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Tools for Skeptical Thinking: Evaluating Science and Pseudoscience

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

Moderated by:
Amy Natho, MS, CCC-SLP, CEU Administrator, SpeechPathology.com

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Tools for Skeptical Thinking:
Evaluating Science and Pseudoscience

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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 curmudg-eons 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.
- **Common Flaws in Thinking** (Travers, 2016)**:** (1) Confirmation Bias; (2) Appeal to Faith; (3) Argument from Ignorance; (4) Anecdotal Evidence; (5) Correlation Fallacy (6) Shifting the Burden of Proof; (7) Appeal to Authority; (8) False Authority; (9) Argument to Moderation; (10) Ad Hominem. See page 9 of this handout.
- Also see the Mental Floss Website for 20 cognitive biases that affect decision making.

5 Ways to Avoid Being Quacked

1. Quackery seldom looks outlandish.
2. Be skeptical of anecdotes and testimonials: Testimonials are not science.
3. Be wary of pseudoscientific jargon: Make sure that the uses of terms are following accepted standards.
4. Be skeptical of claims of effectiveness for a wide range of unrelated problems: There is no such thing as a "cure-all."
5. 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.
- **See "Science vs. Pseudoscience in CSD: A Checklist for Skeptical Thinking" on pages 7-8**

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.

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- **Anna Stubblefield Case:** http://www.nytimes.com/2015/10/25/magazine/the-strange-case-of-anna-stubblefield.html
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- **IES What Works Clearinghouse:** http://ies.ed.gov/ncee/wwc
- **Informed Speech-Language Pathologist:** https://www.theinformedslpmembers.com
- **Lof Science/Pseudoscience Checklist:** http://www.smartspeechtherapy.com/wp-content/uploads/2015/07/LOF-Science-v-Pseudo-ASHA12.pdf
- **Mental Floss:** http://mentalfloss.com/article/68705/20-cognitive-biases-affect-your-decisions
- **MUSEC Briefings:** Go to Google and type in "MUSEC Briefings"
- **Quackwatch:** www.quackwatch.org
- **Skeptics:** www.skeptic.com
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Science vs. Pseudoscience in CSD: A Checklist for Skeptical Thinking

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A poster presentation at the
2012 ASHA Convention, Atlanta Georgia

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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Disclosure Statement

The author has no relevant financial or nonfinancial relationships in the products or services described, reviewed, evaluated or compared in the presentation.

Common Flaws in Thinking

"Thinking Error" Flaw Type	Brief Definition	Example	Problem
Confirmation Bias	Selecting and conforming 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.***