A pilot application of a questionnaire to evaluate visually induced motion sickness in spectators of tri-dimensional (3D) movies

Angelo G. Solimini, Alice Mannocci, Domitilla Di Thiene

Department of Public Health and Infectious Diseases, Sapienza University of Rome, Italy
Correspondence to: Angelo Solimini, Sapienza University of Rome, Department of Public Health and Infectious Diseases, Viale Regina Elena 324, 00161 Rome, Italy. E-mail: angelo.solimini@uniroma1.it

Abstract

Background: The increasing popularity of tri-dimensional (3D) movies has raised public concern and media interest about the safety of projected images for spectators. No specific instrument exists to assess the occurrence of visually induced motion sickness (VIMS) symptoms in 3D movie spectators in movie theaters.
Methods: We developed a questionnaire containing 20 items divided into socio demographics, individual characteristics, movie vision characteristics and VIMS symptoms (during, right after, and at two hours from the viewing of the movie). The questionnaire was self administered to 38 subjects, asking them to report time taken for its completion, comments and eventual difficulties in interpreting items.
Results: Poor understanding or problems in identifying the correct item choice were noted for 4 questions belonging to the socio demographics section that were simplified in the final version of the questionnaire. Two other questions were merged into one after homogeneity analysis. Most VIMS symptoms were observed during the movie and quickly thereafter. Tired eyes was the symptom most often reported (39.5% of responders) followed by headache (18.4%), dizziness (18.4%) and nausea (15.8%). Double vision and palpitation were reported with very low frequency (respectively 5.3% and 2.3%) and vomit was not reported by any respondent. Homogeneity of symptom items was good (Cronbach alpha= 0.69). Reliability analysis showed satisfactory item-total correlations (alpha coefficient ranging from 0.61 to 0.73).
Conclusions: The refined survey questionnaire can be applied in future studies to assess the frequency of VIMS symptoms in spectators of 3D movies and to identify the risk factors connected to inter-individual differences in susceptibility and to the characteristics of the movie viewing.

Key words: visually induced motion sickness, questionnaire, tridimensional 3D movies

Introduction

In the last decade, several events of public health relevance, have been associated with the vision of movies and documentaries. Well known is the "Pokemon incident": in December 1997 approximately 700 people in Japan (mostly children) were rushed to hospitals. The youngsters had been watching the vastly popular TV animated cartoon series Pocket Monsters (Pokemon). In a small percentage, patients were treated for epileptic seizures, but other symptoms like nausea, headache, vomiting, appeared more frequently, and autonomic factors, such as motion sickness, could be considered as possible determinant mechanisms [1]. A posterior analysis of the image features presented in Pokemon Monsters revealed that the cartoon was characterized by rapid changes in luminance, patterns and color at fast flash rates [2] that

were indicated as possible determinants of the observed symptoms. Another incident was the so called "Matsue movie sickness incident". In 2003, 36 out of 294 junior high school students were treated in hospital for symptoms of motion sickness after watching a hand camera made movie characterized by unexpected whole image motion and vibration. The students who reported greater symptom severity were distributed in the front rows and central positions, and those who reported less severity were distributed mostly in the back rows. For the authors, this may indicate that the critical visual angle, above which the risk of visually induced motion sickness noticeably increases, may be between the visual angles obtained in the front rows and at the end of each row, at least in the conditions seen in this incident [3]. More recently, the increasing popularity of tri-dimensional (3D) movies has raised public

concern and media interest about the safety of projected images for spectators.

