

CARGO CULT SCIENCE: A CASE OF CONVENIENT UNTRUTH

*"Assertions – in both science and art – always need justification:
you don't make things true just by saying they are."*

Michael Swan

This paper addresses the issues of the so called cargo cult science or pseudoscience. Based on abundant previous research, as well as on our own findings, linguistic devices that signal pseudoscientific claims in modern English were singled out and analyzed. Emphasized here are the linguistic devices of discerning fact vs. factlet, masking half-truth, scaremongering, vague and misleading language, technobabble. Cases of scientific fraud, the so-called "cosmetic" science, and advertising in light of pseudoscience discourse are also considered.

Key words: cargo cult science/pseudoscience; linguistic devices fact; factoid/anecdota; misleading language; exaggerating; intimidating; scientific fraud; advertising.

У статті розглянуто питання так званого культу карго або псевдонауки. На підставі аналізу наявної літератури з питання та власних спостережень, виявлено мовні засоби, за допомогою яких в сучасній англійській мові маркуються та маскуються псевдонаукові твердження, як-от: недостовірна інформація, схожа на правду, напівправа; залякування, розпливчасті твердження та дезінформація, псевдонаукова мова. Увагу приділено й науковому шахрайству, так званій "косметичній" науці та рекламі як випадкам псевдонаукового дискурсу.

Ключові слова: псевдонаука; мовні засоби; факт; недостовірна інформація, яка схожа на правду; псевдонаукова мова; перебільшення; залякування; дезінформовування; наукове шахрайство; реклама.

В статье рассмотрены вопросы так называемого культа карго или псевдонауки. На основании анализа существующей литературы вопроса и собственных наблюдений, выявлены языковые средства, при помощи которых в современном английском языке маркируются и маскируются псевдонаучные утверждения, а именно: недостоверная информация, похожая на правду, полуправда; устрашение, расплывчатые утверждения и дезинформация, псевдонаучный язык. Внимание уделяется научному мошенничеству, так называемой "косметической" науке, рекламе как примерам псевдонаучного дискурса.

Ключевые слова: псевдонаука; языковые средства; факт; недостоверная информация, выдаваемая за правду; псевдонаучный язык; преувеличение; запугивание; дезинформация; научное мошенничество; реклама.

What is "cargo cult science"? It's just another name – suggested by the US physicist Richard Feynman – for the thing commonly known as "**pseudoscience**". There exist other names for the phenomenon, with subtle shades in meaning, and we'll deal with them, as well as with **linguistic devices** that indicate pseudoscience, in this paper. My principal **aim** is to uncover the essence of pseudoscience as convenient and comforting lies, wrapped in words.

The phrase "cargo cult science" comes from Richard Feynman's Caltech commencement address given in 1974. He vividly depicted the phenomenon:

During the Middle Ages there were all kinds of crazy ideas...

Then a method was discovered for separating the ideas – which was to try one to see if it worked, and if it didn't work, to eliminate it.

This method became organized, of course, into science. And it developed very well, so that we are now in the scientific age. But even today I meet lots of people who sooner or later get me into a conversation about ... astrology, or some form of mysticism, and so forth. And I've concluded that it's not a scientific world.

In the South Seas there is a cargo cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now. So they've arranged to imitate things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas – he's the controller – and they wait for the airplanes to land. They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So I call these things cargo cult science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land.

There is one feature I notice that is generally missing in cargo cult science. It's a kind of **scientific integrity**, a principle of scientific thought that corresponds to a kind of utter honesty... For example, if you're doing an experiment, you should **report everything** that you think might make it invalid – not only what you think is right about it... In summary, the idea is **to try to give all of the information** to help others to judge the value of your contribution; **not just the information that leads to judgment in one particular direction** or another. And it's this type of integrity, this kind of care not to fool yourself, that is missing to a large extent in much of the research in cargo cult science. [19]

The term "pseudoscience" has many faces: "bad science"; "cargo cult science"; "quasi-science"; "junk science" (псевдонаука; лженаука; квазінаука; "культ дарів небесних"/"культ карго"; ренікса). Interestingly, the latter word comes from Anton Chekhov's literary work "Three sisters" (as early as 1900!). It described the case of misreading the Russian word *ренуха* (чепуха), having thought it was written in Latin ("в какой-то семинарии учитель написал на сочинении "чепуха", а ученик прочел "ренікса" – думал, по-латыни написано) [6]. Many years later, academician Alexander Kitaigorodsky titled so his book on pseudoscience. [3]

