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How Searches Fail: Cognitive Bias in Literature Searching

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ABSTRACT

Cognitive bias is a phenomenon applicable to many areas of life, baseball and medical diagnosis among them. The concept originated with Daniel Kahnemann and Amos Tversky, Israeli psychologists. Biases such as satisficing, attribute substitution and the curse of knowledge affect literature searching as well, skewing the results. Simple steps can help us to debias our thinking.

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Introduction

Most literature searches undertaken by librarians succeed in finding information useful to the client. Some can be difficult – not impossible, but problematic. You may feel strongly that the needed information exists, but your search tactics aren't working, and you're not sure why. If you discuss the problem with a colleague, they may find a wealth of information easily. The obstacle may be our own familiar, unconscious patterns of thinking. Once we learn about cognitive biases (or *cognitive dispositions to respond*) we can begin to debias our thought processes (1).

Cognitive bias is a concept within the field of behavioral economics, the intersection of economics and psychology. Economists study not only efficient use of resources, but also incentives. Traditional economic theory assumes that individuals are rational and make choices that maximize their happiness and money. Behavioral economics accounts for non-rational behavior, such as procrastination, laziness, loss aversion, regret, incomplete information and distractions, that do not always result in good decisions. The field looks at the effects of psychological, cognitive and social factors on economic decisions, and how those choices differ from those predicted by classical economic theory. For example, manufacturers and vendors of electronic equipment gamble on their customers being affected by the base-rate fallacy when deciding whether to purchase extended warranties. They know exactly how often the equipment fails, and hope that buyers believe it will break down more frequently, thus making the offer of the warranty seem like a better deal. Previous unpleasant experiences also color our decisions, making us more prone to erring in the opposite direction.

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In 2002, Daniel Kahneman, an Israeli-American psychologist, was a recipient of the Nobel Prize in Economics for work he had done with the late Amos Tversky. Together, they are considered the founders of behavioral economics. Kahneman's job in the Israeli military had been to determine which recruits were most suitable for which positions. This task made no sense to him. Instead, he answered a different but related question – how to prevent the gut feelings of interviewers from skewing their assessment of army recruits. He learned that once subjective feelings were eliminated, judgment improved. This truth proved to be applicable to many situations. After his stint in the army, he earned a Ph.D. in psychology from Berkeley.

Tversky and Kahneman had very different personalities. While Danny was introspective and deliberate, Amos was brash and bold. They were both brilliant, however, and became friends as fellow professors at the University of Michigan. They collaborated over many years on research on cognitive bias. They fed off each other's ideas to the point that they could no longer tell who had written what in their joint articles. For the first, they flipped a coin to see who would be the first author, and alternated thereafter. They claimed that they finished each other's sentences. Tversky once explained their work this way:

People use mental approximations to understand an uncertain world.
As a result, we make certain types of errors in judgment (2).

Michael Lewis, in *The Undoing Project*, chronicles their friendship, intellectual output and eventual falling-out (3). Kahneman, Tversky and others have named over 180 separate cognitive biases. These are mistakes in reasoning, evaluating, remembering or other thinking, often occurring as a result of holding onto one's preferences and beliefs regardless of contrary information. For example, the focusing effect places too much importance on a single aspect of a thing. In confirmation bias, we tend to seek out and overvalue information that reinforces our prior beliefs. The Cognitive Bias Codex arranges and presents them in graphic format, and Wikipedia covers them extensively, both as a group and individually (4,5).

Closely related is the concept of heuristics – educated guesses or rules of thumb that are used to quickly solve problems. Heuristics are good and useful, in the right circumstances. We rely on them to get through everyday life, and humans have always needed to make quick decisions for their survival. However, if heuristics are used when more careful thought is appropriate, then we can easily fall into cognitive bias.

The dual process model categorizes two modes of thought. System I thinking is intuitive and fast, full of habits, intuition and estimations. It is non-analytic. System II, conversely, is rational, slow, systematic and analytic. Brand new drivers may feel overwhelmed with details the very first time they sit behind the wheel. That's System II. Years later, they may feel like they are on automatic pilot, arriving at a destination with little memory of getting there. That's System

I. Kahneman's 2011 bestseller, *Thinking Fast and Slow* helped the public to understand the differences between two modes (6).

