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DEPARTMENT OF EDUCATION

Bureau of Special Education
Pennsylvania Training and Technical Assistance Network

Tools for Skeptical Thinking

Evaluating Science and Pseudoscience in Speech-Language Pathology (pages 2-13)

Logic, Theory, and Evidence Against the Use of Nonspeech Oral Motor Exercises (NSOME) to Change Speech Sound Productions in Children (pages 14-28)

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Quackery

- A type of pseudoscience; any practice or remedy that has no compelling scientific basis for them to work. Includes questionable ideas and questionable products and services, regardless of the sincerity of the promoters.
- A charlatan is a person who pretends or claims to have more knowledge or skill than s/he possesses, knows that his/her skills are not real, uses deception and usually does things to obtain money, fame or other advantages.
- **Why Fad Therapies Exist** (Vyse, 2005): ♦Incomplete effectiveness of available therapies ♦Available treatments are onerous or distasteful ♦Alternative treatments are supported by ideology ♦Treatments are promoted by proprietary groups.
- **Why Fad Therapies Persist** (Lilienfeld, Marshall, Todd & Shane, 2015): ♦Desperation ♦Poor sources of information ♦Seductive appeal ♦Savior effect ♦Naïve realism ♦Personal experiences ♦Confirmation bias ♦Cognitive dissonance ♦Profit.

Skepticism

- A skeptic is a person who has a questioning attitude or has some degree of doubt regarding claims that are taken for granted elsewhere.
- The word *skepticism* can characterize a position on a single claim, but more frequently it describes a lasting mindset.
- Skepticism is an approach to accepting, rejecting, or suspending judgment on new information that requires the new information to be well-supported by evidence**.**
- **Skeptic's Society:** Under the direction of Dr. Michael Shermer, The Skeptic's Society is a scientific and educational organization of scholars, scientists, historians, magicians, professors, teachers, and anyone curious about controversial ideas, extraordinary claims, revolutionary ideas, and the promotion of science. The mission is to serve as an educational tool for those seeking clarification and viewpoints on these controversial ideas and claims.
- **Skeptics' Balancing Act:** Openness to new ideas, no matter how bizarre or counterintuitive vs. a ruthlessly skeptical scrutiny of all ideas, old and new.
- **Are Skeptics Curmudgeons?** "Some people believe that skepticism is the rejection of new ideas, or worse, they confuse 'skeptic' with 'cynic' and think that skeptics are a bunch of grumpy curmudgeons unwilling to accept any claim that challenges the status quo. This is wrong. Skepticism is a provisional approach to claims. It is the application of reason to any and all ideas — no sacred cows allowed. In other words, skepticism is a method, not a position. Ideally, skeptics do not go into an investigation closed to the possibility that a phenomenon might be real or that a claim might be true. When we say we are 'skeptical,' we mean that we must see compelling evidence before we believe."

Common Thinking Errors (Finn, 2011)

- **Three Defining Characteristics:** (1) They typically lead to judgments that are different from the optimal choice, dissimilar from objective reality; (2) They happen automatically so we do not realize they are occurring; (3) They are often difficult to avoid.
- **6 Common Thinking Errors:** (1) We are more likely to be persuaded by personal experience and anecdotes than by objective, statistical evidence; (2) We prefer evidence that support our beliefs and ignore or downplay evidence that questions them; (3) We are prone to ignore the role that chance

events play in our everyday lives and, instead, erroneously assign them to causal status; (4) We believe we see the world as it is, failing to appreciate that our senses can be deceived and that our expectations can shape our perceptions; (5) We oversimplify our thinking, such that we fail to look beyond the obvious, overgeneralize, and engage in either-or thinking—when multiple potential answers are more likely; (6) We believe that our memories are faultless, when in fact they are imperfect because they are often readily influenced by our current beliefs and expectations and are highly suggestible to questioning.

- **Common Flaws in Thinking** (Travers, 2016). See Page 13 of this handout.

Avoid Being Quacked

- Quackery seldom looks outlandish.
- Be skeptical of anecdotes and testimonials: Testimonials are not science.
- Be wary of pseudoscientific jargon: Make sure that the uses of terms are following accepted standards.
- Be skeptical of claims of effectiveness for a wide range of unrelated problems: There is no such thing as a "cure-all."
- Don't let desperation and enthusiasm cloud your judgment.

Science and Pseudoscience (Finn, Bothe, & Bramlett, 2005)

- **Science:** Information that is developed through research and other empirically-based activities. Science is a philosophical doctrine that specifies criteria and standards for describing, explaining, and deciding what stands as real knowledge or truth. It is a quest for knowledge supported by evidence, and an attempt to discover and explain regularities in events (Lum, 2002).
- **Pseudoscience:** A pretend or spurious science; a collection of related beliefs about the world mistakenly regarded as being based on scientific method or as having the status that scientific truths now have (Finn, Bothe, & Bramlet, 2005). A methodology, belief, or practice that is claimed to be scientific, or that is made to appear to be scientific, but which does not adhere to appropriate scientific methodologies, lacks supporting evidence or plausibility, or otherwise lacks scientific status.
- **Markers of Good Science**: (1) It makes claims that can be tested and verified; (2) It has been published in a peer-reviewed journal (beware…there are some dodgy journals out there that seem credible, but aren't); (3) It is based on theories that are discussed and argued for by many experts in the field; (4) It is backed up by experiments that have generated enough data to convince other experts of its legitimacy; (5) Its proponents are secure enough to accept areas of doubt and need for further investigation; (6) It does not fly in the face of the broad existing body of scientific knowledge; (7) The proposed speaker works for a university and/or has a PhD or other bona fide high-level scientific qualification.
- **Markers of Bad Science:** (1) Has failed to convince mainstream scientists of its truth; (2) Is not based on experiments that can be reproduced by others; (3) Contains experimental flaws or is based on data that does not convincingly corroborate the experimenter's theoretical claims; (4) Comes from overconfident fringe experts; (5) Uses over-simplified interpretations of legitimate studies and may combine with imprecise, spiritual or new age vocabulary, to form new, completely untested theories; (6) Speaks dismissively of mainstream science.

How You Know Something is Pseudoscience (Finn, Bothe, & Bramlett, 2005)

- Disconfirming evidence is ignored and practice continues even though the evidence is clear. Once we have evidence against a procedure, then it cannot be ignored in clinical practice. Must be careful of Confirmation Bias, where we pay more attention to things that fit with our beliefs than things that might challenge them. No matter what the evidence shows, many people will not give up on their prior beliefs.
- When the approach is disconnected from well-established scientific models, theories, or paradigms. If theories are ignored, re-interpreted/misinterpreted, or manipulated in some way, then it is probably pseudoscience.
- When new terms are invented or the meanings are redefined in nonstandard ways.
- The only "evidence" is anecdotal, supported with statements from personal experience. A case study does NOT establish a cause/effect relationship and anecdotes and stories are NOT science.
- Inadequate evidence is accepted. Many proponents of some treatments provide insufficient evidence of their benefits.
- The printed materials are not peer-reviewed. Have the claims undergone independent, unbiased critical scrutiny? Or are the results presented directly to the public (e.g., at a conference, CEU event, self-published website/books)?
- Grandiose outcomes are proclaimed. If it is too good to be true, it probably is not true! One therapeutic technique cannot possibly work for all different types of disorders.

