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SCIENCE AND PSEUDOSCIENCE IN LAW ENFORCEMENT

A User-Friendly Primer

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Pseudoscience and questionable science are largely neglected problems in police and other law enforcement work. In this primer, the authors delineate the key differences between science and pseudoscience, presenting 10 probabilistic indicators or warning signs, such as lack of falsifiability, absence of safeguards against confirmation bias, and lack of self-correction, that can help consumers of the police literature to distinguish scientific from pseudoscientific claims. Each of these warning signs is illustrated with an example from law enforcement. By attending to the differences between scientific and pseudoscientific assertions, police officers and other law enforcement officials can minimize their risk of errors and make better real-world decisions.

Keywords: pseudoscience; police; law enforcement; falsifiability; peer review; confirmation bias

Throughout their careers, police and other law enforcement officials face an enormous array of challenges involving threats to life and liberty: questions of innocence versus guilt, split-second decisions regarding how to respond in a crisis, attempts to locate missing persons and solve serious crimes, lie detection, and the reconstruction of past criminal events, to name but a few. The accuracy of these techniques has the potential to determine crucial decisions, even those involving life or death. As in most professions, individuals in law enforcement must evaluate techniques with a critical eye before using them. Like all disciplines that interpret data to make real-world decisions, police work can easily fall prey to the seductive charms of pseudoscience.

Given these formidable challenges, it is hardly surprising that law enforcement officials have turned to scientific psychology for assistance in developing valid forensic techniques and evaluating the validity of scores of others. In the 1870s, Sir Francis Galton, cousin of Charles Darwin, experimented with a word association test (in which a test examiner says a word, like "money," and awaits a response from the respondent) as a tool for lie detection (Matte, 2002). Similarly, in the early 1900s, Hugo Munsterberg (1908) performed classic demonstrations that underscored the fallibility of eyewitness testimony. Since then, psychological researchers have spearheaded the development of scientifically grounded procedures to enhance the accuracy of forensic techniques.

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Nevertheless, like many professions, including psychology itself, law enforcement has long struggled with the thorny problem of distinguishing scientifically supported from scientifically unsupported practices. Because much of police work has developed in isolation from psychological science, its practices are a jumbled mix of legitimate and illegitimate claims (see Brewer & Wilson, 1995, for an introduction). This special issue of *Criminal Justice and Behavior* focuses on the largely neglected problem of pseudoscience in police work and highlights several prominent examples of law enforcement techniques that fall either on or outside the murky fringes of pseudoscience.

PSEUDOSCIENCE DEFINED

Before discussing specific law enforcement techniques that fall under the broad umbrella of pseudoscience, we must define pseudoscience and how it differs from bona fide science. Traditionally, pseudosciences are disciplines that possess the superficial appearance of science but lack its substance (Lilienfeld, 1999; Ruscio, 2006). More informally, pseudosciences are imposters of science: They do not play by the rules of science even though they mimic some of its outward features. As a consequence, they can easily mislead untrained observers into concluding that they possess scientific merit. A cousin of pseudoscience is "junk science," sometimes described as the intrusion of scientifically unwarranted claims into the courtroom (Huber, 1991; Park, 2001).

Pseudosciences have a hoary and checkered history in psychology (Leahey & Leahey, 1983). Such disciplines as phrenology, physiognomy, parapsychology (the study of extrasensory perception and psychokinesis), astrology, and subliminal persuasion for advertising purposes, among many others (see Hines, 2003), have traditionally displayed many of the telltale signs of pseudoscience. Nevertheless, pseudosciences are defined not by their object of study per se but by their approach to evidence, especially negative evidence (Lilienfeld, Lynn, & Lohr, 2003). In contrast to most developed sciences, which eventually—if often reluctantly—assimilate negative evidence into their corpus of belief, most pseudosciences remain largely insulated from contradictory data. It is in principle possible to approach parapsychology, for example, from a scientific perspective, assuming that investigators are willing to admit well-replicated negative data into their web of belief and revise their hypotheses accordingly. Nevertheless, many parapsychologists (e.g., Radin, 1997) have not done so and insist that the evidence for extrasensory perception and related phenomena is promising or even conclusive despite approximately 150 years of repeated failures to replicate initial positive findings (Gilovich, 1991; Hyman, 1989).

Philosopher of science Mario Bunge (1983) proposed the categories of "research fields" and "belief fields" to demarcate sciences from pseudosciences, arguing that scientific practices are distinguished by research support as opposed to intuition or faith. For instance, subjective experience and intuition alone are insufficient for police officers to believe that their interrogation procedures produce accurate confessions; these procedures must be validated by scientific evidence.

