2021

Critically Appraised Topic Paper: What is Motor Learning Theory? How Can It Be Implemented into Occupational Therapy Interventions for Individuals with Cerebrovascular Accidents?

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***This resource was written by doctoral-level students in fulfillment of the requirements of the Occupational Therapy course "OT 403 - Clinical Research Methods in Occupational Therapy" at the University of North Dakota School of Medicine and Health Sciences, under the advisement of Professor/Course Director Anne Haskins, Ph.D., OTR/L, Assistant Professor Breann Lamborn, EdD, MPA, Professor Emeritus Gail Bass Ph.D., OTR/L, and Research and Education Librarian Devon Olson Lambert, MLIS.

Focused Question

Are motor learning theory-based interventions considered to be part of best practice in occupational therapy rehabilitation for individuals with cerebrovascular accidents (CVA)? If so, how might occupational therapists incorporate motor learning theory into intervention design with maximum efficacy?

Purpose Statement

The purpose of this critically appraised topic (CAT) paper was to determine if motor learning theory guides interventions that are considered to be best practice for individuals with CVAs. We want to determine what is best practice for this population to provide practitioners with synthesized research allowing practitioners to implement the most effective, client-centered, evidence-based interventions possible.

Theory

The Ecology of Human Performance (EHP) was selected to understand the role of context in occupational therapy intervention. A foundational postulate to the EHP framework is that the interaction between person and environment affects human behavior and performance; under this lens, performance cannot be understood outside of context (Dunn et al., 1994). The contextual lens interacts with the person's skills and abilities to enable them to perform certain tasks; this interaction results in an individual's performance range (Dunn et al., 1994). The relationship between the person and their context presents an understanding of the extent to which the person can perform specific tasks (Dunn et al., 1994). According to the motor learning theory, occupational therapists develop therapeutic interventions by considering which task requirements are most appropriate and which conditions of their environment may need to be adapted to elicit optimal performance (Sabari, 1990). A person's context is viewed as fundamental to the understanding of human performance according to the motor learning theory and EHP (Dunn et al., 1994; Sabari,1990). If an occupational therapist evaluates an individual's performance without considering the context of the performance, there is a great risk the performance will be interpreted incorrectly (Dunn et al., 1994). The lack of consideration for the contextual role in task performance when designing intervention may result in a poor transference of the skills learned in the contrived setting to a person's natural context.

Case Scenario

According to the Centers for Disease Control and Prevention (2021), in 2018, one in six deaths from cardiovascular disease was due to CVA. The Centers for Disease Control and Prevention (2021) reported that every year more than 795,000 people in the United States have a CVA, and about 610,000 of these are first or new CVAs. CVA is the leading cause of adult disability in the United States, resulting in challenges such as weakness on one side of the body, a decline in cognitive and emotional functioning, social disability, inability to walk, inability to care for themselves, and a decrease in community participation (Nilsen et al., 2015). According to the American Stroke Association (2018), women are at a higher risk of CVA compared to men due to pregnancy, preeclampsia, birth control, hormone replacement, migraines, and atrial fibrillation. The African American population has a higher chance of a CVA leading to death compared to Caucasians due to higher blood pressure, diabetes, and obesity (The American Stroke Association, 2018). People that are affected by CVAs experience deficits in muscle power, balance, different sensations, and speech difficulties (Langhorne et al., 2011). These

implications may result in individuals having rehabilitation goals in areas of occupations such as activities of daily living (ADL) and instrumental activities of daily living (IADL) to improve their performance. There are multiple allied health disciplines that provide interventions addressing functional outcomes for individuals with CVAs (Zahl et al., 2017). The rehabilitation team may include, but is not limited to physical therapy, occupational therapy, recreational therapy, and speech-language pathology (Zahl et al., 2017).

