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COVID-19 and Numeracy: How about Them Numbers?

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COVID-19 and Numeracy: How about Them Numbers?

Abstract

Quantitative efforts to understand the emergence of the COVID-19 pandemic need to be viewed through the lens of social construction. I begin by comparing the efforts to quantitatively measure the plague in London in 1665. Then I develop five propositions for studying the social construction of statistics: (1) facts are social constructions; (2) measuring involves making decisions, (3) counting is not straightforward; (4) all comparisons involve choices; and (5) social patterns shape numbers. After examining how these propositions affect what we know about COVID-19, I consider their implications for moving beyond mathematics when approaching numeracy.

Keywords

coronavirus, COVIS-19, social construction

Cover Page Footnote

Joel Best is a professor of sociology and criminal justice at the University of Delaware. His books include *Damn Lies and Statistics* (University of California Press, 2001), *More Damned Lies and Statistics* (University of California Press, 2004), *Flavor of the Month: Why Smart People Fall for Fads* (University of California Press, 2006), *Stat-Spotting: A Field Guide to Identifying Dubious Data* (University of California Press, 2008), *The Stupidity Epidemic: Worrying about Students, Schools and America's Future* (Routledge, 2011), and *American Nightmares: Social Problems in an Anxious World* (University of California Press, 2018). His papers in Numeracy include a perspective ("Birds—Dead and Deadly: Why Numeracy Needs to Address Social Construction") in the journal's first issue (Jan. 2008).

Introduction: The View from 1665

The opening pages of Daniel Defoe's (1968 [1722]) *A Journal of the Plague Year* should seem familiar to readers in 2020.[1] The book begins in December 1664, when Londoners were trying to figure out just what was happening. The plague had struck Holland in 1663 and 1664; now two men were reported dead from the disease in London. Would those be the only cases, or would there be more? People turned to the weekly Bills of Mortality (an accounting kept by the Worshipful Company of Parish Clerks), which were supposed to track burials in London:

> . . . the usual Number of Burials in a Week, in the Parishs of St Giles's in the Fields, and St Andrew's Holburn, were from 12 to 17 or 19 each, a few more or less; but from the Time that the Plague first began in St Giles's Parish, it was observ'd, that the ordinary Burials encreased in Number considerably. For Example, . . .
>
Jan. 30 to Feb. 7	St Giles's	21	
	St Andrew's	23	
Feb. 7 to 14	St. Giles's	24	(p. 3)

> The usual Number of Burials [for the whole of London] within the Bills of Mortality for a Week, was from about 240 or thereabouts, to 300. The last was esteem'd a pretty high Bill; but after this we found the Bills successively encreasing, as follows:
>
	Buried	Increased	
Dec. the 20th to the 27th	291		
27 to the 3 Jan.	349	85	
January 3 to the 10	394	45	
10 to the 17	415	21	
17 to the 24	474	59	(p. 4)

So more people were dying, but were these deaths from plague? Relative few deaths were ascribed to that cause, but ". . . it began to be suspected, that the Plague was among the People at that end of the Town; and that many had died of it, tho' they had taken Care to keep it as much from the Knowledge of the Publick, as possible . . ." (2). There were competing diagnoses: in the week of April 18–25 "there was buried in St Giles's Parish 30, whereof two of the Plague, and 8 of the Spotted-Feaver, which was looked upon as the same thing . . ." (5). Eventually, efforts to obtain more accurate counts emerged: during May 23–30: ". . . the Burials in St Giles's were 53, a frightful Number! of whom they set down but 9 of the Plague: But on an Examination more strictly by the Justices of the Peace, and

[1] Defoe was a small child in 1665. He would have grown up listening to accounts of people who had vivid recollections of the plague, but his book, much like his better-known *Robinson Crusoe* and *Moll Flanders*, is a fictional account told in the first person.

at the Lord Mayor's Request, it was found there were 20 more, who were really dead of the Plague in that Parish, but had been set down of the Spotted-Feaver or other Distempers, besides others concealed" (6).[2]

These passages indicate that, when faced with a serious but uncertain threat, seventeenth-century Londoners made efforts to quantitatively measure what was happening. In other words, Defoe's book—written fifty years before the word *statistic* was coined—describes the social construction of statistics.[3]