Science and pseudoscience are not always easy to distinguish, because they probably fall at opposite ends of a continuum, differing in degree rather than in kind (Lilienfeld, 1999; Lilienfeld et al., 2003). Like many mental concepts, pseudoscience is probably an open concept (see Meehl, 1986) or "Roschian concept" (see Rosch, 1973; Rosch & Mervis,

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1975), which is marked by indefinite boundaries, an indefinitely extendable list of indicators, and an unclear inner nature. Moreover, Roschian concepts are characterized by a prototype that embodies most or all features of the category. From this perspective, some disciplines (e.g., astrology) embody most or all of the features of pseudoscience we will lay out in the next section, whereas others (e.g., classical psychoanalysis; see Lack of Falsifiability and Overuse of Ad Hoc Maneuvers section) embody some, but not all, of these features (see Hines, 2003; Shermer, 2001, for discussions).

Note that this Roschian analysis does not imply that science and pseudoscience are indistinguishable. As psychophysicist S. S. Stevens remarked, day and night shade into each other imperceptibly (hence the concepts of dusk and dawn), but that does not mean that we cannot differentiate day from night (Leahey & Leahey, 1983). Differences in degree can still be substantial and pragmatically meaningful, especially at the extremes of the distribution.

PSEUDOSCIENCE: KEY WARNING SIGNS AND EXAMPLES FROM POLICE WORK

Indeed, a number of probabilistic indicators—which we can think of as warning signs—can help consumers of the literature to locate practices, including those in police work, on the fuzzy spectrum between science and pseudoscience. Numerous authors have provided varying lists of indicators that help to distinguish science from pseudoscience or "pathological science" (e.g., Bunge, 1984; Coker, 2001; Langmuir & Hall, 1953; Lilienfeld, 1999; Lohr, Fowler, & Lilienfeld, 2002; Park, 2001; Ruscio, 2006).

Here, we focus on 10 such indicators that we believe to be especially pertinent to law enforcement (see Table 1 for a summary of these indicators). Following each indicator, we offer one example from police work. In evaluating this list, we should bear in mind that no single indicator is either necessary or sufficient for the presence of pseudoscience; some developed sciences display one or more of these indicators, and some pseudosciences lack one or more of them. Nevertheless, the more such indicators exhibited by a discipline, the more suspicious of its claims we should become. Moreover, readers should bear in mind that many of the examples we provide from police work probably fulfill multiple hallmarks of pseudoscience.

LACK OF FALSIFIABILITY AND OVERUSE OF AD HOC MANEUVERS

Philosopher of science Sir Karl Popper (1959) proposed that falsifiability is the central criterion distinguishing science from nonscience. By falsifiability, Popper meant that scientific claims could be demonstrated to be wrong if there were evidence contradicting them. Such statements as "God created the universe" or "All humans are born with a soul that is spiritual but nonmaterial" may be true or false, but they are not falsifiable using scientific methods, because they could never be refuted with observable data. Popper criticized most of Freudian psychoanalysis and its offshoots (e.g., Adler's individual psychology) as unfalsifiable (but see Grunbaum, 1984, for a competing view). According to Popper, many of the assertions of psychoanalysis, such as its claims that neurosis arises from a conflict between ego and id or that all children experience an Oedipal conflict, are difficult or impossible to refute with data.

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TABLE 1: Ten Indicators of Pseudoscience and Examples From Police Work

Pseudoscience Indicator	*Example From Police Work*
Lack of falsifiability and overuse of ad hoc maneuvers	Fingerprint analysis
Evasion of peer review	Graphology
Lack of self-correction	Truth serum
Absence of safeguards against confirmation bias	The interrogation process
Overreliance on testimonial and anecdotal evidence	Eyewitness testimony
Extravagant claims	Polygraph tests
Ad antequitem fallacy	Hypnosis for memory enhancement and refreshment
Reversal of burden of proof	Anatomically detailed dolls
Absence of connectivity	Criminal profiling
Use of hypertechnical language	Eye movement desensitization and reprocessing

Note. This table contains a single example from law enforcement for each listed pseudoscientific indicator; however, this is not an exhaustive list of pseudoscientific indicators nor of examples from law enforcement. Moreover, many of the examples from law enforcement probably exemplify more than one of the listed indicators of pseudoscience.