There is a large consensus in the literature that supports using motor learning theory for CVA rehabilitation in occupational therapy. Motor learning refers to internal processes that are associated with practice or experience and lead to relatively permanent changes in motor behavior (Schmidt et al., 1988; as cited in Jarus, 1994). Motor learning theory approaches to CVA therapy consist of addressing motor impairments post-CVA, high repetition of a cumulative of 10,000 repetitions for optimal motor recovery (Kleim et al., 1998; Nudo et al., 1996), positive feedback, and a motivating format (Birkenmeier et al., 2010). The goal of using a motor learning approach in occupational therapy is to assist individuals with developing their strategies for effective movement within their environment (Sabari, 1990). Occupational therapy emphasizes the therapeutic use of purposeful activity allowing occupational therapists to incorporate motor learning concepts into intervention (Sabari, 1990).

While there is large support for motor learning theory in the literature, there are disparities for what is considered best practice for individuals with CVAs. New research has started to show that a task-oriented approach may be better than motor learning theory-oriented approach when providing occupational therapy interventions to individuals with CVAs (Almhdawi et al., 2016). Almhdawi et al. (2016) defined task-oriented training as a "highly individualized, client-centered, occupational therapy, functional-based intervention compatible with motor learning and motor control principles such as intensive motor training, variable practice and intermittent feedback" (p. 445). Scobbie et al. (2013) identified goal setting as best practice for CVA rehabilitation, but there is no consensus regarding key components of goal setting interventions or how they should be optimally delivered in practice. Major advances have occurred in the last 20 years in the development and testing of interventions for CVA rehabilitation, but there are many gaps in the evidence to inform clinical practice (Langhorne et al., 2011). Thus, the purpose of this critically appraised topic paper is to determine if motor learning theory-guided interventions are best practice for individuals with CVA, and how occupational therapists can effectively implement motor learning theory into their intervention design.

Key Terms

Best practice: interventions supported by the literature for the appropriate population. *CVA:* commonly referred to as a stroke, cell death resulting from lack of oxygen and blood flow to the brain (Shiel, 2017). *Intervention:* treatment for a specific diagnosis.

Summary of Search

Our initial literature search yielded 40 articles to review focusing on intervention, best practice, current practice, motor learning theory, and frames of reference used in occupational therapy for individuals with CVAs. Upon refining our focus question, we found that not all of our initial articles were relevant to our topic resulting in 30 articles that met our criteria. Many of our foundational articles were published decades ago, however, are still valid and relevant to our topic and were therefore included in our literature synthesis. Databases searched for evidence to

our focus question include Cumulative Index of Nursing and Allied Health Literature (CINAHL), Pubmed, and the American Journal of Occupational Therapy (AJOT). These databases were chosen given their plethora of evidence-based, occupational therapy literature. Search terms used were: *cerebrovascular accident, CVA, motor learning theory, stroke, intervention, occupational therapy, OT, occupational performance, Ecology of Human Performance, best practice, current practice, and frames of reference*. Articles were excluded if they did not closely fit the population, did not provide good information pertaining to specific interventions used in practice and their efficacy, did not include information related to gaps in practice, or did not contain current evidence.

Synthesis of Evidence Review

Included in this critical analysis portion of this project was one qualitative study (Jaber et al., 2018), one systematic review (Langhorne et al., 2018), and one randomized control trial (Waddell et al., 2015) that all describe the impacts on occupational performance post CVA. These studies found that the top daily activities affected in people post-CVA included challenges in driving, seeking employment, self-care activities, home management, community and functional mobility, leisure activities, and perceptual problems (Jaber et al., 2018; Langhorne et al., 2011., Waddell et al., 2015). Individuals with CVA reported adverse changes in vision, cognition, memory, temperament, personality, energy, sleep, attention, psychomotor and perceptual skills, mobility and stability of joints, muscle power, tone, reflexes, and endurance (Langhorne et al., 2011). Affected body structures that contribute to these impairments include the brain, cardiovascular system, legs, arms, and shoulders (Langhorne et al., 2011).

In a self-survey completed by individuals with CVAs, it has been found that CVAs affect individual's performance in different instrumental activities of daily living (IADL) and activities of daily living (ADL) (Waddell et al., 2015). In IADLs specifically, individuals had difficulties with meal preparation, outdoor maintenance, managing doors around their homes, and driving (Waddell et al., 2015; Jaber et al., 2018). The top reported ADL that is impacted by CVAs was dressing and the top reported IADL was communication (Waddell et al., 2015). Waddell et al., (2015) also reported that some of the challenges noticed with their individuals were in the leisure and work areas of occupation. These occupations may become difficult, as a CVA can cause individuals to have affected brain trauma, leg, or arm challenges and may affect their communication and problem-solving skills (Langhorne et al., 2011).

