2 Statistical storytelling: The language of data

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> *Noting a sharp increase over recent decades, a study released Wednesday by researchers at MIT confirmed that nearly 80 percent of all statistics are now sobering.*
>
> – *The Onion* 2014

Recently, I sat in on an English class as they considered the character Macbeth, looking closely at the play's soliloquies. The teacher pointed to early lines in the play, in which Macbeth notes: "Two truths are told/As happy prologues to the swelling act/Of the imperial theme" (I.iii.128-130). She asked the class to consider why Shakespeare had used the adjective "swelling." This started a discussion of words relating to rot and sickness that increase as the play progresses. When we read literary fiction, we understand word choice as an author's tool used to evoke emotional and build a certain understanding of a character or a theme. We ask why one word was used instead of another. When we switch our reading over to statistics and statistical arguments, however, we rarely model this same level of close reading.

"Close reading" has a variety of definitions. Often, in classroom practice, it means finding and extracting evidence from a text. To think about close reading of statistics as simply retrieving information, however, supports the notion, uncovered by Ann Fields, that students tend to frame research as retrieving information "waiting to be found," without regard to context, and without the need for analysis (Fields 2005, 16). Rather, in "Closing in on Close Reading," Nancy Boyles expresses a preference for close reading targeted at "craft and structure ... and integration of knowledge and ideas" (Boyles 2012). As we strive to help students become data literate, it's essential to increase their awareness of the

words used with the numbers. Writers can — intentionally or unintentionally — tell stories with statistics using language that influences or changes the meaning of the data itself.

Authors who include statistics in their work have interpreted the data and found it to be worthy of inclusion. As a reader, I consider the author as a narrator and storyteller. By doing so, I'm reminded to take the author's word choice, and my emotional response to it, into account.

The goal is to separate the information from its packaging.

Until I actively recognized that the author's word choice changed how I felt about information I was reading, I could not be confident that I was thinking critically about facts and ideas I encountered.

As a librarian, I realized students were not alert to manipulative language. After a while it occurred to me: if no one is teaching them to look for how language impacts their visceral responses, then students are not solely responsible for the quality of their critical thinking.

Thus, this chapter investigates how the language we use impacts our understanding of statistics in three arenas: reading, writing, and searching for information. It is informed by my current work as a high school librarian, as well as past work as Google's Search Educator. Elsewhere in this book, my colleagues discuss choices made with the statistics themselves: poor sampling, visualizations that change the meaning of data, cherry-picking convenient evidence to make an argument, and so forth.

The purpose here is to look specifically at how language ultimately impacts our interpretation and emotional understanding of the numbers embedded within stories we read.

Authors of news articles, scholarly studies, and advocacy reports may select language to make their readers feel afraid, enraged, empowered, mollified, and more. It is our job, as educators and research skills specialists, to help our colleagues and students learn how to transfer the analytical reading we learn to do with literature and primary sources to our everyday reading, and to separate the numbers we encounter from their emotionally persuasive packaging, a packaging I like to call *statistical storytelling.*

Experts and novices

In *How People Learn* (Bransford, Brown, and Cocking 1999), the authors distinguish between experts and novices in a curriculum area. Novices are those new to a content area. It can be difficult for them to see the big picture at first, and they may over-focus on small details. On the other hand, experts are those who are more likely to overlook details and see the big picture. This comparison is useful to keep in mind when exploring statistical storytelling with teens.

Working with teens who are reading nonfiction for either research or pleasure always reinforces for me the sway of loaded language. For example, one science class in my school assigns an adult narrative nonfiction book in an astronomy unit. The teacher wants students to practice recognizing emotionally evocative language to empower them to read science for pleasure in the future. Early in the unit, students argue that passages like the one below are devoid of emotion and totally based on facts:

> Another planet? Such a suggestion would have generally been scoffed at by most astronomers in the last days of the twentieth century. ... There were certainly small asteroids to be discovered, and occasionally a bright comet that had never been seen before would come screaming in from the far depths of space, but certainly nothing major was left out

> there to find. Serious discussions by serious astronomers of another planet beyond Pluto were as likely as serious discussions by serious geologists on the location of the lost continent of Atlantis (Brown 2012, 5).

The narrative laid out by author Mike Brown is factually true. Yet, when expert readers take the time to observe the dismissive tone — which Brown constructs with his use of "scoffed," "certainly," "occasionally," and "serious" — we can see that the author is simultaneously relating a stance that truly existed within the scientific community and what he thinks about the scientists who felt this way.

Alternately, I have seen tenth graders who are tasked with selecting "pro" and "con" articles on current issues reject sources because they are disheartened by the lack of confidence expressed in the writing. For example, a student pointed to this article, and passages like the one below:

> The approximately 200 studies on media violence are remarkable primarily for their inconsistency and weak conclusions. Some studies show a correlation between television and violence; others don't. Some find that violent programming can increase aggressiveness; another finds that *Mr. Rogers' Neighborhood* does. Several studies, including the most-cited ones, are deeply flawed methodologically. (American Psychological Association, 2015).

Expert readers understand that the language of uncertainty (the repeated use of the "some studies show…others don't" structure, for example) is a sign that scientists have yet to prove a cause-and-effect relationship between variables. This kind of language is standard in scholarly research, and a data literate reader recognizes such language as a mark of integrity and a strong grounding in statistics.

However, the less-experienced student interpreted the indecisive language above quite differently. She worried that language was hedging, which in turn indicated to her that the author was not an expert on his topic. Without explicit guidance, students assume an inverse relationship between precise statistical writing and what they view as "factual" or "a good source."

Examples like these demonstrate how easily novices' prior experience with reading for information can get in the way of stronger data comprehension. Let's break down some key aspects of this phenomenon.

Pure statistical storytelling

First, let's look at a few common uses of language that are related to specific statistical practices, and then we will move on to look at language more generally, and how it changes our experience of statistics.

Clarify correlation or causation

> *"When you take acetaminophen, you don't feel others' pain as much: The popular painkiller reduces empathy, study finds."*
>
> – Gabermeier 2016

My colleagues have already addressed the most well-known error made in writing about statistics: describing a correlation as causation (see Chapter 1). Once we know this is a common misspeak, we can, as writers, avoid various forms of the word "cause." As readers, we can also be on the alert when we see the word "cause" or its synonyms, remembering to check and see if the

original research actually found a causal link. What other turns of phrase should we be on the lookout for when we read? What words are better choices when we write?

Exercise: Identify words that indicate correlation or causation

Headlines and first paragraphs of news articles and press releases, like the one above, may be designed to pack maximum impact into minimal print space or to encourage the reader to click through to the entire story (e.g., clickbait). Mainstream media examples make it easy for educators to find material for quick exercises that explore different language traps. The goal of these exercises is to sharpen students' ability to identify language that implies causation or correlation. Ideally an exercise includes at least three steps:

- **Sort:** Determine if headlines indicate causation, or simply correlation,
- **Identify:** Point out the words and phrases that express the nature of the relationship, and
- **Construct:** Collaboratively building a list of terms that fall into each category, allowing for group discussion during the process. For a sample list, see page XXX.

When a recent school assembly speaker made a statement that erroneously implied causation, I heard the entire tenth grade — who had studied the difference in class a few weeks prior — whispering furiously to each other to point out the error. This demonstrates that through practice, recognizing the language used with data becomes much easier. It almost becomes second nature to spot the difference between implied causation and stated correlation. It is empowering for students to know the difference.

Here are a variety of terms that may be used either to imply correlation or causation (Vita n.d.; Miller 2004, 24). See if your group can add to it.

