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Fibroporia radiculosa, First Landing State Park, Virginia Beach, VA, December 29, 2016, photographed by Tom Bigelow of NYMS

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Medicinal Mushrooms and Amateur Mycology: Problems with Anecdotal 'Evidence'

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Referring to the putative benefits of chaga, *Inonotus obliquus*, Michael Kuo, in his popular and authoritative Mushroom Expert website puts it, as he says, bluntly, "There is no legitimate scientific support for the idea that mushrooms are medicinal in any specific, eat-them-to-get-better way. None." (Kuo 2020).

A gentler, more sympathetic take is presented by Konrad A. Szychowski and coworkers. Reviewing the vast literature on the subject in the *Journal of Traditional and Complementary Medicine* (Szychowski et al. 2021), the authors state that "Although *I. obliquus* has a potentially positive effect on health… studies that meet the evidence-based medicine (EBM) criteria [were not to be found and] are needed (emphasis added)." In other words, the purported claims of medicinal benefit for *Inonotus obliquus* are not supported by scientific evidence. And yet, scores of mushroom hunters cite personal medicinal benefits derived from drinking Chaga tea. What gives here?

A central problem when assessing personal claims of medicinal benefits attributed to the ingestion of mushrooms (or other entities be they biological, mineral, or chemical) has to do with the subjective character of the claim. The person making such claims, will inevitably have ongoing belief systems which affect how they perceive and interpret the changes---if any---in their sensorium. These personal claims of the purported effects of the mushroom, tincture, or drug ingested are examples of anecdotes.

While personal anecdotes often/usually have strong subjective truth, that is, they "feel" true, and they may be useful in the formulation of carefully crafted hypotheses, such claims come with multiple flaws which often escape the notice of the naïve observer. Confounding this is the related situation by which beliefs---*in and of themselves*---are often attended by physiological effects and changes within the body's sensorium. These effects and feelings then become

available to influence the beliefs themselves. These intrinsic, subjective effects are often referred to as the expectancy or placebo effect.

This article will attempt to deal with the limits of anecdotal evidence. The placebo effect is dealt with elsewhere (Bakaitis 2021).

ANECDOTAL EVIDENCE: *POST HOC ERGO PROPTER HOC* AND OTHER FLAWS

An obvious problem with using anecdotal evidence is the *post hoc* fallacy[1]. The fact that event X (drinking chaga tea) precedes event Y (my cancer or infection was cured) does not necessarily mean that X caused Y. Consider, for example, the following:

The post hoc fallacy is one of the most common fallacies that I encounter in debates about scientific topics, and it takes the following logical structure.

- *Premise 1: Q happened before U*
- *Conclusion: Therefore, Q caused U*

The problem with that should be pretty obvious: the fact that one thing happened before another doesn't mean that one caused the other. In other words, the conclusion does not follow necessarily from the premise. We can easily illustrate this with simple examples.

- *Premise 1: I performed a sacrifice, then it rained*
- *Conclusion: Therefore, my sacrifice caused the rain*

or

- *Premise 1: I read a book, then had a heart attack*
- *Conclusion: Therefore, reading the book caused the heart attack.*

Do you see how that works (or, rather, doesn't work)? The fact that one thing happened before another does not lead to the conclusion that there is a causal relationship. The logical structure is invalid, and any arguments containing this structure (i.e. containing a post hoc fallacy) must be rejected. On a side note, this is a fundamental reason why anecdotes are worthless as evidence of causation ("5 Reasons Why Anecdotes Are Totally Worthless" 2016). The fact that you got better after taking something doesn't mean that it worked, and the fact that you had an adverse event after taking something doesn't mean that the treatment caused the event. Both of those arguments contain this structure (i.e., they are post hoc fallacies), and, as such, they are

[1] "*Post hoc ergo propter hoc"* from Latin, "After this, therefore because of this."

not valid, and the conclusion does not follow necessarily from the premise ("The Importance of Logical Fallacies" 2017).

The author continues with a discussion of several other problems associated with anecdotal "evidence." Among these are the vanishingly small sample size (N=1), the lack of controlling for placebo or confounding factors, and the fact that the examples---by their very nature---are not representative and non-replicated, nor---in many---cases replicable.