As Popper (1959) observed, when researchers generate findings that seemingly falsify a given claim, pseudosciences often invoke ad hoc maneuvers—that is, escape hatches or loopholes—to explain away these negative findings. Admittedly, many developed sciences similarly invoke ad hoc maneuvers to account for negative findings. Nevertheless, in the case of developed sciences, such maneuvers typically strengthen the theory's substantive content, increase the theory's capacity to make accurate predictions, or both (Herbert et al., 2000; Lakatos, 1970, 1978). In contrast, in most pseudosciences, ad hoc maneuvers are typically tacked onto the theory in a desperate effort to explain away negative findings and rarely enhance the theory's content or predictive power.

Example from police work. In the case of fingerprint analysis, some devotees claim an accuracy rate as high as 100% (Berinato, 2004; Cole, 2005, 2007). They often propose that a given fingerprint can be perfectly matched to an exemplar print, to the exclusion of all other potential sources of that print. When the technique fails, they commonly point to such special circumstances as a distorted or insufficient print or misuse of a fingerprint apparatus to explain why the findings did not support the claims (Cole, 2005, 2007). Furthermore, the FBI's latent print unit has averred that only poorly trained fingerprint examiners make errors; expert practitioners rarely if ever make errors, and the method per se is essentially infallible (Meagher, 1999, 2003). For such an argument to be falsifiable, examiner training and skill must be standardized and tested such that the error rates for all examiners are known prior to their analysis (Cole, 2006; Haber & Haber, 2007) rather than tacked on after a mismatch occurs. The repeated use of such ad hoc hypotheses after the fact to explain away negative findings renders a good deal of fingerprint analysis difficult or impossible to falsify and arguably more pseudoscientific than scientific.

EVASION OF PEER REVIEW

Most mature sciences rely on peer review as a safeguard against error. In peer review, articles that evaluate scientific claims are sent to at least one—and typically three or more—outside experts who are entrusted with the task of subjecting them to relatively impartial scrutiny. In many cases, these articles are rejected outright; in still others, they are either rejected with an invitation to resubmit following substantial revisions or accepted

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provisionally. Peer review is not a perfect filter against poor-quality research (e.g., Cicchetti, 1991; Peters & Ceci, 1982), but it is often an essential safeguard against error. Many pseudosciences bypass this safeguard, preferring to evaluate claims "in house," that is, on their own. As Newbold, Lohr, and Gist (2008) note, this evasion of peer review often stems from a reluctance to subject claims to skeptical inquiry. The infamous fiasco of cold fusion, in which two University of Utah scientists claimed in 1989 to achieve nuclear fusion using a simple tabletop device, illustrates the dangers of announcing scientific findings to the public before subjecting them to peer review. Virtually all later researchers using rigorous controls were unable to replicate their findings (Friedlander, 1998).

Example from police work. Graphology, the use of handwriting to infer personality or psychopathological characteristics, has been used in an attempt to detect child molesters and violent criminals, with virtually no evidence to support its validity (Beyerstein & Beyerstein, 1992). Without subjecting their claims to peer review, many advocates of graphology posit that specific handwriting "signs" are linked to psychological traits; for example, some maintain that people who cross their *t*s with small "whips" are especially sadistic (Beyerstein, 1996). Yet scores of studies suggest that graphology is virtually useless as a personality assessment or crime detection technique. Moreover, different and often contradictory schools of graphology have continued in isolation for decades. Despite the overwhelming scientific evidence refuting its claims, many graphology proponents continue to advance strong assertions without the restraint and measure of objectivity afforded by the peer review process.

LACK OF SELF-CORRECTION

In the long run, sciences tend to be self-correcting: Incorrect claims tend to be revised or weeded out, whereas correct claims tend to survive. In this respect, science at its best operates by means of a process akin to natural selection (see Campbell's [1974] discussion of "evolutionary epistemology"). In contrast, in most pseudosciences, faulty claims tend to persist for lengthy periods of time, resulting in intellectual stagnation (see also Newbold, Lohr, & Gist, 2008). The pseudoscience of astrology, which claims to predict people's futures from the exact position of the stars and planets at the moment of their birth, has persisted in virtually identical form for nearly 4,000 years (Hines, 2003) despite the fact that the gradual shifting of the earth's axis during this time (a phenomenon called "precession") has rendered the night sky of the early 21st century markedly different from the night sky 4 millennia ago.