Words that indicate correlation	Words that indicate causation
Get Have Linked More ... more/ less ... less Tied Connected/Related Tend Associated	Cause Increase/decrease Benefits Impacts Enhances/undermines Effect/affect Improves/Boosts If > Then type statements (implies one-direction) Consequences

Exercise: Ripped from the headlines

This exercise can work on four levels, depending on the amount of time you have and the particular group with whom you are working:

- **Sort:** Provide a selection of headlines on diverse topics and simply sort them by whether they suggest correlation or just causation. Educator Jon Mueller keeps a running list of headlines for this purpose on his "Correlation or Causation?" page (http://jfmueller.faculty.noctrl.edu/100/correlation_or_causation.htm).
- **Compare:** Offer a list of several headlines on a single topic, which have varying degrees of causation implied. Ask participants to rank them from most strongly implying correlation to most strongly implying causation. Appendix B has examples you can use, from a study that clearly states its findings are correlated, not causal.
- **Classify:** Ask participants to classify a series of several first sentences or paragraphs of news coverage as implying just correlation or also causation. Each included excerpt is also based on an original study that clearly states its findings

are correlated, not proving causation. Appendix C offers some examples you can use.

» **Rewrite:** Supply a short selection of first sentences or paragraphs that all inappropriately imply causation. Ask individuals or pairs to re-draft them so that they indicate only correlation.

Contextualize base and rate

> 2015 saw a 100% increase in deaths due to unprovoked attacks by sharks.
>
> – Author summary of research done by University of Florida 1996

As Lynette Hoelter explained in Chapter 1, another form of purely statistical storytelling that can impact meaning is sharing statistics without maintaining their context. Readers should be able to answer the questions, "Compared to what?" or, "Is that a big number?" (Blastland and Dilnot 2009).

There are two kinds of context that are important in statistical storytelling: the first is when we see a statistic without its basis (also known as its raw number). And the second is the opposite: seeing a raw number without any data to compare it to.

Consider these two statements:

> *Imprecise:* "The number of fatal unprovoked shark attacks rose by 100% in 2015!"
>
> *Precise:* "Six of the [shark] attacks were fatal. ... Although fatalities rose from last year's low, which saw only three shark-related deaths, they remained stable when looking at the big picture, precisely matching the decade average...."
>
> – University of Florida 2016

Discovering examples quickly and efficiently

- In both subscription databases and search engines, include the context terms [study], [report], and [research] in your query to locate articles that are reporting on statistical findings. (Note: the search terms to enter in the search box are delineated with brackets, though you do not need to use brackets when typing in your search terms.) For example, students needing content on the Zika virus might search for [zika report] or [zika study].
- Use date range filtering — available in many search engines and databases — to narrow in on articles from a particular timeframe.
- Search in Google News (http://news.google.com) for a current story on a topic, like [nutrition]. Alternately, you can try to find new studies, currently in the news, without regard for their topic. Headlines will often proclaim something like: "New research finds pictures of octopuses cause feelings of joy" or "New study found binge TV watching causes students to skip meals." It looks a little strange until you get used to it, but you can leverage these common turns of phrase by searching for: ["new report OR study OR research" finds OR found]. This odd-looking little search will find current articles that are discussing new research. Or, combine the two: [nutrition "new report OR study OR research" finds OR found].
- Look for an article that has an Explore in depth link on the last line of the result (see Figure 1). Clicking on that link will give you all the articles Google found on that same story.

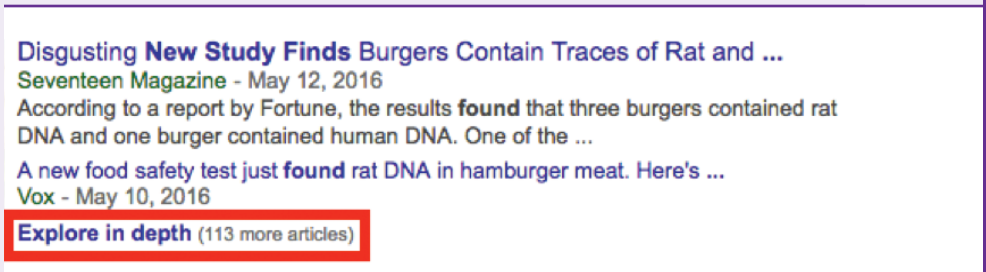


Figure 1: Accessing the "Explore in depth" feature in Google News.

The first statement shares an impressive statistic, depending on a percentage with no point of comparison. As a result, it inspires generalized fear and a sense that something is afoot in the shark population. The second statement, excerpted from a story using statistics from the Florida Museum of Natural History's International Shark Attack File at the University of Florida, explains how the 2015 number of fatalities compared to those in 2014, and also to the general trend in attacks over a larger span of years.

Authors can also make the opposite mistake, sharing a raw number without any signals to help the reader judge its size. Compare these two statements:

> *Imprecise:* "Shark attacks are common ploys in horror films, but there were only 98 unprovoked attacks worldwide in 2015!"
>
> *Precise:* "It's the kind of record no one wants to break: the most shark attacks in a single year. But 2015 did just that, with 98 unprovoked attacks worldwide, beating the previous record of 88 set in 2000, according to the International Shark Attack File housed at the University of Florida."
>
> – University of Florida 2016

The author of the first shares a raw number of attacks without giving the reader any independent way to determine if it is high or low. In the second, the University of Florida compares 2015 numbers against the records in the International Shark Attack File and finds that 2015 saw approximately 11% more shark attacks than the next most attack-filled year. The context given by the inclusion of this range of statistics helps the reader better understand the severity of the number of attacks.

Use statistics as evidence

A statistic or a dataset is not a complete argument in and of itself (The Writing Center at University of North Carolina, 2016). Jane E. Miller, the author of *The Chicago Guide to Writing about Numbers*, reminds writers to report *and* interpret (2004, 24). Data is evidence that is used in *combination with* an author's analysis to create an argument. Data, standing alone, is not sufficient.

Data is not, in and of itself, an argument; it supports arguments.

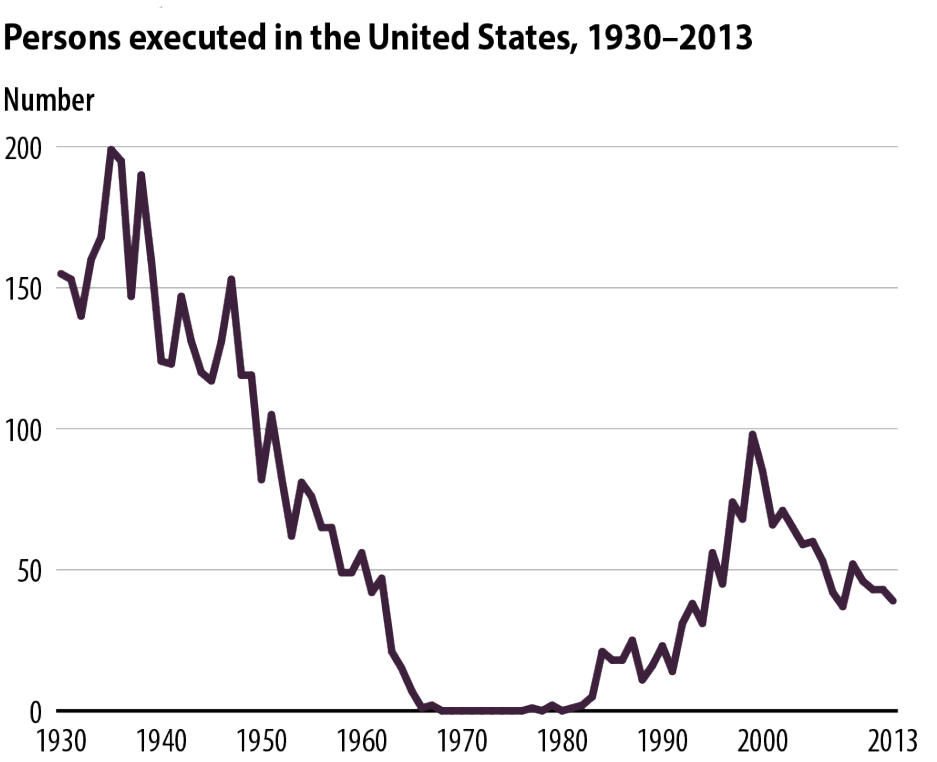
Although we now know, from the two pieces of evidence offered above by the University of Florida, that 2015 saw a sharp increase in unprovoked shark attacks, what we do not really know is what that means in the real world. Why do shark experts think this increase is taking place? We need more information. Thus, it is appropriate that University of Florida follows the startling contention that 2015 had the highest number of shark attacks by a noticeable margin by explaining:

> Sharks plus humans equals attacks. As our population continues to rapidly grow and shark populations slowly recover, we're going to see more interactions.
>
> – University of Florida 2016

Datasets from a wide variety of disciplines could help students practice thinking about context in statistical storytelling.

