

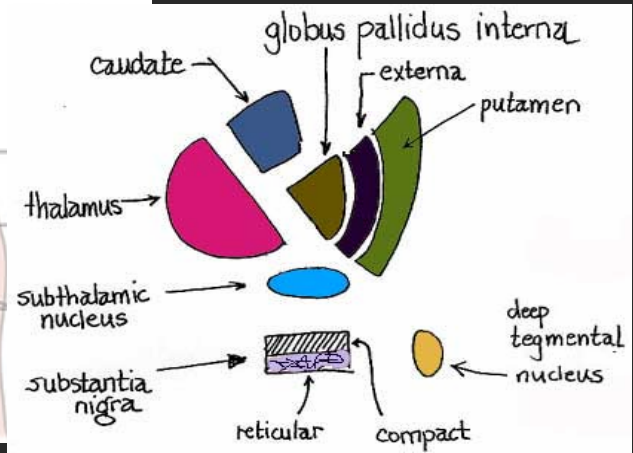
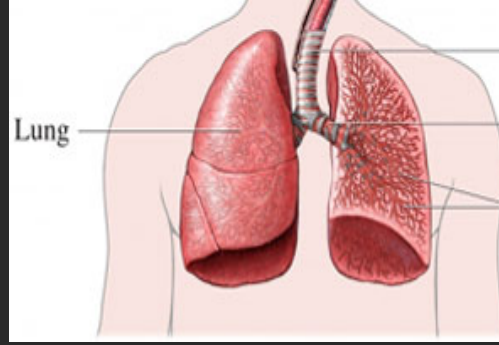
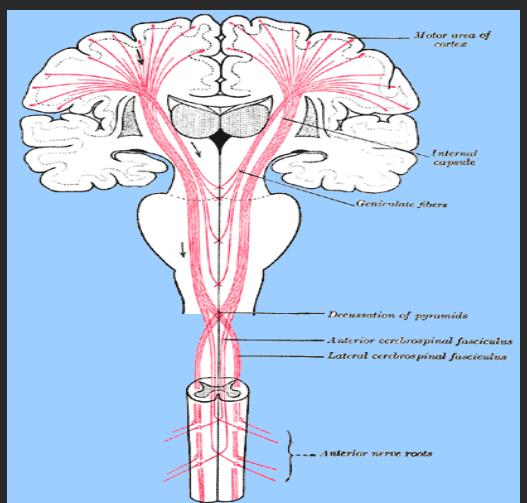
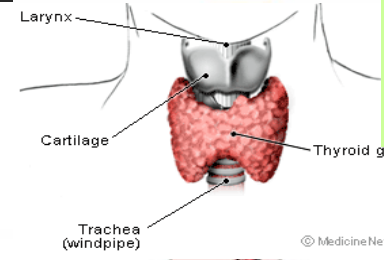
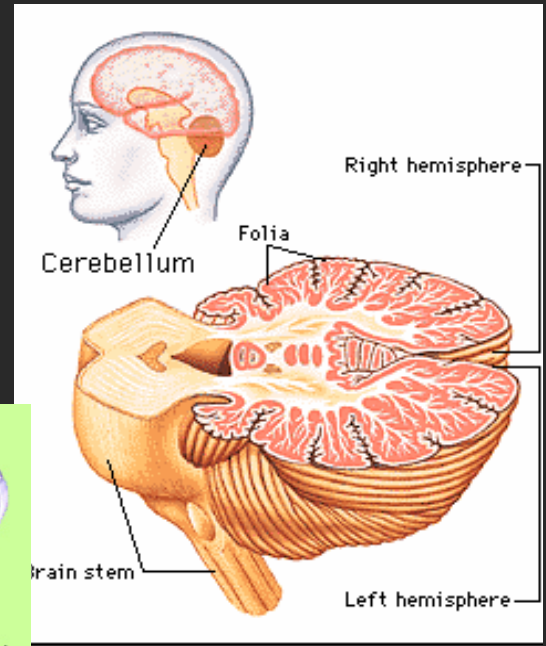
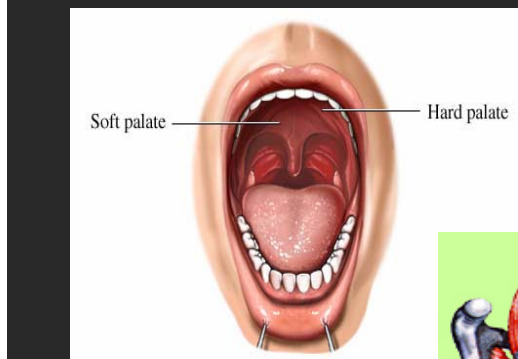
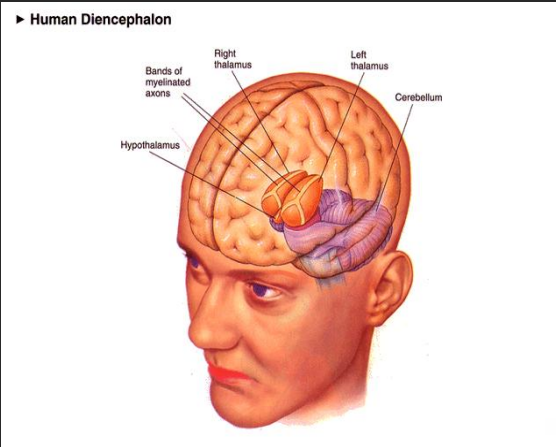


