

# Occupational Therapy: A Glimpse of Its Future

Dr. Jeffrey L. Crabtree, OTD, OTR, FAOTA

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On July 26, 2004 I had the privilege of giving a talk entitled Occupational Therapy: A Glimpse of It's Future to the faculty and students of the Graduate School of Health Sciences, Hiroshima University. My objectives were to explore the possible future of occupational therapy. I explained the concept of *neuro-occupation* first discussed at Crieghton University, discussed constraint-induced movement treatment, and explored the neurological foundations of occupational performance. The following is a summary of that presentation.

## NeuroOccupation

Padilla and Peyton<sup>23)</sup> introduced the idea of *neuro-occupation* as a way of resolving the typically Western conflict inherent in the reductionism-versus-holism dichotomy, or the separation of mind and body. They propose the term *neuro-occupation* signifies occupational therapy's historical view of the person as an active and dynamic participant in doing with the understanding that the central nervous system not only influences occupation, but that through occupation, humans influence, that is organize and reorganize, the central nervous system. The notion of a reciprocal relationship between doing and the central nervous system is not new. However, given recent research findings that support the idea that the nervous system is capable of reorganization in response to external challenges, the concept of *neuro-occupation* provides occupational therapists with a framework for taking advantage of applicable brain research and developing theories and research agendas that have the potential of better explaining the therapeutic use of occupation.

## Historical View

According to Padilla and Peyton<sup>23)</sup> the evolution of the concept of *neuro-occupation* can be described as having gone through three phases: The first during which notions of neuroscience and occupation were separate, a second phase during which the two concepts of occupation and neuroscience overlapped, and the

third phase during which neuroscience and occupation are seen as inseparable concepts. These phases were not mutually exclusive and non-linear, but do serve to help explain the evolution of thinking within occupational therapy that has led to this concept of *neuro-occupation*. In the following section I will explore those three phases.

## Separate Concepts

Early in the history of occupational therapy neuroscience was used to explain how the body works and according to Padilla and Peyton's research<sup>23)</sup>, there was no mention in the literature of how occupation might affect the central nervous system. They point to some of the earliest writers in the American Occupational Therapy Association, Dunton, Slagle, and Tracy as examples of this phase in which knowledge of neurology is necessary for treatment, but the emphasis of the profession during this phase was on the dysfunction and on the "technical procedures to be used in restoring the body and in relieving symptoms" (p. 7).

## Overlapping Concepts

During this stage we see the beginnings of occupation as something that might influence the nervous system indirectly, if not directly. Padilla and Peyton<sup>23)</sup> assert that while neurology and occupation were still viewed as separate concepts, in addition to understanding the nervous system to be able to restore

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• Department of Occupational Therapy, School of Health and Rehabilitation Sciences, Indiana University  
 • 広島大学保健学ジャーナル Vol. 4 (1) : 41 ~ 46 , 2004

it by using occupation, writers during this phase were interested in how the nervous system enable occupation, and how occupation could be used in the process of healing. These authors cite Dr. Llorens' Eleanor Clarke Slagle Lecture<sup>20</sup>, as an example. In that lecture, Dr. Llorens stated that occupational therapy can provide growth experiences to promote early growth and development and to prevent potential "maladaptation related to insufficient nurturance in neuro-physiological, physical, psychosocial, psychodynamic, social language, daily living, and sociocultural spheres of development" (p. 94).

## Inseparable Concepts

This phase may be best characterized by an often quoted maxim from Mary Reilly<sup>25</sup>: "Man, through the use of his hands as they are energized by mind and will, can influence the state of his own health" (p. 88). Her "vision" was mostly a social one in that she seemed to limit her examples of how occupation can influence nervous system to social constructs of "making persons at home in the world and making the world his home" (p. 98). Yerxa<sup>37</sup> clearly articulated the reciprocal nature of neuro-occupation, again mostly in social rather than neurological constructs, when she stated that "self-initiated activity is both a response to sensory stimulation and a source of additional stimulation by which the individual develops patterns of adaptive behavior" (p. 163). Other writers during this phase were a little more specific about how occupation could affect the central nervous system. Ayres<sup>2</sup> spoke of occupational therapy that was based on influencing basic neurophysiological integration, and among several others, Nelson<sup>22</sup> expressed combined concepts when he said that occupation can make changes in sensorimotor, psychosocial, and cognitive abilities.