Exercise: Understanding statistics on the death penalty

Consider Figure 2, found in the Bureau of Justice Statistics' Statistical Tables report on capital punishment from 2013. It records the number of "persons executed in the United States, 1930-2013."



Source: Bureau of Justice Statistics, National Prisoner Statistics Program (NPS-8), 2013.

Figure 2: Number of people executed in the United States per the Bureau of Justice Statistics 2014

As a class or in small groups, ask students what types of context are missing that could help readers understand the meaning of these trends. For example, how do these annual figures measure against the total population at the time? What meaning could we derive if we had that additional information? What was happen-

ing in various states, and on the national stage, with regard to the death penalty and the law over time?

Some helpful resources for this activity

The Death Penalty Information Center has a discussion on the history of the death penalty, as well as a timeline, that can be adapted for use in class (Death Penalty Information Center n.d.). Changes in social and judicial conditions also may play a role in the large number of executions in the early twentieth century. The Bureau of Justice Statistics' "Historical Corrections Statistics in the United States, 1850–1984" breaks down the number of executions and illegal lynchings, including statistics on race, by decade (Cahalan 1986).

Provided with additional evidence from these sources, a class could practice writing brief passages that include some basis and/or other context to data points for these execution statistics.

Which average is the best average: Mean, median, or mode?

> *A certain airline, when asked about the age of a specific plane that crashed, responded that the average age of its fleet is 16 years*
>
> – Tobey n.d.

Simply put, beware of the word "average." Chapter 1 defined median, mean, and mode, and described how they are different and why each one matters.

There are two major errors to avoid with averages. First, take care that the measure used (mean, median, mode, or a specific data point) matches the question being asked. In the case above, the airline was asked the specific age of a particular plane, not the

"average" age fleet-wide. An "average" might have been offered to obfuscate the actual age of the specific plane in question. Secondly, as with the earlier discussion about numbers requiring context, be careful to use the average as a piece of evidence, not as a freestanding analysis. In the case of the airplane's age, the question has not been answered. One plane could be brand-new and another 32 years old to get at the mean of 16 years in age. We would refer to these two planes as likely outliers: extremes in plane age that are outside the rest of the planes' age range. Which plane would you rather be in?

Exercise: Find the correct measure

Fundamentally, a researcher must clearly define what kind of question she is asking, and match the measure to the information need. Consider the amount of exercise the students at your school are getting on a weekly basis. Imagine you have the data on every student's physical activity, in minutes of exercise a week, as shown in Figure 3.

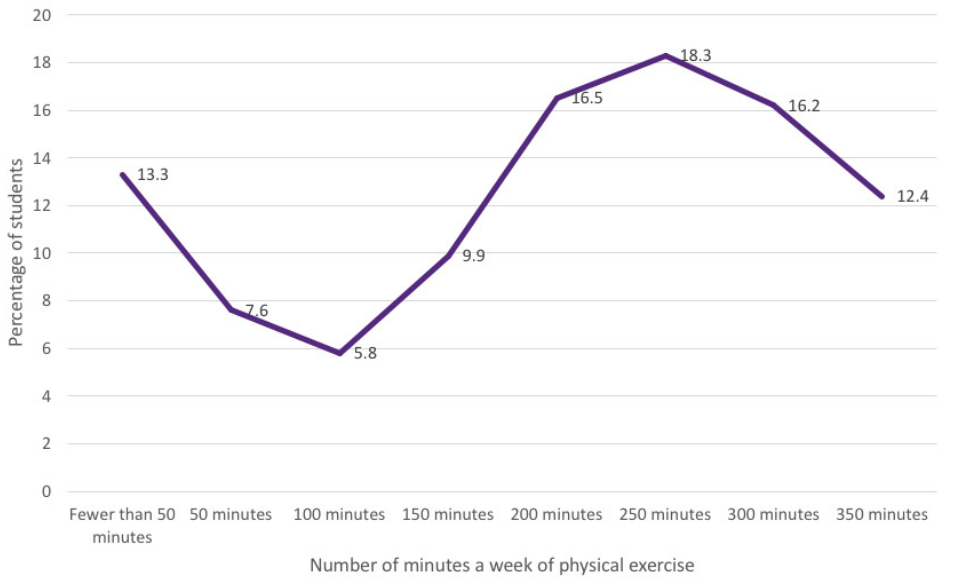


Figure 3: Number of minutes of physical exercise a week for students attending Mythical High School (Fictional data created by author).

Ask the class to calculate the mean, median, and mode for the data points on the graph. Then brainstorm stakeholders in the community who would care about the amount of exercise students are getting. Which stakeholder would benefit by knowing the mean? The median? The mode? Write statements that use the most beneficial form of average for various arguments. Responses like these make sense for this data set:

Those who would benefit from reporting the mean
Stakeholder: Head of Food Services
Goal: Planning caloric intake for students.
Argument: "Our school lunches need to provide adequate calories for a typical student, getting *n* minutes of exercise a week."

Those who would benefit from reporting the median
Stakeholder: The school board member
Goal: The district wants to benchmark for physical activity on the part of the students, comparing national health guidelines to what students are currently experiencing district-wide.
Argument: "National health guidelines suggest a healthy level of activity for students is 300 minutes a week, and right now our median is *n* minutes a week. Fewer than half of our students are meeting these federal guidelines. We need to make this a priority for our district."

Those who would benefit from reporting the mode
Stakeholder: Physical Education District Coordinator
Goal: Requiring daily PE classes all four years of high school.
Argument: "There is a gap of almost 250 minutes of activity a week between our students who meet the Presidential standard for an active lifestyle and those who lead sedentary lives." (Presidential Active Lifestyle Award (PALA+ n.d.)).

Those who would benefit from reporting outliers
Stakeholder 1: Principal
Goal: Arguing her students are getting appropriate amounts of physical activity.

Argument: "Our students are so active, they are getting up to 240 minutes of vigorous activity every day!"

Stakeholder 2: Parent
Goal: Instituting school-wide calisthenics in zero period.
Argument: "Over thirteen percent of the class is getting no physical activity at all!"

After students complete this exercise, engage them in a discussion. Were the arguments being proposed in this exercise manipulative? Objective? Misleading? Accurate? Unfair? When we look at different ways data is communicated, is it always correct, just because it is "good" data? Is it possible for data to be both technically accurate but still misleading?

While you can use data sets in a wide variety of disciplines for this exercise, the Center for Disease Control's Youth Risk Behavior Surveillance System (YRBSS) might offer some useful ones to get you started (Center for Disease Control n.d.).

Use evidence

Once again, statistics are not some numbers sitting around, waiting to be found, imbued with some independent meaning. They really can only be understood within a context.

It is possible that many of us only ever encountered the terms mean, median, and mode in middle or high school math class. Since we are not accustomed to using them in everyday language, authors may worry that using the terms will be off putting to their audience. When an author uses the word "average," it may be an attempt to avoid intimidating readers. Perhaps writers consider "average" easier for readers to understand than "mean," "median," or "mode." Perhaps the author does not understand how the different averaging methods function well enough to

write confidently using proper terminology. Since it is never a good plan to construct an argument or make a decision based on evidence one does not understand, one should only use information containing a statement of averages if one, in fact, understands it.

