
# MYTHS

# Research Does Not Translate to Clinical Practice

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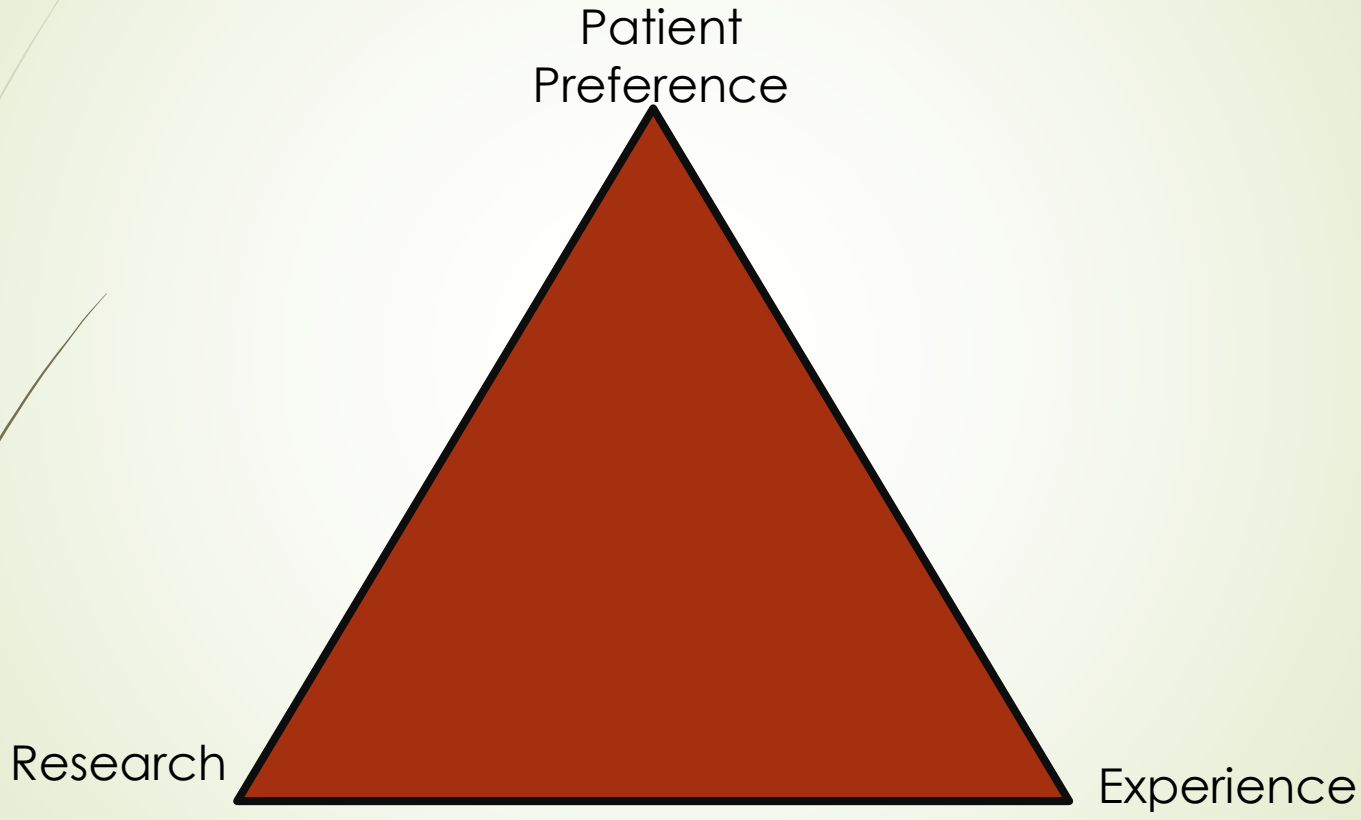
- "That is research and this is the real world."
- "I know they teach that in school but that is not how it really works."

# Evidenced Based Practice



# Examining Evidence Behind Some Common Interventions

- Masako Maneuver
- Chin Tuck Against Resistance

# Evaluating The Tongue Hold Maneuver Using High-resolution Manometry And Electromyography Hammer 2014

- With sEMG the magnitude and duration of tongue and pharyngeal constrictor muscle activity increased
- Manometric pressures and durations remained unchanged
- "Our findings emphasize the need for combined modality swallow assessment to include high-resolution manometry and intramuscular electromyography to evaluate the potential benefit of the tongue-hold maneuver for clinical populations"

# Masako

- Increased pharyngeal constrictor strength may arise from regular training…also may have a negative effect on hyoid anterior movement
- May be contraindicated for those with decreased hyoid displacement
- In patients with poor pharyngeal motility the intervention may be contraindicated
- Males showed reduced oral pharyngeal pressures

# Masako

- The maneuver "was not designed to increase BOT retraction"
- "It is important to note that the effects of the Masako maneuver have not been studied using rehabilitation exercise paradigm in any individuals, particularly those with dysphagia."

