

Purpose: The study's purpose was to investigate the psychometric properties of the Social Communication (SC) item pool as a precursor to its inclusion in a computer adaptive measure of functional cognition (defined as *the ability to accomplish everyday activities that rely on cognitive abilities*, such as locating keys, communicating with family, planning a trip) for individuals with traumatic brain injury (TBI).

Background: Although cognitive impairment following TBI varies from patient to patient, deficits in attention, memory and cognitive processing speed are common (Lezak, Loring, Howieson, Howieson, & Hannay, 2004; Millis et al., 2001). Disruption of relatively basic cognitive functions, such as attention and memory, often cause or exacerbate problems in more complex cognitive functions such as executive functioning and communication (Arciniegas, Held, & Wagner, 2002). Precise evaluation of cognitive functioning in individuals with TBI is critical for directing cognitive rehabilitation and determining a treatment's effectiveness.

Neuropsychological and functional assessment approaches have been used to assess cognition after TBI. Both types of assessment have merits and limitations. Neuropsychological assessments have a long history of statistical validity and quantify important cognitive constructs (e.g., memory, attention, processing speed) effectively (Lezak et al., 2004), but can be time consuming and have been questioned for lacking ecological validity (Chaytor & Schmitter-Edgecombe, 2003). On the other hand, functional assessments such as the Functional Independence Measure (FIM™) are short and have face validity but have limited theoretical bases, are not designed to measure separate cognitive constructs, and fail to capture the full range of cognition in real life (Coster, Haley, Ludlow, Andres, & Ni, 2004). We are attempting to address the inherent limitations of both assessment approaches by developing a new instrument designed to evaluate functional cognition in individuals with TBI using Item Response Theory (IRT) statistical methodologies and computer adaptive test (CAT) item administration.

Item response theory (IRT) (e.g. Rasch measurement model) in combination with computerized adaptive test-administration offers a level of efficiency and precision beyond classical testing methods. Precision is achieved because Rasch measurement provides detailed examination of item difficulty and person ability calibrated on a single interval scale. Efficiency is achieved because items are arranged in a hierarchical difficulty order; therefore individuals do not have to rate items that are clearly above or below their ability levels as they must do in classically designed assessments, where all items must be completed. CAT allows each individual taking a test to receive only those questions from the calibrated item bank that are most relevant (i.e., 5-15 questions per construct) which reduces patient and administrator burden.

Current neuropsychological models of cognition were used to generate relevant cognitive constructs: attention, memory, processing speed, executive functioning, emotional management, and social communication. The constructs and item bank were endorsed by a panel of nationally recognized experts in TBI rehabilitation. Last, to add face validity to the items developed, 20 individuals with TBI, 20 caregivers, and 10 healthcare professionals provided feedback on item relevance, and clarity. The feedback was used to modify the item bank, prior to paper-pencil test administration. The social communication (also called pragmatics of language or language usage) construct was conceptualized using Sohlberg and Mateer's (2001) definition of the pragmatics of language; the system of rules that govern the effective use of language in various verbal and social situations (p.306). Functionally, we defined social communication as the ability to use language appropriately in a given social situation to accomplish the purpose of the communicative interaction. The following taxonomy for pragmatic behaviors was used to direct item development: non-verbal communication, topic management, conversational, register (use

of appropriate tone of voice and language for the speaking situation), word order/complexity/accurateness of the conversation, effectiveness of language usage (Prutting & Kirchner, 1987). To reduce the floor and ceiling effects often seen in traditional cognitive and language assessments, items were developed that reflected the typical progression of TBI recovery: acute hospitalization, inpatient rehabilitation, outpatient rehabilitation, and 1-year post injury.

Methods: Participants originally diagnosed with TBI (n=69, outpatient and one-year post injury) and their caregivers (n=68) responded to the paper-pencil version of the functional cognition item bank. The complete instrument consisted of 228 items divided into the six cognitive domains described above. The SC construct rated by TBI participants contained 30 items with a four-unit rating scale (1=never, 2=sometimes, 3=often, 4=always, 0=n/a). Item-level psychometrics were obtained using *Winsteps* Rasch analysis software. Differential item functioning analysis was used to compare participant and caregiver ratings.

Results: The patient sample included 47 males, 22 females (mean age 40.2, range 18 to 84). Thirty were rehabilitation outpatients and 39 were 1-year post injury. The SC construct demonstrated sound item-level psychometric properties: no ceiling or floor effects were noted; Cronbach's alpha was .92; person separation was 2.67; person separation reliability was .88; and 97% of the items (29 of 30) and 85% of the participants (59 of 69) fit the Rasch model.

The caregiver respondents were 53 females and 16 males (mean age 51 years, range 21 to 88). The SC construct rated by caregivers also demonstrated sound item-level psychometric properties for this group as well: no ceiling or floor effects; Cronbach's alpha was .96; person separation was 3.54; person separation reliability was .93; 87% of the items (26 of 30) and 90% of the participants (62 of 69) fit the Rasch model.

To test the hypothesis that individuals with TBI would rate their cognitive functioning differently than their caregivers rated it, we used differential item functioning (DIF). Evidence of DIF is present when item shift between two groups is $>.05$ logits ($t \geq 1.96$, $p < .05$ (Tristan, 2006). Results showed that patients and caregivers did not rate the items in significantly different ways (i.e., t values ranged from 0 to ± 0.1).

Conclusions: The results of this analysis show that the items developed for the SC construct appear to have promising item level psychometric properties for inclusion in the computerized adaptive measure of functional cognition for TBI. The DIF results have positive implications in that individuals with TBI and their proxies rated items on the SC construct similarly. These results also have positive implications for the use of proxy ratings when a patient is unable to respond. Although TBI participants fitting the model was within acceptable parameters, future investigation into the characteristics of the "misfitting" individuals may lead to a better understanding of who are the best raters for patient reported outcomes, such as the CAMFC-TBI. The next phase of measure development is to complete the concurrent validity analysis comparing item bank construct measures with traditional neuropsychological assessments. In the case of Social Communication, ratings will be compared to ratings of the American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS) (Frattali, Holland, Thompson, Wohl, & Ferketic, 1995).

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