Given the experience we now have with writing about averages, consider what should be taken into account when reading. Always be on the lookout for whether statistics are being used as a freestanding argument or as evidence in support of an argument.

Cite your sources

> *"[T]he levels of driver errors we found [among dehydrated drivers] are of a similar magnitude to those found in people with a blood alcohol content of 0.08%, the current UK legal driving limit. In other words drivers who are not properly hydrated make the same number of errors as people who are over the drink drive limit."*
>
> – Professor Ron Maughan in Loughborough University Media Centre 2015

Above and beyond the ethics of citing sources according scholarly conventions, it is helpful to readers when the text of an article makes note of the source of its data. As a reader, keep an eye out for these citations. The information in the press release above transformed into bold newspaper headlines like: "Driving While Dehydrated Just As Dangerous As Driving Drunk" (Withnall 2015).

Imagine the different perception for the reader if the story actually read:

> A new study, sponsored in part by the European Hydration Institute — an industry foundation established by Coca-Cola and other organizations — suggested that driving while

> slightly dehydrated may lead to a similar number of errors as driving with a blood alcohol level of approximately 0.08% (Watson et al. 2015).

And how, again, would it be different if you knew that Professor Maughan, quoted at the start of this section and a contributor to the study, is also "Chair of the European Hydration Institute Science Advisory Board" (Loughborough University 2015)?

Providing the origin of the statistic provides some context for the outcome of the study, though readers cannot necessarily judge bias on funding alone. In this case, it does seems suspicious that an organization with a "pro-hydration" agenda funded a study that found dramatic consequences of not drinking enough liquids. Pairing the origin of a statistic with the number in the text helps a reader interpret the meaning and quality of the number.

In addition, students may not be aware of the different conventions for conveying an information source: I've had a student complain that an article they were reading from *The Atlantic*'s website did not footnote its sources, but her eyes had skipped right over the phrase "The OpenNet Initiative documents increasingly mature cyber attacks…" to get to the numbers that follow (Wagner 2013). Although the source was clearly named in the article, she was unfamiliar with how media sources cite articles differently than scholarly sources, so she overlooked it. For example, it can be helpful to point out to novice readers that media outlets frequently use the phrase "according to…" to signal when they are naming a source.

When writing, it is helpful to the reader to incorporate the source of a given statistic into the narrative:

> **Less helpful**: The average home price in California is 240% over the national average.

More helpful: California's Legislative Analyst's Office, the research arm of the California State Legislature, calculated that the median home price in California is 240% higher than the national average….

Most helpful: California's Legislative Analyst's Office, the research arm of the California State Legislature, calculated that, with a national median home price of $180,000, and a California median price of $440,000, the median home price in California is 240% higher than the national average…. (Taylor 2015, Gaarder 2016)[1]

The habit of incorporating the source name into the narrative does not require a teaching exercise of its own, but is rather something to remind students to do as they are writing in genres that do not use more formal citation practices. Incidentally, this habit is even more helpful (and required of all my students) when delivering presentations, where citations are not available to the audience in a meaningful manner.

As a rule of thumb, you should only use statistics you truly understand as evidence. As a reader, therefore, you should be selecting sources that provide you with sufficient amounts of information about the data you desire, communicated in a way that does not inherently change its meaning or make its meaning less clear. As a writer, you should understand the evidence you are using and speak about it in a clear and helpful manner that will not detract from the reader's ability to comprehend its true meaning.

[1]The use of the word "average" here is acceptable, because the sentence has already defined the central tendency being used (median). Also, check out what Joel Best has to say about the danger of "Big Round Numbers": Joel Best, *Stat-Spotting: A Field Guide to Identifying Dubious Data* (Berkeley, CA: University of California Press, 2013), 30.

Could Your Fast Food Burger or Burrito Be Making You Infertile? A New Study Concludes, Possibly…

Could your fast food be making you infertile?

Seems like there's a decent chance, or that it isn't helping, anyway, according to a new study, published in Environmental Health Perspectives*, a journal funded by the National Institutes of Health.*

Dr. Ami Zota, an assistant professor of environmental and occupational health at George Washington University, was the lead author of the study and pored over the data of 8,877 participants, collected between 2003 and 2010. They had all been asked about their diets in the past 24 hours, and they all had given a urinary sample. In those samples, Zota and her team of researchers found that the more fast food people ate, the higher the phthalates they had.

And unfortunately, phthalates isn't another name, for, say, vitamins and minerals. Believe me, I checked. I was hoping and rooting for all of us… (Williams 2016 n.p.)

Readers who pay attention to pure statistical storytelling may begin to notice that many instances of reporting actually follow the guidelines laid out previously, but still achieve a level of emotional resonance that impacts reader understanding. Let's turn now to language that is not specifically conveying numbers, but still impacts readers' understanding of those numbers. The opening lines from the above *Forbes* article about a class of chemical called phthalates, used in the packaging for fast food and linked by prior studies to infertility, follows the rules of pure statistical storytelling.

The title:

- **uses a yes/no question,**
- **highlights that it is reporting on a single study's findings, and**
- **includes the word "possibly" to indicate that the author is not claiming causation.**

The text:

- **reiterates the yes/no question in the first sentence,**
- **refuses to provide a definitive answer to the question,**
- **describes, quite succinctly, the sample group and methodologies used in the study.**

Technically, this statistical storytelling could have been extremely straightforward. It could have simply been a dry recounting of facts, and conveyed the study findings quite accurately.

★ **Author's note**

I do appreciate the use of a yes/no question in a title over a title that implies causation where none exists. However, I have recently started teaching my students a highly accurate adage, "Davis's Law":

"If a headline ends in a question mark, the answer is 'no'" (Bloch 1991, 163).

(This phenomenon is often referred to as 'Betteridge's Law of Headlines,' but Davis's work predates that of Betteridge.)

Yet, I found myself chuckling as I read the article. The informal language lightens the tone. The author's voice, talking directly *to* me in that last line — rather than *at* me — makes the storytelling feel personal, like I am being taken into the author's confidence, but as much like he is making fun of himself as that he is dis

cussing scientific findings. He even concludes the article with a message for readers from the lead scientist on the study, urging us not to panic.

It was surprising, then, that this slightly self-deprecating, personable and personal tone at the beginning and conclusion of the article sandwiched a very precise and incisive call to action. Williams suggests that readers bring their own plates to fast food restaurants until the chains change their packaging, and calls for "a movement" to get safer food. He also posits that his suggested changes would not constitute major economic burden for the fast food companies involved. Williams wants me to take action — he outlines suggestions for how I can fight back against fast food companies in a manner that will make their lives difficult and potentially inspire change. Yet, the lightness of his storytelling is the sugar coating on a bitter pill. He uses humor to keep me engaged through his angry retort.

Intensifiers and qualifiers

> *[A] 12-year-old who took longer than 12 minutes to run a mile ... scored lower on state standardized tests than those who were more fit.*
>
> – Adams 2013

In his 2013 book *Stat-Spotting: A Field Guide to Identifying Dubious Data*, Joel Best lays out a number of ways in which language can be used to couch statistics in meanings the numbers themselves do not convey. Be on the lookout for superlatives: labeling a finding as "the best," "the worst," "the biggest," or other fantastical measures. They are often overblown.

What Best refers to as "superlatives" could fall into a category that writers call *intensifiers*. An intensifier is a word added to a sentence to amplify the feeling it conveys. The opposite of an

intensifier is a "qualifier," or a word that introduces some uncertainty into a sentence. Look at these examples:

> **Original sentence:** Students who get at least thirty minutes of activity a day perform better in their classes.
>
> **Soften with *qualifiers:*** Students who get at least thirty minutes of activity a day ***may*** perform ***somewhat*** better in their classes.
>
> **Strengthen with an *intensifier:*** Students who get at least thirty minutes of activity a day perform ***much*** better in their classes.