These dynamics seem strikingly familiar, even though Defoe was describing events more than 350 years ago. It is easy to assume that our situation ought to be very different from that of seventeenth-century London. After all, (1) we have a vastly improved medical system founded on a completely different and vastly superior understanding of disease, with better trained professionals, more accurate diagnoses, and more effective treatments; (2) we have a vastly more sophisticated public health system to trace and control the spread of epidemics; (3) we have vastly more scientific knowledge, as well as institutions to foster its growth and spread; and (4) we have vastly more effective means of communication to spread information. And yet, much like Defoe's Londoners, we find ourselves in the early stages of an epidemic, struggling to use numbers to make sense of what's occurring.

In spite of the obvious differences between then and now, we can see the similarities. I started writing this during the second half of April 2020, when COVID-19 coverage preoccupied a large share of the news media's attention. When I began writing, infections in the US had not yet peaked, and there were bitter debates about the nature of the threat and the best policies to address it. There seemed to be troubling trade-offs between the public health officials' recommendations to maintain social distancing in order to minimize infections and deaths, and the need to restore an economy which had been terribly damaged as a consequence of those recommendations. (Defoe's narrator, a sadler, faced this dilemma at an individual level: "I had two important things before me; the one was the carrying on my Business and Shop; which was considerable; and the other was the Preservation of my Life in so dismal a Calamity . . . which however great it was, my Fears perhaps as well as other Peoples, represented to be much greater than it could be" [9].)

Obviously, mine is a preliminary account—notes for a rough draft if you will. Our understanding of the COVID-19 pandemic will evolve during the coming

[2] The diarist Samuel Pepys also lived through the 1665 plague: "At the end of August, he cited the bill of mortality as having recorded 6,102 victims of the plague, but feared 'that the true number of the dead this week is near 10,000,' mostly because the victims among the urban poor weren't counted" (Lotz-Heumann 2020).

[3] On the social construction of statistics, see Best (2004; 2008; 2012).

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weeks, months, and years. I also need to make it clear that I have no training or background in epidemiology; I am just a sociologist who studies social problems by focusing on how people talk about public issues. Therefore, I am not going to reference the rapidly growing medical literature on COVID-19; rather, I am interested in exploring how the pandemic was discussed in public forums—in news coverage and various online posts. I have ignored the fleeting whims of social media and the noise from television's talking heads, in favor of better thought-out, more coherent written statements. Still, examining how people talked about COVID-19 during the early months of 2020 allows us to identify facets of this topic that are relevant to those interested in numeracy. I present these as a list of observations.

Facts Are Social Constructions

Many of us had a third-grade social studies unit on facts and opinions, wherein we learned that facts are really, indisputably true, whereas opinions are statements that some people may consider to be true, even as other people disagree. Thus, "three times three equals nine" is a fact, while "Superman is the best superhero" is an opinion. However straightforward this may seem to third-graders, things are a bit more complicated than that.

It is not difficult to find people who consider it a fact that the Bible is the one true word of God, and others who consider it a fact that the Koran is the one true word of God. Let's remember that this dispute is not some minor disagreement; it is the root cause of many, many people being killed over centuries. This example tells us that facts are products of particular social groupings at particular times and in particular places. When I went to school, I learned it was a fact that our solar system had nine planets; my grandchildren are learning the fact that there are only eight. Labeling something a fact always occurs within a particular social context.

Understand that I am not suggesting that all claims are equally true or some relativistic nonsense of that sort, but different groups have standards for determining what is factual. Scientists demand empirical evidence to weigh claims, just as historians have standards for judging evidence from the past, and theologians for correctly reading holy writ. Thanks to the Enlightenment, our world shares considerable consensus about lots of facts: most people accept that matter is composed of atoms, the earth orbits the sun, the continents are in motion, and so on—and yet we know that these were once ideas that were seen as dubious. Where there is overwhelming evidence, we may think it very unlikely that knowledge we currently consider factual will ever be overturned. At the same time, we have to acknowledge that knowledge that we may be confident is factual

(e.g., I—and most of the people I know—don't doubt that evolution is a fact), continues to be disputed in other social settings.