Example from police work. A truth serum is a drug, typically a barbiturate (such as sodium amytal), that supposedly elicits truthful information from a suspect or other reluctant individual. Yet research shows that supposed truth serums are misnamed (Piper, 1993). They work in much the same way as do alcoholic beverages: They reduce people's inhibitions, making them more likely to disclose both false and true information. Moreover, evidence suggests that many people can lie even under the influence of truth serum. In the infamous Holly Ramona case (*Ramona v. Isabella et al.,* 1994), Holly "remembered" an 11-year history of continuous sexual abuse by her father, Gary Ramona, after psychiatrist Richard Rose administered sodium

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amytal. The accusations appeared at least in part to be due to suggestions by her therapist, Marche Isabella, and other mental health professionals, who convinced Holly that sexual abuse was a cause of her bulimia and depression (Johnston, 1997). In addition, the 1994 abuse charges against pop singer Michael Jackson surfaced only after Jordan Chandler, age 13, was administered sodium amytal. The boy's father, Evan Chandler, and dental anesthesiologist Mark Torbiner administered the drug in Chandler's office and subjected Jordan to suggestive questioning techniques. Prior to these actions, the boy denied all allegations of sexual abuse (Taraborrelli, 2004). In both cases, purported truth serums may have been instrumental in generating uncorroborated accusations.

Yet there is some evidence that following the September 11, 2001, attacks, the U.S. government has expressed renewed interest in using truth serums to detect potential terrorists and assist in interrogations (Brown, 2006). Investigators in India similarly used truth serums to provide leads to police regarding terrorist attacks in 2003 (Katakam, 2004). The continued use of truth serums to elicit confessions or to unearth supposedly buried memories despite contrary scientific evidence dating back to the early 1950s illustrates a profound failure of self-correction.

ABSENCE OF SAFEGUARDS AGAINST CONFIRMATION BIAS

Some psychologists, such as Carol Tavris (see Tavris & Aronson, 2007), have argued that the scientific method is a systematic set of safeguards against confirmation bias—the tendency to seek out evidence that supports our hypotheses while ignoring, minimizing, or distorting evidence that does not (Nickerson, 1998). As a consequence of confirmation bias, we can blind ourselves to negative evidence, producing a psychological tunnel vision. Moreover, confirmation bias can result in an overemphasis on "hits" (corroborations of one's pet hypothesis) and an underemphasis on "misses" (failures to corroborate one's pet hypothesis). As Bunge (1967) observed, "the pseudoscientist, like the fisherman, exaggerates his catch and neglects his failures or excuses them" (p. 36). Yet as Paul Meehl (1978) noted, negative findings should generally be weighted more heavily than positive findings in evaluating psychological theories because science involves subjecting claims to the risk of refutation.

Scientists may often be just as prone to confirmation bias as are nonscientists (Mahoney & DeMonbreun, 1977). For example, research on the peer review process shows that clinical psychologists are more likely to accept an article if the results agree rather than disagree with their favored theoretical orientation (e.g., behavioral vs. nonbehavioral; Mahoney, 1977). Nevertheless, research methods afford scientists a substantial measure of protection against confirmation bias. For example, double-blind designs, now de rigueur in psychological and psychiatric treatment research, help shield investigators from the potentially distorting influences of their own hunches and hypotheses.

Example from police work. The interrogation process used by many law enforcement officials lacks many crucial safeguards against confirmation bias. Interrogators often form conclusions about the target suspect prior to obtaining sound evidence, and the process may become more about confirming those conclusions than obtaining impartial information (Millar & Millar, 1998; Vrij, 2008). Such presumptions can lead interrogators to become closed-minded toward alternative hypotheses and render them likely to selectively seek out

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support for their initial hunches. Indeed, the presumption of guilt can influence interrogators to adopt an investigative style that inadvertently elicits guilty behavior from suspects. Indeed, Kassin and Gudjonsson (2004) described how suspicion of guilt on the part of interrogators can shape their behavior and lead suspects to act anxiously or defensively, thereby confirming interrogators' suspicions. For example, if questioners increase bodily movement during an interrogation, the suspect is likely to mimic them and in turn appear nervous and "guilty" (Akehurst & Vrij, 1999; Chartrand & Bargh, 1999). As with any belief, an interrogator's confidence in the hunch that he or she is right can make it difficult to attend to data that do not support this belief (see also Snyder & Swann, 1978).

Of course, in the heat of the moment, police officers must often make snap judgments regarding whether to pursue a potential suspect or shoot a potentially armed individual. In such cases, a certain degree of confirmation bias is probably inevitable, perhaps even necessary. Nevertheless, police officers can help to avoid confirmation bias by taking pains to consider contrary evidence throughout all phases of the subsequent criminal investigation.

