and Paul Jennings

- 1) Introduction
- 2) Development and Evaluation
- 3) Outlook
- 4) Final Conceptual Interface Design

- *“Kevin and Linda are planning a user trial to evaluate the distraction of a new voice-based in-vehicle navigation system. Both are familiar with user studies and experts for workload measurement, but they do not have experience with driver distraction measures yet. They start gathering information from different sources and arrange them in a table. But with many measures in the growing table, Kevin and Linda are not sure which of the measures is the best to use.”*
- Wouldn't it be nice if some information about the measures would be already collected and presented in a form for a non-expert in driver distraction?
- Wouldn't it be nice to find a format for an easy comparison of multiple measures?

- What is the toolkit:
 - Easy accessible organisation of human factors related measures for evaluation of driving in automotive context, e.g. driver distraction, workload, user experience ...
- For whom:
 - People who plan a user study
- To do what:
 - Support for measure selection and comparison



- Developed through co-design with future users, automotive HMI engineers in each design step:

- 1) User requirements interviews
- 2) Four paper prototype iterations

- Interviews revealed the key criteria that HMI practitioners from automotive industry use to decide about a measure were:
 - Suitability to research question
 - Frequency of use in research literature
 - Effort to administer
 - Interference with driving
 - Information about implementation and analysis

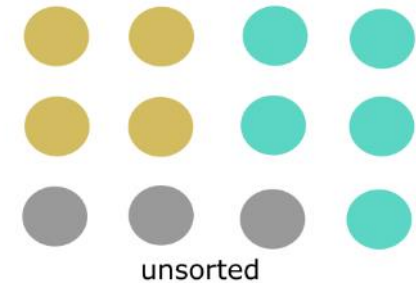


- Visual Information Seeking (VIS), the mantra:

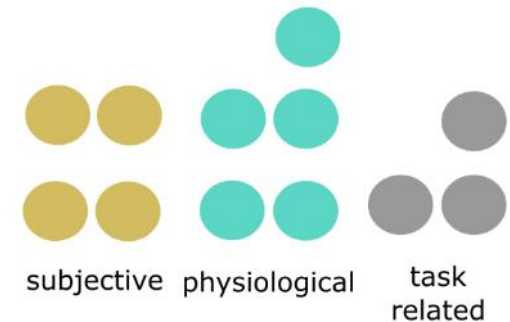
“Overview first, details on demand.”