In summary, using anecdotes as evidence of causation commits a logical fallacy, which means that anecdotal arguments must be rejected. Further, anecdotes don't give you a fair representation of the effects of X on Y, nor do they account for potential confounding factors. Therefore, anecdotes are worthless as evidence. They simply cannot demonstrate causal relationships…. If you want to know whether or not X causes Y, the one and only way to do it is by conducting large, properly controlled studies that account for confounding variables. Nothing else will suffice. It doesn't matter if you have "seen it work," it doesn't matter if something has been used for centuries ("Ancient Knowledge and the Test of Time" 2015), and it doesn't matter if a symptom has been reported in a database like VAERS or printed on a package insert. Unless proper scientific testing has shown that X causes Y, you cannot conclude that there is a causal relationship between the two. ("5 Reasons Why Anecdotes Are Totally Worthless" 2016)

Let's see if we can apply this to a case we all might know.

In a recent, highly promoted and circulated film about "fantastic" mushrooms, one of the central characters, a mycologist of high visibility, describes how a mushroom, *Trametes versicolor,* if I remember correctly, cured his mother of cancer---after her doctors proclaimed her case as hopeless, giving her only months to live. A central vignette was filmed in the presence of his mother who was still very much alive. During the scene the son described how she out-lived her imminent death sentence. He states (paraphrasing), "Science gives us statistics; I give you my mother." as evidence of his claim that mushrooms cured her.

I know very little about this case save what was relayed in the film, but my critical eye immediately picked up on several items which seem to demand further scrutiny. Perhaps the critiques of this case, which follow, have been explored, developed, or refuted elsewhere, but for illustrative purposes, I will use them here.

First, the obvious: I do not mean to be disrespectful to either son or mother, and am glad for both that the mother has survived. I have lived with several family members and friends who

have had to deal with cancer and understand, all too well, the anxiety, pain and turmoil which follows such a diagnosis.

This illustration, however, is a good example of an anecdote: It might be developed into a "case study" perhaps, but remains an anecdote, nonetheless. The N is only 1, the mother. By definition she is not representative of the population as a whole nor is this unique event replicated. In addition, the son, at least, has a finely-honed belief structure surrounding the efficacy of mushrooms as medicinal agents. The film maker, too, has a very strong point which s/he wishes to make, and in all likelihood selected cases and edited segments and sequences which will help make the point that fungi have fantastic properties. This does not, in-and-of itself, negate the point the director, editor or mycologist wishes to make, but it does raise obvious flags for the critical mind.

For example: Upon hearing his statement that "Doctors gave my mother only months to live." I was immediately struck at the stark simplicity of that opinion.

My wife also had cancer. During her treatment we saw multiple teams of doctors at several top hospitals in and around New York City. It was amazing how their diagnosis differed. Most, if not all, used a "7 to 10" phrase, but in widely disparate scales. Depending upon their areas of specialty/concern/research, the physicians gave Leslie "7 to 10 years," "7 to 10 months" or in one case where the head of a department thought the cancer had invaded her meninges, "7 to 10 days" to live!

This disparity existed even within the same department of the same hospital which specialized in the very type of cancer she had. All of the specialists used the same CT scans, the same DNA sequencing of the BRCA1 variant she was born with, the same X-rays, blood tests, past records and used the same tests of vital signs, physical and cognitive functioning. Nevertheless, their diagnoses differed. This variability in the diagnosis caused a great deal of anxiety and confusion for us as we sought both appropriate treatment modalities as well as a time scale upon which we could plan for her life and last days.

A conclusion, easily drawn, is that the opinion of doctors is not an exact science, but an art. And opinions vary widely.

Consider the wife of one of my colleagues who was diagnosed with pancreatic cancer and given only months to live. Being religious (Jehovah's Witnesses), the family seemed to accept her fate and did little or nothing in the way of treatment. Defying all expectations, she survived her

husband's two promotions, a sabbatical, and retirement. When last I heard they were living comfortably in a restored mansion near Hudson, NY.

Or consider this fantastic anecdote reported in *The New York Times* (Blakeslee 1998):

Many doctors know the story of "Mr. Wright," who was found to have cancer and in 1957 was given only days to live. Hospitalized in Long Beach, Calif., with tumors the size of oranges, he heard that scientists had discovered a horse serum, Krebiozen, that appeared to be effective against cancer. He begged to receive it.