When an author makes prolific use of intensifiers, the reader senses that the author strongly supports the statement. An author who uses qualifiers gives the impression of weak support (or little/no agreement with) the topic. By watching for and identifying intensifiers and qualifiers, readers can start to read between the lines on an author's opinion.

There is an exception to this rule of thumb when reading qualifiers in scholarly articles. As with the example of the expert writing about media violence toward the start of this chapter, responsible statistical storytelling employs qualifiers to create "confident uncertainty" (The Writing Center at UNC-Chapel Hill 2016). "Uncertainty," in this case, does not refer to author's level of "grasp" of the topic, but how far developed scientific understanding of the topic is. Statisticians consider it good form to use qualifiers to underline the difficulty in proving causation.

Can students determine the difference between confident uncertainty in the spirit of responsible statistical reporting and reporting that uses qualifiers and intensifiers to convey author's opinion on the topic? In 2016, the Writing Center at University of North Carolina – Chapel Hill offered fantastic guidance for considering how and when to use qualifiers in general-subject

writing. Their handout offers lists of qualifiers that help convey confident uncertainty where appropriate, but also help writers practice stating their own analytical conclusions with confidence.

Exercise: Peer review for intensifiers and qualifiers

In class, students could peer review each other's writing, identifying intensifiers and qualifiers. Where appropriate, peer reviewers can offer suggestions for places to add confident uncertainty, and suggest workable wording, in addition to identifying times that an intensifier could draw attention to an argument.

Teaching the nonfiction writer as narrator

Best points out that another way to evoke emotion in nonfiction writing is to give a situation a cute, distressing, or catchy name. For example, when a reader sees the term "The Pink Tax" used to refer to product pricing that makes items aimed at women more expensive than similar products aimed at men, be aware that someone selected that term specifically because it layered an emotional response onto their argument and, in doing so, potentially provoked a similar emotional response in the reader.

Educators have traditionally helped students identify this strategy when reading fiction in the classroom; now we can help them transfer this skill to reading nonfiction for research and "in the wild." Depending on your faculty's tastes, there are numerous ways to frame the idea of unpacking statistical writing for its emotional resonance.

My favorite frame, when working to identify emotional triggers in writing, is thinking of the writer as a narrator. When either reading or writing, we can extend this frame in a variety of ways:

» **Identify the narrator's personality:** Give participants a passage to read and ask them to describe the personality of the narrator, or describe if this person was a friend, what kind of friend would he or she be? How does the "personality" of the writing impact your response to the statistics you see?

» **Rewrite it:** Ask participants to rewrite a piece that has emotionally evocative overtones, creating a more measured tone.

» **Unpack the unreliable narrator:** Give learners a short passage of a study, news article, or advocacy piece, and ask them to highlight and discuss emotionally evocative language. You can push this exercise one step further — depending on which approach is the best fit for your faculty. Let's look at three ways to approach the question of nonfiction author as unreliable narrator:

Here are three different frameworks for discussing the notion of author as narrator, and exercises you can use for each.

Exercise: Reconstructing a popular graphic organizer

Co-contributor Wendy Stephens introduced me to a graphic organizer to use when analyzing fiction. There appear to be variations of this organizer, created by different individuals and organizations, and your students may be using it elsewhere in their schoolwork. It shows a stick figure that students labeled with:

1. **"The character says…,"**
2. **"The character thinks…,"**
3. **"The character does…."**

If we think of the nonfiction author as a story's narrator, as shown in Figure 4, it allows us to slightly tweak these questions:

1. **"The author says…,"**
2. **"The author thinks…,"**
3. **"The author wants the reader to do or to feel…."**

Consider offering these prompts on a graphic organizer or worksheet for students to practice unpacking the tone and motivation behind statistical storytelling in media, advocacy, or scholarly writing.

Figure 4: Applying story questions to nonfiction.

As with the shorter form of this lesson, asking learners to provide evidence for the answers entered on the graphic organizer is an important way for them to practice their critical reading. Learners should highlight the words and phrases in the reading which signal what the author thinks about the topic, and what s/he wants the reader to do or feel. Discuss the evidence as a group.

With the proper mindset, a lesson of this nature can be both engaging and challenging, as well as pegged for almost any age range.

Exercise: Connotation and denotation

There is another way to talk about these same elements, which might connect to prior learning for a different set of learners. In a sense, when I am reading nonfiction with an eye toward the author's perspective, I think of the writing as having features analogous to *connotation* and *denotation*. The *denotation*, or dictionary meaning, is like the factual information — in this case, the statistics. The *connotation* of the passage is the feeling that the author inspires (intentionally or not) in the reader; the subtext about the story. The *call to action* is what the author wants the reader to take away from the text. Novice researchers must be aware of not just text but subtext, whether reading numbers or words.

When our science students were reading their astronomy-themed narrative nonfiction, I taught a 50-minute lesson (see http://bit.ly/NonFictionAnalysis) that combined the notion of connotation and denotation with that of an unreliable narrator. Our science students successfully unpacked each of these elements from the narrative nonfiction they were reading in groups. We started to move from "the author is just clear and informative," to "the author wants us to think about him as more of an expert than the other experts" or "the author wants us to advocate for a more science-literate society!"

In this approach, these same questions might be framed like this:

- **What was the author's topic** (what was the factual argument the author is presenting)? You could call this the "denotation" of the passage.
- **What was the author's opinion about the topic?** You could call this the "connotation" of the passage.

- **What was the author trying to make you feel about the topic?**
- **What are some words or phrases the author used to evoke those feelings in you?**

Exercise: Aristotle's rhetorical triangle

When you have students studying formal elements of rhetoric, you may want to convey the same lesson using Aristotle's Rhetorical Triangle (shown in Figure 5), which describes how speaker, audience, and subject work together to create meaning.

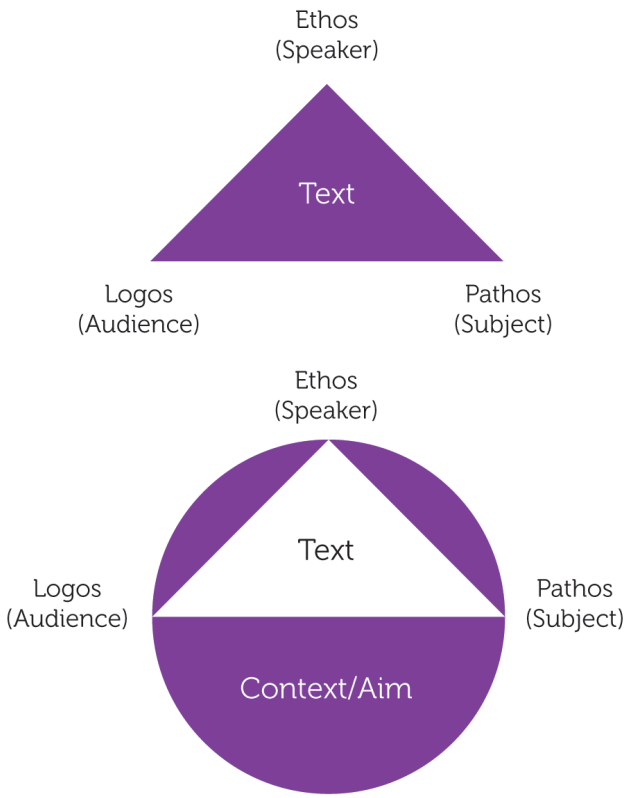


Figure 5: The original version of Aristotle's Triangle (top) demonstrates the relationship between the speaker (ethos, or expert approach), audience (logos, or logical reading), and subject (pathos, or emotional components), and how these elements work together to create the understood meaning of the text. Some scholars add an encapsulating circle to the original diagram (bottom) to communicate that the context or aim of the writing surrounds all these other elements and lends itself to how the text is understood.