OVERRELIANCE ON TESTIMONIAL AND ANECDOTAL EVIDENCE

As a wise person once noted, "the plural of anecdote is not fact." Informal testimonials and anecdotes suggesting that a technique is effective can sometimes provide a justification for investigating that technique further in systematic studies (Gilovich, 1991), but they are never sufficient for concluding that a technique is effective. Many pseudosciences rely on informal personal evidence to validate their claims, thereby confusing Reichenbach's (1938) "context of discovery" and "context of justification." Anecdotes can sometimes be enormously useful in the context of discovery, that is, hypothesis generation. But with rare exceptions (e.g., existence proves that a given phenomenon cannot occur), anecdotes are not especially useful in the context of discovery, that is, hypothesis testing.

Anecdotal evidence, as superficially persuasive as it may seem, suffers from several marked evidentiary limitations. In particular, anecdotes may not be representative of most instances of a phenomenon; the police psychic who claims to have scored a "hit" in detecting a hidden body may not be typical of other psychics. Indeed, virtually all evidence suggests that police psychics are essentially useless for solving crimes (Hoebens, 1982; Marshall, 1978). In addition, anecdotes rarely exclude rival hypotheses for findings; a criminal profiler who correctly fingers the true murderer may have done so by chance or by relying on base rate information available to all nonprofilers (e.g., the fact that the murderer had a history of earlier violent crimes). As Paul Meehl (1995) observed, "the clear message of history is that the anecdotal method delivers both wheat and chaff, but it does not enable us to tell which is which" (p. 1019).

Example from police work. In more than 75% of the now more than 200 cases in which DNA evidence has demonstrated a prior false conviction, eyewitness misidentification was a primary determinant of a guilty verdict (Dwyer, Neufeld, & Scheck, 2000; Gross, Jacoby, Matheson, Montgomery, & Patel, 2005; Rothstein, 2005; www.innocenceproject.org). In many of these cases, law enforcement officials probably relied too heavily on anecdotal testimony for proof of guilt. Individuals' subjective experiences are neither recorded nor preserved in memory exactly as the event occurred (Loftus, 1993) and can be contaminated at many steps between the witnessing of an event and the relayed testimony given at the police station or courtroom (see Turtle & Want, 2008).

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Nevertheless, because anecdotal and testimonial reports are often subjectively powerful and affectively salient (Borgida & Nisbett, 1977; Nisbett & Ross, 1980), we may attach more evidentiary weight to them than they deserve (also see Snook, Cullen, Bennell, Taylor, & Gendreau, 2008, for the dangers of relying excessively on anecdotal evidence for drawing conclusions concerning the efficacy of criminal profiling). Indeed, mock jury decision-making studies demonstrate that jurors tend to place substantial emphasis on eyewitnesses' confidence in their reported memories despite findings indicating only modest correlations between eyewitness confidence and accuracy (Wells et al., 1998).

EXTRAVAGANT CLAIMS

As Richard McFall (1991) observed, science is a prescription for humility. Indeed, Tavris and Aronson (2007) have described science as "a form of arrogance control" (p. 108; see also O'Donohue, 1997). Good scientists are aware that their claims are almost always provisional and might be overturned by later evidence (Sagan, 1995); they are also careful not to overstate assertions in the absence of compelling data. In contrast, advocates of pseudoscience frequently advance extreme claims that greatly outstrip scientific evidence. For example, some advocates of Thought Field Therapy, a technique that purports to treat psychological disorders, such as long-standing phobias, by realigning clients' invisible energy fields, claim to be able to cure more than 97% of individuals with serious psychological disorders in a matter of a few sessions (Gaudiano & Herbert, 2007). A basic tenet of science is that "extraordinary claims require extraordinary evidence" (Sagan, 1995; Truzzi, 1978). The rationale here is that assertions that contradict established scientific principles require a higher onus of evidence than do claims that fit with extant knowledge (Pigliucci, 2005).