CVA rehabilitation is a multistep process involving the assessment and identification of the patient's needs, goal setting to define realistic and attainable goals, intervention to assist in the achievement of set goals, and reassessment to assess progress made toward set goals (Langhorne et al., 2011). Motor learning theory, task-specific training, and goal setting are deemed as "best practices" in the evidence base (Almhdawi et al., 2016; Jarus, 1994; Sabari, 1990; Scobbie et al., 2013). The following paragraphs will compare motor learning theory, task-specific training, and goal setting as interventions for individuals with CVAs.

Motor learning theory is affected by three major factors such as environmental conditions, cognitive processes, and movement organization (Sabari, 1990). Environmental demands determine how people organize purposeful movement and influence a person's choice of motor strategies (Sabari, 1990). Ultimately a person's environment impacts the mental and motor processes required to complete the task at hand. A person's environment influences their motor learning, therefore the therapist must consider the nature of the environment because different environmental factors elicit different motor reactions (Gentile 1972, 1987 as cited in

Sabari, 1990). The occupational therapist must present activities to the client in a manner that will elicit the retention and transfer of the specified skill in a functional setting (Jarus, 1994). There are many strategies supported by the literature to increase retention and transference of learned skills. Strategies such as increasing the difficulty of the learning context during practice, using an open environment, and having limited knowledge of the task response facilitate cognitive-motor functioning during the acquisition stage which enhances the retention and transference of learned skills (Jarus, 1994). Selecting activities that include these strategies further facilitates retention and transference because clients are forced to draw on prior knowledge and develop a new movement plan for each practice trial (Jarus, 1994). Therapists should utilize these strategies when designing interventions based on motor learning theory for individuals with CVAs.

New research has started to show that a task-orientated approach may be better than motor learning theory when it comes to the treatment of individuals with CVAs in occupational therapy (Almhdawi et al., 2016). A task-oriented approach can be broken down into two main aspects, task orientation, and training. Task orientation consists of the client engaging in important behavioral experiences, which replicate the sensorimotor skills needed to successfully complete the task (Lang & Birkenmeier, 2014 as cited in Rowe & Neville, 2018). Training includes behavioral experiences consisting not only of the use of the same sensorimotor skills, but also incorporating meaningful activity and progressive challenges to the client's abilities (Lang & Birkenmeier, 2014 as cited in Rowe & Neville, 2018). Therapeutic activities often focus on sensorimotor control domains such as strength, endurance, active range of motion, degrees of freedom, and postural control (Almhdawi et al., 2016). Therapeutic activities consist of open and closed tasks. Open tasks involve unstable contextual factors during task performance and maybe unpredictable during therapeutic practice (Gentile 1972, 1987 as cited in Sabari, 1990). Open tasks require appropriate timing, sequencing, and spatial anticipation, such as being able to maintain balance when a surface moves unpredictably (Sabari, 1990). Research supports open-task training in a contextually variant environment to produce motor schemata that are versatile enough to adapt to the conditions clients will encounter in their daily lives (Higgins & Spaeth, 1972; Sabari, 1990). Closed tasks are contextually stable and do not vary over time (Sabari, 1990). Closed-task training is not optimal in a task-oriented approach due to the absence of varying contextual conditions. Many daily activities such as dressing and feeding require the client to adapt to varying contextual conditions which cannot be achieved through closed-task training (Sabari, 1990). Contextual conditions are a determining factor in effective sensorimotor learning for individuals with CVAs; intervention should place a strong emphasis on the context to be most successful with a task-oriented approach.

