Chapter 9
Fad, Pseudoscientific, and Controversial Interventions

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Introduction

Special education and related professions are noteworthy for attracting and accepting unsubstantiated interventions (Metz, Mulick, & Butter, 2016). Professionals, families, and other stakeholders affected by ASD have especially been duped into believing in faddish "cures" and unconventional treatment methods. This problem historically has obstructed the progression of understanding and reliable application of effective methods for learners with ASD. The tendency toward unproven and disproven treatments has had harmful, dangerous, and sometimes fatal outcomes. The nefarious legacy and recent resurgence of facilitated communication (FC) perhaps best exemplifies how pseudoscience impinges on special education practice. Alternatively, scientific values and methodology are useful for preventing the spread of worthless and harmful interventions and establishing a repository of interventions supported by verifiable explanations. This special education scientific movement reflects intentions to positively influence how professionals support and educate learners with ASD. In many respects this important prophylactic role parallels the Hippocratic Oath: "First do no harm."

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However, advancing scientific methods, values, and thought has proven insufficient for preventing the proliferation of nonsense within the ASD community. Vyse (2005) explained that simply pointing out fad, disproven, and unproven interventions does not prevent them from spreading. In contrast developing and improving consumer's ability to evaluate interventions is indispensable. We wholeheartedly agree. Although this textbook provides clarity about intervention models most likely to be effective, mere identification will not ensure implementation nor sufficiently deter adoption of fad, pseudoscientific, and controversial interventions. Similarly, providing a list of historical and contemporary examples of fads and pseudoscientific interventions in ASD also is insufficient; such interventions evolve with astounding speed and are easily repackaged. Rather, understanding fundamental scientific principles and rules of argumentation presented alongside characteristics of pseudoscience will best ensure prudent and objective evaluation of educational interventions in ASD.

The intervention models described in previous chapters were derived from scientific investigation. Each represents the accumulation of knowledge acquired during decades of meticulous work. This chapter is in response to the ongoing need to understand why people affected by ASD continue toward unsupported, refuted, or sometimes bizarre treatments. The aim of this chapter is to support professionals and other stakeholders to avoid fad, controversial, and pseudoscientific interventions in ASD by outlaying the tools of science and pseudoscience in ways that support critical analysis of claims about interventions for learners with ASD. Specific attention is dedicated to contrasting science with pseudoscience as well as some related psychological phenomenon and errors in thinking that stimulate irrational thought and behavior. Various historical and contemporary examples also are reviewed to illustrate the characteristics, dangers, and persistence of fads and pseudoscience in ASD. Implications for professionals and families also are discussed.

The Rise in Popularity of Fad, Pseudoscientific, and Controversial Treatment

Much attention and has been dedicated to investigating fad and controversial treatments in ASD. Journal articles (e.g., Mudford et al., 2000; Simpson & Myles, 1995; Todd, 2012; Tostanoski, Lang, Raulston, Carnett, & Davis, 2014; Travers, Tincani, & Lang, 2014) textbooks (e.g., Foxx & Mulick, 2016), and popular print (e.g., Offit, 2010) have dealt with a variety of unsubstantiated claims regarding various treatments. Despite advances in understanding ASD etiology, early identification, and treatment, many unfounded beliefs and pseudoscientific interventions continue to proliferate. The intervention models outlined in this book represent those that have objectively produced desired improvements. These hard-won advancements in knowledge are products of science and represent the state of the art in early intensive behavior intervention (EIBI). Despite these developments, unsubstantiated or inaccurate information about the causes of characteristics of ASD may lead

unsuspecting or uniformed parents to adopt treatments and interventions that are fads, unproven, disproven, and potentially harmful. Several basic factors can be used to explain this problem.

Children with ASD experience an array of challenges effecting social, communicative, and behavioral development. The extent that these areas of development are impaired varies considerably and their causes remain only partially understood. Nevertheless, many children are severely impacted by their ASD and other legitimate comorbid conditions. The resultant turmoil and anguish experienced by parents, family members, and/or other individuals who care about the person with the ASD diagnosis, as well as feelings of love, devotion, and protection undoubtedly serve as motivation for seeking out interventions and treatments that purportedly improve functioning (Metz et al., 2016). Fear of regret for omitting potentially helpful treatments also may play a role in adopting unproven or disproven ASD treatments. Such emotions may compromise rational thinking and lead even highly educated parents to seek interventions that promise small but supposedly important gains (e.g., sensory integration training; SIT) to miraculous breakthroughs (e.g., FC) and warnings of deterioration in functioning if an unsupported method is abandoned (e.g., special diets).

The baffling contradiction of savant-like qualities of a few people with severe ASD, as well as the relatively more common splinter skills among others, also may contribute to adoption of unsupported interventions. This may be because assumptions of hidden potential are inferred based on idiosyncratic splinter skills. For example, children with ASD are characterized as having extensive support needs that are sometimes accompanied by precocious reading ability or advanced visual-spatial skills. Similarly, some parents have reported their children developed normally and suddenly lost communication and social skills, although insufficient evidence of regressive ASD substantiates this claim (Hansen et al., 2008). In rare cases, people with ASD also have savant skills in music (e.g., recite symphonies), mathematical computation (e.g., calendar calculation), artistic ability (e.g., drawing, painting), and/or other areas (Howlin, Goode, Hutton, & Rutter, 2009). Despite the rarity of savant skills, popular media often portray people with ASD as regularly fitting this stereotype. The apparent incongruence between ability and disability is perplexing, even among experts, and may contribute to unfounded beliefs that a person with ASD has normal or superior intellectual functioning, but somehow is trapped in an "autistic world" or an unresponsive body (Stubblefield, 2011). These phenomena may generate an aura of mysticism about ASD etiology that contributes to adoption of related unfounded treatments.

The prevalence of ASD has dramatically increased since 1990 (CDC 2007, 2009; Fombonne, 2007; Yeargin-Allsopp, Rice, Karapurkar, Doernberg, Boyle, & Murphy, 2003). During these decades, fears of an ASD epidemic became increasingly widespread (Fombonne, 2001). The estimated epidemiological prevalence at the time this chapter was written was 1 in 68 (CDC, 2014). Fears of an "ASD epidemic" remain endemic (Lilienfeld & Arkowitz, 2007). Despite increased prevalence, popular belief of an ASD epidemic appears to be inconsistent with the evidence (Gernsbacher, Dawson, & Goldsmith, 2005). The increase has been largely (but not entirely)

attributed to (1) broadening of the diagnostic criteria for ASD, (2) addition of ASD as a special education eligibility category in the Individuals with Disabilities Education Act of 1990 and its subsequent reauthorizations, (3) increased awareness of and monitoring for ASD, and (4) improved assessment and identification methods (Fombonne, 2009; Presmanes, Zuckerman, & Fombonne, 2014). Nevertheless, the apparently sudden and dramatic increase is often national news and has contributed to widespread concerns that vaccines might play a role. This belief is tied to a single retracted paper that appears to have been financially motivated (Offit, 2010). The resulting irrational behavior stemming from this scam includes anti-vaccine rhetoric and likely has contributed to the adoption of duplicitous treatments with limited or no efficacy for treating ASD symptomology.

The limited availability of and costs associated with effective interventions also may send parents to search for alternative (i.e., unproven) interventions (Metz et al., 2016; Tuzikow & Holburn, 2011). While ASD prevalence increased, more Americans gained access to the Internet and information about various fads and alternative treatments became readily available. Some of these alternatives are more affordable, at least in the short term, and easier to administer (e.g., megavitamins) than established methods (e.g., Discrete Trial Training). Some interventions trended in popularity, quickly gaining and losing attention (e.g., secretin therapy); but others have endured (e.g., SIT; FC). Parents who were unable to access proven interventions (e.g., rural families; impoverished families) or simply could not afford them might have turned instead to more accessible but unproven interventions.

The perceived mystery of ASD coupled with the fears of an ASD epidemic and the limited availability of intervention services represented ideal conditions for quacks, confidence men, and crackpots. When infrastructure for online commerce gained consumer confidence, misleading information could be easily disseminated to create an exploitative industry of massive size and scope. False causes were manufactured in lockstep with "miraculous" and "breakthrough" treatments designed to address those causes. Today we witness an array of unsubstantiated claims connected to unproven (and often unregulated) treatments on the Internet, some of which are described later in this chapter. Professionals and parents likely have been exposed to, tempted by, or duped by some of these alternatives. Few are immune to such exploitation.

Characteristics of Fad, Pseudoscientific, and Controversial Interventions

Fad, controversial, and pseudoscientific interventions are terms used to describe distinctively different phenomenon, but each is intended to achieve niche or broad acceptance. The Oxford dictionary defines fad as "an intense and widely shared enthusiasm for something, especially one that is short-lived; a craze; an arbitrary like or dislike." Fads can be beneficial, benign, or harmful as well as expensive or affordable. Fads in diet and fitness may be beneficial if they increase the health of

participants, but harmful if they distract from more effective approaches. Fads in special education are almost always costly and harmful. Education fads rarely confer benefit and waste time, opportunities to learn, effort, and money while sapping optimism for and attainment of better outcomes (Kozloff, 2005). Yet fads are disturbingly common in education. Mostert (2000) explained how the bandwagon effect contributes to fads by attaining a self-perpetuating status that frequently depends on simple but divisive ideology and proselytizing. The field has encountered numerous fads that rapidly gain and lose popularity, but some fads are maintained and become malignant problems that obstruct progress (Kozloff, 2005). In this way, education fads can become controversial practices, usually through the pseudoscientific mechanisms, and be sustained via educational practice and acceptance. This illustrates the power of the bandwagon effect.