The strong sensorial exercise that is caused by watching a 3D movie can cause visual stress in susceptible spectators and the onset of several symptoms, similar to motion sickness. Visually induced motion sickness (VIMS) includes symptoms of eye strain, nausea and dizziness and might arise during or after viewing dynamic tri-dimensional images while being physically still, like in the movie theatre. In a recent paper, Polonen et al. [4] concluded that most of the people viewing a 3D movie will probably experience some symptoms of eye strain (e.g., tired or irritated eyes, blurred vision) or disorientation (e.g., difficulty focusing, nausea, fullness of head, blurred vision, dizziness, vertigo). In 2007, Oyamada and colleagues [5] studied biomedical effects evoked by audiovisual stimulation to monitor the undesirable effect of images and to avoid side effects. They examined changes in pupillary light reflex parameters and cardiovascular reflex evoked by motion pictures whilst subjects watched 3 stereoscopic short movies: two were made of computer graphics (CG), and the other was of a real environment taken with a camera in a car of a roller coaster (R), which gave a strong vection sensation to all subjects. All participants (seven) felt some discomfort after watching 3D movies and either pupillary and cardiovascular parameters, as well as subjective evaluation, were changed after image presentation [5]. Kennedy and colleagues in a recent paper [6] summarized VIMS symptoms into three general types of effects: (1) nausea; (2) oculomotor and (3) disorientation. Nausea referred to gastrointestinal distress such as nausea, stomach awareness, salivation, and burping. Oculomotor symptoms related to visual disturbances such as eyestrain, also known as asthenopia, blurred vision, and headache. Disorientation effects were related to vestibular disturbances such as dizziness and vertigo [6].

Most of the information on VIMS relates to studies on the adverse effects of virtual reality environments (including head mounted displays, HMD; see [7] and references therein), 3D displays (reviewed by [8]), and simulators (reviewed by [6]), but little is known about the occurrence of such symptoms in cinema spectators of 3D movies. A survey of VIMS symptoms conducted on spectators selected from the general population might permit a realistic assessment of the potential predictors of symptoms, which might include inter individual differences in susceptibility and the effects of movie vision characteristics such as the length of the movie seen or the seating position respect to the screen (e.g. the angle and the proximity to the screen of the viewer). Existing evaluative instruments are specific for motion sickness (Motion Sickness Susceptibility Questionnaire, MSSQ; [9]), simulator sickness (the Simulator Sickness Questionnaire, SSQ; [10]), virtual reality using HMD (VRSQ, [7]), and visual fatigue using 3D televisions [11], but no instruments exist to assess symptoms and individual susceptibility in cinema spectators of 3D movies.

In this paper we describe and pilot test a questionnaire that was developed to assess VIMS symptoms in cinema spectators of commercially released 3D movies. The pilot test of the questionnaire regards a basic understanding of items, frequency of endorsement of symptoms and internal consistency. The questionnaire includes items to test possible associations between symptoms and socio demographic characteristics, individual characteristics regarding autonomic nervous related disturbances and visual stress, and movie vision characteristics. It is aimed for large scale surveys of the general public of 3D cinemas and one of our aims was to keep the administration time as short as possible.

Methods
Questionnaire development

We developed a questionnaire containing 20 items which can be grouped into four general categories: socio demographics, individual characteristics, movie vision characteristics and VIMS symptoms. A draft version was administered in a pre- pilot stage to 10 subjects in the presence of one of the co-authors. Ambiguous and not fully understood items were reworded according to the comments received. We added one symptom at this stage (see below). The resulting questionnaire was then pilot tested on 38 subjects, asking them to report time of completion, comments and eventual difficulties in interpreting items.

Questionnaire description
Socio demographics

Socio demographics consisted of 6 questions including age (5 categories: 18-29, 30-39, 40-49, 50-59, >=60), gender, marital status (married or living with partner, never married, widowed or divorced or separated), employment status (self employed, full time employed, part time employed, not employed, university student, retired), educational level (elementary and junior high school, senior high school, university graduate, post graduate studies) and city of residence (open question).
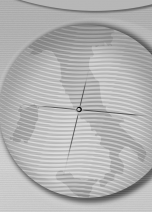
Health related individual characteristics

Individual characteristics (6 questions) included health conditions related to the autonomic nervous activities, 2 questions on the commitment to the use of computers and video game consoles and the use of glasses or prescription lens when watching movies at cinema. Participants were asked to refer to their condition in the few months prior to the compilation.

