



Linguistic Validation of Interactive Educational Interventions in Neurologic Trauma

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■ **BACKGROUND:** Neurological surgeons oftentimes educate patients and their families on complex medical conditions and treatment options. Time constraints and varied linguistic and cultural backgrounds limit the amount of information that can be disbursed. In this study, we assessed the linguistic validity of interactive educational interventions in non-English-speaking patients with traumatic brain injury (TBI) and concussion and their families.

■ **METHODS:** A total of 273 English-, Spanish-, Korean-, and Vietnamese-speaking neurotrauma patients ($n = 124$) and family members ($n = 149$) completed a presurvey to evaluate their incipient understanding, interacted with an iPad-based iBook (Apple) on concussion or TBI in their native language, completed a postsurvey to gauge changes in understanding, and then consulted with their neurosurgeon.

■ **RESULTS:** All participants (124 patients and 149 family members) had significantly increased (95% confidence interval [CI], $P < 0.01$) postsurvey scores (average pre-iBook score, 2.810; average post-iBook score, 4.109), regardless of native language or cultural background. Caucasian participants scored significantly higher than the combination of all ethnicities on both the baseline survey (95% CI, $P < 0.01$) and the post-iBook survey (95% CI, $P < 0.01$), and Asian participants scored significantly lower (95% CI, $P < 0.05$) than the combination regardless of similar baseline scores.

■ **CONCLUSIONS:** Interactive iBook-based interventions on concussion and TBI can increase participants'

comprehension, improve their comfort with their medical condition and the follow-up care, and enhance communication with their physicians. These findings are linguistically valid irrespective of the participants' native language or cultural background.

INTRODUCTION

Traumatic brain injury (TBI) is a prevalent societal problem, affecting 2.5 million individuals each year, at an annual cost of \$60 billion in medical expenses and productivity losses in the United States alone.¹⁻⁵ A variety of contributing etiologic factors can lead to TBI, and patients can present with a wide array of neurologic deficits necessitating careful examination, diagnosis, and intervention.⁶⁻¹⁰ Even minor head injuries, such as concussion (typically defined as a Glasgow Coma Scale score of 13–15), can lead to numerous psychophysiological defects that present immediately or at some time after the insult. Repeated concussions have been linked to severe neurodegenerative disorders, particularly chronic traumatic encephalopathy.¹¹⁻¹⁴

Neurological surgeons are challenged with the important responsibility of treating patients with TBI. Along with surgical and medical interventions, this entails educating patients and their families on the spectrum of TBI, any surgical interventions performed, the recovery process, and preventative measures to reduce further damage.¹⁵⁻¹⁸ The implementation of pedagogic interventions, such as promotion of helmets and protective equipment for children and simple tips to prevent falls in elderly patients, may help prevent further injury and repeat TBI or concussion.¹⁶⁻¹⁸

Key words

- Brain injury
- Concussion
- Culture
- Education
- iBook
- Language
- Neurologic surgery

Abbreviations and Acronyms

ANOVA: analysis of variance

CI: confidence interval

CT: computed tomography

TBI: traumatic brain injury

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Interactive, easy-to-read educational materials that engage patients and their family members can facilitate active learning, knowledge acquisition, and long-term information retention in a variety of clinical and nonclinical locations.^{19–21} Furthermore, comparisons with text-based educational material have demonstrated the advantages of active electronic educational interventions in both preoperative and postoperative settings, specifically in the field of neurotrauma.^{22–28}

A variety of factors, including inadequate information, lack of time, linguistic barriers, and varied cultural backgrounds of patients, can limit the amount of knowledge that can be disbursed by the physician and lead to suboptimal patient education through any medium.^{29,30} Although the efficacy of interactive educational interventions, such as educational iBook modules presented on an iPad (Apple, Cupertino, California, USA), has been demonstrated in English-speaking patients of all ages who are familiar with such technology, the linguistic validity of this intervention has not yet been investigated. In the present study, we assessed and compared the linguistic validity of interactive educational interventions in non-English speaking patients with TBI or concussion and their families as opposed to native English speakers (Figure 1). We hypothesized that interactive presentation of information in outpatient settings will improve self-reported patient knowledge and help optimize the patient–physician interaction.

