Chapter 1

INTRODUCTION

MARGARET M. WEIGHTMAN, PhD, PT* and MARY RADOMSKI, PhD, OTR/L†

PURPOSE

CONTENT AND STRUCTURE

RECOMMENDED ASSESSMENTS AND INTERVENTIONS
    Assessments
    Guidelines for Administering and Interpreting Assessments
    Intervention

REHABILITATION AFTER CONCUSSION/MILD TRAUMATIC BRAIN INJURY
    General Schema for Physical Therapy
    General Schema for Occupational Therapy
    General Schema for Speech-Language Pathology

RESEARCH

REFERENCES

*Clinical Scientist/Physical Therapist, Courage Kenny Research Center, 800 East 28th Street, MS 12212, Minneapolis, Minnesota 55407
†Clinical Scientist, Courage Kenny Research Center, 800 East 28th Street, MS 12212, Minneapolis, Minnesota 55407

PURPOSE

This toolkit was designed to help military and civilian physical and occupational therapists and speech-language pathologists gain knowledge of valid and reliable screening tools, patient-oriented outcome instruments, and evidence-informed intervention techniques that are useful in evaluating and treating service members (SMs) with concussion/mild traumatic brain injury (c/mTBI). It also includes general assessment schema for physical and occupational therapists and speech-language pathologists who are new to the population of patients with c/mTBI.

This toolkit is intended to be a companion document to the *Occupational and Physical Therapy Mild Traumatic Brain Injury Clinical Practice Guidance*[1] and *Speech-Language Pathology Clinical Management Guidance for Cognitive-Communication Rehabilitation for Concussion/Mild Traumatic Brain Injury*.[2] These two guidance documents contain full background information on the rationale and document development process as well as a literature review of the evidence for the recommended assessment and intervention processes.

CONTENT AND STRUCTURE

Toolkit content (assessment tools, outcome measures, interventions) was informed by extensive literature review and consultation with subject matter and clinical experts. In recommending specific assessments and interventions, the authors acknowledge that the typical SM at baseline is young, healthy, and physically fit and, even while injured, often performs well on standard assessment tools that may not fully characterize subtle deficits.

Consistent with the guidance documents, the toolkit is organized by problem area. The initial sections focus on impairments of body structure and function and activity limitations (activity intolerance, vestibular deficits, vision deficits, headache, and temporomandibular joint disorders) that are most often addressed before focusing on further functional or cognitive issues. Remediation of pain, dizziness, nausea and vomiting, and vision impairments is often essential to the SM's participation in other therapeutic interventions (Figure 1-1). The later sections of the toolkit deal with cognition; attention and dual-task performance deficits; performance of self-management, work, school, and social roles; participation in fitness activities; and a brief discussion of the participation measurement and health-related quality of life.

In general, the toolkit sections are self-contained so clinicians may select resources from some sections and not others based on individual patient needs. The degree of specificity of clinical instructions varies by topic. Some sections of the toolkit provide pictures and step-by-step directions for carrying out the intervention techniques while other sections provide clinicians with suggestions and guiding principles for designing appropriate treatment interventions based on an individual SM's specific needs. References are located at the end of each section of the toolkit.

RECOMMENDED ASSESSMENTS AND INTERVENTIONS

The toolkit contains ten sections organized around specific problem areas typical of c/mTBI. Appendix Table 1-1 summarizes all assessment and intervention recommendations and indicates the strength of the recommendation and the described International Classification of Functioning, Disability, and Health (ICF) level. It is intended to be used after clinicians have reviewed the specific introductory information for each toolkit section.

Assessments

As an introduction to an assessment, screening tool, or outcome measure, the reader will find a "face sheet" that is designed to help clinicians select, administer, and interpret the most appropriate assessments for specific patients. The face sheet describes the original purpose or description of the tool, followed by a brief narrative on the recommendations or cautions for an instrument's use and a description of the time, equipment, and type of test used. Finally, all the assessments include information on the types of healthy or patient groups that have been tested with the measurement tool. These face sheets do not provide exhaustive reviews but are intended to provide relevant data. The psychometric information provided in the toolkit depends on the type of assessment tool being described.