Example from police work. Some proponents of the polygraph or lie detector test have advanced extravagant claims regarding the accuracy of this device to detect lies, asserting that it operates with close to a 100% rate of accuracy (Iacono, 2008). If these assertions are to be believed, the lie detector test is far more valid than virtually any known psychological test. Yet as psychologist David Lykken (1998) observed, voluminous evidence suggests that polygraphs probably perform better than chance but are nowhere near as accurate as their most avid promoters assert (see also Ruscio, 2005; Saxe & Ben-Shakhar, 1999). Because it measures physiological arousal rather than lying per se, the polygraph test is prone to mislabeling innocent persons as guilty. Similarly excessive claims have sometimes been made by proponents of voice stress analyzers, which are also used for detecting falsehoods. Like polygraph tests, voice stress analyzers tend to mislabel many innocent persons as guilty (Gamer, Rill, Vossel, & Gödert, 2006; Lilienfeld, 1993; Long & Krall, 1990). As with any tool, extravagant claims should serve as red flags that proponents of a given practice have overstated its predictive capacity and are operating outside the bounds of good science.

AD ANTEQUITEM FALLACY

As the history of science teaches us, claims that have endured for a long time are not necessarily correct. For example, even though astrology is approximately 4,000 years old, there is no scientific support for its claims (Hines, 2003). The same holds for a host of other ancient practices that persist into the present day, including palmistry (palm reading) and numerous forms of fortune telling. Many pseudosciences fall prey to the *ad antequitem*

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fallacy: the error of concluding that because a claim is old, it must be valid. Yet many false claims persist for centuries or even millennia, in part because the influence of tradition and institutional inertia (the unwillingness of organizations, including police departments, to change their long-standing practices) is often powerful (Lilienfeld, Wood, & Garb, 2000).

Example from police work. The use of hypnotic-like procedures dates back to ancient times; the Greeks visited shrines of healing where they were given therapeutic suggestions during trances. The use of hypnosis in police practice probably dates back to at least the 1780s when, based on the work of Franz Anton Mesmer, the Marquis de Puységur famously hypnotized a person, Victor, and found that he showed astonishing clairvoyance. By the 1840s, police solicited the aid of an alleged clairvoyant who purportedly disclosed the identity of a thief under hypnosis (Gravitz, 2006; Ramsland, 2008). Following the lead of the Maryland Court of Special Appeal in 1968 (*Harding v. State,* 1968; Martin, 2004), there has been an upsurge in the use of hypnosis for memory refreshment in criminal investigations (McConkey, 1995; also see Martin, 2004). A few police departments have even erroneously instructed people that memory is analogous to a video recorder, which can lead to confabulation in the absence of clear memories and "memory hardening," that is, unwarranted confidence in memories (Meyer, 1992; Scheflin, Spiegel, & Spiegel, 1999). Despite a growing corpus of research questioning the effectiveness of hypnosis for retrieving accurate memories (Dywan & Bowers, 1983; see also Wagstaff, 2008), it has remained a seductive technique. Because the use of hypnosis for memory recovery and refreshment has a lengthy history, it may be tempting, but erroneous, to conclude that it is strongly supported from a scientific standpoint.

REVERSAL OF BURDEN OF PROOF

In many pseudoscientific disciplines, there is an implicit expectation that others must prove the claims wrong. Yet a key principle of science is that the burden of proof almost always falls on those advancing an affirmative claim. By placing the onus on others to prove the claim false, pseudosciences eschew scientific accountability, which requires the burden of proof to rest on the claimant, not the skeptic. As it is often impossible in science to prove a universal negative, pseudosciences frequently inoculate their untested claims from empirical scrutiny. Furthermore, reversing the burden of proof often results in the commission of the *ad ignorantium* fallacy: the logical error of assuming a claim is correct merely because there is not overwhelming evidence against it (Lilienfeld et al., 2003; Shermer, 1997). For example, proponents of flying saucers have often demanded that skeptics account for every reported case of an unidentified flying object in naturalistic terms (Hines, 2003). Yet the burden of proof falls on proponents to provide unambiguous material evidence for at least one flying saucer, not on skeptics to account for every undocumented flying saucer report.

Example from police work. The use of anatomically detailed (anatomically correct) dolls to detect child sexual abuse has been mired in scientific controversy (Skinner & Berry, 1993; Wolfner, Faust, & Dawes, 1993). In particular, there are serious scientific questions about whether such dolls are valid for detecting child sexual abuse, largely because many nonabused children engage in sexualized doll play. As a consequence, such dolls often result in high false-positive rates of abuse, especially among African American children.

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Moreover, anatomically detailed dolls typically lack standardization or norms and therefore cannot be considered true psychological tests, which would take into account the base rates of sexualized play among nonabused children (Hunsley, Lee, & Wood, 2003).