Is it Real of Fake Science? 10 Questions (Forbes Magazine, 2012)

1. **What is the *source*?** Is the person or entity making the claims someone with genuine expertise in what they're claiming? Are they hawking on behalf of someone else? Do they use a website that's made to look "sciencey" or newsy when it's really one giant advertisement for something that is being marketed to you?
2. **What is the *agenda*?** You must know this to consider any information in context. In a scientific paper, look at the funding sources. If you're reading a non-scientific anything, remain extremely skeptical. What does the person or entity making the claim get out of it?
3. **What kind of *language* is used?** Does it use emotion words (miracle cure)? Or use language that sounds highly technical (jaw slide! enzymes! brain mapping!) or jargon-y but is really meaningless in the therapeutic or scientific sense? If you're not sure, take a term and Google it. Be on the lookout for sciencey-ness. If peddlers feel that they have to toss in a bunch of jargony science terms to make you think they're the real thing, they probably don't know what they're talking about.
4. **Does it involve *testimonials?*** If all the person or entity making the claims has to offer is testimonials without any real evidence of effectiveness or need, be very, very suspicious. Anyone can write a testimonial and put it on a website. If the only thing "showing" effectiveness are testimonials, then you know the science is not there.
5. **Are there claims of *exclusivity*?** New findings arise out of existing knowledge and involve the contributions of many people. It's quite rare that a new therapy is something completely novel without a solid existing scientific background to explain how it works. Watch for words like "proprietary" and "secret." These terms signal that the intervention has likely not been exposed to the light of scientific critique.

6. **Are there mentions of *conspiracy*?** Do they use words like *"...only clinicians know how to do this, not those in the ivory towers*." Is there a belief that they are the only ones in the know? Is there a sense they feel like they are being put down or suppressed because of their unique approach?
7. **Does the claim involve multiple *unassociated* disorders?** Does it involve assertions of *widespread therapeutic benefit* for unrelated disorders? Claims that a specific intervention will cure cancer, allergies, ADHD, and autism are frankly irrational.
8. **Is there a *money trail* or a *passionate belief* involved?** It is always important to follow the money. The ones who benefit financially are those who market cures or therapies, act as consultants, and/or give paid talks. Because of all of our biases and our passion for improvement, we often fail to be as skeptical as necessary.
9. **Were real *scientific processes* involved?** Is there evidence that the product or intervention on offer has been *tested scientifically?* Were the results published in scientific journals? Was there true peer-review that is unbiased? Be careful of self-published books, websites, etc.
10. **Is there *expertise*?** No matter if you dislike "experts" or disbelieve the "establishment", these people have studied the topic deeply. The dichotomy of "clinician vs. researcher" is mostly a false one in speech-language pathology. Just because someone has a PhD does not necessary make them an expert.

See "Science vs. Pseudoscience in CSD: A Checklist for Skeptical Thinking" on pages 11-12.

How We Obtain Evidence

- **Consensus-Based:** Consensus may be largely influenced by group dynamics and the desire to perform like everyone else.
- **Expert-Based:** Might be even worse than consensus. It can have all kind of biases, like expert/opinion bias or financial motivation.
- **Evidence-Based**: Guideline recommendations are based on best available evidence, deals with specific interventions for specific populations and are based on a systematic approach.

The CRAAP Test to Evaluate Information

C **C is for Currency:** The timeliness of the information. When was the information published or posted? Has the information been revised or updated? Will older sources work for your purposes? Are the links functional?

R **R is for Relevance:** The importance of the information for your needs. Does the information relate to your question? Have you looked at a variety of sources? Would you be comfortable citing this source?

A **A is for Authority:** What is the source of the information? Who is the author/publisher /source/sponsor? What are the author's credentials or organizational affiliations? Is the author qualified to write on this topic? Does the URL reveal anything about the author source? *.com .edu .cog. .org .net*

A **A is for Accuracy: R**eliability, truthfulness, correctness of the content. Where does the information come from? Is the information supported by evidence? Has the information been reviewed or refereed? By whom? Can the information be verified in another source? Does the language or tone seem unbiased? Does the author or publisher seem unbiased?

P **P is for Purpose:** Reason the information exists. Why this information? *Inform? Sell? Persuade?* Do the authors/sponsors make their intentions clear? Is the information fact, opinion, propaganda? Does the point of view appear objective and impartial?

Evidence-Based Practice (EBP)

- **Definition:** The conscientious, explicit, and unbiased use of current best research results in making decisions about the care of individual clients. Treatment decisions should be administered in practice only when there is a justified (evidence-based) expectation of benefit (Sackett et al, 1996). EBP is the integration of best research evidence along with clinical expertise and the client values.

- **Some Problems with EBP**: For research evidence, what if we don't have the empirical studies as evidence? For clinical expertise, what if clinicians have been things wrong all along? For client values, just because a client/parent want a treatment, does that mean s/he should receive it?
- **Purpose of EBP:** (1) Promote the adoption of effective interventions; (2) Delay the adoption of unproved interventions; (3) Prevent the adoption of ineffective interventions.

7 Step Process for EBP (McLeod & Baker, 2016)

1. **Generate a PICO clinical question:** P = Patient; I = Intervention; C = Comparison; O = Outcome
2. **Find external evidence relevant to the question:** Now you need to answer your PICO question by searching the external research evidence. Try to locate systematic reviews if possible. Use ASHA Journal Search function, ASHA Practice Portals, ASHA Evidence Maps, Google Scholar, MEDLINE, AHRQ's National Guideline Clearinghouse, IES What Works Clearinghouse.
3. **Critically evaluate the external evidence:**
   - The nature of the evidence: ♦Pre-trial study ♦Feasibility study ♦Early efficacy study ♦Later efficacy study ♦Effectiveness study.
   - **Levels of evidence from studies**: LEVEL IV: WEAK value: Opinion of authorities, based on clinical experience; LEVEL III: LIMITED value: Nonexperimental studies (i.e., correlational and case studies); LEVEL IIb: MODERATE value: Well-designed quasi-experimental study; LEVEL IIa MODERATE value: Well-designed controlled study without randomization; LEVEL Ib: STRONG value: Well-designed randomized controlled study; LEVEL Ia: STRONGEST value: Well-designed meta-analysis of >1 RCT.
4. **Evaluate internal evidence from your clinical practice.** Also known as "Practice-Based Evidence" (see below)
5. **Evaluate the internal evidence with respect to the client and family factors, values, and preferences:** These include child/family factors and values known or believed to influence intervention outcomes and the need to have fully informed children and their families so they can appropriately select their preferences.
6. **Make a decision by integrating the evidence:** There is no single gold-standard decision-making flow chart to guide us to a perfect decision with every client, every time. Must take into account clinical expertise *"…defined not only by technical, procedural, and knowledge-based (intellectual) qualities, but by interpersonal and attitudinal qualities as well"* (Kamhi, 1994).

