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Distinguishing science from pseudoscience in school psychology: Science and scientific thinking as safeguards against human error

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ABSTRACT

Like many domains of professional psychology, school psychology continues to struggle with the problem of distinguishing scientific from pseudoscientific and otherwise questionable clinical practices. We review evidence for the scientist–practitioner gap in school psychology and provide a user-friendly primer on science and scientific thinking for school psychologists. Specifically, we (a) outline basic principles of scientific thinking, (b) delineate widespread cognitive errors that can contribute to belief in pseudoscientific practices within school psychology and allied professions, (c) provide a list of 10 key warning signs of pseudoscience, illustrated by contemporary examples from school psychology and allied disciplines, and (d) offer 10 user-friendly prescriptions designed to encourage scientific thinking among school psychology practitioners and researchers. We argue that scientific thinking, although fallible, is ultimately school psychologists' best safeguard against a host of errors in thinking.

All of us are prone to errors in thinking. School psychologists, despite being highly intelligent and well-educated, are no more immune to such errors than anyone else. In school psychology, cognitive mistakes are especially problematic when they contribute to the adoption of pseudoscientific practices—those that seem to be grounded in science but are not. Such techniques may be ineffective or even harmful to schoolchildren and more broadly, can lead to suboptimal assessment, intervention, or both. Therefore, it is imperative that all psychologists, including school psychologists, embrace scientific thinking tools as

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safeguards against cognitive errors that can contribute to belief in pseudoscientific techniques. In this article, we hope to persuade school psychologists—both practitioners and researchers—to incorporate such safeguards into their everyday thinking, clinical practice, research, and teaching. For those school psychologists who are already making regular use of these safeguards, we hope to provide them with friendly intellectual ammunition for combating resistance to science among their colleagues.

1. The relation between science and practice in school psychology

1.1. The scientist–practitioner gap in school psychology

Concerns about the wide gap between science and practice in psychology, including school psychology, are ubiquitous and longstanding (American Psychological Association Presidential Task Force on Evidence-Based Practice, 2006; Heppner, Carter, Claiborn, & Brooks, 1992; Kazdin, 2008; Weisz, Sandler, Durlak, & Anton, 2005). This *scientist–practitioner gap*, as it has come to be called (Cautin, 2011; Fox, 1996; Tavris, 2003), is marked by a striking disjunction between the scientific evidence regarding the best available assessment and treatment practices on the one hand, and what practitioners—in this case, school psychologists—actually do in their routine practices, on the other.

The popular term, "scientist–practitioner gap," may imply, misleadingly in our view, that one is necessarily either a scientist or a practitioner, not both. To the contrary, as in clinical psychology, we can distinguish between two conceptually independent dimensions in school psychology: science versus non-science, on the one hand, and research and practice, on the other (McFall, 1991). This two-fold distinction results in four quadrants. One can be a scientific researcher, a nonscientific researcher, a scientific practitioner, or a nonscientific practitioner.

This distinction underscores a crucial point. The concept of the scientific practitioner is not an oxymoron, because even school psychologists who conduct no research can in effect act as scientists in the clinical setting. That is, they can bring rigorous scientific thinking to bear on the evaluation of schoolchildren's behavioral, emotional, and learning problems. Moreover, they can be active and discerning consumers of the research literature in school psychology and function as scholar–practitioners (see also Trierweiler & Stricker, 1992) who are continually striving to ground their practices in the best available research evidence.

Alongside their colleagues in clinical psychology (e.g., Lilienfeld, Lynn, & Lohr, 2003) and social work (Thyer & Pignotti, in press), some school psychologists and allied mental health professionals have called for an increase in reliance on evidence-based practices to help close the scientist–practitioner gap (Bradley-Johnson & Dean, 2000; Hoagwood & Johnson, 2003; Hunter, 2003; Kratochwill, 2006, 2007; Kratochwill & Shernoff, 2003; Kratochwill & Stoiber, 2000; Miller & Nickerson, 2006; Stoiber & Kratochwill, 2000; Walker, 2004). As noted by Reynolds (2011), effective school psychologists must learn not to merely administer evidence-based interventions but also to become thoughtful and discerning consumers of the research evidence in school psychology:

> It is not enough to read the literature or to attend in-service or continuing education seminars. We must read and listen carefully. Just because a paper is published in a peer-reviewed journal does not mean the science is accurate or necessarily strong (Reynolds, 2011, p. 5).

Put in slightly different terms, all school psychologists, regardless of the setting in which they operate, need to develop and maintain a skill set that allows them to distinguish evidence-based from non-evidence based practices. Despite the crucial importance of this skill set, some domains of school psychology, like those of allied fields, remain characterized by popular but poorly supported techniques.

Indeed, the problem of questionable and unvalidated claims in school psychology and allied fields, such as educational psychology, is hardly new. Forty-five years ago, Glass (1968) wrote of "educational Piltdown men" (p. 148) infiltrating the research literature on schoolchildren with disabilities, in reference to the infamous early 20th century Piltdown Man hoax that duped many credulous physical anthropologists into accepting the discovery of a new hominid ancestor. (The Piltdown forgery turned out to consist of a human skull and an orangutan jaw, with teeth from a chimpanzee, hippopotamus, and elephant tossed in for good measure.) Referring to "insensitivity to evidence" (p. 148) and the "wishful will to believe" (p. 150) as key contributors to belief in educational Piltdown men, Glass offered three examples of then-popular but unsupported claims concerning exceptional children: (a) a published study that purported to demonstrate remarkable increases in IQ (of 35 points of more) following special (but inadequately described) teaching practices, but that was found to be based on entirely unsupported assertions (see also Reynolds, 1987, for an incisive critique); (b) a widely publicized series of studies from the University of Iowa that claimed to show similarly remarkable increases in IQ in economically disadvantaged schoolchildren after placement in foster homes, but that turned out to be due largely or entirely to enhanced rapport between schoolchildren and psychometricians administering the IQ tests; and (c) astonishing claims of the effectiveness of "psychomotor patterning," a neurological treatment for stuttering, reading problems, cerebral palsy, and other disabilities that requires children to engage in bizarre movements to recapitulate the development of their nervous system, but that is premised on fatally flawed research (see also Singer & Lalich, 1996). As Glass noted, "ignorance of valid standards of empirical evidence and a stubborn will to believe that a panacea had been found combined to divert precious energies and financial resources down essentially blind alleys" (p. 148).

1.2. Survey evidence for the scientist–practitioner gap in school psychology

Have things improved since Glass' commentary in 1966? Sadly, the answer is not especially clear. Like professionals in related fields, school psychologists are interested in promoting the well-being of the people they serve (Shriberg, Satchwell, McArdle, & James, 2010). Nevertheless, surveys suggest that many school psychologists continue to underuse science to inform their clinical practice, and that many routinely use questionable techniques, especially in the domain of clinical assessment.

For example, in a survey aimed at examining regional differences in the assessment practices of American school psychologists ($N=351$), Hosp and Reschly (2002) found that practitioners reported using projective measures nearly as often as behavior rating scales, which were the most frequently used indices. Projective techniques were especially popular in the "coastal" areas of the United States, a finding consistent with the prevalence of psychoanalytic thinking on both coasts (Engel, 2008). A similar and more recent survey by Hojnoski, Morrison, Brown, and Matthews (2006) found that projective tests continued to be widely administered among a sample of 175 randomly selected school psychologists. Specifically, among the most commonly used instruments were sentence completion tests (61%), the Bender Visual–Motor Gestalt Test (50%), the House–Tree–Person test (44%), and the Kinetic Family Drawing Test (41%). The authors noted that "not only are respondents using projective techniques, they are using them for purposes for which they have not been validated specifically" (p. 153). These results are broadly consistent with those of Wilson and Reschly (1996), who found that among school psychologists, the Draw-A-Person (DAP) test, a popular human drawing test, was one of the three most widely used assessment measures (see also Goh & Fuller, 1981; Prout, 1983, for similar results). The findings of Hosp and Reschly and those of Wilson are troubling given evidence that few projective test indices are empirically supported. This is especially the case for the DAP (Chapman & Chapman, 1967; Smith & Dumont, 1995) and other human figure drawing tests, which are of doubtful validity for detecting personality traits and psychopathological symptoms (Dawes, 1994; Lilienfeld, Wood, & Garb, 2000; Motta, Little, & Tobin, 1993; Wood, Nezworski, Lilienfeld, & Garb, 2003).

Investigations of school psychologists' familiarity with and use of empirically-supported intervention practices also offer at least some reason for concern. For example, a survey of a large sample ($N=496$) of practicing school psychologists revealed that 56% of respondents felt that their "knowledge of scientific, research-based reading interventions for students with reading problems" was either "low" or "moderately low" (Nelson & Machek, 2007, p. 317). Although this finding may not be particularly worrisome if these same school psychologists are not choosing which reading interventions to utilize, it may nonetheless be problematic when they are asked to provide referrals (see also Cochrane & Laux, 2008, for evidence regarding many school psychologists' lack of monitoring of treatment integrity, and O'Connor & Kratochwill, 1999, for data on school psychologists' use of self-help materials as psychotherapeutic adjuncts). Bramlett, Murphy, Johnson, Wallingsford, and Hall (2002) found that of the 370 members of the National Association of School Psychologists (NASP) who responded to their survey, 83% reported relying on "personal experiences" to inform their intervention practices (p. 330). By itself, this statistic may not be troublesome given that personal experiences can be helpful in hypothesis generation in clinical and research contexts (Davison & Lazarus, 2007). Nevertheless, in response to the same question, only 62% of participants reported using reference books and only 47% reported using journal articles. Nevertheless, Bramlett and colleagues did not specify whether respondents fall into one or both of these groups (i.e., Are the same school psychologists who reported using journal articles the same ones who use reference books?), nor did they specify whether these journal articles or reference books were based on sound research. Even so, the fact that approximately half of participants reported not using journal articles to inform their clinical interventions is worrisome.

In aggregate, the extant literature on school psychologists' use of evidence-based practices is relatively small and methodologically limited. Nevertheless, the research that exists raises cause for concern and suggests that many school psychologists are not basing their practices on well validated techniques, particularly with respect to assessment. More research concerning school psychologists' use of interventions is clearly warranted.

1.3. Pseudoscience in school psychology

As this collection of surveys suggests, a substantial number of school psychologists appear not to base their practices on solid science. This fact appears to be especially true in the domain of assessment. Moreover, there is ample reason for unease regarding the use of questionable and even pseudoscientific practices in school psychology. But what is pseudoscience?

As we will later discuss in more detail, pseudoscience is "false" or "sham" science that "is not characterized by carefully controlled studies that result in publicly verifiable knowledge" (Lawson, 2007, p. 4). In somewhat different terms, we can think of pseudoscientific practices as those that "possess the superficial appearance of science but lack its substance" (Lilienfeld & Landfield, 2008, p. 1216; see also Lilienfeld, 1998; Ruscio, 2006). In other words, they are imposters of science, although their proponents are rarely deliberate or conscious charlatans. By definition, pseudoscientific practices lack adequate empirical support to back up their extravagant claims. In some cases, they may even cause harm (Lilienfeld, 2007). It is worth noting that pseudoscientific practices are not necessarily entirely invalid or ineffective, but the assertions associated with these practices greatly outstrip the available scientific evidence. Indeed, a broad swath of popular pseudoscientific assessment and intervention strategies are germane to school psychology, including techniques associated with learning disorders, autism, attention deficit disorders, and conduct problems (e.g., see Lilienfeld et al., 2003; Stanovich, 2005; Thyer & Pignotti, in press, for selected examples). We will discuss a number of these approaches later in the article.

