Avoiding Errors in Reasoning: An Introduction to Logical Fallacies

Richard B. Gunderman[1]
Christopher Sistrom[2]

OBJECTIVE. The objective of this article is to provide all students of radiology, from novices to experts, a framework for understanding common errors in reasoning.

CONCLUSION. By familiarizing ourselves with common fallacies, we can take steps to reduce the probability that we will commit such errors or fail to recognize and respond appropriately to them when they occur.

Bad reasoning as well as good reasoning is possible [1].
—Charles Saunders Peirce

It is vital that physicians and other health professionals be adept at clear thinking and logical reasoning. In medical education, we tend to focus much of our attention on epidemiology and statistical inference, but in fact these disciplines are but components of a larger process of medical reasoning [2]. The process of reasoning is present, at least implicitly, in every radiology report that uses empiric observations and established principles of reasoning to arrive at a diagnostic conclusion.

No matter how good our observations, faulty reasoning will invariably lead us from the truth, with adverse consequences for patients, the profession, and our society. Conversely, high-quality reasoning by physicians will permit the profession of medicine to flourish. The journal *Medical Decision Making*, founded in large part through the efforts of radiologist Lee Lusted, is dedicated to such a purpose [3]. It is vital that all students of radiology, from novices to experts, develop an understanding of the features according to which arguments may be judged valid or invalid.

One particularly fruitful way of better understanding medical reasoning is to consider the various ways in which defective arguments can lead us astray [4]. This is the purpose of this article. Although the number of possible errors is infinite, we are fortunate that most invalid arguments generally fall into one of several dozen stereotypical patterns [5]. These patterns are often termed fallacies, from the Latin *fallere*, to deceive. By briefly examining the most notable fallacies, we can equip ourselves more readily to recognize and respond to faulty arguments when we encounter them.

Caveats

Before considering the fallacies, we need to be clear that validity and truth are not synonymous. We can arrive at true conclusions through faulty reasoning, and we can construct internally valid arguments that lead to false conclusions. For example, we may arrive at the correct diagnosis of a lesion on a chest radiograph, even though the process of reasoning we used is faulty. Similarly, when we start with a false premise, although every step in our reasoning process is valid, we may arrive at a false conclusion.

Moreover, logical principles are not the only basis on which we make choices. Nonlogical considerations, such as honor and loyalty, may sometimes sway our decision making in ways that logic alone would not dictate. To convince people of something, we may have to appeal to them in ways that transcend mere logic. Similarly, not all examples of poor reasoning are honest errors, and, in some cases, malicious deception may be involved.

Ad Hominem

In Latin, ad hominem means against the person. Ad hominem arguments attempt to undermine a position by attacking the person taking it. For example, a radiologist might attack an equipment vendor's claims regarding a new

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[1]Department of Radiology, Indiana University School of Medicine, 702 Barnhill Dr., Rm. 1053, Indianapolis, IN 46202-5200, Address correspondence to R. B. Gunderman.

[2]Department of Radiology, University of Florida Health Center, Gainesville, FL.

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product's capabilities by pointing out the vendor's financial interest in selling the product. However, the ad hominem argument does not refute the position itself because it never deals with it directly. The vendor's claims for the product might be absolutely valid.

Just as we cannot determine the quality of a book merely by inspecting its cover, so too we cannot state with certainty that a claim is invalid merely because we object to the person making it. It is natural that we take into account the source of every statement, but the message and the messenger are logically distinct. We should neither shoot the messenger because we do not like the message, nor ignore the message because we do not like the messenger. No matter how intensely we may object to the person advancing an argument, we have a responsibility to evaluate the argument itself on its own merits.

Hypocrisy

A variant of the ad hominem argument is the so-called "hypocrisy fallacy." In this case, we judge someone's statement as false because it is inconsistent with something else the person said or did. Yet mere inconsistency between two positions does not establish that either one is wrong. It merely suggests that both are unlikely to be true. Apparent inconsistency may be explained by the fact that new information has come to light or that decision makers have changed their minds.

We may, for example, legitimately change our minds because of new technological or economic developments. Or perhaps a radiologist recommends examination A for one patient and examination B for another because the two patients actually differ from one another in some subtle but significant way. It is when positions change based purely on pecuniary or political self-interest that the allegation of hypocrisy may come into play.