The Advanced Placement Language and Composition exam focuses on rhetoric, so collaborating with classes preparing for that exam may offer opportunities to practice transfer. (Hepzibah Roskelly's 2016 article "What Do Students Need to Know About Rhetoric?" offers a succinct and clear overview of elements on which you may want to build.)

Applying the rhetorical triangle challenges us to step out of the roll of emotional reader and look at our own responses from a dispassionate distance. Consider the opening of this article on school funding from the conservative-leaning organization New Mexico WatchDog:

> For decades, it's probably the most troublesome question facing education: Why are results for U.S. public school students so mediocre, despite the billions of taxpayer dollars spent?
>
> Andrew Coulson thinks he's got the answer: Because there is no discernible correlation between spending and outcomes.
>
> "The takeaway from this study is that what we've done over the past 40 years hasn't worked," said Coulson, director of the Center For Educational Freedom at the CATO Institute. "The average performance change nationwide has declined 3 percent in mathematical and verbal skills. Moreover, there's been no relationship, effectively, between spending and academic outcomes" (Nikolewski 2014).

In this instance, the author calls on the expertise of a think tank scholar, Andrew Coulson, to provide the ethos to his argument. Drawing on evidence from such an expert provides the reader with the development of a logical argument. As is often the case when authors cite statistics, the use of data to measure change in student achievement appears to offer a logical ground truth. Of course, it is our contention throughout this work that statistics

can also be a tool of pathos, as statistics can be formulated or communicated in such a way as to change the feeling they convey to the reader. Additionally, all of these elements are framed for the reader with an opening appeal to pathos, when author Rob Nikolewski employs phrases like "most troublesome question facing education" to set up the logical argument he proceeds to construct. Finally, school funding, and government spending more generally, are often at the heart of national debates which provide a broader context – and watchdog groups aim to change government behavior. This article is situated within that debate.

Select an article that makes use of statistics and identify the pathos, ethos, and logos. Consider how these elements change readers' interpretation of the statistics shared within the story.

Results required

Beyond engaging in standard close reading, it might also help students to learn about some of the pressures acting on statistical storytelling, and for them to start taking notice of resulting uses of language and structure that can impact their understanding of meaning, especially in the popular media.

One of the differences between writing done by students and the sources students consume is the expected outcome on the part of the audience. That is to say, a student who is investigating whether video games lead to violent behavior may turn in a paper that finds no difference between the two sides and receive a strong grade for good work, while a political advocate — whose funding, career, or cause may depend upon gaining publication and press attention — requires an attention-grabbing sound bite of a response. Students may not always be aware of this difference. Thus, it can be helpful to offer an example of storytelling with the same data set at different stages in its lifecycle to see how its meaning changes as users strive to attract the public.

John Oliver's fantastic (but not appropriate for school) piece, "Scientific Studies" (2016), called out one such example:

- **First, medical researchers,** concerned with "conflicting results regarding the role of chocolate consumption during pregnancy" wondered if there was a difference between consuming high-flavanol and low-flavanol chocolate. They "observed no significant difference" between the two, noting that "daily intake of 30g of high-flavanol chocolate did not improve placental function" compared with low-flavanol versions, noting that it "might suggest that chocolate effects are not solely and directly due to flavanol content." The original study is titled: "High-flavanol chocolate to improve placental function and to decrease the risk of preeclampsia: a double blind randomized clinical trial" (Bujold et al. 2016, S23).
- **Next, the Society for Maternal-Fetal Medicine,** the organization hosting the conference at which the researchers were to present their study, issued a press release about the study, entitled: "The Benefits of Chocolate During Pregnancy." The release ran through the findings, reiterating the baseline statistics with regard to the methods of the study, including the fact that each subject ate 30 grams of chocolate a day for 12 weeks. However, where the original reporting concluded that "...[T]he marked improvement of the pulsatility index observed in the 2 chocolate groups might suggest that chocolate effects are not solely and directly due to flavanol content" (i.e., researchers observed a pattern of change in a notable number of subjects' placentas which was unrelated to the question they were testing, and the cause of which they could not identify), the press release argued that "This study indicates that chocolate could have a positive impact on placenta and fetal growth and development and that chocolate's effects are not solely and directly due to flavanol content" ("The Benefits of Chocolate during Pregnancy" n.d.)

» **Finally, in the hands of the media,** the story morphed yet again, to include headlines and opening lines like:

"Pregnant women SHOULD eat chocolate as it's good for them AND baby"

Pregnant women who crave chocolate are in for a treat – scientists say eating it could be good for them and their unborn babies.

Having just 30g a day may boost a baby's growth, they claim (Christensen 2016).

While students do need to understand the pressures on statistical storytellers to show impressive results to readers, educators do not want to undermine the notion that research in various disciplines can successfully help us build a greater understanding of the world around us.

Exercise: The life-cycle of reporting on research

Consider having students find storytelling about a specific study or data set at different points in its life-cycle and identify how it changes as successive organizations make use of it.

Memory and (mis)information

There is much we still do not know about how memory works. Both academic researchers and marketing professionals experiment with emotionally evocative wording and memory,[2] accumulating growing evidence that triggering strong emotions through word choice helps shape recall. Researchers are also

[2]For example: Elizabeth A. Kensinger and Suzanne Corkin, "Memory Enhancement for Emotional Words: Are Emotional Words More Vividly Remembered than Neutral Words?," *Memory and Cognition* 31, no. 8 (2003). and Tom Channick, "The 1,072 Words That Will Change How You Write Headlines Forever," *Native Advertising*, last modified July 1, 2015, accessed May 14, 2016, http://nativeadvertising.com/contextwords/.

interested to know if headlines influence how readers understand and retain the content of the stories that follow. Lewandowsy *et al* review the scholarship on "Misinformation and Its Correction," confirming a strong research trend hypothesizing that what people first learn to be true will continue to be what they believe, even if corrected later. Only three methods seem to produce some change in what readers remember. One of these methods is offering a new narrative to replace the reader's existing one (Lewandowsky et al. 2012, 117). This finding prompted other researchers to ask whether a complete news story could counteract the impact of a misleading headline. This single study indicated that "misleading headlines affect readers' memory, their inferential reasoning and behavioral intentions" even when the article itself created a replacement narrative, if the headline is just misleading enough that the reader does not notice a glaring contradiction between it and the body of the article (Ecker et al. 2014, 323). As a result, implications of headlines may be coloring readers' understanding of statistical arguments even before the evidence is presented. Among other things, this finding would suggest even further that statistics cannot simply be evidence "waiting to be found" because the reader's understanding of their meaning may essentially be set even before they reach the statistics.

This relationship between the headline and the body of a story play out in different ways across different forms of writing. In her "How to Read and Understand a Scientific Paper: A Guide for Non-Scientists," Jennifer Raff of the University of Kansas suggested upending traditional practice and saving the abstract as the last, not first, part of a paper to read (2013). Reading the abstract first, she hypothesizes, causes the reader to believe the rest of the paper must be true and truncates the close reading process that could lead readers to find new or contradictory findings in the data or its methodology.

Similarly, the opening image of *The Atlantic*'s "Why Internet Headline Writers Hate Themselves" jokingly refers to writing a "One sentence summary that walks back the promise made in the headline" (Thompson 2015, 1). This seems counterintuitive to straightforward reporting practices, but one easily finds numerous examples of this journalistic trick:

Consider this press release from the American Psychological Association:

> **APA Review Confirms Link Between Playing Violent Video Games and Aggression**
>
> ***Finds insufficient research to link violent video game play to criminal violence***
>
> Violent video game play is linked to increased aggression in players but insufficient evidence exists about whether the link extends to criminal violence or delinquency, according to a new American Psychological Association task force report. ... (American Psychological Association 2015)

As you can see, even scholarly organizations can make this error!

Exercise: Exposing contradictions

When students are collecting sources during research, consider asking them to annotate the articles. These annotations should include contradictions they find between a headline's conclusion and the information in the opening paragraphs. Students might be surprised with how often these contradictions occur in the media. Furthermore, this practice will help them attend to the actual message of the statistics within the piece, rather than the title that initially attracted their eye.