7. **Evaluate the outcomes of the decision:** Initially goals and a plan for evaluating progress need to be developed. Need to be able to problem solve things like slow or no progress, lack of carryover, etc. Reevaluate periodically. Reflect on client factors/values. Gather good clinical data.

Practice-Based Evidence and Science-Based Evidence

- Represents the contribution of practitioners who utilize research methodologies to examine the quality of their clinical practice and service provision. If we want more evidence-based practice, we need more practice-based evidence. A balance between Efficacy and Effectiveness.
- **Efficacy:** The tested impact of an intervention under highly controlled circumstances. Maximizes *internal validity* (i.e., the degree to which one can conclude with confidence that the intervention caused the result).
- **Effectiveness:** The tested impact of an intervention *under more normal* circumstances (relatively less controlled, real-time, "typical" setting, population, and conditions). Maximizes *external validity* (i.e., the degree to which one can generalize to other times, places, or populations).
- **Implementation Science:** Creates generalizable knowledge that can be applied across settings and contexts to answer central questions. Use of strategies to adopt and integrate evidence-based interventions and change practice patterns. Translating research into practice. Enhances the extent to which intervention research is generalizable, representative, and comprehensive. Researchers and clinicians need to work together and share their knowledge and expertise to increase the number of evidence-based interventions that are implemented in real-world practices.
- **Science-Based Practice:** If we don't have peer-reviewed studies as evidence, what is the clinician to do? Follow the scientific method to gather practice-based evidence. Use the well-established theories to guide our thinking. (1) Be skeptical; (2) Follow the scientific method; (3) Gather valid data from clinical practice.
- **Experimental Designs**: Can be used to show treatment effectiveness for Practice-Based Evidence: ♦Withdrawal designs (ABA; ABAB; BAB) ♦Multiple Baseline designs (Across behaviors; Across conditions/settings; Across subjects/groups). (See diagrams toward the back of this handout)

Tools for Skeptical Thinking—Baloney Detection (Sagan, 1996)

These ideas can help you remain appropriately skeptical when encountering new therapeutic techniques so you can test and analyze the purported findings.

- **Independent confirmation:** Can other clinicians/researchers come up with the same findings?
- **Encourage debate on the evidence:** There must be open and free dialogue in order for the science of new techniques to be evaluated.
- **Believe data not "experts":** Don't let testimonials and non-scientific findings sway you…these may be interesting and may lead us to ask important questions, but arguments from authorities without proper data should be meaningless.
- **Spin more than one hypothesis:** If there are no conceivable reasons for something to work, then it must be questioned if it really does work.
- **Don't overly attach to a hypothesis:** Believe the research, not the emotions of yourself and others, especially parents.
- **Quantify the findings:** Testimonials cannot be used. We must quantify the results of the techniques and interpret the findings accurately and fairly.

- **Every link in the argument chain must work:** When following the logic of the argument ALL of the pieces must fit together, not just some.
- **Count the HITS and the MISSES:** We cannot overlook the misses and only concentrate on the hits.
- **A case study is not experimental:** A case study cannot and never has been a methodology for explaining cause-effect relationships.
- **If it is too good to be true, it probably is NOT true:** We cannot let our "excitement" dictate over our thinking of the issues.
- **Follow the scientific methodology.**
- **Be wary of information from the popular press:** Only information from peer-reviewed reputable journals can be believed, and then appropriate skepticism must still be applied.

Clinical Scientists – Some Questions to Ask Ourselves (Kamhi, 1999)

- Did you use a proven treatment technique or approach?
- Can you cite studies that support the efficacy of the approach?
- What made you choose the approach you used?
- Are you primarily using the same approach(es) to treatment that you were taught to use in your training program?
- What would make you use a treatment approach that is different from the one you are using now?
- Is empirical validation a prime consideration practitioners use to guide their therapy?
- Why does the intervention literature not translate well into clinical practice?
- Which is more important: effective or efficient treatment?
- Why are scientists/researchers more resistant to change than clinicians?
- If clinicians do not need a "seal of approval" in order to use a particular treatment approach, what do they use to guide their selection of an approach?
- If a parent wants you to implement a new treatment approach but the scientific community is still showing skepticism, what is the practitioner to do?
- What is wrong with "jumping on the bandwagon" and trying a new intervention technique?
- Can clinicians really raise "false hopes" in their clients or the client's parents?
- Do we need to understand everything about a new approach in order to use it?
- How do we weigh the cost and risks of alternative treatments against possible benefits?
- What are the fundamental differences between researchers and clinicians?

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- **Auditory Integration Training (AIT):** http://www.talkaboutcuringautism.org/learning/tomatis.htm
- **Battle Over Controversial Method For Autism Communication:** http://www.theatlantic.com/education/archive/2016/07/a-controversial-method-for-autism-communication/491810/
- **CRAAP Test:** https://www.csuchico.edu/lins/handouts/eval_websites.pdf
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- **IES What Works Clearinghouse:** http://ies.ed.gov/ncee/wwc