> Bandwagons provide a communal sense of purpose, an energizing camaraderie, and a collective voice whose power exceeds its importance. Bandwagons are used to champion a cause, engage in sweeping yet attractive rhetoric, and generally promise far more than they ever have hope of delivering while simultaneously downplaying or ignoring the negative aspects of their edicts (Mostert, 2000, p. 124).

Ideas can be controversial for a variety of reasons. In some cases, controversy refers to differences of opinion. In other circumstances, controversy might refer to an ethical argument that conflicts with evidence. For example, there exists substantial evidence supporting the effectiveness of aversive interventions for modifying extremely dangerous self-injury (e.g., eye-gouging), but many behavior analysts may disagree with the practice. Putting those issues aside, our purpose is to focus on controversial interventions used despite evidence of their effectiveness (Metz et al., 2016; Silver, 1995). Controversial interventions might cause confusion because the available evidence of treatment effects is contradictory or because no confirming or refuting evidence is available. This confusion partly stems from a credulous disposition of accepting a claim as true or withholding doubts until a claim is disproven (or belief becomes untenable) and the misperception that evidence is a synonym for absolute proof. Importantly, evidence exists on a continuum and correlates with degrees of confidence about the validity of claim. Strong evidence typically is represented by multiple methodologically sound studies that result in similar outcomes. Confidence in the claim increases with the quantity and quality of empirical evidence supportive of (or refuting) the claim. A body of high-quality evidence leads to scientific consensus, but is never considered an indication of absolute certainty (i.e., proof); there are no absolutes in science. Chance, poor research design, or confounding factors may produce findings that contradict a larger body of evidence, but do not warrant dismissal of the prevailing evidence.

When the preponderance of evidence supports a claim, that claim is treated as more likely accurate than an alternative explanation supported by a small body of conflicting evidence. Importantly, contradictory minority findings typically are not sufficiently meritorious to justify rejection of scientific consensus. Thus, controversial treatments can be explained in two ways. First, an intervention used in the absence of sufficient supporting evidence is controversial when being used outside carefully controlled and protective boundaries of scientific experimentation. Second, controversial

treatments also are those used in spite of scientific consensus. Proponents of controversial treatments often point to flawed research to support their position, especially when it conflicts with consensus. They also argue that controversy is "proof that it works for some people" and therefore "worth trying for yourself." This logic, in turn, gives way to other claims of conspiracy to suppress alternatives, accusations of "close-mindedness", and shifting the burden of proof from the claimant to the skeptic. Such fallacious reasoning colludes with credulity to convey a sense that "controversial" is a permissive rather than prohibitive label.

Pseudoscience obviates the corrective mechanisms of the scientific method in that it relies on seeking confirmation of an already accepted conclusion. When evidence refuting the claim is obtained, belief often is maintained by altering the explanation for the phenomenon; evidence against is distorted as questionable or favorable evidence (e.g., ad-hoc hypotheses; moving the goalpost fallacy). Society is rife with pseudoscience because it often is difficult to distinguish from authentic science and thrives where there exists little cultivation of analytic behavior. Consequently, pseudoscientific beliefs like astrology, homeopathy, anti-vaccination, SIT, megavitamins, intelligent design, dowsing, ghost hunting, 9–11 truthers, and so on are well-subscribed. We return later to pseudoscience to contrast it with science, but suffice to say that many popular beliefs, therapies, and treatments exist wholly on pseudoscientific ground because (1) they are deceptively cloaked as science and (2) many individuals do not, cannot, and probably should not be expected to evaluate all claims to ascertain validity.

Science, Anti-Science, and Pseudoscience

According to Merriam-Webster, science is defined as "knowledge about or study of the natural world based on facts learned through experiments and observation; a particular area of scientific study (such as biology, physics, or chemistry); a particular branch of science; a subject that is formally studied in a college, university, etc." The Oxford dictionary defines science as action by stating it is "the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment." Generally, science and scientific behavior entails the accumulation of facts via deployment of experimental methods to examine the natural order of our environment. From a behavior analytic perspective, science is comprised of a repertoire of complex behavior reinforced by discovering facts about natural phenomenon.

Science is more than the application of a method. Ultimately, science is a set of attitudes that emphasizes a disposition toward facts rather than arbitrary respect for authority, acceptance of evidence even when it conflict with desires, and suspension of belief or advocacy for a position until sufficient evidence is available (Skinner, 1957). Accordingly, a scientific attitude is conservative in that it minimizes assumptions and instead emphasizes evidence. Science also values testability (i.e., falsifiability), reliability, accuracy, replication, and precision. By definition

and design, the scientific process is geared to facilitate knowledge advancement, positive systems change, and innovation through a systematic and controlled course of action. Logical theories, models, and hypothetical constructs lead to cogent predictions and hypotheses. In turn, ensuing postulations are subjected to measured, organized, and systematic evaluation. Ultimately, empirical investigations in ASD serve as the foundation for knowledge of effective practice. Relative to expediting a conceptual and practical understanding of ASD and pointing the way toward maximally effective and efficient interventions, science ensures conceptual models and theoretical explanations are linked to objective and empirical evaluations of purported interventions. This process stands in sharp contrast to indiscriminate and credulous acceptance of unproven interventions derived from vague and/or peculiar suppositions derived from unsubstantiated anecdotes as the primary or exclusive kind of evidence.

Scientific thinking and methodology are needed to evaluate, refine and bring to fruition beneficial and utilitarian innovations. It is an irrefutable fact that a number of current promising interventions originated as classroom practices that had limited theoretical and empirical support. Because of the heterogeneity of ASD symptomology, practitioners are often required to calibrate interventions to best fit the characteristics of the students in their care. This calibration lends itself to extension, creativity, and innovation. Practitioners who work daily with learners with ASD have developed a host of interventions that we know little about (i.e., consequence maps, social scripting, power cards, cartooning, and so on). These interventions and others like them represent the very essence of what teachers of students with ASD should strive to be: Persistent, imaginative, and dynamic. Indeed special education is replete with examples of interventions for learners with ASD initially devoid of scientific support, but rooted in sound theory (e.g. behavior analysis) and widely used. Some of these methods were later found to have varying degrees of efficacy and utility (Lang, Koegel, et al. 2010; Lang, O'Reilly, et al. 2010).

Social narratives (Bledsoe, Smith, & Simpson, 2003; Crozier & Tincani, 2005; Ganz, Kaylor, Bourgeois, & Hadden, 2008; Kokina & Kern, 2010) and visual schedules (Duttlinger, Ayres, Bevill-Davis, & Douglas, 2013; Cihak, Wright, & Ayres, 2010; Waters, Lerman, & Hovanetz, 2009) are examples of current promising methods. The genesis of both of these interventions was in classrooms for students with ASD and both examples involved wide-scale adaptation of the methods by classroom professionals, independent of and prior to empirical validation via scientific scrutiny. Conversely, and on a far less positive note, myriad examples of intervention methods used by educators have been found to be ineffective and/or detrimental to learners with ASD. The thoroughly discredited FC method was widely used and adopted prior to scientific scrutiny that quickly revealed its destructive and disreputable nature (Palfreman, 1993; Wheeler, Jacobson, Paglieri, & Schwartz, 1993). Such problems highlight the important role of the scientific process as the most effective mechanism for identifying and vetting information about untested methods prior to dissemination. This vetting serves as an objective way of advancing potentially positive methods through a systematic process that enables professionals and other stakeholders to maximize attainment of desirable outcomes.

With only about 40 years of painstaking research, the field remains in early stages of intervention development. Some discoveries have been made and are outlined in previous chapters, but these are hardly satisfactory stopping points for self-congratulation. There remain numerous questions to be answered and our ignorance about various phenomena related to ASD vastly exceeds our collective knowledge. Accordingly, it would be foolish to not pursue refinements of existing repositories or pursue novel methods that enhance our understanding of how best to support persons with ASD. It is equally imprudent, however, to capriciously and impulsively pursue matters related to ASD according to whimsical, unsupported, and unreasoned assumptions and groundless claims. Such pursuits distract from promising research of legitimate interventions. Fad and pseudoscientific interventions claim to be the product of innovative, cutting edge research and discovery in response to (or defiance of) authentic progress portrayed as too slow, deliberate, methodical, and conservative. Yet this is precisely what pseudoscience does; stymies innovation by misdirecting intellectual, financial, and human capital from legitimate and promising investment to the pockets of ideologues and charlatans (e.g., Nancy Lurie Marks Foundation, John P. Hussman Foundation). This protective attitude is, ironically, distorted to persuade consumers that researchers are elitist, self-serving, protective, and conspiratorial.

Scientific illiteracy manifests in myriad ways ranging from superstition to gullibility and outright rejection of evidence (e.g., science denial). Scientific illiteracy is the absence of the basic understanding of the methods and philosophy of science (i.e., rationalism). Scientific illiteracy is perhaps more common, but science denial has become more popular among well- and less-educated individuals alike (Funk & Rainie, 2015). Although science is the best method ever devised for understanding the way the universe works, it remains an imperfect process. There can be no absolute certainties in science. Conclusions are always tentative and subject to scrutiny or disposal when new evidence becomes available. Accepted explanations are accompanied by caveats and differing degrees of confidence. The limitations of the scientific method are often misunderstood and misrepresented as reasons to dismiss scientific evidence, theory, and expertise. Criticism is a fundamental to the scientific method, but healthy criticism is starkly different from anti-science (Schiebinger, 2001). Wholesale rejection of science (Gross & Leavitt, 1997; Kavale & Mostert, 2003; Kozloff, 2005; Sasso, 2001) relies on poorly informed individuals who often confuse free speech with a right to be heard and respected. Treating all ideas with equal respect is intellectually dishonest and a dangerous proposition.

