Psychological Assessment
2018, Vol. 30, No. 4, 524–538

© 2017 American Psychological Association
1040-3590/18/$12.00 http://dx.doi.org/10.1037/pas0000501

Assessment of Emotion Processing Skills in Acquired Brain Injury Using an Ability-Based Test of Emotional Intelligence

Sarah E. Hall and Joanne M. Wrench
University of Melbourne; Austin Health, Melbourne, Victoria, Australia; and Alfred Health, Melbourne, Victoria, Australia

Sarah J. Wilson
University of Melbourne

Social and emotional problems are commonly reported after moderate to severe acquired brain injury (ABI) and pose a significant barrier to rehabilitation. However, progress in assessment of emotional skills has been limited by a lack of validated measurement approaches. This study represents the first formal psychometric evaluation of the use of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) V2.0 as a tool for assessing skills in perceiving, using, understanding and managing emotions following ABI. The sample consisted of 82 participants aged 18–80 years in the postacute phase of recovery (2 months–7 years) after moderate to severe ABI. Participants completed the MSCEIT V2.0 and measures of cognition and mood. Sociodemographic and clinical variables were collated from participant interview and medical files. Results revealed deficits across all MSCEIT subscales (approximately 1 *SD* below the normative mean). Internal consistency was adequate at overall, area, and branch levels, and MSCEIT scores correlated in expected ways with key demographic, clinical, cognitive, and mood variables. MSCEIT performance was related to injury severity and clinician-rated functioning after ABI. Confirmatory factor analysis favored a 3-factor model of EI due to statistical redundancy of the Using Emotions branch. Overall, these findings suggest that the MSCEIT V2.0 is sensitive to emotion processing deficits after moderate to severe ABI, and can yield valid and reliable scores in an ABI sample. In terms of theoretical contributions, our findings support a domain-based, 3-factor approach for characterizing emotion-related abilities in brain-injured individuals.

Public Significance Statement
Difficulties with social and emotional skills are commonly described after acquired brain injury, but are often not formally assessed due to a lack of good quality tests. The results of the present study suggest that an ability-based test of emotional intelligence may be a useful measure of emotional skills in this group, with benefits for clinical practice.

Keywords: emotional intelligence, emotion processing, social cognition, acquired brain injury, psychometrics

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Moderate to severe acquired brain injury (ABI), a condition characterized by damage to the brain due to trauma, stroke, hypoxia, infection, or other causes, can lead to significant and prolonged disability (Mahar & Fraser, 2011). Although historically neglected, changes in emotional and social skills are now increasingly recognized as a significant barrier in returning to social and occupational functioning (for reviews, see Babbage et al., 2011; Bornhofen & McDonald, 2008a; Yuvaraj, Murugappan, Norlinah, Sundaraj, & Khairiyah, 2013). The challenges associated with these difficulties are most prominent during the postacute period of recovery, when individuals are seeking to reintegrate into the community and maintain relationships with friends and family (Burridge, Williams, Yates, Harris, & Ward, 2007; Ietswaart, Milders, Crawford, Currie, & Scott, 2008; Schonberger, Ponsford, Olver, & Ponsford, 2010).

Although there is extensive evidence of the complex and multifaceted nature of emotion-related competencies in the nonclinical literature (for reviews, see Joseph & Newman, 2010; Mayer, Roberts, & Barsade, 2008), research in ABI has focused primarily on a single domain: emotion perception. Numerous studies have now demonstrated that a subset of individuals with ABI have difficulty recognizing emotions in faces, voices, and body postures (for reviews, see Babbage et al., 2011; Bornhofen & McDonald, 2008a; Yuvaraj et al., 2013). Many researchers have urged for a more comprehensive evaluation of emotional functioning after ABI (e.g., Eslinger, Parkinson, & Shamay, 2002; Hynes, Stone, & Kelso, 2011). However, progress has been limited by a lack of psychometrically sound measurement approaches validated for use in this population.

This article was published Online First May 29, 2017.

Sarah E. Hall and Joanne M. Wrench, Melbourne School of Psychological Sciences, University of Melbourne; Royal Talbot Rehabilitation Centre, Austin Health, Melbourne, Victoria, Australia; and Caulfield Hospital, Alfred Health, Melbourne, Victoria, Australia. Sarah J. Wilson, Melbourne School of Psychological Sciences, University of Melbourne.

This research was financially supported by the Windermere Foundation Limited. Special thanks to Madeleine Connellan and Neira Borcic for their assistance with data collection.

Correspondence concerning this article should be addressed to Sarah E. Hall, Melbourne School of Psychological Sciences, University of Melbourne, Grattan Street, Parkville, Victoria 3010 Australia. E-mail: sarah.hall@unimelb.edu.au

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

The Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) V2.0 (Mayer, Salovey, Caruso, & Sitarenios, 2003) is a standardized instrument that has been used extensively with healthy adults (Mayer et al., 2008; O'Boyle, Humphrey, Pollack, Hawver, & Story, 2011) and, more recently, in some clinical populations (Eack et al., 2010; Fett et al., 2011). The MSCEIT V2.0 is based upon Mayer and colleagues' theory of emotional intelligence (EI; Mayer & Salovey, 1997), which conceptualizes emotional skills as comprising four key domains (termed branches): (a) the ability to accurately perceive and appraise emotions in faces, body language, artworks, and other stimuli (Perceiving Emotions); (b) the ability to use emotions to facilitate thinking and performance (Using Emotions); (c) the ability to understand how emotions can blend and change over time and to draw upon a broad knowledge base about emotions (Understanding Emotions); and (d) the ability to manage and regulate emotions of oneself and others in adaptive ways (Managing Emotions). Within the model, the branches are ordered hierarchically according to the proposed degree of sophistication of each skill. The more fundamental skills of Perceiving and Using Emotions are subsumed under the *Experiential EI* area, and the higher level branches of Understanding and Managing Emotions belong to the *Strategic EI* area. All four branches contribute to an overall EI index, which is proposed to represent a general, higher-order factor akin to an emotional "g" (Salovey & Mayer, 1990).

In the general population, the MSCEIT V2.0 has been shown to yield good test–retest reliability (r = .86 over a 3-week period; Brackett & Mayer, 2003) and internal consistency (r = .91–.93 for the overall score, r = .76–.91 for the four branches; Mayer, Salovey, & Caruso, 2002; Mayer et al., 2003; Palmer, Gignac, Manocha, & Stough, 2005). In support of convergent validity, MSCEIT scores have been found to correlate with other conceptually related measures of social cognition, including emotion recognition ability (Schlegel, Grandjean, & Scherer, 2013), empathy (Brackett, Rivers, Shiffman, Lerner, & Salovey, 2006; Ciarrochi, Chan, & Caputi, 2000), theory of mind (Ferguson & Austin, 2010), alexithymia (Lumley, Gustavson, Partridge, & Labouvie-Vief, 2005), and social competence (Barchard & Hakstian, 2004; Márquez, Martín, & Brackett, 2006). Discriminant validity has been provided by low correlations with theoretically distinct measures of cognition and personality, indicating that the MSCEIT assesses a relatively independent construct (Bludau & Legree, 2008; Joseph & Newman, 2010; Mayer et al., 2008; Schlegel et al., 2013). In terms of predictive validity, studies have demonstrated that MSCEIT scores are positively associated with adaptive psychosocial outcomes including well-being, relationship quality, and social support, and negatively associated with antisocial outcomes such as social deviance, violence, and use of illicit substances (e.g., Barlow, Qualter, & Stylianou, 2010; Brackett, Warner, & Bosco, 2005; Di Fabio, 2015; Lopes et al., 2004; Trinidad & Johnson, 2002).

In studies examining the factor structure of the MSCEIT, support for Mayer and colleagues' original theoretical model of EI has been mixed. While Mayer and colleagues (2003) initially showed that scores could be modeled using one-, two-, and four-factor solutions corresponding to scores at the overall, area, and branch levels, others have since found these solutions to be implausible or poor-fitting (Gardner & Qualter, 2011; Gignac, 2005; Keele & Bell, 2009; Palmer et al., 2005; Roberts et al., 2006; Rode et al., 2008; Rossen, Kranzler, & Algina, 2008). An alternative three-factor model has now been proposed that omits the second branch, Using Emotions to Facilitate Thought, due to concerns about the theoretical and statistical redundancy of this branch (Joseph & Newman, 2010; MacCann, Joseph, Newman, & Roberts, 2014). In support of this, a three-factor model has been shown to provide a better fit to MSCEIT scores for healthy adults than the original one-, two-, or four-factor models (for a meta-analysis, see Fan, Jackson, Yang, Tang, & Zhang, 2010).

In addition to its widespread use with healthy adults, more recent studies have found the MSCEIT V2.0 to be sensitive to social–cognitive deficits in clinical disorders such as psychosis, bipolar, substance use, and personality disorders (Ermer, Kahn, Salovey, & Kiehl, 2012; Hertel, Schutz, & Lammers, 2009; Nitzburg, Burdick, Malhotra, & DeRosse, 2015). The MSCEIT has been used extensively in schizophrenia, where patients tend to score consistently below that of healthy controls across all branches of the test (Dawson, Kettler, Burton, & Galletly, 2012; Eack et al., 2010; Kee et al., 2009; Wojtalik, Eack, & Keshavan, 2013). A strength of the MSCEIT V2.0 that is particularly relevant for use with clinical populations is its performance-based format; rather than one's perception of his or her own emotional skills, as is typically obtained through self-report scales, the MSCEIT measures the capacity to perform well on tasks of emotional perception, knowledge, and reasoning. This is especially pertinent in neurological conditions such as ABI, as reduced self-awareness and insight is a common consequence of brain impairment (Gasquoine, 2016; Ownsworth & Clare, 2006; Prigatano, 2005). Other strengths of the scale for use in clinical research identified by the National Institute of Mental Health are superior test–retest reliability of scores (e.g., intraclass correlation coefficients of .73 or better), relationship to functional outcomes, and practicality and tolerability relative to other available social–cognitive measures (Green, Olivier, Crawley, Penn, & Silverstein, 2005; Nuechterlein et al., 2008).

