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Short Communication
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Error Augmentation: The Alternative Approach to Treat Brain Injury

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Abstract

Enhancement of sensory motor performance is vital in rehabilitation after brain injury. This short communication discusses a new approach in motor learning and rehabilitation: The error augmentation (EA) which utilizes incorrect visual and proprioceptive feedback to improve motor adaptation. In EA technology, the computer distinguishes and amplifies errors in a patient's movement from a preferred trajectory, or modifies the visual feedback of the movement trajectory, and consequently gives emphasis to visual and sensory feedback. The existence of this error in visual input requires from patients to reinforce their motor control as they work against the error-driven disturbance to the movements, at the same time it enhances motivation to learn by making even little errors seem great.

Keywords: Error augmentation; Aging brain; Stroke; Rehabilitation

Short Communication

Every year, numerous people worldwide sustain traumatic brain injuries, strokes and Parkinson's Disease, resulted in daily life activity impairments and dysfunction [1].

The restoration of optimal function is the utmost important aspect of becoming independence individual, yet arm-hand mobility remains highly challenged of rehabilitation goal [2], and beyond spontaneous recovery, the traditional or conventional therapies (e.g., Neuro Development Treatment , Proprioceptive Neuromuscular Facilitation, Constrain-induced, massed practice) yield relatively modest outcomes [3,4].

Recently, there is a growing trend toward using feed back technology to rehabilitate the sensory-motor ability by reducing motor impairment more effectively than does conventional therapy of stroke and Traumatic Brain Injury survivors [5].

Motor learning is characterized by long-lasting changes in motor performance, indicating that retention has indeed taken place, and evidenced by normal movement patterns [6].

The most update approach for enhancing motor recovery includes a robotic interface known as error augmentation (EA) [7]. EA utilizes incorrect feedback to boost motor recovery after neurological damage. In EA technology, the computer distinguishes and amplifies errors in a patient's movement from a preferred trajectory, or modifies the visual feedback of the movement trajectory, and consequently gives emphasis to visual and sensory feedback.

The existence of this error in visual input requires from patients to reinforce their motor control as they work against the error-driven disturbance to the movements.

Recently, we have found that augmenting error indeed enhance motor learning [8].

The scientific explanation of such learning process is through creation of neural networks and central adaptation of motor skill acquisition [9].

Adaptation is a key element to understand motor learning. It allows us to determine whether the CNS is still capable to adjust to more patterns of movement. Yet, the durability of adaptation is noticeably differing among people with CNS damage [10].

The washout period does not demolish the memory created during adaptation, although it may temporally inhibits its expression, which returns unexpectedly after period of time.

Since inherent feedback mechanisms are frequently damaged in brain injury, providing better feedback by making errors more obvious to the senses, its notion to be valuable, in that a patient learns faster when the error is larger [11].

Moreover, bigger errors are expected to enhance motivation to learn by making even little errors seem great [12]. In addition, rising error can guide to larger signal-to-noise ratios for sensory feedback and self-evaluation. It is crucial to remember that EA empiric technology facilitates extremely accurate and truthful information, done automatically, and able to produce a wide range of forces and motions.

In summery, to deal with the question in regard to motor learning and adaptation that eventually leads to long-term retention of the motor task, EA is excellent approach. It includes gradual exposure to the perturbation forces, which makes the after-effect smaller when the perturbation forces are switched off, it implements repeated and massed training, and if patient repeatedly practice arm-hand movements even several times a day over 3-4 weeks, he can develop a new “learned” calibration for the context that initially drove adaptation [13]. In other words, he no longer has to adapt from one behavior to the other, but instead have two learned behaviors that he can switch between. Therefore, the training protocol must be longer and comprises additional treatments and more repetitions to enable the CNS to make lasting changes in movement patterns.

However, evaluating the neuro physiological process resulting from EA training may encourage researchers to keep investigating this clinical field, as many of the stroke's patients still do not improve arm ability. Topics like the period of time the effect of treatment continues, and whether the change in motor performance accomplished by motor learning or by increased use of compensation strategies should be further established. Furthermore, it is not yet known whether adaptation process may lead to long lasting motor memory as happen in motor learning.

In conclusion, there is growing evidence supporting the use of EA to improve motor performance of the upper extremity for stroke's patients.

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