Voice Therapy for Neuropathological Voices

**Mary V. Andrianopoulos, Ph.D.
University of Massachusetts-Amherst**



Phonation involves an interplay between.....



© MedicineNet, Inc.

There is an integration, perfect timing and coordination between intellectual + physiological processes

Cognition →	Language semantics + syntax + phonology
Motor Speech Programmer	Programmer + Planner selection + sequencing
Articulation → shaping of sounds	motor speech motor speech precision
Resonation → exhalation Supra-glottic + sub-glottic air flow	shapes acoustic signal via nasal + vocal + oral cavities
Phonation → vibration of vocal folds	voice + sound production
Respiration → juice!	sets air flow in motion + sets vocal folds into vibration

Neuropathological Voices

Dysarthria = neuromotor speech/voice disorder

- Resonation
- Articulation
- Phonation
- Respiration

Dysphonia ≠ Dysarthria

- Non-neurologic voice problem (vocal nodules, etc.)

Dysarthrias with Dysphonias

Spastic → bilateral UMN

- Strained-strangled
- Hypernasality
- Regular, Slow rate

Hypokinetic → BG circuits

- Monoloudness. Monopitch
- Reduced volume (< drive)
- +/- Co-existing Tremor

Hyperkinetic → BG circuits

- Fast vs. slow movement
- Regular vs. irregular
- Phonation, Respiration

Flaccid → LMN (Cranial + cervical nerves)

- Nasal resonance
- Breathiness, hoarseness
- Reduced loudness
- Diplophonia

Ataxic → Cerebellar circuits

- Incoordination, timing issues
- Irregular bursts, silent periods

Dysarthrias also affect breathing

Dyspnea: Neurologic effects → Respiration

Spastic

Spastic Dyspnea

Rigidity, slowness
Central weakness

Hypokinetic

Hypokinetic Dyspnea

↓ volume, ↓ initiation/drive

Hyperkinetic

Respiratory Dystonia

Other Hyperkinetic Dyspneumias
Superimposed involuntary movements

Flaccid

Flaccid dyspnea

Peripheral weakness

“flaccidity”