- Avoids information overload

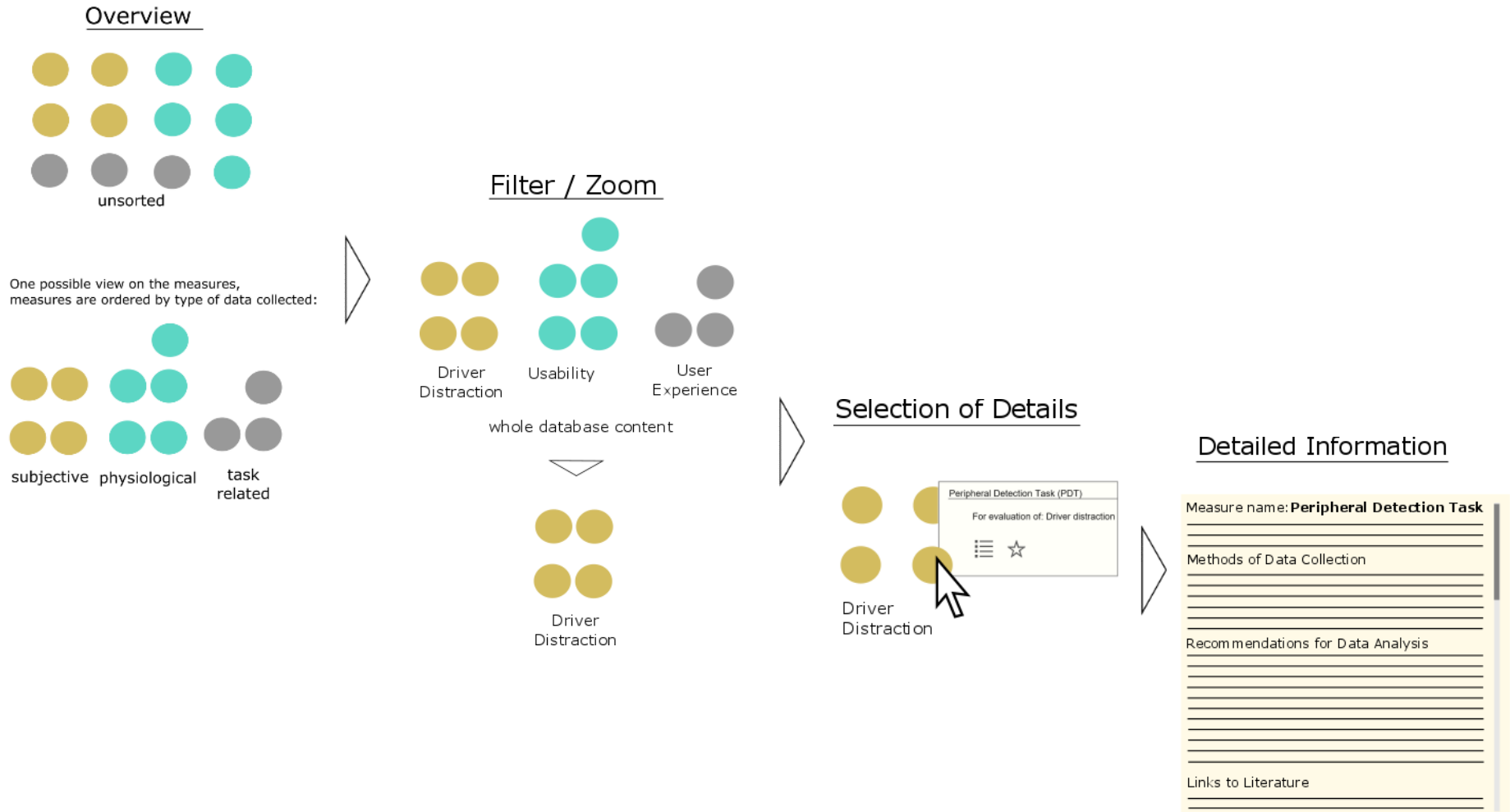
Overview

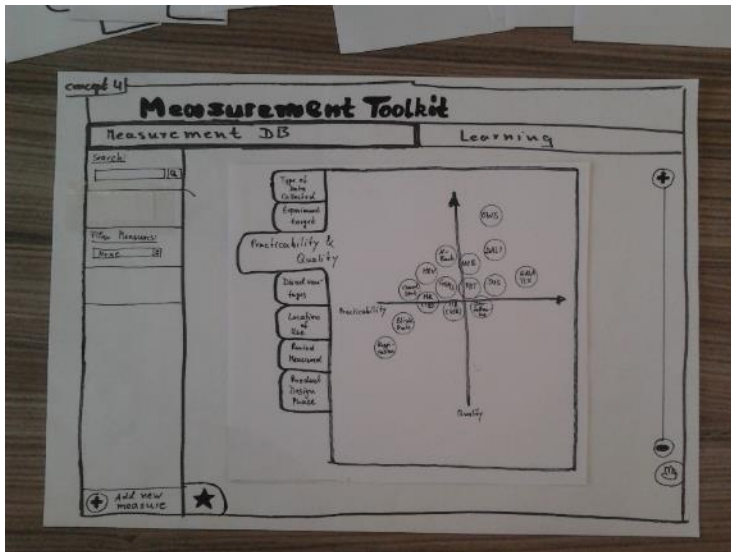
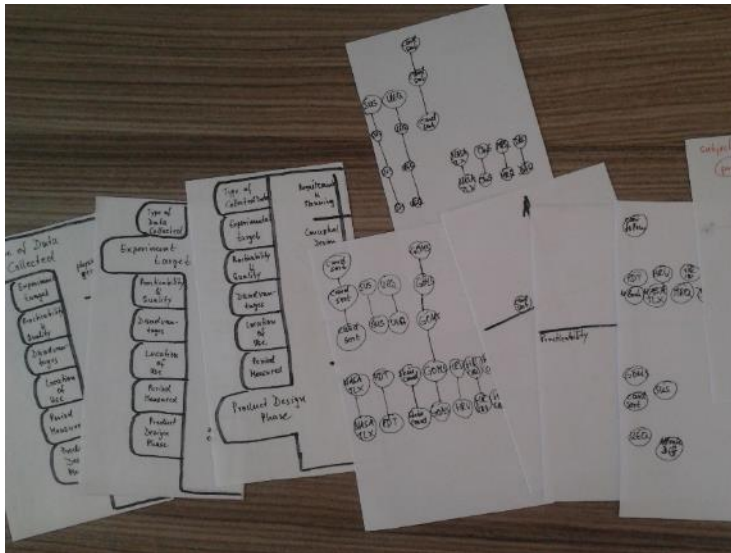


One possible view on the measures, measures are ordered by type of data collected:



“Overview first, details on demand.”