We asked subjects to report frequency of headaches including migraine (4 categories: never, sometimes, often, very often), frequency of motion sickness when traveling by car on a long journey or on winding roads (4 categories: never, sometimes, often, very often), frequency of dizziness or vertigo (4 categories: never, sometimes, often, very often). The following question aimed to assess visual fatigue because of visually demanding daily activities and regarded the daily amount of time spent in front of a computer for work and/or leisure plus the time spent using video game console (no use, <1hours, 1-5 hours, >5 hours). The final question in this section regarded the use of glasses or prescription lens when watching movies at cinema (binary yes or no question).

3D movie vision characteristics

An open question regarding the title of the last 3D movie seen, if the polarization glasses were worn during its vision (binary yes or no question) and when the movie was seen (< 1 month ago; 1-3 months ago; >3 months ago; do not remember).

Two questions regarding the seating location respect to the projection screen during the viewing in the movie theatre. The first question referred to the proximity of the seat to the projection screen (near: sit within the first 3 rows from the projection screen; far: the last 3 rows from the projection screen; other: all the others; do not remember). The second question referred to the angle of vision and choices were between lateral (the last 2 seats to the right or left side of the row) or other positions (all the other seats in the row) or "do not remember".

Health assessment and choice of VIMS symptoms

The first question of this section regarded a self assessment of general health in the week when the movie was seen (5 modalities: do not remember, not good, fairly good, very good, excellent). The Next 3 questions related to VIMS symptoms caused by the 3D movie vision at 3 different times (during the 3D movie vision, just after the end and 2 hours later), one question for each time ("During the movie vision / just after

the movie end / after 2 hours from the movie end, have you observed one or more of the following symptoms?". Report of symptoms was through a dichotomous yes/no scale and each respondent could indicate as many symptoms as applicable.

To select the symptoms, we compiled a list from the current literature concerning visual stress from the use of head mounted displays (virtual reality) and motion sickness (including simulator induced sickness). The list was circulated among coauthors for the final selection. Among the most frequently reported symptoms, we selected a balanced list of eye strain related symptoms (tired eyes, double vision, headache) and motion sickness related symptoms (dizziness, nausea and vomiting). After the pre-pilot stage, we added the symptom of palpitation, suggested by the comments of two responders and cross checked by expert opinion. Palpitation is a symptom related to autonomic activation and vaso-vagal response that might play a role also in VIMS.

Statistical analysis

The characteristics of respondents and the number of missing respondents were described using frequencies. The frequency of endorsement of each symptom was determined by summing the number of yes responses cumulated in the 3 viewings (having the symptom regardless if during the movie, right after or after 2 hours) and dividing it by the total number of respondents (38 subjects).

Cronbach alpha was used as a measure of the internal consistency for symptoms considering the three different reporting times (during the movie, right after or after 2 hours). In addition to checking whether any item was consistent or not with the rest of the scale, and could thus be discarded, a reliability analysis was performed. In this analysis, the item-total correlation and the variability of the alpha between items, adding and eliminating items one at a time, was performed [12]. This analysis was done only for symptoms with a frequency of endorsement >15%. The software used to analyze data was SPSS12.00 for Windows and the significant level was set at $p<0.05$.

Results
Characteristics of respondents

All 38 questionnaires submitted were returned completed with no missing data. The time reported to fill in the questionnaire varied between 2 and 5 minutes. The socio-demographic characteristics of respondents are shown in Table 1. The 3D movies seen were Avatar, A Christmas Carol, Ice age 3: dawn of dinosaurs, Cloudy with a chance of meatballs, and Up.
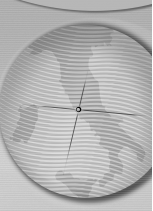
Table 1. Socio demographic, individual and 3D movie vision characteristics of study participants (N=38).