1.4. Widespread myths in school psychology

Like most or all domains of psychology (Lilienfeld, Lynn, Ruscio, & Beyerstein, 2010), school psychology also has more than its share of myths: widely accepted claims that are not buttressed by compelling evidence. Indeed, in 1997 a special issue of *School Psychology Review* was devoted to prominent myths in school psychology, including misconceptions regarding reading and mathematics disabilities, the treatment utility of assessment, the treatment of attention deficit/hyperactivity disorder (ADHD), and school-based suicide prevention programs. Below, we offer a highly selective (and far from exhaustive) sampling of a variety of myths relevant to school psychology (see Lilienfeld et al., 2010; Miller & Sawka-Miller, 2011, for other examples). We discuss several other popular but poorly supported beliefs, such as the purported effectiveness of facilitated communication for autism, the notion that certain people are "left-brained" and others "right-brained," and the claim that matching students' learning styles with teachers' teaching styles boosts their learning, later in the article.

- *Self-esteem*: Many psychologists assume that low self-esteem is highly related to maladjustment and poor school achievement, and many schools provide programs designed to foster self-esteem. Yet studies show that although self-esteem is indeed negatively correlated with depression, this correlation is only modest in magnitude; moreover, self-esteem is minimally related to interpersonal success and substance use (Baumeister, Campbell, Krueger, & Vohs, 2003; Dawes, 1994; but see Swann, Chang-Schneider, & Larsen McClarty, 2007, for a somewhat different view). Moreover, most research suggests that although low self-esteem is correlated with poor school achievement, it is not causally related to it (Mercer, 2010).
- *DARE programs*: Drug Abuse Resistance and Education (DARE) programs, in which uniformed and specially trained police officers teach children about the dangers of substance use, are widely used in schools

in America and around the world; in the U.S., for example, DARE is implemented in approximately 80% of school districts. Nevertheless, controlled research consistently shows that DARE is ineffective in reducing risk for drug use (Lynam et al., 1999).

- *Subtest scatter*: Numerous practitioners rely heavily on subtest scatter (differences among subtests of omnibus tests of mental abilities, such as the Wechsler Intelligence Scale for Children, or WISC) to draw inferences regarding children's specific cognitive deficits. For example, many believe that the “ACID” profile (low scores on the WISC Arithmetic, Coding, Information, and Digit Span subtests) is associated with a markedly higher risk of learning disabilities (Vargo, Grosser, & Spafford, 1995). Yet research shows that subtest scatter accounts for minimal, if any, variance above and beyond general cognitive abilities for predicting academic achievement and learning problems (Watkins, 2003).
- *Late-talking children*: A number of clinicians, including speech therapists, believe that late-talking children are at markedly elevated risk for autism. Yet data suggest that the substantial majority of late-talking children later develop normally, both socially and intellectually (Sowell, 1997).
- *School-based suicide-prevention programs*: School-based suicide intervention programs for adolescents are widespread and increasingly popular in many school districts. Yet controlled studies reveal surprisingly little research evidence for their efficacy and even raise the possibility that such programs are occasionally iatrogenic (Mazza, 1997). Recent reviews of suicide prevention programs focused on targeting broader audiences underscore the need for additional research before firm conclusions can be drawn regarding their efficacy (Mann & Currier, 2011; Rodgers, Sudak, Silverman, & Litts, 2007).
- *Whole-word learning*: Many teachers have argued for whole-word learning approaches (based on the “look–say” method) to teach children to read; programs based on these approaches continue to be widely used. Yet research shows that more traditional reading approaches based on phonics tend to be more effective than whole-word instruction approaches, although phonics approaches may be helpful supplements to whole-word approaches (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).
- *Discovery learning*: A widely accepted “truism” in the science and mathematics education community is that discovery-based approaches, in which children must uncover underlying principles (e.g., of the basic techniques of experimental design) on their own, results in deeper and more enduring knowledge than direct instruction approaches, in which children are simply told what these principles are. Yet most research suggests that although discovery learning approaches often have some role to play as adjunctive educational techniques, they are generally less effective in promoting learning of scientific and mathematical principles than are direct instruction approaches (Klahr & Nigam, 2004).
- *Dyslexia and letter reversal*: A widely held belief is that the defining feature of dyslexia is the tendency to reverse letters, either by seeing certain letters themselves backwards (e.g., seeing the letter “b” and “d”) or by reversing letters within words (e.g., seeing the word “bed” as “deb”). Yet research shows that although letter reversals are generally more common among children with dyslexia than among other children, they are hardly key diagnostic indicators of the condition. Many children with dyslexia do not display letter reversals, and many non-dyslexic children aged 6 or younger display such reversals (Cassar, Treiman, Moats, Pollo, & Kessler, 2005; Shaywitz, 1996).
- *Autism epidemic*: Much of the news media has promulgated the claim that the rates of autism have increased dramatically since the early 1990s. Yet there are serious reasons to question this assertion, because the diagnostic criteria for autism have become considerably less stringent over time and because the reported increases in prevalence derive not from population-based studies that rely on standardized diagnostic criteria for autism, but from school-based studies in which educational districts report the number of children diagnosed with autism (Gernsbacher, Dawson, & Goldsmith, 2005). Indeed, in one study in the United Kingdom, the rates of autism remained unchanged from 1992 to 1998 when the identical diagnostic criteria were used at both assessments (Chakrabarti & Fombonne, 2005).

School psychology myths are important, because they can produce either direct or indirect harm (see also Lilienfeld et al., 2010). For example, school psychologists who rely heavily on intelligence test subtest scatter to diagnose learning disabilities will often misdiagnose these problems, and school psychologists who assist in developing unvalidated suicide intervention programs may waste valuable time, energy, and money on ineffective techniques for potentially life-threatening student problems (to which economists refer as “opportunity costs”). Thus, we believe that school psychologists in training should be introduced to these and other prevalent myths during the course of their graduate education.

1.5. Goals of this article

Our overarching goals in this article are fourfold. First, we outline several basic principles of scientific thinking, with particular reference to school psychology. We argue that science and scientific thinking are valuable, indeed essential, safeguards against the often seductive charms of pseudoscience. They can also help us to identify superficially compelling myths and misconceptions pertinent to school psychology. Second, we delineate widespread cognitive errors that can impede the accurate evaluation of clinical practices and can contribute to the adoption of pseudoscientific practices and the embrace of misconceptions, especially in school psychology. In addition, we discuss potential strategies for minimizing these cognitive errors. Third, we provide a set of user-friendly criteria for distinguishing science from pseudoscience, again with particular reference to practices in school psychology. Fourth, we conclude with a set of concrete prescriptions to school psychology researchers and practitioners for incorporating scientific thinking into their everyday work.

Across the four major sections of our article, our overarching goal is to equip school psychologists and psychologists in allied domains with scientific thinking skills that can better allow them to navigate the often bewildering mix of well-supported, poorly-supported, and equivocally-supported practices that comprise their fields. In this way, readers should emerge with tangible tools for sorting the wheat from the chaff in school psychology and for distinguishing science from pseudoscience across all domains of psychology.

2. Basic principles of scientific thinking: guidelines for school psychologists

2.1. Science: a rough definition

We have already offered a thumbnail definition of pseudoscience. But what is science? Philosophers of science have long debated the answer to this deceptively complex question. Although we do not intend to offer a conclusive answer here, we offer some helpful guidelines.

Whatever science may be, it is clear what it is *not*. Science is not a body of accumulated facts and figures, nor is it a monolithic truth-gathering device that is identical across diverse disciplines. Although “the” scientific method is often introduced in high school biology, chemistry, or physics classes as a single technique for helping us understand the state of nature, each scientific discipline is associated with its own set of safeguards against error. Hence, the concept of “the” scientific method is almost surely a myth (Bauer, 1994) because there are multiple scientific methods, each tailored to answer different kinds of questions. Diverse scientific fields, including psychology, chemistry, biology, and astrophysics, use vastly different methods for minimizing errors and arriving at a closer approximation of the truth. Even within psychology, the research methods used by clinical, counseling, and school psychologists (e.g., correlational designs to examine the predictive validity of intelligence for academic performance), for example, differ sharply from those used by perceptual psychologists (e.g., psychophysical methods to investigate participants' ability to distinguish between two similar visual stimuli).

Yet despite their marked surface differences, the scientific methodologies used by different fields outside of and within psychology share one key feature: a commitment to rooting out errors in our web of beliefs (O'Donohue, Fowler, & Lilienfeld, 2007). Ultimately, as most philosophers conceive of it, the systematic *approach* to knowledge, rather than the characteristics of knowledge *per se*, renders a discipline scientific. Specifically, as Nobel-prize winning physicist Richard Feynman (1985) argued, the essence of science is bending over backwards to prove ourselves wrong. As Feynman noted, we should be continually striving to find ways of subjecting our most cherished beliefs to rigorous testing and to changing our minds when the evidence compels us (O'Donohue, Fowler, & Lilienfeld, 2007).

As astronomer and science writer Carl Sagan (1995a) observed, science is first and foremost a way of thinking, a mindset of doubt coupled with an open-mindedness to new claims. Moreover, as space engineer James Oberg (see also Sagan, 1995b) reminded us, we must strike a healthy balance between doubt and open-mindedness: this balance is the approach often termed *skepticism*. Skepticism, in contrast to *cynicism*, implies a willingness to consider novel claims but also an insistence on evidence to support them. Cynicism is marked by dismissiveness toward new and untested claims, and in many respects is just as problematic as excessive open-mindedness (Beyerstein, 1995). In Sagan's (1995a) eloquent words,

> Science involves a seemingly self-contradictory mix of attitudes. On the one hand, it requires an almost complete openness to all ideas, no matter how bizarre and weird they sound, a propensity to wonder…But at the same time, science requires the most vigorous and uncompromising skepticism, because the vast majority of ideas are simply wrong, and the only way you can distinguish the right from the wrong, the wheat from the chaff, is by critical experiment and analysis. Too much openness and you accept every notion, idea, and hypothesis—which is tantamount to knowing nothing. Too much skepticism—especially rejection of new ideas before they are adequately tested—and you're not only unpleasantly grumpy, but also closed to the advance of science. A judicious mix is what we need (p. 30).

2.2. Science versus common sense

In sharp contrast to writers who have argued that science is little more than formalized common sense (e.g., Huxley, 1863; see also Horgan, 2005), we side with those (e.g., Cromer, 1993; McCauley, 2000; Wolpert, 1993) who have contended that the essence of science is "uncommon sense." That is, science is unnatural, because it often requires us to override our gut hunches and intuitions about the natural world, including the psychological world.

Perhaps most centrally, science is a potent antidote against *naïve realism* (Ross & Ward, 1996), the tempting but erroneous assumption that the world is exactly as we see it. A host of sayings in our language attest to the hold of naïve realism on our everyday thinking: "Seeing is believing," "I'll believe it when I see it," "I saw it with my own eyes." Indeed, naïve realism is arguably the wellspring of many of the most spectacularly wrongheaded scientific theories in history. For most of human history, people assumed that the earth was the center of the solar system, if not the universe, because their raw perceptions—and their naïve realism—assured them that this was the case. After all, each day, we seemingly remain planted on *terra firma* as the sun paints a huge arc around the sky from dawn to dusk (Lilienfeld et al., 2010). Thus, from a phenomenological perspective, we do indeed *seem* to be at the center of things, although this perspective is of course misleading.