# Masako

In oral motor training, specificity and intensity of exercise are important elements for successful outcome. Tongue-hold swallow  can be considered an exercise that meets the principle of specificity. However, it was pointed out that the inability to manipulate the physiological load is a major drawback. Of this technique…In this study, the patterns/forms of pressure waves became **irregular** as the load  increased. It is speculated that because the maneuver **disturbed the anchoring function of the anterior tongue**, the tongue could not move freely and **lost its regular movement pattern**…Subsequently, **irregular production of pressure**, such as multiple peaks and asymmetrical wave formations, was seen."  Fujiu-Kurachi 2014

# Masako

"Caution must be taken when clinically using the maneuver for the following reasons…three negative findings were noted. These include:

- increased pharyngeal residue, particularly in the valleculae
- shortened duration of airway closure
- increased pharyngeal delay time in triggering the pharyngeal swallow.

…these negative findings can increase… aspiration..."

Fujiu-Kurachi 2002

# Evaluation of Manometric Measures During Tongue-Hold Swallows Doeltgen 2009

- Participants produced higher pressure in the oropharynx and hypopharynx during control swallows than during tongue hold swallows
- Gender effect revealed males produced a significantly greater pressure during control swallows than tongue hold swallows in the oropharynx and hypopharynx
- Tongue hold swallows produced shorter pharyngeal durations, particularly in females
- Increased anterior movement of the PPW does not have an immediate, compensatory effect on pharyngeal pressure generation in normals

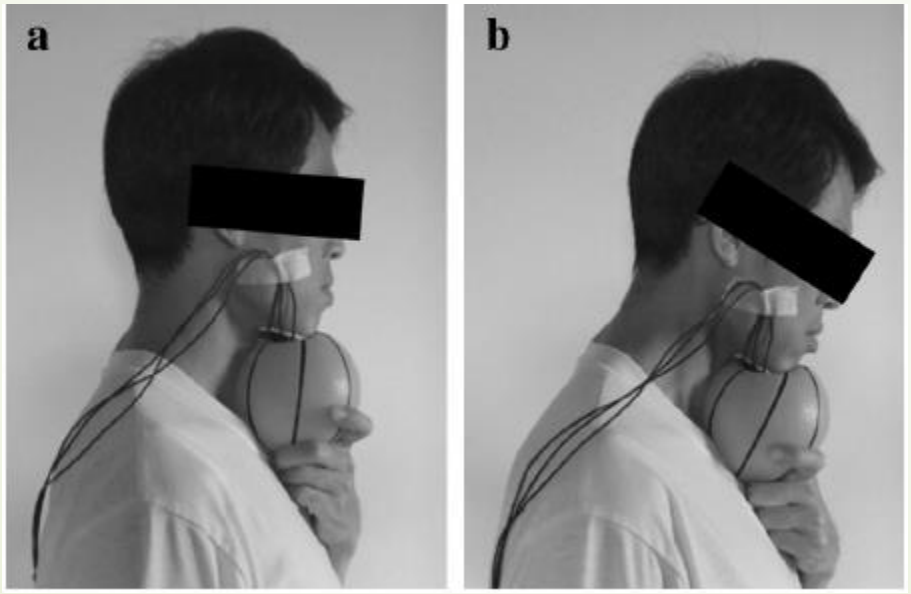
# Evaluation of Manometric Measures During Tongue-Hold Swallows Doeltgen 2009

- Increasing the strength of larger pharyngeal constrictors with repetitive, isolated training may limit anterior hyoid movement
- In clients with both decreased hyoid movement and poor pharyngeal motility the tongue hold maneuver may be contraindicated

# Masako

- How does the tongue hold maneuver change the way the swallow operates across time?
  - Does it have an effect on tongue pressure across time?
  - Does it have an effect on contact between the PPW and BOT across time?
- Why does the maneuver effect males and females differently?
- Are the contraindications important?

# Chin Tuck Against Resistance (CTAR): New Method for Enhancing Suprahyoid Muscle Activity Using a Shaker-type Exercise Yoon 2014




Picture taken from article cited above

# Chin Tuck Against Resistance (CTAR): New Method for Enhancing Suprahyoid Muscle Activity Using a Shaker-type Exercise Yoon 2014

- Let's look at the design
- Every participant performed one trial for each of the four exercise tasks: (1) CTAR isometric, (2) CTAR isokinetic,(3) Shaker isometric, and (4) Shaker isokinetic. A 5-min rest period was provided between the tasks. The mean and the maximum sEMG resting baselines were recorded prior to each exercise

# Chin Tuck Against Resistance (CTAR): New Method for Enhancing Suprahyoid Muscle Activity Using a Shaker-type Exercise Yoon 2014

Conclusion

- "The sEMG results for the maximum activation levels showed that the CTAR exercise, using a ball as resistance under the participant's chin, resulted in significantly greater activation during both the isokinetic and isometric tasks."
- "These findings demonstrate that the CTAR exercise does have an equivalent or greater impact than the Shaker exercise on the suprahyoid muscles, even though it was reported as less strenuous."