Each of these elements of statistical storytelling help form readers' understanding of a story. Taken piece-by-piece, they may feel like too much to handle. It has been my observation, however, that practice noticing even one of these ways in which language can be used to change readers' understanding can have a great impact on the critical thinking that goes on during the overall reading and writing process.

Searching

Once students begin to get a feeling for what to watch out for in reading and writing, the same knowledge can be applied to choices made when searching for statistical stories.

"Garbage in/garbage out"

In our library, we hold the philosophy that source evaluation — the ability to assess the credibility of a resource — begins with strong search skills. All search tools provide a "garbage in/garbage out" experience. That is to say, search engines and databases "read" each page or article they contain, placing each word that appears within that source in an index. When you type a query into the search box (we're using brackets in this book to demarcate text that is typed into a search box), the search engine or database then compares the words in your query to the words indexed for each page or article, and gives you the sources that match. Google is coded to provide the flexibility to consider "related terms" — meaning it "understands" that [correlation] and [link] are often synonymous. Expert searchers know that when you use a word in your search, you should expect to see it on the page that comes back. Formal terminology tends to bring back pages with formal sources, informal language leads to informal sources. Experts consider what kind of language will be used in the *answer* they seek.

Alternatively, the novice searcher is thinking about his or her *question* (and may even have phrased the search string in the form of a question). Therefore, people who want to know *if videos games cause violence* tend to search for [video games cause violence], or even [Do video games cause violence?] but then results are more likely to skew toward articles that are confusing correlation and causation.

Of course, terms like [cause], [impact], and [average] are very tempting to include in queries. But the cleanest searches are *devoid of any words describing relationships* among factors, such as [video games violence] in a search engine, or [(video games) AND violence] in a database.

If you don't know what your answer is (for example, if you don't know that video games cause violence, for certain) then you are best to leave the verb out.

A useful rule of thumb is: *Search for your answer, not your question.*

Familiarity with synonym searching can be crucial in this regard. Building on Best's 2013 point about naming issues to manipulate reader perceptions, the evidence researchers encounter will also skew with the search terms they chose. My students seek help when they are only finding one side of an argument when they are searching with terms that may be named differently depending on one's point of view, as shown in Figure 6.

If a searcher wants to see how various stakeholders address a single issue, it will be necessary to search separately, using each group's name for the topic, in turn. Similarly, different disciplines may use a variety of terms to refer to the same idea. For example, economists and academic librarians talk about "threshold

concepts" as foundational knowledge, while others might use a term like "background knowledge."

If one searchers only for this term,	She may miss stories that use this term
[undocumented worker]	[illegal immigrant] [birthright citizenship] [anchor baby]
[obamacare]	[affordable care act]
[drone]	[unmanned aerial vehicle]
[red scare]	[anti-communism] [mccarthyism] [house un-american activities committee]

Figure 6: similar search terms with different connotations.

Exercise: Write search terms

Select a topic that is relevant to your curriculum. Try one of the following:

- **Discuss that there can be a difference between search results that feel helpful,** which is often code for "easy to find and easy to read" and those that are actually good quality. The best sources often have both of these attributes, but when one searches with a long-form question one often gets results that are "easy" to read rather than those of great quality. Brainstorm more- and less-formal ways of referring to single ideas and try searching with each term – observe the differences in results.
- **Identify synonyms that would be used by different stakeholders to describe a single idea.** Try searching with each term and observe the differences in results.
- **Practice writing searches** that do not include language that would skew toward causation unless you know that causation has actually been proven. Once again, trying searches and comparing results can be helpful.

A quick note before we move on: Web searching can work in unexpected ways. Sometimes, even poorly-constructed searches (according to expert researchers) can still prove successful. This is a chance to observe how *different* approaches produce *different* results.

Context terms

One kind of search term that is revolutionary for student search experiences is *context terms*, named by Daniel M. Russell. A context term is a source type that also functions effectively as a search term. For example, if you wanted to find a dataset showing which states voted Democratic or Republican in a given presidential election, you might suspect that this information would be displayed on a map. You would therefore include the term [map] in your query. Long before I started calling them context terms, I was using source types as search terms to locate statistics. Building a query using terms like [study], [report], [research], [survey], and [poll] can be game-changing. Similarly, thinking about the terms that appear in the captions of data sets in scholarly works makes a huge difference. Try searching in an image collection (such as Google Images) for [*topic* figure OR table] to find the statistical images from academic papers or industry reports.

You can also use terms for collections of information, like [database], [library], [collection], or [archive] to find the collection that holds your desired data.

Just be mindful that while the term [statistics] is increasingly being used as a title or in the metadata of pages created by trusted sources, is not always a helpful term in finding quality data. Experts know that quality sources do not say: "here are some statistics," or "statistics show…," they tend to say: "a recent Gallup poll found," or "see Figure 2."

Less experienced searchers often discover qualitative results, which may include a sprinkling of data, when using paid databases and open web search engines. When my students are looking for information on Turkish citizens' feelings about the country's attempts to join the European Union (EU) over the last forty years, they find articles from a variety of newspapers on online media sites, but somehow never encounter any of the results of the detailed surveys run by the EU itself. My students don't realize the EU might ask the Turkish people specific questions about their attitudes and publish the results in the form of a statistical report (European Commission Directorate-General for Communication 2013, 1-4).

One of the big issues inexperienced researchers face is *source literacy*[3]: an awareness of what kind of sources are even created and available, let alone how to find and understand them.

Exercise: Experimenting to learn context terms

I've had great luck simply posting a slide with context terms. (See Figure 7.) I then ask students to combine their basic topic search terms with one context term at a time and investigate what comes up. I never know which ones will work for which topic, and the list of potential terms changes by discipline.

I set a timer for fifteen minutes and just ask them to go for it and get through as many as possible to see what is there. While they search, I stroll around, helping build understanding for unfamiliar formats.

[3]A topic currently being explored by Nora Murphy. See, for example: Nora Murphy, "How to Develop Strong Source Literacy: Practice!" at http://blog.fsha.org/develop-source-literacy/ and her article "Approaching Source Illiteracy, or How a Source Is Like a Frog" in the May/June 2016 issue of *Knowledge Quest*.

Report	Conference
Survey	Case Study
Study	Book
Infographic	Forum
Figure	Thread
Table	Overview
Poll	FAQ
Survey	Database
Graph (less common)	Museum
Chart (less common)	Library
Data	Archive
Statistics	Collection
Fact sheet	Agency
Overview	Association
White paper	Institute
Presentation	Center

Figure 7: A general list of source terms that can be combined with topic-related terms to tease out less-typical results for students.

Associated search terms

There are some features that make it hard to search for specific information, yet a clever searcher can use them to great advantage. Novice searchers often forget to look beyond the anticipated headlines about their topics to the ways in which it might be discussed.

An *associated search term* is a word that is not directly related to the searcher's topic, but which has a high likelihood of appearing in the source the searcher wants to find. For example, I can find scholarly studies through paid databases and Google Scholar, but also if I know that [methods] and [discussion] are section headings of papers that may include statistical analysis, I can add them as potential search terms.

I frequently use this strategy to find projection data, for example. The notion of "projection" has many synonyms: forecast, estimate, prediction, anticipation, expectation, and sometimes the idea of a forecast is simply implied. However, reports of forecasts

almost always predict some outcome "by the year *x*." An expert searcher can use this convention to find projection data. Consider the query shown in Figure 8:

Try this query	To find projections like
[childhood obesity "by the year 2020..2050" OR "by 2020..2050"]	"The researchers estimate that by 2025, China, which saw a 40 percent rise in childhood obesity between 2000 and 2013, will have the greatest..." (Lepore 2016) "The World Health Organization estimated that childhood obesity rates could rise across the globe from just over 40 million to 75 million by 2025...." (Robinson 2014) "By 2025, 268 million children aged between five and 17 years old...." (De Graaf 2016)

Figure 8: Using date ranges in searches. Putting two periods between two year dates means, "Look for results between this year and this year."