Similarly, when a school psychologist conducts an intervention to alter a child's problematic classroom behavior and observes improvement following that intervention, he or she may assume that the intervention was responsible for the change. That conclusion would be understandable, as it dovetails with naïve realism: "I saw the change with my own eyes." But this inference would be erroneous, as it reflects the logical error of "post hoc, ergo propter hoc" (after this, therefore because of this). Specifically, the conclusion neglects to consider a plethora of rival explanations for the improvement, including naturally occurring changes (e.g., spontaneous remission of symptoms), regression to the mean (the tendency of extreme scores to become less extreme following re-testing), placebo effects (improvement resulting from the mere expectation of improvement), multiple treatment interference (attributing improvement to a specific treatment when in fact it is due to a co-occurring intervention), novelty effects (the tendency of participants to react differently to any new intervention), and other artifacts (Beyerstein, 1999; Lilienfeld, Lohr, & Olatunji, 2008). Instead, to evaluate whether the intervention worked, school psychologists must avail themselves of scientific methods, such as randomized controlled trials (Chambless & Ollendick, 2001) and systematic within-subject designs (Kazdin, 2010), which help to exclude most of these sources of error.

At least some of the reluctance to embrace evidence-based practice in school psychology is therefore understandable, and it largely reflects a preference for intuitive, "commonsense" reasoning over scientific reasoning. The former form of reasoning, we contend, comes more naturally and automatically to all of us. Scientific reasoning, in contrast, is unnatural: it must be learned, practiced, and maintained as a habit of mind (Cromer, 1993; Watkins, 2009). Indeed, recent work in developmental psychology suggests that young children display certain deep-seated impediments to scientific thinking, such as a tendency to infer teleology (i.e., purpose) and causation even when it is absent (Bloom & Weisberg, 2007). Simply put, scientific thinking is not a natural way of conceptualizing the world (McCauley, 2000). Hence, it is hardly surprising that scientific thinking is a relatively recent development in human history, originating in incipient form in Ancient Greece and not emerging full-fledged until the European Enlightenment in the late 17th century (Lilienfeld, 2011).

When viewed from this perspective, some school psychologists' resistance to evidence-based assessment and treatment approaches is not terribly surprising. Most of us are inclined to trust our intuitions and informal observations, which tend to be personal, tangible, and subjectively immediate. We also tend to privilege them over scientific findings, which tend to be impersonal, abstract, and subjectively distant. Hence, when school psychologists' intuitions regarding the validity of an assessment technique or the efficacy of a psychological intervention conflict strongly with well-replicated scientific evidence, they may often side with their intuitions. Yet the lengthy history of errors in medicine, psychology, and other disciplines teaches us that clinical intuitions, although certainly helpful in many circumstances, are fallible (Dawes, Faust, & Meehl, 1989). Many historians of medicine have argued that prior to about 1890, the history of medicine was largely the history of the placebo effect and that most procedures practiced by physicians were useless, harmful, or at best, no more useful than a placebo. For centuries, physicians "knew"—based on their clinical experience—that such treatments as blistering, purging, and blood-letting were effective, even though we now recognize that this "knowledge" was woefully mistaken (Grove & Meehl, 1996).

Still, it is worth noting that intuitions are hardly useless despite their fallibility (Kahneman & Klein, 2009; Myers, 2002). In particular, intuitions can sometimes be extremely helpful in what philosophers of science sometimes term the "context of discovery" (Meehl, 1990; Reichenbach, 1938)—that is, hypothesis generation. For example, an experienced school psychologist who has a strong hunch that a child has been sexually abused should in most cases be certain to check out this hunch, while bearing in mind the hazards of confirmation bias (see below). But in the "context of justification," that is, systematic hypothesis testing, an overreliance on intuitive thinking can be dangerous, even disastrous. That is because our intuitions, which rely on quick, associative thinking rather than slow, analytical thinking, are not generally well suited to addressing scientific questions (Kahneman, 2011). For example, intuitive, "gut level" thinking is not typically geared to ruling out rival hypotheses in school psychology settings, such as hypotheses concerning whether a child with ADHD's improvement following a psychological intervention is due to the intervention itself or to a host of other factors (e.g., placebo effects, regression to the mean, maturation).

The bottom-line message here is not to reflexively ignore our clinical intuitions, as our hunches and subjective clinical observations (a) are sometimes correct and (b) can sometimes be helpful in generating fruitful hypotheses to later be tested in rigorous investigations. Instead, we must treat our clinical intuitions with healthy skepticism and be prepared to modify or even discard them when well-controlled scientific evidence repeatedly contradicts them. In addition, school psychologists should continually strive to put their powerful intuitions to systematic tests in both clinical and research settings. In some cases, these intuitions will turn out to be accurate; in others, they will turn out to be erroneous.

Only scientific methods—safeguards against error—can ultimately tell us whether our intuitions are correct or incorrect. If the history of science has taught us anything, it is that subjective certainty is an untrustworthy guide to the veridicality of scientific claims (see Gardner, 1957; Hyman, 2001; for a number of classic examples). We should listen to our intuitions, but we should not be imprisoned by them.

3. Commonplace cognitive errors relevant to school psychology

School psychologists, like all practicing psychologists, must remain vigilant against a host of errors in thinking that can result in suboptimal practice (see Croskerry, 2003; Crumlish & Kelly, 2009; Gambrill, 2005; Watkins, 2009, for comprehensive descriptions of these and other cognitive errors). These errors may also contribute to the uncritical acceptance of questionable practices, especially those that superficially appear to be scientific but are not (Gilovich, 1991). Like visual illusions, these errors, which we can think of as *cognitive illusions* (Piatelli-Palmarini, 1994; Pohl, 2005), tend to be subjectively compelling: They do not seem to us to be errors at all, even though they are. Moreover, like visual illusions, we may never be able to overcome them fully, because they are byproducts of basically adaptive psychological tendencies, especially our tendency to extract meaning from our worlds even when such meaning is absent (Shermer, 2011). Putting it a bit differently, most errors in reasoning are probably cut from the same cloth as effective reasoning. The good news is that by becoming aware of these cognitive errors, we may be able to develop thinking skills or habits of mind to overcome them.

Incidentally, there is no reason to believe that researchers, ourselves included, are immune from any of the cognitive errors we describe below. To the contrary, at least some data suggest that scientific researchers may be even more prone to certain errors in thinking, such as confirmation bias (see the paragraph that follows), than are nonscientists (Mahoney & DeMonbreun, 1977). The key difference between successful and unsuccessful scientists is not that the former are less susceptible to errors in thinking than the latter. Instead, the key difference is that the former typically avail themselves of the safeguards of scientific methodology, whereas the latter do not. This key difference in mindset, we propose, also separates successful practitioners from unsuccessful practitioners in school psychology and related fields. Ironically, good practitioners are typically those who are most cognizant of their propensity toward mistakes, because they can make concerted efforts to minimize them.

Before proceeding further, it is worth noting that cognitive errors are largely independent of overall intelligence (Stanovich, 2009) and hence should not be attributed to low cognitive ability. Indeed, the history of science is replete with vivid examples of highly intelligent scientists, even Nobel-prize winners, acting in foolish and irrational ways (Hyman, 2001; Shermer, 2002). Two-time Nobel-prize winner Linus Pauling, for example, was convinced that large doses of Vitamin C could cure cancer (Pauling, 1980), despite overwhelming evidence to the contrary. Such observations dovetail with our earlier point that scientific thinking does not come naturally to the human mind: highly intelligent and even brilliant individuals can be prone to serious lapses in such thinking. This is why we need science.

Here we provide a selective list of cognitive errors, with a particular focus on seven classes of errors that are especially pertinent to the everyday work of the school psychologist (see also Wedding & Faust, 1989, for cognitive errors relevant to neuropsychological assessment). Table 1 presents a list of these seven major classes of cognitive errors, along with a number of other errors that are important for school psychologists to consider and avoid (see also Watkins, 2009, for an excellent overview).

3.1. Confirmation bias

As we noted earlier, science is a toolbox of techniques designed to minimize human error. More formally, we can regard science as a formalized set of tools for overcoming *confirmation bias* (Nickerson, 1998), the

Table 1
Widespread cognitive errors and biases relevant to school psychologists.

Error	Description
Naïve realism	Belief that the world is precisely as we see it
Confirmation bias	Tendency to seek out evidence consistent with our beliefs, and deny, dismiss, or distort evidence that is not
Premature closure	Coming to a premature conclusion before adequate evidence is available
Belief perseverance	Tendency to cling to beliefs despite repeated contradictory evidence
Illusory correlation	Tendency to perceive statistical associations that are objectively absent
Hindsight bias	Error of perceiving events as more predictable after they have occurred
Groupthink	Preoccupation with group unanimity that impedes critical evaluation of an issue
Overreliance on heuristics	Tendency to place too much weight on mental shortcuts and rules of thumb
Availability heuristic	Judging the probability of an event by the ease with which it comes to mind
Anchoring heuristic	Tendency to be unduly influenced by initial information
Affect heuristic	Judging the validity of an idea by the emotional reaction it elicits in us
Representativeness heuristic	Judging the probability of an event by its similarity to a prototype
Base rate neglect	Neglecting or ignoring the prevalence of a characteristic in the population
Bias blind spot	Tendency to see ourselves as immune to biases to which others are prone
Unpacking[a]	Failure to elicit all relevant diagnostic information about an individual
Aggregate bias[a]	Assumption that group data are irrelevant to a given individual or client
Search satisfying[a]	Tendency to end one's search for other diagnostic possibilities once one has arrived at an initial diagnostic conclusion
Diagnostic overshadowing[a]	Tendency for a dramatic, salient diagnosis (e.g., major depression) to lead clinicians to overlook less obvious diagnoses (e.g., learning disability)
Diagnosis momentum[a]	Tendency to uncritically accept previous diagnoses of the same individual
Psych out error[a]	Neglecting the possibility that a behavioral problem is medical, not psychological, in origin
Pathology bias[a]	Tendency to overpathologize relatively normative behavior

[a] *Note.* Error or bias not discussed in the text.

deeply ingrained tendency to seek out evidence consistent with our hypotheses and to deny, dismiss, or distort evidence that is not (Tavris & Aronson, 2007). We can sum up confirmation bias in five words: "Seek and ye shall find" (Lilienfeld, Lynn, Namy, & Woolf, 2011). As described eloquently by Baron (1994), confirmation bias "makes us into lawyers, hired by our own earlier views to defend them against all accusations rather than detectives seeking the truth itself" (p. 218; see also Watkins, 2009). To a large extent, scientific thinking is designed to minimize confirmation bias, especially the tendency for investigators to find evidence for their preferred hypotheses. Richard Feynman (1985) put it well when he described science as a set of methods developed to minimize the chances that we can be fooled—and fool ourselves.

In the domain of school psychology, confirmation bias can manifest itself in a host of ways. For example, a school psychologist may form an initial impression of a child as possessing a learning disability. She may then selectively seek out all evidence consistent with that diagnosis, such as anecdotal reports from school teachers and parents, while ignoring or minimizing evidence that is inconsistent with it, such as average performance on a well-validated test battery designed to detect learning disabilities. Unless school psychologists are perpetually on guard against their own deep-seated preconceptions, confirmation bias can easily become "tunnel vision," blinding them to evidence that calls their hunches and hypotheses into question.

In psychological research, essential safeguards against confirmation bias include (a) *randomized controlled trials*, which help to control for the experimenter expectancy effect (i.e., the tendency for researchers' preconceptions to unintentionally bias their recording, interpretation, or both of findings) and other biases (Rosenthal, 1994), (b) *systematic within-subject designs*, which help to control for the erroneous tendency of observers to attribute naturally occurring changes over time within subjects to the treatment (Moran & Tai, 2001), (c) *longitudinal designs*, which help to control for hindsight bias (Arkes, 1991), that is, perceiving outcomes as more predictable than we would have in advance (see section on hindsight bias that follows), and (d) *correlational designs*, which minimize the probability of illusory correlations, that is, perceiving statistical associations in their objective absence (see section on illusory correlation that follows; Chapman & Chapman, 1967, 1969). In regard to the last design, it is crucial that we not lose sight of the familiar statistical mantra that correlation does not necessarily imply causation (i.e., the fact that an association between two variables exists does not imply a causal association between them).