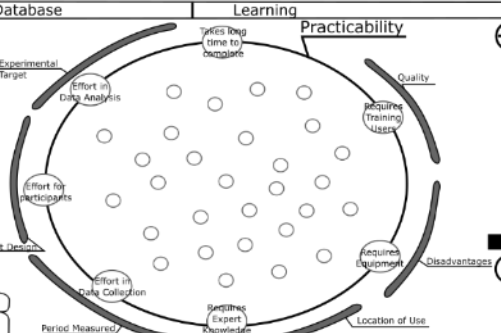
- Paper prototypes
 - For rapid design iteration
 - Paper based interface
 - Interaction mimics that with a computer interface
 - Good to test:
 - General arrangement
 - Navigation
 - Available functions
 - Structure of information in the interface

Development and Evaluation

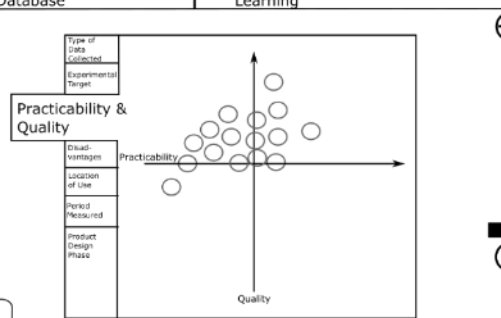
Measurement Toolkit

Measurement Database	Learning
List of measures 1. Attrak Diff. ★ 2. Blink Rate ★ 3. Car-following ★ 4. Card sorting ★ 5. DALI ★ 6. GOMS ★ 7. HR (HR) ★ 8. HR (IBI) ★ 9. HRV ★	Favourite Measures for Comparison ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Detailed compare Quick compare
Filter of measures Type of Data Collected ▶ Experimental Target ▶ Quality ▶ Practicability ▶ Disadvantages ▶ Location of Use ▶ Period Measured ▶ Product Design Phase ▶	

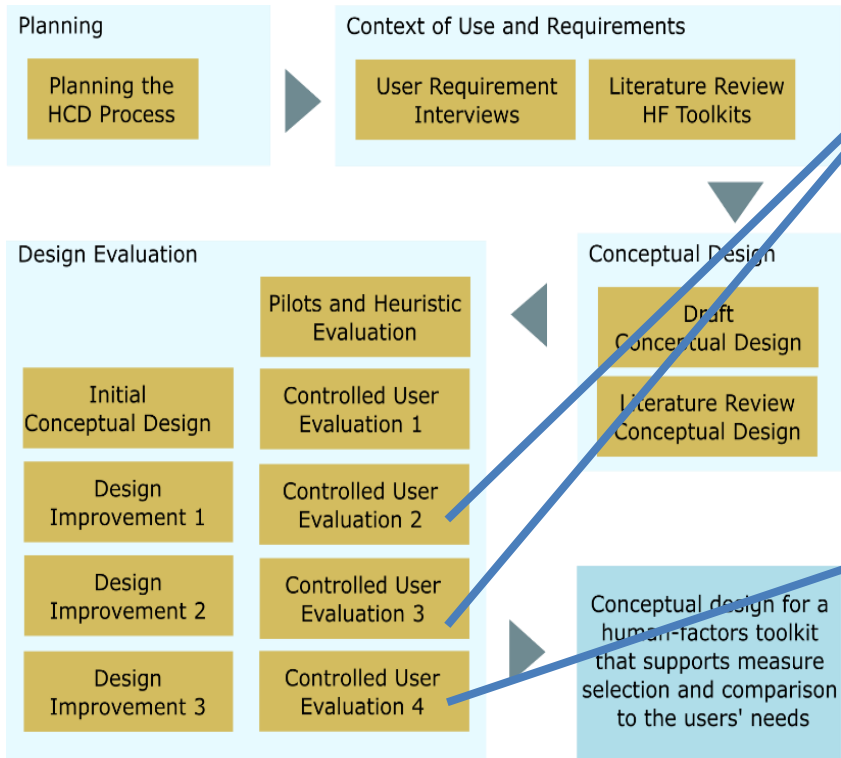
Measurement Toolkit

Measurement Database	Learning
Search: <input type="text"/> Group Measures by Type <input type="checkbox"/> Filter Measures: <input type="text"/>	Practicability Quality Requires Training/Usage Requires Equipment Disadvantages Location of Use Requires Expert Knowledge Period Measured Effort in Data Collection Effort in Data Analysis Effort for Participants Experimental Target Takes long time to complete
<input type="button" value="Add New Measure"/> ★	