In very general terms, our profession has come to the brink of a scientific paradigm—one that construes occupation as an agent of neurological organization and sees human neuronal architecture and function as an agent of occupation. This paradigm is likely to stimulate many important research questions and open many new avenues for intervention.

In the next section I explore a number of theoretical papers that have emerged since the articulation of the notion of neuro-occupation. In addition, I explore some of the research investigating a

treatment approach called constraint-induced (C-I) movement treatment—an approach that did not emerge from the notion of neuro-occupation per se, but from brain research that assumes the same reciprocal relationship of performance and the central nervous system. Finally, I will explore the neuronal foundations of *intention* as a harbinger of occupational research to come.

## Implications for Treatment and Research

Several theorists have explored the reciprocal relationship of occupation to the nervous system. Way<sup>36</sup>, for example, explored the relation of play to the autonomic nervous system (ANS), and showed how play is supported by the involuntary homeostatic functions of the ANS. Walloch<sup>35</sup> discussed how chronic pain can lead to occupational dysfunction and how mindfulness meditation figures into the management of the sensory and affective dimensions of chronic pain. Howell<sup>13</sup> shows how either sensory deprivation or sensory overload, often occurring in hospital intensive care units, can cause decreased cognitive function, difficulty organizing information, visual, auditory, or perceptual hallucinations and other problems that can have an impact on the patient's ability to follow directions and perform activities of daily living (ADL). She suggests that when possible, asking patients to perform simple ADL and reducing or increasing the sensory stimuli in the ICU, among other things, can help reduce the "burden" of the reticular activating system and thereby reduce the effects of sensory overload or deprivation and can ultimately facilitate.

Most of the literature regarding neuro-occupation explains the reciprocal relationship of occupation and the nervous system, but does not reflect research that sheds light on whether and how occupation might help to reorganize the nervous system. One example outside of the neuro-occupation literature, however, explores how an understanding of occupational performance deficits (specifically ADL) reflects possible neurological dysfunction. Árnadóttir<sup>1</sup> developed the *Árnadóttir OT-ADL Neurobehavioral Evaluation (A-ONE)* which was designed to reveal direct information regarding "neurobehavioral deficits and how they relate to localization of lesions and of processing sites that underlie dysfunction" (p. 3). Árnadóttir explores theory that supports the measure, and in a later study

Gardarsdottir and Kaplan<sup>11)</sup> reported that the construct validity of the A-ONE indicated support for this measure.

While the above theorists confirm the reciprocal nature of occupation and the nervous system, and suggest that occupation could help to reorganize the central nervous system, none of these authors, and as far as I know no-one under the "banner" of neuro-occupation, has researched this possibility. There exists another body of research not within the rubric of neuro-occupation, however, that reflects attempts to make "hard-wire" changes in the central nervous system—namely constraint-induced (C-I) movement treatment.

## Constraint-Induced Muscle Training

Constraint-Induced Movement Therapy (C-I therapy) is a technique used with people exhibiting hemiparesis as result of neurological damage in which the uninvolved upper extremity is immobilized for varying periods of time and the patient is given specific tasks to perform using the involved extremity. This relatively new approach has been shown to effectively increase the amount of use of the involved upper extremity after intervention (Miltner et al.<sup>21)</sup>; Taub<sup>27)</sup>. C-I therapy is believed to effect reorganization of the cortex, thus producing results that are considered permanent (Taub et al.)<sup>28)</sup>. Kunkel et al.<sup>19)</sup> reported improvement in the performance times of the laboratory tests and in the quality of movement particularly in the use of the extremity in 'real world' environments supported by results of quantitative evaluation. Taub et al.<sup>29)</sup> recently studied the applicability of C-I therapy to young children with cerebral palsy with hemiparesis. The intervention appeared to have a significant and sustained improvement in motor function in the children studied. Also, DeLuca et al.<sup>9)</sup> reported improved upper extremity function of a young child with cerebral palsy.