Cognitive bias theory has been applied to numerous fields. Tavris and Aronson's popular book, *Mistakes Were Made But Not by Me* shows how refusal or inability to recognize our own mistakes leads us into treacherous waters (7). Michael Lewis, author of *The Undoing Project*, wrote earlier about sport in *Moneyball* (8). This book chronicled the attempt by the Oakland Athletics to find a better way to build a great baseball team. Their strategies were adopted by the Boston Red Sox, leading them to win their first World Series Championship since 1918. Jerome Groopman explored cognition in medicine in his 2007 book *How Doctors Think* (9). Pat Croskerry calls emergency medicine a *natural laboratory of error*, due to the task of integrating sometimes huge amounts of data and the importance of getting it right (1). Time pressures and the chaotic environment also contribute (10).

Bias is especially evident in diagnostic decisions. The Society to Improve Diagnosis in Medicine (SIDM) considers cognitive bias to be as important a driver of misdiagnosis as complexity in the medical system. SIDM's website provides extensive references in the Clinical Reasoning Toolkit (11). The Society's journal, *Diagnosis*, frequently publishes articles exploring the role of bias in diagnostic error.

Biases in searching

If bias affects economics, medicine, diagnosis, science, sport, and a host of other fields, can any group imagine itself to be immune? Can librarians? No, information professionals make the same cognitive mistakes as physicians and umpires. Only the application changes.

A search retrieved two articles addressing bias in the literature search process. Lau and Coiera studied the anchoring, order, exposure and reinforcement effects as they affect the interpretation of search results on the web (12). Another publication by the same authors focused on searches for consumer health information (13). Both represent original research, and are of a more technical nature than the description presented here.

Here is a brief exploration of some of the biases that may cloud our thinking. If you think that a given example may fit better into different bias, you may be right. Just as a single misdeed may break a number of laws, one mental mistake can be described as more than one bias.

Search satisficing (from the words satisfy + suffice) is the tendency to consider a search finished once anything is found. This happens when a literature search ends as soon as the first items meeting the search criteria have been found, whether or not they constitute the *best* answer—the most evidence-based or the most representative. Perhaps the searcher is writing a paper, and was told that a minimum of five articles are required. They interpret

this number as a maximum, and stop looking as soon as that many articles are in hand. Had the search continued, articles demonstrating a higher level of evidence, or reports of trials of equal rigor that drew opposite conclusions, may have been found.

Premature closure may factor into searches in which little or no relevant information is found. When empty-handed, we must first assume that the information exists somewhere, and only our search techniques keep us from it. One librarian said that she crafted very precise search strategies and ran them once. If nothing was found, she believed the information didn't exist. End of search. On the contrary, being open and flexible will serve searchers well. There may be other resources that should have been consulted, or other methods used. If we find little, the requestor may be pleased, especially if the search is for an intended dissertation topic. Premature closure closely resembles satisficing. In each, we find one or a few results and shut down. We quit looking before we find the mother lode of useful information.

Inexperienced or hurried searchers are especially prone to these two errors. They may be using only one familiar resource, unaware of its limitations. Their skills may be poor, and they may not take the time, or understand how, to evaluate the literature thoroughly. Librarians must do better. People consult with us because they recognize that they may not be finding the best evidence. Librarians can bring our skills to the table by using more advanced techniques and recognizing alternative sources for the needed information. We are responsible for overcoming satisficing, premature closure and other biases in our clients' work, and can begin by looking inward to recognize our own cognitive shortcomings.

Confirmation bias afflicts both the searcher and the user of information. We tend to search for, interpret, focus on and remember information in a way that confirms and reinforces our prior beliefs. One quality improvement officer asked for information on how electronic health records affect patient safety. When she was given the results – articles mostly pointing out problems – she responded that she'd only wanted the ones discussing an increase, not a decrease, in safety. Lyme disease and complementary medicine are other areas in which people can be very partial to one view or another (14). Providers may be protective of their own turf, believing their own field offers the best treatments. When one librarian extensively supported her hospital's Tumor Boards, she was asked specifically to include the spectrum of evidence-based literature from the medical oncology, surgical oncology, radiation oncology and specialist (GI, OB/GYN, for example) fields whenever possible. This was intended to counteract territorialism.

