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Liverpool Investigation of Virtual Reality in Radiotherapy (LIViRR)

Abstract

An important innovation in radiotherapy training is the current introduction of virtual reality training packages throughout England. In Liverpool the Virtual Environment for Radiotherapy (VERT) will allow students to operate a simulated clinical linear accelerator. They will alter treatment parameters, position a virtual patient for radiotherapy delivery and inspect the resulting distributions of radiation dose. However, simulator systems typically induce unwelcome symptoms in a proportion of the population ("cybersickness"). We propose to monitor students before, during and after use of the system, investigate symptoms reported, and look for predictors for those students who will encounter problems.

Methodology

a) Aim

To investigate the prevalence of "cybersickness" in a cohort of radiotherapy students who are exposed to a virtual reality training environment (the Liverpool VERT) as part of their skills training and acquisition.

Objectives

1) To document symptoms induced by the Liverpool (immersive) VERT.
2) To relate symptoms to baseline measures of visual and visuomotor function.

b) Methodology

Subjects: The subjects will be 33 students undertaking the first year of the BSc (Hons) Radiotherapy programme, in the School of Health Sciences, University of Liverpool.

Measurements: Given the type of VR system to be used in Liverpool, the 13 item Virtual Reality Symptom Questionnaire (VRSQ; Ames et al, 2005) is an appropriate instrument for measuring likely symptoms. The VRSQ will be completed prior to exposure to the VR system, immediately after the first session using the system, and after subsequent exposure (the timing will depend on how the VR system is incorporated into the Radiotherapy programme). Participants will keep a dosage diary to supplement academic records. For comparative purposes, the VRSQ will also be completed by a group of control subjects (not exposed to VR); these will be non-radiotherapy students from the School of Health Sciences. Each Radiotherapy student will have a full vision assessment, prior to exposure. This will include measurement of visual acuity (distance and near), refraction, stereoacuity, cover test, and measurement of fixation disparity. Their current spectacle/contact lens correction will be recorded if appropriate, and a short ocular history taken.

Analysis: Non-parametric descriptive statistics will be used to analyse the questionnaire data, and some of the vision data where ceiling or floor effects might occur. The sample will be stratified using the qualitative data in order to explore systematic relationships between symptoms and vision and oculomotor data. At the end of the academic year, we will examine relationships between dose, VRSQ and functional data, and training outcomes.

c) Potential Impact

If "cybersickness" is found to be prevalent in the student population, it may become necessary to include vision assessment and the VRSQ as part of health screening for radiotherapy students entering pre-registration programmes. The VERT will be closely monitored from an educational perspective. However, given the occurrence of cybersickness, a number of important functional questions need to be addressed. If, for example, this particular VR environment induced significant symptoms in a large proportion of a student cohort, this would have an impact on its use as a teaching tool. At the very least it would constrain the levels of exposure. In the system to be used, any cybersickness is likely to stem from visual or visuomotor problems. We therefore propose to collect baseline visual (eg measurements of stereoacuity, accommodation) and eye movement data (eg motility, vergence measurements) from a student cohort, along with data from a symptom questionnaire (the Virtual Reality Symptom Questionnaire; Ames et al, 2005). We will be able to correlate physiological and qualitative measures with dosage and educational measures of the training outcomes.

d) Outcomes

VRSQ: This should reveal the occurrence and severity of symptoms. Moderate to severe symptoms in more than two or three students (given a total of 33) would be a worrying finding. Mild symptoms in four to ten students are more likely. We require definite symptoms in some, and no symptoms in others, to examine whether measures of vision and/or oculomotor control can act as predictors, and perhaps be used to screen students. Symptom levels and training performance will also be examined to investigate how experience of VERT impacts on training.

e) Evaluation and Dissemination Strategy

The project will be continuously monitored and evaluated by the project team. It will also be subject to internal monitoring and evaluation within the School of Health Sciences. Data relevant to the educational and training used of the VERT will be provided to the Radiotherapy programme team in the University as appropriate. The project will also be subject to School and Faculty governance procedures.

Interim and final project outcomes will be presented to the College of Radiographers' Annual Radiotherapy Weekend, UKRO, at the Association of Medical Education Annual Conference and the HEA's annual Festival of Learning. Papers will be submitted to Radiography and/or Journal of Radiotherapy in Practice, and disseminated to radiotherapy and vision professionals via CPD. Vision related data will be presented internationally (eg at the annual ARVO meeting in the USA) and submitted to vision journals (eg Vision Research, Investigative Ophthalmology and Vision Science).

f) Timetable

Months 1-3	Baseline vision data, pre-exposure VRSQ questionnaires
Months 4-6	First set of post-exposure VRSQ and dose diaries; preliminary analysis; initial publication (abstract)
Months 7-9	Collection of control (non-exposed subjects) VRSQ data. Further analysis
Months 10-12	Collection of final VRSQ, collation of final dose diaries. Completion of analysis. Paper completed in draft

Literature Review

The 1990's saw the rapid deployment of virtual reality (VR) systems in industrial, public and educational contexts. As technology has developed, and costs have reduced, larger scale deployments in education and training have become possible. However, the use of VR has brought with it problems. VR induces a range of unwelcome symptoms in a proportion of the population which have collectively become known as "cybersickness" (see Cobb et al. 1999). Estimates of the prevalence and severity of cybersickness vary. A surprisingly high proportion of the general population experience mild symptoms (of the order of 60% to 95%; Regan & Price, 1994; Stanney et al, 1998; Cobb et al, 1999). In a small proportion (5%; Cobb et al, 1999) symptoms are so severe that it is necessary to discontinue VR exposure. These figures are highly influenced by the nature of the VR technology (eg head mounted vs projected displays), the nature of the VR environment (eg sparse vs rich content) and the nature of the tasks undertaken (eg fine motor tasks in a fixed position vs passive viewing) as well as participant specific factors. Many of these, and the interactions between them, have yet to be investigated in detail.

References

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