# What is Wrong With My Myth?

If you do not know the research, you can be harming your patients or be doing nothing at all.

# What Do I Do With This Information?

# Medical SLPS Are Dysphagia Experts

# What is an Expert

- Simply knowing more than others around does not make one an expert
- If everyone is an “expert” in swallowing than no SLP is an expert in swallowing

# What is an Expert?

- "An expert in a given domain is 'somebody who obtains results that are vastly superior to those obtained by the majority of the population.'"

Gobet 2011

# What is an Expert?

- Epistemic expertise is the capacity to provide strong justifications for a range of propositions in a domain
- Performative expertise is the capacity to perform a skill well according to the rules and virtues of a practice

Weinstein 1993

# Crisis In Dysphagia Management

Rosenbek 1995

“In 1969 an alarm sounded throughout the aphasiology community when the efficacy of aphasia treatment was challenged in a Medical World News article. Part of that article's message was that aphasic patients arrive at the hospital not walking and not talking and walk out not talking. The future of aphasia treatment was described as "bleak." Alarmed and challenged, the aphasiology community began collecting efficacy data. No such alarm has yet sounded in dysphagia.”

# Oropharyngeal Dysphagia In Long-term Care: Misperceptions Of Treatment Efficacy Campbell-Taylor 2008

"The assessment and management of patients in long term care who have oropharyngeal dysphagia has developed into an apparently complex and distinct field of practice. It is unfortunate that it lacks an evidence base, the efficacy of treatment is not established, and many clinicians are unfamiliar with appropriate and effective interventions because of a lack of training. Some commonly used interventions are not only ineffective but potentially hazardous. Physicians must become more familiar with the assessment process and appropriate management."

# Oropharyngeal Dysphagia In Long-term Care: Misperceptions Of Treatment Efficacy Campbell-Taylor 2008

"It appears that a set of procedures and expectations has developed in advance of the evidence required to support it."

# Oropharyngeal Dysphagia In Long-term Care: Misperceptions Of Treatment Efficacy Campbell-Taylor 2008

"The most common misperception about swallowing treatment is that the primary purpose of intervention is to identify aspiration and that aspiration can and must be prevented. The overwhelming emphasis on the supposed negative effects of aspiration seems to have developed from the early literature on swallowing disorders in which it was repeatedly stated that all aspiration was probably lethal. These early publications relied on the seminal work of Bartlett, Cameron, and others who were writing of the hazards of aspiration of stomach contents including vomitus…"

# Oropharyngeal Dysphagia In Long-term Care: Misperceptions Of Treatment Efficacy Campbell-Taylor 2008

"Some of the frequently used **test items** have no bearing on the ability to swallow. One example is examining tongue movements outside the mouth. These are voluntary movements and as such are cortically controlled and distinct from the brain stem–modulated function involved in swallowing. Tongue movements inside the mouth are important and revealed through speech abnormalities."