Overall, there is good evidence to suggest that the MSCEIT may hold promise for assessment of emotion processing skills in ABI. Despite this, its psychometric properties have not yet been formally investigated in this population. Thus, the aim of this study was to conduct an initial exploratory psychometric evaluation of the utility of the MSCEIT as a tool for assessing emotional abilities in ABI. In particular, we sought to examine the utility of the MSCEIT among individuals with moderate to severe ABI who had received treatment from an ABI rehabilitation service. Despite heterogeneity in injury etiology, this group tends to have complex support needs and often experiences chronic disability, including social and emotional dysfunction (Teasell et al., 2007; Turner-Stokes, Pick, Nair, Disler, & Wade, 2015). We sought to address the following three research questions:

1. What are the psychometric properties of the MSCEIT V2.0 in an ABI sample?

2. Is the MSCEIT V2.0 sensitive to emotion-processing deficits after ABI?

3. Does the factor structure of MSCEIT V2.0 scores in ABI align with existing theoretical models from the general population?

Method

Participants

Participants comprised 82 adults with ABI recruited as outpatients through the Victorian ABI Rehabilitation Services, two state-wide specialist brain injury services consisting of the Royal Talbot Rehabilitation Centre (RTRC) ABI Unit, Austin Health ($N = 65$) and the Caulfield Hospital ABI Rehabilitation Centre, Alfred Health ($N = 17$). All participants had sustained an ABI of sufficient severity to warrant a period of specialist ABI inpatient rehabilitation postinjury. Consistent with the type of patients typically admitted to inpatient brain injury rehabilitation, all participants had moderate to severe ABI as determined by at least one of the following characteristics: initial Glasgow Coma Scale (GCS) <13 (lowest GCS during the first 24 hours of admission not associated with intubation, sedation, or intoxication), posttraumatic amnesia >24 hours (for TBI participants), evidence of ABI-related abnormalities on neuroimaging, and/or clinical impression of moderate to severe injury documented by the treating team in the medical file. All participants had been discharged from inpatient rehabilitation and were living in the community at the time of the assessment, with time since injury ranging from 2 months to 7 years.

Criteria for inclusion in the study were: (a) age of 18 years or over, (b) a diagnosis of ABI according to medical records, (c) capacity to provide informed consent as determined by the treating rehabilitation consultant or clinical neuropsychologist, (d) adequate proficiency in English, (e) no significant visual, hearing or language impairment that would preclude participation in neuropsychological testing, and (f) no severe psychiatric comorbidities, such as active psychosis or delirium, or preexisting diagnosis of neurodegenerative disease such as Dementia of the Alzheimer's Type.

Sociodemographic and injury-related characteristics of the sample are presented in Table 1. Consistent with the higher prevalence of ABI among males in the broader population, the majority of participants (81%) were men. Participants were sampled across a broad spectrum of age ranges typically admitted to inpatient ABI rehabilitation units, including young adults (18–35; 28%), middle-aged adults (36–60; 55%), and older adults (61–80; 17%). TBI was the most common etiology across sites, comprising 63% of ABIs at RTRC and 71% of ABIs at Caulfield Hospital, and across all age groups, accounting for 65% of injuries among young adults, 67% of injuries among middle-aged adults, and 50% of injuries among older adults. The most frequent cause of TBI for each age group was a fall, constituting 38% of TBIs in young adults, 70% of TBIs in middle-aged adults, and 71% of TBIs in older adults. Stroke was the second largest contributor to ABI across both sites (20% of RTRC patients and 12% of Caulfield patients), and included both ischemic (53%) and hemorrhagic (47%) strokes.

Table 1
Participant Characteristics

Characteristics	Mean (*SD*)/Freq (%)	Range
Sociodemographic characteristics		
Age	44.84 (14.85)	18–80
Young adults (18–35 years)	17 (28%)	
Middle-aged adults (36–60 years)	45 (55%)	
Older adults (61–80 years)	14 (17%)	
Gender (male)	66 (81%)	
Education (≤ Year 12)	38 (46%)	
Preinjury employment (full- or part-time)	71 (87%)	
Postinjury employment (full- or part-time)	27 (33%)	
Preinjury marital status (married/de-facto)	40 (49%)	
Postinjury marital status (married/de-facto)	38 (46%)	
Injury-related characteristics		
Time since injury (months)	17.05 (17.48)	2–88
Aetiology		
Traumatic Brain Injury (TBI)	52 (63%)	
MVA	11 (13%)	
Assault	10 (12%)	
Fall	32 (39%)	
Vascular	15 (18%)	
Hypoxic	6 (7%)	
Multiple	3 (4%)	
Other^	6 (7%)	
Initial GCS (score out of 15)	8.49 (4.06)	3–15
PTA (days, for TBI only)	25.54 (17.18)	1–90
Duration of acute hospital admission (days)	23.61 (19.16)	2–85
Duration of inpatient rehabilitation admission (days)	40.93 (53.85)	1–328
FIMs at discharge (total)	116.32 (10.03)	78–126
FIMs at discharge (cognition)	30.06 (4.58)	17–35

Note. MVA = motor vehicle accident; GCS = Glasgow Coma Scale; PTA = Post Traumatic Amnesia; FIM = Functional Independence Measure.
^ Aetiology (Other) = Encephalitis ($N = 3$), Meningitis ($N = 2$), and Stroke-like migraine attacks after radiation therapy (SMART) Syndrome ($N = 1$).

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Stroke was the second most common cause of injury across all age groups, comprising 22% of ABIs sustained by young adults, 13% of those sustained by middle-aged adults and 29% of those sustained by older adults.

Design

The study used a cross-sectional design, with participants assessed at a single time point postinjury. Preinjury and medical data were collected retrospectively.

Procedure

Ethics approval was obtained from the Austin Hospital, Alfred Hospital, and University of Melbourne Human Research Ethics Committees. A total of 236 individuals meeting selection criteria were shortlisted by a Senior Clinical Neuropsychologist or Medical Rehabilitation Consultant and provided with verbal and written information about the study. Of the 236 individuals invited to participate, 154 declined due to difficulty accessing transport, lack of time or interest in the project, or because they did not attend their outpatient appointment and could not be contacted by other means. The 82 individuals who provided written informed consent to participate attended a 2-hr assessment at the hospital site where they had received treatment. The assessment consisted of a brief structured interview to obtain sociodemographic information, the computer-based MSCEIT V2.0, cognitive tests, and self-report questionnaires. Participants received a small financial reimbursement for travel expenses associated with attending the appointment.

Measures

Sociodemographic information including age, gender, years of formal education, marital status (single or married/defacto), and employment status (full-time, part-time or unemployed) pre- and postinjury was collected via participant interview. Medical and injury-related information was collated from medical records, including lowest initial GCS score during the first 24 hours of hospital admission, posttraumatic amnesia (PTA) duration (for TBI participants) measured using the Westmead PTA Scale (Shores, Marosszeky, Sandanam, & Batchelor, 1986), duration of acute and rehabilitation admissions, and rehabilitation team-rated Functional Independence Measure (FIM) scores (Keith, Granger, Hamilton, & Sherwin, 1987).

Emotion processing skills were measured using the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT V2.0). This 141-item test is based on Mayer et al.'s (2003) four-branch theoretical model of EI and takes approximately 30–45 min to complete. It is divided into eight tasks, with each of the four EI branches measured via two tasks. Perceiving Emotions is assessed by asking respondents to identify emotions in facial expressions (Faces task) and in landscapes and abstract designs (Pictures task). Using Emotions to Facilitate Thoughts is measured by asking respondents how emotions relate to sensations such as temperature and color (Sensations task), and which emotions are best for facilitating cognitive and social tasks (Facilitation task). Understanding Emotions is assessed by asking respondents how emotions can coexist in particular situations (Blends task), and how emotions can change in intensity over time (Changes task). Finally, Managing Emotions is measured by asking respondents to select the most effective action to achieve a desired outcome in an emotional situation (Emotion Management task) and in an emotional situation involving other people (Emotional Relations task). Response formats vary across tasks to reduce correlated measurement error (Mayer et al., 2003). The Faces, Pictures, Sensations, Emotion Management and Emotional Relations tasks use variations of 5-point Likert scales with words or pictures, whereas the Facilitation, Blends and Changes tasks use a multiple-choice format with three to five response options.

Participants' responses are sent in de-identified format to Evidence Based Psychology LCC, the consulting company responsible for managing MSCEIT licenses in Australia, for electronic scoring. In line with recommendations by Mayer and colleagues (2003), expert rather than consensus scoring protocols were used (Mayer et al., 2002). Using the expert method, responses to each item are scored relative to the proportion of experts (21 members of the International Society for Research on Emotions) who endorsed that response as the correct answer (Mayer et al., 2002, 2003). For example, if a participant selects a response designated as correct by 80% of the experts, then the participant receives a score of .80. The weights for each item are summed to yield eight task-level scores, four branch-level scores, two area-level scores and an overall score. These raw scores are standardized relative to a normative sample of 5,000 individuals described as representative of the general U.S. population in terms of gender, age, ethnicity, and education level ($M = 100$ and $SD = 15$; Mayer et al., 2003). The profile of MSCEIT scores in an Australian sample ($N = 431$) has been found to be highly comparable with the U.S. standardization sample ($r = .89$; Palmer et al., 2005), supporting the use of this normative dataset in other Western countries. Further detail on item format, scoring and standardization methods can be found in the *MSCEIT User's Manual* (Mayer et al., 2002).

Cognitive abilities were assessed using several neuropsychological measures. General intellect was estimated using one of two brief measures to minimize the time burden on participants: the Wechsler Test of Adult Reading (WTAR; $N = 20$) or Wechsler Abbreviated Scale of Intelligence Two-Subtest Form (WASI; $N = 62$; Wechsler, 1999). The WASI tests verbal and nonverbal abilities using Vocabulary and Matrix Reasoning tasks, which are combined to yield a composite score (FSIQ-2). FSIQ-2 has been shown to have adequate internal consistency ($\alpha = .93$) and test–retest reliability ($r = .88$), and good convergence ($r = .87$) with FSIQ from the Wechsler Adult Intelligence Scale Third Edition (WAIS-III; Wechsler, 1997, 1999). Working memory was assessed using Digit Span scaled scores and information processing speed was assessed using Digit-Symbol Coding scaled scores from the WAIS-III (Wechsler, 1997). Verbal fluency was measured with the Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1976), using the raw score of the total number of words generated for the letters *F*, *A*, *S*.

