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PSEUDOSCIENCE AND THE PARANORMAL: OBLIGATIONS AND OPPORTUNITIES FOR SCIENTISTS AND SCIENCE EDUCATORS

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Despite increasing reliance on science and technology in everyday life, public surveys conducted over the past decade have shown consistently low levels of general science literacy, both factual and conceptual, and correspondingly high levels of belief in pseudoscience and the paranormal. Scientists and science educators have largely failed to effectively counter these beliefs through traditional education and outreach initiatives, suggesting a new approach is in order. In the academic setting, general science instruction shows little effect on pseudoscientific belief, but trial projects show that pedagogical approaches that directly engage these beliefs are both popular with students and effective at increasing skepticism.

Malgré une dépendance accrue de la vie quotidienne sur les sciences et la technologie, les sondages publics réalisés au cours de la dernière décennie ont constamment reflété un faible niveau de littéracie, tant factuelle que conceptuelle, en sciences générales et un haut niveau correspondant de croyance dans les pseudosciences et le paranormal. Les scientifiques et les éducateurs en sciences ont largement échoué dans leurs tentatives de contrer ces croyances par des initiatives de vulgarisation et d'éducation traditionnelle, ce qui permet de croire qu'une nouvelle approche est de mise. En milieu scolaire ou universitaire, l'apprentissage des sciences générales se révèle sans grand effet sur les croyances pseudoscientifiques, mais des projets pilotes démontrent que les approches pédagogiques qui prennent directement à partie ces croyances ont la faveur des écoliers et étudiants, et parviennent à accroître le scepticisme.

MONTEL WILLIAMS: And he could be found near there?

SYLVIA BROWNE: He's near the boulders.

PAM HORNBECK: Is he still with us?

SYLVIA BROWNE: No.

January 12, 2007 a miracle took place, or maybe two miracles if you're counting. That stormy Friday, 15-year-old Shawn Hornbeck, missing since October 6, 2002, and 13-year-old Ben Ownby were discovered in the custody of Michael J. Devlin, a 41-year-old pizzeria manager in Kirkwood, Missouri. As the news spread, the state and much of the country—glued to the investigation since the younger Ben was abducted four days earlier—let out a collective sigh of relief. They hadn't expected this. These things don't usually work out well, and everyone realized the odds of finding Ben

alive were low. Those for Shawn were astronomical, especially since he had been previously pronounced dead. Twice.

The story of Shawn's premature declaration of "passage" is a sordid one. In their desperate search for answers, Shawn's parents had turned to two celebrity "psychics", Sylvia Browne and James Van Praagh, both of whom confirmed on international television their worst fears: Shawn had been murdered (Boyle 2007).

With the recovery of Shawn Hornbeck alive, these readings were revealed as failures in every conceivable detail, failures which had wasted police resources and caused unimaginable anguish for the Hornbecks. The media response was swift and violent. In the days following, skeptics were rounded up for interviews and exposé segments on psychic charlatans aired. And then, a few weeks later, it all blew over, and the psychics again began appearing on talk shows.

The immovable presence of mediums and psychics is just one manifestation of the popular media's systematic uncritical promotion of fringe claims. The market mechanism here is obvious: the strange, the bizarre, and the just-might-be-true sell. To cite one example, 15 million Americans—nearly one in twenty—tuned in to watch Fox Television's *Conspiracy Theory: Did We Land on the Moon?* It is hard for networks to resist this kind of cash cow. What is less clear is why the public is so interested.

Defining the issue: What is 'Pseudoscience'? What is 'Science'?

Whole subfields of philosophy, history, and sociology exist to debate this question, and it won't be resolved here. But, useful working definitions can be easily produced. Michael Shermer (1997), author of *Why People Believe Weird Things*, defined 'science' as "a set of methods designed to describe and interpret observed and inferred phenomena, past or present, and aimed at building and testing a body of knowledge open to rejection or confirmation" and 'pseudoscience' as "claims presented so they appear [to be] scientific even though they lack supporting evidence and plausibility".

The philosopher Michael Martin (1994) offered similar criteria for demarcation, emphasising the differences between superficial and depth qualities of science: pseudoscience is linked to science by surface similarities, such as its tendency to develop a technical language, require specialized training, reference evidence, etc. However, it differs at depth by a reluctance to subject its claims to proper test, the frequent invocation of *ad hoc* explanations when its claims fail tests, and a tendency to isolate itself from other scientific disciplines.