Admittedly, this technique is not for the faint of heart. I would not recommend teaching it to others until a clear need arises, but it is great to have in your toolbox for that perfect moment. Just remember, a little creativity can go a long way.

Search with precise statistical terminology

[Correlation], [link], [sample] and [predictor] can make excellent search terms. For example, to continue with the same topic, the search [predictor childhood obesity] will bring up scholarly articles outlining the predictors, and probably with data to help explain them. Just remember that [predictor childhood obesity] is open-ended and avoids confirmation bias while [exercise predictor childhood obesity] pre-supposes that the searcher already knows what causes obesity and will skew results.

Additionally, be specific when searching for averages. Have you determined that your research needs are best met by knowing a *median* statistic? Search explicitly for [median home price Atlanta] rather than [average home price Atlanta]. Consider that most

search tools cannot see percentage signs (%), but can see the word [percent OR percentage] (as well as [percentile] – just don't confuse it with the others).

Searchers can use specific statistical terminology, as well, to track down studies that make use of a specific sampling method, for example: [childhood obesity multistage random sample] or [childhood obesity longitudinal]. Or, if many of the results one is finding are based on poor or unhelpful methodology, eliminate more of those results using a minus sign (-) immediately before the search term, without a space separating them. Imagine you are mostly getting results that use a method called *snowball sampling*, in which individuals recruit acquaintances to participate in a study, poll, or survey. In most cases, that method does not lead to valid results. A search like [*topic* -snowball] will assure that you get no results that include the word *snowball* anywhere in the document. Similarly, if you need quantitative studies, then a qualitative method like ethnography – while valid – may not be helpful, so [iPad-ethnographic] would eliminate any iPad studies that had an ethnographic method.

Search with terms for parts of a paper

As with using context terms to find a particular type of source, you can use the formal names for parts of a scholarly paper to find your topic within a scholarly paper, as mentioned above. Are you looking for a study that will give you context for what came before it? Use the search term [literature review] in your search query. Looking for press releases, blog posts, newspaper or magazine articles that report a study in more accessible language, but still tell you something about how the study was carried out? Consider using search terms like [method], [discussion] or [conclusion].

Exercise: Using statistical terminology or section titles to find content

Select a topic relevant to your participants, or let them chose one for themselves. Simply try combining words describing the topic with some of the vocabulary discussed in the last two sections and ask them to observe what happens.

Conclusion

Thinking about responsible statistical language can be a bit frightening, because fewer authors than we would like speak of their work with confident uncertainty, and it can feel to students like equivocating and not appearing expert. Of course, learning to communicate with confident uncertainty where appropriate may also reincarnate the notion that it is best to use "unbiased" sources, when, in fact, such a source rarely exists. In our program, we approach bias and/or perspective as anticipated elements in our sources, and therefore aim to give students to tools to recognize it, name it, and use that understanding to place the facts they are finding in context. We believe recognizing word choices that are emotionally resonant is a powerful tool, critical for both source evaluation and synthetic thinking, and is a habit that — once formed — will become second nature for many of our students.

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Appendix A: Tips for integrating lessons on unpacking language into your research process

If you have five minutes, share these rules of thumb before students begin creating their product:

- When you find a statistic or data set you want to use, step back and think about the emotion conveyed by the source in which you found it. How do you feel after reading it? Excited? Angry? Upset? Identify the words that give you those feelings. If the words were different, would you feel the same about what you are reading?
- When you are writing, you may often try to use descriptive language. Consider the tone of your writing. How would you characterize it? Check for intensifiers and qualifiers, making sure you have used them in good measure. Add confident uncertainty where appropriate.
- When you are searching for statistics, are you keeping your searches very simple? Are you trying different terms that are used to describe your topic?

If you have thirty minutes, provide students with lists of words and phrases to use and avoid, as well as some small data sets related to the topic under discussion. Ask them to draft a paragraph using the provided statistics and being careful to craft a narrative employing careful and intentional statistical storytelling.

If you have one class period, pick a fun opening exercise to get students to think about one way in which words chosen by an author can impact their feelings about what they are reading, such as ranking news headlines on a fun topic by the level of causation implied. Introduce/review connotation and denotation. Brainstorm a list of synonyms for a common emotion, like "anger," and then consider the differences in connotation. If students are researching, have them go through a source they are using for their research and identify emotionally loaded language, name the feeling the author is trying to inspire; if they are writing, have them draft a sentence or paragraph conveying statistical information they are

planning to use, trade with a partner, and check the emotional resonance of each other's writing.

If you have multiple class periods, use the first day to discuss the impact of language choice in reading and writing, drawing on some of the activities outlined in this chapter. On the second day, teach students a bit about searching for statistical information (based on this and other chapters) and have them begin to identify sources on a topic chosen by them or identified by the teacher. Remind them to keep an eye out for emotionally loaded language that might sway the reader's opinion.

Appendix B: Causation and correlation worksheet

In April 2016, researchers at the University of Pittsburgh released a study that found a correlation between sleeplessness and social media use. The study clearly stated that future work was needed to understand "directionality" and "the influence of contextual factors".

Consider these headlines reporting on that study (full citations are available in the bibliography of this chapter).

First, underline or highlight words and phrases that indicate correlation or causation.

Next, rank them in order from most suggestive of correlation to most suggestive of causation; #1 indicates strong correlation language, #9 means a clear statement of causation.

___ "Study Finds Social Media Leads to Sleep Disturbance"

___ "Is Social Media Keeping You Awake?"

___ "Social media is Keeping Young Adults Awake"

___ "Research Links Extreme Social Media Use With Disrupted Sleep"

___ "Social Media Use in Young Adults Linked to Sleep Disturbance"

___ "How Social Media is Wrecking Your Sleep"

___ "Blame Social Media for Your Child's Sleeplessness"

___ "Too Much Social Media Could Mess Up Your Sleep"

___ "According to New Research, If You Love Social Media, You Probably Don't Sleep Well"

Appendix C: Does this sound like correlation, or is there a causal hint, too?

In April 2016, researchers at the University of Pittsburgh released a study that found a correlation between sleeplessness and social media use (Levenson et al 2016). The study clearly stated that future work was needed to understand "directionality" and "the influence of contextual factors".

Read each of these first paragraphs of different news stories on the study. Decide if they are suggesting correlation or causation. Highlight or underline the words or phrases that suggest one or the other.

Examples

Just when you thought it was safe to click on that funny Facebook video of an aardvark carrying a shovel to dig a hole under a cinderblock wall while a pair of Peruvian flute-players cavort in green onesies, researchers at the University of Pittsburgh have found that social media wreaks havoc on your sleep patterns.

Obsessive social media use on Facebook, Twitter and similar platforms are linked to sleeping disturbance. According to a study conducted by the lead author, Jessica C. Levenson, Ph.D., a postdoctoral researcher at Pitt's Department of Psychiatry, published in *Preventive Medicine*, young adults who spend more time checking their social media, during the day or those who frequently check their social media accounts, are more likely to suffer from sleep disturbance.

Young adults who spend a lot of time on social media during the day or check it frequently throughout the week are more likely to suffer sleep disturbances than their peers who use social media less, according to new research from the University of Pittsburgh School of Medicine.

Young adults who spend too much time on Facebook, Twitter and Instagram may pay the price in poor sleep, new research suggests.

Social media usage correlates with sleeplessness, according to a new study, although it doesn't necessarily cause sleep troubles. According to researchers at the University of Pittsburgh School of Medicine, young adults who spend a lot of time on social media tend to also have trouble sleeping. It's not known whether sleep deprivation leads to increased social media usage, or whether all that Twitter scrolling is leading to sleep loss — but the two definitely seem to be connected.