His physician, Dr. Philip West, finally agreed and gave Mr. Wright an injection on a Friday afternoon. The following Monday, the astonished doctor found his patient out of his "death bed," joking with the nurses. The tumors, the doctor wrote later, "had melted like snowballs on a hot stove."

Two months later, Mr. Wright read medical reports that the horse serum was a quack remedy. He suffered an immediate relapse. "Don't believe what you read in the papers," the doctor told Mr. Wright. Then he injected him with what he said was "a new super-refined double strength" version of the drug. Actually, it was water, but again, the tumor masses melted.

Mr. Wright was "the picture of health" for another two months -- until he read a definitive report stating that Krebiozen was worthless. He died two days later.

If true, this is a remarkable anecdote, and may even suggest a possible hypothesis of causality, especially since the physiological effects were shown to advance and retreat in the same patient over a short period of time and in apparent direct connection to the patient's belief in efficacy of the treatment. Such use of the "subject (patient) as his own control" is one way to attempt to hold otherwise uncontrolled variables constant.

There is, of course, the very distinct possibility that this 60 year-old episode was concocted/remembered/recorded/exaggerated for purposes unknown to us at present.

At a minimum, let's remember that extraordinary claims require extraordinary proofs.

THE LAW OF PARSIMONY

To return to the claim made in the film that mushrooms cured the mother of cancer, a second point also leaps out. If memory is correct, I recall the son stating that his mother was treated not only with Turkey Tail (*Trametes)*, but also with tamoxifen, a drug used to treat estrogen

receptive breast cancer. He did not say if the treatment with tamoxifen continued after his mother was treated, but since this is the standard of modern care, we should probably infer that it was. Scientific evidence indicates that the use of tamoxifen has been shown unequivocally to improve the outcomes of breast cancer survival rates, especially in cases where patients continue to take the drug for an extended period of time. According to an analysis of 20 long term follow-up studies conducted by the National Institute of Health, "The fact that, 15 years after the start of treatment, rates of relapse for women who took 5 years of tamoxifen remain lower than those for women who did not take the drug…means that 5 years of tamoxifen can prevent a high proportion of recurrences and potentially cure many patients." (National Cancer Institute 2011) The Law of Parsimony is a cardinal rule in science. It proposes that in cases of competing hypotheses, the simplest one is usually correct. Tamoxifen is known to be an effective treatment in preventing relapse and potentially curing cancer. Since the mother in this case was treated with tamoxifen, the most parsimonious (conservative) conclusion is that tamoxifen, not *Trametes,* cured the cancer.

This, of course, does not preclude other hypotheses such as tamoxifen plus *Trametes* is better (or worse, or more comfortable, or better controls for side effects, etc.) than tamoxifen alone. But those claims can only be demonstrated by more rigorous testing, not by anecdote alone. Scientific findings are inherently conservative. Understandings developed via the scientific method accumulate predictive power and robustness by their fundamental ability to dovetail with larger bodies of established evidence and to survive systematic attempts to be disproven. In this sense, Scientific Truth is fundamentally different from the felt, Emotional Truth which seems to propel many non-scientific anecdotal claims.

Of some saving grace to those of us who believe in the curative power of mushrooms, and who might have been following mycological developments for a period of time, is the story of the development of Taxol (paclitaxel). Taxol, which is also used to treat breast cancer, was first isolated from the stem bark of the western yew, *Taxus brevifolia*, in 1971. As the source from trees was exploited and dwindled, other sources were explored and now involve the use of fungi. Recent work, for example, has been with *Taxomyces andreanae,* an endophytic fungus of Pacific yew. See (Soliman and Raizada 2018) for a discussion of techniques used to produce the drug from the few tiny threads of fungal hyphae buried within host plants. Spoiler alert: It ain't easy.

ANECDOTES AND GAMES WITH NUMBERS

There is another, more technical, problem with the attempt to use anecdotes as evidence. This comes from the type of data anecdotes usually produce. By its very nature, anecdotal evidence is usually non-parametric, that is, the data is of a non-mathematical nominal or ordinal scale.

"After taking the herbal supplement I felt better." (Nominal scale).

"After taking the tincture my pain fell from an 8 to a 6." (Ordinal scale)

I should probably expand for those of us who have forgotten, or were never exposed to this concept. All numbers are not created equal: some are much more powerful than others. This is so, even if they look and sound identical.