All of this is relevant in a world where some people denounce "fake news" or defend "alternative facts," even as others pound the table and insist that the facts are on their side. Declaring that something is a fact hardly guarantees that debate will disappear, and often people on opposing sides of a debate insist that their views are the ones actually founded on facts.

Measuring Involves Making Decisions

When numbers appear in discussions of public issues and public policy, they almost always involve attempts to measure what is occurring. We are used to reifying these numbers; we talk about the crime rate or the unemployment rate as though they are straightforward facts, accurate statements about the amount of crime or unemployment. In so doing, we tend to gloss over the rather messy procedures used to create those numbers. Assume we want to measure the extent of crime. Before we can count crimes, we must first define just what we will consider criminal. Notice that many crimes are hidden because people try to conceal the crimes they commit, and we lack any sort of platform from which we can omnisciently identify every crime that has occurred. The Federal Bureau of Investigation (the agency that calculates the crime rate) gets around this problem by surveying local law enforcement agencies and asking them how many instances of particular crimes (such as criminal homicide and forcible rape) in their jurisdiction came to their attention during the previous month. In other words, the crime rate is actually the rate of crimes known to the police, and there are other issues: not all law enforcement agencies report their data to the FBI, there are occasional scandals revealing that an agency has deliberately underreported crimes, and so on.

Every effort to measure social conditions has analogous limitations.[4] A long series of choices shapes whatever is being counted and how the counting occurs. When we talk about the resulting numbers as facts (e.g., equating the crime rate with the amount of crime), we ignore the very real processes by which those numbers are socially constructed, and the inevitable flaws and limitations in the results.

In the case of COVID-19, measurement choices are complex. News coverage tends to highlight two sorts of statistics: the numbers of cases, and the numbers of

[4] There are large social science literatures discussing the limitations that lead to inaccuracies in crime rates, unemployment rates, the census, and so on. For an introduction to some of these issues, see Nagaraja (2020).

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deaths. Alas, neither of these is at all straightforward. Koerth et al. (2020) offer a basic formula for calculating the number of deaths from COVID-19:

size of susceptible population x infection rate x fatality rate = total deaths

However, this formula is deceptively simple. There is evidence that susceptibility varies wildly by age, gender, social class, and individual health factors, so that any effort to measure the susceptible population must weigh the proportion of people in different risk groups. The infection rate is and will remain uncertain until effective, systematic testing methods are available; while people who exhibit the most severe symptoms are likely to seek medical care and be noticed, other infected people may have moderate or mild symptoms—or no symptoms at all. And until we have a clear sense of the infection rate, it will be impossible to calculate an accurate fatality rate.

Early attempts to measure the disease tended to involve small-scale, localized studies (on a cruise ship or in a city or some other geographic area), and these led to very different estimates for both infection rates and fatality rates:

> The data on Covid-19 differs wildly from country to country. Look at the figures for Italy and Germany. At the time of writing, Italy has 69,176 recorded cases and 6,820 deaths, a rate of 9.9 per cent. Germany has 32,986 cases and 157 deaths, a rate of 0.5 per cent. Do we think that the strain of virus is so different in these nearby countries as to virtually represent different diseases? Or that the populations are so different in their susceptibility to the virus that the death rate can vary more than twentyfold? If not, we ought to suspect systematic error, that the Covid-19 data we are seeing from different countries is not directly comparable. Look at other rates: Spain 7.1 per cent, US 1.3 per cent, Switzerland 1.3 per cent, France 4.3 per cent, South Korea 1.3 per cent, Iran 7.8 per cent (Lee 2020a).

Undoubtedly this discrepancy will all get sorted out over time, but in the short run, measurements have produced limited and contradictory information. This is important because efforts to model the course of the disease inevitably require plugging best-guess estimates of these various factors into their formulas; depending on which estimates are chosen, the models' forecasts can be very different, and they can change from day to day as new data become available.[5]

[5] The COVID Projections Tracker (2020) is an online tool that makes the day-to-day changes in model projections visible. For instance, at the time I wrote this paper, the University of Washington's Institute for Health Metrics and Evaluation (the IHME, whose model was frequently cited by the media) projections for the death toll had ranged from 60,307 (on April 16) to 93,762 (on March 31). As states began relaxing their social distancing earlier than public health officials recommended, the IHME estimates rose markedly. See also Best and Boice (2020).