The following is a summary of key measurement issues that relate to the included instruments, intended as a brief reminder of the definitions and clinical utility of psychometric information in
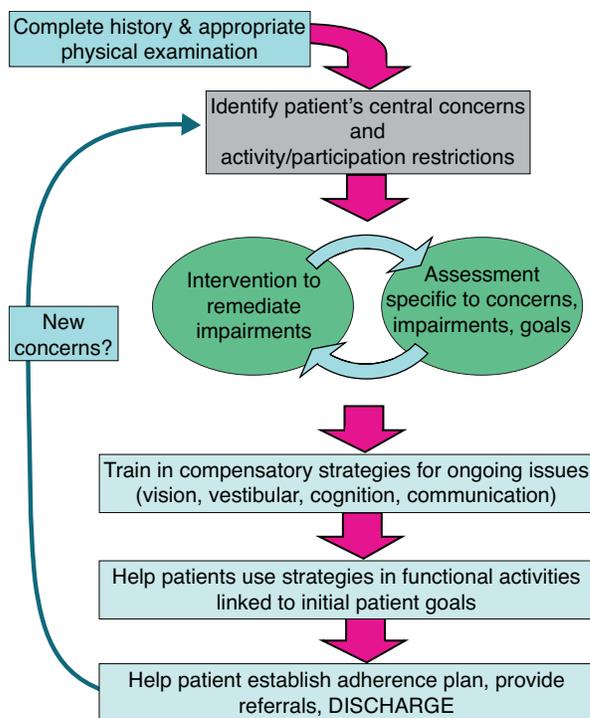
Figure 1-1. The general process for delivering occupational and physical therapy and speech-language pathology services specific to concussion/mild traumatic brain injury. The therapy schemas are provided for general practice clinicians new to this patient population. Although occupational and physical therapy and speech-language pathology schemas are presented separately for purposes of clarity, it is essential that clinicians collaborate to minimize redundancy and optimize outcomes.

regard to tests and measures and their application to an individual SM. Readers are strongly encouraged to review clinical or rehabilitation research texts, such as Domholdt's *Rehabilitation Research Principles and Applications*[3] and *Foundations of Clinical Research: Applications to Practice*[4] by Portney and Watkins, to refresh their knowledge of pertinent test psychometrics, specifically issues of tests and measure reliability and validity.

Reliability is defined as the extent to which the instrument yields the same results on repeated measures. There are a number of types of reliability important in the use of tests and measures (eg, rater and test-retest reliability). In a practical sense, a test does not provide useable information if it does not result in consistent or stable responses when there have been no changes in the subject, or if two raters scoring the same test responses do not obtain consistent test scores. Depending on the level of measurement, intraclass correlation coefficients

are typically used to evaluate rater reliability, with the values closer to 1.00 representing stronger reliability. For clinical measures, reliability coefficients greater than .90 are considered excellent and supportive of reasonable validity.[4]

An unreliable assessment tool would result in the inability to determine if a change in patient scores reflected a true change or merely resulted from unstable or inconsistent test scoring. According to Domholdt, "An unreliable measure is also an invalid measurement, because measurements with a great deal of error have little meaning or utility."[3(p259)]

In a practical and clinical sense, the evaluating clinician must be consistently aware of the **minimal detectable change (MDC)** for a measurement tool. There is variability and error in all measurement. Clinical test interpretation must recognize that for a true change to occur, the change demonstrated by a SM must be greater than the error variability of a measurement. Haley and Fragala-Pinkham write that the "MDC is considered the minimal amount of change that is not likely to be due to chance variation in measurement."[5] Other measures are used to detect change that is clinically important for the patient, such as minimal clinically important differences (MDICs); however, for this toolkit, we have chosen to report MDC where available.

Measurement of test validity indicates the meaningfulness of test scores as they are used for a specific purpose; that is, it gives usefulness to the inferences made from test scores. Information on face, content, criterion, and construct validity all indicate the extent to which a measurement tool fully measures the construct it is intended to measure. According to Portney and Watkins, validity is not "inherent in an instrument, but must be evaluated within the context of the test's intended use and a specific population."[6(p81)]

Specific to the screening tools used to diagnose a specific condition (eg, benign paroxysmal positional vertigo, unilateral vestibular hypofunction [UVH], or unilateral vision loss [UVL] described in the vestibular section of this toolkit), information is provided on the **sensitivity** (test is positive when the condition is present) and **specificity** (test is negative when the condition is absent) of the test. As Portney and Watkins write, the validity of a diagnostic tool is "evaluated in terms of its ability to accurately assess the presence and absence of the target condition."[6(p93)]

Another critical issue in measurement tools is the **responsiveness to change** of a measurement. Clinicians hope their interventions result in positive

and useful change in their patients, and a measurement tool must be able to provide a useful metric that can show change when the client has made a significant clinical improvement.

