Age-related differences in the response to traffic situations

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Overview

1. A small history of risk
2. Fuller’s Task Capability Interface Model
3. Study on risk perception: Hypotheses & methods
4. Results
5. Summary & discussion
A small history of risk

- Understanding risk has profound implications for development of effective road safety interventions

- Dominance of models on individual differences for collision prediction in 1960/70

- Paradigm shift in the 80ties: Comprehensive models of driver behaviour replace models of collision prediction

- Driving now described as a “self-paced task” in which the driver creates the demands of the driving task in interaction with a dynamic road environment
Nobody sets out on a journey to have a collision; until a certain threshold has been surpassed, the statistical risk of being involved in a collision does not enter our minds when driving.

What does? According to Fuller it is a feeling of risk which varies with the perceived difficulty of the driving task.

Every driver has a preferred range of task difficulty.

The physiological correlate of feeling of risk is arousal, measurable in electro-dermal activity.
The Task Capability Model (Fuller, 2000)

D > C

Task difficulty

Capability

Task demand

Control

C > D

Damasio’s Somatic Marker Hypothesis (2003)
The Task Capability Model (Fuller, 2000)

- Constitutional features
  - Training
  - Education
  - Experience
  - Competence

- Human Factors
- Task difficulty

- Capability
- Task demand
- Control
- Road position & trajectory
- Speed
- Environment
- Other road users
- Vehicle

D > C
C > D
“Inevitable” age-related deteriorations

- **Cognitive**
  - Deceleration of information processing, deterioration of working memory, selective/divided attention

- **Perceptual**
  - Reduced visual & aural acuity, sensitivity to glare

- **Physical**
  - Restricted mobility & joint movements (particularly head & neck), reduction of (grip) strength
  - Higher need for recovery from physical demands

Age should lead to a reduction in driver capability & increased ratings of task difficulty/feeling of risk
Research hypotheses

1. Task difficulty & feeling of risk ratings will be significantly correlated. Task difficulty & perceived risk of a collision will not correlate as strongly.

2. Older drivers will provide significantly higher ratings of task difficulty & feeling of risk in high difficulty situations than younger drivers.

3. Older drivers increases in skin conductance & heart rate variability will be significantly larger in high difficulty situations than younger drivers’
The video study

- Simulator study at TRL with 34 current, healthy drivers (young, middle-aged, older)

- Questionnaire on driving habits & experience

- Drivers watched high versus low difficulty versions of eight driving situations:
  - Turning right onto a major road at a t-junction
  - Turning left at a junction
  - Turning right at a roundabout
  - Drive straight across a roundabout
  - Negotiating a bend
  - Following a vehicle
  - Overtaking
  - Pedestrian crossing the driver’s path

- Independent measures included:
  - Subjective ratings: perceived task difficulty (7 point Likert scale), feeling of risk (7 point Likert scale) & collision likelihood (%)
  - Physiological measures: skin conductance level & heart rate variability
The set up

Three large flat screens to replay left, middle & right channel of video simultaneously
Hypothesis 1: Task difficulty, feeling of risk & collision likelihood correlations

<table>
<thead>
<tr>
<th>Pearson correlation</th>
<th>Low difficulty</th>
<th>High difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty with feeling of risk</td>
<td>0.87**</td>
<td>0.84**</td>
</tr>
<tr>
<td>Difficulty with collision likelihood</td>
<td>0.54*</td>
<td>0.33</td>
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</tbody>
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* p< .05; ** p< .01

Conclusion Hypothesis 1:
Findings support the hypothesis; correlations between task difficulty & feeling are stronger than those between task difficulty & collision likelihood.
Hypothesis 2: Age effects for task difficulty & feeling of risk

Individual situation ratings added up to sums scores for perceived difficulty & feeling of risk

![Bar chart showing mean sum rating scores for different age categories and difficulty levels. Error bars represent +/- 1 SD.](chart_image)
Hypothesis 2: Age effects for task difficulty ratings

**Perceived task difficulty**

Significant main effects for:
- Difficulty F(1, 31)= 31.19, p<.001; partial $\eta^2$=.50
- Age F(2, 31)= 3.98, p=.03; partial $\eta^2$=.20

LSD post-hoc: Older drivers’ ratings sg. higher than middle-aged & young drivers (mean diff $65+;21-25 = 5.14$, p=.024; mean diff $65+;40-55 = 4.25$, p=.028)

**Feeling of risk**

Significant main effects for:
- Difficulty F(1, 31)= 31.19, p<.001; partial $\eta^2$=.50
- Age F(2, 31)= 3.98, p=.03; partial $\eta^2$=.20

LSD post-hoc: Older drivers’ ratings sg. higher than young drivers’ (mean diff$65+;21-25 = 7.37$, p=.010; mean diff$65+;40-55 = 4.49$, p=.057)
Summary Hypothesis 2

- Difficulty manipulation (high versus low difficulty situations) successful for subjective ratings

- Hypothesis 2 partly supported:
  
  Significant main effects for age indicate that older drivers always rate task difficulty & feeling of risk higher than youngers drivers, not only in high difficulty situations
Hypothesis 3: Age effects for SCL & HRV

No significant differences found for skin conductance level or heart rate variability
Summary Hypothesis 3

- Loss of physiology data for ten participants resulted in loss of statistical power
- Paradoxically, descriptives indicate higher SCL change & HRV for older drivers in low difficulty situations
- Hypothesis 3 rejected: no significant age differences identified
Study limitations

- Loss of data does not allow conclusions about the physiological component of a risk response
- Reliance on subjective ratings of risk alone for exploration of age effects & further research necessary
- Study included no objective measure of driver capability, only self-reported capability; observed age-effects cannot be attributed to reductions in capability
- Further research should explore risk perceptions in clinical groups
Conclusions

- Estimates of collision likelihood are readily produced, but are unsuitable as the parameter that guides driving decisions.
- Older drivers generally perceive the difficulty & feeling of risk in traffic situations as higher than middle-aged & young drivers.
- It remains unclear at this stage whether this is attributable to an age-related reduction in capability; older participants report equal ratings of skilfulness, caution & confidence as drivers.
- Fuller’s notion of driving as a self-paced task is likely to not apply in situations that have been highlighted as particularly difficult for older drivers (junctions).
Practical implications

- Improve calibration (Kuiken & Twisk, 2001):
  - Interventions needed that feed back objective information on driver capacity to facilitate self-regulatory adaptation of driving style in older driver (healthy bias versus clinical lack of insight); studies suggest good acceptance for feedback & guidance in this area
  - Interventions could also explore how to make the task demand of the situation more salient to the older drivers; infrastructure design

- Practical training interventions for older drivers maintain driving practice in different situations.
Questions?
Thank you

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