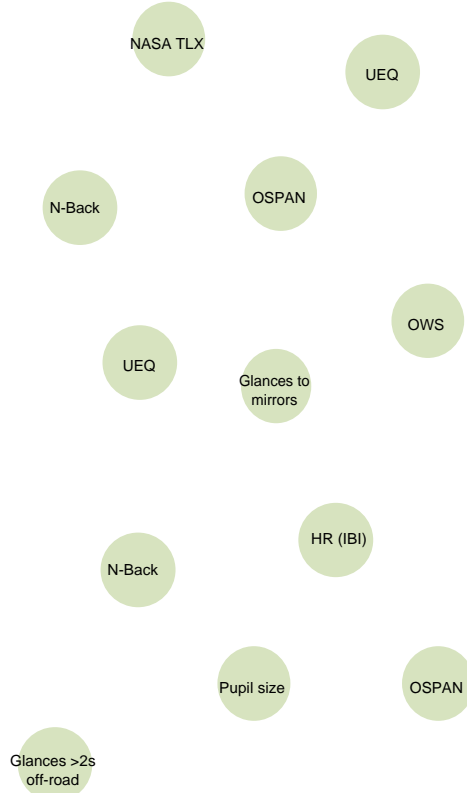
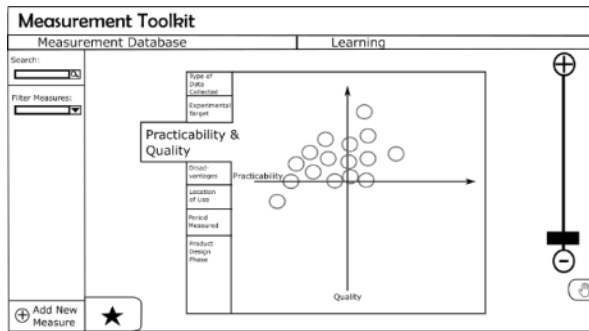
Measurement Toolkit

Measurement Database	Learning
Search: <input type="text"/> Filter Measures: <input type="text"/>	Practicability & Quality Disadvantages Location of Use Period Measured Product Design Phase Practicability Quality
<input type="button" value="Add New Measure"/> ★	

- First round to compare three designs (left, top to bottom):
 - Spreadsheet
 - VIS visual
 - VIS with diagram
- The best performing design from round 1 was subsequently evaluated in 3 further iterative studies



- Iterations 2 and 3 considered specifically the categories for overview and filter information
- Iteration 4 considered all functions of the toolkit



- Participants preferred the interface with the visual information seeking approach
- Users quickly understand the concept of the division between overview and detailed information
- Specific challenge was defining appropriate names for categories for overview information
- Final interface attained a positive rating in usability and user experience
- Implementation ongoing
- Portal for measure selection and use
 - Integration with existing procedures
 - Integration with available software for data collection and data analysis

Final Conceptual Interface - Overview

Measurement Toolkit

Measurement Database | **Learning**

Search: Search

Quick comparison | Detailed comparison | Measure Comparison Drag & drop

Save set | Load set

Filters, to reduce the shown measures

Comparison

Measures

Overview / Sort

Sort By (on y-axis):

- Aim
- Data Type
- Design Phase
- Studied Period
- Study Location
- Practicability Rating
- Quality Rating