Scientists in fields related to ASD should be unapologetic critics of fads, hyperbolic claims, and treatment whims, but also equally strong advocates for responsible innovation. We argue for a reasoned course of action. First, rely on evidence-based interventions while simultaneously pursuing novel, rational, and plausible explanations along with innovative methods derived from prevailing theories of learning (i.e., operant, respondent, and observational). Second, include content in professional and parent training to aid the establishment of skills for evaluating claims for scientific (or pseudoscientific) merit. Discovery and validation of interventions via the scientific method will expedite productive research and development outcomes that,

in turn, translate to improvements in the lives of the children with ASD and their families. This advancement is unlikely without consumers who readily recognize the ploys associated with pseudoscience.

Pseudoscience

Pseudoscientific interventions are those that do not adhere to scientific standards, but attempt to cloak themselves in the fabric of science. This deceptive tactic makes establishment of a clear demarcation between science and pseudoscience difficult. Indeed, "science probably differs from pseudoscience in degree rather than kind" (Lillienfeld, Lynn, & Lohr, 2003, p. 5). However, there exist clear indicators of pseudoscience that enhance differentiating between plausible and fantastic claims. Whereas science pursues knowledge by accumulating facts via observations to inform development of beliefs, pseudoscience *begins with a conclusion* rather than a hypothesis and seeks ways to confirm the suspicion rather than test it. In other words, whereas scientific thought requires suspension of belief until sufficient evidence is available, pseudoscience begins with unsupported conclusions followed by biased selection of information that conforms to preconceived belief. Science recognizes the potential impact of bias and has designed systems to limit human tendencies to confirm inaccurate but personally favorable or cherished beliefs. Pseudoscience relies on a preconceived agenda and pursues supportive findings while simultaneously (and often subconsciously) dismissing negating results. Lack of controls for the influential effects of this confirmation bias is a hallmark of pseudoscience.

Pseudoscience typically is associated with grandiose claims that are uncoupled from evidence. It also is dogmatic in the face of new and conflicting evidence. Arguments in support of pseudoscientific interventions appear rooted in scientific evidence or theory and thereby convey a sense of legitimacy. For example, learners with ASD often engage in repetitive behavior and sometimes those behaviors serve the purpose of self-stimulation. Sensory integration has attached itself to this phenomenon to give credence to "mentalistic" and unverified suppositions of causes of and treatments for stereotyped (and other) behaviors. When studies fail to find predicted effects, or when studies reporting positive findings do not meet minimal quality standards for methodological rigor, proponents rely on selective evidence and retreat to dogmatic and fallacious reasoning ("I've seen it for myself. It worked for my son."). Indeed, pseudoscience relies on testimonial rather than empirical data to advance the claim and protect belief. Inspirational anecdotes usually are provided to support extravagant claims of major breakthroughs (i.e., appeals to emotion) or quell criticism. In this way, it becomes clear how such thinking and behavior contributes to the proliferation of pseudoscience in ASD. Drawing conclusions without evidence about an intervention, defending those conclusions, and delivering interventions according to those beliefs beyond experimental conditions is potentially harmful.

A related defensive tactic of pseudoscientists is to demand that all ideas be treated as equally valid and deserving of respect. In this way, criticism of ideas is

taken as an offensive attack on the person rather than their espoused beliefs. People may confuse their right to an opinion with a right to have their opinion heard and respected, perhaps because personal beliefs often are deeply intertwined with personal identity. This is especially common among uninformed or misinformed individuals who receive criticism from well-informed others. Indeed, "Anti-intellectualism has been a constant thread winding its way through our political and cultural life, nurtured by the false notion that democracy means that '*my ignorance is just as good as your knowledge*'" (Asimov, 1980, p. 19, italics in original). The posturing by purveyors of pseudoscience is conducive to ad-hominem attacks in defense of their wares. In a society that increasingly and rightly values cultural, ethnic, and linguistic diversity, a progressive attitude may sometimes lead to overly cautious treatment of bad ideas for fear of giving offense or being labeled a bigot. When questions or doubt arise, the skeptic is considered "close-minded." This political correctness run amok combined with attacks to suppress criticism promotes undue caution, thereby legitimizing unfounded beliefs and behavior. We should not confuse value for respecting people with respect for their ideas, especially when the ideas directly impact the lives of others.

Pseudoscience differs from science in that it often relies on ostentatious claims unsubstantiated by evidence. Claims of "miraculous", "amazing", and "breakthrough" treatments constitute red flags for pseudoscience. Pseudoscience makes claims of "proof" obtained from anecdotal and testimonial endorsement. Statements from actual or purported consumers who claim the treatment was effective are presented as evidence of the positive effects of a particular treatment. Conversely, science requires careful interpretation of findings in light of experimental limitations that, in turn, lead to conservative interpretation and tentative claims. To be clear, scientists should never claim to be absolutely certain of anything; caveats and hedges abound in accordance with available evidence. Science usually results in incremental change and revolutionary evidence is exceptionally rare. Credence is not granted to testimonial evidence because its susceptibility to a broad array of mistaken conclusions and errors in thinking. Thus, consumers should recognize that extraordinary claims should be carefully scrutinized both in terms of the reliability of the source and the ways the claim is being disseminated. Consumers should take pause when grandiose or seemingly legitimate claims derived from testimonials are promoted by popular media without peer review for publication in reputable scientific journals.

Peer review is a pillar of science because it provides a mechanism for filtering erroneous findings to provide increasing clarity about phenomena under investigation. Scientists engage in criticism of peer ideas and evidence while actively seeking criticism of their own. This community of scholarship serves as a mechanism for maintaining quality during the imperfect scientific process. Accordingly, scientists recognize that it is better to prove yourself wrong than be proven wrong by others. Conversely, pseudoscientists avoid peer review or, when their methods do not meet basic quality indicators of empirical research, claim conspiracy and seek alternative ways to disseminate their flawed findings (Lillienfeld et al., 2003). Pseudoscientists advance agendas that conflict with finding truth, though they may claim and genuinely believe to be seeking it. Quacks and con artists make no attempt (or are unable)

Table 9.1 Contrasted characteristics of science and pseudoscience

Science	Pseudoscience
Discovers evidence and uses it to inform belief; relies on entire body of evidence.	Forms belief and selects evidence to confirm; disqualifies or rejects disconfirming evidence.
Conservative claims that are tentative and based on evidence; changes in conjunction with evidence.	Grandiose claims uncoupled from evidence; dogmatic and unchanging when provided new/conflicting evidence.
Precise and measurable terminology conducive to understanding and replication.	Convoluted explanations with jargon to elude criticism, inhibit replication, and defend outstanding findings.
Knows, understands, and applies logic with body of evidence to defend position.	Relies on logical fallacy and selected evidence to advance a position.
Views critics as colleagues; seeks criticism and refutation.	Views critics as adversaries; avoids criticism and condemns dissent; works alone.

to critically examine the methods used to support their claims or develop alternative explanations for findings. When confronted with questions or refuting evidence, they revert to fallacious argument including conspiracy to suppress evidence, shifting the burden of proof, hypothesis saving, ad hominem attack, straw man fallacy, and so on. Table 9.1 provides a side-by-side contrast of distilled characteristics of science and pseudoscience to support consumer evaluation of any claim.

Skepticism and Credulity

Skepticism is "not a position; skepticism is an approach to claims, in the same way that science is not a subject but a method" (Shermer, 2002, p. xvii). Credulity, by contrast, is an almost complete willingness to trust claims and positions put forth by others as being true without evaluating their plausibility. We may, in social engagements, silently accept as true what someone tells us to avoid conflict or embarrassment. We sometimes may find ourselves at least tacitly agreeing with someone's position. For example, we may entertain flattery even when the logic is absurd (e.g. "You're a Scorpio so you must be very brave!") or attempt to carefully navigate social situations, but critical skepticism should guide most of our actions. This is especially important when making decisions that affect lives (i.e., treatment for a medical condition; addressing education needs). We may accept without thinking benign declarations, but the degree to which we accept a claim without evidence is proportionate to the plausibility of the claim, its convention, and its impact. Ordinary claims that are plausible, conventional, and of little impact are granted more credence and require little or no evidence (e.g., I have a pet dog). Extraordinary claims (e.g., I have a pet dragon.) are implausible, unconventional, and directly impact a worldview and therefore require much stronger evidence. The great science communicator Carl Sagan often quipped that extraordinary claims require extraordinary evidence.

Credulity exists on a continuum from extreme optimism (total credulity—accepting all claims without question) to complete pessimism (incredulity—rejecting all claims as false without examination). Credulity may be taken to mean gullible and incredulity may be mistaken for skepticism, but these terms refer to different approaches to a claim. The credulous, incredulous, and skeptical individual all make decisions about belief when presented with new information. Invoking some classical examples of this tension, if we situate Candide and Dr. Pangloss (characters from Voltaire's satire) discussing the latest fad in ASD treatment, we would witness two distinct approaches to a novel claim of treatment efficacy. As a classical optimist, Dr. Pangloss would assume that "all is for the best in the best of all possible worlds" and therefore a new nasal spray treatment for ASD must be effective; the spray was created to treat ASD so surely it must (i.e., credulity). Candide, on the other hand, would respect the nature of the claim but question its veracity until presented with supporting evidence (i.e., skepticism). A credulous person immediately accepts the claim as true irrespective of the (absent or conflicting) evidence. An incredulous person rejects the claim outright irrespective of the evidence. Candide (the skeptic) is the only person who evaluates the claim and remains open to either possibility. Skeptics suspend belief in a claim until sufficient evidence exists for either position. Similarly, the skeptic rejects a claim when evidence indicates it should be. The skeptic values evidence and therefore changes belief in accordance with the evidence. Conversely, the judging process of the incredulous individual parallels the credulous individual: Both make and adhere dogmatically to decisions irrespective of the evidence.