Mood was measured using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), a brief 14-item self-report screening questionnaire that assesses the severity of symptoms of anxiety and depression. It contains seven items measuring anxiety (HADS-A subscale) and seven items measuring depression (HADS-D subscale). Items are rated on a 4-point scale (0–3) to indicate how an individual has been feeling over the past week,

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

with the total score for each subscale ranging from 0 to 21. Studies of reliability and validity support the use of the HADS as a screening tool for symptoms of depression and anxiety among individuals with brain injury (Dawkins, Cloherty, Gracey, & Evans, 2006; Ownsworth & Fleming, 2005; Salter, Bhogal, Foley, Jutai, & Teasell, 2007; Schonberger & Ponsford, 2010).

Sample Size and Power

In light of criticisms of the "rule-of-thumb" approach for determining sample size in CFA,[1] we consulted previous Monte Carlo simulation studies to estimate the required sample size (Muthén & Muthén, 2002; Wolf, Harrington, Clark, & Miller, 2013). Simulation studies have demonstrated that smaller sample sizes are sufficient for CFA models that have fewer factors, more indicators, strong factor loadings, and/or strong factor correlations (Marsh, Hau, Balla, & Grayson, 1998; Wolf et al., 2013). In a meta-analysis of 18 studies ($N = 10{,}573$) examining comparable CFA models of MSCEIT structure in the healthy population, average factor loadings were .67 and factor intercorrelations ranged from .61 to .90 (Fan et al., 2010). According to calculations by Wolf and colleagues (2013), the minimum sample size required to achieve adequate statistical power (>80%), minimal bias and solution propriety for a three-factor CFA with eight indicators, factor loadings of .65 and factor intercorrelations of .50 has been estimated at $N = 55$. As we anticipated strong factor loadings and intercorrelations among MSCEIT variables based on previous findings, we estimated that a sample size of $N > 80$ should be sufficient to achieve a reasonable degree of power.

Statistical Analysis

Descriptive analyses were conducted in SPSS Version 22. Some data were missing for GCS scores, FIM scores, and cognitive variables. Overall, missing data totaled less than 2% of the dataset. Little's MCAR test was nonsignificant, $\chi^2(199) = 204.43$, $p = .381$, indicating that data were missing completely at random (R. J. Little & Rubin, 2002). For data missing completely at random, single imputation using the expectation maximization algorithm has been shown to provide unbiased parameter estimates and increased statistical power (Do & Batzoglou, 2008; Gold & Bentler, 2000; R. J. Little & Rubin, 2002; Musil, Warner, Yobas, & Jones, 2002). Missing data were imputed using the expectation maximization algorithm under the Missing Values Analysis function in SPSS v22.0. Correlational analyses were performed with and without the imputed values, with no change to the interpretation of findings. Thus, the results for the complete data set are reported.

All variables were normally distributed except for time since injury (positively skewed), duration of acute and rehabilitation hospital admissions (positively skewed), FIMS total and cognition scores at discharge (negatively skewed) and GCS score (multimodal). Correlations between these non-normal variables and MSCEIT scores were conducted using Spearman's rho. Correlations between normally distributed continuous variables were conducted using Pearson's *r*. Relationships between continuous and binary variables were investigated using point-biserial correlations. Criterion α was set at $p < .05$ (two-sided). Corrections were not applied for multiple comparison testing due to the exploratory nature of the study (Armstrong, 2014). For reliability analyses, the split-half reliability method (using the Spearman-Brown formula) was used for MSCEIT scores at the overall, area, and branch levels due to heterogeneity in item response formats, in line with recommendations by Mayer et al. (2003). Cronbach's alpha was used for assessing consistency at the task level, as the items within each task have a homogenous response format.

To compare competing theoretical models of EI, we performed confirmatory factor analysis (CFA) with maximum likelihood estimation using AMOS V23.0 (Arbuckle, 2014). Models were specified a priori to replicate those tested in previous MSCEIT factor analytic studies with healthy samples (Gardner & Qualter, 2011; Mayer et al., 2003; Palmer et al., 2005; Rode et al., 2008; Rossen et al., 2008). In line with these studies, second-order measurement models were used, whereby the eight task scores were modeled as indicators rather than the 141 items (Bagozzi & Edwards, 1998). Additionally, latent variables were allowed to correlate, error variances were uncorrelated for all models except Model 5, and one regression coefficient for each latent variable and all regression coefficients for the residuals of the observed variables were set at unity to achieve model identification, as per previous studies.

Multiple statistics were considered to inform decisions about model fit. To assess absolute fit, we used χ^2(α set to $p < .01$) and the root mean square error of approximation (RMSEA), for which smaller values are indicative of better fit. To assess incremental fit, we consulted the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Akaike's Information Criterion (AIC). Higher values of CFI and TLI and lower values of AIC indicate better fit relative to other models tested (Hooper, Coughlan, & Mullen, 2008), with the AIC penalizing most for model complexity (Williams & Holahan, 1994). We additionally consulted two indices of model parsimony, the Parsimonious Normed Fit Index (PNFI) and Parsimonious Comparative Fit Index (PCFI), for which higher scores indicate more parsimonious solutions (Mulaik et al., 1989). In evaluating acceptable fit, we considered previously established criteria of RMSEA < .06 and CFI and TLI > .95 as representing good fit, and RMSEA < .08 and CFI and TLI > .90 as representing moderate fit (Browne & Cudeck, 1993; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Ultimately, our final decision about the best-performing model was informed by a range of factors, including absolute and incremental model fit, parsimony, factor loadings and meaningfulness.

Results

Descriptive Statistics

Examination of the distribution of scores revealed a good spread of MSCEIT overall, area, and branch scores within the sample. Inspections of histograms and Shapiro-Wilk tests indicated that scores for the overall EI index, two areas, and four branches were approximately normally distributed (all W > .97). The means and standard deviations of the MSCEIT subscales are presented in Table 2. Single-sample *t* tests comparing mean scores obtained by the current sample against the mean of 100 ($SD = 15$) from the

[1] Many authors have argued that generic "rules-of-thumb" (i.e., minimum subject-to-variable or subject-to-parameter ratios) rarely result in accurate estimates because they do not account for variability in model specification (MacCallum, Widaman, Zhang, & Hong, 1999; Velicer & Fava, 1998).

Table 2
Descriptive Statistics and Normative Comparisons for Overall Index, Two Areas and Four Branches of the MSCEIT V2.0

MSCEIT V2.0 Scores							
Total	Area	Branch	*M*	*SD*	*t*	*p*	*d*
Overall EI			84.09	16.03	−8.99	<.001	1.00
	Experiential EI		90.73	19.64	−4.27	<.001	.61
		Perceiving emotions	94.29	20.03	−2.58	.012	.38
		Using emotions	89.03	15.91	−6.25	<.001	.73
	Strategic EI		84.21	12.72	−11.25	<.001	1.00
		Understanding emotions	85.26	13.93	−9.58	<.001	.98
		Managing emotions	87.77	13.68	−8.99	<.001	.82

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; EI = emotional intelligence. Single-sample *t*-tests comparing scores in this sample to the normative mean of $M = 100$, $SD = 15$ ($N = 5{,}000$; Mayer et al., 2002).

large normative sample of $N = 5{,}000$ published by Mayer and colleagues (2003) revealed that participants performed significantly below the standardization sample on all four branches and the overall index of EI (see Table 2). Cohen's *d* calculations, as a measure of the magnitude of the difference in scores of the current sample compared to the standardization sample, revealed effect sizes ranging from medium (for the Perceiving Emotions branch) to large (for the Understanding Emotions branch, Strategic EI area and overall EI score; Table 2). On overall EI, 22% of participants scored in the extremely low range (<70), 14% in the borderline range (70–79), 28% in the low average range (80–89), 32% in the average range (90–109), and 4% in the superior range (120–129).

Reliability

Internal consistency reliability estimates for the overall, area, branch, and task levels are presented in Table 3. Overall, split-half reliability was excellent at the overall EI level and ranged from good to excellent at the branch level. At the task level, Cronbach's alpha ranged from poor to excellent. Split-half reliabilities at the overall, area, and branch levels in the current sample were generally equivalent to or higher than those reported in previous studies of samples drawn from the general Australian and American populations (e.g., Mayer et al., 2003; Palmer et al., 2005) as well as in clinical samples (e.g., Eack et al., 2010).

Validity

Convergent, discriminant and criterion validity. We conducted an initial examination of the validity of MSCEIT score interpretations in ABI by investigating how participants' scores related to demographic variables, injury-related factors, cognition and mood (see Table 4). In terms of convergent and discriminant validity, MSCEIT scores correlated in expected ways with demo-

Table 3
Internal Consistency Reliability Estimates for Overall Index, Two Areas, Four Branches and Eight Tasks of the MSCEIT

MSCEIT V2.0 scores					
Total	Area	Branch	Task	No. items	r^a
Overall EI				141	.96
	Experiential EI			80	.97
		Perceiving emotions		50	.97
			Faces	20	.91
			Pictures	30	.95
		Using emotions		30	.78
			Facilitation	15	.59
			Sensations	15	.61
	Strategic EI			61	.88
		Understanding emotions		32	.83
			Changes	20	.64
			Blends	12	.59
		Managing emotions		29	.73
			Management	20	.50
			Relationships	9	.50

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; EI = emotional intelligence.
[a] In line with Mayer et al. (2003), internal consistency estimates were calculated using Cronbach's α at the task level due to item homogeneity, and using the equivalent forms split-half reliability method (Spearman-Brown formula) at the branch, area and overall index level due to heterogeneity in item format.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Table 4
Correlations Between MSCEIT Scores and Demographic Variables, ABI-Related Characteristics, Cognition, and Mood

Variables	Overall EI	Perceiving emotions	Using emotions	Understanding emotions	Managing emotions
Demographics					
Age	−.08	−.08	−.07	−.12	.12
Gender (0 = male, 1 = female)	.23*	.27*	.11	.07	.22*
Education (0 = ≤ Year 12, 1 = tertiary)	.21	−.01	.16	.37**	.09
Injury-related characteristics					
Recruitment site (0 = RTRC, 1 = Caulfield)	.14	.20	.08	−.05	.12
Time since injury†	.04	.05	.00	.03	.13
Aetiology (0 = traumatic, 1 = nontraumatic)	.03	.05	.10	.01	.07
Initial GCS within first 24 hours (/15)†	.37**	.23*	.33*	.28*	.26*
Duration of acute hospital admission (days)†	−.27*	−.19	−.23*	−.24*	−.07
Duration of rehab admission (days)†	−.27*	−.20	−.23*	−.27*	−.19
FIM at discharge (total)†	.22*	.25*	.19	.21	.10
FIM at discharge (cognition)†	.28*	.29**	.15	.29**	.11
Mood					
Depression symptoms (HADS-D)	.01	.06	.12	−.04	−.14
Anxiety symptoms (HADS-A)	−.03	−.03	.09	.03	−.12
Cognition					
Estimated FSIQ	.44**	.18	.50**	.49**	.23*
Working memory (Digit Span SS)	.30**	.13	.12	.22*	.36*
Processing speed (Coding SS)	.35**	.18	.19	.35**	.26*
Verbal fluency (COWAT total score)	.42**	.25*	.33*	.39*	.24*