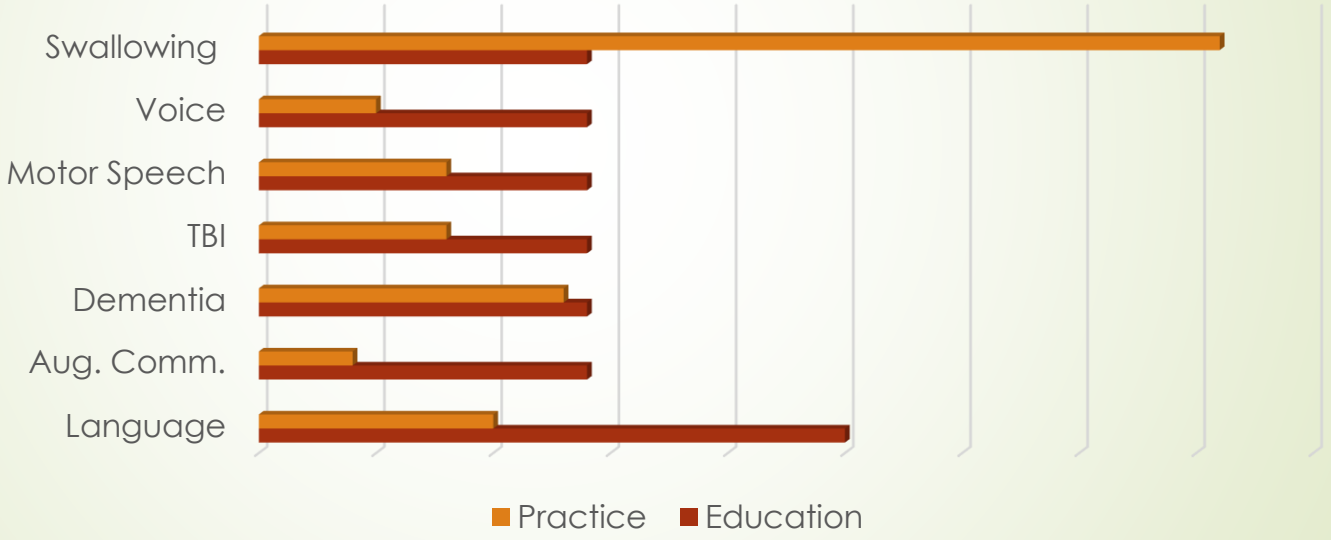
# CRISIS IN DYSPHAGIA MANAGEMENT

Huckabee 1997 The Risks of Good Intentions: Neuromuscular Electrical Stimulation *ASHA Perspectives 13:*

“Probably half of what we do in rehab is useless or harmful. Unfortunately I don't know which half that is.”

-Basmajian 1997

# SLP Training Verses Practice ASHA 2105/Humbert 2018




Mmmm, Tastes
like a combination
of Who Cares?
&
So What?
someecards
user card

# SLP Training Verses Practice Humbert 2018


Long Term Outcomes

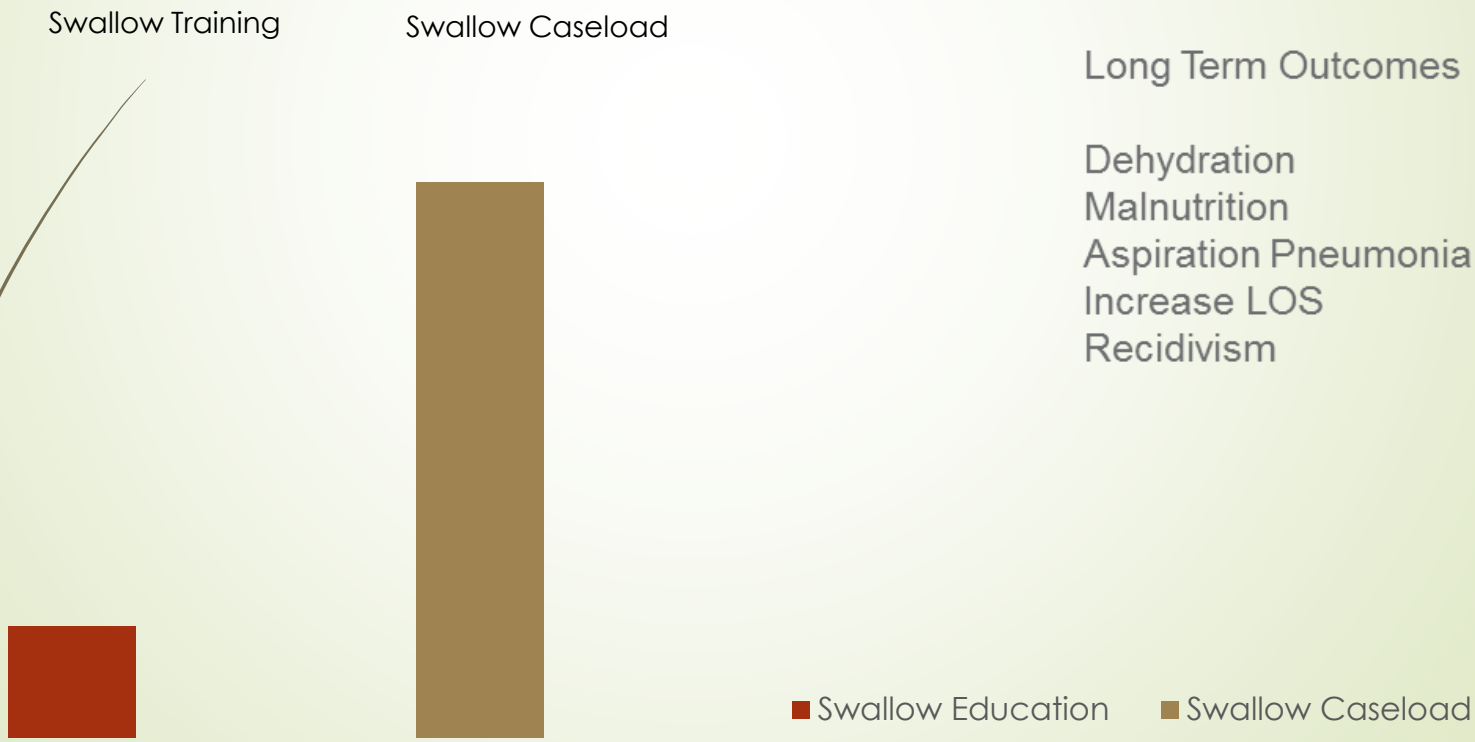
Credit Card Debit Bankruptcy

# SLP Training Verses Practice Humbert 2018


Long Term Outcomes

Obesity
Diabetes
Knee replacements
Vanity sizing

# SLP Training Verses Practice Humbert 2018



# SLP Training Verses Practice Humbert 2018

Making decisions without ever seeing the swallow is standard for dysphagia management

Would not be tolerated in other medical domains?

