Revising the factor structure of the Simulator Sickness Questionnaire

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Introduction

- Cybersickness, or more precisely virtual reality induced side effects, represents a variety of unwanted symptoms caused by an immersion in a virtual environment.
- Cybersickness does happen, at least in some specific settings (e.g., training, experimental research).
- However, data based on clinical sample is more scarce.

Side effects of VR

- Some basic incidence data *(Lawson et al., 2002)*:
  - almost 60% of people on first immersion report some Sx,
  - 5% report significant Sx.
  - 35% report no Sx at all.
- *Wilson (1997; VIRART)*, N = 233, HMD, immersions from 20 to 120 min.
  - 80% has some symptoms, 5% had to stop.
- Not dangerous in "healthy" subjects.
- Rarely a problem in FoF, maybe more prevalent in the treatment of other mental disorders. But still…

Simulator sickness

- First documented by Havron and Butler (1957) and Reason (1969).
- Motion sickness (motion maladaptation syndrome)
  - Simulator sickness
    - Virtual Reality-induced symptoms and effects.
- Sopite Syndrome *(Graybiel & Knepton, 1976)*
  - Drowsiness, difficulty concentration, apathy

Some limitations of incidence studies

- Studies on cybersickness revealed that symptoms depend on several factors:
  - technology used (CAVE vs HMD, FoV, etc.);
  - speed and accuracy of the hardware;
  - the task performed by the user;
  - individual differences.
- How does these studies, often based on military personnel using flight simulators, relate to our clinical populations?

These limitations also apply to the measurement of cybersickness

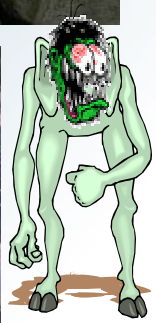
- There are few instruments available:
  - Motion Sickness Questionnaire
    - Kellogg, Kenedy & Graybiel, 1965.
  - Simulator Sickness Questionnaire
    - Kenedy, Lane, Bermbaum & Lilienthal, 1993

* developped with Navy simulators

  - Virtual Reality Symptom Questionnaire
    - Ames, Wolffsohn & McBrien, 2005.

Typical symptoms

	SSQ subscales
• Discomfort	N, O
• Fatigue	O
• Headache	O
• Eyestrain	O
• Diffic. Focusing	O, D
• Salivation	N
• Sweating	N
• Nausea	N
• Dizzy	D
• Vertigo	D
• Etc.	

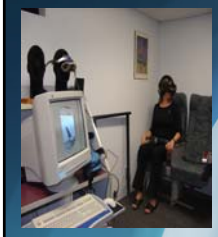


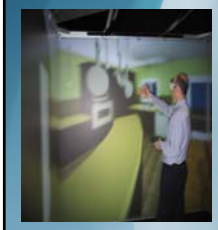
Aim

- Assess the factor structure of the SSQ with a sample of people drawn from the general population, including people suffering from anxiety disorders.

Method

- 371 adults (71% female) recruited in the general population either for research on anxiety disorder
  - (n = 164 DSM-IV diagnoses based on the SCID)
  - specific phobia, social phobia, generalized anxiety disorder, panic disorder with agoraphobia and post-traumatic stress disorder.
- or experiments with "normal controls"
  - (n = 207 screened with the SCID for the absence of anxiety disorders).
- Mean age 35.2 (s.d. = 12.96, range from 18 to 68).





Material

- In order to maximize the generalization of the results, participants were immersed in virtual reality with different technologies (HMD, CAVE-like), different HDM (I-Glass, Cy-Visor, nVis, V8, Visettre-pro), different trackers (Intertrax2 , Inertia CUBE, IS-900), and performed different tasks (i.e., exposure to feared stimuli, exploration, attention) and for different durations (immersions lasted between 5 to 60 minutes).

Results

- Analyses conducted separately with anxious and non-anxious people yielded similar results. Data were therefore collapsed for the final analyses.
- A principal factor analysis was performed, followed by a varimax rotation. The number of factors was assessed based on three criteria: eigenvalue higher than one, the scree-plot test and the interpretability of the factor solution (including reducing cross-loadings to a minimum). The eigenvalue criteria pointed towards a three-factorial solution but between two to four factors were examined.
- Only the two-factor solution was satisfactory.

