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Abstract: For the purpose of this paper, human beings are viewed as information processors. Human learning involves information processing which requires memory structures. In the context of motor learning, the major goal of the teaching-learning process is to develop long term memory for the movement. Movement can be stored in the long term memory as motor programs (Schmidt, 1988). Rhythmical intention (RI) is a unique facilitation tool used by the cerebral palsied for acquiring motor skills in Conductive Education. RI is a mental preparation, via symbolic representation, for overt behaviour (Hari & Tillemans, 1984). It is suggested that RI takes the roles of assisting the assembly of motor programs, assisting anticipation of the movement to be executed and providing feedback on the movement performed.

Information Processing in Multiple Memory Compartments

A human being can be considered as an information processor which interacts with the constantly changing environment. Demands and feedback from the environment serve as inputs to an individual while his or her behaviour serve as outputs from the individual to the environment.

Information processing is divided into 3 stages, namely stimulus identification stage response selection stage and response programming stage (Schmidt, 1988). Stimulus identification is the first stage through which an individual receive inputs from the environment. It is responsible for detecting and encoding sensory and proprioceptive cues, and for identifying and interpreting the input stimulus patterns from the environment. The response selection stage is responsible for deciding which output response should be executed based on the information obtained from the stimulus identification. The response programming stage is the final stage through which the individual provide outputs to the environment. It is responsible for translating and structuring the abstract idea of the selected response into a set of muscular actions through central activation.

According to Schmidt (1988), these 3 stages of information processing are performed in various memory structures. These memory structures allow the input signals to be recognised, and the output signals to be stored and retrieved. They consist to be 3 compartments, namely short term sensory storage (STSS), short term memory (STM) and long term memory (LTM). STSS allows large amount of sensory and proprioceptive information to be stored for less than a second. Useful information is selected from the STSS through the process of selective attention while the irrelevant one is ignored. STM is the work station for information processing. Based on the incoming information selected, the STM retrieves and rehearses the stored information from the LTM. When suitable information has been retrieved from the LTM, the STM will translate the retrieved information into muscular actions and a centrally activated movement is executed.

Information of a movement is stored in the LTM in form of a package which is known as motor program. By repeatedly practicing a cyclic or repetitive movement, a motor program will be formed in the LTM. When motor program is formed, the response selection stage will be by-passed when executing the movement concerned (Schmidt, 1988).

A one-to-one matching of the motor program and the movement may lead to overloading of the memory capacity. To alleviate the problem of overloading, Schmidt (1988) put forwards the idea of a generalised motor program. The generalised motor program consists of an invariant parameter and a number of variant parameters. The invariant parameter refers to the movement sequence which is fixed and fundamental to the movement. The variant parameters refer to spatial, temporal and force parameters which can be varied according to the environment in which the movement is executed. To execute a motor program, its variant parameters should be specific ahead. These parameters define exactly how the motor program will be executed in the subsequent movement.

The concept of motor program is founded on a feedforward mechanism. In the feedforward mechanism, movement is preprogrammed in advance before its execution. Once a motor program has been initiated, a predetermined pattern of actions will be carried out for at least one reaction time even if the environmental information indicates that an error has been made. To compensate for the error, the variant parameters of the generalised motor program should be updated in the next reaction time (Schmidt, 1988).

Rhythmical Intention as a Facilitation Tool for Motor Learning

People with cerebral palsy suffer form both motor cognitive deficits. Common cognitive deficits include loss of attention, memory and perception. According to the information processing theory, motor learning involves cognitive activities and the major goal of the teaching-learning process in motor learning is to develop long term memory for the movement. Cognitive deficits of the cerebral palsied may therefore adversely affect their abilities in motor learning.

Norman (1976) reported that speech is a powerful mediator for memory retention. On the other hand, Luria (1963, 1979) pointed out that children utilise speech to regulate their own movement. It is plausible that speech takes a role of assisting the cerebral palsied to overcome parts of their cognitive deficits that hinder motor learning.

In Conductive Education, a unique facilitation tool has been used by the cerebral palsied during the learning of motor skills. The tool is known as rhythmical intention (RI) which utilise speech to facilitate motor learning. RI is composed of an 'intention' component and a 'rhythm' component. The 'intention' component involves verbalised expression of a movement to be executed. In other words, the verbalised expression is feedforward to the execution of the movement. The 'rhythm' component can either be in form of 'verbal counting' or of 'dynamic speech'. It is performed during the execution of the movement. 'Verbal counting' usually involves a count form 1 to 5 while 'dynamic speech' involves 2-3 times repetition of the 'verb' describing the main action of the executing movement. The 'rhythm' component serves to regulate the speed or strength of the movement performed.

