COMMENTARY

Cognitive Versus Functional Approaches to Rehabilitation After Traumatic Brain Injury: Commentary on a Randomized Controlled Trial

Gordon Muir Giles

I describe the findings of one of the largest randomized controlled trials (RCTs) of rehabilitation after traumatic brain injury (TBI) ever conducted, examine the theoretical relationship between cognitive and functional rehabilitation after TBI, and describe the historical preference for cognitive (top-down) rather than functional (bottom-up) interventions. I also contrast the goals and principles of cognitive rehabilitation and of the neurofunctional approach of Giles and Clark-Wilson (1993; Giles, 2005)—a bottom-up approach. Findings of the RCT provide empirical support for both functional and cognitive interventions following acute TBI. In addition, they provide evidence that each type of intervention offers significant advantages for a specific subpopulation. The clinical implications of these findings for occupational therapy practitioners are discussed.


Randomized Controlled Trial of Cognitive Versus Neurofunctional Interventions After Traumatic Brain Injury

A randomized controlled trial (RCT; Vanderploeg et al., 2008) has shown that an approach modeled on the neurofunctional approach (Giles, 2005; Giles & Clark-Wilson, 1993) is as effective as cognitive intervention in assisting clients recovering from acute traumatic brain injury (TBI) with return to work, school, or independent living. In addition, the RCT showed that both cognitive and neurofunctional interventions, when provided in addition to standard rehabilitation, offered significant advantages for specific subpopulations. In this commentary, I explore the theoretical background of the cognitive versus neurofunctional rehabilitation comparison, place the recent RCT in context, and discuss the implications of recent findings for occupational therapy practitioners.

Randomized Controlled Trial of Cognitive Versus Neurofunctional Interventions After Traumatic Brain Injury

An article published in the Archives of Physical Medicine and Rehabilitation described one of the largest RCTs of rehabilitation after TBI ever conducted (Vanderploeg et al., 2008). The RCT was funded by the U.S. Departments of Defense and Veterans Affairs and had been in process for more than a decade. The study was carried out at four centers (Minneapolis, MN; Palo Alto, CA; Richmond, VA; and Tampa, FL), participants were enrolled beginning in 1996, and the treatment phase of the protocol was completed in 2003 (Vanderploeg et al., 2006). Participants were included if
they had moderate to severe TBI, provided consent, were admitted to one of the participating centers, had a Rancho Los Amigos level (Hagan, Malkmus, & Durham, 1979) of V to VII at enrollment, needed ≥30 days of acute rehabilitation, and were ages 18 to 65. Study interventions were described as cognitive–didactic (using Sohliberg and Mateer’s [1987a] Cognitive Rehabilitation Model) or functional–experiential (on the basis of Giles and Clark-Wilson’s [1993] neurofunctional approach) and were provided in addition to standard rehabilitation. Treatment was hospital based and provided by independent teams of therapists who were trained and monitored to ensure fidelity to each distinct treatment protocol. By the study’s completion, 366 participants had been randomized, and 180 participants were included in each arm of the study. The principal hypothesis of the RCT was that the cognitive–didactic intervention would be superior to the functional–experiential intervention on primary outcome measures. Contrary to expectations, however, Vanderploeg et al. (2008) found no difference between cognitive–didactic and functional–experiential interventions on the primary outcome measures, but they did find significant differences in a preplanned subset outcome analysis (Giles, 2009; Vanderploeg et al., 2008). Younger participants (<30) and those with less education who participated in the cognitive–didactic intervention group had better work-related outcomes at 1-year follow-up than participants in the functional–experiential group. Moreover, older participants (>30) and those with more education who participated in the functional–experiential group had better independent living outcomes at 1-year follow-up than participants in the cognitive–didactic group (Vanderploeg et al., 2008).

**Historical Perspective on Cognitive Versus Functional Interventions**

Since their modern origins in the 1970s, cognitive interventions have been preferred to functional interventions for people after TBI on the basis of the theoretical relationship between cognition and function (Gianutsos, 1980; Sohliberg & Mateer, 1987a; Vanderploeg et al., 2006). Cognitive deficits were regarded as the primary cause of dysfunction, and functional deficits were seen as resulting from them (Gianutsos, 1980). According to this logic, functional assessment and treatment would be unnecessary if cognitive functioning could be adequately remediated: Cognitive rehabilitation would “automatically” result in improved functional behaviors (i.e., a top-down approach; Soderback & Normell, 1986; Vanderploeg et al., 2006). A considerable amount of research attempted to use cognitive deficits to predict functional deficits (Chelune & Moehle, 1986; Heaton & Pendleton, 1981). Although most studies showed a relationship between cognition and function, attempts to predict the one from the other with precision were unsuccessful (Smith-Knapp, Corrigan, & Arnett, 1996). Nonetheless, cognition was still regarded as a primary target for intervention (Scherzer, 1986; Soderback & Normell, 1986).