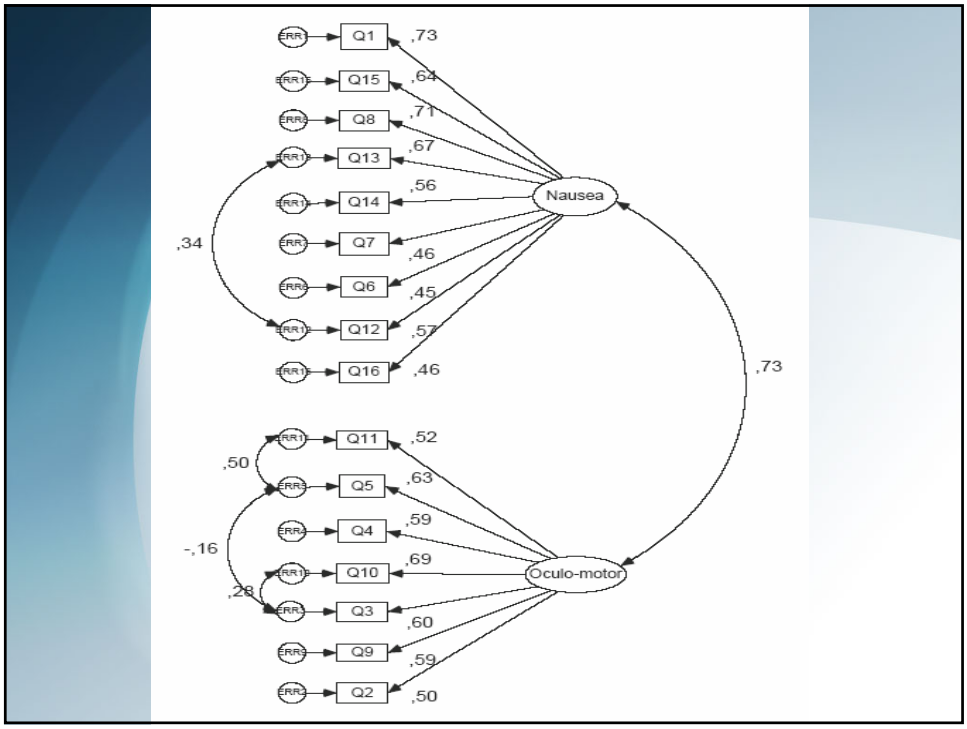
Table 2. Factor structure of the French SSQ in the current sample. N = 371.

Items	Factor 1 Nausea	Factor 2 Oculomotor
1. General discomfort	.70	
2. Fatigue		.44
3. Headache		.56
4. Eyestrain		.72
5. Difficulty focusing		.76
6. Increased salivation	.54	
7. Sweating	.61	
8. Nausea	.67	
9. Difficulty concentrating		.51
10. Fullness of head		.66
11. Blurred vision		.79
12. Dizzy (eyes open)	.52	
13. Dizzy (eyes closed)	.63	
14. Vertigo	.62	
15. Stomach awareness	.69	
16. Burping	.48	

Note. Factor loadings lower than .40 are not reported.

A confirmatory factor analyses (SEM)

- The two factor model provided an adequate fit to the data, as shown with a variety of fit indexes:
  - χ^2 (99, N = 141) = 280, p <0.01
  - CFI = 0.91, NFI = 0.66, GFI = 0.92
  - RMSEA = 0.07, RMR = 0.02
  - and examination of the modification indexes.
- A comparison between the two and three factors model confirmed that the two-factor model was more parcimonious:
  - AIC = 354 vs 369, respectively
  - BIC = 498 vs 536, respectively



Discussion

- The SSQ may have two factors in clinical samples.
  - Differences in population…
  - Differences in tasks…
  - Differences in hardware / software…
- It needs replication.
- The oculomotor Sx may relate more to the technology used to display the image and the nausea factor to the effect of postural imbalance.
- The overlap with anxiety Sx must be documented.