Counting Is Not Straightforward

Precisely because so much about COVID-19 is unknown, the most authoritative numbers tend to come from the records kept by established bureaucracies, in particular, medical records and death records. These records are health-system choke points even in normal, non-pandemic times; that is, it is relatively easy to get fairly accurate counts of the cases that appear at these points in the system. At least in theory, everyone who becomes very sick should wind up seeing a doctor and being admitted to a hospital (institutions that keep records), and all fatalities should be recorded in death certificates. This reasoning is why the news media focus on the number of cases (i.e., the number of people being treated for COVID-19, which, in practice, means the number who have been admitted to hospitals) and the number of deaths attributed to the disease. (Things haven't changed all that much: recall Defoe describing Londoners relying on the bills of mortality's burial records to track the plague's spread.) At first glance, depending on the number of cases and the number of fatalities might seem commonsensical, but any time we count anything, we are inevitably forced to choose—to decide what to count and how to go about counting (Stone, in press).

So what is a COVID-19 case? In many places, being counted as a case requires being admitted to a hospital, tested, and identified as someone infected by COVID-19. Defining cases this way is bureaucratically convenient: we presumably know how many hospitals there are, we can arrange for them to cooperate in reporting the cases they identify, and the people who are to be counted arrive on site. The problem is that counting patients in hospitals inevitably undercounts the actual number of cases. We know that many people infected with COVID are asymptomatic; that is, they have the virus but not the disease. Others have mild or moderate cases; they feel sick, even quite sick, but are discouraged from seeking hospital care unless they experience serious difficulty breathing. Still others—particularly in the US—may be very sick but lack health insurance, so are reluctant to present themselves for treatment.

All of this means that using the number of patients in hospitals to count cases will severely underestimate the extent of the problem. The solution—and there is widespread agreement on this point—is to have testing programs that can identify infected people so they can be isolated before they infect others. The problem is that tests have been in short supply, causing different localities to adopt different procedures for deciding who gets tests, which in turn affects the numbers of cases identified (Silver 2020). Without widespread testing using a standard protocol, the numbers of cases reported are likely to undercount the extent of the disease.[6]

[6] Because testing covers only small, usually nonrandom samples, there are efforts to devise more

What, exactly, is a COVID-19 death? We may imagine a case—call him "Adam"—who gets very sick, is tested, and is found to be infected with COVID-19. He is admitted to the hospital, succumbs, and winds up with a death certificate that lists COVID-19 as the cause of death. Adam's case represents the circumstances that are most likely to be accurately counted. But what about Betty and Carl, both residents in nursing homes who have long lists of serious chronic health problems such that they are already near death, and who become infected with COVID-19? Perhaps Betty's death certificate mentions COVID-19, but Carl's does not (Perls 2020). And what about Doris and Edward, elderly people living alone who become infected and are discovered dead in their homes—perhaps Doris's body is tested and the death is attributed to COVID-19, while Edward's death is assigned some other cause? And so on. These examples suggest that COVID-19 death tolls are almost certainly undercounts (Koerth 2020), just as the crime rate inevitably undercounts the actual number of crimes.

At the same time, it is also possible for overcounting to occur. Perhaps a hospital's deaths are accidentally counted twice in tallying total deaths in a state, or:

> Consider some examples: an 87-year-old woman with dementia in a nursing home; a 79-year-old man with metastatic bladder cancer; a 29-year-old man with leukaemia treated with chemotherapy; a 46-year-old woman with motor neurone disease for 2 years. All develop chest infections and die. All test positive for Covid-19. Yet all were vulnerable to death by chest infection from any infective cause (including the flu). Covid-19 might have been the final straw, but it has not caused their deaths (Lee 2020b).[7]

Common sense tells us that death is an absolute, something that seems like it ought to be easy to count, but every count depends on the choices made. Even if a bureaucracy establishes a clear definition of what counts as a COVID-19 death and a set of procedures that ensures that definition is implemented in a thorough and evenhanded manner, there is no reason to assume that the authorities in other jurisdictions will use the same definition or procedures (Brown et al. 2020). Moreover, as concern about an epidemic increases over time, the definitions and procedures for recording deaths often change, making it difficult to compare counts across time.