A searcher's own personal beliefs can come into play just as easily. If one has strong feelings about issues ranging from vaccination to reproductive matters to the value of libraries, it is easy to discount those findings that contradict our beliefs (15).

Attribute substitution, a common psychological process, comes into play when we are confronted with a complex question. We understand it in general

terms, but perhaps miss some of the nuances. Or, the question may have been communicated in the cafeteria line, and filed only in our memory. Consciously or not, we simplify the concept in our minds and may inadvertently alter it. This may be an instance of using System I, rather than System II, thinking. Simplification can be useful in searching. After all, the PICO method teaches clinicians to discern the patient, intervention, comparison and outcome amid the many details of a case (16). Only when the parameters of the search request are altered does it become a problem. The read-back method used in high reliability organizations is valuable here, verifying that what one person said was what another person heard.

When we use the **availability heuristic**, we judge things as more likely if they readily come to mind. A search request may sound similar to another recent one, and we assume that this person wants the same information. Perhaps it reminds us of an important and often-discussed quality issue in the hospital. However, our requestor may be looking for information that overlaps with, but substantively differs from, the concept we have in mind.

The **focusing effect** places too much importance on a single aspect of a thing. It may happen when a question involves multiple parameters and we lose sight of one or more. In a cancer search, for example, you may be asked about a patient with a certain tumor in a given organ, but lose sight of the fact that the carcinoma is squamous, not adenocarcinoma; that the patient is premenopausal; or that certain therapies have already failed. Or, attention may drift as we work on a search for an extended period of time. Overuse of PubMed's otherwise very helpful *similar articles* link may lead to inadvertent focusing, as it could retrieve information concentrating more on some aspects than others, perhaps not the one that most concerns us (17).

We may even be just plain wrong about our focus. One librarian naturally assumed that a question from a child psychiatrist was for information relating to adolescents, when it actually concerned an elderly family member. This detail had not been disclosed.

In the closely related **anchoring bias**, we lock onto the characteristics of early search results, and fail to adjust our thinking as we proceed. Perhaps in searching for drug therapy for a given condition, we initially retrieve an article discussing one drug. We cannot assume that this is the only alternative, that there are not other pharmaceuticals used for the disease. Indexing may have changed, or terminology itself may have evolved. For example, the term *pressure ulcer* has been dropped in favor of *pressure injury*.

The **framing effect** refers to the way a question is asked or put into context, and affects the outcome of the search. For instance, when several staff members are involved in an investigation into a hospital's serious safety event, the librarian may field questions from more than one in the group. Their views may differ on the most relevant information to deal with the issue, and they may be reluctant to discuss the event more than absolutely necessary. Dr. A may complain that the

librarian gave more (or more useful) information to Dr. B, believing they asked the same question. Two physicians once asked around the same time about a specific surgical complication, one seeing it as a consequence of a hysterectomy, the other as a result of the lithotomy positioning of the patient.

The **not invented here** frame of mind may slant our search habits toward articles written in our own country. As Sting tells us:

We share the same biology regardless of ideology (18).

However, some regions have a higher incidence of a disease – for example, gastrointestinal cancer in Asia. We would expect more publications from those areas. Given conditions – liver, breast and non-small cell lung cancer, to name just a few – are sometimes treated differently in other parts of the world. Also, several countries are far ahead of the US in evidence-based medicine. As we get further from the clinical, toward quality and policy issues, the less relevant non-US literature may be. Rather than guessing what will be useful to your client, ask.

The **curse of knowledge** comes into play when an individual assumes that the person they are speaking to understands what they are talking about. It may be difficult for a person with advanced learning in a field to imagine themselves in the place of someone outside that discipline. Librarians pick up plenty of medical knowledge over years on the job. However, the fine points of hematopathology or neurophysiology may baffle anyone other than a specialist. In this situation, clarifying questions are key. Also frustrating is the situation in which clients relate just a sketchy idea of the topic they're dealing with, without telling us about the underlying problem. Badke urges us to search the problem, not the topic (19).