The scope of the problem

About 75 percent of Americans hold at least one of ten common pseudoscientific beliefs, with 22 percent believing in five or more (Moore 2005). Particularly popular are telepathy, ghosts, haunted houses, and precognition, all of which are accepted as true by 30 to 40 percent of respondents. As for most of the topics discussed in this paper, data are limited or absent for Canada, but Canadians and Americans tend to share similarly high

levels of belief in pseudoscience and the paranormal (Lindeman & Aarnio 2006)—for example, 40 percent of British Columbians believe in ghosts (Leung 2006)—so the American data can stand as a reasonable proxy.

Scientists, science educators, and science students tend to be somewhat less credulous than the general public, but even within the science community, pseudoscientific belief is remarkably strong. One survey of high school biology teachers found that 34 percent believed in psychic powers, 22 percent in ghosts, and 18 percent in a supernatural explanation for the Bermuda Triangle (Eve & Dunn 1989). A more recent qualitative study of Australian and British working scientists and science professors found widespread belief in alien landings, the healing powers of crystals, and the existence of ghosts, as well as strong individual support for nearly all major categories of the paranormal, e.g., Ouija boards, water divining, etc. (Coll & Taylor 2004).

Finally, although science students have been shown in several studies to manifest lower levels of paranormal belief (e.g., Aarnio & Lindeman 2005), the reduction is only marginal, with field of study statistically less predictive of level of belief than numerous other variables (such as sex).

What's the harm in a little pseudoscience?

This question can and has been treated at book length, e.g. James Randi's *Flim-Flam!* (1982), but two particularly widespread examples—"psychic" phenomena and alternative medicine—can serve to illustrate the potential for harm, both direct and indirect.

No figures are kept on the amount of money spent annually on psychic consultations. Fees can range from a few dollars to several thousand (bids for pet psychic readings start at \$50 US on eBay), but the total is likely in the billions. As an indication of scale, in 2002 Florida-based ARS, Inc. (the company behind prominent telephone psychic "Miss Cleo") agreed to forgive nearly \$600 US million in outstanding bills following action by the Federal Trade Commission and several states into deceptive marketing practices (Christopher 2003).

Some psychics also profit by extortion, demanding payment for protection against supernatural threats. During 2005, the Australian Department of Consumer and Employment Protection reported 1,326 individual scams involving psychics (DOCEP 2005). In one example, an 82-year-old pensioner was convinced to pay \$40,000 AU for protection from evil forces. Similarly, recent research commissioned by the UK's Office of Fair Trading showed more than 170,000 consumers fall victim to clairvoyant mail scams every year, losing around £40 million (Moon 2007).

Regardless of monetary costs, many skeptics object primarily to what they see as intellectual and emotional fraud. For example, although psychics who claim to contact the dead may provide some immediate relief to the bereaved, the dishonest, manipulative use of stock magician's tricks to deliver that result is ethically dubious. Additionally, this temporary fix can spawn future problems by, as reformed spiritualist conman M. Lamar Keene

(1997) explains, “hinder[ing] him or her in developing the inner resources to face life realistically.”

Complementary and alternative medicine (CAM) presents another growing area of concern. The term is a grab bag of health modalities that embraces literally everything from alchemy and “psychic surgery” to meditation and a healthy diet. The risks and/or benefits associated with their use vary accordingly.

The majority of CAM therapies are physically benign (and ineffective); however, their cost and troubled relationship with conventional medicine raise thorny ethical and patient welfare issues. Many herbs do contain active ingredients, but often these herbal drugs are marketed with little or no standardization of dosage. Potential interactions with other common drugs or impact on existing medical conditions are also frequently unknown and/or not noted on product labels.

CAM treatments are used by up to 73 percent of cancer patients (Neuhouser et al. 2001), and the potential for dangerous interactions with chemotherapeutic drugs is well documented (Meijerman et al. 2006). Similarly, Lee et al. (2006) recorded elevated incidence of post-operative events in surgical patients who had previously taken prescribed traditional Chinese herbal medicines. St John’s Wort, an herb widely used to treat depression, has been discovered to interfere dangerously with AIDS medications (Henney 2000). Beta-carotene, a popular CAM treatment for lung cancer, has, ironically, been shown to increase rates of the disease, especially among smokers (Goodman et al. 2004).

Delay or rejection of scientifically tested medical interventions is another area of concern. Davis et al. (2006) found that patients with head and neck cancer that used alternative medicine significantly delayed seeking conventional treatment. Although most North American patients with serious illnesses such as cancer use CAM therapies as adjuncts to regular treatment (Maddalena et al. 2006), some do not. Adams et al. (2002) relate the case of a patient who chose to treat her cervical cancer with Reiki (an “energy” therapy where the practitioner waves his or her hands over a patient’s body), instead of the recommended surgery. And, in 2000, a jury awarded damages against a New York physician—for the second time in three years—following the death of a patient whose cancer had been treated with a regimen of vitamins and coffee enemas (Radford 2000).