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; EI = emotional intelligence; ABI = acquired brain injury; RTRC = Royal Talbot Rehabilitation Centre; GCS = Glasgow Coma Scale; FIM = Functional Independence Measure; HADS = Hospital Anxiety and Depression Scale; FSIQ = Full Scale Intelligence Quotient; SS = Scaled Score; COWAT = Controlled Oral Word Association Test. † Correlations conducted using Spearman's rho due to non-normality. All remaining correlations represent Pearson's *r* (for continuous variables) and point-biserial correlations (for binary variables).
* $p < .05$. ** $p < .01$, 2-tailed.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

graphic factors, cognitive test performance, and self-reported symptoms of mood disturbance. Consistent with established findings on the relationship between gender, education and MSCEIT performance, Understanding Emotions scores were higher for those with tertiary education ($r_{PB} = .37$, $p < .001$), and females in our sample tended to obtain higher scores than males on Perceiving Emotions ($r_{PB} = .27$, $p = .014$), Managing Emotions ($r_{PB} = .22$, $p = .043$) and overall EI ($r_{PB} = .23$, $p = .035$). As expected, MSCEIT scores did not correlate substantially with self-reported symptoms of depression and anxiety as measured by the HADS, but did show small to medium positive associations with cognitive task performance (*r*s = .12 to .50; see Table 4), consistent with previous findings in the general population (e.g., Joseph & Newman, 2010; Lopes, Salovey, & Straus, 2003; Roberts, Zeidner, & Matthews, 2001; Schulte, Ree, & Carretta, 2004).

Investigation of concurrent validity revealed a positive association between MSCEIT scores and clinician-rated measures of global and cognitive functioning at the time of discharge. Participants with lower scores on the cognition subscale of the FIMS (which assesses functional memory, problem-solving, social interaction and language skills), demonstrated lower performances on overall EI, $r = .28$, $p = .011$, Perceiving Emotions, $r = .29$, $p = .008$ and Understanding Emotions, $r = .29$, $p = .009$. In terms of injury severity, participants with lower GCS scores tended to perform more poorly overall, $r = .37$, $p = .001$, and on each subscale, including Perceiving Emotions, $r = .23$, $p = .036$, Using Emotions, $r = .33$, $p = .003$, Understanding Emotions, $r = .28$, $p = .012$, and Managing Emotions, $r = .26$, $p = .018$. A similar pattern was seen for participants with longer acute and rehabilitation hospital admissions and lower scores for overall EI, Using and Understanding Emotions, $r = .23$ to $.27$, $p < .05$.

Construct validity. To examine the construct validity of the conceptual model underpinning the MSCEIT, we first examined the intercorrelations between the test's tasks, branches, areas and overall index (see Table 5). At the task level, correlations were highest for the task pairs within each branch, ranging from moderate ($r = .39$ for tasks within the Perceiving Emotions branch) to large ($r = .57$ for tasks within the Understanding branch). The relationship between tasks belonging to different branches ranged from $r = .06$ to $.51$, with weak correlations observed between tasks assessed by the Perceiving Emotions branch with those from the Understanding Emotions branch, $r = .06$ to $.07$, $p > .05$ as well as the Relationships task from the Managing Emotions branch, $r = .16$, $p > .05$. At the branch level, associations were generally moderate to large, $r = .38$ to $.52$, $p < .05$, except for the Perceiving and Understanding branches, which were not significantly associated, $r = .21$, $p > .05$. The two areas (experiential and strategic EI) showed a significant positive relationship, $r = .44$, $p < .01$.

Confirmatory factor analysis. Finally, we tested the validity of six competing theoretical models of EI from the literature within the current ABI sample using CFA. Details of the models tested and their parameter estimates are outlined in Table 6, with fit statistics presented in Table 7.

Model 1. The first model tested was a single-factor solution comprising eight MSCEIT tasks loading onto an overall factor. Although factor loadings on the latent variable were all positive and significant ($p < .001$) as shown in Table 6, this model yielded

Table 5
Intercorrelations Among MSCEIT Task, Branch and Overall Scores

	MSCEIT Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Overall EI															
2	Experiential EI	.88**														
3	Perceiving emotions	.74**	.90**													
4	Faces	.62**	.79**	.89**												
5	Pictures	.64**	.71**	.75**	.39**											
6	Using emotions	.78**	.78**	.52**	.42**	.48**										
7	Facilitation	.57**	.54**	.37**	.25*	.43**	.72**									
8	Sensations	.72**	.73**	.56**	.49**	.45**	.90**	.43**								
9	Strategic EI	.79**	.44**	.32**	.22*	.36**	.53**	.43**	.49**							
10	Understanding emotions	.68**	.32**	.21	.09	.34**	.43**	.39**	.37**	.91**						
11	Changes	.61**	.31**	.16	.07	.27*	.44**	.32**	.39**	.81**	.86**					
12	Blends	.58**	.27*	.18	.06	.30**	.34**	.36**	.25*	.80**	.90**	.57**				
13	Managing emotions	.68**	.46**	.38**	.35**	.26*	.48*	.33**	.50**	.74**	.41**	.43**	.32**			
14	Management	.60**	.46**	.36**	.31**	.35**	.49**	.33**	.51**	.62**	.38**	.45**	.24*	.77**		
15	Relationships	.59**	.38**	.33**	.33**	.16	.37**	.28**	.39**	.67**	.35**	.32**	.31**	.93**	.49**	

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; EI = emotional intelligence. Pearson's correlation coefficients.
* $p < .05$. ** $p < .01$, 2-tailed.

fit statistics that were not within acceptable limits (e.g., $\chi^2_{(20)} = 49.609$, $p < .001$[2]; TLI = .751). This is consistent with previous findings demonstrating that a single EI factor model does not provide good fit to the data (Fan et al., 2010; Palmer et al., 2005; Rossen et al., 2008).

Model 2. For the oblique two-factor model, consisting of two latent variables representing the Experiential and Strategic Areas of EI, all factor loadings were positive and significant ($p < .001$). There was a strong positive correlation between the two factors, $r = .76$, $p < .001$, suggesting the existence of a higher order factor. However, the model yielded nonsatisfactory levels of absolute and relative model fit ($\chi^2_{(19)} = 39.302$, $p < .01$; TLI = .820), consistent with previous studies (Fan et al., 2010; Palmer et al., 2005; Rossen et al., 2008).

Model 3. Model 3 was an oblique four-factor solution, with the eight tasks loading onto factors corresponding to the four branches of the MSCEIT. This model yielded a nonpositive definite covariance matrix due to collinearity between the Perceiving and Using Emotions branches ($r = .98$), replicating previous findings (Brackett & Mayer, 2003; Day & Carroll, 2004; Gardner & Qualter, 2011; Gignac, 2005; Palmer et al., 2005). This solution is inadmissible, and suggests that these two branches are statistically redundant in the model.

Model 4. Following Palmer and colleagues (2005), Model 4 consisted of the eight MSCEIT tasks loading onto both a first-order overall EI factor and four first-order branch factors (see Figure 1). This model was specified using a nested factor modeling technique (Gustafsson & Balke, 1993; Mulaik & Quartetti, 1997), permitting assessment of Model 1 and Model 3 simultaneously. The factor loadings from the task pairs onto each branch first-order factor were constrained to be equal to ensure model identification, as per Little, Lindenberger, and Nesselroade (1999) and Palmer and colleagues (2005). The model yielded a $\chi^2_{(16)} = 26.597$ ($p = .046$), with incremental statistics indicating better fit than the one- and two-branch models (e.g., TLI = .889). Of particular concern, the factor loadings for the Using Emotions branch were zero ($SE = 1.16 \times 10^{13}$), and thus this could not be considered a suitable model. This mirrors the results of Palmer and colleagues, who also found factor loadings equivalent to zero for the Using Emotions branch.

Model 5. Next, we sought to test a model representing all three factor levels (branch, area, and overall levels) proposed by Mayer et al. (2002). However, given that higher-order factors require at least three corresponding lower-order factors to permit model identification (Bollen, 1989), and Mayer et al.'s (2002) theoretical model only contains two lower-order factors per higher-order factor, it is not mathematically possible to directly test this third-order conceptual framework. Instead, we followed Rode et al. (2008) by specifying a second-order model which most closely approximates Mayer's intended conceptual model. As shown in Figure 2, this model specifies the eight tasks as loading onto the two area-level factors of Experiential and Strategic EI. The area-level factors were allowed to covary, thus modeling the shared variance representative of a higher-order overall EI factor. Finally, to represent the unmodelled branch-level factors, the residuals for the task pairs within each branch were allowed to correlate.

Model 5 yielded acceptable levels of overall fit ($\chi^2_{(15)} = 21.664$, $p = .117$) and superior incremental fit relative to the four previously tested models (e.g., TLI = .925). However, the model performed more poorly on indices of parsimony (PNFI = .476, PCFI = .514) due to the large number of parameters specified. While there was a significant positive correlation between the Experiential and Strategic areas, $r = .77$, $p < .01$, supporting the existence of a higher order general factor of EI, and between the residuals for the Changes and Blends tasks, $r = .44$, $p < .01$, supporting the presence of the unmodelled Understanding Emotions branch, the remaining three task pairs did not correlate significantly, $r = -.40$ to $.15$, $ps > .05$. Thus, there was a lack of evidence for the four branches posited in Mayer et al.'s (2002) original theoretical structure. Hence, this model could not be retained as providing acceptable fit to the data.

[2] A significant value for χ^2 is indicative of poor fit (i.e., rejection of the null hypothesis that the model provides a good fit to the data).