Variables		N	(%)
Age	18-29	19	50
	30-39	10	26.3
	40-49	9	23.7
Gender	Female	16	42.1
	Male	22	57.9
Marital status	Married (or co-habitant with partner)	15	39.5
	Never married	23	60.5
Educational level	High school diploma	24	63.2
	University level degree	14	36.8
Employment status	Currently employed	17	44.7
	Currently unemployed or retired	3	7.9
	University student	18	47.4
Region of residence	Lazio	35	92.1
	Marche	2	5.3
	Sardegna	1	2.6

Comprehension and coherence of items

Based on comments received, we added a category to the question on educational level (post graduate degree) and changed the question regarding the Italian region of residence to "City of residence" (Table 2). Poor understanding or problems in identifying the correct item choice regarded 2 questions belonging to the socio-demographic section. Marital status (Q3) and employment status (Q4) were simplified and possible choices were reduced by grouping original items into broader categories (Table 2). Few respondents asked for changes to other items, and these regarded mainly semantic (e.g. jargon related) issues. Items were reworded according to the comments received in the final version (see Annex).

The homogeneity analysis of the two questions related to daily use of computer and videogame consoles gave a negative Cronbach alpha (alpha = -0.01), violating the reliability model assumptions. To avoid this problem, the question on the daily time spent using computers and the question on the daily time spent using video game consoles were merged into a single question (Daily time spent using of computer or videogame consoles) in the final version of the questionnaire (Table 2 and Annex).

Frequency of endorsement and duration of symptoms

Tired eyes was the symptom most often reported followed by headache, dizziness and nausea (Table 3). Symptoms such as double vision and palpitation had a very low frequency and vomit was not reported by any respondent (Table 3). The distribution of the number of the symptoms for each responders, stratified by time (during, right after and after 2 hours) showed a decrease in symptom frequency with time (Figure 1).

Homogeneity of symptom items

The test of the homogeneity of symptoms was performed on items with a frequency of endorsement >15%, excluding double vision, vomit and palpitation. The Cronbach alpha on the remaining 12 items (see questions 18-20 in Annex, letters a, c, d and e) was 0.69. Reliability analysis showed satisfactory item-total correlations (Table 4). Interestingly, the exclusion of question 19.a (tired eyes, right after the movie), caused a rise of the alpha coefficient from 0.69 to 0.73.

Discussion

The primary aim of this paper was to describe a new survey questionnaire that may be used to assess the frequency of VIMS symptoms in spectators of 3D movies in cinema theatres. Additionally, we included several individual and movie vision related factors that may be associated with symptom frequency. Pilot testing of the questionnaire was performed for basic understanding of items, frequency of endorsement of symptoms and their internal consistency.
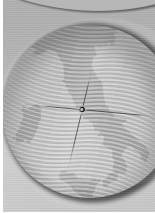
In general terms, symptom related items were

Table 2. Changed questionnaire items after the pilot stage.

Original item (choices)	New Item (see annex for changed categories)	Reason
Region where you live	Q3. City where you live	Comments received: question too vague
Civil status (never married, married, cohabitant with partner, widowed, divorced, separated)	Q4. Marital status	Comments received: difficulties in identifying the correct item choice
Educational level (Elementary, junior high, senior high, university degree)	Q5. Educational level	Comments received: difficulties in identifying the correct item choice for post graduate degrees
Employment type (managers and professionals, technicians and associate professionals, clerks, service, shop and market sales workers, craft and related trades workers and skilled workers, plant and machine operators and assemblers, elementary occupations, armed forces)	Q6. Employment status	Comments received: difficulties in identifying the correct item choice
Daily use of computer (<1 hour, 1-4 hours, 5-8 hour, >8 hours) and Weekly use of videogame consoles (<1 hour, 1-4 hours, 5-8 hour, >8 hours)	Q11 Daily use of computer or videogame console	Negative Cronbach alpha among the 2 original questions
Symptoms (tired eyes, double vision, headache, dizziness, nausea, vomit)	Q18-20 Symptoms	Comments received at pre-pilot stage

all easily understood and the time spent compiling the whole questionnaire, which included items related to socio-demographic, individual and movie vision characteristics, was very satisfactory (2-5 minutes). This is comparable to the time it takes to compile the symptom only sections of more specific and time consuming instruments such as SSQ [6] and VRSQ [7]. Therefore, the proposed questionnaire might be useful for large scale surveys in general population, for example in 3D movie theatres, where short compilation time is an advantage.