RI has clinically been introduced to a number of brain damaged clients including cerebral palsy, stroke, and Parkinsonism to facilitate motor learning. At present, no objective outcome study has been conduced in this area. Based on the clinical experience of the Spastics Association of applying RI to more than 1000 cerebral palsied children, adolescents and adults in the past 10 years, it seems that RI does play a role in facilitating motor learning for these clients. However, the underlying mechanism of RI has not yet been defined.

Plausible Roles of RI in Facilitating Motor Learning

Richardson (1967a, b) demonstrated that mental practice prior to the execution of movement improved the acquisition, the retention and the immediate performance of the required motor skills. Johnson (1984) reported that mental practice aided in acquiring the movement sequence and the spatial relationship involved in the subsequent movement. By combining the findings of Johnson and that of Schmidt, it is plausible that mental practice assists the formation of motor programs through the provision of information on the movement sequence and the spatial parameter of the movement to be executed.

Hari and Tilleman (1984) defined RI as a mental preparation, via a symbolic representation, for overt behaviour. The verbalised expression of the 'intention' component of RI is feedforward to the movement. The 'intention' component can be regards as a mental practice which is reinforced by speech. Mental practice is mostly a cognitive activity. Due to their cognitive deficits, cerebral palsied persons may have difficulty in performing mental practice. Since speech has been reported as a powerful mediator which intensifies cognitive activities (Norman, 1976), the use of speech for assisting the cerebral palsied to perform mental practice is plausible. According to the findings of Johnson (1984), the contents of the verbal expression should therefore contain information on the movement sequence and the spatial relationship of the movement to be executed.

Schmidt (1988) stated that when two movements are performed simultaneously, they interfere with each other unless one movement is made automatic (i.e. does not require attention). This phenomenon is applied to the simultaneous actions in which one is motor and other is verbal. In RI, the 'rhythm' component is performed simultaneously with the movement. To avoid interference, clients must be trained so that no attention is required during performing the verbal count.

Schmidt (1988) also pointed out that movement is organised under an underlying temporal structure. The motor system appears to 'prefer' a mode in which simultaneous actions are couple in time, that is the two actions are performed at the same tempo (Klapp, 1981; Klapp et al, 1985). These findings may shed light on the underlying mechanism of the 'rhythm' component of RI in facilitating motor learning. Once the 'verbal counting' is made automatic, it may be used to couple with the motor actions which are performed simultaneously with the counting. This may contribute to the regulation of the temporal parameter of the movement.

On the other hand, when 'dynamic speech' (repetition of a 'verb') is used as the 'rhythm' component of RI, the meaning of the selected 'verb' may provide information on the required strength of the movement. By careful selection of the 'verb' used or by changing the 'tone' in saying the 'verb', the dynamic speech' may provide information related to the force parameter of the movement.

In summary, the 'intention' component of RI serves as a speech reinforced mental practice which provides information on the movement sequence and the spatial parameter of the movement. On the other hand, the 'rhythm' component may either regulate the temporal parameter through 'verbal counting' or regulate the force parameter through 'dynamic speech'. With these possible mechanisms, RI may play the role of assisting the assembly of motor program which is founded on these four parameters.

Other Plausible roles of RI in Facilitating Motor Learning

The other plausible roles of RI in facilitating motor learning includes promoting anticipation and providing feedback.

Anticipation

To verbalise an intention with one's own speech helps an individual to anticipate for the motor actions. This anticipation may contribute to preparing the effectors ready for performing future actions and receiving future commands. It also contributes to prepare the STM to anticipate the required spatial information from STSS and hence facilitates the process of selective attention.

Feedback

In 'verbal counting', client is expected to start and accomplish the whole range of movement during the counting from 1 to 5. In saying each number, the client is encouraged to look at his or her own movement. Both the verbal and visual information provide feedback of the knowledge of performance of the movement that is being executed. In addition, each verbalised number represents a reference regarding the correctness, ensuring that executed movement is performed at the predetermined speed.

Conclusion

Traditionally, facilitation of motor actions for cerebral palsy emphasises manual facilitation. With manual facilitation, clients act as passive recipients of the treatment technique. In our model, active cognitive involvement of clients is highly emphasised. They are encouraged to use their own speech to reinforce their cognitive activities for learning and regulating their own movement through the use of RI. However, it must be stressed that RI is a facilitation tool used by the clients rather than a facilitation technique used by the staff. They should be encouraged to use RI in daily activities without the presence of staff.

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