# Let's think about it…

# Would this be okay?

An OB does not have access to ultrasound, but is required to assess risk of intra-uterine growth restriction. So, instead of measuring the head circumference and thorax of the baby, the OB listens to the baby's heartbeat and palpates mom's belly to determine if the baby should be induced 4 weeks early

**No!**

# Would this be okay?

- A physical therapist does not have access to the patient's room, but is required to assess fall risk. The patient is restricted to her room. So, instead, with the patient inside her room, fall risk is assessed from the hallway by listening for the sound of falls or near falls during the patient's first attempt at transferring out of the bed.

**NO!**

# Would this be okay?

An SLP does not have access to imaging, but is required to assess aspiration risk. So, instead, aspiration risk is assessed by listening for the sounds of swallowing and coughing.

**YES?!**

*At a nursing home somewhere in Canada*

[Rips bong and coughs]

“Don’t let the speech therapist hear you cough. She’ll downgrade your diet and watch you eat for a month”

# Suggestions for Critical Evaluation of a Procedure

- Where did you hear about it?
- Critically evaluate even what you read in journals with a keen eye on methodology, underlying theoretical support, and evaluative measures.
- Search the literature for replications of the research that supports the technique.

Huckabee 1997

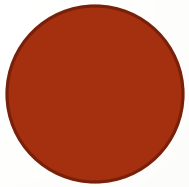
# Suggestions for Critical Evaluation of a Procedure

- Consider the professional and personal implications of utilization of the technique as being equally important as the possible implications for patient care.
- Recall your responsibility to the ASHA Code of Ethics under which we all practice.

Huckabee 1997

# We All Swallow the Same

# How long is it taking the dot to rest on the page?



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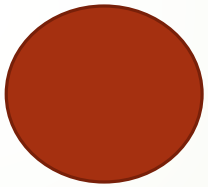


# How long is it taking the box to rest on the page?

# How long is it taking the box to rest on the page?

# Questions to Ponder

- How many people perform imaging studies?
  - How many use fluoroscopy as your primary tool?
  - How many use endoscopy as your primary tool?
- How many comment on hyoid or laryngeal elevation?
  - How are you measuring it on fluoroscopy?
  - How are you measuring it on endoscopy?
- How many comment on swallow timing?
  - How are you measuring it with fluoroscopy?
  - How are you measuring it with endoscopy?

# Physiological Variability in the Deglutition Literature: Hyoid and Laryngeal Kinematics Molfenter 2011

- Anterior hyoid displacement: 7.6 mm – 18 mm
- Superior hyoid displacement 5.8 mm – 25 mm
  - Although this various with bolus size and seems to decrease with age, even using the same bolus and within the same age group there is variability
- Anterior laryngeal displacement: 3.4 mm – 8.2 mm
- Superior laryngeal displacement: 21.1 mm – 33.9
  - Multiple studies use a 10 ml bolus with high variability

# Temporal Variability in the Deglutition Literature Molfenter 2012

- UES opening duration: 0.21–0.67 s
- Laryngeal closure duration: 0.31 to 1.07 s
- Hyoid movement duration: 0.79 to 1.39 s
- Stage transition duration: –0.22 to 0.54 s
- Pharyngeal transit time: 0.35 to 1.19 s

Volume, viscosity and age impact timing measures

# A Normal Swallow: Age Related Changes Lazarus 2017

- Reduced hyolaryngeal movement
- Reduced pharyngeal contraction
- Reduced width and duration of UES opening
- Reduced pharyngeal pressures
- Increased pharyngeal residue
- Reduced sensation in the pharynx and larynx
- Changes in taste and taste acuity

# Swallow Event Sequencing: Comparing Healthy Older and Younger HERZBERG 2018

- Prolonged pharyngeal transit times
- Pharyngeal contraction interval increases (onset to peak contraction)
  - Last event to occur 99% of the time in older adults verses 36% of the time in healthy adults
- UES relaxation interval decreases
- UES opening before/with bolus at UES
  - 86% in healthy older
  - 12% in healthy younger
- Less sequence variation

# Volumetric Changes In The Pharynx In Healthy Aging; Consequence For Pharyngeal Swallow Mechanics And Function Molfenter 2018

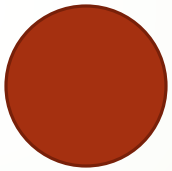
- Pharyngeal atrophy
  - Larger lumen
- Increased pharyngeal residue
- Decreased pharyngeal constriction
- Increased vallecular residue
- Increased pyriform sinus residue (trending toward significance)