The quick disappearance of symptoms was similar to that reported by others [7] for exposure to HMD and suggests researchers to limit the questions to those short-term symptoms observed proximally to post viewing times (e.g. within 0-30 minutes from the end of the movie viewing).
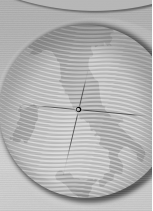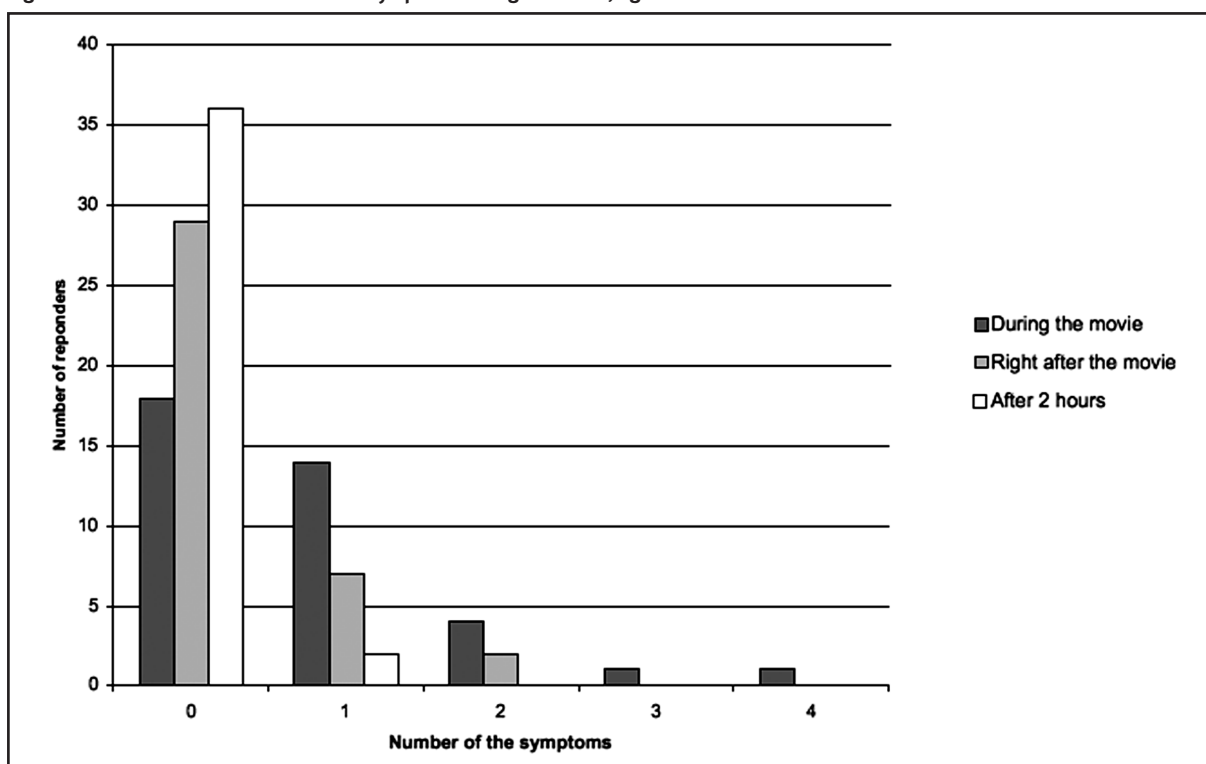
Table 3. Frequency of endorsement of each symptom.