So far, I have been arguing that even people of good will can mess up counting. Beyond that, there are cases of intentional underreporting, attempts to disguise how bad things are. The most glaring example involves China, where

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representative methods, such as sampling DNA samples from wastewater and determining which proportion show evidence of the disease (Chakradhar 2020). Kaplow (2020) is an example of calls for randomized testing.

[7] The numeracy literature tends to speak of undercounting and overcounting as false negatives and false positives (Boersma and Willard 2008).

COVID-19 originated. While the Chinese government did announce that the coronavirus was spreading, there is considerable evidence that their reports downplayed the extent of the problem (Associated Press 2020; Bloomberg 2020; Davidson 2020). In addition, the World Health Organization seems to have uncritically accepted China's reporting and delayed announcing that there was a "public health emergency of international concern" until January 30 (Feldwisch-Drentrup 2020). Similarly, other authoritarian regimes have produced dubious reports (e.g., North Korea continued insisting it had no COVID-19 cases long after both China and South Korea acknowledged that the disease was in their countries) (Walsh 2020). And, as weeks went by and the debate about rolling back social distancing became more intense, there were complaints that officials in some US states were defining cases in ways that would increase or decrease their numbers (Koerth 2020).

One way to try to grasp the extent of undercounting is to compare the acknowledged COVID-19 death toll with the ordinary number of deaths in the same jurisdiction during the same time of year. Say that records show that a place routinely has around 500 deaths during the first week in April, and there were 1,000 deaths that week during the spread of the virus; this suggests that COVID-19 increased the death toll by 500 deaths. Once people began to examine such data, it became clear that the level of undercounting was significant (Giles 2020; Wu and McCann 2020; Wu et al. 2020). In some cases, there were efforts to correct the undercounts by retroactively reclassifying causes of death (Goodman and Rashbaum 2020).

All Comparisons Involve Choices

It is often hard to know what to make of a number. Is it large or small? Ordinarily, placing a figure in some interpretive context requires making some sort of comparison. In the case of COVID-19 numbers, three sorts of comparisons predominated: comparisons with other epidemics; comparisons across geographic units, such as countries, states, or cities; and comparisons with other causes of death.

Comparisons with Other Epidemics

Epidemic diseases are not uncommon. Just since the year 2000, Americans' attention has been drawn to SARS (2003), H1N5 flu (2005), H1N1 flu (2009), West Nile virus (2012), MERS (2013), Ebola (2014), and Zika virus (2016) (David J. Sencer CDC Museum 2020). US media, particularly in the cases of H1N5 and Ebola, treated these as major threats (Best 2008). Dozens of other disease outbreaks occurred in other countries (World Health Organization 2020).

Yet, with the exception of the flu, which circulates in new variants each year, none of these epidemics claimed many lives in the US.

The last major epidemic to cause widespread deaths in the U.S. was the so-called Spanish flu of 1918–20 (Barry 2004). It killed more—perhaps hundreds of thousands more—than half a million people in the US, and over 100 million worldwide. But of course, the medicine of 100 years ago was markedly less effective than it is today, so it is hard to compare the terrible devastation of the 1918 pandemic with what is likely to happen with COVID-19. Similarly, it is always possible to go further back into the historical record, as I have done by making comparisons with Defoe's account of the 1665 plague. History offers all manner of examples of terrible epidemics, such as the Black Death of the mid-fourteenth century, but again, living conditions, transportation, and medicine were vastly different in earlier eras. It is hard to conclude much from these examples, except we may find comfort in the realization that, although modern transportation has enabled COVID-19 to span the globe with astonishing rapidity, it is unlikely to kill anything like the number of victims in earlier epidemics.