- **Implementation Science:** H*ttp://www.ucdenver.edu/academics/colleges/medicalschool/programs/crisp/about/Pages/About-Dissemination-and-Implementation-Science.aspx*
- **Lof Science/Pseudoscience Checklist:** http://www.smartspeechtherapy.com/wp-content/uploads/2015/07/LOF-Science-v-Pseudo-ASHA12.pdf
- **MUSEC Briefings:** Go to Google and type in "MUSEC Briefings"
- **Practice-Based Evidence:** http://www.astdd.org/docs/LarryGreenPresentationSelectedSlides.pdf
- **Quackwatch:** www.quackwatch.org
- **Skeptics:** www.skeptic.com
- **Speech Pill:** http://www.speechnutrients.com/products/speak/
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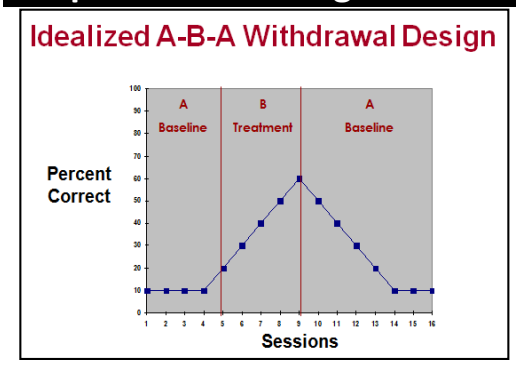
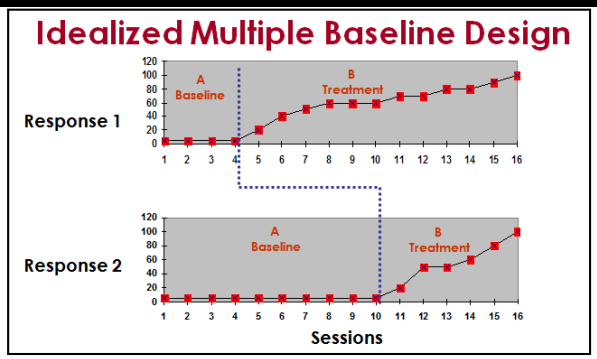
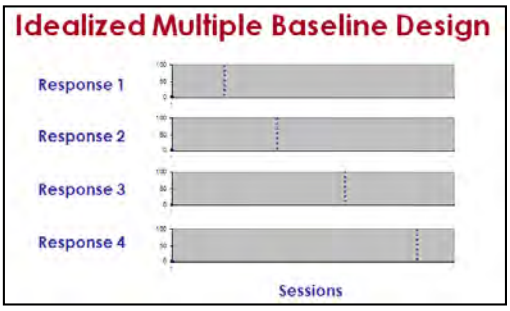
Experimental Designs that Can be Used to Demonstrate Practice-Based Evidence







Science vs. Pseudoscience in CSD: A Checklist for Skeptical Thinking

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There are many questionable alternative treatment approaches that are heavily marketed and promoted but have no evidence to support their use. Even experienced clinicians frequently resort to these fad or alternative treatments…in other words, they "get quacked" into using them. Quackery is a type of pseudoscience because it is a practice or remedy that has no compelling scientific basis; it includes questionable ideas, products and services. Clinicians may get quacked because they are not being appropriately skeptical or they do not have the tools to help distinguish between science and pseudoscience. Below is a checklist that can help clinicians evaluate claims made by promoters of products or services to help determine if they are based on scientific principles or on pseudoscience.

Healthy Debate About the Therapy	
The debates and discussions are About efficacy findings/data	The debates usually are not about data, but instead about beliefs and opinions
❒ **Science**	❒ **Pseudoscience**

Quantifiable Data are Used	
Data are quantitative, gathered following the scientific method	Data are qualitative, based on expert opinion
❒ **Science**	❒ **Pseudoscience**
Higher level studies tested the procedure	Data are testimonials and case studies
❒ **Science**	❒ **Pseudoscience**

Valid Data are Disseminated	
Information is presented at conferences that use peer-review and scientific standards	Information is presented at CEU events and other non peer-reviewed conferences
❒ **Science**	❒ **Pseudoscience**
Information and data are presented in reputable journals	Information appears in self-published books or in the popular press
❒ **Science**	❒ **Pseudoscience**
Information is found on trustworthy, professional websites	Information is on proprietary, self-developed websites
❒ **Science**	❒ **Pseudoscience**
Valid and reliable data are presented in prominent spots on the webpage	Websites reporting findings have a testimonial section for hearsay but no research section
❒ **Science**	❒ **Pseudoscience**

Information is Peer-Reviewed	
Anonymous (blinded), impartial refereeing of data/findings	No peer review or only quasi/pseudo peer review of the findings
❒ **Science**	❒ **Pseudoscience**

Independent Confirmation of Findings	
Independent because the researchers are not connected to the therapy	No independent confirmation by impartial reviewers
❒ **Science**	❒ **Pseudoscience**

Scientific Method is Followed	
Data obtained follow the scientific method to determine effectiveness	Use only clinician experience and judgments as the "best way" to determine effectiveness
❒ **Science**	❒ **Pseudoscience**
Data are gathered by professionals who are qualified to study clinical questions	Implicit disdain for researchers because of the belief that "only clinicians really understand clinical work"
❒ **Science**	❒ **Pseudoscience**

Results Have Theoretical Explanations	
Theoretical models explain why therapy works	Poorly defined theoretical models for explanation of why a procedure is effective
❒ **Science**	❒ **Pseudoscience**
Every link in the chain of explanation is connected	Gaps and missing information break the chain of plausibility
❒ **Science**	❒ **Pseudoscience**

Use of Historical Data	
Appropriate reporting of prior data relevant to the therapy	Claims of effectiveness because it has been done a long time in the field (e.g., "Van Riper said…")
❒ **Science**	❒ **Pseudoscience**
Correct referencing of historical researchers and their findings	Claims of effectiveness only because of extensive clinical experience of clinician
❒ **Science**	❒ **Pseudoscience**
Unbiased and honest reporting of the pros and cons of a procedure	Claims of effectiveness because of promoter's authority or charismatic nature
❒ **Science**	❒ **Pseudoscience**
Appropriate use of data and theories from multiple perspectives	Only use information from outside the field because "other fields know better"
❒ **Science**	❒ **Pseudoscience**

Results are "Too Good to be True"	
Findings are specific for when and with whom a procedure may work	Claims of effectiveness for a wide range of clients with unrelated problems
❒ **Science**	❒ **Pseudoscience**
Objective terms about effectiveness for specific populations are stated	Claims appeal to fears or wishful thinking about effectiveness or cure
❒ **Science**	❒ **Pseudoscience**
Well-defined target population	Treatment often focused on desperate clients (e.g., highly involved, severely impaired, difficult to teach, etc.)
❒ **Science**	❒ **Pseudoscience**
Non-subjective terms describe effectiveness	Use hyperbole such as: "results in minutes," "miracle cure," "problem solved"
❒ **Science**	❒ **Pseudoscience**

Both Misses and Hits are Counted	
Candid about when a procedure is and is not effective	Data ignored when a procedure does not work but referred to when it does work
❒ **Science**	❒ **Pseudoscience**
Disproving evidence is not ignored	Practice remains unchanged even with disproving evidence
❒ **Science**	❒ **Pseudoscience**

Terms and Concepts are Standard and Conventional	
Use of terms that are agreed upon by the scholarly community	New terms are created that are neither scientific nor conventional ("pseudoscientific jargon")
❒ **Science**	❒ **Pseudoscience**

