

MOTION SICKNESS IN CARS: A holistic approach of a design pattern for constructing in-car motion sickness studies

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Motivation

The issue of Motion Sickness across a variety of disciplines has an ancient history. For land transport as in cars it was already scientifically focused on back in the 1980th. Nevertheless in today's manual driven automotive world no explicit measures to reduce motion sickness are applied. With the development of automated driving and an enlargement of passenger's activities in cars, the demand for cues becomes stronger.

In order to develop measures, the theories of the underlying conflict can easily be reviewed. **The challenge is to apply this knowledge to generate empirically strong results for the provoking everyday situation¹.**

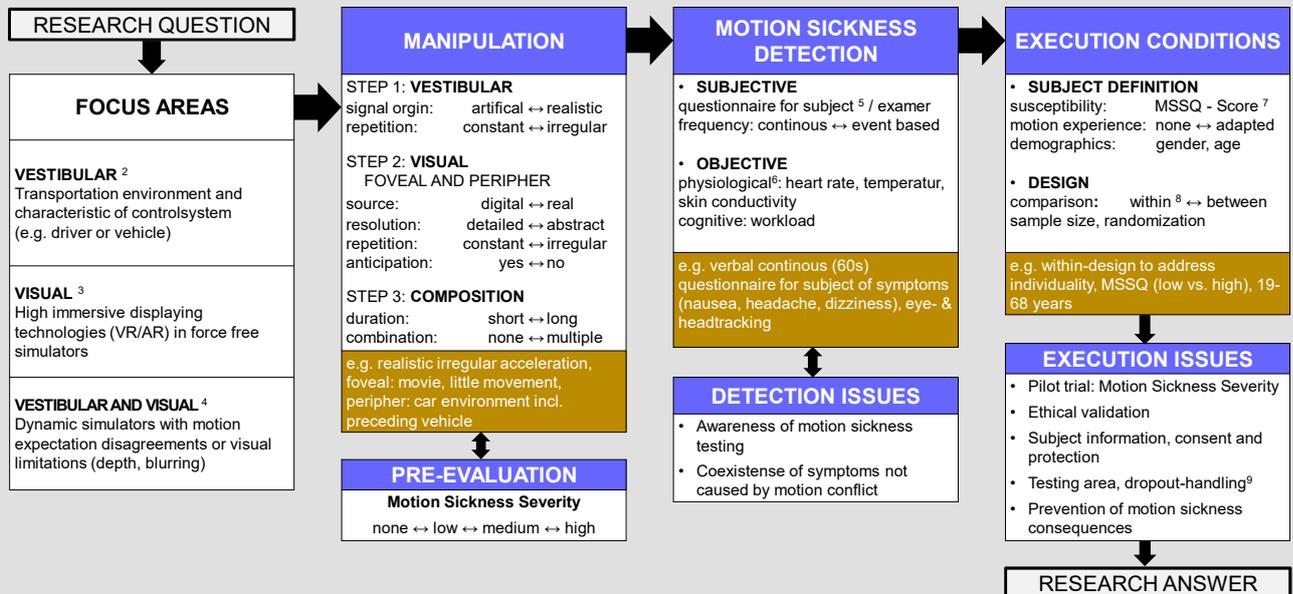
This leads to the aim of the design pattern presented, which is to offer an overview for the major considerations. Additionally white spots in the methodology of motion sickness testing are mentioned.

Method

This literature-based structure was developed by the inspiration of about 40 years of studies focusing on car sickness. A number of 233 publications was found. 35 publications of those executed real driving studies.

The reviewed knowledge was used to execute six real driving studies. Each study showed strong case dependent specifications that would exaggerate the idea of a general pattern. Therefore, strongly motion sickness depending considerations are listed (blue) and the belonging variations or extremes added. To help the reader understand the category, an example out of one self-conducted study is given (yellow). Some considerations are referenced by important sources, which give a basic understanding of the topic or show the potential of further research.

Results



Example

Driving study with two vehicles in artificial stop & go situation

- Passenger tasks in following Vehicle:
 - A) Focussing on preceding car
 - B) Watching movie
- Sample groups: resistant (n=30) and susceptible (n=30)
- 11 minutes of driving on straight highway
- Longitudinal control of cars by digital command and AdaptiveCruiseControl
- Recording of subjective motion sickness symptom rating by the subject and head / eye movement



figure top: Stop & Go scenario with preceding car.¹⁰
figure bottom: Subject as passenger with video watching side task and head mounted eyetracking.¹¹

Conclusion

- For the execution of driving studies focusing on motion sickness, critical issues have to be considered
- **Especially the risk of extensive motion sickness symptoms for the subject during and after the trial should be controlled**
- As a proposal the given categories Focus Areas, Manipulation, Motion Sickness Detection, Execution Conditions and the listed issues should be look at carefully
- The setup has to balance between ethical limitations and a sufficient symptom occurrence

As an outlook some areas of special research interest:

- **The definition of subject susceptibility and influence of individual motion history¹¹**
- **Side effects / bias of motion sickness awareness or direct questioning of symptoms on measured rating¹²**

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