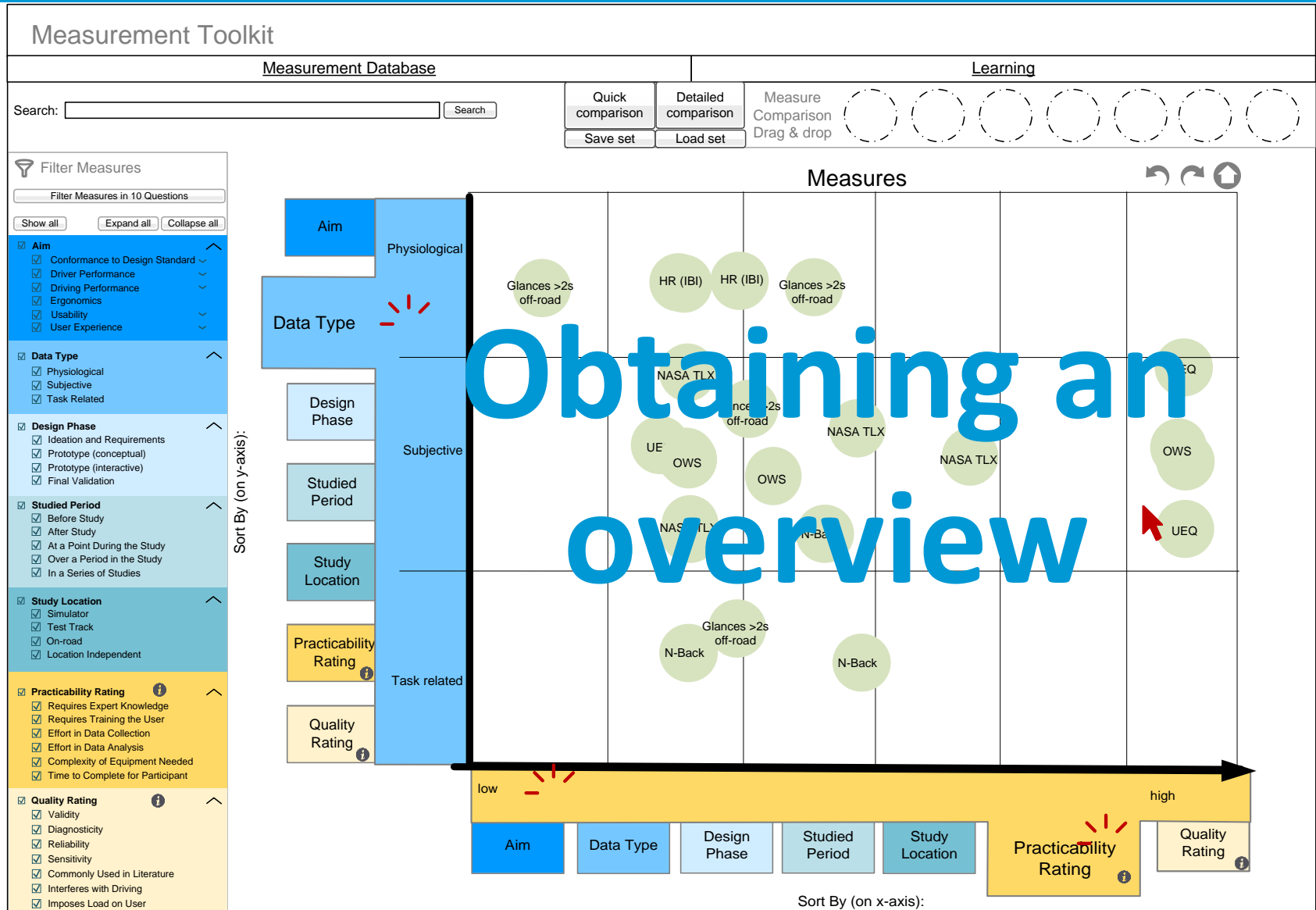
Sort By (on x-axis):

- Aim
- Data Type
- Design Phase
- Studied Period
- Study Location
- Practicability Rating
- Quality Rating