Overconfidence, a universal tendency to believe we know more than we do, pervades several other biases. When we assume too quickly that we know what is being asked, we may fail to do a thorough reference interview. One librarian expressed her dismay about responses she got when asking colleagues for advice on the MEDLIB-L discussion list. She had worded her question carefully, put it in context and indicated resources already consulted. Yet most of the replies showed that the responders – other librarians, trained in the interpretation of questions – had not even read the posting through to the end, or skimmed it too quickly to enable comprehension.

The straightforwardness of a question is not necessarily proportional to the time and effort needed to find an answer. As we delve into a search, we may find that the situation is more complex than we anticipated. Overconfidence may color our next steps. We might look up the concepts in a general source to learn more, perhaps to determine whether variant terminology we're finding represents a synonym, a subset or something quite different. If we've found one good article, we may read at least the abstract to gain a better understanding and look for alternative terminology. We may contact the requestor to ask clarifying questions, as high reliability training teaches us. Or, we may forge ahead blindly,

sending only those few items that exactly match the terms used by the requestor. Bates suggests a pre-searching phase to gather more information about a topic, and uncover alternative terminology (20).

An overabundance of confidence also comes into play when we fail to search as thoroughly as we know we should. Do we insist that our favorite database is the only one worth using? Do we neglect to utilize features that may have helped lead to more relevant content? Do we avoid those databases with difficult interfaces? Habitually searching only with thesaurus terms, or only text and title words, will limit retrieval. Not checking to see who has cited or commented upon an article will impact the ability to uncover new thinking.

Automation bias, or too much faith in tools, can interfere with good searching. We do well to remember that indexing is as much an art as a science, as catalogers and indexers know. Different authors study phenomena from different angles, and they come from diverse professional backgrounds. Each shift in focus (see framing) will affect the indexing of that item, and the rules can be intricate (21). Use of the Yale MeSH Analyzer, a wonderful and useful tool in itself, should disabuse any searcher of belief that indexing terms are assigned in a way that each of us may consider consistent (22). As mentioned previously, over-reliance on PubMed's Similar Articles link, another useful tool in the right circumstances, can lead us astray. In addition, librarians often seek information on a finer level of granularity than the use of MeSH terms facilitates.

In addition to these defined cognitive biases, **preconceived notions** that librarians bring to their work can hinder successful retrieval. Searchers believe, or at least hope, that the answer to any given question can be found in the one perfect peer-reviewed article in MEDLINE, written in English in a mainstream journal in the last 5 years. Further, end-users will often disregard any literature not freely available on the web in full text. Sometimes, the answer may be spread out among several articles. If no national statistics can be found on a topic, perhaps the numbers from several large trials can suffice. If a client seeks evidence of an association between A and B, it may be that the best available is a look at the associations of both to another factor, C. Or, there may be intermediate steps between A and B, for which it is simpler to show causation. Inactivity during long flights may lead to blood clots, which become thromboemboli, which if they move to the lungs are pulmonary emboli.

The needed answer may be outside formal publications, in the gray literature. One colleague was asked to find the utilization rate of a particular imaging modality. After spending quite a bit of time searching in what she considered all the right places, the librarian admitted to the strategic planner that she'd come up empty-handed. The planner said she had found the answer herself:

I did a quick and dirty Google search, and the answer came up right away.
It had been quoted from an imaging journal considered a throwaway.

The sought-after answer may be in a dataset, or a person's head – giving rise to data curation and knowledge management as fields of focus within our profession. The best librarians are well-positioned to tap into networks of people. We are familiar with the concerns of many individuals within and outside of our own hospitals, and can contact colleagues to benefit from their knowledge.

Databases may have their own biases. A charming article relates how the author looked for material on preservation of skin integrity, with little result (23). Her colleague easily found much on the topic. The second librarian understood MEDLINE's bias toward pathology,

reflect[ing] the American bias toward healthcare and medicine,
that something must be wrong in order to fix it.