The weakest numbers have only the property that "1 does not equal 2." This is the nominal scale where the number is only a name. The condition of "feeling better" might be given the number/name, 1, and the condition 'not feeling better' might be given the number/name, 0 or 2 or even 1,000. Very little can be done with data such as this. For example, Kobe Bryant was number 33 in high school and 8 or 24 in his professional career. Joe Namath was number 12 when he played for Alabama. You can't tell from these numbers who was the greatest player, scored the most points, earned the highest salary, gained the most respect, etc. And then there was the wide receiver Kenny Burrough of the Houston Oilers who wore "00" during his NFL career in the 1970s. Those of a certain age will remember 'double-ought' as one of the best.

Numbers from an ordinal scale are somewhat stronger. They have not only the property of the nominal scale "1 does not equal 2," but also the quality that "2 is greater than 1."

How much greater, well, you just can't say. The difference between 1 and 2 is not necessarily the difference between 2 and 3 or 5 and 6, or any other two consecutive integers. Think of the results of a horse race and the difference between "Win, Place and Show." All we can say is that "Win" came in first place, "Place" crossed the finish line next (second) and "Show" trailed both "Win" and "Place," coming in third. We do not know the differences in time between them. But the glamorous model who placed the wreath around the horse's neck and gave the jockey a kiss… Well, she, like Bo Derek, was quite possibly a "10!"

Or consider pain. The array of facial icons in a doctor's office, shading from a distinct smile to a distinct frown, is another example of ordinal data. It might record the subjective measure of pain felt at the moment, but is not able to calibrate the difference between 3 and 4 as the same as between 7 and 8.

Both nominal and ordinal scale data are called non-parametric measures and have severe limitations. This is easily seen when they are compared with parametric data involving true numbers which have true mathematical properties.

There are two parametric scales, interval and ratio.

In an interval scale, a condition of "equal interval between integers" is added to the powers of the ordinal scale: 1 does not equal 2; 2 is greater than 1; and the difference between 1 and 2 is the same as that between 3 and 4, or 1,001 and 1,002. A ruler, thermometer, or clock are good examples of interval data.

A ratio scale meets all of the criterion of an interval scale plus that of a true zero. Height is often used as an example, as one cannot have zero height.

These are true number with true mathematical properties. These numbers can be added, subtracted, multiplied, divided, squared, cubed and rooted with tautological precision.

Since parametric scales have these mathematical properties, data accumulated from these measures can be used to generate both an arithmetic average (the mean) and a standard distribution (the average distance any single score will fall from the mean). From these scores, a theoretical frequency distribution under a normal probability distribution (The Bell-Shaped curve) can be described with the ability to test how likely any particular score (or average of a group of scores) will occur by chance alone (Figure 1).

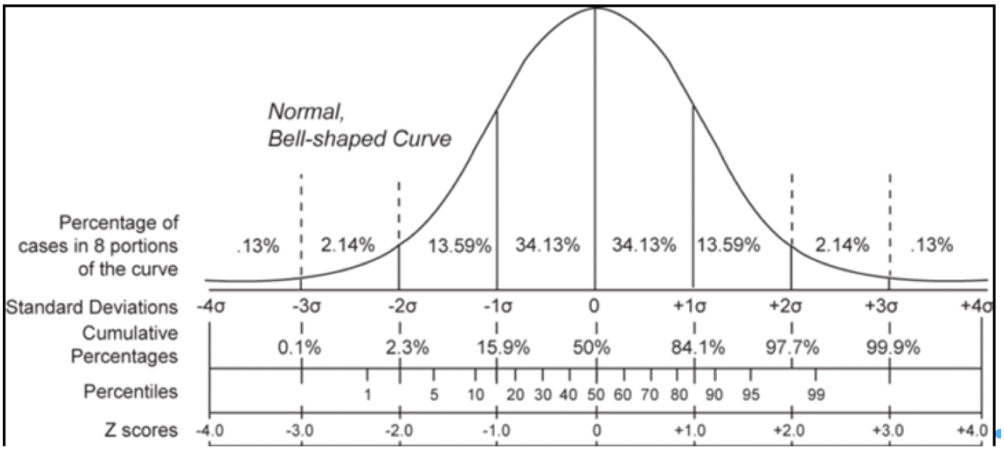

Figure 1. Normal distribution and scales. (Kemp 2005)