This very brief and superficial review of the literature suggests that C-I therapy may be the best example thus far of how performance can help to reorganize the central nervous system. Carson<sup>4)</sup>, however, conducted a study using the C-I protocol, but using occupation-based activities chosen by the patients. According to the author, resulting improvements in speed and quality of movement during the study were not sustained following treatment.

Despite these results, C-I therapy, using patient-preferred, meaningful activities, may still prove a useful intervention in occupational therapy.

Carson's optimistic view of the usefulness of C-I using patient-preferred, meaningful activities, in my opinion, hinges on a better understanding of the uniqueness of patient-preferred, meaningful activity. That is, what makes patient-preferred, meaningful activity different from other kinds of activity or performance? In the next section I refer to previous work regarding intention in which I speculate that intention may be one of the critical treatment variables and assuming that people intend to perform when they do a preferred, meaningful activity, accounts for why occupation-based interventions work. In addition, I will review some of the literature that looks at the neuronal correlates of intention. It is important to note here, that I am not looking at competing theories about the best kinds of activity to use during C-I. I am only sharing some of the literature that suggests that the notion of intention has neurological underpinnings.

## The Neuronal Foundation of Intention

A number of researchers over the past 15 years have explored the neuronal foundation of various sorts of movement. In many of those cases they have discovered the involvement of not only the primary motor area (M1) and premotor cortices, but of the supplementary motor area (SMA). The following is a review of some of that research. It is not meant to be an exhaustive review, but only an indication of what might be!

- Keller and Heckhausen<sup>17)</sup>, comparing the onset time of a readiness potential with the onset time of the corresponding intention to perform a spontaneous voluntary motor act, found that the activation of the SMA and the urge to move occurred at the same time.
- Using functional positron emission tomography (PET), and measuring regional cerebral blood flows, researchers found that the premotor cortical areas (SMA, PM) and the inferior parietal lobule (IPL) may participate in the preparation of an intended action (Hsieh et al.)<sup>14)</sup>.
- Rock et al.<sup>26)</sup>, in studying the dominant theory of reversal of ambiguous figures, they conclude that what matters is the subject's knowledge that the

figure is reversible and specific knowledge of how its alternative construals appear. This leads to an intention to reverse the figure, and the intention may become involuntary and automatic.

- Jabre and Salzsieder<sup>16)</sup>, using EMG technology, propose the existence of functional cortico-motoneuronal connections which provide for a large number of combinations between affector cortical motoneurons (CMNs) and effector spinal motoneurons (SMNs) for the generation of a purposeful movement. They argue that these connections provide the essential link between volition and movement and function as a 'volitional unit' which consists of the CMNs, the SMNs and the anatomical and interneuronal connections between them.
- Urbano et al.<sup>33, 34)</sup>, through EEG studies, found what might reflect functional coupling of primary sensorimotor and supplementary motor areas during the planning, starting, and performance of unilateral movement.
- Terada<sup>30)</sup>, using EEG studies, concluded that the voluntary muscle relaxation, similarly to the voluntary muscle contraction, involves the cortical preparatory activity at least in the M1 and probably the SMAs. There is no evidence to suggest that the primary negative motor areas is also active prior to the voluntary muscle relaxation.
- Some researchers conclude that performance of a voluntary act is preceded by an intrinsic process of intention and preparation accompanied by specific patterns of scalp-recorded EEG Dushanova and Popivanov<sup>10)</sup>.
- Gentilucci et al.<sup>12)</sup> suggest the existence of an anatomical "motor" circuit formed by the supplementary motor areas, Basal Ganglia, and Thalamus, and that this circuit may be involved in planning the necessary sequence of reaching, grasping and placing motor tasks.
- Rektor et al.<sup>24)</sup> found that bilateral SMA and the contralateral MC were the only cortices in which the movement-accompanying potential was linked constantly to potentials preceding the movement in their tests.
- Deecke<sup>8)</sup>, in results of regional cerebral blood flow studies, asserts that in the preparation period before movement, a readiness potential, can be recorded. The BP precedes all our self-initiated (i.e.