Goal setting is viewed as a necessary and effective component of stroke rehabilitation (Scobbie et al., 2013). Goal setting provides the opportunity for client-centered care which increases the client's adherence to their therapy program and optimizes their goal-related behaviors (Scobbie et al., 2013). Scobbie et al. (2013) designed a goal-action planning framework to guide health professionals through a systematic goal-setting process, which consists of four main stages: goal negotiation, goal setting, action planning and coping planning, and appraisal and feedback. The primary goal of this framework is to optimize client goal-attainment and client involvement (Scobbie et al., 2013). Research has shown that clients that are more involved in the goal-setting process set goals with a stronger personal relevance and are more satisfied with their therapy experience (Scobbie et al., 2013). Recommendations for effective goal setting in practice include five main criteria: goals should be specific, measurable,

achievable, realistic or relevant, and timed (Scobbie et al., 2013). In order to implement optimal goal-setting strategies in practice, therapists should include the client in the goal-setting process and ensure that the set goals include the five recommended criteria.

Conclusion

There are multiple claims of what is considered best practice intervention for individuals with CVAs. In this literature synthesis, we explored the evidence in the literature claiming motor learning theory, task-oriented training, and goal setting as best practice interventions. While there is large support for motor learning theory in the literature, there is not a claim that this is the gold standard of practice for this population. Our synthesis of motor learning literature suggests a shift from neurofacilitation techniques towards motor learning theory approaches, as clients achieve greater improvement when therapy is guided by the principles of motor learning theory (Latham et al., 2006; Jarus, 1994). There is confusion in the literature as to if task-oriented training is a component of motor learning theory or if it is a stand-alone intervention approach. Langhorne et al. (2011) stated that "task-specific and context-specific training are well accepted principles in motor learning" (p. 1695). On the contrary, Almhadawi et al. (2016) concluded that a task-oriented approach is similar to motor learning, but task-oriented has a more client-centered approach. While task-oriented training has similar concepts to motor learning theory, it is only supported by a handful of case studies (Flinn, 1995; Gillen, 2000, 2002). Goal setting is claimed to be best-practice in stroke rehabilitation, but according to the literature, there is no consensus regarding how to optimally deliver the goal-setting intervention in practice or what the key components of goal-setting interventions consist of (Scobbie et al., 2013). Our literature synthesis provided the strongest support for motor learning theory as best practice intervention for individuals with CVAs.

Clinical Bottom Line

Are motor learning theory-based interventions considered to be part of best practice in occupational therapy rehabilitation for individuals with CVAs? If so, how might occupational therapists incorporate motor learning theory into intervention design with maximum efficacy? Based on the literature, a best practice intervention for individuals with CVAs is motor learning theory (Jarus, 1994; Gentile 1972, 1987 as cited in Sabari, 1990; Sabari, 1990). The three main components of motor learning theory are environmental conditions, cognitive processes, and movement organization (Sabari, 1990). These components should all be identified and evaluated when designing interventions. The EHP framework supports that the interaction between person and environment affects human behavior and performance; clearly aligning with motor learning theory, which states that a person's environmental demands determine how they are able to organize purposeful movement and influences their choice of motor strategies (Dunn et al., 1994; Sabari, 1990). Context is a fundamental component to both EHP and motor learning theory and should be considered when designing interventions for individuals with CVAs. When a client receives occupational therapy due to a CVA, it is often because of a need to learn or relearn motor skills and a desire to be able to perform them in many contexts (Jarus, 1994). Individuals with CVAs experience daily challenges completing occupations such as driving, self-care, home management, community mobility and leisure activities due to adverse changes in vision, cognition, memory, temperament, personality, energy, sleep, attention, psychomotor and perceptual skills, mobility and stability of joints, muscle power, tone, reflexes and endurance (Jaber et al., 2018; Langhorne et al., 2011; Waddell et al., 2015).The occupational therapist

should seek acquisition conditions that will produce the greatest retention and transfer of the learned motor skills for successful completion of their desired occupations (Jarus, 1994). Occupational therapy places a large emphasis on purposeful activity. The use of purposeful activity provides the therapist with an opportunity to incorporate motor learning theory concepts into goals that are occupation-based and client-centered (Sabari, 1990). The occupational therapist should consider the client's cognitive processes and desired motor skills when designing intervention to ensure the tasks or activities are challenging yet attainable (Sabari, 1990). Research also supports the administration of motor training in the client's natural context to most closely align with common, everyday occurrences (Jarus, 1994; Langhorne et al., 2011). Occupational therapists understand that motor skills also need to be applicable and transferable to contexts outside of the client's most common or contrived contexts. In order to produce the greatest retention and transference of learned motor skills across a variety of contexts, the therapists should utilize progressive difficulty, randomization, and variant contexts during the learning period (Jarus, 1994). It is important for occupational therapists to have a clear understanding of the components of motor learning theory, in order to provide interventions with the largest support from the current evidence base (See Table 2).