Symptom	Number of yes responses	Frequency of endorsement %
Tired eyes	15	39.5
Double vision	2	5.3
Headache	7	18.4
Dizziness	7	18.4
Nausea	6	15.8
Palpitation	1	2.6
Vomit	0	0

Figure 1. Distribution of the number of the symptoms during the movie, right after and after 2 hours.


However, the persistence of symptoms even after 2 hours from viewing in few individuals might reflect their higher susceptibility to VIMS, possibly linked to personal history of susceptibility to migraine, dizziness, or motion sickness. Therefore, we believe that the question on the evidence of symptoms two hours after the end of the movie in the final version of the questionnaire should remain included.

Among the most frequently reported symptoms in literature for VIMS [6], virtual reality [13, 14], stereoscopic motion images [8] and simulator sickness [6, 15], we selected a balanced list of eye strain related symptoms (tired eyes, double vision, headache) and motion sickness related symptoms (dizziness, nausea and vomiting).

Some symptoms that were reported with high frequency of endorsement in virtual reality studies (general fatigue and discomfort, drowsiness, difficult in concentrating; [7]) were excluded because considered too general for our aims and/ or too difficult to match with the items indicative of potential associated factors. On the other hand, after the pre-pilot stage, we included palpitation, that is a symptom related to autonomic activation and vaso-vagal response. Intriguingly, recent evidence suggests a possible link between motion sickness and vaso-vagal syncope, possibly because of many common symptoms of an autonomic nature [16].

We also made changes to four socio-demographic questions that were originally perhaps too specific for the aim of the current
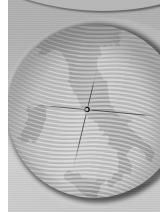
Table 4. Item-total correlation and variability of Cronbach's alpha if one item was deleted after discarding items with low frequency of endorsement.

Times	Items concerning symptoms*	Corrected item-total correlation	Cronbach's Alpha if item deleted
During the movie	18.a (Tired eyes)	0.320	0.707
	18.c (Headache)	0.218	0.693
	18.d (Dizziness)	0.561	0.630
	18.e (Nausea)	0.689	0.617
Right after the movie	19.a (Tired eyes)	-0.075	0.726
	19.c (Headache)	0.816	0.610
	19.d (Dizziness)	0.203	0.699
	19.e (Nausea)	0.340	0.676
After 2 hours from movie	20.a (Tired eyes)	0.001	0.701
	20.c (Headache)	0.816	0.610
	20.d (Dizziness)	0.001	0.701
	20.e (Nausea)	0.001	0.701

The number and letter correspond to the items showed in annex

questionnaire (questions on job type and civil status; see Table 2) or too broad (questions on region of residence and educational level). Finally, in the original pre-pilot questionnaire we included two separate questions both related to activities that could induce visual fatigue to individuals (daily use of computer and daily use of videogame consoles). However, the statistical analysis revealed an antagonistic behavior of those items, possibly because of respondents spending long periods in front of a computer, and spending a small fraction of time using video game consoles and vice versa. For this reason we merged the 2 questions into one (daily use of computer for work or leisure and/or video game console) in the final version of the questionnaire.

The most frequently reported symptoms (tired eyes, headache, nausea and dizziness) are consistent with previous studies on simulator sickness [6] and virtual reality induced sickness [7]. Tired eyes and headache (symptoms of visual fatigue or eye strain), nausea and dizziness might result from the visual stress caused by the intense stimulation during the viewing of the 3D movie. Frequency of endorsement of symptoms indicated that 3 of these (vomit, palpitation and double vision) could be discarded, as very few respondents (none for vomit) experienced them. Interestingly, double vision was also reported with very low frequency of endorsement in another study on virtual reality induced sickness [7]. However, the low number of individuals recruited in the present test stage, suggests to keep items referred to those symptoms included in the final version of the questionnaire for broader testing.

The homogeneity of the symptoms in the questionnaire was acceptable (Chronbach alpha of 0.69) and all symptoms correlated quite well, as evident from the high item-total correlation values (0.61-0.73). This indicates that the three basic dimensions used in simulator sickness studies, and included in a simulator specific instrument (SSQ: visual fatigue, nausea and disorientation; [6]), were all represented in our VIMS questionnaire. We did not evaluate test–retest reliability or time-based criterion validity, and further studies should focus on those aspects of the questionnaire too.