Detailed Information

N-Back, HR (IBI), Glances >2s off-road, NASA TLX, UEQ

Outlook: prototype toolkit



Outlook: prototype toolkit

Measurement Toolkit

Measurement Database | **Learning**

Search: Search

Quick comparison | Detailed comparison | Measure Comparison Drag & drop

Save set | Load set

Filter Measures

Filter Measures in 10 Questions

Show all | Expand all | Collapse all

- Aim**
 - Conformance to Design Standard
 - Driver Performance
 - Driving Performance
 - Ergonomics
 - Usability
 - User Experience
- Data Type**
 - Physiological
 - Subjective
 - Task Related
- Design Phase**
 - Ideation and Requirements
 - Prototype (conceptual)
 - Prototype (interactive)
 - Final Validation
- Studied Period**
 - Before Study
 - After Study
 - At a Point During the Study
 - Over a Period in the Study
 - In a Series of Studies
- Study Location**
 - Simulator
 - Test Track
 - On-road
 - Location Independent
- Practicability Rating**
 - Requires Expert Knowledge
 - Requires Training the User
 - Effort in Data Collection
 - Effort in Data Analysis
 - Complexity of Equipment Needed
 - Time to Complete for Participant
- Quality Rating**
 - Validity
 - Diagnosticity
 - Reliability
 - Sensitivity
 - Commonly Used in Literature
 - Interferes with Driving
 - Imposes Load on User

Sort By (on y-axis):

Measures

Filter measures

low | high

Sort By (on x-axis):

Measurement Toolkit

Measurement Database
Learning

Search: Search

Quick
comparison

Detailed
comparison

Measure
Comparison

Drag & drop

Save set

Load set

+ 🖨 📄 ✕

Filter Measures

Filter Measures in 10 Questions

Show all Expand all Collapse all

- Aim
 - Conformance to Design Standard
 - Driver Performance
 - Distraction
 - Fatigue
 - Stress
 - Workload
- Driving Performance
 - Ergonomics
 - Usability
 - User Experience
- Data Type
 - Physiological
 - Subjective
 - Task Related
- Design Phase
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 - Sensitivity

		Glances >2s off-road	Peripheral Detection Task	Glances to mirrors
Section title	Sub-sections	Description	Description	Description
Name		-----	-----	-----
Data Type		subjective / physiological / task related	subjective / physiological / task related	subjective / physiological / task related
Aim	Conformance to design standard	yes	no	no
	Driving Performance	no	no	no
	Driver Performance	yes	yes	yes
	Ergonomics	no	no	no
	User Experience	no	no	no
	Usability	no	no	no
Main Details	Dependent Var and Unit	Dicat vocibus persecuti cu cum. Per vero minim lobortis ut. Ex has aliquip conclusionemque. An dico iudicabit pri, ne error volumus epicurei qui, te blandit tincidunt persecuti vel. Nec te hinc soleat feugiat. Te laudem mentium	Dicat vocibus persecuti cu cum. Per vero minim lobortis ut. Ex has aliquip conclusionemque. An dico iudicabit pri, ne error volumus epicurei qui, te blandit tincidunt persecuti vel. Nec te hinc soleat feugiat. Te laudem mentium	Dicat vocibus persecuti cu cum. Per vero minim lobortis ut. Ex has aliquip conclusionemque. An dico iudicabit pri, ne error volumus epicurei qui, te blandit tincidunt persecuti vel. Nec te hinc soleat feugiat. Te laudem mentium persequeris qui,
	Definition	Mel eu case inductum dissentias, sed ex sint cetero scriptorem. Per eu reque inani, ne putant facilis oportere	Mel eu case inductum dissentias, sed ex sint cetero scriptorem. Per eu reque inani, ne putant facilis oportere	Mel eu case inductum dissentias, sed ex sint cetero scriptorem. Per eu reque inani, ne putant facilis oportere est
	Rational for Use (main advantage)	Mea no offendit honestatis philosophia, ei est causae	Mea no offendit honestatis philosophia, ei est causae	Mea no offendit honestatis philosophia, ei est causae impetus
	Confounding variables	Mel eu case inductum dissentias, sed ex sint cetero	Mel eu case inductum dissentias, sed ex sint cetero	Mel eu case inductum dissentias, sed ex sint cetero
Quality	Validity			
	Diagnosticity			
	Notes Validity / Diagnosticity	Pri propriae atomorum in, eos sint ludus solet ea. Id impetus expetendis sea, ea mea vide graecis officis. Mei	Pri propriae atomorum in, eos sint ludus solet ea. Id impetus expetendis sea, ea mea vide graecis officis. Mei	Pri propriae atomorum in, eos sint ludus solet ea. Id impetus expetendis sea, ea mea vide graecis officis. Mei ut exerci
	Reliability	average	average	average
	Sensitivity	average	average	average
	Commonly used in literature	yes	yes	yes
Questionnaire	Interferes with Driving	no	no	no
	Imposes load on driver	no	no	no
	No of questions			
Practicability	Open / closed questions	Only open questions	Only open questions	Only open questions
	Customised Version			
	Estimated time to complete			
	Comment			
	Requires Expert Knowledge	yes	yes	yes
	Requires Training Users	no	no	no
Utilisation	Effort Data collection	average	average	average
	Effort Data analysis	high	high	high
	Complexity of Equipment needed	high	high	high
	Time to complete for participant	low	low	low
Utilisation	Implementation of the measure (including the equipment, if needed)	Vim omnes interesset ea. His et denique vivendum imperdiet, id dicam vivendo sea, eius voluptat nam no. Mel in mazim malorum malusset, sale equidem epicuri no qui. Choro omnes delicatissimi ius at	Vim omnes interesset ea. His et denique vivendum imperdiet, id dicam vivendo sea, eius voluptat nam no. Mel in mazim malorum malusset, sale equidem epicuri no qui. Choro omnes delicatissimi ius at	Vim omnes interesset ea. His et denique vivendum imperdiet, id dicam vivendo sea, eius voluptat nam no. Mel in mazim malorum malusset, sale equidem epicuri no qui. Choro omnes delicatissimi ius at
	Calibration of equipment	Propriae persequeris ullamcorper id ius. Epicurei phaedrum percipitur ius te, pro ignota graeci ex, usu in	Propriae persequeris ullamcorper id ius. Epicurei phaedrum percipitur ius te, pro ignota graeci ex, usu in	Propriae persequeris ullamcorper id ius. Epicurei phaedrum percipitur ius te, pro ignota graeci ex, usu in quot definitionem.