In psychological practice, including that of school psychology, scientific practice similarly incorporates formal safeguards against confirmation bias and allied errors. For example, standardization of aptitude test administration and scoring minimize—although do not eliminate—the likelihood that a school psychologist who believes that a child is intellectually gifted will inadvertently give that child "a break" when scoring certain items, especially those that he or she barely missed. By incorporating standardized questions and prompts, structured and semi-structured interviews for child psychiatric disorders, such as the Kiddie-Schedule for Affective Disorders and Schizophrenia (KIDDIE-SADS; Puig-Antich & Chambers, 1986), similarly minimize the likelihood that interviewers' initial hunches about a child's diagnosis or diagnoses will become self-fulfilling prophecies.

Confirmation bias is associated with two closely related errors that are relevant to school psychology. *Premature closure* (Gauron & Dickinson, 1969) is the tendency to arrive at confident diagnostic judgments before adequate data are available. For example, a school psychologist might quickly leap to the conclusion that a child has attention-deficit/hyperactivity disorder (ADHD) on the basis of an initial classroom observation that he is jumpy and fidgety. This conclusion would typically be problematic because many normal children, including intellectually gifted children, display such behaviors on occasion, especially when bored or unstimulated (Hartnett, Nelson, & Rinn, 2004). A second related error, *belief perseverance*, is the tendency to cling to initial ideas despite repeated contrary evidence (Ross, Lepper, & Hubbard, 1975). For example, when presented with evidence that the child mentioned immediately above was not perceived as especially inattentive, impulsive, or hyperactive by his parents or by several independent teachers, the same school psychologist might continue to insist that this child must have ADHD. Although holding on to one's beliefs in the face of contrary evidence is sometimes warranted if there is good reason to doubt the quality or quantity of that evidence, one must be willing to abandon it when the evidence becomes convincing.

There is no simple "cure" for confirmation bias. Nevertheless, research suggests that by forcing ourselves to "consider the opposite"—that is, to ask ourselves what conclusions we would have drawn had the findings contradicted our beliefs—we can sometimes compensate for confirmation bias by envisioning alternative hypotheses (Lilienfeld, Ammirati, & Landfield, 2009; Lord, Lepper, & Preston, 1984). For example, imagine a school psychologist who has a strong suspicion that a girl was sexually abused by her father. The psychologist then comes across evidence that the child is usually shy and inhibited around male adults, including male teachers. He concludes that such behaviors support his suspicion of abuse. To consider the opposite, the school psychologist should ask himself "Would I have drawn the same conclusion if the child were unusually comfortable or excessively friendly around male teachers?" If the answer is a possible or probable yes, the teacher may become less confident of his conclusion—as he probably should.

3.2. Illusory correlation

As a number of psychologists (e.g., J.E. Alcock, 1981; Pinker, 1997) and science writers (e.g., Shermer, 2002) have noted, the human mind is a pattern-seeking organ. Shermer (2011) has aptly described it as "a belief engine." We tend to look for and find connections among events in our environments. In this way, we often find order in disorder and sense in nonsense. The adaptive significance of this tendency is undeniable, as it helps us to make sense of our often bewildering worlds.

Nevertheless, this meaning-making tendency can sometimes lead us to perceive statistical associations even when they are objectively absent, a remarkable phenomenon that psychologists Chapman and Chapman (1967, 1969) termed *illusory correlation*. Many school psychologists are convinced that a strong association exists between certain "signs" or indicators in children's human figure drawings and their propensity for psychological problems. For example, some school psychologists believe that physical proximity in kinetic family drawing tests (e.g., placing oneself near one's parents in the drawing) is a good indicator of interpersonal closeness to others. Others believe that the presence of large eyes in a DAP drawing is a dependable indicator of suspiciousness. Yet controlled research demonstrates that these associations are largely or entirely illusory, as are the substantial majority of other purported associations between specific figure drawing signs and either personality or psychopathology (Motta et al., 1993; also see Gresham, 1993; Kahill, 1984; but see Holtzman, 1993, for a different view).

Although there are probably multiple sources underlying illusory correlation, perhaps the most important for our purposes is the all-too-human tendency to recall our hits, and forget our misses. When a finding seemingly corroborates our expectations, we usually attend to it and remember it, an error termed the "fallacy of positive instances" (Coon, 2005). In contrast, when a finding violates our expectations, we more often than not ignore it or explain it away as a "near miss" (Gilovich, 1991). By predisposing us to weight certain occurrences more than we should, this propensity toward selective perception and memory can lead us to perceive statistical associations that are not present as well as to perceive weak statistical correlations as strong in magnitude.

By learning to attend to our misses as well as our hits, we may be able to overcome or at least minimize our propensities toward illusory correlation (see T. Alcock, 1981). For example, a school psychologist whose clinical experience leads her to believe that children who are intellectually gifted tend to have poor social skills may wish to force herself to keep track of all of the instances that do not fit this pattern, especially cases of intellectually gifted children who are socially skilled. She may also want to force herself to keep track of all of the cases of non-intellectually gifted children who are socially unskilled. By doing so, she may help to avoid the fallacy of positive instances by attending to instances that do not corroborate her expectations.

3.3. Hindsight bias

We have all learned that hindsight is 20–20, but this axiom is easy to forget in the busy world of everyday clinical practice. Indeed, we are all susceptible to *hindsight bias*—the "I knew it all along effect"—which is the error of perceiving events as more predictable after they have occurred compared with before they occurred (Fischoff, 1975; Hawkins & Hastie, 1990). Arkes, Wortmann, Saville, and Harkness (1981) presented physicians with a hypothetical case history of a patient with ambiguous physical symptoms along with four alternative medical diagnoses that could explain his symptoms. Some physicians were not told which of the four diagnoses were correct; others were. Sure enough, the latter physicians were much more certain that they *would* have made the correct diagnosis than were the former. The knowledge of the outcome had biased their estimates of the certainty of their predictions.

As Arkes et al. (1981) observed, hindsight bias can contribute to overconfidence, as well as to second opinions spuriously corroborating first opinions. For example, a school psychologist might learn that a new child in the school who speaks up frequently in class and challenges his teachers' authority was diagnosed by a psychologist at his previous school with oppositional defiant disorder (ODD). Having learned this information, the school psychologist may become overly confident in her diagnosis of the child as having ODD and may conclude that she surely would have made the same diagnosis based on the child's behavior (e.g., "From practically the moment I saw him in the classroom, I could tell that he had ODD"). This undue confidence may then lead her to become unduly certain of her future diagnostic judgments.

Hindsight bias is potentially problematic for reasons other than overconfidence. For example, it can lead school psychologists to engage in "deterministic reasoning" (Garb, 1998; Moran & Tai, 2001): presuming that an event that preceded a pathological outcome is likely to be causally related to that outcome. For example, the first author of this article consulted on a case in which an adopted young adolescent was charming and intelligent, yet dishonest, disruptive, and oppositional with adults. Perhaps largely because of their knowledge of the child's behavior, the school psychologist and a social worker working with the teenager were quick to place blame on the adoptive parents for the child's misbehavior, despite any compelling evidence that their parenting skills were suboptimal and in spite of at least some evidence to the contrary (e.g., that their biological children were well adjusted). Moreover, they initially ignored plausible competing hypotheses, such as the possibility that much of the child's behavior could reflect his genetic background; indeed, there was ample evidence that his biological father not only had a lengthy criminal record but also exhibited many classic features of psychopathic personality, such as lack of guilt and empathy (see Hare, 2003).

Although there is no foolproof strategy for overcoming hindsight bias, at least some evidence suggests that generating reasons for why possibilities other than the actual outcome might have occurred can minimize such bias (Arkes, Faust, Guilmette, & Hart, 1988; but see Sanna & Schwarz, 2003, for evidence that asking participants to list too many reasons may occasionally backfire). For example, a school psychologist who is certain that a previous psychologist's diagnosis of ODD for a given child is correct may wish to generate reasons why alternative diagnoses (e.g., ADHD) might instead be correct. By doing so, he may come to realize that the diagnosis was not so self-evident after all.

3.4. Groupthink

Because we humans are social beings, we are readily influenced by the opinions of others. This is not necessarily a net negative, as the views of other people are often worth considering. Yet our susceptibility to group opinion can occasionally predispose us to *groupthink*, a term coined by Janis (1972) based on his analysis of the Kennedy administration's disastrous 1961 decision to invade Cuba's Bay of Pigs. According to Janis, groupthink is a preoccupation with group unanimity that can impair the critical evaluation of decisions. As Janis noted, groupthink comprises a host of "symptoms," including (a) a pressure toward conformity (e.g., "We really need to come to a consensus on this issue"), (b) an illusion of the group's unanimity (e.g., "We all agree, right?"), (c) an illusion of the group's correctness (e.g., "Clearly, we're on the right track"), (d) the presence of mindguards, that is, self-appointed members of the group who suppress dissent (e.g., "Are you sure you know what you're talking about?"), and (e) self-censorship, that is, the tendency to keep doubts about the group's decision to oneself (e.g., "This seems like a really bad decision, but I must be missing something, so I'll keep quiet"). Admittedly, groupthink is not invariably negative (Tyson, 1987), as it can sometimes lead to accurate and efficient decisions. Yet groupthink has a pronounced dark side, as it may lead groups, even those comprising highly intelligent and informed individuals, to make profoundly misguided decisions.

Because school psychologists often work in teams of other professionals, they must remain vigilant against the perils of groupthink. For example, some authors have argued that groupthink may sometimes come into play during team decisions regarding special education disability services (e.g., VanDerHeyden, Witt, & Naquin, 2003; Ysseldyke, 1987). In such cases, school psychologists may feel compelled to accede to other members' opinions about whether a child is entitled to disability accommodations even when they disagree with them. Gutkin and Nemeth (1997) noted in their review of the literature that "Multidisciplinary diagnostic teams in school settings, for example, have been found to reach inappropriate decisions based on irrelevant student data (e.g., naturally occurring pupil characteristics such as gender, socioeconomic status, and physical appearance), resource availability, and 'teacher squeak' (i.e., how potently a teacher complains about a referred student)" (p. 197).

Fortunately, as Janis (1972) observed, groupthink may be mitigated by explicitly encouraging minority dissent and perhaps by appointing a “devil's advocate” whose explicit role is to raise questions regarding group decisions (see also Gutkin & Nemeth, 1997). At least some research supports the value of minority dissent in encouraging diversity of thinking in teams (Nemeth, Brown, & Rogers, 2001).

3.5. Overreliance on heuristics

Heuristics are mental shortcuts or rules of thumb that we all use to simplify and streamline our processing of information (Herbert, 2010; Tversky & Kahneman, 1974). In general, heuristics are adaptive and efficient, as they allow us to make “fast and frugal” decisions based on relatively little information (Gigerenzer & Brighton, 2009). For example, the “recognition heuristic” is the guideline that “If we've heard of something, it's probably higher in quality” (see Goldstein & Gigerenzer, 1999). So, if we learn that an academic job candidate graduated from the psychology department at Harvard University, we might be inclined to conclude that the candidate—all else being equal—is better trained than if that candidate graduated from the psychology department at Nowhere Community College.