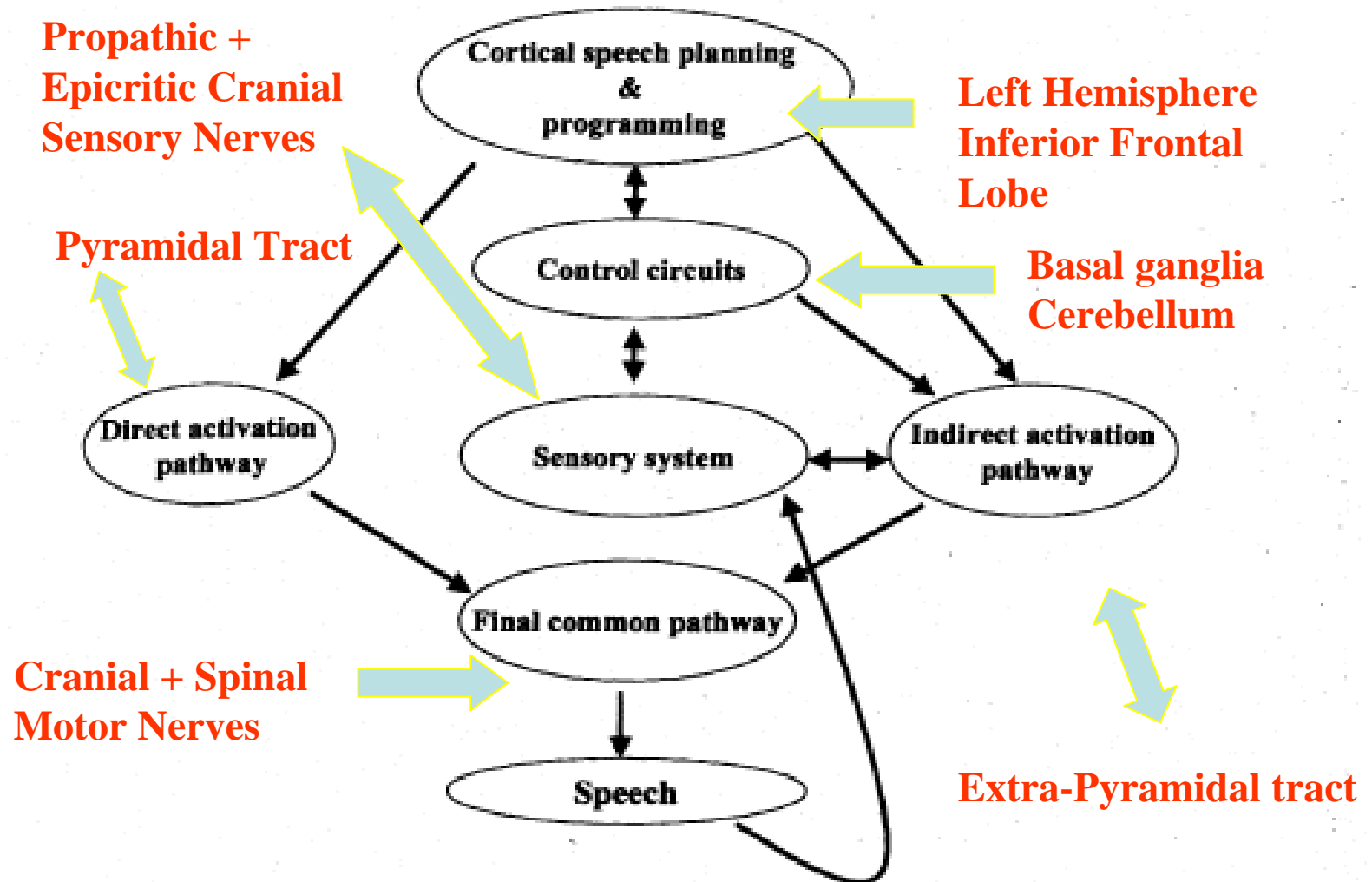
MG, ALS,
VF paralysis

Ataxic

Ataxic dyspnea

Incoordination/timing

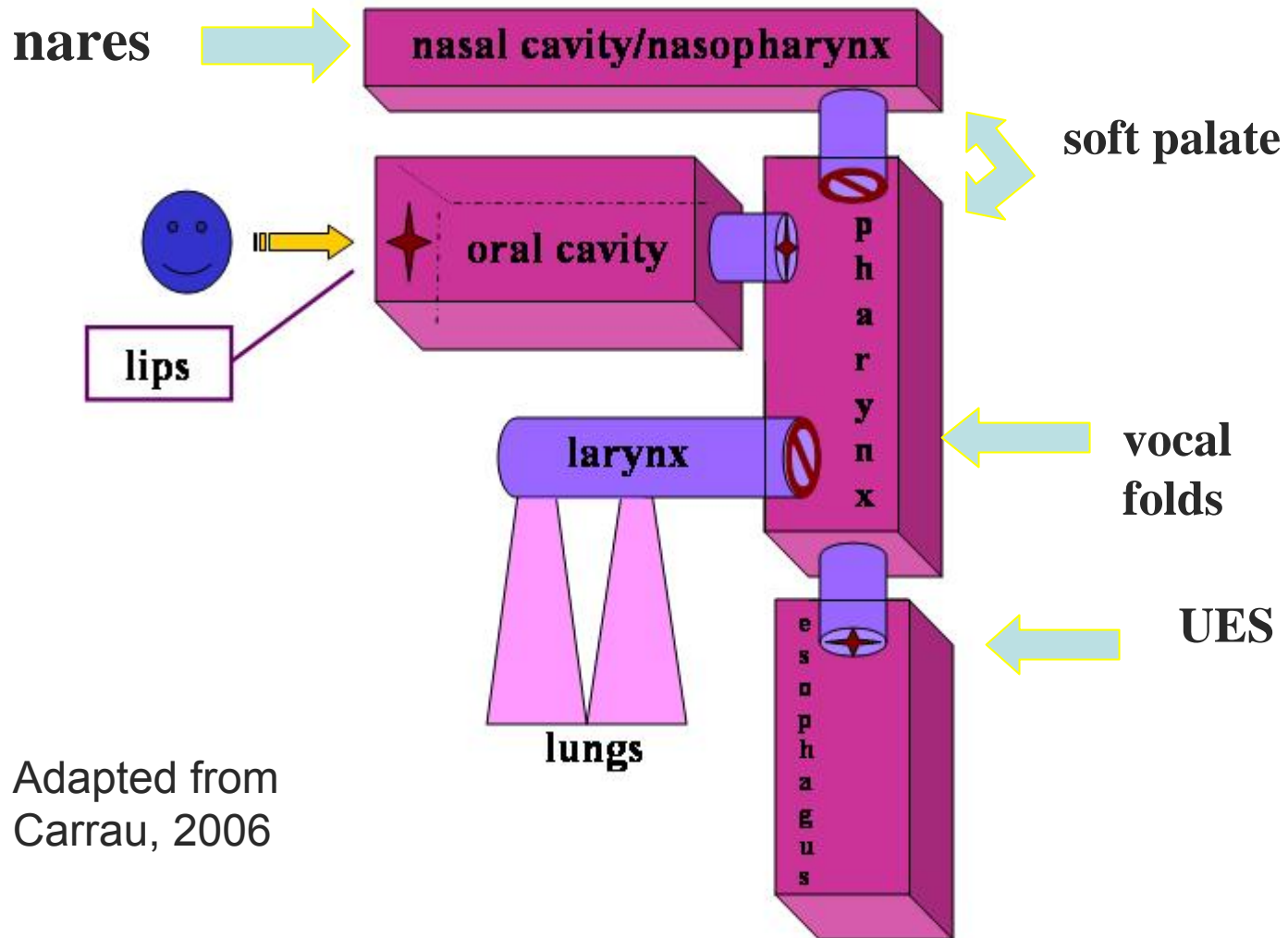
Respiration → Phonation



JRE 2-11 Relationships among the major divisions of the motor system, the sensory system, the motor speech program-

The Final Common Pathway of Speech and Voice

A system of tubes + valves
With Sensory + Motor networks



Adapted from
Carrau, 2006

Therapeutic Pre-requisites

1) Differential Diagnosis

- Multidisciplinary team approach
 - Medical assessments (ENT, Neurology, etc.)
 - Voice assessment (ENT, SLP-Vocologist)

2) Scope of Practice

- Preferred Practice Patterns

3) Amass Baseline Data

- Pre-Tx, Per-session, Post-Tx, Follow-up

Regarding Tx for Neuropathological Voices

What are the beneficial effects of Tx?