Despite scant evidence of efficacy, spending on CAM therapies is immense. The online industry hocking alternative cancer “cures” alone has become so large—and profitable—that in March, 2008, the Canadian Competition Bureau launched a special program, Project False Hope, to deal with it. Up-to-date figures do not exist, but out-of-pocket expenses in 1997 for alternative therapies and books were estimated at over \$34.4 US billion in the United States (Eisenberg 1998) and \$3.8 billion in Canada (Ramsay et al. 1999). Today’s figures are likely much higher, given the steady rise in popularity of these treatments.

A deeper concern

The emotional, financial, and physical consequences of some pseudo-scientific beliefs are troubling, but they are symptomatic of a more worrying civic issue. Most pseudoscientific beliefs are not just unsupported by evidence, they are in direct *conflict* with large bodies of well-established data and longstanding theory. That so many people are unable to differentiate real science from pseudoscience exposes a profound and shockingly widespread ignorance of both basic scientific facts and the nature of the scientific method(s). This ignorance limits the appreciation of nature, increases vulnerability to consumer fraud, and—most importantly—restricts participation in many of the most pressing contemporary policy debates, e.g., Climate Change, effectively disenfranchising a large portion of the population (Maienschein 1999).

Ignorance of what science does, ignorance of what science says

Data for Canada are lacking, but surveys of general science knowledge amongst adult Europeans and Americans show depressingly low levels of scientific literacy. Only 20 percent of US adults meet minimum requirements for scientific literacy (Miller 2004). For example, only 50 percent recognize that the Earth rotates around the Sun once a year. Twenty percent believe that the Sun rotates around the Earth (NSB 2000). Depressingly, these numbers have remained fixed for the last decade.

The average North American also has no clear idea of how science *works*. In a 2004 National Science Foundation survey, only 23 percent of respondents were able to articulate what it meant to study something scientifically, and only 43 percent could identify that an experiment with a control is superior to one without (NSB 2006).

Ignorance of basic science concepts is not limited to the public at large. A survey of US judges found that just 5 percent demonstrated a clear understanding of falsifiability and only 4 percent a clear understanding of error rate. This is despite their being charged as gatekeepers of expert testimony and scientific evidence (Gatowski 2001). Science students do little better. In a study of University of Tennessee science majors enrolled in a second year biology course, not one basic science concept question (e.g., “Science produces tentative conclusions: true or false?”) was answered correctly even 50 percent of the time (Johnson & Pigliucci 2004).

Sourcing the problem

Despite these statistics, the average North American is not anti-science. In fact, both Canadians and Americans have very favourable opinions of scientists' intentions and of the benefit of science to their lives (CBS 2005). They also profess a strong interest in scientific topics. A 2001 study found that 45 percent of Americans profess to be “very interested in science and technology,” compared with only 30 percent of Europeans (NSB 2006).

Overall, fully 90 percent of Americans claim to be at least moderately interested in science, a statistic that is at least partially born out in practice. According to a study by the European Commission, Americans are twice

as likely as Europeans to go to science and technology museums, and are considerably more likely to go to zoos and aquariums than their European and Asian counterparts (NSB 2006). Given the persistent ignorance of science described above, this seems a paradox.

The astronomer and science popularizer Carl Sagan (1997) explored this conundrum in his book, *The Demon-Haunted World*, and offered an explanation by way of an anecdote: One day his taxi driver, having recognized him as the host of the popular science television series *Cosmos*, began to enthusiastically prod him for information on a number of "scientific" topics of personal interest. But, instead of real science, each question was invariably about some pseudoscientific claim, and each time Sagan had to disappoint him by explaining the reasons why the claim was unlikely to be true. With each answer the driver became more depressed, as Sagan took a little more wonder out of his world.

Sagan uses this story to illustrate what he saw as the double failure of scientists and science educators. First, they failed to ensure their voices stood out against the chorus in favour of the pseudoscientific. And second, and perhaps more importantly, scientists failed to offer an equally interesting alternative. The taxi driver "had a natural appetite for the wonders of the universe. He wanted to know about science. It's just that all the science had gotten filtered out before it reached him." The moral: pseudoscientific topics like ESP and alien abduction are popular precisely because they are exciting and widely available; genuine science, if it is to capture the public's attention, has to learn to compete on these fronts."

A failure to engage

There is wisdom in this argument. Americans, like their international counterparts, express both strong interest in science and dissatisfaction with their current level of knowledge. In the 2004 NSF survey, 69 percent of Americans expressed interest in scientific discoveries, but only 15 percent considered themselves "well-informed" on scientific topics (NSB 2006). These figures suggest an immense opportunity, one that scientists have thus far failed to capitalize on.