Image safety of three-dimensional movies is of increasing interest for public health because
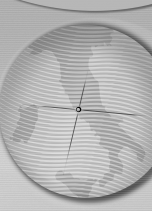
of the recent rise in the commercial offer of 3D movies in cinemas. Additionally, new 3D display televisions available for home entertainment have just arrived on the market at affordable prices. The intense visual experience, especially when viewing 3D motion images for a long time, might cause VIMS symptoms in susceptible individuals. Mechanistically, visual stress can be linked to any visual stimuli to which the visual system is most sensitive, that interfere with the perception of other stimuli, and that give rise to large electrical and vascular brain response [17]. In susceptible individuals visual stress can cause eyestrain, migraine, nausea and even seizures [17].

In conclusion, we have developed a survey questionnaire to assess the frequency occurrence of VIMS symptoms in spectators of 3D movies in theatres that should facilitate a more general assessment of the inter-individual differences in VIMS susceptibility and the risk factors connected to the characteristics of the movie viewing itself. Future studies should consider the experimental submission of the questionnaire to two different groups of 3D movie spectators: one symptomatic (presenting a pre-existent co-morbidity, like nausea or oculomotor or disorientation symptoms) and the other one asymptomatic. The comparison among these groups should enable a more precise analysis of the resulting symptoms and of the risk factors related to lengthened exposure to dynamic tridimensional images.

References

1) Furusho J, Suzuki M, Tazaki I, et al. A comparison survey of seizures and other symptoms of Pokemon phenomenon. Pediatr Neurol 2002; 27:350-5.

2) Harding GRA. TV can be bad for your health. Nat Med 1998; 4:265-7.

3) Ujike H, Ukai K, Nihei K. Survey on motion sickness-like symptoms provoked by viewing a video movie during junior high school class. Displays 2008;29:81-9.

4) Pölönen M, Salmimaa M, Aaltonen V, Häkkinen J, Takatalo J. Subjective measures of presence and discomfort in viewers of color-separation-based stereoscopic cinema. J Soc Inf Display 2009;17:459-66.

5) Oyamada H, Iijima A, Tanaka A, et al. A pilot study on pupillary and cardiovascular changes induced by stereoscopic video movies. J Neuroeng Rehabil 2007; 4:37.

6) Kennedy RS, Drexler J, Kennedy RC. Research in visually induced motion sickness. Appl Ergon 2010;41:494-503.

7) Ames SL, Wolsohn JS, McBrien NA, The development of symptom questionnaire for assessing virtual reality viewing using a head-mounted display. Optom Vis Sci 2005;82:168-76.

8) Ukai K, Howarth PA. Visual fatigue caused by viewing stereoscopic motion images: Background, theories, and observations. Displays 2008; 29:106-16.

9) Golding JF. Motion sickness susceptibility questionnaire revised and its relationship to other forms of sickness. Brain Res Bull 1998;47:507-16.

10) Kennedy RS, Lane NE, Berbaum KS, Lilienthal MG. Simulator Sickness Questionnaire (SSQ): a new method for quantifying simulator sickness. Int J Aviat Psychol 1993;3:203-20.

11) Kuze J, Ukai K. Subjective evaluation of visual fatigue caused by motion images. Displays 2008;29:159-66.

12) Mannocci A, Di Thiene D, Del Cimmuto A, Masala D, Boccia A, De Vito E, La Torre G. International Physical Activity Questionnaire: validation and assessment in an Italian sample. Ital J Public Health 2010;7:369-76.

13) Howarth PA, Costello PJ. The occurrence of virtual simulation sickness when a HMD was used as a personal viewing system. Displays 1997;18:107-16.

14) Lo WT, So RH. Cybersickness in the presence of scene rotational movements along different axes. Appl Ergonom 2001;32:1-14.