Linguistically, the dichotomy between real science and pseudoscience is that between fact and factoid. While a **fact** (факт, що відповідає дійсності) implies something that has proved to be true, a **factoid** (a **factlet**) (недостовірна інформація, яка схожа на правду і яку зазвичай вважають такою через тиражування у засобах масової інформації; факт, що не відповідає дійсності) is a historical fact that isn't true, but presented in press as factual, real one – because of frequent repetition. The term was coined by the US Pulitzer Prize-winning author Norman Mailer. For example, Thomas Edison did not invent the lightbulb, or even the first incandescent one. British scientist Warren De La Rue made a lightbulb in 1840 using a platinum filament, and the first demonstration of incandescence (making a wire glow by running electricity through it) was in 1802 by British

chemist Humphry Davy. In 1879, Edison did invent the first incandescent lightbulb that was reliable, long lasting, and manufacturable. Similarly, **urban legends** (міська легенда, "страшна" історія, що видається за реальну) are unscientific by their very nature. [2: 219, 575].

Pseudoscience stems from anti-intellectualism [21; 22] and poor science education that nurtures it. For example, Bill Bryson's book on science for kids "A Short History of Nearly Everything" [11], though extremely popular, contains way too much anecdotal evidence, to say nothing of many mistakes that have been already noticed by the educated readers and interpreters of the book [1; 16]. Another issue is the so called magical thinking that relies on the belief of interconnectedness of all things through forces and powers that transcend both physical and spiritual connections [26].

Such ideas have been in the air since ancient times – recall the works of Sextus Empiricus [7], or the Danish astronomer Tycho Brahe, who both promoted mathematical approach to astronomy vs. astrology-oriented one. Tycho Brahe supported credibility and observational astronomy. The abandonment of astrology in public discourse is primarily explained by Tycho's social position and greater sensibility to controversial issues [8].

In the mid-20th century, Karl Popper suggested the criterion of falsifiability, refutability, and testability to distinguish science from nonscience [28]. In a similar vein, Imre Lakatos proposed the demarcation criterion of pseudoscientific theory: if it can't make any novel predictions of previously unknown phenomena [24].

On the other hand, such philosopher of science as Paul Feyerabend, the proponent of theoretical anarchism, argues that a distinction between science and pseudoscience is barely possible, as there are no methodological rules at all, just ephemeral generalities [17].

In a more popular, everyday sense, pseudoscience, according to Charles Pierce, is about the following Great Premises:

1. Any theory is valid if it makes money.
2. Anything can be true if it is said loudly enough.
3. Fact is what enough people believe (the Truth is what you believe). [27]

that also represent an unscientific approach.

What it means is that pseudoscience tends to be driven by ideological, commercial or similar goals. It has evolved very little since it was first established. A challenge to accepted dogma is considered heresy, the data that are not consistent with the existing beliefs are ignored or suppressed. Pseudoscientific concepts tend to be shaped by individual egos and personalities; pseudoscientific explanations tend to be vague and ambiguous. According to Russel Turpin, "paradigm" is perhaps the most abused word. Its uses are often so vague that no significant meaning can be attached. For that matter, the phrase "scientific paradigm" has almost no useful meaning. Another case is the word "science" used narrowly, or "theory" ("it's only a theory") [32].

Critical thinking and evidential reasoning are essential to scientific literacy. Skills for critical thinking are summarized by C. Wade and C. Travis [33]:

<i>Skills</i>	<i>Simple Techniques</i>
1. Ask questions: be willing to wonder	Start by asking "Why?"
2. Define the problem	Restate the issue several different ways so it is clear.
3. Examine the evidence	Ask what evidence supports or refutes the claim. Is it reliable?
4. Analyze assumptions and biases	List the evidence on which each part of the argument based. The assumptions and biases will be unsupported.
5. Avoid emotional reasoning	Identify emotional influence and "gut feelings" in the arguments, and exclude them.
6. Don't oversimplify	Do not allow generalization from too little evidence.
7. Consider other interpretations	Make sure alternate views are included in the discussion.
8. Tolerate uncertainty	Be ready to accept tentative answers when evidence is incomplete, and new answers when further evidence warrants them.