endogenous or willed) movements and actions by 1 sec or more prior to the onset of muscular contraction.

- Urbano et al.<sup>33, 34)</sup> in an EEG study of unilateral internally triggered one-digit movements found that the primary sensorimotor and SMAs were active during the planning, starting, and performance of unilateral movements.
- "Recent functional magnetic resonance (Kim et al.<sup>18)</sup>; Boecker et al.<sup>3)</sup>) and positron emission tomography studies (Thatcher et al.<sup>32)</sup>; Thatcher<sup>31)</sup>) have demonstrated that contralateral sensorimotor areas (M1-S1), supplementary motor area (SMA), and to a lesser extent ipsilateral M1-S1 are active during human unilateral repetitive self-paced finger movements.
- Ikeda et al.<sup>15)</sup> concluded that the SMA plays a significant supplementary role in the organization of voluntary movements, but not a "supramotor function."

So what might this research have to do with occupational therapy and the notion of neuro-occupation? I speculate that intention, from both social psychological and neurological perspectives, has a special role to play in the therapeutic use of occupation (Crabtree<sup>5-7)</sup>). From a neurological perspective, it appears there is evidence that intention as measured by activity in the SMA occurs milliseconds before motor planning as measured by activity in the pre-motor cortex before movement occurs as measured by activity in M1. From a social psychological perspective, I want to make the case that a) purposeful activity, or any meaningful doing, requires intention and b) for any activity or doing to be therapeutic, the patient or client must intend to do the activity.

## Social Psychological Perspective

What distinguishes intention from other thought processes? The answer to this question lies in the relationship of a given thought process and doing. Thinking, remembering, musing, desiring, wishing, dreaming, knowing, etc. do not set doing systems in motion. However, intention seems to be a central nervous system activity that *sets systems in motion* in some way. In other words, one can think, remember, muse, desire, wish, dream, and know without doing

anything about it, but when one *intends*, one sets systems in motion.

I maintain that there are at least two kinds of intention: a) immediate intention and b) mediate intention. Immediate intention helps explain short term doing, things like dressing for work, eating, walking, applying lip stick, and reaching for an object. Mediate intention helps explain continuous doing over time such as playing a game of pickup basketball, walking the dog, studying for an exam, learning to play the viola, or studying to become an occupational therapist. Mediate intention also helps explain intermittent doing over time—things like annual fly fishing trips, annual spring cleaning, or years of weekend gardening.

One can view these two types of intention as having a function beyond setting systems in motion. For example, immediate intention initiates the doing while mediate intention sustains doing by helping to keep the person connected to why she or he continues to do . . . To put this in other words, without immediate intention, one never initiates the doing, and without mediate intention, one does not sustain the doing over time.

Acquiring certain habits serves as an example and will help to explain intention. Take for example, a young woman accepts an OT position in a new community. Initially she intends to go to bed at 10 PM and get up at a 6 AM. Early on, her intentional efforts are immediate. But as she performs these tasks repeatedly, she no longer consciously intends to do many of these tasks. She finds herself waking, even on weekends, at 6 AM, the hour she initially intended to get up for work.

## So What?

I believe the future of occupational therapy is bright. Occupational therapists are on the threshold of understanding the therapeutic dynamics of occupational performance. However, with this new perspective come many challenges. If we are to use occupation therapeutically, we need to understand how occupation connects the person's hopes, desires, goals, wants, wishes, etc. to doing. We need to understand the neurological basis of intention so we can explain the power of occupation and help explain the difference between a person's doing with no special meaning, compared to doing with meaning. There are many challenges before us, but I believe we are ready to

accept those challenges and ready to create our future today.