This is a theoretical curve. By chance 50% of all scores---or the mean average of any randomly drawn sample of scores (see The Central Limit Theorem (Frost n.d.))---will fall above the mean. Also, again, by chance alone, any single score---or mean of a set of scores randomly drawn and computed under the assumptions of a *t* test---will fall 2 standard deviations above the mean about

2.27% of the time. If you can predict in advance the direction of a hypothesis, you can place all your bets in this area. This is called the rejection region of a "one-tailed" test. For example, medicinal mushrooms will improve patient outcomes as measured by parametric data collected by the operational definition "Reduction in tumor size as measured by CAT scan." "Increase in post-treatment survival rate measured by days alive" is another operational definition of efficacy which might be used.

If you are unable to predict the direction of your hypothesis (You don't know ahead of time whether this fungus will improve or harm patient outcomes), you must split the rejection region placing half in each "tail" of the distribution: hence, a "two-tailed" test.

The rejection region is your decision as to what level of chance you will accept as proof that you can reject the null hypothesis, which holds that there is nothing going on which cannot be explained by chance alone. Typical values used are 0.1(1/10), 0.05 (1/20), 0.01(1/100) or 0.001(1/1,000) depending upon other interacting variables.

Note that the tails never touch the base line. Even exceedingly rare occurrences will occur by chance alone. Recall Mr. Wright and Krebiozen.

In general, the larger the sample size, the more powerful the test and finding (ability to reject the null hypothesis) will be. With operational definitions using parametric data even small sample sizes have valid predictive power. Non-parametric measures however demand very large sample sizes to carry the same power and validity (Frost n.d.).

But this is only so if the sample is representative of the population as a whole. Consider the case of the early days of the famous "Hite Report on Female Sexuality." In order to capture a large audience to survey, a questionnaire was inserted into the then current issue of *Cosmopolitan Magazine*, inviting readers to respond. The staid, homely nature of this magazine, which had previously featured articles on home cooking, ladies' fashion, and home décor changed radically in the 1960's when "Helen Gurley Brown stepped in as editor-in-chief. She brought with her the message of sexual freedom for single women, and started replacing the cover illustrations with photos of young models in minimal clothing. Sales increased as a result.", (McGuire 2010) and provided sociologist Shere Hite with the large survey population she desired for her research. See (McGuire 2010) for more.

Consequently, the Hite study reported behaviors which appeared to be in conflict with the received wisdom of other major studies, a conflict which became readily understandable once the

triple bias of Hite's study was revealed: 1. Readers of "Cosmo" were not representative of the population of American women of the 1970s. 2. Those readers, who chose to respond to this survey reporting their very private sexual practices, were also not representative of the population of all readers of the magazine. 3. Nor were those 4% whose data was crucial for the study's reported "findings" representative even of those who returned surveys.

Journalists and researchers investigating this story reveal that the study's "trouble with numbers" may be just the tip of an iceberg of biased work. This report and its flaws is often a standard case study in research literature on how not to conduct research (Streitfeld 1987).

When this understanding is applied to mycophiles --those among us who like/love mushrooms, who form identities around mycology, and especially those of us who have gravitated toward one of the cults of psycho-myco-spiritual advancement -- the implications seem rather obvious. Reports of spiritual claims or medicinal cures from this subset of the population as a whole are quite likely skewed by their beliefs, values, and expectations.

The cure for this, as has been pointed out elsewhere, is rational skepticism, not romanticized journalism or ritualistic acceptance of "fantastic" claims.

In addition to the well-known parametric tests of validity (the *t* or *F* Tests), there are also measures of statistical significance which can be ascertained with non-parametric data. The "chi square" or "Goodness of Fit" is probably the best known, but these non-parametric measures lack the power of parametric statistical tests. Siegal and Castellan's *Nonparametric Statistics for the Behavioral Sciences* (Siegal and Castellan 1988) is still as much a standard as when I studied with him at Penn State in the early 1960's. It is still available at the Amazon website and elsewhere. Bear in mind, however, that these easy-to-do, non-parametric studies need to be much larger than for those where parametric data is used.