Evidential reasoning is the key to the scientific method [25]:

Falsifiability	Conceive of all evidence that would prove the claim false
Logic	Argument must be sound
Comprehensiveness	Must use all the available evidence
Honesty	Evaluate evidence without self-deception
Replicability	Evidence must be repeatable
Sufficiency	1. Burden of proof rests on the claimant. 2. Extraordinary claims require extraordinary evidence. 3. Authority and/or testimony is always inadequate

It is argued that when distinguishing science from nonscience, one must clearly understand the nature of science itself – the criteria of valid evidence, the design of meaningful experiments, the weighing of possibilities, the testing of hypotheses, the establishment of useful theories, which enables drawing accurate, reliable, meaningful conclusions about the phenomena of the physical universe. However, every now and then, the media provide sheer nonsense and misinformation, fantasy and confusion –all proclaimed to be "true facts. " Sifting sense from nonsense is an almost overwhelming job. It is claimed that there exist some **signals**, or **earmarks** of **pseudoscience** one can easily detect, namely:

- indifference to fact; use of bogus, fictitious facts ("factoids") makes extraordinary claims and advances fantastic theories that are in contradiction to what is known about nature.
- pseudoscientists never revise; they use the inherited "sacred texts" as if they were contemporary science textbooks;
- pseudoscience begins with a hypothesis – usually one which is appealing emotionally, and spectacularly implausible – and then looks only for items which appear to support it; conflicting evidence is ignored;
- pseudoscience shows a total indifference to criteria of valid evidence, and controlled, repeatable, reproducible scientific experiments;
- pseudoscience relies heavily on **subjective validation**;

- pseudoscience does not progress; just switch from one fad to another;
- pseudoscience persuades using misinformation, appeals to widespread belief, rhetoric, propaganda, and misrepresentation, rather than presenting valid evidence
 - pseudoscience argues from ignorance, from alleged exceptions, errors, anomalies, strange or paranormal events; it bases claims on incompleteness of information about nature, rather than on what is known at present; it appeals to the ancient human habit of magical thinking;
 - pseudoscience appeals to false authority, to emotion, to sentiment, or to distrust of established fact. Emotional appeals are common: "If it makes you feel good, it must be true." "In your heart, you know it's right." "Follow your bliss!" "Use your intuition!";
 - pseudoscience is fond of imaginary conspiracies "Scientists don't know everything!" "the government keeps it secret";
 - pseudoscience makes heavy use of an invented vocabulary in which the new terms introduced do not have precise or unambiguous definitions, and most have no definitions at all.

And, finally, pseudoscientists tend to be the so-called "crossovers": "a scientist almost invariably winds up doing pseudoscience when he moves out of a field in which he is knowledgeable and competent, and plunges into another field of which he is quite ignorant. A physicist who claims to have found a new principle of biology – or a biologist who claims to have found a new principle of physics – is almost invariably doing pseudoscience. A scientist becomes a pseudoscientist when he defends an idea when all evidence and experiment is against it, because he is emotionally or ideologically committed to it. A scientist who forges data, or suppresses data which do not agree with his preconceptions, or refuses to let others see his data for independent evaluation, has become a pseudoscientist. Science is a high peak of intellectual integrity, fairness, and rationality" [14].

An even shorter such guide is suggested by Russell Mayne, who studied cases of pseudoscience in English language teaching. He puts forward two main problems: lack of evidence and erosion of standards.