What level of evidence is available?

Consider + Contribute to:

- Evidence Based Medicine (EBM)
- Evidence Based Practices (EBP)

Empirical Studies Reviewed for EBP + levels of Evidence

Total # published studies	N = 55 (1996-2007) ~ 50 eliminated
Breakdown of Studies	69.0% Behavioral TX 16.3% Biofeedback TX 14.3% Instrumentation TX
Reasons for elimination	No SLP TX administered Medical- Surgical TX, Hypnosis, Acupuncture, Chiropractic, etc.

Group Design

(Andrianopoulos, Whitmal, & Astin, 2007)

Criterion	Response	%	Number studies
Subject selection criteria	Inclusion	67%	33
	Inclusion exclusion	33%	16
Randomization	Yes	29%	14
	No	71%	35
Blinding	Yes	10%	15
	No	90%	44

Conclusions

(Andrianopoulos, Whitmal & Astin, 2007)

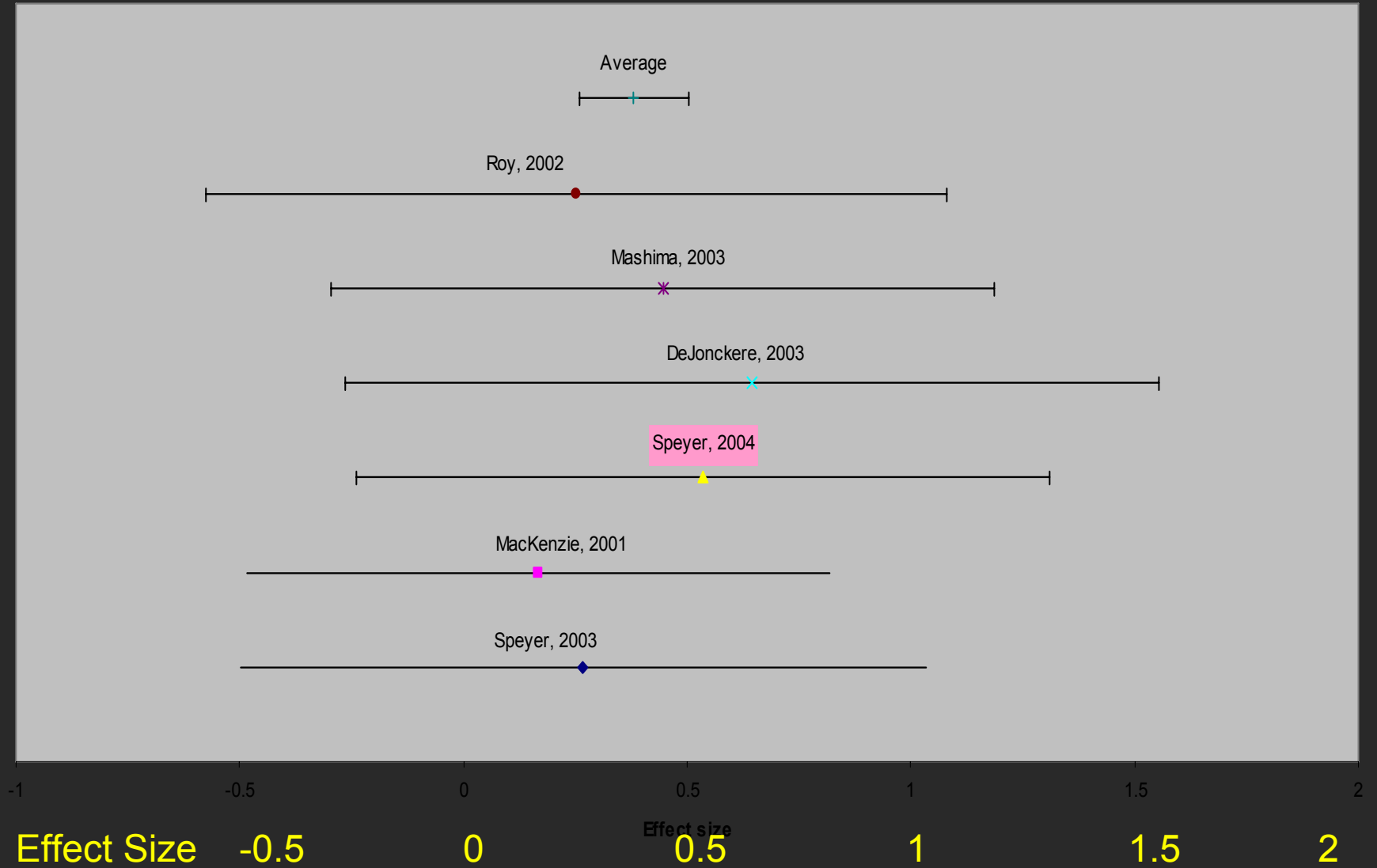
We found that:

- Prospective studies: 95% (52/55)
- Retrospective studies : 4% (2/55)
- 94% of studies reported change 2° TX
 - Pre-TX → Post-TX studies (94.5%)
- 62% of the studies were type Ib + IIa
- 71% reported statistical significance, yet
- 12% reported Effect size
- 6% reported Confidence Intervals
- 29% reported Reliability, 0% Validity

Effect Size	% Subjects in Control group below average subject in treated group.	% overlap	Chance of guessing group membership from a single score
0.0	50	100	50%
0.2	58	85	54%
0.4	66	73	58%
0.6	73	62	62%
0.8	79	53	66%
1.0	84	45	69%
1.2	88	38	73%
1.4	92	32	76%
1.6	95	27	79%
1.8	96	23	82%
2.0	98	19	84%

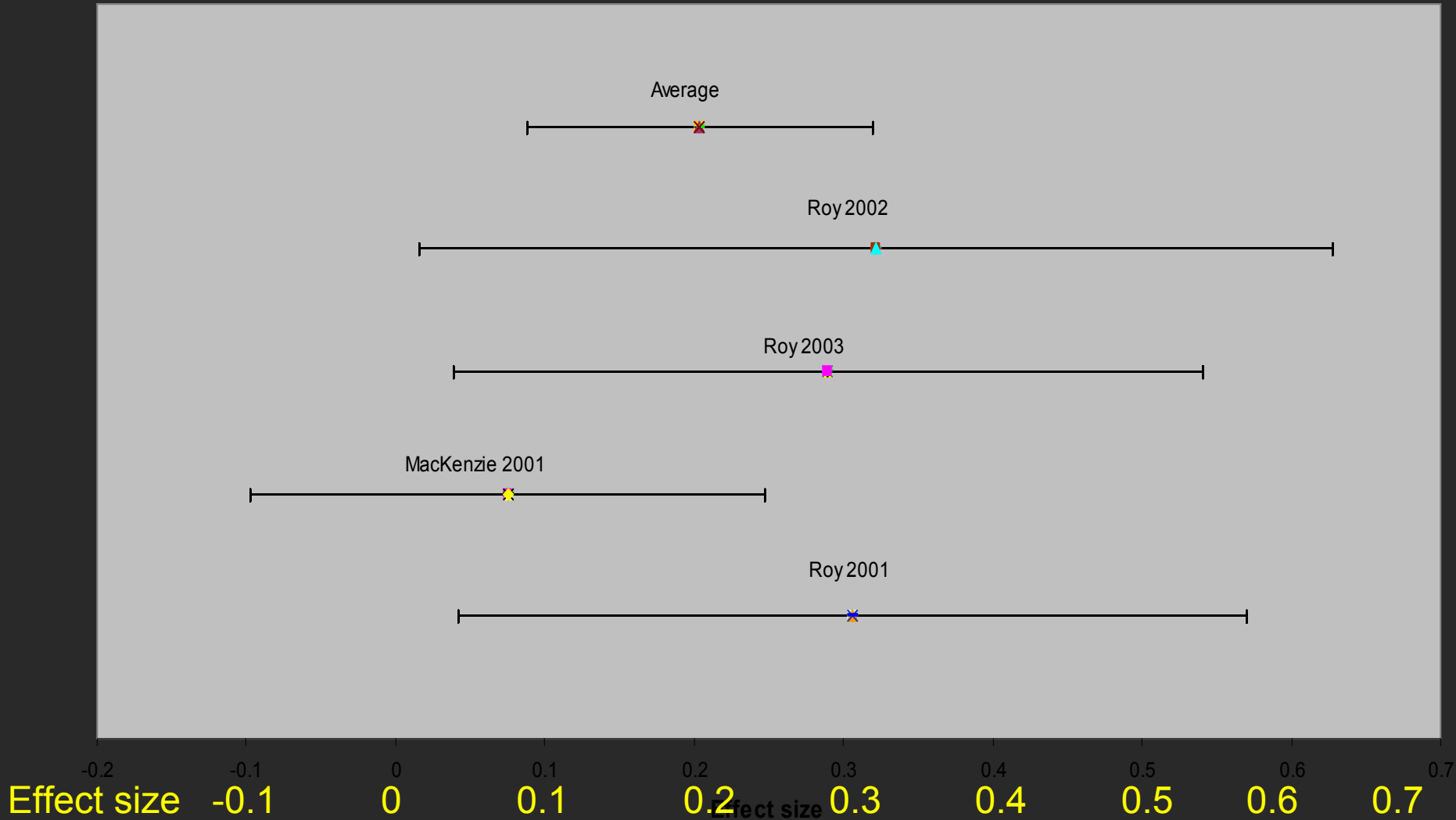
Treatment Effects Acoustic Changes in Dysphonic Patients