BIO-PSYCHOLOGICAL ROOTS OF IRRATIONAL BELIEFS

A Google search will reveal a long list of unproven cancer cures. These purported "cures" are driven not by science, but by beliefs, beliefs which run the gamut from the efficacy of smelling of flowers and herbal essences (aromatherapy) to the drinking of urine (urotherapy). It begs the question to ask, "What drives these beliefs?" ("List of Unproven and Disproven Cancer Treatments," n.d.)

One driver is certainly Hope and few of us would want to deny that to someone facing a diagnosis of death, prolonged illness, deep anxiety, despair or depression.

Embedded within that word, Hope, is a constellation of critical understandings which can also help illuminate its power. Begin with the associated term, "Belief."

For those of us who study "Belief," there is unequivocal evidence that beliefs are examples of learned behavior shaped by family, friends and culture. This shaping occurs as rewards are given for certain behavior, including mental behavior, and withheld for others. This will not come as a surprise to most of us. Nor would many of us quibble with the notion that an increase in pleasure or decrease in pain are both inherently rewarding.

Learning Theory, however, has produced insights which might be new to the general public. One observation is the introduction of the theoretical concept, tension – at root, biological tension, discussed below, and the derivative equivalent, psychological tension. The corollary which follows is that any increase in tension is perceived/felt as pain, any decrease, as pleasure. Both drive behavioral change.

Armed with just this one generalization, it becomes relatively easy to untangle many of the causes for our learned---and often irrational---beliefs.

Hunger is a biological need; food deprivation leads to motivated behavior to relieve hunger. Mothers and drill instructors alike know how to consciously use hunger to control behavior and attitude.

So, too, with approval and social belonging. At mom's hand, the unsocialized "Naked Ape" becomes an altar boy. Upon meeting the drill sergeant, one is reborn as an aggressive killing machine. One throws the grenade, which saves the patrol, and is transformed into a hero and leader. The hero returns to society, finds it impossible to adjust to social norms, and is motivated to commit murder or suicide.

Skipping over acres and acres of associated territory and findings from the Behavioral Sciences, all of which enhance this central idea, it should be relatively easy for each of us to find examples in our own life which illustrate the concept.

We have a crisis. Our life is in turmoil. Nothing we can do is making sense. Old ways of behaving or believing seem not to work. Friends, family may fall away. Despair mounts. We feel bad as normal neurotransmitter pathways begin a cascade of uncontrolled autonomic activity. We hurt. We cry. We are in pain as the tension in the body mounts.

And then something happens: We may have a vision. Hear or read a message from a friend, counsellor, or visitor with another viewpoint. Receive some comforting words, take a stiff drink, walk in the woods, eat a mushroom or fall in love and get laid. The particular activity does not so much matter as much as the fact that whatever the activity, belief or attitude happens to be, which becomes associated with the decrease in tension, it will be rewarded.

Here it is probably necessary to make a distinction between Classical Conditioning (Emotional Learning) and Instrumental Behavior (Cognitive Learning). Both are involved---but understanding the distinction---allows us to see how emotional Beliefs can become divorced from rational thinking (Cherry 2020).

Neither reason nor awareness is necessarily involved in Classical Conditioning which is under the control of smooth muscle glandular secretions and monoamine neurotransmitters. Recall that Pavlov's dog was passive and that the conditioned (new) response was a glandular response (saliva) produced by the sound of a bell which had been associated with the food. Similarly, the adrenal gland produces adrenalin (epinephrine) to all sorts of stimuli which are associated with a frightening experience. This is emotional learning, not rational, problem-solving behavior. And perhaps most importantly, these Classically Conditioned associations are non-verbal and non-conscious. (Gilbert, n.d.)

By way of contrast, instrumental behavior, where Skinner's dog learns to press a bar to get a pellet of food, is both active and voluntary. In humans it is also verbal: we can think about a plan to solve a problem and mentally rehearse potential solutions. The neurotransmitter most associated with this activity is acetylcholine, which activates striated (not smooth) muscles. These are biochemically different pathways than the monoamine suite of neurotransmitters most closely associated with emotion (Hall 1998).

A critical understanding is that Classically Conditioned fears and associated learned responses, such as generalized anxiety, often swamp the rational pathways in the brain leading us to behaviors and or thoughts which may be helpful in reducing the anxiety---the symptom---but not in solving the problem.