Despite such mixed and largely negative evidence, a working group commissioned by the American Psychological Association demurred from making any clear recommendations concerning anatomically detailed doll use, arguing that such dolls can "provide a useful communication tool in the hands of a trained interviewer" (Koocher et al., 1995, p. 218). Surprisingly, this working group offered this recommendation even after acknowledging that "the data on AD [anatomically detailed] dolls may be equivocal when claims for diagnostic discrimination are made" (p. 218). The working group's recommendation reflects a misunderstanding of the onus of proof in clinical science. If the evidence for a technique's validity is largely negative or at best equivocal and if the technique has the potential to produce harm (in this case, false allegations of abuse against family members or others), the scientifically appropriate stance is not agnosticism but rather serious cautions or even prohibitions against continued use pending further data.

ABSENCE OF CONNECTIVITY

Unlike most well-validated areas of research, pseudoscientific disciplines lack "connectivity" with other scientific disciplines, meaning that they do not build on the existing corpus of evidence generated by previous research programs (Bunge, 1983; Stanovich, 2007). As a consequence, they typically lack the cumulative character of developed sciences. Pseudosciences frequently fail to build on well-established scientific principles, often claiming to have forged a novel paradigm that has been rejected by the scientific establishment. In doing so, pseudosciences often insulate themselves from extant knowledge and the greater scientific community. For example, many advocates of extrasensory perception, such as telepathy (mind reading), claim that extrasensory perception violates most or all known physical laws of information transmission (e.g., the inverse square law; Beyerstein, 1996). For example, they typically contend that people with extrasensory perception can read the thoughts of people halfway across the world just as well as those of people in an adjacent room. Although scientists should not completely dismiss the idea that unconventional evidence points to a paradigm shift, they are right to require compelling evidence before abandoning well-established scientific knowledge.

Example from police work. A great deal of criminal profiling lacks connectivity to previous psychological research (see Snook et al., 2008). In particular, the controversy regarding criminal profiling could perhaps have been averted had closer attention been paid to the long-standing literature on clinical versus actuarial (statistical) prediction (Meehl, 1954). In essence, criminal profilers are relying on clinical prediction: They are subjectively integrating information regarding details of the crime in their heads in an effort to pinpoint the likely culprit.

Yet we have known since Paul Meehl's (1954) classic "little book" that cross-validated statistical formulas derived from outcome data consistently perform at least as well as, if not better than, clinical prediction. Indeed, a meta-analysis of 136 studies across a diverse body of domains, including criminal recidivism, response to psychological treatment, and graduate school performance, showed that statistical prediction is equal or superior to clinical

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prediction for the overwhelming majority of judgmental tasks (Grove, Zald, Lebow, Snitz, & Nelson, 2000). Had criminal profilers attended to this accumulated body of literature, they might have been more circumspect in their claims. In particular, they might have been considerably more cautious in their assertion that their accuracy exceeds that afforded by easily programmed actuarial formulas derived from the psychological and life history characteristics of known criminals. Moreover, although criminal profilers typically assert that their accuracy stems from years or decades of exquisitely honed experience observing crimes and criminals, research consistently demonstrates that the relation between amount of experience and the accuracy of clinical prediction is negligible or nonexistent across a variety of judgmental tasks (Dawes, Faust, & Meehl, 1989; Garb, 1998; Grove & Meehl, 1996).

USE OF HYPERTECHNICAL LANGUAGE

The use of overly technical language or specialized jargon can lend an air of authority to a discipline that is otherwise devoid of scientific legitimacy. In scientific disciplines, a new phenomenon often requires new terminology to differentiate it from a related concept. The use of neologisms may be warranted when they denote meaningful concepts, especially in cutting-edge fields of research. Pseudosciences, however, often employ impressive-sounding psychological jargon ("psychobabble"; Rosen, 1977) to serve as scientific paraphernalia without tethering these terms to clear empirical referents (Lilienfeld et al., 2003; Tavris, 2000; van Rillaer, 1991). As Newbold et al. (2008) point out, hypertechnical language often imports superficially similar concepts and terms from scientific disciplines, such as neuroscience ("neurobabble"), to lend pseudoscientific assertions the cachet of scientific respectability.