15) Johnson DM. Introduction to and review of simulator sickness research. U.S. Army Research Institute for the Behavioral and Social Sciences,2005.

16) Bosser G, Caillet G, Gauchard G, Marçon F, Perrin P. Relation between motion sickness susceptibility and vasovagal syncope susceptibility. Brain Res Bull 2006;68: 217-26.

17) Wilkins A. Visual Stress. Oxford: Oxford University Press, 1995.
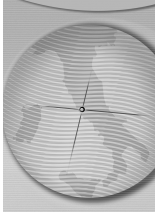
Annex

A questionnaire for survey of visually induced motion sickness symptoms and possible associated factors in spectators of 3D movies in theatres.

(mark where appropriate, please answer to all questions)

Section I. Socio demographic characteristics of responder

1) Age

☐ 18-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ >60

2) Gender

☐ Male ☐ Female

3) City where you live

…………………………..

4) Marital status

☐ Married or cohabitant with partner

☐ Never married

☐ Separated or divorced or widowed

---

5) Educational level

☐ Elementary or junior high school

☐ Senior high school

☐ University level degree

☐ Post graduate degree (PhD, Master, Specialization school etc.)

6) Employment status

☐ Full time employed

☐ Part time employed

☐ Self employed

☐ Currently unemployed

☐ Retired

☐ University student

Section II. Health related individual characteristics (think to the past few months)

7) How often do you suffer of motion sickness when travelling by car on a long journey/ roads with many curves

☐ Very often

☐ Often

☐ Sometimes

☐ Never

8) How often do you suffer because of headache (including migraine)

☐ Very often

☐ Often

☐ Sometimes

☐ Never

---

9) How often do you suffer because of dizziness and/or vertigo

☐ Very often

☐ Often

☐ Sometimes

☐ Never

10) Daily time spent using computer for work and leisure and/or video game console

☐ None

☐ Less than 1 hour per day

☐ 1-5 hours per day

☐ More than 5 hours per day

Annex

A questionnaire for survey of visually induced motion sickness symptoms and possible associated factors in spectators of 3D movies in theatres.
(mark where appropriate, please answer to all questions)

Section III. 3D movie vision characteristics

11) When watching a movie in a cinema, do you use glasses or prescription lenses?

☐ Yes   ☐ No

12) Title of the last 3D movie seen

………………………………………

13) When have you seen this movie?

☐ Within the past month

☐ Between 1 to 3 months ago

☐ More than 3 months ago

☐ Do not remember

14) Did you use the polarization glasses during the vision?

☐ Yes   ☐ No

15) Position during vision in the cinema: proximity to the screen

☐ Seated within first 3 rows from screen

☐ Seated within the last rows, further from the screen

☐ Others

☐ Do not remember

16) Position during vision in the cinema: viewing angle

☐ Lateral (last 2 sits in a row at right or left sides)

☐ Others (all the other sits in a row)

☐ Do not remember

Section IV. Health assessment before, during and after the 3D movie vision

17) How would you define your health during the week when you saw the movie?

☐ Excellent

☐ Very good

☐ Fairly good

☐ Not good

☐ Not remember

18) During the movie vision, did you experience one or more of the following symptoms?

☐ A. Tired eyes

☐ B. Double vision

☐ C. Headache

☐ D. Dizziness

☐ E. Nausea

☐ F. Palpitation

☐ G. Vomit

☐ H. None

19) Right after the end of the movie, did you experience one or more of the following symptoms?

☐ A. Tired eyes

☐ B. Double vision

☐ C. Headache

☐ D. Dizziness

☐ E. Nausea

☐ F. Palpitation

☐ G. Vomit

☐ H. None

20) After 2 hours from movie vision, did you experience one or more of the following symptoms?

☐ A. Tired eyes

☐ B. Double vision

☐ C. Headache

☐ D. Dizziness

☐ E. Nausea

☐ F. Palpitation

☐ G. Vomit

☐ H. None