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Common Flaws in Thinking

"Thinking Error" Flaw Type	Brief Definition	Example	Problem
Confirmation Bias	Selecting and conforming to evidence to maintain cherished beliefs.	*"I found a case study in an online-journal that supports me using this therapy, so I'm using evidence and am going to keep using the therapy."*	Purposely or implicitly ignores contradictory evidence and promotes positive evidence; disregards how personal investment influences perceived outcome; ignores placebo effect.
Appeal to Faith	Intervention effectiveness depends on belief that it works.	*"Facilitated communication cannot be empirically tested because skeptical examination compromises its effects."*	Requires acceptance of a claim in the absence of evidence; intervention is only effective when the person believes it will be.
Argument from Ignorance	Absence of evidence that an intervention doesn't work is deemed reason to believe it is effective.	*"There is no proof that this intervention won't work, so it's worth trying."*	Absence of data against an intervention is not a valid reason to believe it may or will be effective.
Anecdotal Evidence	Personal experience is treated as reason to believe a claim.	*"It worked for my student with ADHD. I've seen it work so it must work. So it should work for Tom."*	Anecdotes may or may not be true, but are never representative. Anecdotes are the lowest form of evidence and are extremely unreliable and can be dangerous.
Correlation Fallacy	Belief that because something occurred after an event, the event must have caused it.	*"My child got vaccinated and now he has autism. Therefore the vaccines must have caused his autism"*	Coincidences are common in a world filled with countless random and non-random events. Just because something followed an event doesn't mean the preceding event caused it.
Shifting the Burden of Proof	Requiring the skeptic to refute a claim that already lacks sufficient evidence.	*"Can you prove to me that this student won't benefit from sensor-integration treatments?"*	The claimant bears the burden of proof, but instead expects doubters to provide proof against his/her unsupported claim/position.
Appeal to Authority	Status of the claimant is used to support the claim.	*"Professor Poe who does a lot of presentations says this intervention works, so I should use it."*	Belief in the claim stems from the status of the person making it rather than from evidence.
False Authority	The purported expertise of the claimant is used to make or defend claims.	*"Only specially certified trainees can comment of the efficacy of Rapid Prompting Method; they are the only ones in-the-know.'*	Props up claims or deflects criticism by discounting arguments from individuals who do not have the dubious credential.
Argument to Moderation	Asserting the truth is somewhere between two claims despite the amount or quality of evidence.	*"Many people say some phonics is the best way to teach reading, but others argue for whole language. We should use a little bit of both."*	Position with less/no evidence and position with most/all evidence are treated as extremes; concludes truth reside between two polar positions when one is actually more likely to be true.
Ad Hominem	Attacking the claimant's character rather than the evidence for the claim.	*"The researcher is in his ivory tower and doesn't care about kids like I do. He cannot be trusted."*	Ignores the argument and evidence for the effectiveness of the intervention and instead focuses on attacking a person.

Adapted from: **Travers, J. (2016). Evaluating claims to avoid pseudoscientific and unproven practices in Special Education.** ***Intervention in School and Clinic.***

Logic, Theory, and Evidence Against the Use of Nonspeech Oral Motor Exercises (NSOME) to Change Speech Sound Productions in Children

Gregory L. Lof, PhD ,CCC-SLP, FASHA

Nonspeech Oral Motor Movements Defined

- NSOMs are motor acts performed by various parts of the speech musculature to accomplish specific movement or postural goals that are not sufficient in themselves to have phonetic identity (Kent, 2015).

Nonspeech Oral Motor Exercises (NSOME) Defined

- Any technique that does not require the child to produce a speech sound but is used to influence the development of speaking abilities (Lof & Watson, 2008).
- A collection of nonspeech methods and procedures that claim to influence tongue, lip, and jaw resting postures, increase strength, improve muscle tone, facilitate range of motion, and develop muscle control (Ruscello, 2008).
- Oral-motor exercises (OMEs) are nonspeech activities that involve sensory stimulation to or actions of the lips, jaw, tongue, soft palate, larynx, and respiratory muscles which are intended to influence the physiologic underpinnings of the oropharyngeal mechanism and thus improve its functions. They include active muscle exercise, muscle stretching, passive exercise, and sensory stimulation (McCauley, Strand, Lof, et al., 2009).

Do SLPs use NSOME? What Kind?

- 85% of SLPs in the USA use NSOME to change speech sound productions (Lof & Watson, 2008); 85% of Canadian SLPs use NSOME (Hodge et al., 2005); 79% in Kentucky (Cima et al., 2009); 81% in South Carolina (Lemmon et al., 2010); 46% in Minnesota (Louma & Collins, 2012); 91% in India (Thomas & Kaipa, 2015).
- **Most frequently used exercises** (in rank order): Blowing; Tongue push-ups; Pucker-smile; Tongue wags; Big smile; Tongue-to-nose-to-chin; Cheek puffing; Blowing kisses; Tongue curling.
- **Reported benefits** (in rank order): Tongue elevation; Awareness of articulators; Tongue strength; Lip strength; Lateral tongue movements; Jaw stabilization; Lip/tongue protrusion; Drooling control; VP competence; Sucking ability.
- **These exercises are used for children with** (in rank order): Dysarthria; Apraxia of speech (CAS); Structural anomalies; Down syndrome; Enrollment in early intervention; “Late talker” diagnosis; Phonological impairment; Hearing impairment; Functional misarticulations.

Logical Reasons to Question Using NSOME

- **Some logical questions about NSOME**★There is evidence that shows that NSOME do not work. Why is it being ignored? ★There is NO evidence that shows that NSOME do work. Why is this being ignored? ★Why are the materials and procedures used in NSOME not submitted for peer-review scrutiny? ★Why are the materials and procedures promoted only in self-published materials and on proprietary websites? ★Why do these websites have a section for “testimonials” but not for “research”? ★How could one procedure work to remediate so many disparate types of problems?★What are the monetary benefits to the promoters of NSOME?

Theoretical Reasons to Question Using NSOME #1: Part-Whole Training and Transfer

- **Basic questions:** ①Does training on a smaller portion of the articulatory gesture transfer over to the whole gesture? ②Is it more efficient and better for learning by first training just part of the movement and not the whole movement?
- Tasks that comprise highly organized or integrated movements (such as speaking) will not be enhanced by learning the constituent parts of the movement alone; training on just the parts of these well-organized behaviors can actually diminish learning. Highly organized tasks require learning the information processing demands, as well as learning time-sharing and other inter-component skills (Kleim & Jones, 2008; Wightman & Lintern, 1985).
- "*Fractionating a behavior that is composed of interrelated parts is not likely to provide relevant information for the appropriate development of neural substrates*" (Forrest, 2002).
- Some clinician-researchers believe that it can be more effective to "Train the Whole" (Ingram & Ingram, 2001) and to use "Whole-Word Phonology and Templates" (Velleman & Vihman, 2002*)* rather than breaking up the gesture into small parts.