Appeal to Authority

A related logical fallacy is the appeal to authority. In it, we take a recommendation at face value merely because the source is a recognized authority. Radiology residents frequently encounter such reasoning on call when a house officer in another specialty insists that an examination be performed simply because the attending physician said so. Authority and expertise do not necessarily imply validity. The history of medicine is littered with useless and, in some cases, frankly harmful practices, such as bloodletting, that gained favor based strictly on the authority of an eminent physician or scientist.

While it is reasonable to evaluate the trustworthiness of a recommendation's source, mere authority is no substitute for critical investigation. This principle underlies the current enthusiasm for evidence-based medicine [6]. We need experts to help guide our practice, but true scholars and statesmen do not expect us to adopt their recommendations strictly on the basis of their authority. In fact, the best among them expect us to regard their claims with thoughtful skepticism. In science and medicine, the best practitioners are their own harshest critics, always trying out alternative explanations and seeking to uncover hidden biases that might have led them astray.

Expertise itself deserves careful examination. In most cases, expertise is attainable in only a relatively small domain. Just because people have achieved mastery in one domain does not automatically qualify them as experts in another. When doubts arise about the legitimacy of someone's claims to expertise, we can critically examine the boundaries of that person's expertise, attempt to ensure that no unrecognized biases are involved, and inquire whether other experts in the field would reach similar conclusions.

Appeal to Convention

Another dangerous fallacy is the appeal to convention. Just because the majority of people, or even everyone, says or does something, we cannot be certain that it is the correct thing to say or do. Many physicians once believed that it was reasonable to use external beam ionizing radiation to shrink the enlarged thymuses of children with stridor. The procedure not only turned out to be of no benefit, it actually increased the risk of other diseases, such as cancer of the thyroid gland, and was largely abandoned by 1960 [7]. Our most important discoveries often occur when thoughtful people begin asking probing questions.

We need not continue to tolerate inefficiency, ineffectiveness, rude behavior, or even duplicity merely because the precedent for such behavior has been set or because others are doing the same thing. For example, just because some researchers are manipulating their data does not make it right for us to manipulate our data. Moreover, rigid adherence to convention slows the rate at which we adapt and improve what we do. If we are not careful, appeals to convention can leave us clinging to little more than the lowest common denominator of behavior in our field. If we want to identify the most effective approach to a problem, we cannot simply take a poll.

Flattery

One of the most powerful but ultimately vacuous techniques of persuasion is flattery, sometimes referred to as apple polishing. All of us enjoy being admired and praised, but sometimes our appetite for flattery can leave us vulnerable to invalid arguments. For example, someone may tell us how brilliant they think we are. Naturally impressed with this person's astute judgment, we may then treat less critically some of the other things he or she says. People in positions of authority are especially likely targets of flattery. Examples include faculty members whose students seek good grades and supervisors whose employees seek retention, promotion, and other rewards.

Emotional Appeal

Closely related to flattery are other forms of emotional appeal such as appeals to fear, compassion, and the desire to belong. Appeals to fear encourage us to accept a proposition merely because it frightens us. Yet how likely is the adverse outcome, and what can we do to prevent it? When we allow fear to cloud our judgment, we set ourselves up for a violent collision with reality.

Appeals to compassion are attractive, but just because an action would manifest genuine sympathy does not mean it is the right thing to do. Sometimes doing what the evidence warrants requires us to set aside our personal feelings. Likewise, we may be duped into doing something unjustified out of a desire to be part of a group. To give in to that temptation is to unnecessarily open ourselves up to the criticisms of an unbiased observer.

Begging the Question

Known in Latin as petitio principii, begging the question occurs when the premises of an argument assume the truth of its conclusion. An example would be this argument: "Our group should do everything possible to increase revenue because generating revenue is what we are in business to do." It is not unreasonable to assume that a particular premise is true, but when we do so we should not pretend that we are advancing an argument or arriving at a new conclusion.

Whenever someone who has been asked to defend a position responds by merely restating the position, they are begging the question. It also occurs when a position springs from wishful thinking or is grounded in ignorance. If a vendor simply asserts that his or her product is best but has little or no knowledge of the competitors' products, then the

question is being begged. The reasoning is more likely to be sound, however, if the vendor can offer supportive experience and data.

Biased Sample

Biased samples occur when we draw conclusions based on methods of empiric investigation that are skewed in some way. For example, a radiology chair might argue that a particular compensation system should be adopted based on the fact that six other chairs recommended the same system. In fact, it is possible that the chair tends to speak with friends who share similar views. If a less biased survey were conducted, a different conclusion might emerge.