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Table 6
Standardized Parameter Estimates for the Series of MSCEIT Models Tested Using Confirmatory Factor Analysis (CFA)

Variables	Model 1	Model 2	Model 3		Model 4	Model 5	Model 6
Branch 1	*I*	*I*	*I*	*I*	*I*	*I*	*I*
Perceiving emotions							
Faces	**.49**	**.55**	**.63**	**.31**	**.51**	**.51**	**.56**
Pictures	**.57**	**.61**	**.62**	**.30**	**.57**	**.55**	**.60**
Branch 2			*II*	*II*			
Using emotions							
Facilitation	**.57**	**.58**	**.77**	.00	**.57**	**.64**	**.56**
Sensations	**.74**	**.80**	**.55**	.00	.79	**.88**	**.81**
Branch 3		*II*	*III*	*III*		*II*	*II*
Understanding emotions							
Changes	**.58**	**.53**	**.92**	**.66**	**.52**	**.59**	**.90**
Blends	**.48**	**.71**	**.62**	**.56**	**.39**	**.41**	**.63**
Branch 4			*IV*	*IV*			*III*
Managing emotions							
Management	**.68**	**.60**	**.80**	**.43**	**.65**	**.74**	**.80**
Relationships	**.56**	**.66**	**.61**	**.41**	**.49**	**.57**	**.61**

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test. Roman numerals represent the factors specified for each model. Estimated factor loadings for each task onto the relevant factor are presented beneath each Roman numeral. Factor loadings in bold are significant at $p < .05$. Model 1 = one-factor model with eight tasks loading onto an overall factor (Mayer et al., 2002); Model 2 = oblique two-factor model representing Experiential and Strategic areas of EI (Mayer et al., 2002); Model 3 = oblique four-factor model reflecting four branches of EI (Mayer et al., 2002); Model 4 = nested four-branch model consisting of four first-order branch factors and one first-order overall factor as per Palmer et al. (2005); Model 5 = hierarchical model from Rode et al. (2008) consisting of eight tasks loading onto two area-level factors (the area-level factors were allowed to covary to represent the shared variance representative of a higher-order overall EI factor and the residuals for the task pairs within each branch were allowed to correlate to represent the unmodelled branch-level factors); Model 6 = oblique three-factor model representing the Understanding and Managing branches and Experiential area (Rossen et al., 2008).

Model 6. For the final model, we followed previous authors (Fan et al., 2010; Gardner & Qualter, 2011; Palmer et al., 2005; Rode et al., 2008; Rossen et al., 2008) by specifying an oblique three-factor solution in which the four tasks from the Perceiving and Using Emotions branches load onto a common factor (see Figure 3). This latent factor was allowed to covary with the remaining two factors, corresponding to the Understanding and Managing Emotions branches. This solution yielded a $\chi^2_{(17)}$ = 23.948 (p = .121), with overall fit statistics indicative of acceptable fit according to conservative cut-offs (Browne & Cudeck, 1993; Marsh et al., 2004). Incremental fit statistics demonstrated superior fit compared to all other models tested (e.g., TLI = .937). The model also performed well on indices of parsimony relative to previous models. The three factors were significantly positively correlated, r = .50 to .75, $p < .01$, and the standardized factor loadings from the tasks onto the factors were all significant and positive ($p < .001$). Each task explained a considerable portion of the variance in the factors (R^2 = 31% to 82%). Thus, on the basis of our data set Model 6 was determined to be a useful model in accounting for the covariance between MSCEIT tasks within this ABI sample on the basis of reasonable model fit, parsimony, sensible factor loadings and meaningfulness, replicating previous findings of the utility of this solution in the healthy population (Fan et al., 2010; Gardner & Qualter, 2011; Rode et al., 2008).

Discussion

The aim of this study was to formally evaluate the utility of the MSCEIT V2.0 as a means of characterizing emotional skills deficits in ABI. We found evidence of weaknesses in overall EI and on all four branches of the MSCEIT in this sample of individuals with moderate to severe ABI. On average, participants performed approximately 1 *SD* below the normative mean overall (Mayer et al., 2003), indicative of difficulties in the "low average" range. These findings suggest that the MSCEIT is sensitive to emotion processing difficulties after ABI. Participants in the current sample

Table 7
Fit Statistics for Series of MSCEIT Models Tested Using CFA

Model	$\chi^2(df)$	RMSEA (90% CI)	TLI	CFI	PNFI	PCFI	AIC
1. One factor	49.609 (20)***	.135 (.088–.183)	.751	.822	.532	.587	81.609
2. Two factor	39.302 (19)**	.115 (.063–.166)	.820	.878	.542	.596	73.302
3. Four factor^	20.353 (14)	.075 (.000–.141)	.924	.962	.448	.481	64.353
4. General factor + Four branches	26.597 (16)*	.090 (.012–.149)	.889	.936	.493	.535	66.597
5. Hierarchical	21.664 (15)	.074 (.000–.138)	.925	.960	.476	.514	63.664
6. Three factor	23.948 (17)	.071 (.000–.132)	.931	.958	.532	.582	61.948

Note. MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; CFA = Confirmatory Factor Analysis.
^ Model inadmissible due to nonpositive definite covariance matrix.
* $p < .05$. ** $p < .01$. *** $p < .001$.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

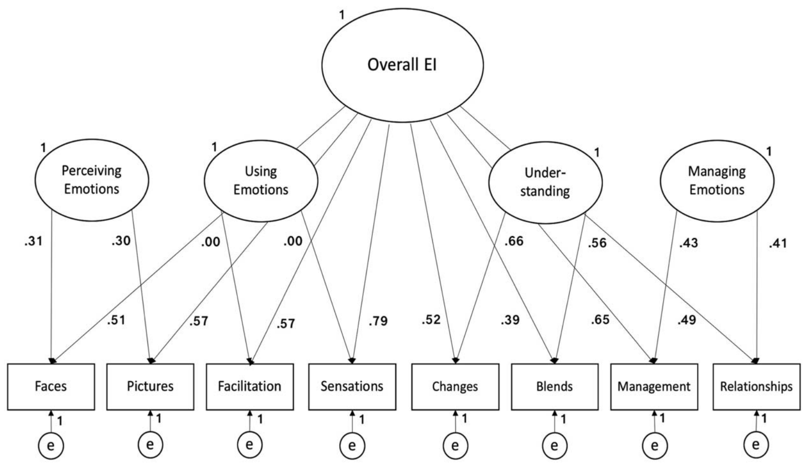

Figure 1. Model 4, consisting of a general factor representing overall emotional intelligence and four nested branch-level factors, as per Palmer, Gignac, Manocha, and Stough (2005). e = residual variance unaccounted for by the latent variables.

had the most difficulty on tasks assessing strategic aspects of EI (i.e., understanding and managing emotions), in line with the broader literature documenting difficulties with theory of mind and emotion regulation after ABI (Hynes et al., 2011; McDonald & Flanagan, 2004; Newsome et al., 2013; Radice-Neumann, Zupan, Tomita, & Willer, 2009).

Evaluation of the test's psychometric properties revealed satisfactory internal consistency for scores at the overall, area, and branch levels, consistent with previous findings reported in the general population (Mayer et al., 2003; Palmer et al., 2005). In support of the validity of test scores, performance on the MSCEIT was found to relate in theoretically predicted ways to demographic variables of gender, age, and education within this ABI sample (Eack et al., 2010; Livingstone & Day, 2005; Roberts et al., 2006). As expected, MSCEIT scores correlated more strongly with performances on tests of cognition than with self-reported symptoms of depression and anxiety, supporting the conceptualization of emotion processing skills as a set of mental abilities rather than an aspect of mood-related emotional functioning (Mayer, Caruso, & Salovey, 1999; Mayer, Salovey, Caruso, & Sitarenios, 2001). Further, correlations with cognitive task performance were small to medium in size, indicating that the MSCEIT measures skills related to but relatively independent of "cold" cognition.

A novel contribution of this study was the finding that MSCEIT performances related in important ways to ABI-related variables. MSCEIT scores tended to be lowest for individuals with markers of more severe injuries (i.e., GCS and length of hospital stay), suggesting that the test assesses skills that are vulnerable to the effects of moderate to severe brain damage. Furthermore, reduced performance on the MSCEIT was associated with lower clinician-rated functioning at discharge, indicating that the test may capture skills of relevance to independent functioning after ABI.

In terms of underlying MSCEIT structure, we did not find support for Mayer and colleagues' (2003) original one-, two-, or four-factor structure of EI in this sample of individuals with ABI. The Using Emotions branch was statistically redundant with other factors in the four-branch models tested, consistent with the growing consensus that it does not measure unique variance in MSCEIT scores (Day & Carroll, 2004; Gardner & Qualter, 2011; Gignac, 2005; Palmer et al., 2005). Instead, our best performing model was

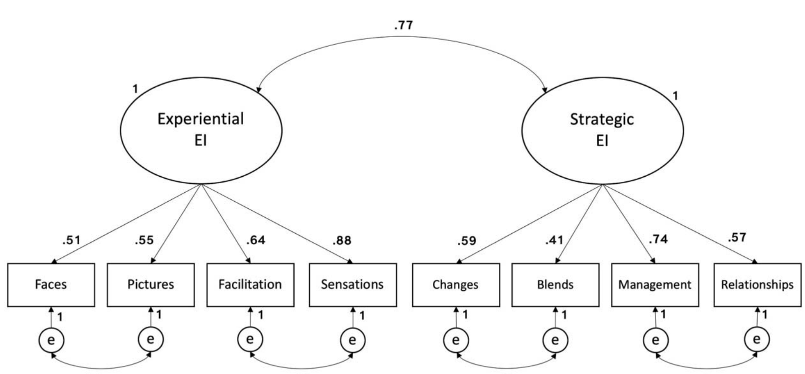

Figure 2. Model 5, representing Mayer and Salovey's (1997) proposed theoretical structure as per Rode et al. (2008). e = residual variance unaccounted for by the latent variables.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

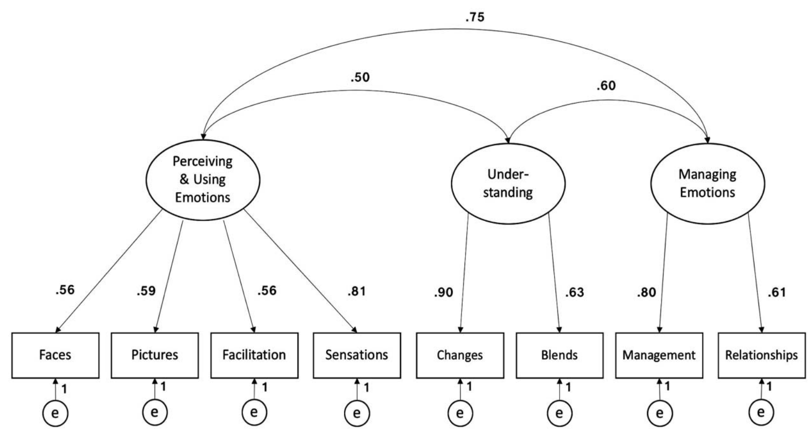

Figure 3. Model 6, consisting of three oblique factors, as per previous studies (Fan, Jackson, Yang, Tang, & Zhang, 2010; Gardner & Qualter, 2011; Palmer et al., 2005; Rode et al., 2008; Rossen, Kranzler, & Algina, 2008). e = residual variance unaccounted for by the latent variables.

a three-factor model consisting of Experiential EI, Understanding Emotions, and Managing Emotions. This model is also preferred in the general population (Fan et al., 2010; Gardner & Qualter, 2011; Rode et al., 2008), and aligns with recent theoretical conceptualizations of EI as three distinct skills (Joseph & Newman, 2010; MacCann et al., 2014; MacCann & Roberts, 2008; Matthews, Zeidner, & Roberts, 2012).