Theoretical Reasons to Question Using NSOME #2: Strengthening the Articulatory Structures

- Basic questions**:** ① Is strength necessary for speaking? If so, how much? ② Are the articulators actually strengthened by using NSOME? ③ How do SLPs objectively document weakness of articulators and objectively document supposed increases in strength after NSOME? ④ Do children with speech sound disorders have weak articulators?
- **Articulatory strength needs are VERY low** for speech and the speaking strength needs do not come anywhere close to maximum strength abilities of the articulators. For example, lip muscle force for speaking is only about 10-20% of the maximal capabilities for lip force, and the jaw uses only about 11-15% of the available amount of force that can be produced (see also Bunton & Weismer, 1994).
- *"…only a fraction of maximum tongue force is used in speech production, and such strength tasks are not representative of the tongue's role during typical speaking. As a result, caution should be taken when directly associating tongue strength to speech…"* (Wenke et al., 2006).
- **Agility** and fine articulatory movements, rather than strong articulators, are required for the ballistic movements of speaking. NSOME encourage gross and exaggerated ranges of motion, not small, coordinated movements that are required for talking.
- **NSOME may not actually increase articulator strength**. To strengthen muscle, the exercise must be done with multiple repetitions, against resistance, until failure…and then done again and again. Most NSOME do not follow this basic strength training paradigm so there are probably no actual strength gains occurring due to these exercises.
- **Articulators can be strengthened** (e.g., the tongue for oral phase of swallowing or the VP complex) but these strengthened articulators will not help with the production of speech. Clark et al. (2009; 2013) and Robbins et al. (2005) have demonstrated ways to increase oral strength.
- **Measurements of strength are usually highly subjective** (e.g., feeling the force of the tongue pushing against a tongue depressor or against the cheek or just "observing" weakness), so clinicians cannot initially verify that strength is actually diminished and then they cannot report increased strength following NSOME.
- **Only objective measures** (e.g., tongue force transducers, Iowa Oral Performance Instrument [IOPI]) can corroborate statements of strength needs and improvement. Without such objective measurements, testimonials of articulator strength gains must be considered suspect.

- *"To assess tongue strength, clinicians commonly hold a tongue depressor beyond the lips and the patient pushes the tongue against the depressor. Strength is rated perceptually, often with a 3-5 point equal-appearing interval scale or with binary judgments of "normal" or "weak"* (Solomon & Monson, 2004).
- **Preschool children with speech sound disorders may actually have STRONGER tongues** than their typically developing peers (Sudbery et al., 2006).
- **Tone vs. Strength.** Muscle tone refers to the resilience or elasticity of the muscle at rest. "Low tone" indicates less contraction of the fibers than typical. Observing low tone does not automatically mean that the child has weakness. Working on strengthening probably will not influence tone (Clark, 2005; 2010).

Theoretical Reasons to Question Using NSOME #3: Relevancy of NSOME to Speech

- **Relevancy is the only way to get changes in the neural system**; the context in which a skill is learned is crucial. In order to obtain transfer from one skill to another, the learned skills must be relevant to the other skills.
- ***"…muscle fibers are selectively recruited to perform specific tasks**, so static non-speech tasks do not account for the precise and coordinated activity needed during speech"* (Hodge & Wellman, 1999).
- **For sensory motor stimulation to improve articulation**, the stimulation must be done with relevant behaviors, with a defined end goal, using integration of skills. "*The PURPOSE of a motor behavior has a profound influence on the manner in which the relevant neural topography is marshaled and controlled"* (Weismer, 2006).
- **Most NSOME dis-integrate the highly integrated task of speaking** (e.g., practicing tongue elevation to the alveolar ridge with the desire that this isolated task will improve production of the lingual-alveolar sound /s/). For example, a motor task (e.g., shooting a free throw using a basketball) must be learned in the context of the actual performance goal. By analogy, no one would teach a ballplayer to *pretend* to hold a ball and then *pretend* to throw it toward a non-existent hoop with the eventual hope of improving free throwing ability. Breaking down basketball shooting or the speaking task into smaller, unrelated chunks that are irrelevant to the actual performance is not effective.
- Another non-speaking example would be the illogical finger pounding on a tabletop to simulate playing on a piano. Learning and improving piano playing must be practiced on a piano, not on a tabletop. Likewise, learning and improving speaking ability must be practiced in the context of speaking. To improve speaking, children must practice speaking, rather than using tasks that only superficially appear to be like speaking.
- Because isolated movements of the tongue, lips and other articulators are not the actual gestures used for the production of any sounds in English, their value for improving production of speech sounds is doubtful. That is, no speech sound requires the tongue tip to be elevated toward the nose; no sound is produced by puffing out the cheeks; no sound is produced in the same way as blowing is produced. Oral movements that are irrelevant to speech movements will not be effective as speech therapy techniques.

Theoretical Reasons to Question Using NSOME #4: Task Specificity

- **The same structures used for speaking and other "mouth tasks"** (e.g., feeding, swallowing, sucking, breathing, etc.) function in different ways depending on the task and each task is mediated by different parts of the brain. The organization of movements within the nervous system is not the same for speech and nonspeech gestures. Although identical structures are used, these structures function differently for speech and for nonspeech activities.
- **Weismer (2006):** The control of motor behavior is task (speaking) specific, not effector (muscle or organ) specific. There is strong evidence against the "shared control" for speech and nonspeech. *"Motor control processes are tied to the unique goals, sources of information (e.g., feedback), and characteristics of varying motor acts, even when those share the same effectors and some neural tissue."*

- **Some examples of task specificity:** Babbling and early nonspeech oral behaviors are not related (e.g., Moore & Ruark, 1996); Patients can have dysphagia with and without speech problems (i.e., "double dissociations;" Ziegler, 2003); It is well documented that the VP mechanism can be strengthened, however, reduction of speech nasality does not occur (e.g., Kuehn & Moon, 1994); Breathing for speech is different than breathing at rest or during other activities (e.g., Moore, Caulfield, & Green, 2001). See Weismer (2006) for summary of 11 studies that show that speech and nonspeech are different for a wide variety of structures, including facial muscles, jaw motion, jaw operating space, jaw coordination, lingual movement, lip motions, levator veli palatini, and mandibular control.
- **Research has shown** that non-speech movements activate different parts of the brain than does speech movements (Bonilha et al., 2006; Ludlow et al., 2008; Schulz et al., 1999; Yee et al., 2007). This shows that the neural basis of motor control is different for speech and non-speech oral movements.
- **Bunton (2008) and Wilson, Green, Yunusova, and Moore (2008)** provide examples and concepts dealing with the importance of task specificity.
- **Clark (2005), Kent (2015), and Maas (2016)** provide reviews of the use of nonspeech movements and related concepts for oral motor disorders.