Treatment effects on acoustic parameters in dysphonic subjects



Effects of Voice Tx using Rating Scales of Dysphonic Patients

Effects of voice therapy on self-rating scales for dysphonic patients



Conclusion...

Although a study demonstrates ***statistical significance***, it does not demonstrate ***practical significance*** unless it determines its Effect Size (ES).

So, a study can have statistical significance and may not be practically significant. An ES size of 1.0 has an overlap of 45%. The smaller the ES, the more overlap, the less difference between groups as a result of TX.

General Principles

- Many patients with neuromuscular problems affecting phonation develop bad habits (valves + tubes)
- Many of these habits do not always go away once you repair lost function.

(Wan-Fu Su; Yu-Che Hsiao; Chung-Ching Hung, 2007)

General Treatment Principles

Objective:

- To Improve effectiveness, efficiency and naturalness of phonation for its intended purpose
 - Restore lost function
 - i.e., ENT surgery for VF paralysis, etc.
 - Compensate, pleasant as possible
 - Adjust with least effort as possible

Neuropathologies with Hypophonia

Increase volume → louder

Greater prosodic range

Examples: LSVT (Ramig et al.)

- Parkinson's Disease
- Aging Effects: Presbylaryngeus
- Ataxia
- VF paralysis, Cerebral Palsy, Downs
- Swallowing

Neuropathologies with Hyperphonia

Strained, harsh, tight →

Relaxation, alter pitch + intonation, stretch,
flow, laryngeal massage

Examples:

- Spastic Dysarthria
- Rigidity

Vagus Nerve Lesions

- Pharyngeal nerve → Soft palate
 - Hypernasality
 - Prosthetic Devices → LMN weakness
 - Possible for UMN weakness ? results