Measurement Toolkit

Measurement Database

Search:

Learning

Filter Measures

Filter Measures in 10 Questions

- Aim**
 - Conformance to Design Standard
 - Driver Performance
 - Living Performance
 - Ergonomics
 - Usability
 - User Experience
- Data Type**
 - Physiological
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Aim	Conformance to design standard	no	no
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	Driver Performance	no	no
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	Usability	no	no
Main Details	Dependent Var and Unit	Dicat vocibus persecuti cu cum. Per vero minim lobortis ut. Ex has aliquip conclusionemque. An dico iudicabit pri, ne error volumus epicurei qui, te blandit tincidunt persecuti vel. Nec te in soleat feugiat. Te laudem mentium	Dicat vocibus persecuti cu cum. Per vero minim lobortis ut. Ex has aliquip conclusionemque. An dico iudicabit pri, ne error volumus epicurei qui, te blandit tincidunt persecuti vel. Nec te in soleat feugiat. Te laudem mentium
	Definition	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae
	Rational for Use (main advantage)	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae
	Confounding variables	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae	Mel eu case doctum dissentias, sed ex sint cetero sceleris. Ut eu reumque phas est causae
Quality	Validity		
	Diagnosticity		
	Notes Validity / Diagnosticity	Pri propriae atomorum in, eos sint ludus solet ea. Id impetus expetendis sea, ea mea vide graecis officis. Mei	Pri propriae atomorum in, eos sint ludus solet ea. Id impetus expetendis sea, ea mea vide graecis officis. Mei
	Reliability	average	average
	Sensitivity	average	average
	Commonly used in literature	yes	yes
	Interferes with Driving	no	no
	Imposes load on driver	no	no
Questionnaire	No of questions		
	Open / closed questions	Only open questions	Only open questions
	Customised Version		
	Estimated time to complete		
	Comment		
Practicability	Requires Expert Knowledge	yes	yes
	Requires Training Users	no	no
	Effort Data collection	average	average
	Effort Data analysis	high	high
	Complexity of Equipment needed	high	high
	Time to complete for participant	low	low
Utilisation	Implementation of the measure (including the equipment, if needed)	Vim omnes interesset ea. His et denique vivendum imperdiet, id dicam vivendo sea, eius volutpat nam no. Mel in mazim malorum maluisset, sale equidem epicuri no qui. Choro omnes delicatissimi ius at	Vim omnes interesset ea. His et denique vivendum imperdiet, id dicam vivendo sea, eius volutpat nam no. Mel in mazim malorum maluisset, sale equidem epicuri no qui. Choro omnes delicatissimi ius at
		Propriae persequeris ullamcorper id ius. Epicurei phaedrum percipit ius te, pro ignota graeci ex, usu in	Propriae persequeris ullamcorper id ius. Epicurei phaedrum percipit ius te, pro ignota graeci ex, usu in
	Calibration of equipment	Vim id erat hendrent, ne eam fugit libris salutat. Habeo	Vim id erat hendrent, ne eam fugit libris salutat. Habeo