Theoretical Reasons to Question Using NSOME #5: Warm-Up/Awareness/Metamouth

- **Warm-up has a physiological purpose** during muscle exercise: to increase blood circulation so muscle viscosity drops, thus allowing for smoother and more elastic muscle contractions (Safran, Seaber, & Garrett, 1989).
- **Warm-up of muscles** may be appropriate (Pollock et al., 1998) when a person is about to initiate an exercise regimen that will maximally tax the system (e.g., distance running or weight training). However, muscle warm-up is not required for tasks that are below the maximum (e.g., walking or lifting a spoon-to-mouth). Because speaking does not require anywhere near the oral muscular maximum, warm-up is not necessary.
- If clinicians are not using the term warm-up to identify a physiological task to "wake up the mouth," then perhaps they believe that they are providing some form of "metamouth" knowledge about the articulators' movement and placement.
- **Awareness and its role in therapy** is always questioned. It is well known that young children have difficulty with various metaphonological awareness tasks (Kamhi & Catts, 2005). For articulation awareness, Klein, Lederer and Cortese (1991) reported that children age 5 and 6 years had very little consciousness of how speech sounds were made; 7 year olds were not very proficient with this either. According to Koegel, Koegel, and Ingham (1986), some children older than 7 years were successful during a metalinguistic speech intervention program, but only when they have the *"…cognitive maturity required to understand the concept of a sound…"*
- **It appears that young children cannot take advantage of the non-speech mouth cues** provided during NSOME that can be transferred to speaking tasks. More research is needed to determine the minimum cognitive, linguistic, and motor abilities of children that are necessary for such "meta" skills.

Childhood Apraxia of Speech (CAS) and NSOME

- **Children with CAS have adequate oral structure movements for nonspeech activities** but not for volitional speech (Caruso & Strand, 1999), so this would preclude the use of NSOME because non-speech is not the problem.
- **There is no muscle weakness for children with CAS**, so there is no need to do strengthening exercises. If there is weakness, then the correct diagnosis is dysarthria, not apraxia.
- *"The focus of intervention for the child diagnosed with CAS is on improving the planning, sequencing, and coordination of muscle movements for speech.* ***Isolated exercises designed to "strengthen" the oral***

muscles will not help. CAS is a disorder of speech coordination, not strength." (ASHA Technical Report on Childhood Apraxia of Speech, 2007).

Cleft Lip/Palate and NSOME

- The VP mechanism can be strengthened through exercise (many studies have demonstrated this since the 1960s), but added strength will not improve speech productions.
- *"Blowing exercises, sucking, swallowing, gagging, and cheek puffing have been suggested as useful in improving or strengthening velopharyngeal closure and speech. However, multi-view videofluoroscopy has shown that velopharyngeal movements of these nonspeech functions differ from velopharyngeal movements for speech in the same speaker. Improving velopharyngeal motion for these tasks does not result in improved resonance or speech. These procedures simply do not work and the premises and rationales behind them are scientifically unsound."* (Golding-Kushner, 2001).
- **Ruscello (2008)** evaluates the use of NSOME and craniofacial anomalies in his article.
- **Don't Blow This Therapy Session!** See Lof & Ruscello (2013)

NSOME for Non-Motor Speech Disorders?

- Some may believe that motor exercises can help children with motor production speech problems, such as functional misarticulators (phonetic/articulatory problems) or children with structural problems; however the evidence does not support this.
- **It makes no sense** that motor exercises could help improve the speech of children who have non-motor problems such as language/phonemic/phonological problems like children in Early Intervention diagnosed as late talkers.
- It is puzzling why clinicians would use a motor approach for non-motor speech disorders; therapy must target the system that is impacting the speech problem.

NSOME for Children with Dysarthria?

- **NSOME are frequently used for acquired dysarthria**, but their use is influenced by "folklore" and not by evidence of effectiveness (Mackenzie et al., 2010).Following guidance from adults with acquired dysarthria, *"…strengthening exercises are probably only appropriate for a small number of patients"* (Duffy, 2013).
- ***"…weakness is not directly related to intelligibility..."*** *for patients with ALS* (Duffy, 2013).
- Based on the adult acquired dysarthria literature, it appears that NSOME are not recommended as a technique that can improve speech productions.

Evidence Against the Use of NSOME

- **Evidence-Based Systematic Review: Effects of Nonspeech Oral Motor Exercises on Speech (McCauley, Strand, Lof, et al., 2009)**. Purpose was to conduct evidence-based systematic review on NSOME. Only 8 peer-reviewed articles met rigorous criteria for inclusion. "*Insufficient evidence to support or refute the used of OMEs to produce effects on speech was found…"*
- **There are a few studies evaluating the effectiveness of NSOME** that are not in peer-reviewed journals**;** most of these studies were reported at ASHA Conventions. Of the 11 studies available, 10 showed that NSOME were NOT effective as a treatment approach. See Lass and Pannbacker (2008) and Ruscello (2008) for a review of these and other studies. Many references to studies are listed in the reference list.

Evidence Against the Horn Hierarchy

- **Reasons to Question Using NSOME** in pressure or resistance from one horn to the next. There really is NO hierarchy in the Horn Hierarchy (Jones, Hardin-Jones & Brown, 2011; 2012).

Combining Treatment Approaches

- **Many SLPs use a combination of treatment approaches** so it is difficult to "tease apart" which approach is providing therapeutic benefit. Additionally, whenever intervention approaches are combined, it is unknown if and how they actually work in conjunction with each other to enhance performance.

- There is much evidence that the NSOME portion of combined treatments is irrelevant to speech improvements.
- NSOME probably do not harm the child when used in combination with traditional approaches (however, Hayes [2006] found that some children may be negatively affected by a combination approach).
- It seems reasonable that if there is no speech improvement using combined approaches, then clinicians should eliminate the approach that is not effective (i.e., NSOME) so as to not waste valuable therapy time with an ineffectual technique.

In Conclusion

- **Potential reasons why NSOME continue to be used (Lof, 2015):** ①The procedures can be followed in a step-by-step "cookbook" fashion; ② The exercises are tangible with the appearance that something therapeutic is being done; ③There is a lack of understanding the theoretical literature addressing the dissimilarities of speech-nonspeech movements; ④The techniques can be easily written out to produce; ⑤There are a wide variety of techniques and tools available for purchase that are attractively packaged; ⑥Many practicing clinicians do not read peer-reviewed articles but instead rely on unscientific writings; ⑦SLPs attend non-peer reviewed activities that encourage their use; ⑧Parents and therapists on multidisciplinary teams encourage using NSOME; ⑨Frequently, other clinicians persuade their colleagues to use these techniques.
- **If clinicians want speech to improve**, they must work on speech, and not on things that LOOK like they are working on speech.
- **Phonetic placement cues** that have been used in traditional speech therapy are NOT the same as NSOME.
- **NSOME are a procedure not a goal.** The goal of speech therapy is NOT to produce a tongue wag, to have strong articulators, to puff out the cheeks, to blow "harder" horns, etc. Rather, the goal is to produce intelligible speech.
- **We have been burned before**. Beginning in the 1990s many SLPs inappropriately embraced Facilitated Communication (FC) as a treatment approach because they thought they observed that it worked. Once it was tested using scientific methodology, it was found to not work. Pseudoscientific methodologies can persuade clinicians to provide the wrong treatment.
- **Following the guidelines of Evidence-Based Practice**, evidence needs to guide treatment decisions. Parents need to be informed that NSOME have not been shown to be effective and their use must be considered experimental.