But as this example amply illustrates, heuristics can sometimes lead us astray, as all things are not always equal. Indeed, some job candidates from Nowhere Community College are probably better trained than those from Harvard University, so recognition is not a foolproof barometer of quality. Similarly, a practitioner might assume that Test X is a more construct valid measure of reading disabilities than is Test Y merely because it is better known, but perhaps Test X is less valid for this purpose but has been marketed and promoted more extensively. The last several decades of psychological research have taught us that heuristics, although generally helpful and even necessary for functioning in everyday life, can lead to predictable errors if we apply them uncritically (Gilovich, Griffin, & Kahneman, 2002). Here, we briefly review four heuristics that are especially pertinent to school psychology (see Herbert, 2010, for a comprehensive description of heuristics).

The *availability heuristic* is the tendency to judge the likelihood of an occurrence by the ease with which it comes to mind. For example, if I ask a school psychologist whether more boys than girls in his school are on stimulants (e.g., Ritalin) for ADHD and related disorders, he may quickly bring to mind the many cases of boys on stimulants and conclude—in this case probably correctly—that more boys than girls in his school are on stimulants. Nevertheless, the availability heuristic can sometimes lead us to judge probabilities inaccurately, especially if we accord undue weight to certain salient, but unrepresentative, examples. For instance, if we hear of two or three tragic shootings in various U.S. schools over the past few months, we may be tempted to conclude that violence in schools is of epidemic proportions, because such violence comes readily to mind. In this case, we would be mistaken, as most evidence actually suggests a decrease, not an increase, in school violence over the past decade or two (Cornell, 2006).

The *anchoring heuristic* is the tendency to be influenced too heavily by initial information; once we obtain such information, we often do not adjust away from it sufficiently. For example, a school psychologist may learn mistakenly that a child's IQ is low (e.g., 75). When later informed that the IQ test was administered and scored incorrectly and that the child's actual IQ is closer to 100, the psychologist may not fully “wipe the slate clean” and disregard the initial information. Instead, the psychologist may remain anchored to the earlier IQ estimate and assume erroneously that the child is of below average overall cognitive ability. We can also think of confirmation bias and its close relatives (i.e., premature closure and belief perseverance) as derivatives of the anchoring heuristic, as this bias reflects a failure to modify our initial beliefs sufficiently following the receipt of new information.

The *affect heuristic*, sometimes also referred to as “emotional reasoning,” is the tendency to use our emotions as guides to evaluating the veracity of an assertion. More often than not, if a claim arouses positive emotions in us, we may be inclined to believe it; conversely, if a claim arouses negative emotions in us, we may be inclined to disbelieve it. Imagine a school psychologist whose graduate school training has led him to believe that projective testing is helpful for detecting child sexual abuse (see Garb, Wood, & Nezworski, 2000, for evidence to the contrary). Further, assume that he relies heavily on projective techniques in his everyday clinical practice and views them as broadly consistent with his psychodynamic perspective on personality. Upon attending a conference presentation that calls into question the use of projective techniques for detecting child sexual abuse, he may become angry and upset and use this negative emotional reaction as an indication that the conference presenter's conclusions were mistaken. Yet becoming a good scientist requires us to set aside our emotions in favor of data, a capacity that few (if any!) of us are good at.

The *representativeness heuristic* is the tendency to assume that "like goes with like." When we use this heuristic, we are gauging the likelihood that an event or object is a member of a broader class by evaluating its similarity to a prototype. In essence, we are judging a book by its cover. Of course, sometimes books do resemble their covers: most people who seem very angry in fact are angry, and most people who greet us with a warm smile like us. Yet if used uncritically, the representativeness heuristic can lead us to commit systematic mistakes, because appearances can sometimes be deceiving. For example, when administering an IQ test to a child referred for behavioral difficulties, a school psychologist might fixate on the fact that some of the child's responses (e.g., idiosyncratic definitions of several vocabulary items) remind him of responses he has observed among a few children with autism spectrum disorders. By placing undue weight on these similarities, the psychologist may conclude erroneously that the child has an autism spectrum disorder.

3.6. Using heuristics thoughtfully

Heuristics are essential for everyday functioning, and they are also essential for the routine clinical practice of the school psychologist. They save time and often lead to approximately correct solutions (Gigerenzer, 2007). But as we have learned, they can lead to certain predictable errors if used uncritically (Herbert, 2010; Tversky & Kahneman, 1974). Thus, it is crucial for school psychologists to learn to question their initial judgments, especially when they are relevant to important clinical decisions, and actively seek out evidence that might call them into question.

3.7. Base rate neglect

The representativeness heuristic, discussed earlier, can contribute to another cognitive error: *base rate neglect*. Base rate neglect is the error of underemphasizing the base rate—that is, the prevalence—of a phenomenon when evaluating the likelihood of an occurrence. For example, to evaluate the likelihood that a child has been sexually abused, a school psychologist must take into account not only the validity of the psychological tests administered to detect abuse, but also the base rate of abuse in his sample (see Wood, 1996, for a user-friendly introduction). In this context, it is crucial to remember that even a test with extremely high validity can be virtually useless clinically when administered to detect an extremely low base rate phenomenon (Meehl & Rosen, 1955). Bayes theorem teaches us that all things being equal, the lower the base rate of a phenomenon, in this case, abuse, the lower will be the hit rate of one's predictions (Finn & Kamphuis, 1995). Conversely, the higher the base rate of a phenomenon, the higher will be the hit rate. Hence the need for valid screening tests, which can help to isolate subsamples in which the base rate of a disorder is high, in this way maximizing the hit rates of our predictions.

To return to the child sexual abuse example, a school psychologist may be so impressed by the "match" of a child's symptoms to those of other children who have been abused (e.g., they may say to themselves, "Wow, this child behaves like so many of the other sexually abused children I've worked with")—a consequence of an over-application of the representative heuristic—they may tend to neglect or ignore the base rate of abuse in their sample. Yet because this base rate may be extremely low, the school psychologist may conclude erroneously that the child was sexually abused even when she was not. Because diagnostic information (e.g., a child's presenting psychological symptoms) tends to be much more dramatic and salient than base rate information, which is often dry and abstract, it tends to be overweighed relative to such information (Nisbett & Ross, 1980).

3.8. Bias blind spot

As you read about the cognitive errors we have described, you may have thought to yourself, "Although this information may be important for other people, it really doesn't apply to me, because I'm not that biased." If so, you're hardly alone. As Emily Pronin and others have noted (e.g., Ehrlinger, Gilovich, & Ross, 2005; Pronin, Gilovich, & Ross, 2004; Pronin, Kruger, Savtisky, & Ross, 2001; Pronin, Lin, & Ross, 2002), we often fail to recognize the existence of cognitive biases and errors in ourselves while readily detecting them in others. She and her colleagues argued that this *bias blind spot* may stem from a combination of factors, including (a) naïve realism (we assume that we are seeing the world as it is, so that people who disagree with us are surely mistaken), (b) the ubiquitous propensity to see ourselves more positively than others (the "Lake Wobegon effect"; see Dunning, Meyerowitz, & Holzberg, 1989; John & Robins, 1994), and (c) the tendency to rely more heavily on our own introspections than on others' (Pronin et al., 2004). Although many school psychologists (Nelson & Machek, 2007) and similar professionals may agree that learning about evidence-based practices is important for their colleagues, the bias blind spot may lead them to believe that such knowledge is not especially important, let alone necessary, for them (as though they were saying, "I don't need research—I know when *my* treatments are working"). They may see themselves as largely immune to biases that afflict others; for this reason, bias blind spot is sometimes referred to as the "not me fallacy" (Lilienfeld et al., 2011). Nevertheless, research on the bias blind spot reminds us that we are all prone to biases in evaluating information under conditions of uncertainty, even as we may be oblivious to our own biases.

4. Science vs. pseudoscience: *ten warning signs*

The cognitive errors we have discussed, as well as others (see Table 1 for additional cognitive errors relevant to school psychology), can lead to suboptimal school psychology practices; in some cases, they can lead school psychologists to fall prey to pseudoscientific claims. As noted earlier, pseudosciences can be thought of as disciplines that display the superficial appearance of science but that lack its substance (Hines, 2003; Lilienfeld et al., 2003). In contrast to many other implausible claims, they can be especially dangerous because they so often seem to be convincing on the surface. As a consequence, they can fool even highly intelligent and well trained individuals (Lilienfeld et al., 2009). As is the case for cognitive errors, acceptance of pseudoscientific claims is rarely a matter of low overall intelligence (Hyman, 2001; Stanovich, 2009) or insufficient education. Instead, we can all fall victim to pseudoscientific claims unless we are cognizant of their most common characteristics (Herbert, 2003).

Science and pseudoscience almost surely differ from each other in degree rather than in kind, so there is unlikely to be a single necessary or sufficient criterion for distinguishing science from pseudoscience. Nevertheless, we can identify several helpful indicators or "warning signs" of pseudoscience (see also Bunge, 1983; Langmuir, 1953; Lilienfeld et al., 2003; Lilienfeld & Landfield, 2008; Ruscio, 2006, for these and other warning signs). Although none of the warning signs we discuss provides dispositive evidence that a claim is dubious, the more such signs a claim exhibits, the more skeptical of it we should become. Many dubious claims in school psychology, we should note, embody several warning signs simultaneously.

Here we delineate 10 warning signs (see Table 2) that should be especially helpful to school psychologists in differentiating scientific from pseudoscientific assertions and practices. Such warning signs can come in handy to school psychologists when evaluating claims in the news media, on the internet, at workshops, in the peer-reviewed literature (but see the fourth warning sign that follows), and even in conversations with their colleagues. Along with each sign, we present one example from the school psychology literature (or allied literatures) that helps to illustrate it.

Table 2
Ten warning signs of pseudoscience relevant to school psychologists.

Pseudoscience indicator
Lack of falsifiability and overuse of ad hoc hypotheses
Lack of self-correction
Emphasis on confirmation
Evasion of peer review
Overreliance on testimonial and anecdotal evidence
Absence of connectivity
Extraordinary claims
Ad antequitem fallacy
Use of hypertechnical language
Absence of boundary conditions

4.1. Warning sign # 1: Lack of falsifiability and overuse of ad hoc hypotheses

According to philosopher of science Sir Karl Popper (1959), falsifiability—the capacity to disprove a theory with evidence—is a key characteristic of science, whereas unfalsifiability is a key characteristic of pseudoscience. Popper (1959) famously criticized Freud's and Adler's personality theories as unfalsifiable, as they were consistent with virtually any set of observed findings. For example, Adler (1922) proposed that the core organizing force in human personality is the striving for superiority: We desire to be better than others. As Popper noted, this theory is virtually impossible to falsify and therefore unscientific. A person who aspires to become a powerful world leader could be accommodated within the theory, but according to Adler, so could a person who becomes a chronic alcoholic; the latter person could merely be using his drinking to persuade himself that "Had I not become a heavy drinker, I surely would have become a great person." A theory that explains every conceivable outcome, Popper observed incisively, in effect explains nothing. As a consequence, it is no longer scientific. Scientific theories must not only anticipate certain outcomes; they must preclude other outcomes.

Theories can be rendered essentially unfalsifiable by the overuse of ad hoc hypotheses (Law, 2011). An *ad hoc hypothesis* is essentially an "escape hatch" or "loophole" that researchers and clinicians can use to explain away negative findings—results that challenge their hypotheses. For example, when a scientist conducts a study designed to test the hypothesis that ADHD is associated with laboratory deficits in sustained attention obtains negative results, she may initially doubt these results. As a consequence, she may invoke one or more ad hoc hypotheses to account for these unexpected findings. Perhaps the sustained attention task she used was inappropriate for this population; perhaps her diagnoses of ADHD were not made as rigorously as in previous studies; perhaps the sample size in her study was too small; perhaps the comparison group of non-ADHD children actually included several children with mild attentional problems; and so on. One or more of these ad hoc hypotheses may even be correct.