In contrast to healthy adult samples, which have consistently demonstrated a manifold of strong positive correlations between MSCEIT tasks (Mayer et al., 2003; Palmer et al., 2005), we found low correlations between tasks of Perceiving Emotions and Understanding and Managing Emotions within this ABI sample. In combination, these findings support the characterization of emotion processing skills after ABI as a set of three related but distinct abilities, encompassing the more fundamental perceptual aspects of emotion processing, the ability to understand emotional meanings, and the ability to manage and regulate emotions. Based on knowledge of the brain networks underpinning social cognition, these skills are likely to have different neurobiological substrates (Green, Horan, & Lee, 2015; Henry, von Hippel, Molenberghs, Lee, & Sachdev, 2016), and thus may be differentially affected by acquired brain impairment. A domain-based approach to characterizing EI also has clinical utility, as it permits identification of specific targets for remediation using specialized training programs (e.g., Bornhofen & McDonald, 2008b; Radice-Neumann et al., 2009).

Limitations and Future Directions

This study has a number of limitations that should be noted. Although reasonable for a clinical sample, 82 participants represent a small sample size for CFA. As such, these results should be considered preliminary until replicated with a larger sample. Despite the small sample size, our results mirrored previous findings from larger factor analytic studies of the MSCEIT within the healthy population (Fan et al., 2010), including the generation of a sensible three-factor solution with good convergence and reasonable fit statistics, and demonstration of poor convergence of solutions modeling Using Emotions as an independent factor. As our results replicate these well-established findings, and considering the mounting theoretical evidence supporting a three- rather than four-branch model of EI (Joseph & Newman, 2010), there appears to be tentative support for further examination of this refined three-branch model of EI in ABI research. Further investigation of the relevance of skills assessed by this model for predicting functional and psychosocial outcomes after ABI would improve our understanding of the clinical utility of this measure.

A further limitation of the study is that we were not able to cross-validate the MSCEIT against other performance-based tests of emotional ability. One of the recognized problems within this literature is the lack of other psychometrically sound ability-based tests of EI against which the MSCEIT can be evaluated (as discussed in MacCann & Roberts, 2008). An examination of how MSCEIT scores relate to test performance on conceptually distinct but related facets of social cognition after brain injury (e.g., theory of mind) may be of interest to further develop our understanding of the relationships between these theoretical constructs and the relative utility of these tools for individuals with ABI. Additionally, examination of MSCEIT performance relative to a more comprehensive assessment of executive functioning may be worthwhile in future research, in light of studies finding a relationship between executive skills and social cognition in TBI (Ganesalingam, Sanson, Anderson, & Yeates, 2007; Henry, Phillips, Crawford, Ietswaart, & Summers, 2006).

Participants in this study were sampled from a broad spectrum of time periods postinjury, as well as a wide range of ages, reflecting the demographic of patients typically admitted to specialist ABI rehabilitation units. This heterogeneity reflects a potential limitation as it may impact on test performances. However, we note that previous studies have found emotion processing deficits to be relatively consistent over time after brain injury (Ietswaart et al., 2008; Spikman et al., 2013), and that MSCEIT performance tends to be stable across age ranges and illness phases in other clinical samples (i.e., schizophrenia; Green et al., 2012). Consistent with this, neither age nor time since injury were related to MSCEIT performance in this sample.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

We note that the purpose of this study was to conduct an initial investigation into the potential utility of the MSCEIT within a general moderate to severe ABI sample, rather than to map changes in emotional functioning to specific neurobiological substrates. As such, we did not restrict the sample to patients with a particular etiology of brain damage or assess the contribution of circumscribed lesions on MSCEIT test performance, although this represents an important avenue to pursue in future studies.

In conclusion, the current findings suggest that the MSCEIT V2.0 can provide a useful profile of an individual's emotion processing skills after moderate to severe ABI. We found evidence of validity and reliability of MSCEIT test scores when interpreted at the full-scale, area, and branch level. Consistent with recent findings in the general population, we found little evidence to support the inclusion of the Using Emotions branch. Moving forward, a revised three-factor model appears to provide a suitable framework for conceptualizing emotion-related abilities in both healthy and brain-injured individuals.

References

Arbuckle, J. L. (2014). *Amos (Version 23.0)*. Chicago, IL: IBM SPSS.

Armstrong, R. A. (2014). When to use the Bonferroni correction. *Ophthalmic & Physiological Optics, 34,* 502–508. http://dx.doi.org/10.1111/opo.12131

Babbage, D. R., Yim, J., Zupan, B., Neumann, D., Tomita, M. R., & Willer, B. (2011). Meta-analysis of facial affect recognition difficulties after traumatic brain injury. *Neuropsychology, 25,* 277–285. http://dx.doi.org/10.1037/a0021908

Bagozzi, R. P., & Edwards, J. R. (1998). A general approach for representing constructs in organizational research. *Organizational Research Methods, 1,* 45–87. http://dx.doi.org/10.1177/109442819800100104

Barchard, K. A., & Hakstian, R. A. (2004). The nature and measurement of emotional intelligence abilities: Basic dimensions and their relationships with other cognitive ability and personality variables. *Educational and Psychological Measurement, 64,* 437–462. http://dx.doi.org/10.1177/0013164403261762

Barlow, A., Qualter, P., & Stylianou, M. (2010). Relationships between Machiavellianism, emotional intelligence and theory of mind in children. *Personality and Individual Differences, 48,* 78–82. http://dx.doi.org/10.1016/j.paid.2009.08.021

Benton, A. L., & Hamsher, K. (1976). *Multilingual Aphasia Examination manual*. Iowa City, IA: University of Iowa.

Bludau, T. M., & Legree, P. (2008, April). *Breaking down emotional intelligence: A meta-analysis of EI and GMA*. Paper presented at the 23rd Annual Meeting of the Society for Industrial/Organizational Psychology, San Francisco, CA.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York, NY: Wiley. http://dx.doi.org/10.1002/9781118619179

Bornhofen, C., & McDonald, S. (2008a). Emotion perception deficits following traumatic brain injury: A review of the evidence and rationale for intervention. *Journal of the International Neuropsychological Society, 14,* 511–525. http://dx.doi.org/10.1017/0S1355617708080703

Bornhofen, C., & Mcdonald, S. (2008b). Treating deficits in emotion perception following traumatic brain injury. *Neuropsychological Rehabilitation, 18,* 22–44. http://dx.doi.org/10.1080/09602010601061213

Brackett, M. A., & Mayer, J. D. (2003). Convergent, discriminant, and incremental validity of competing measures of emotional intelligence. *Personality and Social Psychology Bulletin, 29,* 1147–1158. http://dx.doi.org/10.1177/0146167203254596

Brackett, M. A., Rivers, S. E., Shiffman, S., Lerner, N., & Salovey, P. (2006). Relating emotional abilities to social functioning: A comparison of self-report and performance measures of emotional intelligence. *Journal of Personality and Social Psychology, 91,* 780–795. http://dx.doi.org/10.1037/0022-3514.91.4.780

Brackett, M. A., Warner, R. M., & Bosco, J. S. (2005). Emotional intelligence and relationship quality among couples. *Personal Relationships, 12,* 197–212. http://dx.doi.org/10.1111/j.1350-4126.2005.00111.x

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Burridge, A. C., Williams, W. H., Yates, P. J., Harris, A., & Ward, C. (2007). Spousal relationship satisfaction following acquired brain injury: The role of insight and socio-emotional skill. *Neuropsychological Rehabilitation, 17,* 95–105. http://dx.doi.org/10.1080/09602010500505070

Ciarrochi, J., Chan, A. Y., & Caputi, P. (2000). A critical evaluation of the emotional intelligence construct. *Personality and Individual Differences, 28,* 539–561. http://dx.doi.org/10.1016/S0191-8869(99)00119-1

Dawkins, N., Cloherty, M. E., Gracey, F., & Evans, J. J. (2006). The factor structure of the Hospital Anxiety and Depression Scale in acquired brain injury. *Brain Injury, 20,* 1235–1239. http://dx.doi.org/10.1080/02699050601076414

Dawson, S., Kettler, L., Burton, C., & Galletly, C. (2012). Do people with schizophrenia lack emotional intelligence? *Schizophrenia Research and Treatment, 2012,* Article ID 495174. http://dx.doi.org/10.1155/2012/495174

Day, A. L., & Carroll, S. A. (2004). Using an ability-based measure of emotional intelligence to predict individual performance, group performance, and group citizenship behaviours. *Personality and Individual Differences, 36,* 1443–1458. http://dx.doi.org/10.1016/S0191-8869(03)00240-X

Di Fabio, A. (2015). Beyond fluid intelligence and personality traits in social support: The role of ability based emotional intelligence. *Frontiers in Psychology, 6,* 395. http://dx.doi.org/10.3389/fpsyg.2015.00395