Guidelines for Administering and Interpreting Assessments

Ideally, assessments and outcome measures would be tested for reliability and validity in the settings and with the raters and specific populations for which they are to be used. This has not yet happened with many of the tests and assessments recommended in this toolkit. Many of the tools have been tested on patients with the problems reported by SMs with c/mTBI (eg, balance complaints or posttraumatic headache). However, most of the instruments have not yet been fully characterized in the young, fit, and healthy population typical of enlisted SMs; specifically those who have some of the pervasive comorbidities found in this population, such as posttraumatic stress disorder or acute stress reaction. This lack of information specific to SMs does not render the test unusable; rather it should caution the evaluating clinician to carefully interpret the data. Again, because of the lack of specific reliability and validity for measurement tools used for SMs with combat-related c/mTBI, the evaluating clinician must consider all factors when interpreting the obtained data.

In addition, measurement tools are not valid and reliable in and of themselves. These qualities depend on the raters (the ability to reliably administer and score a test may require prior training), the patients, the setting, and comorbid conditions (such as posttraumatic stress and acute stress reaction). To optimize the accuracy and interpretability of the assessments, tests and measures must be administered and scored true to the instructions. Attempts to change or invent categories of responses, adapt scoring rubrics, or give "bonus points" or second chances will all reduce the reliability and validity of a tool.

Intervention

Similarly, intervention descriptions begin with a face sheet that is designed to inform clinical reasoning and decision making. The face sheet gives background on the intervention and specifies the strength of recommendation.

Given the scarcity of specific literature to guide recommendations in many of the reported symptom areas, specifically for young and previously healthy SMs, we chose to borrow from Cicerone and colleagues[7] and characterize recommendations as either a **practice standard** or **practice option**.

- Practice standards: recommended practices that are supported by existing c/mTBI guidelines or published, evidence-based reviews concerning the problem area.
- Practice options: potentially beneficial practices that do not have such support but are consistent with current theory, literature, or expert opinion.[7]

REHABILITATION AFTER CONCUSSION/MILD TRAUMATIC BRAIN INJURY

The toolkit specifies clinical practices that are supported by the guidance documents. As such, readers are advised to carefully review the contents of the guidance documents. The guidance documents specify several assumptions about SMs and the clinicians involved in their care and provide several guiding principles for c/mTBI-related rehabilitation across all levels within the military and civilian systems of care. The guidance documents and the toolkit were developed specifically for general practice clinicians whose clinical judgment is fundamental to providing the highest level of care for injured SMs. The guidance documents and toolkit should supplement sound clinical judgment and are premised on the following key assumptions:

- Clinicians use a patient-centered approach in which they communicate an optimistic expectation for an SM's full recovery.

- Clinicians incorporate an SM's goals and priorities into the evaluation process along with evaluating c/mTBI-related symptoms and impairments.
- The scope of practice for the occupational therapist, physical therapist, and speech-language pathologist may vary depending on the level of care, the location of the facility, and access to other healthcare providers (rehabilitation teams and specialists), and military practice may be different from that of civilian practice.
- Whenever feasible, the ICF is used, with problem areas described in terms of body structure/body function, activity, or participation limitations. Clinicians are encouraged to consider all levels of the ICF model when assessing and intervening with SMs or civilians with c/mTBI.

Both personal and environmental factors can impact limitations at each level of the model.

Figure 1-1 outlines a general process for delivery of occupational and physical therapy and speech-language pathology services specific to c/mTBI. The following therapy schemas are provided for general practice clinicians new to this patient population. Although occupational and physical therapy and speech-language pathology schemas are presented separately for purposes of clarity, it is essential that clinicians collaborate to minimize redundancy and optimize outcomes.

