Therapeutic Drills for Apraxia of Speech

An essay submitted for the fulfillment
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Eman Samir

Contents

List of abbreviations

AAC	Augmentative and Alternative Communication
AAS	Acquired apraxia of speech
ABA-2	Apraxia Battery for adults second edition
ALS	Amylotropic lateral sclerosis
AOS	Apraxia of Speech
ASHA	American Speech-Language Hearing association
ASL	American Sign Language
CAS	Childhood apraxia of speech
CHF	Case History Form
CHI	Case History Interview
CNS	Central nervous system
CSS	Conversational Speech Sample
CWT	Challenging Words Task
DAS	Developmental apraxia of speech
DDK	Diadochokinesis Task
DTTC	Dynamic Temporal and Tactile Cueing
DVD	Developmental verbal dyspraxia
EC	Examiner Checklist
EMA	Electromagnetic articulography
EMG	Electromyogram
EPG	Electropalatography
EST	Emphatic Stress Task
FOXP2	Forkhead-box P2
GFTA-2	Goldman-Fristoe Test of Articulation-2 (2^{nd} ed.)
GMP	Generalized motor programs
KBIT-2	Kaufman Brief Intelligience Test (2nd ed.)
KP	Knowledge of performance
KR	Knowledge of results (knowledge of results
LST	Lexical Stress Task
MAT	Melodic apraxia training
MCC	Manual Control Console
MIT	Melodic intonation therapy

MSAP	Madison Speech Assessment Protocol
MSDs	Motor speech disorders
MSE	Motor Speech Evaluation
MWT1	Multiyllabic Words Task 1
MWT2	Multisyllabic Words Task 2
NRT	Nonword Repetition Task2
OA	oral apraxia
OWLS	Oral and Written Language Scales2
PAOS	Progressive apraxia of speech
PCC	Percentage of Consonants Correct
PMA	Premotor area
PROMPT	Prompts for restructuring oral muscular phonetic target
RST	Rhotics and Sibilants Task
SCT	Sustained Consonant Task
SCT	Orofacial Examination Task
SGD	Speech generating device
SMA	Supplementary motor area
SOPs	Significant other persons
SPT	Speech Phrases Task 2
SPT	Sound Production Treatment
SRT	Syllable Repetition Task
STCDA	Screening test for Developmental Apraxia in Arabic speaking children:
STDAS	Screening test for developmental apraxia of speech
SVT	Sustained Vowel Task
TBI	Traumatic brain injury
VDOE	Virgenia Department of Education
VT1	Vowel Task 1
VT2	Vowel Task 2
VT3	Vowel Task 3
WJ-III	Woodcock-Johnson III Tests of Achievement 2

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Introduction

Speech is the final expression of concepts & emotions translated through linguistic pathways that involve lexical, syntactic, phonological & phonetic stages ***(Levelt, 1989)***, as well as prosody. Speech production is a complex motor act, involving rapid sequential motor movements that often extend over many seconds before a pause. It depends on integration of monitoring and guiding rapid modification of motor command to the larynx, pharynx, & articulators. This allows the maintenance of intelligible speech, even under adverse speaking conditions. It depends on motor (frontal), auditory (temporal), somatosensory (parietal) cortex, as well as insula, cerebellum & subcortical nuclei ***(Guenther et al., 2006; Ventura et al., 2009; Golfinopoulos et al., 2010).***

Historically, the theoretical understanding of motor control including the motor control of speech was dominated by generalized motor programs (GMP), or the idea that movement is guided by a mental representation of some kind ***(Kent et al. 1996).***

Recently, research into other areas of motor control has benefited from a vigorous interplay between people who study& engineers who develop mathematical approaches to the abstract problem of control. One of the key results of

these collaborations has been the application of state feedback control (SFC) theory to modeling role of higher central nervous system in motor control ***(Arbib, 1981; Todorov and Jordan, 2002; Todorov, 2004; Guigon et al., 2008; Shandmehr and Krakauer, 2008).***