In some cases, ad hoc hypotheses have a legitimate role to play in science, especially when they strengthen the theory's content, predictive power, or both (Law, 2011; Meehl, 1990). In contrast, in pseudosciences, ad hoc hypotheses rarely strengthen either, and instead are typically invoked as a desperate means to salvage claims from all but certain falsification. The overuse of ad hoc hypotheses can render claims virtually impossible to falsify in practice, because an accumulation of such hypotheses can in effect serve as impenetrable protective shields against negative findings. As a consequence, the overuse of ad hoc hypotheses can place claims outside the purview of scientific testing.

Example: Despite overwhelming scientific evidence that demonstrates the ineffectiveness of facilitated communication (FC) for autism and other developmental disabilities (see Jacobson, Mulick, & Schwartz, 1995; Mostert, 2001, 2010, for reviews), most proponents of FC continue to insist that this body of research is flawed. FC was designed to allow individuals with a wide range of developmental disabilities (e.g., autism, cerebral palsy, Down syndrome) to communicate via typewriters or keyboards with the aid of a facilitator. The facilitator supports a nonverbal individual's hands to allow him or her to type out meaningful messages (purportedly *without* the facilitator's influence). Nevertheless, a plethora of carefully controlled studies have demonstrated that facilitators are unknowingly influencing the substance of these messages via an ideomotor ("Ouija board") effect (Jacobson et al., 1995; Lilienfeld, 2005). By means of the ideomotor effect, facilitators' thoughts are unconsciously influencing their actions, and guiding the nonverbal individual's fingers to the desired keys.

Still, FC supporters dispute this overwhelming negative verdict, often by invoking a variety of ad hoc explanations. Some have criticized experimental studies of FC as failing to acknowledge FC's inherent "complexities" (e.g., Emerson, Grayson, & Griffiths, 2001; Sheehan & Matuozzi, 1996), whereas others insist that evidence of FC's efficacy has not emerged because researchers give participants tasks that are too difficult (e.g., Borthwick & Crossley, 1993) or rely on facilitators who do not believe in the method or facilitate incorrectly (Brown, 1982; Casti, 1989). Although these criticisms may initially appear legitimate, they render claims concerning the effectiveness of FC virtually unfalsifiable. Moreover, they fall prey to what Meehl (1974) called a "double standard of evidential morals" (p. 264), a tendency to shift the bar for evidence depending on whether it supports or disconfirms one's hypotheses. For example, the claim that FC does not work in certain cases because the tasks are too difficult is belied by evidence that many of the experimental tasks used in FC research are far simpler than those that were adduced as positive evidence of FC for the same children. As Jacobson et al. (1995) noted, "Controlled research that disconfirms the phenomenon is criticized on grounds of rigor and procedure not even remotely addressed by studies that purport to demonstrate the effectiveness of the technique" (p. 757). In essence, FC becomes impossible to falsify in practice because proponents of the method continue to insist that they alone are qualified to test it appropriately.

4.2. Warning sign # 2: Lack of self-correction

Over the long haul, scientific claims tend gradually to be self-correcting, as scientific methods are designed to root our errors in our web of beliefs (Quine & Ullian, 1978). In contrast, pseudosciences tend to be stagnant over lengthy time periods, often showing scant change in the face of repeated contrary evidence. Ironically, science's provisional status, which has sometimes led postmodernist scholars to call it into question, is one of its foremost strengths, because accepted scientific knowledge is always open to revision pending new data. At the same time, some scientific findings, including those in psychology (e.g., the phenomenon of classical conditioning and the bystander intervention effect), are so well established that we can place substantial confidence in them, even as we recognize that there is some remote possibility that they could be overturned or revised one day.

Example: The idea of matching students' learning styles to teachers' teaching styles has remained pervasive in both research and practice despite a wealth of evidence pointing to its invalidity (Pashler, McDaniel, Rohrer, & Bjork, 2008; Stahl, 1999; Tarver & Dawson, 1978). Taking shape in the 1940s, the concept of learning styles suggests that individuals differ significantly from one another in the way they process information. Undeniably, there is some truth in this notion. Nevertheless, many proponents of this concept go much further, arguing that to maximize students' potential for learning, instructors must match their teaching methods to their students' distinctive learning styles (Pashler et al., 2008).

Although this "matching hypothesis" may seem intuitive, research on learning styles has not supported it. In a review of 15 studies that differentiated visual from auditory learners, Tarver and Dawson (1978) concluded that "modality preference and method of teaching reading do not interact significantly" (p. 25). More recently, in a comprehensive examination of the literature on learning styles, Pashler et al. (2008) found only one study that offered evidence for matching teaching styles to learning styles that met their criteria for adequate evidence (Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999), and even this study was marked by serious methodological flaws. In contrast, Pashler et al. located numerous well-designed studies meeting their criteria that directly contradicted the matching hypothesis. For example, Massa and Mayer (2006) conducted a series of three computer-based studies that paired visual and verbal learners with specially designed "help-screens" that matched their learning preferences. In general, the researchers found no relation between performance levels and pairing with preferred help-screens. Similarly methodologically rigorous studies reviewed by Pashler et al. (e.g., Constantinidou & Baker, 2002; Cook, Thompson, Thomas, & Thomas, 2009) offer no support for the matching hypothesis of learning styles.

Flouting this negative research evidence, proponents of learning styles have established a flourishing market for assessment and measurement tools (Pashler et al., 2008). Many educational institutions, including Yale University (Gawboy & Greene, 2011), continue to emphasize the importance of utilizing "different modes of communication to serve a range of learners" and scores of curricula are based on the largely discredited matching hypothesis (Lilienfeld et al., 2010). Given the wealth of evidence contradicting the matching hypothesis of learning styles, students and teachers would do well to turn to educational techniques that are grounded in more solid scientific research.

4.3. Warning sign # 3: Emphasis on confirmation

As we noted earlier, confirmation bias can lead us to seek out evidence that is consistent with our hypotheses and to ignore or selectively reinterpret evidence that is not. Sciences incorporate systematic safeguards against confirmation bias, such as randomized control designs; in contrast, pseudosciences tend to cavalierly flout such safeguards. Moreover, in pseudosciences, positive results are generally accorded considerably more weight than negative results; this emphasis on confirmation rather than refutation runs counter to the principle that science works best by subjecting claims to the risk of falsification (Meehl, 1978). As philosopher of science Mario Bunge (1967) wrote colorfully, "the pseudoscientist, like the fisherman, exaggerates his catch and neglects his failures or excuses them" (p. 36).

Example: School psychologists may be familiar with the lofty claims associated with the widely publicized "Total Transformation Program" (www.thetotaltransformation.com), which has been advertised extensively on television and radio commercials. As is the case with many questionable claims (see Warning sign # 7), James and Janet Lehman, the creators of the program, assert that it can be used to treat "every behavior problem." To bolster their claims (and most relevant to the current warning sign of pseudoscience), the creators present numerous quotes and reviews on their website as evidence of their program's effectiveness. Website visitors are greeted with quotations like, "My kid did a complete 180" and "The Total Transformation actually works as advertised," as well as with videos of actual people providing testimonials of how the program changed their lives (see also Warning Sign #5 for a discussion of anecdotal and testimonial evidence). Nevertheless, the website contains no mention of the possibility that the program may not work for all children. In fact, the Lehmans go so far as to insist that they are "100% confident" that their program will "turn your defiant child around," and even offer parents a full $327 refund in return for written feedback (as long as it is sent within 90 days of receiving the product). Curiously, however, the advertisements request feedback from users not to improve the program, but to help the Lehmans "prove" the product's effectiveness. Although a few aspects of their program may well be based on some empirically-supported behavioral therapy techniques (Forgatch & Patterson, 2010), it is exceedingly unlikely that "The Total Transformation," even if highly effective, will work for everyone. It also seems unlikely that the Lehmans will advertise any negative feedback they receive on their website or on commercials.

4.4. Warning sign # 4: Evasion of peer review

Although the peer-review process is far from perfect (Godlee & Jefferson, 2003), and is not free of political influence or biases, it typically affords at least some protection against poor quality research. In the peer-review process, journal editorial boards and grant review committees send articles and grant proposals out for review by several, often three or more, independent (and usually anonymous) scholars. Whereas sciences rely on peer review as a partial safeguard against error, many pseudosciences fly under the radar of peer review, disseminating and promoting claims before they have been subjected to careful scrutiny by experts.

Example: The popular Brain Gym program developed in the 1970s by Paul and Gail Dennison has become increasingly popular in educational settings. Brain Gym is based on the largely unsupported claim that learning difficulties result from disconnections between certain areas of the brain and the rest of the body (Hyatt, 2007). The program prescribes a series of 26 movements designed to strengthen neural pathways thought to be unintegrated in individuals with learning difficulties. Since its development, this program has skyrocketed in popularity; it is now marketed in over 80 countries (www.braingym.org/about).

Despite the commercial hype surrounding Brain Gym, this program has consistently managed to escape peer scrutiny. The official Brain Gym website contains a page titled "Brain Gym Studies," which boasts an expansive list of investigations seemingly supporting the benefits of the program. Although this list may appear impressive, on closer inspection it becomes evident that most of the evidence is qualitative or anecdotal (www.braingym.org/studies). Of the studies that are experimental in nature, only two have been published in peer-reviewed journals (Khalsa, Morris & Sifft, 1988; Sifft & Khalsa, 1991). In a review of the literature, Hyatt (2007) identified only five peer-reviewed articles that examined the effectiveness of Brain Gym. Of these five, "one was discarded because the author of that article was one of the four participants in the study" and three others "were published in the same journal, in which authors must pay for publication" (Hyatt, 2007, p. 120). In an effort to explain the dearth of peer-reviewed articles examining the efficacy of the program, the Brain Gym website states that "Articles published in peer-reviewed journals are generally required to be based on scientific studies. … For the ethical reasons mentioned above, and because of the expertise required for statistical work and the high costs of doing such research over time, we haven't yet seen many such studies" (http://www.braingym.org/studies). But one cannot have things both ways: if one does not possess the expertise or resources to conduct studies on the effectiveness of one's program, one must await such studies before promoting the program widely to parents, teachers, and others.

4.5. Warning sign # 5: Overreliance on anecdotal and testimonial evidence

As some scholars have observed, the plural of anecdote is not fact (see Lilienfeld & Landfield, 2008). In other words, multiple pieces of anecdotal evidence (e.g., "My son had a severe learning disability for years;

now, after the school's treatment, he's cured!") are rarely, if ever, sufficient to conclude that an assertion (in this, case, the assertion that the treatment was effective) is correct. This conclusion holds because anecdotes are (a) often difficult to verify, (b) of unclear or questionable representativeness, and (c) almost always vulnerable to multiple competing explanations. As Gilovich (1991) observed, the relation between anecdotal evidence and treatment efficacy is typically asymmetrical. If a treatment is efficacious, one should certainly expect to hear anecdotal claims of its effectiveness from at least some consumers. In this respect, anecdotes, like clinical intuition, can be helpful in the context of discovery (Reichenbach, 1938), as they may provide researchers with sufficient grounds for investigating a promising intervention. Yet if one hears anecdotal claims of a treatment's effectiveness from consumers, one should not conclude that the treatment must be efficacious. Only controlled studies that have been replicated by independent scholars can allow one to draw this conclusion.