General Schema for Physical Therapy

A general plan for physical therapy assessment of an SM with c/mTBI complaints contains both subjective and objective components. It is assumed that physical therapists are aware of relevant background information when taking history (eg, family support, medications, work-related requirements, etc). Initial intake involves taking a thorough history that includes detailed information of the traumatic or causative event (ie, mechanism of injury, occurrence and duration of altered awareness, and duration of posttraumatic amnesia). The patient should be asked for presenting complaints and complete a checklist of current symptoms (eg, Neurobehavioral Symptom Inventory), and should also be asked about prior resolved symptom complaints. A number of patient questionnaires may be appropriate at this time depending on the SM's presenting complaints, such as the:

- Dizziness Handicap Inventory,[8]
- Jaw Functional Limitation Scale,[9,10]
- Patient-specific Functional Scale,[11]
- Headache Disability Inventory,[12]
- Activities-specific Balance Confidence Scale,[13] and
- Numeric Pain Rating Scale.[14]

Additionally, patients should be asked to describe their current activity level, including the type, duration, and intensity of participation in fitness activities; SMs should also be asked to describe their goals for the current physical therapy episode of care. A physical assessment for someone with a history of concussion and ongoing complaints follows the interview segment of the evaluation. It should include the following assessments:

- strength: manual muscle testing; functional strength test using the High Level Mobility Assessment Tool (HiMAT[15,16]) or the Five Times Sit-to-Stand Test[17];
- range of motion;
- range-of-motion screening in major joints, including the neck, and oculomotor mobility;
- sensation;
- gross sensory test for somatosensation, proprioception;
- balance;
- balance screening using a simple balance test, and more extensive balance testing as appropriate (see Chapter 3, Balance Assessment and Intervention);
- coordination (HiMAT may test some gross coordination issues);
- gait velocity;
- comfortable and fast walking speed (consider Functional Gait Assessment); and
- dual-task assessment.

Further physical and functional assessment will depend on the presenting complaints found during the intake interview regarding vestibular and balance complaints, posttraumatic headache, and temporomandibular disorders. Additionally, fitness level may be evaluated using military standards as appropriate at some point during the episode of care. As always, clinician judgment is key to deciding when additional assessment is needed.

Based on history and assessment findings, provide appropriate intervention, education, and discharge planning, including home programming, appropriate referrals and follow-up, exercise recommendations, and planning for resumption of military and social roles.

General Schema for Occupational Therapy

Therapists should acquaint themselves with the patient's diagnosis, comorbidities, and past medical, social, educational, and service history by careful review of the patient's chart. This information is critical to selecting assessment tools and interpreting assessment results. Assessment follows this general sequence.

- Interview the patient (and family members, if available) to discover background information that may be not be included in the medical record. Therapists may also use the interview to better understand the patient's most pressing concerns,

problem areas, and priorities specific to interventions. The Canadian Occupational Performance Measure[18] is recommended for initial interview and periodic progress reassessment.

- Screen for vision problems. Administer the College of Optometrists in Vision Development (COVD) Quality of Life Assessment[19] (a symptom questionnaire). If the patient has vision complaints, conduct a full vision assessment, including visual acuity, visual fields, oculomotor control, and binocular vision. Refer patients with vision impairments to an ophthalmologist or optometrist who specializes in TBI for more in-depth evaluation.
- Implement vision remediation intervention as directed by a neuro-ophthalmologist or optometrist and help the patient identify and implement vision compensations to optimize functioning.
- Collaborate with other team members to address potential problems with sleep and structure-recommended changes in sleep hygiene.
- Identify potential cognitive inefficiencies. Observe the patient's functional performance under circumstances that require varying degrees of memory, attention, and executive functioning and consider a standardized functional assessment, such as the Mortera-Cognitive Screening Measure[20,21] or the Dynamic Observation of Function Checklist (see Chapter 7, Cognitive Assessment and Intervention). If a full neuropsychological battery has been recently performed, review the results to obtain information about the patient's cognitive status. If not, administer cognitive assessments based on problem areas evident during functional task performance. Options include the following:
  - Behavioural Assessment of Dysexecutive Syndrome,[22]
  - Cognistat,[23]
  - Repeatable Battery for the Assessment of Neuropsychological Status,[24]
  - Behavior Rating Inventory of Executive Function–Adult (BRIEF–A),[25]
  - Contextual Memory Test,[26]
  - Rivermead Behavioral Memory Test,[27] and
  - Test of Everyday Attention.[28]
- Instruct the patient in compensatory cognitive strategies (attention, memory, and executive function) based on the nature of patient complaints and assessment results. Collaborate with patients to identify the compensatory strategies they are most likely to adopt and benefit from.
- Structure clinical and nonclinical opportunities for the patient to rehearse the new skill or strategy, and help the patient implement the new skill or strategy within the context of personally relevant self-management tasks, such as medication management or bill paying and budgeting.
- Continue to develop additional compensatory strategies as indicated. As patients adopt and employ an array of successful compensatory strategies, help them use those skills to resume social, work, and school roles; schedule a regimen of declining contact with patients so they remain supported while increasingly and successfully resuming these roles.
- Set up a discharge plan that includes problem solving with the patient regarding long-term adherence to therapy recommendations and resources if new problems arise.