- Does it make too good to be true claims (panacea, cure-all)?
- Does it make claims that are vague or hard to test?
- Does it use a lot of science-sounding (wonderful and exotic) terms?
- Does it have little or no scientific credibility?
- Does it lack rigorous scientific evaluation?
- Is contrary evidence ignored by supporters? [30]

Based on all of the above, as well as on our own findings, let's provide our own **summary of linguistic indicators of pseudoscience.**

Here belong:

- **factoids and various endorsements from celebrities or anyone who has no scientific expertise rather than facts;**
- **covering only the tiny part of actual events that claims "all the truth"; employing linguistic devices that mask half-truth ("further research is needed") and eclecticism ("a novel multidisciplinary approach");**

- **ignoring "facts in a world of disinformation"** [22];
- **use of scaremongering, -phobia and hoax-laden, alarmist and hysteria language** (ominous future; ominous truth behind ...; rhetorical questions like "Can you imagine a life without smartphones?" "Imagine going two months without clean water?" using phrases like "global warming", "climate breakdown/disruption/shock/failure", instead of more scientifically accurate and far more linguistically neutral "climate change");
 - **exaggerated language**, use of **weasel words** and **glittering generalities**; propaganda and sensationalist mass-media language ("sensational"; "a revolutionary discovery"; "one-of-a-kind" etc.)
 - **use of empty words** and **vague language** to create the Woozle effect ("everyone knows", "it is clear that..."; "it is obvious..."; Cf. давно вже доведено; вчені вважають; сучасна наука говорить, по словам експертів, сучасні вчені признають);
 - **empty posturing**. Says Noam Chomsky:

"What you're referring to is what's called "theory". And when I said I'm not interested in theory, what I mean is, I'm not interested in posturing – using fancy terms ... and pretending you have a theory when you have no theory whatsoever. So there's no theory in any of this stuff, not in the sense of theory that anyone is familiar with in the sciences or any other serious field. Try to find in all of the work you mentioned some principles from which you can deduce conclusions, empirically testable propositions where it all goes beyond the level of something you can explain in five minutes to a twelve-year old. See if you can find that when the fancy words are decoded. I can't. So I'm not interested in that kind of posturing. " [12];
 - use of **scientific-sounding** but **misleading** and **unclear language** (a. k. a **technobabble**; **technospeak**; **scientese**).



This is also reflected in the following neologisms:

fruitlooper

n. The improper or ignorant use of scientific or technical language to make a false or impossible claim seem more believable.

"In 2005 Mike Holderness, a freelance contributor to New Scientist, wrote of "professional dissidents" who are given the oxygen of publicity by those journalists who "divide all stories into precisely two sides that get equal space: too often the reality-based community Versus fruitloops and/or special interests. " Language needed a term like that, and Holderness's choice was inspired. "Fruitlooper" became the New Scientist's generic word for advertisers' use of science either unverifiably or wildly out of context. Fruitlooper indicators in ads include the words quanta, tachyons, vibrational energies, or restructured water, especially in combination" [34].

nasty effect

n. The polarization of opinions on a particular topic caused by exposure to uncivil commentary about that topic.

"Science" magazine reported on the effects of nasty comments about science stories online. Not only do they fail to improve the debate, they also make people stupider... the readers become more entrenched in their previous opinions, whether positive or negative. " [34];

- **lack of self-correction**; over-reliance on personal experience, on confirmation rather than refutation;
- **making "too good to be true" claims**;
- **anecdota, or anecdotal evidence used to attempt to prove a hypothesis or to make a forecast or used just for fun:**

PAUL SOLMAN: You actually come to this place to find evidence for your forecast?

DAVID WYSS: Yeah, I actually do. I come to the Burlington Mall, especially like at Christmastime, just to see how many people are shopping. Is there a recovery in consumer spending, or are the stores empty?

MR. SOLMAN: This store is empty.

DAVID WYSS: This store is empty, no question.

MR. SOLMAN: A handful of stores, just one mall, not what you'd call a statistically significant sample. In fact, the most recent government report was that retail sales rose in January, which just goes to show why the journalist's approach to reality, what you might call "**anecdota**," may be the flimsiest form of forecasting. [34]

Or: "Physicists are notoriously scornful of scientists from other fields. When the great Austrian physicist Wolfgang Pauli's wife left him for a chemist, he was staggered with disbelief. 'Had she taken a bullfighter¹³ I would have understood,' he remarked in wonder to a friend. 'But a chemist ...'" [10];

- trying to detect some kind of **conspiracy** behind something:
"There seemed to be a mystifying universal conspiracy among textbook authors to make certain the material they dealt with never strayed too near the realm of the mildly interesting" [10].