Example: *Scared Straight* programs rely primarily on scattered anecdotes to validate their effectiveness, ignoring evidence that these programs are potentially detrimental to adolescents (Lipsey, 1992; Petrosino, Turpin-Petrosino, & Buehler, 2003). Originating in New Jersey's Rahway State Prison in the 1970s, *Scared Straight* programs bring at-risk and delinquent adolescents to high-security prisons in an attempt to scare them away from future lives of crime (Lilienfeld, 2007). These programs acquired initial popularity with the airing of a 1979 Academy Award-winning documentary "Scared Straight!" They recaptured public attention on January 13, 2011, when the A&E Network introduced a new series "Beyond Scared Straight", produced by Arnold Shapiro, director of the original "Scared Straight!" documentary. Although *Scared Straight* Programs have gained support from policy makers and the general public (Petrosino, Turpin-Petrosino, & Flinckenauer, 2000), research shows that this support is not buttressed by research evidence. Program evaluations and several randomized studies demonstrate that *Scared Straight* programs are ineffective in reducing crime rates among adolescents (e.g., Finckenauer, 1982; Lewis, 1983; Yarborough, 1979; see Petrosino et al., 2000, for a discussion). In fact, in a meta-analysis of seven quasi-experimental studies, Petrosino et al. (2003) showed that involvement in *Scared Straight* programs significantly increased the risk of offending among adolescents (see also Lilienfeld, 2007).

Despite this negative evidence, proponents of *Scared Straight* programs continue to invoke anecdotal reports and testimonials as evidence for their effectiveness. For example, in a recent interview, producer Arnold Shapiro stated that he is convinced that *Scared Straight* programs are effective because of what "youth counselors and teachers and police officers and others who bring kids to these programs tell me." He went on to claim that there are no negative consequences of *Scared Straight* because in speaking with the original participants, "14 out of the 17 attributed their turn-around to that prison visit" (Sharenow & Shapiro, 2011). Although individual success stories can be moving, they cannot provide scientific evidence for the efficacy of a practice. Among other things, informal self-reports of improvement are susceptible to a host of alternative explanations, including regression to the mean, placebo effects, demand characteristics, retrospective biases, and effort justification (i.e., the tendency to justify the time, energy, and expense of a treatment by convincing oneself that it must have worked; see Lilienfeld et al., 2008, for a discussion of these and other ways in which people can be fooled by ineffective or harmful therapies). Instead, lawmakers, clinicians, and film-makers alike must turn to well-controlled data to establish the efficacy of their programs.

4.6. Warning sign # 6: Absence of connectivity

Keith Stanovich (2009) defined "connectivity" as the extent to which claims build on, or "connect up with," other claims. Developed sciences tend to display a cumulative character, with novel claims drawing on well-established findings. In contrast, pseudosciences often lack connectivity with other knowledge, purporting to construct entirely new paradigms out of thin air (see Herbert et al., 2000, for a striking example within clinical psychology). Of course, in rare cases, entirely new paradigms that overthrow extant knowledge emerge in science, a phenomenon that Kuhn (1962) famously termed "revolutionary science." Yet such spectacular successes are exceedingly few and far between, and are accompanied by especially persuasive evidence that the new paradigm can predict findings than previous paradigms cannot (see also "Extraordinary claims" section that follows).

Example: Proponents of the idea that some individuals are "left-brained" whereas others are "right-brained" draw on legitimate scientific findings indicating that the two hemispheres often differ somewhat in their cognitive styles (Sperry, 1974). Nevertheless, these advocates ignore the sizeable corpus of research showing that both hemispheres are in virtually continuous interaction and do not inhabit separate psychological "worlds" (Corballis, 1999; Hines, 1987). They also ignore evidence that the two hemispheres are much more similar than different in their information processing.

According to advocates of the extreme laterality view, "left-brained" individuals are more logical and analytic than right-brainers, whereas "right-brained" individuals are more creative, emotional, and artistic than left-brainers. In fact, the differences between these two groups of individuals are only of degree, not of kind; moreover, being logical and analytic is not mutually exclusive with being creative, emotional, and artistic. Erroneous beliefs of this nature can influence how student learning and activities are structured, with seeming left-brainers afforded more opportunities to practice logic skills, and seeming right-brainers afforded more opportunities to be creative and artistic. For examples, numerous websites present different school curricula or teaching methods for "left-brain" versus "right-brain" learners (e.g., http://www.homeschool-by-design.com/right-brain-vs-left-brain.html). One contends that "yucky, bulky textbooks" are for left-brain learners and that right-brain learners require visual aids for learning (http://www.study-skills-for-all-ages.com/right-brain-left-brain.html; see also Warning sign # 2 for a discussion of misconceptions regarding student learning styles). An online search of the terms "left-brain" or "right-brain" also yields numerous quizzes and blogs that help parents and teachers determine which side of a child's brain is dominant (e.g., http://www2.scholastic.com/browse/article.jsp?id=3629). Apparently, believers in the myth of left brainers and right brainers are content to remain disconnected from the broader scientific literature.

4.7. Warning sign # 7: Extraordinary claims

As Marcello Truzzi (1978) and later Sagan (1995a,b) argued, extraordinary claims require extraordinary evidence. That is, if one advances an assertion that runs counter to virtually all existing knowledge, one must provide especially convincing evidence for this assertion. This principle dovetails with the basic principles of Bayesian thinking, an approach that incorporates the *a priori* plausibility of assertions when evaluating their evidentiary strength (see Goodman, 1999; Lilienfeld, 2011). Yet many pseudosciences advance extraordinary claims without offering equally extraordinary evidence.

Example: In the field of school psychology and allied fields, the concept of "Indigo Children" (Carroll & Tober, 1999, 2009; Tappe, 1999) is a prime example of an extraordinary claim that is not accompanied by equally extraordinary evidence. Two proponents of the concept, Carroll and Tober (1999), wrote that:

> An Indigo Child is one who displays a new and unusual set of psychological attributes and shows a pattern of behavior generally undocumented before. This pattern has common unique factors that suggest that those who interact with them (parents, in particular) change their treatment and upbringing of them in order to achieve balance. To ignore these new patterns is to potentially create imbalance and frustration in the mind of this precious new life (p. 1).

During a 2009 interview on the "Virtual Light Broadcast" (http://www.lightworker.com/VirtualLight/VLBroadcasts/2008/2008_12_20.php), Lee Carroll similarly claimed that Indigo Children possess a "different kind of consciousness" that allows them to intuitively "know how everything works." He suggested that Indigo Children know things that their parents do not and are privy to information that is beyond most peoples' comprehension. Carroll and others (e.g., Tappe, 1999) believe that most individuals born in the late 1960s and beyond can be characterized as Indigos and that they emit an Indigo "energy color" (which can be perceived only by special people). Many proponents of the concept of Indigo Children further believe that the prevalence of ADHD has increased in recent years (Khan & Faraone, 2006) because attentional problems are a byproduct of the highly evolved consciousness that Indigos are said to possess.

Although claims about Indigo Children are expansive, there is no convincing or even suggestive evidence that humans born during the past few decades are somehow special. Proponents of the concept typically only offer anecdotal evidence to buttress their claims (see Warning sign # 5). In fact, when one looks at the "ten most common traits of Indigo children" (Carroll & Tober, 1999, p. 1), the descriptions seem more consistent with the possible increase in narcissism among recent generations (Twenge & Foster, 2008; but see Donnellan & Trzesniewski, 2009, for a different view), rather than the sudden emergence of a special class of human beings equipped with remarkable cognitive abilities. For example, although children today may indeed be more likely to "get frustrated with systems that are ritual-oriented and don't require creative thought" (Carroll & Tober, 1999, p. 2), this does not mean that they herald the next great leap in human evolution. It is far more plausible that the increased rates of the ADHD diagnosis in recent years are due to greater recognition and sensitivity to the features of the disorder (or to what epidemiologists call "detection bias") than to Indigo children's ostensible special talent for "see[ing] better ways of doing things" (Carroll & Tober, 1999, p. 2).

4.8. Warning sign # 8: Ad antequitem fallacy

If a practice has been popular for a long time, it may be tempting to assume that there must be something to it. Yet there are glaring counterexamples to this conclusion: Astrology has been used for about 4500 years despite a decided absence of evidence for its validity (Hines, 2003). The problem here is that practices may be enduring not because they are effective, but because certain cognitive biases, like confirmation bias and illusory correlation, have consistently fooled people for decades or even centuries into believing that they are effective. Pseudoscientific disciplines often fall prey to the *ad antequitem fallacy*, the error of invoking the antiquity of claims as a means of bolstering their legitimacy.

Example: As suggested earlier, one of the most problematic trends in school psychology has been the continued uncritical use of certain projective methods, such as human figure drawing tests and many Rorschach Inkblot Test indices, in the absence of convincing support for their validity (Gresham, 1993; Hojnoski et al., 2006; Miller & Nickerson, 2006). Some have speculated that these methods owe their longevity to a combination of cognitive biases and "institutional inertia"—the tendency of longstanding clinical traditions to change slowly (Lilienfeld, Wood, & Garb, 2007). Hojnoski et al. (2006) similarly suggested that the continued inappropriate use of projective techniques may stem from "simple habit" (p. 156).

Proponents of projective techniques, however, have sometimes argued that their continued use bolsters their credibility. For example, when arguing for the validity of the Rorschach Inkblot Test, Weiner, Spielberger, and Abeles (2002) asked rhetorically:

> How likely is it that so many Rorschach assessors have been using the instrument for so long, in so many places and contexts, solely on the basis of illusory correlation? If this seems unlikely, is it unreasonable to infer that there has been some utility in their work? (p. 11)

Although the questions posed by Weiner and colleagues are worth asking (and indeed, at least some Rorschach indices, especially those designed to detect thought disorder, possess at least some degree of validity; see Lilienfeld et al., 2000), they neglect the possibility that erroneous conclusions can be passed on to subsequent generations of professionals. In an effort to understand the enduring popularity of projective methods, Hojnoski et al. wondered whether "the training one receives may highly influence choice of assessment methods" (p. 156). The words of counseling psychologist Donald Super are also germane in this context: "Unorganized experience, unanalyzed data, and tradition are often misleading. Validation should be accomplished by evidence gathered in controlled investigations and analyzed objectively, not by the opinions of authorities and impressions of observers" (see Buros, 1949, p. 167). In other words, tradition should not be confused with validation.

4.9. Warning sign # 9: Use of hypertechnical language

In an effort to accurately differentiate among superficially similar concepts, scientists often find it useful to introduce new and distinct terminology. Nevertheless, this practice can be abused, especially when the terminology provides unsupported techniques with a cachet of unearned scientific respectability. Promoters of pseudoscience often rely on overly technical language in an effort to establish legitimacy for their otherwise invalid practices. In contrast to the language of well-established sciences, this language frequently lacks precision, meaning, or both (Lilienfeld & Landfield, 2008).

Example: Proponents of Auditory Integration Training (AIT) routinely use hypertechnical language when explaining the purported effectiveness of this practice for autism spectrum disorders. Developed by French otolaryngologist Guy Berard, AIT generally consists of two daily half-hour sessions for approximately

10 days in which affected individuals listen to music that varies in volume and pitch (Herbert, Sharp, & Gaudiano, 2002). Proponents of AIT maintain that autism involves a hypersensitivity to sound, and that auditory intervention allows for the retraining of a disordered auditory system (AIT Institute: Auditory Integration Training). Although these claims sound impressive, research over the past three decades has yielded negative evidence for the effectiveness of AIT for autism spectrum disorders (Bettison, 1996; Gillberg, Johansson, Steffenburg, & Berlin, 1997; Mudford, et al., 2000; Zollweg, Palm, & Vance, 1997).