Skeptical behavior entails ongoing examination of evidence and reformation of belief. Likewise, science is a process involving testing hypotheses and the acknowledgement that conclusions derived from the scientific process are temporary. This illustrates the imperfection of science resultant of human proclivity for errors in thinking. Shermer (2002) highlights "the fallibility of science and the scientific method. But within this fallibility lies its greatest strength: self-correction" (p. 21). Dr. Panglos might self-correct, but this may occur as rapidly as the wind changes direction and on the basis of weak logic. Conversely, a scientist may change positions on an issue but only does so after careful consideration of evidence. This means science progresses with meticulous analysis of claims. This also means admitting that claims made via the scientific process progress from temporary to incontrovertible fact. Some claims hold sway for centuries (e.g. Newton's laws of motion) and become foundational fact, while others are short lived and abandoned (e.g., cold fusion). In either case, scientific claims inspire refutation and innovation via replication.

Skepticism is a repertoire of behavior that typically is developed gradually and in lockstep with scientific literacy. The concept alone is difficult to understand because many individuals have acculturated a credulous disposition and repertoire of superstitious behavior. Science fundamentally involves acquiring an understanding of problems or phenomena, gathering evidence through experimentation, followed by close analysis of that evidence. From a scientific perspective, the skeptic posits a testable statement about a phenomena and proceeds to evaluate evidence that may support or refute that position before ascribing belief.

Errors in Reason and Psychological Explanations Related to Unsupported Interventions

Pseudoscience and credulous thinking often are associated with shortcuts around critical thinking. Espousing or defending a position requires the organization of reasons consistent with sound and valid logic. Although science commands logical consistency, pseudoscience wins appeal with simple violations of the rules of critical thinking and debate. Importantly, a fully developed ability to detect fallacious arguments confers a wealth of benefits that extend beyond recognizing pseudoscience in ASD. However, an understanding of a handful of tactics often employed to defend fad, pseudoscientific, and controversial interventions in ASD may support professionals in avoiding them. Table 9.2 provides an overview of some common errors in thinking along brief explanations, examples, and problems associated with fad, controversial, and pseudoscientific interventions.

Fallacious Logic and Argument

An argument from ignorance fallacy is an attempt to support a position by asserting that a claim is or could be true and therefore should be treated as such until refuting evidence is available (e.g., "We don't know what causes autism, so it could be vaccines."). This fallacy often is packaged with anecdotal evidence (e.g., "Chelation worked for my child, so it might work for yours.") and shifting the burden of proof. Shifting the burden of proof is a fallacy in which the person making a claim requires the challenger to disprove it rather than offering evidence to support their assertion (e.g., "Prove to me chelation won't help my child."). Each of these fallacies operates from a credulous disposition in which credence in the claim is granted until evidence against it is available. However, at least two problems arise when subscribing to this logic. First, it discounts the influence of investment in an intervention/product. People are more likely to subconsciously perceive a positive effect when none exists if time, money, effort, emotion, and other resources are invested in a treatment. Second, fallacious reasoning welcomes an ocean of unproven interventions that hinge on claims impervious to refutation or confirmation through experimentation (e.g., telepathic claims made by some proponents of FC). Indeed, pseudoscience depends on untestable claims and fallacious logic. If all claims were to be treated as potentially valid until disproven, then effective interventions would have to contend with those proposed by individuals who unwittingly or intentionally violate the rules in the competition of ideas. The amount of nonsense alone would sufficiently bewilder consumers, obscure access to validated interventions, and stymie progress.

Purveyors of pseudoscience also may use appeal to authority and/or false authority fallacies. These fallacies distract from an argument by emphasizing the status of the person making the claim rather than the reasons behind it. The false authority is often used by self-proclaimed experts (e.g., holistic doctor; certified reiki practitioner). By asserting false authority, quacks and frauds claim that the person without the authority does not (and could not) adequately appreciate the claim to fairly criticize it.

Table 9.2 Common errors in thinking, brief explanations, examples, and problems associated with fad, controversial, and pseudoscientific interventions

Error	Brief explanation	Example	Problem
Argument from Ignorance Fallacy	Lack of evidence is treated as evidence in favor of a claim.	"We don't know if gluten-free diet will improve ASD symptoms, so we should try it."	Absence of data and potential harm using an unknown treatment or accepting unsupported claim.
Anecdotal Evidence	Testimonial from people who claim to have benefited.	"It worked for my child."	Anecdotes do not qualify as scientific evidence; no experimental control is provided.
Shifting the Burden of Proof Fallacy	Requiring the skeptic to refute unfounded claim	"Can you prove that sensory integration training won't work for my child?"	Claimant not required to support position with evidence; skeptic is expected to prove a negative.
Appeal to Authority Fallacy	Relying on status of the claimant to support the claim.	"That doctor said anti-fungal medication may help behavior, so why should we doubt it?"	Belief stems from person making claim; has nothing to do with evidence for claim.
False Authority Fallacy	Relying on purported expertise to refute argument.	"Only a homeopathic doctor can accurately comment on the efficacy of homeopathy."	Gives credence to claims made by quacks and frauds by discounting arguments from those without the credential.
Argument to Moderation Fallacy	Asserting the truth lies between two claims despite of amount or quality of evidence.	"Some say FC doesn't work at all, but others say it is a type of communication. It must work for some people or some of the time."	Position with or less/no evidence is perceived as valid as the position supported by more or most evidence. Concludes truth is somewhere between both positions.
Ad Hominem Fallacy	Attacking the person making the claim rather than their argument or the evidence presented.	"That guy is a rude jerk so anything he says shouldn't be trusted."	Ignores the opponent's argument and instead focuses on attacking their character.
Ad-hoc Fallacy	Adjusting claims to preserve belief in spite of contradictory evidence.	"Putting people in test conditions causes the intervention to stop working."	Refutation is always just beyond the realm of science. Claim is treated as too sensitive or complex for scientific evaluation; demands faith.
Straw Man Fallacy	Intentionally misrepresenting the opposing argument then attacking the misrepresentation as if suggested by the opponent.	"I don't believe in using negative reinforcement because it requires the child to want to escape discomfort. Wanting to make children uncomfortable just to get them to learn is unethical and immoral."	Intentionally avoids discussing the crux of the argument by replacing it with a position not espoused by the opponent and attacking it instead.
Confirmation Bias	Selecting and conforming evidence to maintain cherished beliefs.	"We started using hyperbaric oxygen therapy a few weeks ago and he really seems to be improving."	Ignores contradictory data and elevates positive data; discounts the influence of personal investment in outcome on perceptions.
Magical Thinking	Attributes causality to unfalsifiable phenomena.	"Disruptions in spiritual energy are causing his tantrums"	Outside the scientific process because it cannot be tested.

Similarly, authorities with more social status and respect (e.g., medical doctor; professor) may be used as an appeal to authority fallacy. In this way, people may argue that the authority made a claim and, given their status, the claim is more likely true than untrue (e.g., "She's a doctor, so she's probably basing her judgment on science."). To be clear, people with authority are often intentionally misrepresented and also are susceptible to conflicting values (e.g., money) that encourage endorsement of a product or practice. Consumers should recognize these fallacies as a likely reflection of inadequate evidence to support a claim.

If the proponent of an unsupported claim gives any ground, it is often via an argument to moderation fallacy. This fallacy relies on perspectives that two positions represent extremes on a continuum of possible truths and these extreme positions are always incorrect. The mistake stems from presumptions that an apparently less extreme position better approximates the truth. For example, one position in the FC "debate" is that the method is without merit and should be completely avoided. This position is entirely consistent with the prevailing evidence. The alternative (and unsupported position) is that FC works for "some individuals". The argument to moderation fallacy implies that FC should be *part of* a communication support system in which the person uses multiple means of communicating. Not surprisingly, this is precisely the position FC advocates espouse (ICI, n.d.). In this way, a harmful intervention can gain some legitimacy by appealing to moderation (i.e., "FC probably works for some people."). The fallacy is that an accurate position (FC is a farce) is treated as an extreme and therefore not likely factual. There can be no compromise when the evidence is unequivocal; to do so is to accept falsity. Further problematic is that the moderate position can then be presented as the new extreme in an attempt to compel agreement from the previously uncompromising perspective. Truth is conceded for regressive moderation.

Other fallacies commonly used to protect pseudoscience from criticism include ad hominem (e.g. "You think you know everything."), ad-hoc fallacy (i.e., adjusting evidence to accommodate belief), argument from personal incredulity (e.g., "I can't imagine how that could be true."), correlation fallacy (e.g., "He started talking after we gave him vitamins."), straw man (e.g., "ABA used punishment like electric shock. Why do you support inhumane treatment like electric shock?"). As stated, there are numerous fallacies commonly used to defend unproven interventions in ASD. Consumers would be wise to refine their ability to recognize them.

Confirmation Bias

"The first conclusion colors and brings into conformity with itself all that come after" (Bacon, 1620/1939, p. 36). Given the confluence of circumstances that give rise to spurious interventions, it is understandable that stakeholders might be convinced an intervention is responsible for some improvement when none exists. Improvements might be attributed to the questionable intervention when other known or unknown factors (e.g., other interventions, child learning, teacher skills, parent knowledge, maturation) are more likely the cause. The expectation of change

when instituting a new treatment generates increased attention to specific behaviors that were previously less attended to (or ignored) and can result in perceived changes (i.e., increased awareness and attention explain noticed differences when no actual difference exists). Documentation by invested persons also may be skewed to provide further confirmation. This phenomenon is a main reason why double-blind randomized trials are highly valued; they control for confirmation and other biases that wreak havoc on the internal validity of experimental studies.