Comparisons Across Geography

Commentators on COVID-19 have made far more use of comparisons among countries, states, or cities, easily accomplished because the agencies that keep records on cases and deaths have responsibility for counting events in their jurisdictions, and researchers are almost certain to sample cases from particular places. In addition, public policies for dealing with COVID-19 usually involve government officials establishing rules for the areas they administer, and these rules often vary both in their timing (i.e., how soon the policies were implemented after the first local infections became known) and their stringency (i.e., both the policies' range and their enforcement can vary).

These various policies create what amount to natural experiments. If Location A took action early (by closing schools, businesses, etc.) while Location B took much longer to act, these differences might be expected to have effects on how widely COVID-19 could spread, how much difficulty hospitals would have dealing with the increase in patients, and the number of deaths in each location. Commentators devoted a good deal of attention to such comparisons. For instance, US state governors were praised or denounced for their actions (Scher 2020). Similarly, some countries adopted stricter policies, sometimes much earlier in the disease outbreak. At least in the early weeks of the epidemic, taking action quickly seemed to be fairly effective in minimizing the spread of the disease (Glanz and Robertson 2020).

Comparisons with Other Causes of Death

COVID-19 can be lethal, of course, and the media constantly updated death tolls. But how big a deal is COVID-19? After all, lots of people die every year. In 2017 (the most recent year for which complete data are available), more than 2.8 million people died in the US, and about 56 million worldwide (Kochanek et al. 2019; Ritchie and Roser 2019). While I was drafting this paper, the global death toll surpassed 200,000, of which more than 50,000 were in the US—and of course those figures will have certainly increased by the time anyone reads this. But do those death tolls suggest that COVID-19 is a big problem, or a relatively minor matter?

While the alarming tone of media coverage might make it seem obvious that the coronavirus is a big deal, some commentators sought to downplay its large-scale significance. This was particularly true during February and early March, when the US death tolls were still very low, and there were even claims (not, to be sure, by medical authorities) that the final US death toll might be in the hundreds. Compared to the nearly three million deaths occurring each year in the US, a death toll of 50,000, or 100,000, or even 200,000 might be seen as a relatively small increase. After all, the flu kills tens of thousands of Americans each year, and traffic accidents nearly 40,000. While we encourage people to buckle up and get a flu shot, we see flu and traffic fatalities as ordinary, routine causes of death, inevitable costs of living a large, complex society. We don't implement social isolation policies for the flu each year, so is it really necessary to take drastic measures to fight the apparently more-or-less equivalent threat of COVID-19?

The answer, of course, is that the death toll during the first few weeks after the sudden onset of the coronavirus and the annual tallies for deaths attributed to flu or traffic fatalities are not really comparable (Faust 2020; Schulman et al. 2020). Traffic fatalities are spread out over 52 weeks, averaging roughly 700 deaths per week; after about only nine weeks, COVID-19 deaths far exceeded the annual traffic death toll. Once we compare death tolls from different causes for, say, a given week, the impact of the coronavrius becomes apparent: during the week of April 6–12, COVID-19 killed more Americans than cancer (usually the second leading cause of death), and nearly as many as heart disease. The threat varied from place to place: in New York, Louisiana, and Washington, D.C., COVID-19 was the leading cause of death for that week; it killed more than ten times as many people as heart disease in New York City (Keating and Esteban 2020).

The other feature of COVID-19's spread is its dramatic increase in cases. While there may be minor season fluctuations, deaths from heart disease, cancer, and traffic accidents are spread more or less evenly across the year. In contrast, there were markedly more COVID-19 cases and deaths in each successive week

as the disease spread. The great danger, of course, was that serious cases would outpace the capacity of hospitals and medical professionals to provide the needed care. This process was slowed only with the implementation of social distancing measures. Moreover, until there is an effective vaccine for COVID-19, it is likely that, when social distancing is relaxed, there may be successive outbreaks that will require again tightening social distancing.

In short, the dynamics of an epidemic make it very difficult to make comparisons with the usual causes of deaths.