A famous example of biased sampling involved the 1948 U.S. presidential contest between Harry Truman and Thomas Dewey. Based on the results of telephone surveys conducted by the most respected polling organizations, Dewey was favored over Truman by more than 10 percentage points. A famous photograph from the *Chicago Daily Tribune* shows president-elect Truman holding up an early edition with the headline "Dewey Defeats Truman," yet Truman won. What happened? In 1948, only relatively affluent people owned telephones. By conducting their sample via telephone, the pollsters had biased the result.

False Dilemma

A particularly insidious fallacy is the false dilemma. This occurs when someone seeking to influence a decision inappropriately narrows the range of alternatives, often down to only two. For example, someone might say that a radiology department must either immediately purchase a state-of-the-art piece of equipment or close its doors forever. Although it may in fact be the case that the purchase is warranted, other options, such as a 3- to 6-month delay, may also be reasonable.

An ultimatum is often a particularly dramatic form of false dilemma. People may threaten that if they do not get their way they will quit, or seek to have someone fired, or do everything in their power to make life miserable for those standing in their way. It may take courage to resist such threats. When it comes to sound reasoning, however, the general level of complexity in human affairs makes it unlikely in any situation that there are two and only two alternatives, one of which is a little short of doom. In benign hands, the false dilemma may merely represent an oversimplification, but in the most dire situations it may reflect deceit that quickly erodes a reputation for probity.

Compromise

The converse of the fallacy of the false dilemma is the fallacy of compromise. We cannot assume that an intermediate position between two extremes is necessarily the correct one. There is no question that when conflicts arise compromise is often desirable. Yet the midpoint is not always the correct balance, and in some cases may be more unjust than either of the opposed positions. A revealing tale concerning compromise is told of King Solomon.

A woman's infant died. During the night, she took another woman's infant as her own, placing her dead infant by the second woman's side. When the second woman awoke, she knew what had happened. When they presented their dispute to the King, he ordered that the live infant be cut in two, with half given to each woman. When only one of the women objected and said she would sooner forfeit her half, he knew that she was the real mother. In this case, the refusal to accept compromise showed who was advancing the legitimate claim.

Radiologists should not assume that compromise is always the appropriate course of action, or that when compromise is called for, the parties should always meet each other "half way." For example, a group of cardiologists might argue that they should perform all of a hospital's vascular angiographies, while a group of radiologists might argue that cardiologists should perform none. Having the cardiologists assume responsibility for half the cases is not necessarily the appropriate resolution. Radiologists who assume that compromise is always the best route need only recall what happened some years ago with obstetrical sonography, in which most radiology departments no longer participate.

Slippery Slope

The slippery slope argument attempts to prevent small changes by arguing that they will inevitably lead to large changes that are widely recognized as undesirable. For example, a hospital administrator might argue that outpatient imaging clinics are unacceptable because if every physician began seeing all their patients in outpatient clinics the hospital would be forced to close. Taking one small step does not necessarily entail going all the way to the extreme. It is often possible for people and organizations to make incremental changes without completely overthrowing the established order. Incrementalism is actually a reasonable approach in many real-life situations.

Straw Man

The straw man is involved when someone misrepresents another's position to make it easy to overcome. For example, a residency program director might encounter resistance to proposed reductions in resident work hours. Opponents to such a reduction might argue that residents will no longer gain enough experience to become clinically proficient. "If we are graduating incompetent physicians," the opponent might argue, "we will be defaulting on our responsibility as a residency program. Therefore, we should leave the duty hours as they are." However, it may not be accurate to imply that any reduction whatsoever leads inexorably to incompetence. Perhaps the training experience could be altered in such a way that residents suffer no loss of proficiency or even become more proficient, despite the fact that they are logging fewer hours in the hospital.

Conclusion

In view of the complexity of contemporary radiology and health care, a completely fail-safe strategy by which we can protect ourselves from errors of reasoning is not possible. However, by familiarizing ourselves with common fallacies, we can take steps to reduce the probability that we will commit such errors or fail to recognize them when they occur. In addition to recognizing and avoiding them, by understanding them better we can also prepare ourselves to respond effectively when we see them being committed. To err may be human, but taking the appropriate steps to prevent and counteract such errors is divine.

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