Easy access to detailed info - on demand -

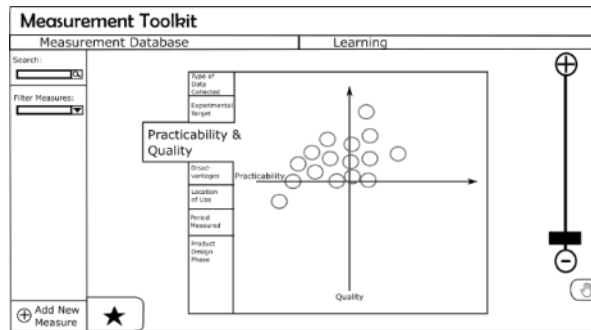
Do you have any questions?

Contact details: c.Geitner@warwick.ac.uk

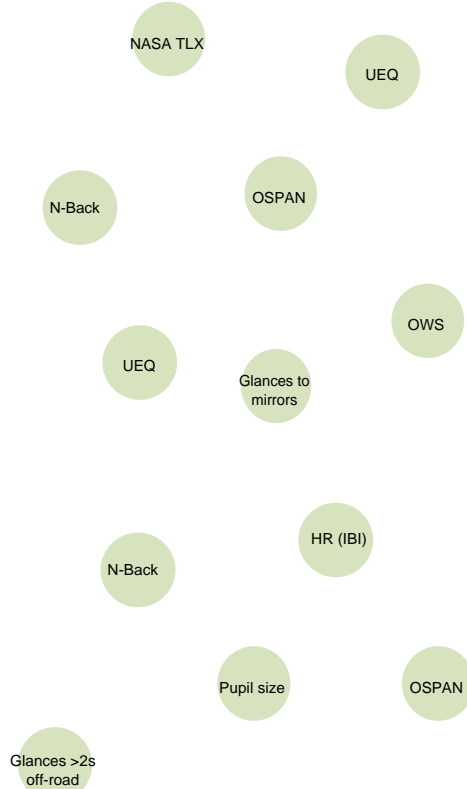


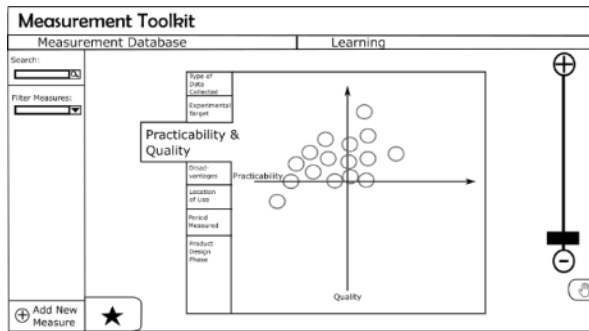
Summary:

- A conceptual interface for an electronic aid to compare / select human factors related measures for the evaluation of in-vehicle devices
- Employs methodology from visual information seeking
- Evaluated over expert interviews and in four paper prototyping studies



- Paper prototype 1
 - Four tasks with the interface
 - Usability rating
- Paper prototype 2 and 3
 - Four tasks with the interface
 - Tree analysis
 - Usability rating and user experience rating
- Paper prototype 4
 - Free interaction
 - Usability rating and user experience rating





Tree analysis

- From web-design
- Specific test for structure of information
 - Question for every category that is going to be evaluated to participant, requesting to look for a certain information that is in that category; e.g. Where would you look for a driver distraction measure?
 - Participant points on the category where he/she expects that information
 - Analysis of answers
 - Information that could not be found
 - Attempts needed

Tree-analysis paper prototype two and paper prototype three.

	Average			
	1 st answer	2 nd answer	3 rd answer	Not found
	Study Target	5	4	2
Type of Data Collected	8	1	1	2
Product Design Phase	8	3	-	1
Period Measured	5	2	2	3
Location of Use	9	1	-	2
Practicability	4	3	2	3
Quality	10	1	-	1
Disadvantages	3	2	-	7

	Average			
	1 st answer	2 nd answer	3 rd answer	Not found
	Objective	10	3	-
Data Type	13	-	1	-
Design Phase	6	5	1	2
Studied Period	8	-	2	4
Study Location	13	-	1	-
Practicability Rating	12	1	1	-
Quality Rating	5	2	1	6