**Cognitive Intervention in the Randomized Controlled Trial**

During the decade of the study, cognitive retraining programs were used to address cognitive dysfunction in clients with TBI in inpatient and outpatient rehabilitation settings (Blundon & Smits, 2000). Office-based interventions using primarily paper-and-pencil activities were popular and were initiated when clients could tolerate this type of intervention (Blundon & Smits, 2000; Vanderploeg et al., 2006). **Attention Process Training (APT)** is an influential model of cognitive rehabilitation (Sohlberg & Mateer, 1987a), and it was used as a model for the cognitive–didactic arm of the Vanderploeg et al. (2006) RCT. In APT, attention is viewed as a multidimensional cognitive function with subcomponents of sustained attention, selective attention, alternating attention, and divided attention. The APT model suggests that placing each subcomponent under stress facilitates improved functioning in that system. Sohliberg and Mateer (1987a) developed hierarchies of treatment tasks for each of the four components of attention and described six basic tenets of the APT approach: (1) the theoretical model, (2) comprehensive assessment, (3) process approach, (4) repetition, (5) knowledge of results, and (6) use of probes to evaluate generalization (Sohlberg & Mateer, 1987a).

**Neurofunctional Approach in the Randomized Controlled Trial**

The neurofunctional approach was designed primarily for people who are unlikely to develop self-care or community independence skills spontaneously. Treatment focuses on learning by doing. In the neurofunctional approach, this “doing” is not random and is structured using (1) identification and analysis of the essential requirements of specific task performance for each person; (2) consideration of client strengths and individual motivational factors; and, where clinically indicated, (3) an errorless learning approach and repetition to develop internalized performance models intended to automatically guide future performance. Practice of the actual task in a prescribed format reduces the executive demands of the activity. Practiced tasks are expected to improve, and as the person develops competencies, effects on goal states and self-esteem may further enhance performance (i.e., a bottom-up approach; see Parish & Oddy, 2007, for evidence for this effect; Giles, Ridley, Dill, & Frye, 1997; Parish & Oddy, 2007). These latter factors are maximized by the use of goal-setting groups and strategies for providing positive feedback. In the Vanderploeg et al. (2008) RCT, the neurofunctional intervention was provided in a group format and focused on the performance of independent living activities.

**Experimental Designs**

Several factors have limited the number of RCTs comparing types of TBI rehabilitation. The number of clients who fit inclusion criteria and who are available for
treatment is limited (e.g., the Vanderploeg et al. [2008] RCT required four sites and 6 years to recruit participants). Rehabilitation is both labor intensive and costly, and the opportunity to provide more than one treatment is rare. Treatment comparisons using clients from different settings have been invalidated by unforeseen noncomparability of treatment populations (Giles, 2001). The length of rehabilitation combined with the belief that a critical period for treatment exists makes wait-list controls or even standard-care design unethical; relevant outcomes are not available for months or years, requiring extensive follow-up resources. In addition, rehabilitation interventions for clients with TBI have until recently been poorly defined, and little research attempted to identify the active component of treatment. For these reasons, large-scale RCTs have been few in number, and clinicians have had to make treatment decisions from the evidence available (Turner-Stokes, 2008).

Status of Knowledge Before the Randomized Controlled Trial: Evidence for Cognitive Versus Neurofunctional Interventions

Before the Vanderploeg et al. (2008) RCT, the effectiveness of cognitive rehabilitation had not been demonstrated in acute rehabilitation (Park & Ingers, 2001; Sohliberg & Mateer, 1987b; Sohliberg, White, Ellis, & Mateer, 1992; Vanderploeg et al., 2006). Small-scale “proof-of-concept” studies have shown some evidence that cognitive rehabilitation could improve cognitive skills in postacute TBI settings (Giles, 2001), and recent controlled trials have found that holistic neuropsychological rehabilitation improves community functioning (Cicerone et al., 2008). Park and Ingers (2001) performed an influential meta-analysis of 30 attention-retraining studies and concluded that the hypothesis that retraining can restore or strengthen damaged attention functions had little support. However, studies that addressed attention-dependent specific skills (i.e., driving) showed that attentional performance on demanding functional tasks can be improved, suggesting that functionally oriented cognition is a more appropriate target for cognitive retraining. Currently, cognitive retraining models have become more holistic and address issues such as self-esteem, self-management skills, and functionally oriented cognitive skills. Independent living skills or return to work are treated as primary outcome measures rather than measures related to basic-level cognitive processing (Cicerone et al., 2008).