Confirmation bias usually is an implicit thought process in which an individual selects evidence and molds facts in order maintain alignment with personally favored beliefs (Nickerson, 1998). This flawed thinking acts as a protective boundary against potentially threatening evidence that contradicts cherished beliefs (Davies, 1993). Pseudoscience and confirmation bias often accompany each other because both emphasize attention to stimuli that support pre-conceived ideas, judgments, or expectations rather disconfirming stimuli. This tendency is complicated by the presence of denial when contradictory evidence is produced, causing a retreat to the original conclusion rather than acceptance of a more probable alternative (Garb & Boyle, 2003). Travers et al. (2014) described the role of confirmation bias in maintaining belief in and continued dissemination of FC, a widely debunked intervention responsible for a variety of traumatic and tragic outcomes (see, for example, Boynton, 2012; Flaherty, 2015; Green, 1994; Siegel, 1995). Increasingly bizarre trends associated with FC underscore the moral obligation to remain empirical (Todd, 2012) and the importance of developing a thorough understanding of the influence of confirmation bias in ASD intervention research and practice.

Magical Thinking

Magical thinking is the attribution of causality to some unverifiable phenomena and partly explains our human tendency to engage in superstitious behavior. People from various cultures have entertained fanciful (or frightening) ideas to explain phenomena that did not have easily observable causes (e.g., disease, famine, luck). Advances in our knowledge have eliminated many beliefs of our ancient ancestors, but superstitions still abound. Peculiar beliefs are commonly subscribed to and often serve to explain things in ways that prevent identification of actual causes. For example, teachers may believe that a full moon or the weather explains inappropriate behavior of children in school (Van Buskirk & Simpson, 2013). Teachers may simultaneously witness two distinct and unrelated phenomena and attribute the cause of one to the appearance of the other when, in fact, the two are entirely coincidental (e.g., child eats cheese and later has a tantrum; cheese is eliminated and child has a good day). Rather than explore as many potential causes for behavior, consultation of a lunar calendar or meteorologist absolves responsible agents from identifying actual (but less salient) causes for the phenomenon. Scientists tend to be inspired by their ignorance, while others may find not knowing terribly discomforting.

Humans have a desire for explanations for seemingly inexplicable events and therefore often rely on magical thinking (Shermer, 2002). We experience this in our daily interactions and witness it in the popular media. Lucky charms, rituals, cursed words, karma, forbidden foods, and etcetera are commonplace. Adherence to these beliefs may seem provincial, but they and others have been reinforced by cultures and are cherished to various degrees. For example, popular tropes like lunar explanations for classroom misbehavior are extensions of archaic attributions of inexplicable causes of various behavior to the lunar cycle. The term "lunatic" is rooted in astrology and was for nearly 2000 years commonly believed to be the cause of epilepsy and other diseases and disorders. In this way, these and countless other "self-evident truths" were passed on through the folklore of the culture. These explanations helped people cope with daily tragedies (e.g., disease, pain, famine) that often accompanied humankind's collective ignorance, but they anesthetized curiosity and inhibited searches for verifiable causes or explanations. Adopting an inaccurate explanation is more comforting than having no explanation, but science has taught us that knowledge, acquired through scientific method, confers unprecedented benefits to humankind. Nevertheless specious beliefs of all sorts apply the brakes to this advancing agenda in order to protect beloved but untenable beliefs. Advances in medicine, chemistry, biology, astronomy, physics, technology, education, and others have bestowed fantastic benefit. Each generation has been better off than the previous.

The misattribution of observations to unsupported causes is not a benign phenomenon. Given our limited knowledge about ASD, it is no surprise that many speculative and supernatural explanations and treatments exist. Divine communication, extrasensory perception, telepathic communication, spiritual medium, and others have been offered as having something to do with ASD. One child died during an exorcism to cast out demons alleged to be the cause of his ASD (Collins, 2003). Other, more earthly but unfounded explanations include vaccine injury, intestinal bacterial overgrowth, genetically modified foods, non-organic produce, hormones in beef, and unloving parents. Belief in these or other groundless causes and treatments lead parents to tragic outcomes. For example, children with ASD have died from chelation therapy, a medical procedure to remove metals mistakenly thought to cause ASD from the body (e.g., Baxter & Krenzelok, 2008; Davis et al., 2013).

Well-intentioned professionals, passionate about their work and dedicated to students with ASD and their families, are not immune from similar folly. In an educational setting, similar scenarios run their course and entire schools or programs are shaped by a combination of a few anecdotes and a climate of confirmation bias. People see examples of "effective" intervention and ignore examples of the same intervention failing. This has the effect of allowing unfounded practices to proceed unchecked and opens the proverbial schoolhouse doors to exploitative charlatans. A stroll of many major education conference expositions reveals a buffet of baloney, pitched by brash swindlers bent on bamboozling benevolent professionals. Buyers beware!

Specific Fad, Controversial, and Pseudoscientific Interventions in ASD

It would be impossible to overview every present or historical fad, controversial, and pseudoscientific intervention associated with ASD. The intent of our discussion up to this point was illustrating some key indicators of potentially harmful treatment approaches in ASD. Red flags include grandiose claims that are contrary to mainstream scientific discovery, usually supported only by baseless assertions, testimonial anecdotes, and fallacious reasoning. We also outlined some reasons why disproven and unproven interventions become popular. Nevertheless, it seems pertinent to contextualize some ways these problems have manifested over the past 40 years. In the following sections, we discuss some communication, sensory, developmental, and biomedical interventions that have gained and lost (and sometimes recaptured) attention.

Communication-Based Interventions

Communication deficits are a core characteristic of ASD and often are central to EIBI programming. The progression of communication intervention research has been particularly slow, perhaps because of the complex topographical and functional features of communicative behavior. Learning essential and complex communication requires a technology of teaching that is both effective and efficient. Unfortunately practitioners have not consistently mastered this. The limited knowledge about promoting communication, the advanced technical skill required for teaching most communication skills, and limited resources are, as discussed previously, fertile conditions for fad, pseudoscientific, and controversial interventions. Indeed, quintessential fad and pseudoscientific interventions in ASD are directly related to communication.

Facilitated Communication

Facilitated communication (FC) is a method of physically prompting a person to use a keyboard or letter board to spell words that allegedly convey their thoughts (Biklen, 1992; Institute for Communication and Inclusion, n.d.). The underlying theory advanced by FC proponents is that the person with ASD has intact (and often untaught) reading and writing skills and FC taps into those skills. The method involves holding the person's finger, hand, wrist, arm, or shoulder to prompt the person to point to letters/type, give reminders to look at the letterboard/keyboard, and to pull the FC user's hand back from the keyboard between letters when typing. However, over time increasingly subtle prompts including touching the back, waist, or non-physical indicators (head movement, verbal prompts, and so on) can be used

to manipulate the user to type words. Supplemental verbal prompts to begin or stop pointing are essential for ensuring the FC user looks at the keyboard as well clarifying questions from the facilitator to FC user (ICI). The ICI also emphasizes facilitator emotional support via development of a relationship for FC success.

Rosemary Crossley developed the method in Australia (Crossley & MacDonald, 1984) and Douglas Biklen brought it to the United States in the late 1980s (Biklen, 1990). The introduction initiated an unprecedented cult-like movement in special education and related fields. The dramatic results accompanied claims consistent with pseudoscience (i.e., miraculous, revolutionary, breakthrough treatment method) (Berger, 1991), but only were supported with testimonials disguised as qualitative research (Biklen, 1990; 1997). Researchers immediately responded and failed to validate claims made about FC (Hudson, Melita, & Arnold, 1993; Szempruch & Jacobson, 1993; Wheeler et al., 1993). Subsequently, study after study failed to demonstrate any authenticity of FC (Mostert, 2001; 2010; Simpson & Myles, 1995). It is widely accepted that messages obtained via FC are mere manifestations of the ideomotor response, the same phenomenon associated with the movement of the Ouija board planchette (Burgess et al., 1998). To date, no person has demonstrated the validity of FC under well-designed experimental conditions and, despite proclamations to the contrary, no person has become an independent author of thoughts due to FC. In sum, FC users indefinitely depend on the presence of a facilitator who can see the keyboard/letterboard to communicate.

The absence of supporting evidence and the wealth of refuting evidence has not stopped FC proponents from advancing the technique. Proponents appear to exploit hyperlexia, the authentic but rare phenomenon of precocious reading by some people with ASD, to argue in support of FC. Other absurd rationales also exist, including supernatural autistic telepathy (Haskew & Donnellan, 1993), divine inspiration (Bilu & Goodman, 1997) and ASD as a movement disorder (e.g., Biklen, 1993; Stubblefield, 2011). Travers et al. (2014) described how FC proponents have rebranded FC as "supported typing" and portray the technique with tablet computers, exploiting popular beliefs about the benefits of touch technology. Travers et al. also pointed out other rebranding and marketing tactics to advance FC including changing the FC Institute name to ICI, dishonestly referring to FC as a type augmentative and alternative communication, and promoting FC in popular media instead of traditional academic channels.

The FC crusade has brought unwarranted resurgence in FC's popularity, but this has come at deeply troubling costs. More parents have been unjustly accused and charged with sexual crimes via FC and families have been devastated (Braiser & Wisely, 2014). One mother killed her 8-year-old son after claiming he suggested via FC they both commit suicide (McKinley Jr, 2014; Sanchez & Remizowski, 2014). A university philosophy professor was convicted of two counts of sexual assault after she claimed she obtained consent for sex via FC from a man with a severe disability (Flaherty, 2015). Similarly, a caregiver pleaded guilty to sexual crimes after claiming her client consented via FC to various sexual acts with her (Sundstrum, 2014). These and numerous other but similar issues associated with FC overshadow larger concerns that FC usurps the voice of people with disabilities, treats them as

puppets in their own lives, and attempts to diminish the very real effects of their disabling conditions. The long list of potential danger and actual damage associated with FC illustrates how well-intentioned people seek out, irrationally defend, and relentlessly promote interventions that have no tangible benefit and only cause harm.