## References

1. Árnadóttir, G. : The Brain and Behavior: Assessing cortical dysfunction through activities of daily living (ADL). The C.V. Mosby Co., St. Louis, 1990
2. Ayres, A.J.: The development of perceptual-motor abilities: A theoretical basis for treatment dysfunction. *Am. J. Occup. Ther.*, 17: 221-225, 1963
3. Boecker, H., Kleinschmidt, A. and Requardt, M. et al.: Functional cooperativity of human cortical motor areas during self-paced simple finger movements. A high-resolution MRA study. *Brain*, 117: 1231-1239, 1994
4. Carson, S.A.: Occupation based constraint-induced movement therapy. Master Degree Thesis, Ithaca College, Ithaca, NY, 2002
5. Crabtree, J.L.: On occupational performance. *Occup. Ther. Health Care*, 17: 1-18, 2003
6. Crabtree, J.L.: What is a worthy goal of occupational therapy? *Occup. Ther. Health Care*, 12: 111-126, 2000
7. Crabtree, J.L. : The end of occupational therapy. *Am. J. Occup. Ther.*, 52 : 205-214, 1998
8. Deecke, L.: Electrophysiological correlates of movement initiation. *Rev. Neurol. (Paris)*, 146: 612-619, 1990
9. DeLuca, S.C., Echols, K. and Ramey, S.L. et al.: Constraint-induced movement therapy in pediatrics: Case study involving two therapy epochs. *Phys. Ther.*, 83: 1003-1013, 2003
10. Dushanova, J. and Popivanov, D.: Nonlinear prediction as a tool for tracking the dynamics of single-trial readiness potentials. *J. Neurosci. Methods*, 70: 51-63, 1996
11. Gardarsdottir, S. and Kaplan, S.: Validity of the modified OT-ADL Neurobehavioral Evaluation (A-ONE): Performance in activities of daily living and neurobehavioral impairments of persons with left and right hemisphere damage. *Am. J. Occup. Ther.*, 56: 499-508, 2002
12. Gentilucci, M., Bertolani, L. and Bunuzzi, F. et al.: Impaired control of an action after supplementary motor area lesion: A case study. *Neuropsychologia*, 38: 1398-1404, 2000
13. Howell, D.: Neuro-occupation: Linking sensory deprivation and self-care in the ICU patient. *Occup. Ther. Health Care*, 11: 75-85, 1999
14. Hsieh, J.C., Hagermark, O. and Stahle-Backdahl, M. et al.: Urge to scratch represented in the human cerebral cortex during itch. *J. Neurophysiol.* 72: 3004-3008, 1994
15. Ikeda, A., Lders, H. and Burgess, R. et al.: Movement-related potentials recorded from supplementary motor area and primary