Another case of pseudoscience is scientific misconduct. **Scientific fraud** is not just about **plagiarism**, but also about

- "**scamferences**", when scientists are sent a well-written email inviting them to an international conference in their research field, complete with actual research topics that will be discussed, a professional looking conference website and a personal invitation to submit a paper. If the invitation is accepted, a notification of the paper's acceptance is sent and the author is asked to pay a standard subscription fee. All seems perfectly normal and very convincing, until people arrive on the venue, only to find that the conference never existed;

- **computer-generated research papers to mimic actual research.**

Most of them were "created" by using SCiGen computer program.

Here's the actual story of Phil Davis:

"Would a publisher accept a completely nonsensical manuscript if the authors were willing to pay Open Access publication charges? After being spammed with invitations to publish in Bentham Science journals earlier this year, I decided to find out. Using SCiGen, a software that generates grammatically correct, "context-free" (i. e. nonsensical) papers in computer science, I quickly created an article, complete with figures, tables, and references. It looks pretty professional until you read it. For example:

In this section, we discuss existing research into red-black trees, vacuum tubes, and courseware [10]. On a similar note, recent work by Takahashi suggests a methodology for providing robust modalities, but does not offer an implementation [9].

The manuscript, entitled "Deconstructing Access Points" was submitted on January 29th, 2009, to *The Open Information Science Journal (TOISCIJ)*, a journal that claims to enforce peer-review. The manuscript was given two co-authors, as was their institutional affiliation: The Center for Research in Applied Phrenology based in Ithaca, New York. If the acronym didn't reveal the farce right away, phrenology is the pseudoscience of reading personality traits from the lumps on one's head. Bentham confirmed receipt of my submission the very next day (January 30, 2009). Nearly four months later, I received a response. The article was accepted. The acceptance letter read:

This is to inform you that your submitted article has been accepted for publication after peer-reviewing process in TOISCIJ. I would be highly grateful to you if you please fill and sign the attached fee form and covering letter and send them back via email as soon as possible to avoid further delay in publication.

The letter was written by a Ms. Sana Mokarram, the Assistant Manager of Publication. She included a fee schedule and confirmation that I would pay US\$800. The manuscript was subsequently retracted:

Dear Ms. Mokarram,

I'm afraid that we have to retract this article. We have discovered several errors in the manuscript which question both the validity of the study and the results.

I have yet to receive a response. What is surprising is that the assistant manager claimed that the article went through peer-review although there is no evidence that it actually did. Anyone with English proficiency – with or without a degree in computer science – would recognize that this manuscript makes absolutely no sense. Had it gone through peer review, I should have received reviewer comments. If you are skeptical that I might be misreading the response of someone whose first language is not English, I clarified the decision in a previous email with the simple question, "Does this mean that our manuscript was accepted for publication?" Her answer was the above quote. " [13].

Doing "cosmetic" science has nothing to do with fancy cosmetics world, of course. The term is inspired by "cosmetic engineering":

"Equally unscientific is the so-called **cosmetic engineering**, that deals not with fancy world of cosmetics, of course, but is about the impact that personal computers with elaborate graphical environments have had on modern engineering practice: "These tools have eliminated much tedium from the design process, allowed us to stimulate many systems before prototype construction, and provided a means of quickly visualizing complex phenomena... One unfortunate result has been the encouragement of a type of engineering best characterized as "cosmetic". Cosmetic engineering is more concerned with appearance than substance. It is performed by cosmetic engineers whose first priority is to create things that look good; content and performance are of secondary importance. Cosmetic engineering's products are many and (one might say) many-splendored. On paper, they take the form of bland, immaculate graphics, often in color, and always of "publication quality". The computer screen is the medium of choice for the true cosmetic engineer since it provides a dazzling variety of ingenious means for saying something about nothing... This is not to deny appearance its rightful place in product design. An automatic dishwasher should look good in addition to being able to wash dishes. The trouble starts when they get involved in the guts of the technical design itself. Worse yet, one of them may be allowed to manage the project with the values of cosmetic engineering. Imagine, if you will, the development of a complex piece of military software by a team consisting of entirely cosmetic engineers. The topics are technical, in a sense, but have little relevance to the fundamental tasks the engineers are being paid to perform. Instead, they focus on the mechanics of producing the visible end-item. As in all cosmetic endeavors, the issues that ought to be addressed become secondary. Finally, a demonstrable product emerges. It displays its results in luscious, 24-bit true color. It has only one fault: it produces erroneous results" [23].