With regard to functional retraining, strong evidence suggests that multidisciplinary acute care improves community functioning after TBI and that more intensive functional programs are associated with more rapid functional gains (Turner-Stokes, 2008; Turner-Stokes, Nair, Disler, & Wade, 2005). Postacute rehabilitation programs targeting functional skills have demonstrated that clients improve in independent living and return to work, that care costs decrease, and that the improvement in function is durable. Most studies have, however, been simple preintervention-postintervention studies and often failed to define the intervention any more specifically than “life-skills training” (Giles, 2001; Harrick, Krefting, Johnston, Carlson, & Minnes, 1994; Johnston, 1991a, 1991b).

Before the Vanderploeg et al. (2008) study, the neurofunctional approach added to standard multidisciplinary care had not been evaluated in acute TBI rehabilitation. Similar to cognitive approaches, the neurofunctional approach had limited proof-of-concept studies (i.e., multiple case-study designs). It has been described as the only functional approach demonstrated to be effective in improving independence skills >10 years after a severe TBI (Giles et al., 1997; Parish & Oddy, 2007).

Discussion of the Randomized Controlled Trial and Its Relevance for Practitioners

The Vanderploeg et al. (2008) RCT evaluated both cognitive and neurofunctional approaches and demonstrated their effects in an acute TBI rehabilitation population. Both cognitive–didactic and functional–experiential (neurofunctional) treatment in addition to standard care may have specific advantages in certain subpopulations and for achieving specific outcomes in acute TBI rehabilitation. Confidence in the empirical findings is enhanced by their being consistent with theoretical expectations (i.e., the impact of treatment is observed in places in which one would predict it; Giles, 2009). The Vanderploeg et al. (2008) study provided evidence that two viable interventions are available for use in acute rehabilitation after TBI and that targeting specific populations and goals may maximize treatment effectiveness.

The neurofunctional approach was intended to be applied to people with severe impairments and independent living goals and over a considerable period (rather than the 20–60 days in the Vanderploeg et al., 2008, study). The intended application of the approach was primarily individual rather than group based, although it had important group components. Given these protocol variations, the Vanderploeg et al. (2008) RCT provides a hard test of the neurofunctional approach. Also largely missing from the description of the way in which the neurofunctional approach was implemented in the Vanderploeg et al. (2008) study were the identification and analysis of specific task requirements, the identification of specific strengths to be emphasized in the development of retraining programs, self-regulation training, and the use of small groups to enhance goal setting and self-esteem.

The neurofunctional approach is intended to be implemented by occupational therapists and occupational therapy assistants, but it is clearly distinct from standard care. Task analysis, cue experimentation, and errorless-learning programs for skill acquisition continue to be non-standard practice in occupational therapy for people with TBI (Giles, 2005; Giles & Clark-Wilson, 1993; Parish & Oddy, 2007). Independent living goals continue to be challenging for many people 1 year after a TBI, and this is especially true of older adults (Powell, Temkin, Machamer, & Dikmen, 2007). Clinicians may consider the structured approaches that are part of the neurofunctional approach in working with clients for whom, at least in the short term, the goal is independent living rather than return to work or school.
The neurofunctional approach is multidimensional, and more research is required to further define timing and intensity and provide greater specificity regarding the type of patient most likely to respond positively to the approach. Taken together with earlier work (Giles & Clark-Wilson, 1993; Giles, Wagner, Fong, & Waraich, 2005; Giles et al., 1997; Parish & Oddy, 2007), Vanderploeg et al.’s (2008) study adds considerably to the evidence base supporting neurofunctional intervention in addition to standard care in improving independent living skills in people after moderate to severe TBI. ▲

Acknowledgments
Thanks to David Manchester, Egle Narevic, and Jo Clark-Wilson for commenting on a draft of the article.

References