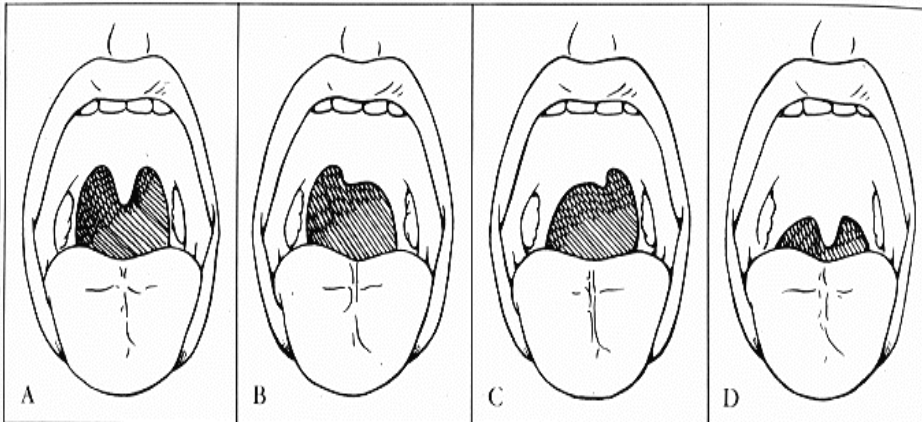
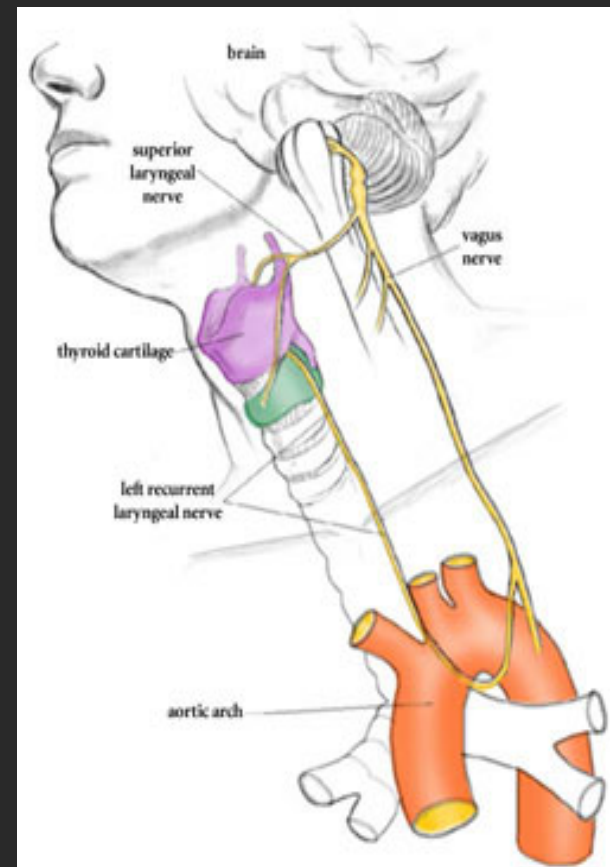


FIGURE 18-10 Tests of uvular deviation (cranial nerves IX and X). A. Normal. B. Left IX and X palsy. C. Right IX and X palsy. D. Bulbar palsy.



Spasmodic Dysphonia

- SD → abnormal involuntary movements:
 - are action induced and task specific
- Movement during vocalization:
 - Involuntary co-contraction of muscles used to produce sound.
- Yet, patient has normal structure

Patient Complaints, Other Symptoms

- **Spastic Dysarthria**
 - “Speech is slower, it tires me”
 - “My speech is nasal”
 - Swallowing difficulty
 - Drooling
 - Difficult to control laughter or crying (pseudobulbar affect)
 - Pathologic reflexes
 - Weakness
- **Spasmodic Dysphonia**
 - Negative impact on job, social life, and emotions
 - Vocal fatigue caused by increased effort in speech
 - Body motions or tenseness may be present secondary to spasms (AD type)
 - Frustration getting accurate DX

Differential Diagnosis

ADSD vs. MTD

Currently there are no definitive diagnostic criteria used to differentiate between these two very different voice disorders!

But, we are getting better:

(Andrianopoulos, 2008; Duffy, 2005; Roy, 2001)

Differential Dx: MTD vs. ADSD

- **Phonatory air flow** (*Higgins et al., 1999*)
 - ADSD vs. MTD vs. Normals
 - ADSD > Phonatory airflow + Air Flow Perturbation
- **Task specific phonation** (*Roy et al., 2005; 2007*)
 - During speech + sustained vowel [ah]
 - Spastic Dysarthria → continuous speech, vowels
 - ADSDs > severity → connected speech vs. vowels
 - MTD → no difference, speech vs. vowels

Compensation

Use of residual function

- Modifications in rate + prosody
- Prosthetic devices to amplify voice/speech
- Reduce nasal airflow (palatal lift, CPAP)
- Pace rate of speech to increase precision
- Alternative means of communication
- Modify physical environment

Factors that Influence Voice Treatment

- Stability of medical and neurological condition



Factors that Influence Voice Treatment

- Do you defer voice treatment after surgery or the therapeutic effects of medications?



Factors that Influence Voice Treatment PD; ALS, MS, other neuropathologies

- For degenerative cases,
- Stepwise management counseling
- Maintain intelligibility
- Counsel patients
- Prepare for AAC
- Quality of Life



Individual considerations

- Major + Minor voice impairments have Major + Minor effects on the patient



Focus of treatment

- Work on systems or components:
 - From which the greatest benefit will be derived rapidly
 - that will provide the greatest support for voice improvement
 - More Bang for your Buck!!
- For example: improve respiration
 - to improve loudness, voice + intelligibility
 - Lee Silverman Voice Treatment (LSVT→ PD)

Management Approaches

- Prosthetic
 - Voice amplifiers
 - Palatal lift prosthesis/bite blocks
 - Pacing tools: metronomes, DAF, biofeedback
 - Augmentative + Alternative Communication

Behavioral Management

Goal is to maximize communication

- **Speaker-oriented:**
 - improve voice, resonance, intelligibility
 - reduce impairment
- **Communication-oriented:**
 - environmental manipulations