Furthermore, the very reward quality of those behaviors---including mental behaviors/beliefs---increases the probability that the initiating event will be repeated. In turn, the self-reinforcing cycle which results helps explain a wide range of maladaptive thoughts, beliefs, and actions.

ANECDOTES AND EVOLUTION

Within the field of biopsychology is the notion that the very laws which underlie learning theory spring from evolution. Life proceeds best under a narrow range of biological conditions. Behaviors which lead to these states tend to survive. Those which deviate tend to be eliminated. The selfish gene and adaptive/protective behavior survive.

This idea is sketched out in the following *Scientific American* piece:

Thinking anecdotally comes naturally, whereas thinking scientifically does not.

The reason for this cognitive disconnect is that we have evolved brains that pay attention to anecdotes because false positives (believing there is a connection between A and B when there is not) are usually harmless, whereas false negatives (believing there is no connection between A and B when there is) may take you out of the gene pool. Our brains are belief engines that employ association learning to seek and find patterns. Superstition and belief in magic are millions of years old, whereas science, with its methods of controlling for intervening variables to circumvent false positives, is only a few hundred years old. So it is that any medical huckster promising that A will cure B has only to advertise a handful of successful anecdotes in the form of testimonials. (Shermer 2008)

The following excerpt makes an even finer point:

Scientific skepticism, at its core, is about good cognitive hygiene – having respect for the evidence, using valid logic and avoiding fallacies, and having respect for the various mechanisms of self-deception and pitfalls of human thinking. These are all generic and undeniable intellectual virtues – not unique to science or skepticism. No one, not even the most strident true believer, openly advocates the use of logical fallacies or unsound arguments. Gullibility and true belief, rather, result from a significant lack of understanding of these common mental foibles.

Combined with errors in thinking is a profound human need to believe. The result is the tendency to arrive at beliefs for cultural or emotional reasons, and then to commit errors in thinking in order to defend and maintain those beliefs. The overall effect is to insulate belief from falsification.

Susan Blackmore equates such belief to mental viruses – which she calls memes. She argues that beliefs (memes) have undergone Darwinian evolution over the course of human cultural history. Those beliefs that are more psychologically attractive have a greater rate of infection. Further,

those beliefs that better insulate themselves from disproof have a greater survival rate. Some beliefs incorporate elements that anticipate future attacks and protect against them (like HIV attacking the immune system). Others make themselves more infective by including mechanisms for their own spread – the commandment to proselytize. I think the analogy is apt – there is differential survival for different versions of different beliefs, adaptive radiation, variation, mutation, replication, etc. All the elements of an evolving system are there, and the selective pressures are obvious.

The cure for mental viruses is good cognitive hygiene and inoculation with all the tools of skepticism. (Novella 2007b)

And this…

Believers in the paranormal and unscientific healing modalities chafe at [science] and have rushed to the defense of anecdotal evidence, as it is often the only substrate out of which they construct their fantasies and attempt to pass them off as science.

One of the hard-won lessons of the process of scientific discovery is that anecdotal evidence is very unreliable. Psychologist Barry Bayerstein summarized it well when he wrote (Bayerstein 1997), "Anecdotal evidence leads us to conclusions that we wish to be true, not conclusions that actually are true." So anecdotes can be worse than worthless, they can be misleading.

At this point in the history of science, with all that has gone before, it is hopelessly naïve to put any faith in anecdotal evidence. It is utter folly to use such weak and flawed evidence as a basis for concluding that a new and unusual phenomenon is real and that our science textbooks need to be rewritten. At best, anecdotes can be used as an indication of a possible (not even probable) phenomenon that is deserving of further research or exploration. But it should not be used as a basis for firm conclusions.

I think it is accurate to say that trusting in everyday experience is what led to our pre-scientific view of the world. Scientific methodology is largely about controlling for all those factors that make anecdotal experience misleading. (Novella 2007a)

THE PLACEBO EFFECT

Two major problems in assessing the purported claims of medicinal mushrooms have to do with the nature of "anecdotal evidence" and with the placebo effect (Blakeslee 1998), both of which

seem intrinsically attached to many claims made by some members of our mycological communities.

I hope this article helps in clarifying some of the problems of anecdotal evidence. The placebo effect is an issue large enough to warrant a separate article.

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