In a hilarious demonstration of the seductive allure of hypertechnical language, in 1996, New York University physicist Alan Sokal submitted an article to the postmodernist peer-reviewed journal *Social Text* titled "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity." Unbeknown to the *Social Text* reviewers or editor, Sokal's article was a hoax intended to highlight the superficial persuasiveness, but utter vacuousness, of postmodernist language in the physical sciences. Remarkably, the article was accepted and published despite containing such nonsensical passages as the following:

> In mathematical terms, Derrida's observation relates to the invariance of the Einstein field equation . . . under nonlinear space-time diffeomorphisms (self-mappings of the space-time manifold that are infinitely differentiable but not necessarily analytic) . . . . In this way, the infinite-dimensional invariance group erodes the distinction between observer and observed; the p of Euclid and *G* of Newton, formally thought to be constant and universal, are now perceived in their ineluctable historicity; and the putative observer becomes fatally decentered, disconnected from any epistemic link to a space-time point that can no longer be defined by geometry alone. (p. 222)

Example from police work. An increasingly popular psychotherapy, eye movement desensitization and reprocessing (EMDR), is used by a number of police departments in the United States in an effort to ward off stress reactions following shootings and other traumatic events (Parnell, 1997; Shapiro & Forrest, 2004; Wilson, Tinker, Becker, & Logan, 2001). EMDR was even used with a number of police officers who witnessed the terrorist attacks of September 11, 2001. Among other things, EMDR asks clients to imagine the traumatic events they witnessed while tracking the therapist's back-and-forth finger movements with their eyes. A large body of controlled research demonstrates that EMDR,

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although more efficacious than no treatment, is no more efficacious than long-standing behavioral treatments involving exposure to traumatic imagery, suggesting that it is probably just a variant of exposure therapy (Devilly, 2002; Herbert et al., 2000). Moreover, numerous studies suggest that EMDR's distinctive feature—the presence of lateral eye movements—is irrelevant to its therapeutic effects (Davidson & Parker, 2001).

Despite these findings, many proponents of EMDR have invoked explanations derived from neuroscience, such as synchronization of the brain's hemispheres or simulation of rapid eye movement sleep, to account for the purported therapeutic effects of eye movements (e.g., Shapiro, 1995). For example, one prominent sleep researcher and EMDR advocate conjectured that

> the repetitive redirecting of attention in EMDR induces a neurobiological state, similar to that of REM [rapid eye movement] sleep, which is optimally configured to support the cortical integration of traumatic memories into general semantic networks. We suggest that this integration can then lead to a reduction in the strength of hippocampally mediated episodic memories of the traumatic event as well as the memories' associated, amygdala-dependent, negative affect. (Stickgold, 2002, p. 61)

In attempting to explain the effects of EMDR at a neural level, the developer of this method (Shapiro, 1995) similarly argued that "when the processing system is catalyzed in EMDR, the valence of the receptors is shifted downward so that they are capable of linking with the receptors of the neuro networks with progressively lower valences" (pp. 317-318).

Yet these accounts are "explanations in search of a phenomenon" because controlled studies indicate that eye movements do not contribute to EMDR's clinical effectiveness. As a consequence, these hypotheses are largely or entirely devoid of scientific meaning. As a general take-home recommendation, law enforcement officials who are unschooled in psychological science should not assume that hypertechnical language necessarily communicates substantive meaning.

CONCLUDING THOUGHTS

Police and other law enforcement workers, like individuals in all applied disciplines, must keep a watchful eye on pseudoscientific and otherwise unsubstantiated claims. If they do not, they can end up making flawed decisions that result in false confessions, erroneous convictions, confabulated memories of early trauma, and a plethora of other harmful real-world consequences. Fortunately, by attending to the key warning signs of pseudoscience, law enforcement workers can learn to differentiate more from less scientifically plausible assertions and exercise appropriate skepticism when evaluating novel, controversial, and unsubstantiated techniques. In the long term, attention to these warning signs may help police officers to decrease their risk for plausible, but erroneous, decisions.

We therefore recommend that training curricula for all law enforcement officers include an introduction to user-friendly guidelines for distinguishing scientific from pseudoscientific claims and for compensating for errors in reasoning (e.g., confirmation bias) to which all people are prone. In addition to modeling such curricula on research findings on human judgment and prediction (e.g., Arkes, 1981), psychological scientists can benefit from input from law enforcement officials to maximize the relevance of these curricula to the real-world

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exigencies of everyday police work. As humorist Josh Billings is said to have observed, "The trouble with people is not that they don't know but that they know so much that ain't so" (Knowles, 1979, p. 491; see also Gilovich, 1991). By learning to distinguish science from pseudoscience, police and other law enforcement workers can become more discerning consumers of the psychological literature and minimize their chances of believing what ain't so.

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