Social Patterns Shape Numbers

Early discussions of COVID-19 tended to gloss over how the epidemic was shaped by social patterns, but by late April, a good deal of commentary focused on ethnic differences. That is, it became clear that African Americans and Latinos accounted for a much larger share of cases and deaths than their proportions in the population (Daniels and Morial 2020). This almost certainly had nothing to do with inter-group biological differences. Rather—as is so often the case—ethnicity served as a proxy for thinking about social class. Our readiness to focus on ethnicity—rather that class—reflects the presence of established groups of advocates committed to drawing attention to the inequities of ethnicity in our society, the terrible practical problems involved in measuring social class, and Americans' distaste for talking about class and their casual acceptance of racial classifications.[8]

Class is important because it shapes susceptibility to disease generally, and COVID-19 particularly. Those with higher incomes have better access to health care in the US, they have lower risks (e.g., they are less likely to smoke, and their work is less likely to expose them to health hazards), and as a result they have longer life expectancies. Those with lower incomes are more likely to have chronic health problems such as heart disease, lung disease, and diabetes that make them more vulnerable to COVID-19. They also tend to live and work in more crowded conditions that make social distancing more difficult.

News coverage tends to draw attention to atypical cases, such as reports of celebrities sick with COVID-19, and it often treats infection as a purely biological process while ignoring its social context. But epidemics do not spread evenly through societies; they routinely disadvantage the poor (Hays 2009). Defoe noted

[8] This is, as an anonymous reviewer points out, a complicated issue. Both race and class are of course multi-faceted and socially constructed and have inspired vast social scientific literatures. My point—and here I agree with most COVID-19 commentators—is that the disadvantaged positions of ethnic minorities (their occupations, their residential areas, their access to medical services, and so on) are fundamentally about their place in the economic order, i.e., their class.

that the Londoners who could afford to do so tended to leave the city in 1665, just as contemporary observers warn that those who were most vulnerable when the COVID-19 epidemic began could be expected to bear a disproportionate share of the risks as society tried to relax social distancing measures (Lane 2020). Raw numbers, such as total cases or total deaths can obscure such social patterns.

The Relevance of COVID-19 for Numeracy

When advocates promote numeracy, they often emphasize the need for citizens to have a grasp of mathematics and statistics:

> Quantitatively literate citizens need to know more than formulas and equations. They need a predisposition to look at the world through mathematical eyes, to see the benefits (and risks) of thinking quantitatively about commonplace issues, and to approach complex problems with confidence in the value of careful reasoning (Steen 2001).

And yet, because many of those most concerned with numeracy or statistical literacy are mathematics or statistics educators, they tend to define innumeracy in terms of an inability either to understand mathematical concepts, or to apply what is learned in math classes to real-world problems. Thus, we are warned that many people, faced with the need to paint a room of known dimensions, and knowing how many square feet a gallon of paint should cover, still cannot figure out how much paint they need to buy to do the job.[9]

COVID-19 clearly presents a major challenge to citizenship. It is important that people understand the scope and nature of the problem, and that they can use that knowledge to guide their behavior. And just as in Defoe's plague year, this knowledge involves trying to interpret numbers that reveal what's going on. There is some evidence that some quantitative arguments have been fairly widely understood: the importance of "flattening the curve" has been repeated enough that opinion polls suggest that a substantial majority of the population supports the need for social distancing policies (Kirzinger et al. 2020). However, the discourse that surrounds this issue is confused because not everyone can agree on the facts. There are multiple contradictory rumors, and the nature of the most common indicators is not well understood.[10] While some of these problems may

[9] There are even more fundamental ways to misunderstand numbers. There are many different known coronaviruses. Some commentators—including a prominent conservative talk-radio personality and a member of the White House staff—misunderstood the label *COVID-19* to mean that this was the 19th coronavirus to have been discovered and reasoned that, since the previous eighteen had no memorable impact, fears about COVID-19 must be exaggerated. Of course, the designation *COVID-19* actually refers to the fact that the virus was identified in 2019.

[10] Rumors and other misinformation related to epidemics are common (Kitta 2019). Defoe refers to rumors at several points. In particular, the claim that the COVID-19 virus had originated in a

involve some mathematical confusion, most of them also involve a fundamental failure to understand and appreciate how claims about COVID cases, COVID deaths, and so on are socially constructed. Teaching numeracy cannot be understood only as a mathematical project that can ignore the way numbers are brought into being.

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