Rapid Prompting Method™

Rapid Prompting Method (RPM) is a trademarked method in which a learner touches or points to letters on a board or tablet computer to spell out words, fragmented or full sentences, or entire paragraphs that reflect the thoughts of the learners. RPM™ users allegedly communicate very complex ideas, author books, and suggest radical change in the way ASD is understood. This explanation is similar to those provided for FC because the procedures and claims underpinning both methods are strikingly similar (Tostanoski et al., 2014). The mother of a child with ASD invented the method and claims "RPM is distinct from other methods as it is based upon how the brain works. The aim is to bring the student to maximum learning through the open learning channel and to elicit the best (not simply to test) out of the child to enable maximum output in that given time" (HALO, n.d.). Such claims are consistent with several qualities of pseudoscience.

The RPM™ appears to rely on the same ideomotor effect responsible for FC, but it differs in ways that may make it difficult for consumers to see the connection. A primary difference is that unlike FC, the RPM™ support-person holds the device (i.e., tablet computer) or letterboard instead of the person's finger, hand, wrist, arm, or shoulder. The letterboard is held under the hand of the pointing individual and each letter is announced as the person's finger touches the letter. As with FC, increasing subtle and non-physical cues are used to manipulate behavior that appears to emanate from the individual, including traditional handwriting, but there is no evidence to substantiate this claim. The dangerously persuasive power of RPM™ lies in its absence of physical touch to control the messages. The method has garnered widespread attention in the popular media, including features on 60 min II (Kohn, 2003), CNN (McEdwards, 2008), the New York Times (Blakeslee, 2002), and others. These sources portray RPM™ users in ways that eerily parallel FC in the early 1990s.

Only one experimental study has examined RPM, but the findings do not warrant application of RPM as an intervention method to support communication or any other skills. Chen, Yoder, Ganzel, Goodwin, & Belmonte, 2012 examined videotaped sessions of RPM sessions to evaluate effects on joint attention, repetitive behavior, open learning prompts (i.e., a concept of sensory integration treatment), response complexity, and relationship between types of prompt and accurate responding. Authorship authenticity was not evaluated. They reported decreases in repetitive behavior, but no significant differences in their analyses were found in relation to the other behaviors investigated. Despite this, the authors made positive and speculative claims that appeared to contradict their results. A value-added

abstract and commentary of Chen et al. indicated numerous serious methodological problems and specious conclusions about RPM's effectiveness (Lang, Tostanoski, Travers, & Todd, 2014). Lang et al. strongly suggested that RPM appears similar to FC and concluded results obtained by Chen et al. more likely reflected prompt dependency than a dramatic breakthrough in ASD.

Sensory-Based and Neurological Interventions

Sensory Integration

Sensory integration (SI) interventions purport to assist learners to interpret and respond to sensory input. The conceptual foundation for SI is that sensory processing is the way the nervous system takes in and makes meaning of environmental stimuli and sensations (Hanft, Miller, & Lane, 2000; Kandel, Schwartz, & Jessell, 2000). Thus, it follows that SI interventions and supports can be applied to facilitate meaningful awareness of how the body and environment are linked to inform treatment for improving the ability of people to understand the contextual features of their bodies (Coren, Porac, & Ward, 1984).

It is well known and empirically accepted that individuals with ASD commonly experience sensory irregularities and differences (American Psychiatric Association, 2013). Children and youth with ASD are characterized by hyper- and/or hyposensitivity to environmental stimuli (e.g., find it difficult to tolerate certain clothing fabrics, are unusually sensitive to certain noises and other common environmental stimuli, appear to be unaware of cold weather conditions). It is thus logical and reasonable to generally assume and accept the underlying biological and neurological explanation for ASD. The conceptual leap that follows is the bridge to SI, specifically that SI interventions and supports provide therapeutic benefit to individuals with ASD.

A variety of SI methods are widely used in countless ways by both clinical and educational professionals. Moreover, in many settings, SI is a generally accepted treatment and support for children and youth with ASD-related disorders and judged by many professionals and parents as a necessary part of a comprehensive ASD program. In spite of this popularity and implicit acceptance the effective-practice credentials of specific SI practices are questionable (National ASD Center, 2009).

Unlike many fads and pseudoscientific interventions for learners with ASD, SI is seemingly underpinned by a foundation of biological science and physiology. It is well documented that individuals with ASD manifest atypical responses to environmental stimuli. Indeed, teachers, parents and other stakeholders accept these characteristics as common elements and features of ASD; based on this knowledge, they plan accordingly. For example prudent and informed teachers of students with ASD carefully plan for fire drills and similar events that involve loud sirens and irregular loud sounds. Teachers and parents are aware of students' food-texture preferences and they make necessary accommodations and take steps to expand students' tolerance

for different foods. Adjustments are made to deal with unusual responses to particular types of clothing, and so forth. These are practical, logical, and necessary accommodations, albeit not necessarily SI treatments.

What places SI in the camp of "unproven" and "unsupported" methods is advancement of the notion that therapists and other caregivers are able to manipulate and modify an individual's sensory system via application of a variety of untested and non-validated "sensory intervention techniques." These so-called interventions, treatments, and supports purport to modify an individual's vestibular, visual, hearing, smelling, and tasting systems. The intent is to manipulate an individual's neurology to improve how they orient in space and time so as to help the child make better decisions about appropriate actions. A number of purported SI tools are applied without treatment fidelity and with little logical or scientific connection to human biological and neurological structures. Consider, for example, weighted vests and support garments, vestibular movement activities such as swinging, sensory rooms, and sensory activities such as giving children opportunities to play at a water table and with vibrating materials lack the scientific support needed for evidence-based status (Lang et al., 2012).

Auditory Integration Training

Auditory integration training (AIT) was developed by the French otolaryngologist Guy Berard (Berard, 1993). Berard's method was based on the work of Alfred Tomatis, his predecessor and colleague. AIT typically consists of 20 half-hour sessions of listening to specially filtered and modulated music over 10 to 20 days. AIT has been reported to result in positive outcomes for individuals with a variety of disorders, including ASD. In spite of these claims there is little in the way of supporting empirical evidence for AIT and the method has not met scientific standards for efficacy that justify its use as a treatment for any disorder.

Berard developed the AIT method in the late 1960s as a treatment for auditory sensitivity and processing problems in persons with ASD and other disorders. According to Berard (1993), middle ear abnormalities and acute hyperactivity of cochlear hair cells are the cause of auditory distortions and related difficulties that adversely affect behavior and learning. AIT purportedly mitigates and treats these problems via exposure to modulated and filtered sound.

AIT was popularized in the 1990s through Annabel Stehli's book, *The Sound of a Miracle* (1994). Stehli described how AIT allegedly produced significant improvements in her daughter, an individual with a diagnosis of ASD. The publicity resulting from the book led to wide scale use of AIT during the 1990s. There was initial anecdotal evidence and claims of positive outcomes for AIT based on a few poorly designed studies. However, closer scrutiny and vetting based on more robust and scientifically grounded research consistently revealed the method to have little efficacy or utility. In sum, there is insufficient evidence to justify using the method with individuals diagnosed with ASD or other conditions.

Irlen Lenses

A *google* search "Irlen Lenses" leads to the Irlen Lenses website and the following claim: "The Irlen Method helps individuals with Autism (sic) & Asperger syndrome who have perceptual problems, light sensitivity & sensory overload" (n.d.). Irlen Lenses purportedly treat a condition known as scotopic sensitivity syndrome (SSS), allegedly a common malady among individuals with ASD. SSS is supposedly a central nervous system condition wherein a person's eyes interact with light levels to create visual distortions. Irlen Lenses claim to treat this condition through colored lenses and overlays.

In a joint statement by The American Academy of Ophthalmology, American Academy of Pediatrics, American Association for Pediatric Ophthalmology and Strabismus and American Association of Certified Orthoptists, experts bluntly rejected the notion that lenses were a suitable or effective treatment for SSS (American Academy of Pediatrics, 2009). The basis for this judgment was an absence of supporting scientific evidence. We agree with this assessment, and consider this method to be a classic example of a commercial enterprise preying on vulnerable and desperate individuals in search of simple solutions for developmental disorders and disabilities.

Brain Gym

"Brain Gym" is the prototypical personification of a faddish and pseudoscience intervention. The organization that promotes Brain Gym claims that doing specified exercises result in improved academic performance and other positive outcomes, including improved spatial, listening, eye-hand coordination, and memory and related cognitive gains. Case studies and anecdotal reports are used to support Brain Gym, including professed positive outcomes of children with ASD who are involved in Brain Gym activities. According to information on the Brain Gym website, the program is used to: "promote play and the joy of learning; draw out and honor innate intelligence; build awareness regarding the value of movement in daily life; facilitate the ability to notice and respond to movement-based needs; encourage self-responsibility; leave each participant appreciated and valued; empower each participant to better take charge of his own learning; encourage creativity and self-expression; inspire an appreciation of music, physical education and the fine arts." One might conclude Brain Gym could also increase the approval rating of the U.S. Congress, if only given the chance.