# Back to the Dot

- Dot one was 0.21 s
- Dot two was 0.67 s
  - The range of UES opening
- Square one was 0.12 s
- Square two was 0.84
  - This represents the range of pharyngeal trigger

# Does this circle rest within the limits of normal UES opening?

- No, it is too slow



# Does this circle rest within the limits of normal pharyngeal trigger?

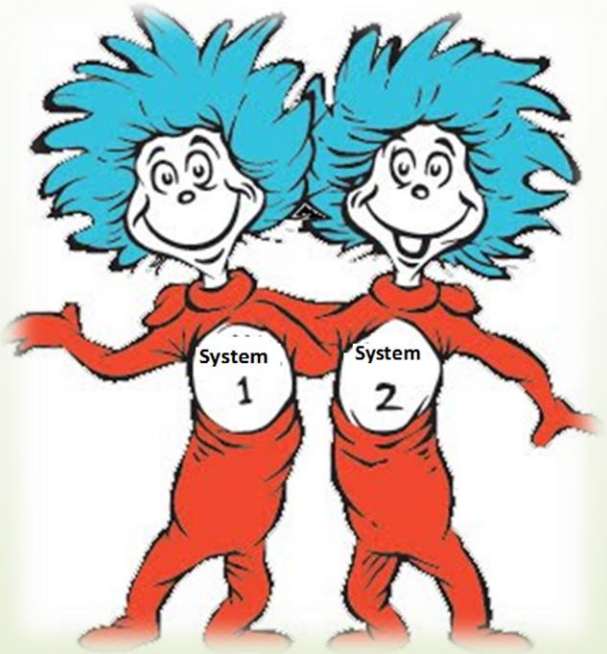
- Yes, it was within the normal range

# Why Is It Important?

- Incomplete understanding of normal swallowing physiology could lead to:
  - misdiagnosis
  - over-referral patterns
  - incorrect treatment targets
  - misuse of patients' money insurance allocation and time
  - unethical treatment of normal function or normal variations in function

Ernster, 2018

# So What About My Clinical Judgement?



# So, What About My Clinical Judgement?

"The perspective through which we look at something determines what we see. What we see, determines what we think. What we think, determines how we act.

In this way, perspective is powerful.

Therefore, it's important to evaluate the perspective through which we see the world around us. When our perspective is narrowed, our ability to *see* the whole picture is limited. This can skew the way we *think* about what we see and ultimately affect the way we *act*."

Ernster 2018

# So What About My Clinical Judgement?

- Recently I was engaged in a conversation related to the ability of a speech pathologist to clinically determine swallowing pathophysiology.
- A therapist responded she had paid a great deal of money for her degree and if she could not rely on her "clinical judgement" to accurately diagnose patients with dysphagia she had wasted her money.

# So What About My Clinical Judgement?

- When a child is referred for articulation disorders we administer the Goldman-Fristoe, Khan-Lewis, or some other such assessment to quantify the impairment even though the deficits are quite clear from simply listening to the child speak?
- When a child is referred for intellectual disabilities do we simply spend a bit of time with the child and try to quantify the level of disability or is an IQ test is required?

# So What About My Clinical Judgement?

- If a child has been identified with a hearing loss we do just give a label and move on? No, a referral is made for audiological testing.
- The same holds true for childhood language disorders, aphasia, cognition, fluency, etc.
- Why is this concept lost lost when it comes to dysphagia.

# Dual Processing Theory

- A widely accepted explanation of cognitive processes that characterizes human decision-making.
- This theory postulates that reasoning and decision-making can be described as a function of both an intuitive, experiential, affective system (System I) and/or an analytical, deliberative (System II) processing system (Stanovich 2011, Croskerry 2009, Evans 2007, Stanovich 2000).

# Dual Processing Theory

- When providing a diagnosis using System I processing alone, medical professionals are influenced by factors that may be irrelevant such as gender (Borkhoff 2008), race (Green 2007), obesity (Hebl 2001), history of psychiatric illness (Daumit 2006), and age (Podplsky 1993).
- Typically when making clinical decisions no account is taken of ambient conditions, such as other cases being managed concurrently, team dynamics, fatigue, sleep deprivation, location, and other variables critical to performance (Croskerry 2009).

# Dual Processing Theory

- System II processing is a robust decision making paradigm that is more analytical than intuitive. It is a systematic approach that leads to making effective decisions. It is typically analytical, slow and resource intensive. However, it is more likely to end with a correct diagnosis/decision (Croskerry 2009).

# Dual Processing Theory

- Imagine, for instance, a clinician taking a break in the middle of a work day to have lunch with a friend. During the course of lunch the friend takes a drink and begins to cough. Both people laugh and make a joke about aspiration, and the meal continues without concern. Upon returning to work, a nurse comes to the clinician reporting that patient X coughed during lunch. An order is requested for a speech evaluation, and in the interim, for safety, the patient is placed on nectar thick liquids.