She searched with terms *skin diseases/prevention & control*. PubMed's journal selection policy tells us that it includes articles predominantly on core biomedical subjects (24). As topics stray from this, they are less likely to be found in PubMed. Within the mental health field, for example, we find more psychiatric literature, per se, than psychology topics. Business concepts that are very specific to the healthcare system are included, but as the concepts become more generalized, they must be searched elsewhere.

Cognitive debiasing

Some writers have said that we cannot debias our own thinking, as we're trying to do it with the same brain making the mistakes. Undaunted, Pat Croskerry compiled the debiasing advice of several authors, as it applies to diagnosis (1). We can apply those simple techniques to our own work.

Developing insight and awareness of the issues is, in itself, a first step. Realize that every search is different, and that we are all prone to bias.

In **metacognition**, we *think about thinking*. Slow down and reflect on what you are doing. When results are not needed immediately, put the search aside for a few hours or overnight and allow yourself to come back to it with a fresh mind.

Make the task easier. Do a thorough reference interview up front, as knowing exactly what information is sought is half the job. Ask clarifying questions. *Tell me more* can ease the situations in which you're not even sure what to ask. Repeat the question back, as high reliability training teaches. Be sure to ask about intended use. As you begin to find results, read those abstracts to learn more about the topic, or look up the topic elsewhere. Mine documents for alternative terminology. Minimize interruptions, to the best of your ability.

Decrease reliance on memory. Write down on paper the details of the search request immediately. Not only will this capture details before they are forgotten, but the simple act of writing will help fix them in memory. As often as needed, compare it to interim results of the search, to ensure that

you're not getting off track. Keep notes while searching, to record ground already covered.

In **mental simulation**, imagine yourself in the requestor's situation. Think critically about the stated question and its intended use. You may then see a need for information on another closely related topic.

One librarian fielded a question about the incidence of shoulder dystocia from a risk manager. Once she understood the context, she realized that information about the complications of perinatal nerve damage might be more useful. The risk manager appreciated that the librarian understood not only what she asked for, but what she needed. Keep in mind who's asking, as different specialties have different needs. One emergency physician told his librarian that although she had given him information on exactly the procedure he had asked about, there was a problem. The article discussed the procedure as it was done by gastroenterologists, working in ideal conditions. In the ED, he explained, the patients often had bellies full of beer and pizza. In a third example, one librarian heard at a meeting about a service her colleague was working to implement. She found and forwarded an article about the success of a similar project elsewhere, saying

This will help when you write the justification.

Consider alternatives, other places where one may be able to find information. Lucian Leape once expressed to librarians his frustration with the imbalance between the abundance of medical errors reported and the dearth of literature on the subject. The suggestion to look in the psychological and social science databases surprised him, but a wealth of information was found there, leading to the birth of the patient safety movement. Business, education and technology are other fields in which librarians may serve clients well by looking outside the self-referential world of the health sciences.

Admit weaknesses and get **specific, targeted training**. Perhaps you tend not to use a certain database, because you are less adept in using it. Or, you may not use advanced features, either through avoidance or a lack of knowledge. Address that. Have a basic knowledge of the principles of systematic review searching, even if you don't provide systematic reviews yourself. Because these are among the most complex of searches, librarians promote the use of techniques that make the job easier and keep it more organized. Some of those methods translate well to non-systematic searches.

Feedback acknowledges the difficulties of debiasing our own thinking. Don't be afraid to ask a colleague to help critique your searching, or to ask the client if the items you're finding are helpful and relevant. If you are a solo professional, partner with a trusted colleague, so that you can provide each other with a second set of eyes.

Even simply taking care of our own selves is relevant here. If we haven't slept well, or are even mildly dehydrated, our mental acuity won't be at its peak (25).

Above all, don't fall victim to **blindspot bias**—the belief that we are less susceptible to cognitive bias than others, due to faith in our own patterns of thinking.

Conclusion

Cognitive bias has been recognized in many fields, and librarians are not immune. Specific named biases are consistently found to affect people's thinking, regardless of application. Becoming aware of bias is one step toward reducing its effect on our own work.

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