There is a wealth of data to support the benefits of exercise and physical activity. These advantages also apply to individuals diagnosed with ASD (Lang, Koegel, et al., 2010; Lang, O'Reilly, et al., 2010). Indeed a healthy lifestyle, including exercise, bodes well for the physical and emotional well-being of every person. In spite of this general acceptance, there is no supporting evidence for Brain Gym as a valid intervention program for individuals with ASD. The behavioral science principles and educational theorists used to prop up Brain Gym are unquestionably genuine

(e.g., Piaget, Gesell, Carl Rogers). However, except in the most general and vague fashion, these supporting elements lack any scientific link to Brain Gym. In his review of Brain Gym research, Hyatt (2007) concluded that the five studies supporting the method were poorly designed and that Brain Gym was linked to the discredited and dangerous Doman-Delacato theory of development, further raising questions as to its suitability for use with persons with ASD.

Psychomotor Patterning

In spite of consistent findings over several decades that it offers no positive outcomes and has all the markings of a classic pseudoscience method, psychomotor patterning interventions continue. Psychomotor patterning was first promoted and used as a treatment for individuals with intellectual impairments, learning disabilities and neurological impairment. It has more recently been promoted as an intervention for individuals with ASD. In all cases psychomotor patterning has failed to yield convincing and scientifically-supported positive outcomes.

The notion of patterning as a therapeutic treatment is credited to Glenn Doman and C. Delacato; thus often referred to as the Doman-Delacato technique (Doman, Spitz, Zucman, Delacato, & Doman, 1960). The theoretical underpinnings for psychomotor patterning are loosely based on theories of ontogeny (stages of development, beginning from a single cell stage to full maturity) and that an organism should develop through each of the adult stages of its evolutionary history. The assumption is that normal childhood neurodevelopmental stages of crawling, creeping, and the various phases of walking are a direct link to historical human development (i.e., amphibian, reptilian, and mammalian evolution). Doman and Delacato theorized that intellectual disability was a failure of the individual to develop through the proper evolutionary stages. Related to psychomotor patterning methodology, the treatment attempts to stimulate the proper sequential development of developmental stages. The purported therapeutic stimulation is known as "patterning."

Patterning takes the form of individuals repeatedly engaging in moving in accordance with various stages of development (e.g., crawling). Exercises are sometimes combined with other techniques, such as sensory stimulation, breathing exercises, and attempts to program and influence hemispheric dominance. In spite anecdotal and unsupported claims that the technique can lead to normal social, intellectual, physical and motor abilities, there is overwhelming evidence psychomotor patterning methodology is without merit. Moreover, because it preys on desperate parents and families and requires a heavy financial and emotional toll, we consider psychomotor patterning to be a potentially harmful method.

Neurofeedback and Mirror Neurons

A mirror neuron is a cell that supposedly processes and transmits information relative to performing an action and performing the same action of others. Thus, the neuron "mirrors" the behavior of the other, as though the observer were itself acting.

Mirror neurons have been directly observed in animals, especially related to imitative behaviors; and there is some neurological evidence suggesting the presence of some form of mirroring system consistent with the presence of mirror neurons in humans (Molenberghs, Cunnington, & Mattingley, 2009). The exact function, as well as the existence of the mirror system, is a subject of much conjecture and theory. Some researchers speculate the mirror neuron system is the neurological structure supporting the link between observations, perceptions, and actions. Thus mirror neurons are considered by some to be important in understanding the actions of others, learning new skills through imitation, and understanding others' actions and intentions. Relative to persons with ASD, mirror neurons are speculated to be the neurological mechanism responsible for imitative learning and cognitive difficulties and emotional and "theory of mind" impairments (Dapretto et al., 2006).

Studies of mirror neuron activity among individuals with ASD purport to show atypical neurological patterns. One indicator in particular is known as mu brainwave suppression; this mechanism is supposedly absent in individuals with ASD. Based on the theory individuals with ASD have deficient mirror neuron activity, neurofeedback training (NFT) is used to normalize mu suppression and therefore mirror neuron activity. Outcomes of this treatment purportedly result in improved learning ability, especially in imitation, as well as improvements in emotional, social and behavioral functioning (Oberman, Ramachandran, & Pineda, 2008). To date there are no credible scientific studies that have described how mirror neuron activity supports imitation learning and other cognitive and emotional functions (Murphy, Brady, Fitzgerald, & Troje, 2009). Thus, in spite of significant hype over the presence and impact of mirror neuron treatments, neurofeedback has yet to be supported by research and therefore is controversial outside of experimental conditions.

Developmental Treatment Models and ASD

One approach to early learning for students with autism is a developmental approach. Developmental learning encourages practitioners and caregivers to use typical developmental sequences as the foundation for interventions and assessments (Wagner, Wallace, & Rogers, 2014). These early intervention procedures primarily focus on adult-child attachment and social interactions within the context of natural environments, and are often intensive in nature (Wagner et al., 2014). Some developmental interventions target skills using principles and approaches consistent with applied behavior analysis (ABA), and have shown very promising results. However, other developmental interventions appear particularly concerned with improving and repairing the relationships and interpersonal connections of individuals with ASD. These interventions focus on increasing attachment, appropriate affect, and interpersonal bonds to indirectly improve social, communication, and other core ASD deficits (Heflin & Simpson, 1998). Common treatments of this variety include: *gentle teaching*, *holding therapy*, the *Son-Rise Program*, and *Floortime*.

Gentle Teaching

Gentle teaching (GT) is focused on establishment of a deep relationship with the child in order for the child to feel completely valued and respected. A secondary goal is to instill in therapists an appreciation for the individual with ASD and to respond with affection (Howlin, 1997). According to proponents, GT was developed in response to vehement and absurd claims that ABA used tactics consistent with torture (Jones & McCaughey, 1992). Given this emotional rather than empirical foundation, it is particularly concerning that vague procedures and unmeasurable outcomes (i.e., bonding, solidarity) are the primary focus (Bailey, 1992). Terms are used that borrow from ABA, such as errorless learning, task analysis, prompting, extinction, and feedback routines, but differ in that the procedural explanations are vague and accompanied with dramatic claims of improvement (Bailey, 1992). These qualities have made rigorous investigation of GT largely impossible and the evidence from initial investigations indicate it is both ineffective for improving targeted skills associated with ASD and developing relationships (Heflin & Simpson, 1998). GT is absent sound theoretical explanations, fails to describe clear procedures for replication in experimental or practical situations, does not emphasize verifiable outcomes of the method, and relies on emotional appeal and testimonial anecdotes as evidence. Thus, GT appears wholly pseudoscientific.

Holding Therapy

The holding therapy (HT) approach purportedly improves the attachment and bonding between caregivers and children with ASD and attachment disorders. It became popular in Europe in the 1980s (Tinbergen, Tinbergen, & Welch, 1983). HT proponents posit that lack of eye contact signifies a breakdown in the attachment between child and caregiver and that caregivers must maintain close physical contact (holding) and proximity, with breaks of no more than 2 h to restore this bond and improve social relatedness (Heflin & Simpson, 1998). This is an invasive treatment; it requires confrontation accompanied by physical restraint to rebuild the bond, but is void of any scientific support (Pignotti & Mercer, 2007). HT also has been implicated in several deaths (Shermer, 2004). Clearly HT is a controversial treatment for children with ASD and in our opinion it should be avoided.

Son-Rise Program™

Also called "Options" the Son Rise Program™ (SRP) is an intensive developmental treatment designed by Barry Neil Kauffman for his son who was diagnosed with autism at an early age (Kaufman, 1976). SRP utilizes high intensity intervention (i.e., 40 h per week) in play environments to improve social initiations and social responsiveness. While SRP uses some traditional practices found in other skill

interventions (i.e., naturalistic feedback), it relies on some unique practices, including imitations of the child as a means of social bidding. A substantial component of the intervention protocol is to imitate the child's play, ritualistic, and stereotypic behavior in order to develop and sustain attention (Heflin & Simpson, 1998). Social reinforcement (e.g., praise, attention) is recommended after the child attends to the therapist (through eye gaze or vocalizations), but otherwise the therapist ignores the child (Houghton, Schuchard, Lewis, & Thompson, 2013). Pitched as a cure for ASD, SRP proponents have for decades relied exclusively on anecdotal claims of effectiveness. Only recently has an investigation of SRP effectiveness been published in a peer-reviewed journal (Houghton et al., 2013), more than three decades after its inception. Importantly, SRP is expensive, highly intensive for the child and caregiver, and has very little scientific evidence. As such, SRP appears pseudoscientific and can be considered at best a controversial intervention.

Floortime

The Developmental, Individual Difference, Relationship-Based Approach Model (Floortime) was created by Stanley Greenspan in the early 1990s. Floortime encourages adult structured and spontaneous play sessions to build relationship, social engagement, and complex thinking and problem solving in young children with ASD (Wieder & Greenspan, 2003). Like SRP, Floortime is a largely home-based, parent delivered, intensive treatment for individuals with ASD, focused on improving social engagement and interaction (Pajareya & Nopmaneejumruslers, 2011). The key components include reciprocal social interactions, called communication circles. These communication circles purportedly are designed to take advantage of naturally occurring motivators and activities. Floortime therapists take advantage of the intense interests of children with ASD to facilitate and maintain these interactions. They also create opportunities for interaction attempts by blocking access to preferred items/activities or intentionally misinterpreting the child (Heflin & Simpson, 1998). Some evidence has emerged (see Liao et al., 2014; Pajareya & Nopmaneejumruslers, 2011; Solomon, Necheles, Ferch, & Bruckman, 2007) to suggest Floortime may be increase social interactions and engagement of young children with ASD. Similar to the SRP model however, Floortime proponents have been advocating its use for over 20 years, albeit without scientific evidence of its effectiveness.

Although a developmental approach in some ways makes sense for young children with ASD (especially when packaged with ABA methods), the models we discuss here lack scientific support. These models call for many hours of therapy per week and are often expensive to implement and maintain. These interventions require families and practitioners to invest heavily in a system in which there is little scientific support for positive returns. Thus, Floortime must currently be classified as a controversial intervention method and in our opinion most suited for controlled scientific vettting.