Use Principles of Motor Learning

- It is a process of acquiring the capability for producing skilled actions
 - (Schmidt, 1988; 1998, 2000)
 - (Clark, 2005; Duffy 2005, Robbins, 2007; Seminars in SLP, Nov. 2008)
- Sensori-Motor (vocal) learning is a result of:
 - Experience: Proprioceptive → learned
 - Practice (systematic, frequent, shorter sessions)
 - Feedback
 - Change

Conditions of Practice

1. Prepractice

- Vocal Warm-up exercises

2. Repetitive practice

3. Mass vs. distributed practice

4. Low force → high velocity

5. Recovery period

muscle overload → strength → power → endurance

Practice

- Consistent: repetitions on a single task
 - reduce the *df*
 - increases immediate learning of skill
 - facilitates speed + automaticity of response
- Variable practice:
 - range of related activities that target same objective and muscle groups
 - better retention + generalization
- Systematic routines + practice

More on Feedback

- Instrumental feedback:
 - Biofeedback, Visual Feedback-strobe, EMG
 - Mirror, VU meter
- Quantity and quality of feedback
 - Knowledge of Results
 - Knowledge of Performance
 - Journal, data, regression/improvement

Specificity of Training

- Important to match the contraction characteristics of the exercise to the desired movement outcome.
- You treat voice with voice specifically for
 - Communication
 - Singing
- Work with functional groups of muscles as treatment targets

Are non-verbal oral motor speech and exercises beneficial for speech??

- For swallowing, there is evidence (some)
- For speech/voice, controversial for neuropathological dysarthrias + dysphonias
- Seminars in SLP (November 1988)

Hypotonia: Increasing Strength

- Overloading muscle → increase strength
 - Low-resistance, high-repetition exercises** voice
 - High-resistance, low-repetition exercises (swallowing)
- Isotonic exercises vs. Isometric exercises
 - Isometric → muscle stays the same length, but changes tension (Relaxation, massage)
 - Isotonic → muscle changes length, maintains the same tension (using voice with less effort, no MTD, good PTP → Resonant Voice TX)

Voice Therapy Approaches

- **Direct** → Patient Oriented
 - improve voice, resonance, intelligibility
 - Increase loudness
 - LSVT-Ramig et al
 - Expiratory Muscle Strengthening (Sapienza, Murdoch, etc.)
- **Indirect** → Adjustments + Education
 - Use amplification

Behavioral Treatment: Flaccid Dysarthria

Unilateral Vocal Fold involvement

Objective: To improve vocal fold adduction and vibration without strain and muscle tension

- Inhalation Phonation
- Head turning to left or right (Casper + Colton)
- Lateral digital manipulation
- Vocal Function Exercises
- Glottal Gap Reduction Techniques (MTD)

Treatment: Flaccid Dysarthria

Soft palate weakness

Objective: To reduce nasal resonance for speech purposes

- Velopharynx:
 - Sensory, mechanical or electrical stimulation (?)
- Muscle strengthening:
 - Continuous Positive Airflow Pressure
 - (Kuehn, 1991; 1994; 2004)
- Feedback: nasometer
- Frontal Focus → tongue adjustments
- Palatal lift (prosthetic, best candidates)

Treatment: Spastic Dysarthria

- Avoid exercises that increase hypertonicity
- LSVT
 - (1 patient with Hypokinetic Spastic, Solomon, 2004)
- Be cautious of Treatments that increase weakness →
 - Team Decision → Botox in Spastic Dysarthria to decrease rigidity → aspiration + dysphagia

Treatment: Hypokinetic Dysarthria

- **Surgical Treatments:**
 - thalamotomy, pallidotomy, deep brain stimulation.
- **Pharmacotherapy (L-Dopa, Clonazepam)**
- **Behavioral Tx:**
 - LSVT (Greatest empirical significance, 20 studies)
 - (Ramig et al.1993-2006)
 - Volume lip/jaw stability (Kleinow, 2001)
 - For rate: pacing boards, metronome → pacing
 - For volume: intensity monitors
 - feedback devices, amplification, postural adjustments (Laukkanen, 2004)

Treatment: Hyperkinetic Dysarthria

- Spasmodic Dysphonia
 - Medical Management → Botox Injection
 - Voice Monitoring →
 - Behavioral Tx alone contraindicated
 - Pre-op + Post-op monitoring
- Palatal pharyngeal myoclonus
 - Pharmacological + medical Tx (some positive results)
 - Behavioral Symptomatic Tx → poor carry over
- Behavioral Tx:
 - bite-block or pipe → mandibular dystonia/dyskinesia
 - Compensatory Techniques (efficacy?)
- Tremor: (?)

Treatment: Ataxic Dysarthria

- Behavioral Tx:
 - Metronome pacing w/ speech, singing
 - (Pilon et al., 1998)
 - Metered pacing
 - (Yorkston et al., 1990)
 - LSVT on a case study with ataxic dysarthric
 - (Sapir, 2004)