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Parent-Friendly Information about Nonspeech Oral Motor Exercises

Poster presented at the 2011 ASHA Convention, San Diego, CA

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INTRODUCTION

Nonspeech oral motor exercises (NSOME) are techniques that do not involve speech production but are used to influence speaking abilities. These often include blowing bubbles and horns, tongue pushes/wags/curling, pucker/smile movements and other mouth gymnastics[18]. Although often used by many SLPs, the legitimate professional literature refutes the appropriateness of NSOME for intervention to change speech sound productions[18, 24].

Parents may request NSOME be used because:[15] •Their child's previous SLP used NSOME, •NSOME objectives may already be on the child's IEP, •They have read testimonial information on the internet encouraging NSOME, •There is a proliferation of attractively packaged NSOME products available for purchase, •Other professionals (e.g., OT, PT) recommend their use, •These exercises provide something concrete for parents to do with their children under the guise of "therapy."

PARENTS COMMENTS/QUESTIONS	POSSIBLE RESPONSE
The SLP has my child practicing sticking her tongue in and out and side-to-side before working on speech. Is this a good idea?	These nonspeech movements will not help with speech because the parts of the brain that control movements for speech are different from the parts that control nonspeech movements. It's a brain thing! [3, 6, 10, 25, 27]
My child has a repaired cleft lip/palate. To me it makes sense that blowing must be a good way to get his speech to not come out his nose.	For over 50 years it has been proven that blowing exercises will not prevent speech from coming out the nose. It is surprising that this technique is still being used! [7, 22]
The SLP working with my child says that exercises "warm up" their mouths. What's wrong with that?	Because limited strength is needed to speak, warm-up is not necessary. While a few simple mouth movements may provide some focus on the mouth area, they should only be a very minor part of therapy. [5, 24]
I have been told that many kids are diagnosed with Childhood Apraxia of Speech. Aren't these kinds of exercises necessary to help their speech improve?	Children with CAS need therapy devoted to making speech, not movements that barely mimic speech (because of how the brain organizes information). Children with CAS have "Apraxia of Speech" so speech is what needs to be worked on, not nonspeech tasks. [1, 16]
On the internet, I've read information provided by experts who say these exercises work and are necessary to help children learn to speak. It is all over the web, so it must be legitimate.	You must use caution about believing information found on websites. Research shows that a technique works, not opinions, testimonials, and "expert" advice. While these statements may be interesting, they do not prove that the exercises work. Special care should be taken if you are encouraged to buy a product. [17]
The last SLP my child had said oral motor exercises will help develop necessary speech awareness. Don't children need to become aware of their mouth movements in order to improve speech?	Research has shown that young children have little awareness of mouth movements. Children need to learn how different mouth movements affect speech, not mouth movements that are not speech. [13, 14]
My child can move his tongue up and down quickly, so why can't he make "tongue tip" sounds such as "l" or "t"?	The tongue can make many different kinds of movements; however, tongue movements for speech are controlled by a different part of the brain than movements that don't Involve speech. [2, 3, 26]

Won't working on chewing and swallowing help my child speak better? Doesn't she need to become good at these nonspeech movements before we can work on actually making her talk?	Chewing and swallowing are unrelated to speaking. Even though the tongue, lips and other parts of the mouth are used for speech and nonspeech movements, nonspeech movements do not influence how she talks. [8, 9, 20 ,21]
PTs and OTs often use exercises to improve motor skills. Isn't speech also a motor skill?	Yes, but speech is much more than just a motor skill becasue it involves communication. Speech is different from other motor tasks. Speech is special because it involves language. Speech motor tasks are organized in the brain in a unique way. [11, 12]
It was recommended that my child receive muscle-based therapy because he has "low muscle tone". So that must mean his muscles are weak.	Muscle tone and muscle strength are different. Tone refers to the elasticity of muscles at rest. Just because your child has low muscle tone does not necessarily mean that he has weak muscles. Working on strengthening will not have an effect on tone. [3]
My child has something called a "phonological" problem. Why not mouth exercises for this?	Phonological issues are a problem with the language aspects of talking and do not involve simple mouth movements. Your child needs to learn the "rules" of speech/language, and these rules are not learned by mouth movements. Therapy must be done in meaningful communication contexts. [18, 19, 24]
We have fun doing these exercises at home. What can it hurt to do them?	Although these exercises probably won't harm your child, focused talking time is too valuable to be wasted. Work at home should be based on practicing valuable skills that will improve speaking. [18, 19, 24]
According to the occupational therapist, my child has speech problems because her mouth is not strong enough. So isn't strengthening the mouth important?	Very little strength is needed to produce speech; agility and coordination are needed, but little strength. Also, it is surprisingly difficult to accurately determine strength. Therefore, any statements about weakness are questionable. [4, 23]
My child is blowing horns in therapy and has progressed from one horn to the next. That is progress, right?	It is progress in horn blowing but not in speech. Blowing and speaking are completely different from each other and doing one well will not have an impact on the other. [25, 26]

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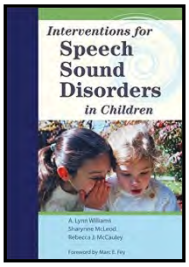
What Intervention Works for Children's Speech Sound Disorders

Book Recommendations



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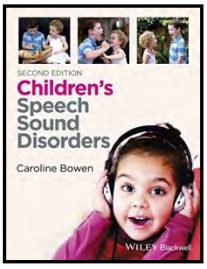

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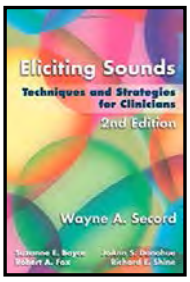

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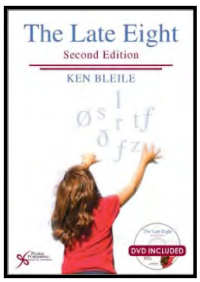

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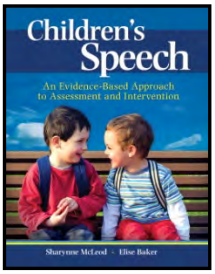

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Website Recommendations

ASHA Practice Portals and Evidence Maps: http://www.asha.org/practice-portal/

Bowen, Caroline: www.speech-language-thearapy.com

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Article Recommendations

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