Biomedical Treatments of ASD

These types of treatments attempt to adjust the neurological and physiological processes that result in ASD symptomology (Bodfish, 2004; Levy & Hyman, 2005). Clearly, there are traditional pharmacological approaches to addressing the parallel behavioral (i.e., aggression, anxiety) and medical (i.e., seizures) symptoms associated with the ASD spectrum that have been thoroughly vetted through systematic investigation (Bodfish, 2004). However, there exists a host of alternative treatments, often referred to as complementary and alternative medical treatments (CAM) that lack sufficient scientific evidence, yet are widely adopted and administered. Surveys of the prevalence of CAM treatments estimate that between 52 and 95 % of youth with ASD are being treated by at least one of these alternative procedures (Golnik & Ireland, 2009). It appears that questionable organizations like Talk About Curing Autism and Defeat Autism Now! (DAN!) have encouraged parents, medical professionals, and practitioners to adopt CAM treatments despite lack of evidence. Common CAM treatments include vitamin supplements, secretin, probiotics and other gastrointestinal treatment, gluten-free casein-free (GFCF) diets, chelation therapy (CT), and hyperbaric oxygen therapy (HBOT).

Vitamin Supplements

Vitamins are easily obtained without a prescription, often have few side effects, and are taken by increasing numbers of the population in spite of significant evidence to their ineffectiveness in preventing chronic illness (Guallar, Stranges, Mulrow, Appel, & Miller, 2013). Orthomolecular psychiatry (Pauling, 1968) advocates the use of concentrated vitamins and minerals to treat a variety of disorders (i.e., schizophrenia, ASD, ADHD; Pfeiffer, Norton, Nelson, & Shott, 1995). While largely rejected due to unproven claims and poor research methodology (Lipton et al., 1973), this approach has found traction in the treatment of ASD due in large part to the support from the Autism Research Institute (ARI) and DAN!. The most common forms of concentrated vitamin treatments for ASD include Vitamin C, Vitamin B6, Magnesium, and Vitamin B12 (Levy & Hyman, 2005).

Investigations of outcomes connected to these treatments have been plagued by small sample sizes, poor research methodology, and inconsistent results (Levy & Hyman, 2005; Pfeiffer et al., 1995). More importantly the dosage regimens recommended by advocates often far exceed the recommended daily dosages for these supplements, and while adverse side effects of vitamins are largely unknown or minimal, there has been documentation of negative side effects connected to high dosages of certain vitamins (Guallar et al., 2013; Levy & Hyman, 2005). Vitamin and mineral supplements as treatments for ASD generally are pseudoscientific or fads reflective of the way society at large views vitamin supplements.

Secretin

Secretin became an enticing superfad to treat the symptoms of ASD following three case studies (Horvath et al., 1997) and attention from broadcast journalists. A pancreatic peptide that stimulates the pancreas, secretin is most commonly used to test pancreatic function. In one television story, a young child was given secretin to treat chronic gastrointestinal trouble and was reported to have remarkably improved language and behavior (Perry & Bangaru, 1998). A swift and robust response from the scientific community ensued and secretin therapy is distinguished as one of the most investigated ASD treatments; several randomized controlled trials were conducted and all failed to demonstrate evidence of its effectiveness (Bodfish, 2004). This fad has waned, but illustrates how rigorous scientific investigation often must distract from promising work to respond to fads and pseudoscience.

Probiotics and Other Gastrointestinal Treatments

While secretin may have fallen out of fashion, other gastrointestinal treatments remain commonplace. Gastrointestinal issues (i.e., diarrhea, constipation, reflux, excess gas, bloating, food selectivity) have been widely described for individuals with ASD (Molloy & Manning-Courtney, 2003), however population studies indicate many of these symptoms do not occur at a higher rate than among non-ASD groups (Ibrahim, Voigt, Katusic, Weaver, & Barbaresi, 2009). The prevailing argument made by individuals supporting these treatments (Horvath, Papadimitriou, Rabsztyn, Drachenberg, & Tildon, 1999; Wakefield et al., 2000) is that individuals with ASD have a unique inflammation of the intestinal tract. This irritation impacts the permeability of the intestines and allows built up toxins and proteins to pass into the bloodstream and ultimately to the brain where they produce the neurobehavioral symptoms associates with ASD (Ibrahim et al., 2009). This "leaky gut syndrome" is controversial and unproven (Cass et al., 2008; Robertson et al., 2008). Nevertheless treatments to decrease inflammation, adjust levels of intestinal bacteria flora (probiotics, antifungals), and improve digestion and eliminate toxins (enzymes), are widespread. These treatments have demonstrated efficacy treating authentic gastrointestinal symptoms, however claims these conditions are ASD causal factors are unsupported and evidence regarding efficacy for treating ASD symptomology is controversial.

Gluten-Casein-Free Diet

Though utilizing the same rationale as the other gastrointestinal treatments, gluten-and-casein-free (GCF) diet is a particularly pervasive treatment. It has been estimated that as high as 70 % of cases have accessed this treatment option (Levy & Hyman, 2005; Marí-Bauset, Zazpe, Mari-Sanchis, Llopis-González, &

Morales-Suárez-Varela, 2014). As the name suggests, the treatment involves eliminating foods that contain gluten (found in grains) and casein (found in all dairy products). Proponents (e.g., Reichelt, Ekrem, & Scott, 1990) argue that these foods release proteins during digestion that can pass through permeable intestines (i.e., "leaky gut syndrome"), cross the blood-brain barrier, and negatively affect neurological functioning (Marí-Bauset et al., 2014). However, no scientific evidence supports GCF diet (Mulloy et al., 2010, 2011). Rigorous investigations (e.g., Hyman et al., 2010) have found no positive effects of GCF diet for ASD symptoms. Further, side effects of elimination diets include nutritional deficiencies, financial loss, and stress maintaining protocol (Mulloy et al., 2010).

Chelation Therapy

Chelation therapy, in our opinion, is a dangerous and persistent ASD treatment. Chelation is a complex medical procedure used to remove lead and other heavy metals from the bloodstream, and has been historically used with individuals who have heavy metal toxicity. Chelation Therapy (CT) involves injections of chelating agents into the bloodstream that bind metal ions so they can be carried out of the body through urine and feces (Crisponi et al., 2015). The prevailing theory that perpetuates CT as a treatment for ASD is connected to the mercury compound thimerosal, a vaccination preservative. The theory posits ASD etiology associated with thimerosal toxicity as a result of vaccination regimens (Bernard, Enayati, Redwood, Roger, & Binstock, 2001; Crisponi et al., 2015; Wakefield et al., 1998). This linkage has never been thoroughly investigated and never substantiated (CDC, 2014), with several high profile and rigorous investigations refuting the linkage between thimerosal-containing vaccinations and ASD diagnosis (Madsen et al., 2003; Price et al., 2010). Furthermore, studies investigating the CT for individuals with ASD have found no discernable positive effects (see Davis et al., 2013). Unfortunately this unsupported and controversial practice is not without consequences. The chemicals used as chelating agents can have serious side effects, including cardiac arrest and deaths of young children with ASD have been attributed to CT (Baxter & Krenzelok, 2008).

Hyperbaric Oxygen Therapy

Historically HBOT has been used to treat decompression sickness associated with deep sea diving, and astronautics. HBOT involves the application of gases into a confined chamber, ranging from normal levels of oxygen (21 %) to enhanced levels of oxygen (up to 100 %) under differing amounts of pressure (Granpeesheh et al., 2010). Exploratory findings have indicated that individuals with ASD have oxidative stress and nueroinflammation, both of which have been successfully limited in rat populations using HBOT (Granpeesheh et al., 2010). As with the other treatments discussed above, this approach is based on flawed or unproven theoretical underpinnings, however this has not prevented its wide usage. To date rigorous

scientific research (Granpeesheh et al., 2010; Jepson et al., 2011) has indicated that HBOT does not result in improvements in ASD symptoms. This is another example of a controversial, expensive treatment based on unfounded ideas that is without supporting evidence.

Conclusion

Our aim was to shed light on some of the factors that give way to unproven treatment and advance skeptical scrutiny by professionals, parents, and organizations responsible preparing individuals to work with individuals with ASD. Fad, pseudoscientific, and controversial interventions for ASD proliferate for various reasons. They often are more affordable and easier to access than evidence-based interventions. Evidence-based interventions can be time intensive and difficult to procure, resulting in misinformation of desperate and dedicated parents and professionals. These factors alone do not explain adoption of all unsupported treatments. Indeed, as we have discussed, a confluence of idiosyncratic factors, each with varying degrees of influence, likely encourage embracement of interventions that ought to be entirely avoided until substantiated by evidence. Development of an understanding of science and scientific thought, including skepticism and rhetorical fallacies, are safeguards against exploitation and self-deception associated with pseudoscientific and fad interventions.

When professionals and families approach intervention decisions buoyed by emotion rather than reason, optimism rather than skepticism, and anecdote rather than data, they ultimately become victims of an industry preying on benevolent but desperate people behaving under duress. Mere knowledge of what has been disproven or is unproven is insufficient for preventing dissemination of new fad, pseudoscientific, and controversial interventions. Our advocacy for skepticism and a scientific attitude toward treatment decisions is necessary because the list of dubious treatments will continue to grow. Combatting pseudoscientific and fad treatments begins with service providers and families who make decisions. Researchers, professionals, and parents who are skilled at evaluating ASD treatment claims must assume leadership roles and support individuals unaccustomed to this important type of decision-making. Such an informed and active community is the best and likely only way to effectively prevent exploitation of individuals connected to people with ASD.

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