Do, C. B., & Batzoglou, S. (2008). What is the expectation maximization algorithm? *Nature Biotechnology, 26,* 897–899. http://dx.doi.org/10.1038/nbt1406

Eack, S. M., Greeno, C. G., Pogue-Geile, M. F., Newhill, C. E., Hogarty, G. E., & Keshavan, M. S. (2010). Assessing social-cognitive deficits in schizophrenia with the Mayer-Salovey-Caruso Emotional Intelligence Test. *Schizophrenia Bulletin, 36,* 370–380. http://dx.doi.org/10.1093/schbul/sbn091

Ermer, E., Kahn, R. E., Salovey, P., & Kiehl, K. A. (2012). Emotional intelligence in incarcerated men with psychopathic traits. *Journal of Personality and Social Psychology, 103,* 194–204. http://dx.doi.org/10.1037/a0027328

Eslinger, P. J., Parkinson, K., & Shamay, S. G. (2002). Empathy and social-emotional factors in recovery from stroke. *Current Opinion in Neurology, 15,* 91–97. http://dx.doi.org/10.1097/00019052-200202000-00014

Fan, H., Jackson, T., Yang, X., Tang, W., & Zhang, J. (2010). The factor structure of the Mayer-Salovey-Caruso Emotional Intelligence Test V2.0 (MSCEIT): A meta-analytic structural equation modeling approach. *Personality and Individual Differences, 48,* 781–785. http://dx.doi.org/10.1016/j.paid.2010.02.004

Ferguson, F. J., & Austin, E. J. (2010). Associations of trait and ability emotional intelligence with performance on Theory of Mind tasks in an adult sample. *Personality and Individual Differences, 49,* 414–418. http://dx.doi.org/10.1016/j.paid.2010.04.009

Fett, A. K., Viechtbauer, W., Dominguez, M. D., Penn, D. L., van Os, J., & Krabbendam, L. (2011). The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: A meta-analysis. *Neuroscience and Biobehavioral Reviews, 35,* 573–588. http://dx.doi.org/10.1016/j.neubiorev.2010.07.001

Ganesalingam, K., Sanson, A., Anderson, V., & Yeates, K. O. (2007). Self-regulation as a mediator of the effects of childhood traumatic brain injury on social and behavioral functioning. *Journal of the International*

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Neuropsychological Society, 13, 298–311. http://dx.doi.org/10.1017/S1355617707070324

Gardner, K. J., & Qualter, P. (2011). Factor structure, measurement invariance and structural invariance of the MSCEIT V2.0. *Personality and Individual Differences, 51,* 492–496. http://dx.doi.org/10.1016/j.paid.2011.05.004

Gasquoine, P. G. (2016). Blissfully unaware: Anosognosia and anosodiaphoria after acquired brain injury. *Neuropsychological Rehabilitation, 26,* 261–285. http://dx.doi.org/10.1080/09602011.2015.1011665

Gignac, G. E. (2005). Evaluating the MSCEIT V2.0 via CFA: Comment on Mayer et al. (2003). *Emotion, 5,* 233–235. http://dx.doi.org/10.1037/1528-3542.5.2.233

Gold, M. S., & Bentler, P. M. (2000). Treatments of missing data: A Monte Carlo comparison of RBHDI, iterative stochastic regression imputation, and expectation-maximization. *Structural Equation Modeling, 7,* 319–355. http://dx.doi.org/10.1207/S15328007SEM0703_1

Green, M. F., Bearden, C. E., Cannon, T. D., Fiske, A. P., Hellemann, G. S., Horan, W. P., . . . Nuechterlein, K. H. (2012). Social cognition in schizophrenia, Pt. 1: Performance across phase of illness. *Schizophrenia Bulletin, 38,* 854–864. http://dx.doi.org/10.1093/schbul/sbq171

Green, M. F., Horan, W. P., & Lee, J. (2015). Social cognition in schizophrenia. *Nature Reviews Neuroscience, 16,* 620–631. http://dx.doi.org/10.1038/nrn4005

Green, M. F., Olivier, B., Crawley, J. N., Penn, D. L., & Silverstein, S. (2005). Social cognition in schizophrenia: Recommendations from the measurement and treatment research to improve cognition in schizophrenia new approaches conference. *Schizophrenia Bulletin, 31,* 882–887. http://dx.doi.org/10.1093/schbul/sbi049

Gustafsson, J. E., & Balke, G. (1993). General and specific abilities as predictors of school achievement. *Multivariate Behavioral Research, 28,* 407–434. http://dx.doi.org/10.1207/s15327906mbr2804_2

Henry, J. D., Phillips, L. H., Crawford, J. R., Ietswaart, M., & Summers, F. (2006). Theory of mind following traumatic brain injury: The role of emotion recognition and executive dysfunction. *Neuropsychologia, 44,* 1623–1628. http://dx.doi.org/10.1016/j.neuropsychologia.2006.03.020

Henry, J. D., von Hippel, W., Molenberghs, P., Lee, T., & Sachdev, P. S. (2016). Clinical assessment of social cognitive function in neurological disorders. *Nature Reviews Neurology, 12,* 28–39. http://dx.doi.org/10.1038/nrneurol.2015.229

Hertel, J., Schütz, A., & Lammers, C.-H. (2009). Emotional intelligence and mental disorder. *Journal of Clinical Psychology, 65,* 942–954. http://dx.doi.org/10.1002/jclp.20597

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6,* 53–60.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1–55. http://dx.doi.org/10.1080/10705519909540118

Hynes, C. A., Stone, V. E., & Kelso, L. A. (2011). Social and emotional competence in traumatic brain injury: New and established assessment tools. *Social Neuroscience, 6,* 599–614. http://dx.doi.org/10.1080/17470919.2011.584447

Ietswaart, M., Milders, M., Crawford, J. R., Currie, D., & Scott, C. L. (2008). Longitudinal aspects of emotion recognition in patients with traumatic brain injury. *Neuropsychologia, 46,* 148–159. http://dx.doi.org/10.1016/j.neuropsychologia.2007.08.002

Joseph, D. L., & Newman, D. A. (2010). Emotional intelligence: An integrative meta-analysis and cascading model. *Journal of Applied Psychology, 95,* 54–78. http://dx.doi.org/10.1037/a0017286

Kee, K. S., Horan, W. P., Salovey, P., Kern, R. S., Sergi, M. J., Fiske, A. P., . . . Green, M. F. (2009). Emotional intelligence in schizophrenia. *Schizophrenia Research, 107,* 61–68. http://dx.doi.org/10.1016/j.schres.2008.08.016

Keele, S. M., & Bell, R. C. (2009). Consensus scoring, correct responses and reliability of the MSCEIT V2.0. *Personality and Individual Differences, 47,* 740–747. http://dx.doi.org/10.1016/j.paid.2009.06.013

Keith, R. A., Granger, C. V., Hamilton, B. B., & Sherwin, F. S. (1987). The functional independence measure: A new tool for rehabilitation. *Advances in Clinical Rehabilitation, 1,* 6–18.

Little, L., Lindenberger, U., & Nesselroade, J. R. (1999). On selecting indicators for multivariate measurement and modeling with latent variables: When "good" indicators are bad and "bad" indicators are good. *Psychological Methods, 4,* 192–211. http://dx.doi.org/10.1037/1082-989X.4.2.192

Little, R. J., & Rubin, D. B. (2002). *Statistical analysis with missing data* (2nd ed.). Hoboken, NJ: Wiley. http://dx.doi.org/10.1002/9781119013563

Livingstone, H. A., & Day, A. L. (2005). Comparing the construct and criterion-related validity of ability-based and mixed-model measures of emotional intelligence. *Educational and Psychological Measurement, 65,* 757–779. http://dx.doi.org/10.1177/0013164405275663

Lopes, P. N., Brackett, M. A., Nezlek, J. B., Schütz, A., Sellin, I., & Salovey, P. (2004). Emotional intelligence and social interaction. *Personality and Social Psychology Bulletin, 30,* 1018–1034. http://dx.doi.org/10.1177/0146167204264762

Lopes, P. N., Salovey, P., & Straus, R. (2003). Emotional intelligence, personality, and the perceived quality of social relationships. *Personality and Individual Differences, 35,* 641–658. http://dx.doi.org/10.1016/S0191-8869(02)00242-8

Lumley, M. A., Gustavson, B. J., Partridge, R. T., & Labouvie-Vief, G. (2005). Assessing alexithymia and related emotional ability constructs using multiple methods: Interrelationships among measures. *Emotion, 5,* 329–342. http://dx.doi.org/10.1037/1528-3542.5.3.329

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4,* 84–99. http://dx.doi.org/10.1037/1082-989X.4.1.84

MacCann, C., Joseph, D. L., Newman, D. A., & Roberts, R. D. (2014). Emotional intelligence is a second-stratum factor of intelligence: Evidence from hierarchical and bifactor models. *Emotion, 14,* 358–374. http://dx.doi.org/10.1037/a0034755

MacCann, C., & Roberts, R. D. (2008). New paradigms for assessing emotional intelligence: Theory and data. *Emotion, 8,* 540–551. http://dx.doi.org/10.1037/a0012746

Mahar, C., & Fraser, K. (2011). Barriers to successful community reintegration following acquired brain injury (ABI). *International Journal of Disability Management, 6,* 49–67. http://dx.doi.org/10.1375/jdmr.6.1.49

Márquez, P. G.-O., Martín, R. P., & Brackett, M. A. (2006). Relating emotional intelligence to social competence and academic achievement in high school students. *Psicothema, 18*(Suppl.), 118–123.

Marsh, H. W., Hau, K. T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. *Multivariate Behavioral Research, 33,* 181–220. http://dx.doi.org/10.1207/s15327906mbr3302_1

Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling, 11,* 320–341. http://dx.doi.org/10.1207/s15328007sem1103_2

Matthews, G., Zeidner, M., & Roberts, R. D. (2012). Emotional intelligence: A promise unfilled? *Japanese Psychological Research, 54,* 105–127. http://dx.doi.org/10.1111/j.1468-5884.2011.00502.x

Mayer, J. D., Caruso, D. R., & Salovey, P. (1999). Emotional intelligence meets traditional standards for an intelligence. *Intelligence, 27,* 267–298. http://dx.doi.org/10.1016/S0160-2896(99)00016-1

Mayer, J. D., Roberts, R. D., & Barsade, S. G. (2008). Human abilities: Emotional intelligence. *Annual Review of Psychology, 59,* 507–536. http://dx.doi.org/10.1146/annurev.psych.59.103006.093646

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.