# Dual Processing Theory

- Why were to two situations handled differently?
- There are many possible answers
- Much of it has to do with biases of location, prescribed roles, etc.

# Dual Processing Theory

- Vose (2018) provided SLPs with video clips of one swallow. Clinicians were asked to identify the swallow impairments. In one clip the obvious abnormal physiology was a delay in the pharyngeal trigger (27 seconds). Although the swallow delay was quite compelling, 33% of the respondents did not identify the delay as the primary impairment. 67% of therapists identified the delay as the primary issue, but only 58% said this would be the focus of treatment. In addition, 77% of respondents indicated there were 5 -9 impairments and 27% indicated there were 10 or more issues.

# Dual Processing Theory

- In this case the use of System I processing would have caused the patient to be both misdiagnosed and given inappropriate treatment. If a System II approach had been used, the clinician would use quantifiable measures to analyze the videos, employing a systematic approach such as measuring the delay using a frame by frame analysis. Once the pathophysiology was determined, the clinician would reference literature (or rely on having referenced literature previously) to determine possible treatments.

# Dual Processing Theory

- When performing a swallow study, the clinician observes the patient has laryngeal penetration at a PAS of 2 and 3. When documenting the events the therapist transcribes, "The patient displayed silent penetration."

# Dual Processing Theory

- The term "silent penetration" would suggest that not responding to laryngeal penetration is pathological. In fact a review of the afferent innervation of the airway teaches that the hypopharynx is innervated by the internal branch of the superior laryngeal nerve. When stimulated the nerve facilitates a swallow, not a cough (Mazzone 2016). This causes the material to be ejected from the laryngeal vestibule disallowing aspiration. In a System I approach the patient might be placed on altered liquids due to the concern of aspiration "risk" even though their body acted in a healthy manner. Investigation of the literature concerning basic neuroanatomy would yield a different result (System II approach).

# Dual Processing Theory

- When Plowman (2018) provided clinicians with five swallows that had been recorded on videofluoroscopy, clinicians were asked to determine if the swallow was "normal" or "abnormal." As an average, 34% of clinicians labeled each of the 5 swallows as "impaired" (range 54% to 6%). In fact, all of the swallows were performed by healthy graduate students.

# Dual Processing Theory

- In a System I approach the clinicians most likely hypothesized that some of the swallows were impaired and randomly assigned impairments.
- This is the same rationale the SLP may employ when a patient is referred for a swallow study.
- Instead of simply reviewing anatomy and physiology, the therapist is looking for something wrong.
- A critical analysis of a swallow requires employing quantifiable measures of both temporal and kinematic events and recognizing the internal bias to "find" issues that do not actually exist. This approach would lead to a more reliable diagnosis.

# Dual Processing Theory

- One of the most compelling concerns related to reliance on System I processing comes from Croskerry 2009:
  - "Autopsy findings have consistently shown a 20% to 40% discrepancy with the antemortem diagnosis, and a third of these autopsies would not have taken place if the true diagnosis had been known. Despite improved technology and an improved evidence base in medicine, the misdiagnosis rate detected through autopsy studies has not changed significantly during the last century"

# Dual Processing Theory

- Possible reasons why we rely more heavily on System One Processing (Plowman 2018)
- Education has a focus on the disordered system leaving clinicians with a poor understanding of a "normal" swallow.
- Clinicians are trying to conserve cognitive energy (System I processing is easier and faster).

# Dual Processing Theory

- Swallowing is complex and the consequences of swallowing impairment are more complicated than we understand.
- The inability to visualize the swallowing processes, clinically and the limited exposure to "normal" when performing imaging.
- Productivity requirements

Plowman 2018

# Course of Action?

# Clinical Signs are a Reliable Way to Assess Swallowing

# If My Patient Coughs While Eating There is a Problem

- Daniels (1997) found cough was associated with aspiration in 61% of 59 subjects
- 25% or more of chronic cough cases are associated with gastroesophageal reflux (Madanick 2013)
- Ace Inhibitors have been reported to cause a cough in up to 35% of users (Dicpinigaitis 2006)

# If My Patient Coughs While Eating There is a Problem

- Beta blockers induce bronchoconstriction which can lead patients display a chronic chough, especially in those with underlying respiratory compromise (Tafreshi 1999).
- Cold slows the passage of food through the esophagus and may cause a cough response in those with decreased esophageal emptying (Elvevi 2013).