Despite this absence of supportive evidence, AIT has acquired substantial popularity as a treatment for autism spectrum disorders. This popularity may be buttressed in part by the rampant use of hypertechnical language in expositions of this treatment. For example, on the AIT Institute Website, proponents of this practice claim that it "efficiently retrains a disorganized auditory system and improves hearing distortions and sound sensitivity" (www.aitinstitute.org). Similarly, the Berard AIT website explains that "The Berard method of auditory integration training stimulates the auditory system with unique sounds [that] stimulate the auditory system to reduce or eliminate the problems with this system" (http://www.berardaitwebsite.com/WhyBerard.htm). Still another website says that "The Kirby Method of AIT uses classical music exclusively (not the pop music used by Berard practitioners). Classicfal (sic) music is used because of the statistical content that mirrors normal brain function (theorizes Professor Anderson of Harvard). The active modulation is determined by the power density spectrum of the music." (http://www.kirbyait.com/). Although these explanations of AIT as a treatment for autism spectrum disorders may sound legitimate, they are vague and lack clear-cut scientific referents.

4.10. Warning sign # 10: Absence of boundary conditions

Scientific theories and practices typically incorporate clearly defined boundary conditions: instances in which the claims associated with the theory are, and are not, applicable. For example, although there is clear support for the efficacy of exposure therapies—those that systematically expose individuals to anxiety-provoking stimuli, often for prolonged time periods—for anxiety disorders (Barlow, Allen, & Basden, 2007), no credible proponents have proposed that they are efficacious in the treatment of schizophrenia or autism, let alone Alzheimer's disease or cancer. In stark contrast, "most pseudoscientific phenomena are purported to operate across an exceedingly wide range of conditions" (Lilienfeld et al., 2003; p. 9; see also Hines, 2003), such that proponents may claim that their concept or treatment applies to virtually all conditions, or virtually everyone.

Example: The Irlen Method, devised by Licensed Marriage and Family Therapist Helen Irlen, is characterized by a conspicuous absence of boundary conditions. In 1983, Irlen claimed to have discovered a previously unknown condition called Scotopic Sensitivity Syndrome, which supposedly results in problems with reading, behavior, and emotion (Hyatt, Stephenson, & Carter, 2009). Irlen asserted that this syndrome could be treated only using colored lenses and overlays, which "improve the brain's ability to process visual information" (www.irlen.com). Although Irlen's claims are bold, neither she nor her supporters have provided adequate evidence to support them over the past three decades (Evans & Drasdo, 1991; Hyatt et al., 2009).

Yet Irlen continues to advertise her Irlen lenses as an effective treatment for a plethora of psychological and physical conditions. On the Irlen Method Website, Irlen claims that her "non-invasive technology … can improve reading fluency, comfort comprehension, attention and concentration while reducing light sensitivity" (www.irlen.com). She goes on to claim that Irlen colored overlays and filters can help individuals suffering from "Reading and learning problems, Dyslexia, ADD/HD, Autism, Asperger Syndrome, behavioral and emotional problems, headaches, migraines, fatigue and other physical symptoms, light sensitivity/photophobia, Traumatic brain injury, whip lash, concussions, and certain medical and visual conditions" (www.irlen.com). Indeed, it is difficult to conceive of any psychological condition for which Irlen lenses would not purportedly be effective. Irlen's expansive claims clearly lack boundary conditions: she puts forth her method as a cure-all treatment for virtually all disordered individuals.

5. Parting words, implications, and prescriptions

In this article, we have offered a user-friendly primer of scientific thinking principles for school psychologists and a set of guidelines for distinguishing scientific from pseudoscientific claims. We suggest that in an ideal world, these principles should come to take their place alongside of the WISC-IV and Woodcock–Johnson (Wechsler, 2004; Woodcock, McGrew, & Schrank, 2007), and other standard psychometric tools as essential components of the school psychologist's everyday armamentarium. More broadly, we have argued that scientific thinking skills, which we can think of as tools designed to compensate for cognitive biases to which all humans are prone, are ultimately school psychologists' best safeguards against errors in judgment and decision-making. In turn, they are also school psychologists' optimal protection against the seductive charms of pseudoscientific practices and myths, many of which seem persuasive at first blush but lack compelling scientific support.

5.1. The limitations and powers of science

Of course, science and scientific thinking, being inherently human products, are themselves fallible and prone to error. The scientific process is not immune to biases, political influence, or in rare cases, outright fraud. Yet most of the shortcomings of scientific methodology have, perhaps not surprisingly, been uncovered by scientists themselves. Indeed, to the extent that scientific methods are not working as efficiently or accurately as they should, scientific methods themselves can help us make them work better. For example, recent discussions in the scientific community and popular press have highlighted the fact that the effect sizes of initial studies are often larger than those of later studies—the so-called “decline effect” or “law of initial results” (Ioannidis, Ntzani, Trikalinos, & Contopoulos-Ioannidis, 2001; Lehrer, 2010). That is, early spectacular findings in science, including psychology, are often difficult to replicate (see also Lykken, 1968, 1991). To the extent that the decline effect is genuine, it will be ultimately be recognized as a biasing factor in scientific studies, and scientists will almost certainly find ways of correcting statistically for its influence in their analyses.

As many philosophers of science have pointed out, science, despite its inevitable imperfections, is unrivaled in human history for its problem-solving power (O'Donohue & Lilienfeld, 2007). It derives much of this power by rooting out errors in our web of beliefs, thereby increasing the probability of—although not ensuring—reasonably accurate conclusions. Moreover, science, in contrast to other ways of knowing, such as intuition, has the virtue of being self-correcting (Thagard, 1978), even if such self-correction sometimes takes longer than we might wish. Perhaps more than anything else, science is a prescription for humility (McFall, 1996), as it is an explicit admission that we might be wrong and that we need to rely on formal protections—namely, scientific methods—against our own fallibility. As Tavris and Aronson (2007) noted, science is a method of “arrogance control”: Whether we like it or not, it forces us to doubt our cherished and strongly held assumptions.

5.2. Educational implications

If our position has merit, it suggests several educational implications for the training of school psychologists. All graduate students in school psychology, we believe, must learn about the cognitive errors to which all humans are susceptible, and come to understand why scientific methods, such as randomized controlled trials, are essential bulwarks against these errors. Equally essential, school psychology students must come to understand that their discipline has evolved over time by eliminating errors, and come to see scientific methods as invaluable tools for improving the rigor of their clinical judgments and research endeavors. These basic principles of scientific thinking should, we argue, be taught not in a single course but rather integrated through school psychologists' didactic and practicum training. In addition, graduate students in school psychology should be exposed to key warning signs of pseudoscience so that they can better differentiate well-supported from poorly supported techniques and claims.

Most of all, school psychologists in training must be encouraged to cultivate the healthy skepticism about which Sagan (1995a,b) wrote so eloquently: a skepticism that requires us to keep an open mind to novel claims while insisting on rigorous evidence. This delicate balancing act is often cognitively and emotionally difficult, because it requires us to avoid the extremes of excessive gullibility, one the one hand, and cynicism, on the other. But in the long run, this is the middle ground that school psychologists must seek out and occupy to evaluate the validity and efficacy of their interventions, and that will ultimately be the most beneficial for the children they serve.

5.3. Ten prescriptions for school psychologists

In closing, we offer readers the following 10 bottom-line prescriptions to take with them in their school psychology work. These 10 prescriptions, which distill many of the core principles we have reviewed, should be helpful to all school psychologists, regardless of whether their principal setting is research, practice, or both (see Table 3).

(1) Seek out disconfirming evidence. To minimize confirmation bias, school psychologists should actively search for data that might prove their hunches and hypotheses wrong. They should also be certain not to dismiss too quickly or readily research or clinical data that run contrary to their hypotheses; instead, they should seriously entertain these hypotheses at least briefly.

(2) Do not become overly attached to one's hypotheses. Psychologist Edward Bradford Titchener implored others to "Know all theories, love some, wed none." If we become overly wedded to our hypotheses, we can refuse to consider evidence that could challenge our most deeply held assumptions, whether they be assumptions regarding a favored theoretical model or assumptions regarding the causes of a child's behavioral or learning difficulties. As Greenwald, Pratkanis, Leippe, and Baumgardner (1986) pointed out, "Theory obstructs research progress when the researcher is an ego-invested advocate of the theory and may be willing to persevere indefinitely in the face of prediction-disconfirming results" (p. 227).

(3) Consider rival hypotheses. As a corollary of the immediately preceding prescription, school psychologists should be sure to ask themselves whether alternative hypotheses could account for their research of clinical findings just as well as their favored hypothesis. Indeed, as rule of thumb, school psychologists should be reluctant to accept any explanation as adequately corroborated unless it has "beaten out" at least one other plausible rival explanation.

(4) Do not cherry-pick. The too-often-ignored rule of total evidence (Carnap, 1962) reminds school psychologists to examine all pertinent evidence, not just selected evidence, before concluding that their preferred hypothesis is well confirmed. Similarly, this rule cautions us to avoid cherry-picking evidence that conveniently fits our research or clinical hypotheses. A successful hypothesis must explain all relevant data, not merely data that are favorable to our position.

(5) Put one's intuitions to systematic tests. As noted earlier, intuitions can be helpful in the context of discovery (Reichenbach, 1938) but are rarely well suited to testing hypotheses systematically. We encourage school psychologists to routinely place their clinical intuitions to the test in "action research" (Mills, 2000), examining whether their gut hunches are correct or mistaken.

(6) Be skeptical of clinical wisdom. The reliance on established clinical authority—sometimes humorously termed "eminence based practice" as opposed to "evidence-based practice" (Isaacs & Fitzgerald, 1999)—can be dangerous, because longstanding clinical wisdom is not always correct. One vital function of school psychology research is distinguishing which aspects of clinical wisdom are worth retaining and which are worth discarding.

(7) Be cognizant of one's blind spots. Because of bias blind spot (Pronin et al., 2002), we are virtually all oblivious to our biases, including confirmation bias. One reason that "hermit scientists" (Gardner, 1957) are so prone to spectacularly wrong-headed ideas is that they insulate themselves from external criticism, so that they never become aware of their errors in thinking. Routinely running our research

Table 3
Ten take-home prescriptions for improving school psychology research and practice.

Seek out disconfirming evidence
Do not become overly attached to one's hypotheses
Consider rival hypotheses
Do not cherry-pick
Put one's intuitions to systematic tests
Be skeptical of clinical wisdom
Be cognizant of one's blind spots
Encourage dissent
Quantify, quantify, quantify
Maintain a self-critical attitude

and clinical hypotheses past our school psychology colleagues and students—and asking them to detect any weak spots in these hypotheses—may be a partial antidote to serious blind spots in our thinking. As we have noted earlier, intelligence offers little or no immunity against bias.

(8) Encourage dissent. In research teams and clinical decision-making teams, we should go out of our way to encourage dissenting points of view. For example, we should reinforce colleagues and research assistants for raising alternative interpretations of findings and reinforce clinical colleagues who offer case conceptualizations that differ from ours. Such disagreement can be ego-bruising in the short term, but it will tend to result in more accurate interpretations of research and clinical data in the long-term.

(9) Quantify, quantify, quantify. Even those school psychologists who are math-phobic should understand that quantification is essential, as it can reduce uncertainty in inferences (Sechrest, 2005). For example, researchers who suspect that their interview-based impressions of schoolchildren possess useful information should attempt to assess these impressions numerically, and clinicians who want to find out whether their school-based interventions are efficacious should measure their client outcomes systematically using well-validated scales.

(10) Maintain a self-critical attitude. Finally, as we have noted, humility is the heart of the scientific attitude, which entails a willingness to acknowledge that one might be mistaken (Sagan, 1995a,b). The best school psychology researchers and practitioners are continually questioning their preconceptions, subjecting them to searching criticism, and most important, modifying their beliefs when the evidence compels it.

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