Mayer, J. D., & Salovey, P. (1997). What is emotional intelligence? In P. Salovey & D. Sluyter (Eds.), *Emotional development and emotional intelligence: Educational implications* (pp. 3–31). New York, NY: Basic Books.

Mayer, J. D., Salovey, P., & Caruso, D. R. (2002). *Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT): User's manual*. Toronto, Ontario, Canada: Multi-Health Systems.

Mayer, J. D., Salovey, P., Caruso, D. R., & Sitarenios, G. (2001). Emotional intelligence as a standard intelligence. *Emotion, 1,* 232–242. http://dx.doi.org/10.1037/1528-3542.1.3.232

Mayer, J. D., Salovey, P., Caruso, D. R., & Sitarenios, G. (2003). Measuring emotional intelligence with the MSCEIT V2.0. *Emotion, 3,* 97–105. http://dx.doi.org/10.1037/1528-3542.3.1.97

McDonald, S., & Flanagan, S. (2004). Social perception deficits after traumatic brain injury: Interaction between emotion recognition, mentalizing ability, and social communication. *Neuropsychology, 18,* 572–579. http://dx.doi.org/10.1037/0894-4105.18.3.572

Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., & Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin, 105,* 430–445. http://dx.doi.org/10.1037/0033-2909.105.3.430

Mulaik, S. A., & Quartetti, D. A. (1997). First order or higher order general factor? *Structural Equation Modeling, 4,* 193–211. http://dx.doi.org/10.1080/10705519709540071

Musil, C. M., Warner, C. B., Yobas, P. K., & Jones, S. L. (2002). A comparison of imputation techniques for handling missing data. *Western Journal of Nursing Research, 24,* 815–829. http://dx.doi.org/10.1177/019394502762477004

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling, 9,* 599–620. http://dx.doi.org/10.1207/S15328007SEM0904_8

Newsome, M. R., Scheibel, R. S., Mayer, A. R., Chu, Z. D., Wilde, E. A., Hanten, G., . . . Levin, H. S. (2013). How functional connectivity between emotion regulation structures can be disrupted: Preliminary evidence from adolescents with moderate to severe traumatic brain injury. *Journal of the International Neuropsychological Society, 19,* 911–924. http://dx.doi.org/10.1017/S1355617713000817

Nitzburg, G. C., Burdick, K. E., Malhotra, A. K., & DeRosse, P. (2015). Social cognition in patients with schizophrenia spectrum and bipolar disorders with and without psychotic features. *Schizophrenia Research Cognition, 2,* 2–7. http://dx.doi.org/10.1016/j.scog.2014.12.003

Nuechterlein, K. H., Green, M. F., Kern, R. S., Baade, L. E., Barch, D. M., Cohen, J. D., . . . Marder, S. R. (2008). The MATRICS Consensus Cognitive Battery, Pt. 1: Test selection, reliability, and validity. *The American Journal of Psychiatry, 165,* 203–213. http://dx.doi.org/10.1176/appi.ajp.2007.07010042

O'Boyle, E. H., Jr., Humphrey, R. H., Pollack, J. M., Hawver, T. H., & Story, P. A. (2011). The relation between emotional intelligence and job performance: A meta-analysis. *Journal of Organizational Behavior, 32,* 788–818. http://dx.doi.org/10.1002/job.714

Ownsworth, T., & Clare, L. (2006). The association between awareness deficits and rehabilitation outcome following acquired brain injury. *Clinical Psychology Review, 26,* 783–795. http://dx.doi.org/10.1016/j.cpr.2006.05.003

Ownsworth, T., & Fleming, J. (2005). The relative importance of metacognitive skills, emotional status, and executive function in psychosocial adjustment following acquired brain injury. *The Journal of Head Trauma Rehabilitation, 20,* 315–332. http://dx.doi.org/10.1097/00001199-200507000-00004

Palmer, B., Gignac, G., Manocha, R., & Stough, C. (2005). A psychometric evaluation of the Mayer-Salovey-Caruso Emotional Intelligence Test Version 2.0. *Intelligence, 33,* 285–305. http://dx.doi.org/10.1016/j.intell.2004.11.003

Prigatano, G. P. (2005). Disturbances of self-awareness and rehabilitation of patients with traumatic brain injury: A 20-year perspective. *The Journal of Head Trauma Rehabilitation, 20,* 19–29. http://dx.doi.org/10.1097/00001199-200501000-00004

Radice-Neumann, D., Zupan, B., Tomita, M., & Willer, B. (2009). Training emotional processing in persons with brain injury. *The Journal of Head Trauma Rehabilitation, 24,* 313–323. http://dx.doi.org/10.1097/HTR.0b013e3181b09160

Roberts, R. D., Schulze, R., O'Brien, K., MacCann, C., Reid, J., & Maul, A. (2006). Exploring the validity of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) with established emotions measures. *Emotion, 6,* 663–669. http://dx.doi.org/10.1037/1528-3542.6.4.663

Roberts, R. D., Zeidner, M., & Matthews, G. (2001). Does emotional intelligence meet traditional standards for an intelligence? Some new data and conclusions. *Emotion, 1,* 196–231. http://dx.doi.org/10.1037/1528-3542.1.3.196

Rode, J. C., Mooney, C. H., Arthaud-day, M. L., Near, J. P., Rubin, R. S., Baldwin, T. T., & Bommer, W. H. (2008). An examination of the structural, discriminant, nomological, and incremental predictive validity of the MSCEIT V2.0. *Intelligence, 36,* 350–366. http://dx.doi.org/10.1016/j.intell.2007.07.002

Rossen, E., Kranzler, J. H., & Algina, J. (2008). Confirmatory factor analysis of the Mayer-Salovey-Caruso Emotional Intelligence Test V2.0. *Personality and Individual Differences, 44,* 1258–1269. http://dx.doi.org/10.1016/j.paid.2007.11.020

Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, Cognition and Personality, 9,* 185–211. http://dx.doi.org/10.2190/DUGG-P24E-52WK-6CDG

Salter, K., Bhogal, S. K., Foley, N., Jutai, J., & Teasell, R. (2007). The assessment of poststroke depression. *Topics in Stroke Rehabilitation, 14,* 1–24. http://dx.doi.org/10.1310/tsr1403-1

Schlegel, K., Grandjean, D., & Scherer, K. R. (2013). Constructs of social and emotional effectiveness: Different labels, same content? *Journal of Research in Personality, 47,* 249–253. http://dx.doi.org/10.1016/j.jrp.2013.02.005

Schönberger, M., & Ponsford, J. (2010). The factor structure of the Hospital Anxiety and Depression Scale in individuals with traumatic brain injury. *Psychiatry Research, 179,* 342–349. http://dx.doi.org/10.1016/j.psychres.2009.07.003

Schönberger, M., Ponsford, J., Olver, J., & Ponsford, M. (2010). A longitudinal study of family functioning after TBI and relatives' emotional status. *Neuropsychological Rehabilitation, 20,* 813–829. http://dx.doi.org/10.1080/09602011003620077

Schulte, M. J., Ree, M. J., & Carretta, T. R. (2004). Emotional intelligence: Not much more than *g* and personality. *Personality and Individual Differences, 37,* 1059–1068. http://dx.doi.org/10.1016/j.paid.2003.11.014

Shores, E. A., Marosszeky, J. E., Sandanam, J., & Batchelor, J. (1986). Preliminary validation of a clinical scale for measuring the duration of post-traumatic amnesia. *The Medical Journal of Australia, 144,* 569–572.

Spikman, J. M., Milders, M. V., Visser-Keizer, A. C., Westerhof-Evers, H. J., Herben-Dekker, M., & van der Naalt, J. (2013). Deficits in facial emotion recognition indicate behavioral changes and impaired self-awareness after moderate to severe traumatic brain injury. *PLoS ONE, 8*(6), e65581. http://dx.doi.org/10.1371/journal.pone.0065581

Teasell, R., Bayona, N., Marshall, S., Cullen, N., Bayley, M., Chundamala, J., . . . Tu, L. (2007). A systematic review of the rehabilitation of moderate to severe acquired brain injuries. *Brain Injury, 21,* 107–112. http://dx.doi.org/10.1080/02699050701201524

Trinidad, D. R., & Johnson, C. A. (2002). The association between emotional intelligence and early adolescent tobacco and alcohol use. *Personality and Individual Differences, 32,* 95–105. http://dx.doi.org/10.1016/S0191-8869(01)00008-3

Turner-Stokes, L., Pick, A., Nair, A., Disler, P. B., & Wade, D. T. (2015). Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database of Systematic Reviews, 12,* CD004170. http://dx.doi.org/10.1002/14651858.CD004170.pub3

Velicer, W. F., & Fava, J. L. (1998). Effects of variable and subject sampling on factor pattern recovery. *Psychological Methods, 3,* 231–251. http://dx.doi.org/10.1037/1082-989X.3.2.231

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale* (3rd ed.). San Antonio, TX: Psychological Corporation.

Wechsler, D. (1999). *Wechsler Abbreviated Scale of Intelligence*. San Antonio, TX: Psychological Corporation.

Williams, L. J., & Holahan, P. J. (1994). Parsimony-based fit indices for multiple-indicator models: Do they work? *Structural Equation Modeling, 1,* 161–189. http://dx.doi.org/10.1080/10705519409539970

Wojtalik, J. A., Eack, S. M., & Keshavan, M. S. (2013). Structural neurobiological correlates of Mayer-Salovery-Caruso Emotional Intelligence Test performance in early course schizophrenia. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 40,* 207–212. http://dx.doi.org/10.1016/j.pnpbp.2012.09.013

Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and Psychological Measurement, 73,* 913–934. http://dx.doi.org/10.1177/0013164413495237

Yuvaraj, R., Murugappan, M., Norlinah, M. I., Sundaraj, K., & Khairiyah, M. (2013). Review of emotion recognition in stroke patients. *Dementia and Geriatric Cognitive Disorders, 36,* 179–196. http://dx.doi.org/10.1159/000353440

Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67,* 361–370. http://dx.doi.org/10.1111/j.1600-0447.1983.tb09716.x

Received December 3, 2016
Revision received March 10, 2017
Accepted April 17, 2017 ■

This document is copyrighted by the American Psychological Association or one of its allied publishers.
This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.