General Schema for Speech-Language Pathology

Begin the SLP focus by reviewing the patient's chart. As with the OT approach, clinicians should acquaint themselves with the patient's diagnosis, comorbidities, and past medical, social, educational, and vocational and military service history. This information is critical for selecting assessment tools and interpreting assessment results. Also as with OT, interview the patient (and family members, if available) to obtain additional background information that may not be included in the medical record and to better understand the patient's most pressing concerns, problem areas, self-help strategies, priorities, goals, and expectations specific to rehabilitation.

Refer the patient to an audiologist for evaluation to determine if auditory symptoms are associated with c/mTBI. Collaborate with other team members to address comorbidities such as pain, sensory impairments, fatigue, stress, sleep deprivation, drug effects, and psychosocial concerns that can contribute to cognitive and communication inefficiencies, and identify potential cognitive-communication inefficiencies. If a full neuropsychological battery has been recently performed, review the results to

obtain information about the patient's cognitive status, strengths and weaknesses, and measures of effort.

If not, consider referral to a neuropsychologist to obtain the necessary information. Assess problem areas using standardized instruments (eg, broad assessment of cognitive-communication abilities, domain-specific assessments, and functional performance assessments) and self-report measures.

Observe the patient's functional performance under circumstances that require varying degrees of attention, speed of information processing, memory, self-regulation, social communication, and executive function. Instruct the patient in compensatory cognitive-communication strategies (attention, memory, speed of information processing, executive functions, social communication, and conversational disfluencies) based on the nature of patient complaints and assessment results. Collaborate with the patient to identify the compensatory strategies most likely to be beneficial in real-life contexts; structure functional and meaningful tasks within clinical sessions for the patient to practice and habituate the new skill or strategy.

Perform ongoing assessment to determine the effectiveness of intervention and modify compensatory strategies as appropriate to optimize function. As the patient adopts and employs an array of successful compensatory strategies, facilitate generalization of the new skill or strategy to personally relevant contexts—including new settings, people, and situations—to enable the patient to resume social, work, and school roles.

Schedule a regimen of declining contact so the patient remains supported while increasingly and successfully resuming personal, social, work, and school roles. Discharge the patient from therapy and formulate a plan for follow-up that includes problem solving with the patient regarding long-term adherence to therapy recommendations and resources if new problems arise.

RESEARCH

Published research and guidelines are constantly being updated. The guidance documents and toolkit are based on currently available evidence. Where appropriate, the guidelines, tools, and interventions recommended incorporate clinical expertise and may be biased by the consulted expert panel. With this in mind, the authors welcome feedback and recommendations for omissions, updates, and future inclusions in this toolkit.

REFERENCES

1. Radomski MV, Weightman MM, Davidson L, Rodgers M, Bolgla R. *Clinical Practice Guidance: Occupational Therapy and Physical Therapy for Mild Traumatic Brain Injury*. US Army Office of the Surgeon General: Falls Church, VA; 2010.

2. Cornis-Pop M, Mashima PA, Roth CR, et al. Guest editorial: cognitive-communication rehabilitation for combat-related mild traumatic brain injury. *J Rehabil Res Dev*. 2012;49(7):xi–xxxii.

3. Domholdt E. *Rehabilitation Research Principles and Applications*. 3rd ed. St. Louis, MO: Elsevier Saunders; 2005.

4. Portney LG, Watkins MP. *Foundations of Clinical Research: Applications to Practice*. 3rd ed. Upper Saddle River, NJ: Pearson/Prentice Hall; 2008.

5. Haley SM, Fragala-Pinkham MA. Interpreting change scores of tests and measures used in physical therapy. *Phys Ther*. 2006;86(5):735–743.