METHODS

English-, Spanish-, Korean-, and Vietnamese-speaking patients and accompanying family members attending the American College of Surgeons—verified level I trauma center at University of California Irvine between August 2015 and June 2017 consented to participate in this Institutional Review Board–approved study. After providing consent, the participants received a presurvey to evaluate their incipient understanding of their medical condition, treatment options, and follow-up care. Survey responses were scored on a 5-point Likert scale, with scores closer to 5 indicating higher self-reported knowledge (Supplemental Digital Content 1).³¹

The participants then received a standard 32-GB Apple iPad displaying an interactive iBook on TBI or concussion, depending on the patient's clinical diagnosis (Figure 2).^{32–34}

Patients were seen between 2 weeks and 6 months following their initial injury to ensure recovery to a considerable degree, as indicated by a Glasgow Outcome Score of 5.³⁵ Patients who presented with distinct injuries shown on computed tomography (CT) scan at admission received information on TBI. Head injuries implicated on CT scans included skull fracture, subarachnoid hemorrhage, diffuse axonal injury, traumatic contusion, subdural hematoma, and epidural hematoma. Some patients with TBI had undergone an operative procedure (e.g., brain monitoring, craniotomy); however, only those who had recovered to a Glasgow Outcome Score of 5 before their clinic visit were included in this study. Patients with concussion had normal CT scans and were diagnosed clinically. Accompanying family members were provided with the same educational content given to the patients.

All electronic modules were synthesized using iBooks Author software and presented in each patient's native language. The synthesized information focused on head injury prevention, management, prognosis, and treatment, all at a 10th-grade reading level based on the Coleman–Liau Index.³⁶ Reading time for the iBook, which consists of interactive diagrams, videos, and pop-out widgets, was approximately 10 minutes. While participants reviewed the educational information, researchers were asked to leave the room to diminish bias. Afterward, participants were provided with a Likert-scale postsurvey to gauge any changes in their understanding of head injury. Finally, patients and family members had a standard clinical encounter with their neurosurgeon.

Both surveys were provided in each patient's native language, with approximately half of the surveys including not only knowledge questions, but also communication and comfort questions to allow internal assessment of response reliability. Surveys and iBooks were initially crafted in English and then meticulously translated via the 5-step process described by Forsyth et al: (1)

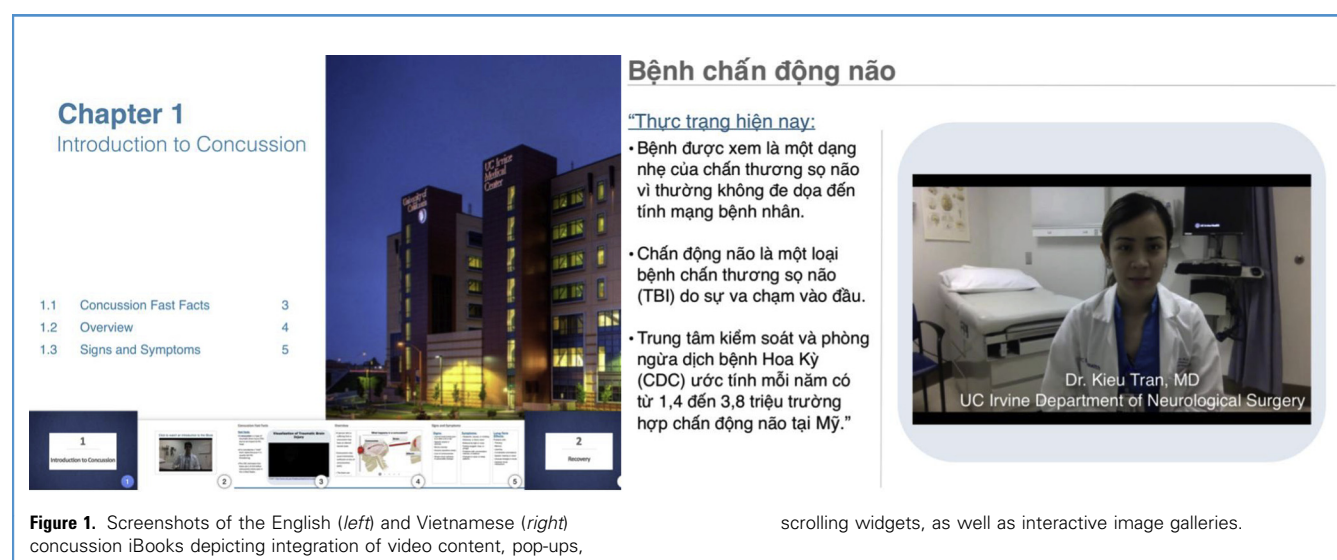


Figure 1. Screenshots of the English (left) and Vietnamese (right) concussion iBooks depicting integration of video content, pop-ups,

scrolling widgets, as well as interactive image galleries.

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