In other words, research becomes a **simulacra** and **simulation** (terms by Jean Baudrillard who claims that modern society has replaced all reality and meaning with symbols and signs, and that the human experience is of a simulation of reality rather than reality itself [9]), which brings to mind another pseudoscientific simulacrum case of **advertising**. Its inherently unscientific nature is aptly revealed by Richard Feynman, who analysed the case of one of TV commercials:

"Wesson oil doesn't soak through food. Well, that's true. It's not dishonest; but the thing I'm talking about is not just a matter of not being dishonest, it's a matter of scientific integrity, which is another level. The fact that should be added to that advertising statement is that no oils soak through food, if operated at a certain temperature. If operated at another temperature, they all will – including Wesson oil. So it's the implication which has been conveyed, not the fact, which is true, and the difference is what we have to deal with" [19].

Let's compare what the ad says (left column) with scientist's comments [11]:

<i>Advertising</i>	<i>Skeptical scientist's comment</i>
<p>Imagine a world without laundry detergent. No more troublesome decisions as to whether to buy <i>Cheer</i> or <i>Joy</i> or <i>Surf</i> or <i>Tide</i> or <i>Amway</i>. What a wonderful world it would be! Well, it's here. You can quit buying detergent. The new ABI Laundry Ball is here. The what? The ABI Laundry Ball. You can buy one for a mere \$75. Here is how it works:</p> <p>The ABI Laundry Ball emits a charge into the water which breaks the bonds between molecules, enabling the individual water molecules to penetrate the fabric. The water is also highly charged with negative ions. The dirt, which is highly positive in charge, is attracted to the individual water molecules and it [sic] flushed out with the water during the rinse cycle. The rinse cycle actually acts like a second wash cycle, since there in NO SOAP to rinse out. Clothes are clean at a cost of approximately 5 cents per load.</p> <p>By manipulating the electric fields associated with hydrogen and oxygen atoms, crystals are formed in the shape of electrical keys. These keys fit into locks and bonds of other compounds to dissolve away dirt much like the action of enzymes in the human digestive system.</p> <p>These crystals [sic] retain their form in boiling liquids. I, Crystals, although completely benign to man and the environment, can perform and enhance reactions formerly only possible by chemicals, soaps, and detergents.</p>	<p><i>I find this information a bit puzzling in light of another claim made by the people at ABI. In their explanation as to how laundry detergents work they say:</i></p> <p><i>The detergent saturated water enters the fabric and the dirt is attracted to the positive charge in the soap molecule. The dirt and detergent rinses out during the rinse cycle (in theory). Clothes are clean at a cost of approximately 11 to 25 cents per load.</i></p> <p><i>If dirt is highly positively charged and soap molecules are positively charged, the dirt should be repelled by the soap, not attracted to it. This must be an example of New Age Physics where "energy" means whatever you want it to mean because Quantum Mechanics proves that anything goes. Here is some especially interesting technological information for New Agers who love their crystals:</i></p> <p><i>So, there you have it. The ABI people even quote Dr. Shui-yin Lo, nuclear physicist, who apparently spends his time working on new and improved ways to do the laundry. Some people might wonder what is in this little ball that can manipulate electrical fields and form little crystals. I wonder if the crystals act as anti-matter and annihilate the dirt, too. If not, where do all the little dirt ball locks go with their crystal keys stuck in them? And do they bond together into one giant dirt ball crystal?</i></p>

The above case clearly proves the idea that advertising went a long way from informing to persuading, and from persuading to manipulating and suggestion. [5]

Finally, it could be concluded that pseudoscientific discourse can be pervasive and sometimes very persuasive. We see it in everyday life (e. g. magical thinking), in popular science and science education, in mass media, and, of course, in science itself. The comforting untruth of pseudoscience leads to denying the uncomfortable truth. However, there are many clues that reveal pseudoscientific claims wrapped in words in virtually any setting imaginable. It's about reading between the lines to understand someone's real intentions from what they write or say.

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