Motor learning theory and occupational therapy are both focused on the learning of new skills, but each emphasizes different aspects of the learning process. Occupational therapy focuses primarily on the rehabilitation aspect of how the skill contributes to the client's independence and is less concerned with how the skill is learned (Gliner, 1985). In opposition, motor learning theory is primarily focused on how the skill is learned, controlled, and retained (Gliner, 1985). By implementing motor learning theory into occupational therapy intervention, learning processes supported by research designed to increase transference and retention are utilized, which overall increases the client's independence in daily activities, catering to the primary focus of occupational therapy. Clients who receive care in a stroke unit were most likely to be alive, independent, and at home within one-year post-CVA (Latham et al., 2006). Multiple health disciplines such as physical therapy, recreational therapy and speech language pathology may also use motor learning theory to address functional implications of CVAs (Zahl et al., 2017). Barriers to the implementation of these interventions in a clinical setting need to be better understood because many effective interventions are not present in the clinic (Langhorne et al., 2011). Studies have found a 17-year time lag between scientific discoveries in health care and the implementation of them into practice, and that of these discoveries, only 14% of them are implemented (Balas & Boren, 2000; Green et al., 2009; Morris et al., 2011). Understanding the barriers behind why there is such a gap between what is done in practice, and what is supported by the literature is fundamental to ensuring that most therapists are providing evidence-based practice. Some barriers present in the literature include lack of evidence-based practice experts amongst staff, increased cost associated with selecting evidence-based practice, time constraints, logistical challenges, inadequate equipment, limited ability to trial and observe evidence-based practice in entry-level education and practice (See Table 1) (Bayley et al., 2012; Levac et al., 2016; McCluskey et al., 2013; Petzold et al., 2014; Scobbie et al., 2013; Scott et al., 2020). Through our literature search, it was discovered that there is not a document that clearly defines best practice interventions for individuals with CVAs. The presence of a document with clear guidelines for best practice in the literature would make best practice guidelines more accessible for practitioners to follow and implement. Other opportunities that would be beneficial to reducing barriers of evidence-based practice implementation include experiential learning opportunities in entry level education and professional development, along with

independent research. These strategies are supported by the literature to increase consumer access to evidence-based practice and improve occupational outcomes (Scott et al., 2020). As a practitioner, schedules are often filled, and interventions are often habitual. It is important to continue researching evidence-based practice after leaving an educational program. This can be achieved through independent research, attending conferences, panels, or workshops, or by enrolling in a program with mastery in the field of interest.

Table 1

Barriers to Evidence-Based Practice Implementation and How to Overcome Them

Barriers to Implementing Evidence-Based Practice (EBP)	Methods to Overcome Barriers to EBP Implementation
• Lack of EBP experts among staff • Increased cost associated with selecting EBP • Time constraints • Logistical challenges • Limited ability to trial and observe EBP in entry-level education and practice	• Independent research • Attending conferences, panels, or workshops • Enrolling in a program with mastery in field of interest

Table References: Bayley et al., 2012; Levac et al., 2016; McCluskey et al., 2013; Petzold et al., 2014; Scobbie et al., 2013; Scott et al., 2020

Table 2

How to Implement Motor Learning Theory into OT Intervention Design with Maximum Efficacy

Components for Intervention
• High repetition (Kleim et al., 1998; Nudo et al., 1996) • Positive feedback (Birkenmeier et al., 2010) • Environmental conditions (Sabari, 1990) • Randomization (Jarus, 1994) • Cognitive processes of client (Sabari, 1990) • Movement organization (Sabari, 1990) • Utilization of an open environment (Jarus, 1994) • Increased difficulty of learning context during practice of motor skills (Jarus, 1994) • Inclusion of client in goal-setting process (Scobbie et al., 2013) • Purposeful Activity (Sabari, 1990)

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