This is at least partially, as Sagan (1997) suggests, for lack of effort. A 2001 survey of US scientists found that 42 percent engaged in no public outreach at all, and only 12 and 20 percent engaged in political and media outreach, respectively. The number one reason given, at 76 percent, was insufficient time, but 28 percent also answered that they did not want to, and 17 percent that they did not care (Research!America/Sigma Xi 2001).

Sagan's second prediction is also backed up by recent research. Concerned with public apathy towards science, in 1998 NASA's Space Sciences Laboratory commissioned a blue ribbon panel to evaluate current best practice in science education. Their report criticized many traditional notions about the nature and goals of science communication. In particular, it stressed the gap between the information scientists want to disseminate, and the information the public wants to know (Borchelt 2001). This is a key detail:

the public is interested in the anomalous and the sublime, but scientists have shied away from their coverage, leaving these areas to sensationalistic and/or non-scientific treatments.

A formula for success

Carl Sagan famously applied his own advice in his television series *Cosmos: A Personal Journey*. Airing in 1980, this 13-part science series dealt with topics as diverse and complex as the evolution, structure, and age of the universe; the historical origins and philosophy of science; and the environmental consequences of nuclear war. Despite this, *Cosmos* was a runaway success, winning a Peabody Award and garnering a viewership of over 600 million people world wide.

The phenomenal success of the 2006 BBC series *Planet Earth* (broadcast in over 130 countries) demonstrates that the success of *Cosmos* was not anomalous—popular science can compete with not only pseudoscience, but drama and comedy for a share of the entertainment market. Both of these series succeeded by trading in awe, capturing the audience's attention through the grandeur of nature, and using this as a platform from which to engage in basic science instruction.

The explosive popularity of the Discovery Channel's *MythBusters* demonstrates that in addition to scientific fact, scientific investigative techniques themselves can be popularized. *MythBusters* employs an experimental approach to testing controversial or fringe claims. Episode topics—mostly urban myths—come from audience suggestions and run from the absurd (Can mirrors be used to make a death ray? Can a ninja deflect a bullet with his hand?) to the almost practical (Can running in a zig-zag line save you from a Crocodile? How do you escape from a sinking car?).

Although light-hearted, the show provides a compulsively watchable—and frequently pyrotechnic—illustration of the nature of experimental design and, more importantly, the importance of fact-checking claims. Explaining the design of each test also usually requires a crash course in mechanics or chemistry, providing almost unconscious instruction in often complicated material.

This format has also been used by the illustrated magazine *Jr. Skeptic*, which critically examines claims of the paranormal as a means of teaching children general critical thinking and science concepts. A similar approach can be adapted to the classroom.

The effectiveness of imaginative pedagogy

Frustrated with the resiliency of pseudoscience, even amongst science students, several educators have designed courses that directly target these beliefs. Morier and Keeports (1994) describe the results of one such course: over two years, students consistently showed a substantial drop in belief in pseudoscience relative to a control class. Reductions in belief were also recorded by Wesp and Montgomery (1998) for their course, *Experimental Investigation of the Paranormal*, as well as a significant improvement in students' ability to critically read scientific literature. Dougherty (2004),

Gray (1984), Woods (1984), and Martin (1994) all also recorded positive outcomes for similarly themed courses.

All of these courses taught general nature of science concepts (theory development, hypothesis testing, probability, nature of evidence, logic, etc.) using specific paranormal examples. This approach allowed students to apply conceptual principles to claims and to assess evidence, rather than simply being told what was and was not true. Most of the courses featured an experimental or demonstrative component. Several courses brought in professional mentalists to illustrate techniques by which magicians appear psychic, and one incorporated a controlled test of a professional dowser.

Morier and Keepports (1994) credit this active engagement of claims with providing more consistent changes in belief than other courses that teach general critical thinking. In addition, taking a lesson from Sagan's (1997) taxi driver, learning was aided by using material – the paranormal – that students found naturally interesting, adding a little excitement to a potentially dry subject. In each of three semesters it was offered, *Pseudoscience and Psychology* student evaluations averaged above 8.5 on a 9 point scale for satisfaction with learning outcomes (Lilienfeld et al. 2001). High scores were also recorded by the other instructors noted above.

These examples illustrate the potential for novel pedagogical approaches to increase students' knowledge of science and their ability to think critically – knowledge that is indispensable to making informed judgements on socioscientific issues (Kolsto et al. 2006).

Changes to teaching practice, combined with an active engagement of the public and a more honest and thorough attempt to communicate the processes and pitfalls of science, hold real potential for benefit to the public. The advantages gained from scientific understanding extend far beyond the paranormal; science literacy is indispensable in the very normal, but profoundly important day-to-day choices faced by the consumer and voter.

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