Speech motor control

It is not controversial that CNS plays a role in speech motor output: cortex appears to be a main source of motor commands in speaking. In humans, the speech relevant areas of motor cortex make direct connection with neurons of the lips, tongue, and other speech articulators ***(Jurgens et al., 1982; Jurgens, 2002; Ludlow, 2004).***

The organized motor patterns are built into a hierarchy of six levels within the nervous system; (1) the lower motor neuron, (2) vestibular –reticular level, (3) the extarpyramidal level, (4) the upper motor neuron, (5) the cerebellum, and (6) the conceptual-programming level.

The upper levels act by activation, inhibition and modulation of the lower levels. The lower levels act reflexly with synergism between extension and flexion ***(Darley et al., 1975).***

(1) The lowest level is that of the **lower motor neuron**. It includes the alpha (direct) system which is responsible for

rapid skillful movement and the gamma (indirect) system which is responsible for maintenance of muscle tone and body posture.

(2) The next level is the **vestibular –reticular** level, the role of the vestibular –reticular level is to regulate the activity of the lower motor neuron.

(3) The third level is **the extarpyramidal** level that is chiefly involved in the subconscious, automatic performance, regulation of muscle tone and inhibition of involuntary movement.

(4) The fourth and highest purely motor level is **the upper motor neuron** level anatomically represented by the motor cortex and responsible for skilled, discrete and spatially oriented movement.

(5) The fifth component is **the cerebellum**, which is responsible for detection and correction of errors that occur during the course of movement.

(6)The highest level of motor organization is **the conceptual-programming** level; this level is dependent upon the integration of a variety of cortical arrangements ***(Darley et al., 1975).***

Stages of conceptual-programming of motor organization for speech:

(1) The first stage is *conceptualization*, involving a desire to do something and establishing a plan of action to carry out the desire (e.g. thinking of calling a friend on the phone).

In this stage, cortical activity is probably bilateral and widespread, and if interfered with can result, for example, in cognitive thought disorder called dementia.

(2) The second stage is *spatial-temporal* (linguistic planning), involving language (e.g. planning what one will say on the phone).

In this stage, cortical activity for linguistic processes is located in the left hemisphere for the great majority of people, if interfered with can result in aphasia.

(3)The third stage is *motor planning* (programming), which is the bridge between the language formulation and motor execution of the neuromuscular system. This stage is responsible for connecting the inner language processes into the endless number of speech utterance. Because of the complexity and the almost instantaneous speed and timing of these movements needed for speech, it is postulated that these movements have been stored in the brain (programmed) ready to do activities immediately.

In this stage brain activity for motor planning is located for the great majority of people in the left hemisphere, involving Anterior language area (44) and its connections to (a) the language portion of the temporal and parietal lobes; areas (22, 39, 41& 42), (b) primary motor area (4) (frontal lobe), (c) supplementary motor area (6) (frontal lobe), (d) somatosensory areas (1,2& 3) (parietal lobe), (e) supramarginal gyrus (parietal lobe), and (f) insula. If this stage is interfered with, the result can be *apraxia of speech.*

(4)The forth stage is *performance*, which is the executive portion of the neuromuscular system involved in speaking (e.g. talking on the phone). The brain activity is bilateral involving (a) activation pathways, (b) the control circuits, (c) the final common pathways, (d) and the continuous commands from the motor speech programmer.

(5)The fifth stage is *feedback*, which provides sensory information about ongoing and completed speech movements. The modification of presently occurring and future speech movements is based upon the sensory information.

The brain activity may occur at the spinal and brainstem level, in the cerebellum, thalamus, basal ganglia, and cortex. If this stage is interfered with, the result can be dysarthria. ***(Haplem and Goldfarb, 2012).***

Each disorder has its specific therapy program of rehabilitation.

Regarding apraxia, there are different therapy programs; however there is no available program for Arabic speaking patients constructed in a systematic way.