- motor area. Role of supplementary motor area in voluntary movements. *Brain*, 115: 1017-1043, 1992
16. Jabre, J.F. and Salzsieder, B.T.: The volitional unit: A functional concept in cortico-motoneuronal connections in humans. *Electroencephalogr. Clin. Neurophysiol.*, 105: 365-369, 1997
  17. Keller, J. and Heckhausen, H.: Readiness potentials preceding spontaneous motor acts: voluntary vs. involuntary control. *Electroencephalogr. Clin. Neurophysiol.*, 76: 351-361, 1990
  18. Kim, S.G., Ashe, J. and Georgopoulos, A.P. et al.: Functional imaging of human motor cortex at high magnetic field. *J. Neurophysiol.*, 69: 297-302, 1993
  19. Kunkel, A., Kopp, B. and Muller, G. et al.: Constraint-induced movement therapy for motor recovery in chronic stroke patients. *Arch. Phys. Med. Rehabil.*, 80: 1606-1607, 1999
  20. Llorens, L.A.: Facilitating growth and development: The promise of occupational therapy. *Am. J. Occup. Ther.*, 24: 93-101, 1970
  21. Miltner, W.H.R., Bauder, H. and Sommer, M. et al.: Effects of Constraint-Induced Movement therapy on chronic stroke patients: A replication. *Stroke*, 30: 586-592, 1999
  22. Nelson, D.L.: Why the profession of occupational therapy will flourish in the 21st century. *Am. J. Occup. Ther.*, 51: 11-24, 1997
  23. Padilla, R. and Peyton, C.B.: Neuro-occupation: Historical review and examples. Royeen, C.B. (ed.). *Neuroscience & occupation: Links to practice*. American Occupational Therapy Association, Bethesda, MD, 1997
  24. Rektor, I., Louvel, J. and Lamarche, M.: Intracerebral recording of potentials accompanying simple limb movements: a SEEG study in epileptic patients. *Electroencephalogr. Clin. Neurophysiol.*, 107: 277-286, 1998
  25. Reilly, M.: Occupation can be one of the great ideas of the 20th-century. In *American Occupational Therapy Association. A professional legacy: The Eleanor Clarke Slagle Lectures in occupational therapy, 1955-1984*. Bethesda, MD, 1985
  26. Rock, I., Hall, S. and Davis, J.: Why do ambiguous figures reverse? *Acta Psychol. (Amst.)*, 87: 33-59, 1994
  27. Taub, E.: Guest editorial. New discovery equals change in clinical practice. *J. Rehabil. Res. Dev.*, 36, vii-viii, 1999
  28. Taub, E., Crago, J.E. and Uswatte, G.: Constraint-Induced Movement Therapy: A new approach to treatment in physical rehabilitation. *Rehabil. Psychol.*, 43: 152-170, 1998
  29. Taub, E., Ramey, S.L. and DeLuca, S. et al.: Efficacy of Constraint-Induced (CI) Movement therapy for children with cerebral palsy with asymmetric motor impairment. *Pediatrics*, 113: 305-312, 2004
  30. Terada, K., Ikeda, A. and Yazawa, S. et al.: Movement-related cortical potentials associated with voluntary relaxation of foot muscles. *Clin. Neurophys.*, 110: 397-403, 1999
  31. Thatcher, R.W.: Tomographic electroencephalography and magnetoencephalography. Dynamics of human neural network switching. *J. Neuroimaging* 5: 35-45, 1995
  32. Thatcher, R.W., Toro, C. and Pflieger, M.E. et al.: Human neural network dynamics using multimodal registration of EEG, PET, and MRI. Thatcher, R.W., Toro, C. and Pflieger, M.E. et al. (eds.). *Functional Neuroimaging: Technical foundations*. p.269-278, Academic Press, Orlando, 1994
  33. Urbano, A., Babiloni, C. and Onorati, P. et al.: Dynamic functional coupling of high resolution EEG potentials related to unilateral internally triggered one-digit movements. *Electroencephalogr. Clin. Neurophys.*, 106: 477-487, 1998
  34. Urbano, A., Babiloni, C. and Onorati, P. et al.: Responses of human primary sensorimotor and supplementary motor areas to internally triggered unilateral and simultaneous bilateral one-digit movements. A high resolution EEG study. *Eur. J. Neurosci.*, 10: 765-770, 1998
  35. Walloch, C.L.: Neuro-occupation and the management of chronic pain through mindfulness meditation. *Occup. Ther. Int.*, 5: 238-248, 1998
  36. Way, M.: Parasympathetic and sympathetic influences in neuro-occupation pertaining to play. *Occup. Ther. Health Care*, 12: 71-86, 1999
  37. Yerxa, E.: Authentic occupational therapy. In *American Occupational Therapy Association. A professional legacy: The Eleanor Clarke Slagle Lectures in occupational therapy, 1955-1984*. Bethesda, MD, 1985