# If My Patient Coughs While Eating There is a Problem

- Bernard (2009) found 54.5% of patients who aspirated did without coughing
- Leder (1998) found 40% of participants who aspirated on FEES did not respond
- Butler (2018) examined 6404 swallows in 203 healthy individuals across the lifespan. 18% of the participants aspirated and 75% of the time it was "silent"

# If My Patient Coughs While Eating There is a Problem

- Miles (2018) With 5 ml volumes, 20 patients coughed when they aspirated thin fluids but silently aspirated thick fluids (35% of the cohort)

# Wet Vocal Quality Equals Aspiration

- "Seventy-eight subjects underwent videofluoroscopic swallow study, and simultaneous recording of time-linked videofluoroscopic and acoustic data was conducted during post swallow phonation. Experienced dysphagia clinicians then rated randomized audio samples for presence or absence of wet vocal quality."
- "Wet vocal quality is not reliably perceived by clinicians when material is present in the larynx in the region of the glottis during phonation, and there is a high degree of interrater variability for perceptual judgments of wetness."
- Material in the larynx during phonation may result in multiple voice quality percepts. Even experienced clinicians are not be adept at identifying the perceptual consequences.

Groves-Wright 2010

# Runny Nose Indicates Aspiration

- Allergic rhinitis affects 10 - 30% of the adult population in the US. Many people suffer from seasonal or persistent allergies that result in a runny nose and watery eyes. Interestingly enough, rhinitis is more common in males during adolescence and young adulthood but shifts to being more common in females in the aged population.
- An estimated 19 million people in the US suffer from nonallergic rhinitis. The occurrence increases with age and is more common in females. Greater than 60% of rhinitis patients over the age of 50 suffer from this type.

# Runny Nose Indicates Aspiration

- The increase of nonallergic rhinitis in the aging population is multifactorial.
  - Immunosenescence, the change of immune function with age, occurs due to deterioration of the thymus, decreasing T-cell production.
  - Anatomical and physiological changes occur in the nose. The loss of nose tip support develops because of weakening of fibrous connective tissue. Weakening and fragmentation of the septal cartilage and retraction of the nasal columella causes changes to the nasal cavity. These changes may lead to decreased airflow leading to complaints of nasal obstruction, cough, a loss of smell, and a runny nose.

# Runny Nose Indicates Aspiration

- Geriatric rhinitis is a broad term used to signify rhinitis due to age related changes. These changes lead to persistent mucus, postnasal drip, chronic chough, nasal obstruction and dryness. Patients may also complain of the need to clear the throat frequently.
- Many medications commonly prescribed in the geriatric population are known to induce rhinitis. These medications include beta blockers, alpha blockers, antihypertensive, ACE inhibitors, typical antipsychotics, gabapentin (Neurontin), citalopram (Celexa), and niacin (vitamin B3). This information validates the importance of reviewing medications prior to patient assessment.

# What IF The Patient Has ALL Of These Clinical Signs?

0+0+0+0 = 0

Let's Talk About it

# “Chin Tuck” is a Universally Beneficial

# “Chin Tuck” is a Universally Beneficial

- The effectiveness of chin tuck is related to the overall degree of dysphagia, the more severe the dysphagia, the less effective the maneuver. Saconato 2016

- Chin down position improved airway protection in patients with impaired swallowing safety during cup drinking with thin liquid barium in the upright position. The chin down maneuver did not lead to improved airway protection with teaspoon-sized thin liquid bolus volumes. Clinicians should not recommend the chin down maneuver without first ruling out detrimental effects and seeing evidence of its benefit in videofluoroscopy. Fraser 2012

# The Swallow is Easily Fatigued

# The Swallow is Easily Fatigued

Let's consider the mechanism:

Most of the tongue consists primarily of fatigue resistance muscle fibers (Type I and IIa) with a smaller portion being Type IIb. The facial muscles are generally Types I and IIa as well (i.e. orbicularis oris and buccinators). Therefore by very nature they are resistant to fatigue. This makes sense considering their ongoing function is essential for life. (Solomon 2006)

# Effects of Dining on Tongue Endurance and Swallowing-Related Outcomes Kays 2010

- Twenty-two healthy young (M = 25.7) and old (ages M = 70.7) adults were studied
- Each subject completed two baseline measures of tongue strength and endurance with a 20-min rest period between measures
- All individuals demonstrated a moderate yet significant decline in both tongue strength and endurance after eating a standardized meal
- This suggests that the daily activity of dining may be sufficient to negatively impact lingual pressure generation.
- An intriguing finding was that young subjects demonstrated a significantly greater decline in anterior tongue endurance than older adults after eating a meal.

# The Swallow is Easily Fatigued

- It is possible to fatigue the normal tongue but it requires excessive, strenuous exercises, not normal activity. When the tongue is "fatigued" articulation will deteriorate as well. The interesting thing is that it returns to near normal in a short amount of time (Solomon 2006)

# The Swallow is Easily Fatigued

- Ravenhorst-Bell 2012
  - N=20 all older adults
  - Served the regular lunch at an ALF
  - Measured Pmax and Endurance (50% of Pmax)
  - After the meal both Pmax and endurance improved to the level of statistical significance.

# The Swallow is Easily Fatigued

- Other considerations
  - Respiratory demand
  - Emotional demand
  - Cognitive demand