6. Portney LG, Watkins MP. *Foundations of Clinical Research: Applications to Practice*. 2nd ed. Upper Saddle River, NJ: Prentice Hall; 2000.

7. Cicerone KD, Dahlberg C, Kalmer K, et al. Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Arch Phys Med Rehabil*. 2000;81:1596–1615.

8. Whitney SL, Marchetti GF, Morris LO. Usefulness of the dizziness handicap inventory in the screening for benign paroxysmal positional vertigo. *Otol Neurotol*. 2005;26(5):1027–1033.

9. Ohrbach R, Granger C, List T, Dworkin S. Preliminary development and validation of the Jaw Functional Limitation Scale. *Community Dent Oral Epidemiol*. 2008;36:228–236.

10. Ohrbach R, Larsson P, List T. The Jaw Functional Limitation Scale: development, reliability, and validity of 8-item and 20-item versions. *J Orofac Pain*. 2008;22:219–230.

11. Stratford P, Gill C, Westaway M, Binkley J. Assessing disability and change on individual patients: a report of a patient specific measure. *Physio Canada*. 1995;47(4):258–263.

12. Jacobson GP, Ramadan NM, Aggarwal SK, Newman CW. The Henry Ford Hospital Headache Disability Inventory (HDI). *Neurology*. 1994;44(5):837–842.

13. Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. *J Gerontol Med Sci*. 1995;50(1):M2834.

14. Jenson MP Karoly P Braver S. The measurement of clinical pain intensity: a comparison of six methods. Pain 1986; 27:117–26.

15. Williams G, Robertson V, Greenwood K, Goldie P, Morris ME. The high-level mobility assessment tool (HiMAT) for traumatic brain injury. Part 1: item generation. *Brain Inj*. 2005;19(11):925–932.

16. Williams G, Robertson V, Greenwood K, Goldie P, Morris ME. The high-level mobility assessment tool (HiMAT) for traumatic brain injury. Part 2: content validity and discriminability. *Brain Inj*. 2005;19(10):833–843.

17. Csuka M, McCarty DJ. Simple method for measurement of lower extremity muscle strength. *Am J Med*. 1985;78:77–81.

18. Law M, Baptiste S, McColl MA, Carswell A, Polatajko H, Pollock N. *Canadian Occupational Performance Measure*. 2nd ed. Toronto, Ontario: Canadian National Organisation of Occupational Therapists–ACE Publications; 1994.

19. Maples WC. Test-retest reliability of the College of Optometrists in Vision Development Quality of Life Outcomes Assessment short form. *J Optom Vis Dev*. 2002;33:126–134.

20. Mortera MH. Instrument development in brain injury rehabilitation: Part I. *Physical Disabilities Special Interest Section Quarterly*. 2006a;29(3):1–4.

21. Mortera MH. Instrument development in brain injury rehabilitation: Part II. *Physical Disabilities Special Interest Section Quarterly*. 2006b;29(4):1–2.

22. Wilson BA, Evans JJ, Alderman N, Burgess P. The development of an ecologically valid test for assessing patients with a dysexecutive syndrome. *Neuropsychol Rehabil*. 1998;8:213–228.

23. Kiernan RJ, Mueller J, Langston JW, Van Dyke C. The Neurobehavioral Cognitive Status Examination: a brief but quantitative approach to cognitive assessment. *Ann Intern Med*. 1987;107(4):481–485.

24. Randolph C. *Repeatable Battery for the Assessment of Neuropsychological Status: Manual*. San Antonio, TX: Psychological Corporation; 1998.

25. Roth R, Isquith P, Gioia G. *Behavior Rating Inventory of Executive Function-Adult version (BRIEF-A)*. Lutz, FL: Psychological Assessment Resources, Inc; 2005.

26. Toglia JP. *The Contextual Memory Test*. San Antonio, TX: Harcourt Assessments; 1993.

27. Wilson BA, Cockburn J, Baddeley AD, Hiorns R. The development and validation of a test battery for detecting and monitoring everyday memory problems. *J Clin Exp Neuropsychol*. 1989;11(6):855–870.

28. Robertson IH, Ward T, Ridgeway V, Nimmo-Smith I. The structure of normal human attention: The Test of Everyday Attention. *J Int Neuropsychol Soc*. 1996;2(6):525–534.