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Knowledge, ignorance and the popular culture: climate change versus the ozone hole

Sheldon Ungar

This paper begins with the “knowledge–ignorance paradox”—the process by which the growth of specialized knowledge results in a simultaneous increase in ignorance. It then outlines the roles of personal and social motivations, institutional decisions, the public culture, and technology in establishing consensual guidelines for ignorance. The upshot is a sociological model of how the “knowledge society” militates against the acquisition of scientific knowledge. Given the assumption of widespread scientific illiteracy, the paper tries to show why the ozone hole was capable of engendering some public understanding and concern, while climate change failed to do so. The ozone threat encouraged the acquisition of knowledge because it was allied and resonated with easy-to-understand bridging metaphors derived from the popular culture. It also engendered a “hot crisis.” That is, it provided a sense of immediate and concrete risk with everyday relevance. Climate change fails at both of these criteria and remains in a public limbo.

1. Introduction

Having done research on climate change since 1988, I routinely bring it up in conversations pertaining to “strange weather.” Such events seem to have become more commonplace, and whenever I suggest that the climate might be changing, others who know of my research interests almost invariably ask the same question: “Is global warming real?”¹ I hedge in answering, allowing that the vast majority of physical scientists in the area believe it is. My interlocutors usually have little of substance to add. And I am forced to admit that after a decade of clipping articles from *Science* and *Nature*, my sense that climate change is real ultimately boils down to picking the experts you think you can trust.²

Not only is it a daunting task for members of the public to go beyond simple recognition of the issue and grasp some of its scientific underpinnings, but the venues for doing so are quite limited. Excepting perhaps the *New York Times*, few of the other mass media provide sufficiently accurate, detailed, sophisticated, or concerted coverage to take someone much beyond simple awareness of the issue.³ For those willing to take the initiative, there are books, films and Internet sites that afford a “social scientific” perspective on the issue. That is, a passable grasp of the main scientific claims can be found. However, people remain utterly dependent on experts for evaluating the global circulation models on which the whole game is predicated. As Stephen Schneider put it, climate change mainly exists in the silicon chips of supercomputers.⁴

Implicit in the preceding discussion is a model that reverses the conventional approach to knowledge. Rather than starting with any expectations about the knowledge that the public

should possess, it takes ignorance as the starting point and the norm. Ignorance in this context is not just a presupposition, but a social fact that can be deduced, observed and explained. Indeed, the theoretical unfolding of what is termed the “knowledge–ignorance paradox” implies that pockets of observed public knowledge are exceptional and require specific explanation. The public’s grasp of scientific knowledge in particular is anomalous. Metaphorically at least, scientific issues that manage to break through the veil of ignorance are akin to beacons that spark obsessive interests or distress signals.

This paper first explicates how the explosion of knowledge gives rise to a knowledge–ignorance paradox. It then outlines the roles of personal and social motivations, the public culture, and technology in establishing consensual guidelines for ignorance. The upshot is a sociological model of how the “knowledge society” actually militates against the acquisition of scientific knowledge. Given this backdrop, it tries to show why the ozone hole was capable of engendering *some* scientific understanding and public concern, while climate change has not achieved a breakthrough in scientific comprehension. The ozone hole operated as a beacon for two reasons. First, it was allied and resonated with easy-to-understand bridging metaphors derived from the popular culture. Second, it engendered a “hot crisis.” That is, it provided a sense of immediate and concrete risk with everyday relevance and strong emotional overtones. Climate change fails at both of these criteria and remains in a public limbo.

2. The knowledge–ignorance paradox

Rapid developments in the quantity and complexity of information have occurred in practically every field of human endeavor.⁵ So great has been this growth that efforts to locate either a “primary information sector” in the economy or to form a typology of “information occupations” become so extensive as to be uninformative.⁶ There has also been a “technization” of work, whereby computerization leads to increased emphasis on the “creation and manipulation of symbols to work on things.”⁷ Many specialty domains face what amounts to exponential growth in the volume and complexity of information.

Informational explosions spread throughout the economy affect not only what people know, but the social distribution of ignorance as well. Martin Bauer employs the notion of a knowledge–ignorance paradox to capture how the growth of specialized knowledge implies a simultaneous increase in ignorance.⁸ Julius Lukasiewicz observes that exponential growth in the volume and complexity of information creates the prospect of “instant antiquity.” In addition, one’s degree of grasp (the ratio of information the human intellectual can handle to the volume of information available) “is quickly diminishing while one’s [degree of] ignorance is on a fast rise.”⁹

Significantly, these analyses do not make the mistake of treating ignorance as the mere statistical flip side of knowledge. Analyzing the distribution of the former rather than the latter highlights different questions, since an overall rise in ignorance does not indicate how it is constructed and distributed. Thus ignorance can be intentional or willful, a kind of refusal to know specific things.¹⁰ While it is common to develop links between knowledge and the culture and technology of virtual reality, I reverse this copula and develop a sociology of ignorance in a culture of virtual reality.¹¹

We begin with occupations. Role-incumbents in many specialized knowledge domains may well feel besieged, although the extent of this will depend on the strategies used to manage information pressures. Contrary to expectations, experts do not always optimize their use of knowledge. Despite the fact that more women die of cardiovascular disease than any other cause, a recent poll of family physicians revealed that 64 percent do not know that the symptoms of heart disease differ in women and men.¹²

Rather than simply falling behind, a more general strategy is to increasingly constrict defined areas of specialization. What was noted about nuclear physics in the 1940s—professional talk could not be conducted with colleagues in adjacent offices—has extended to other realms of knowledge.¹³ As specialized knowledge domains are becoming ever more onerous, experts are becoming more ill informed about related knowledge domains.

Assuming that human information processing capacity is more or less fixed, increases in the time and (personal) memory demands imposed by the need to keep up in one's field serve to reduce the time and memory available to assimilate other information. Hence the specialized knowledge–ignorance paradox predicts a decline in the stock of general information and knowledge. The implications of the knowledge–ignorance paradox, however, go beyond the specialization pressures that can besiege occupational role incumbents. Whether the knowledge demands of one's own occupational role are onerous or not, increases in the volume and complexity of information have escalated the entry costs to virtually every other knowledge domain.

Research on the knowledge gap hypothesis reveals that prior knowledge in an area is critical to understanding and assimilating new information in that area.¹⁴ Starting with conceptual anchors for framing information, the gaining of knowledge in a field tends to follow a spiral model, with new bits added to prior accumulations. But the narrowing and differentiation of specialties means that the sheer number and diversity of conceptual anchors continue to multiply. As proliferating technical terms and ideas (or what librarians call “twiggings”) are overlaid with new facts and frequent revisions, specialty knowledge domains become forbidding to outsiders. All but the most persistent non-specialists are effectively precluded from keeping up with developments.

The entry cost hypothesis is not limited to individuals, however. Escalating entry costs impact on the public culture in at least two ways. First, the media, as purveyors of information, must take cognizance of the common information resources and probable motivations held by their audience. For the most part, the anchoring concepts and operative “grammar” in any domain (such as the logic of experimentation or of microwave communication) fall beyond the resources that audiences can be expected to have. And while it is easy to recommend that the media educate the audience, limitations in their resources to convey information (from time constraints through accessible and lucid experts) coupled with limited audience forbearance render the advice simplistic. To be understood and retain an audience, the media must either avoid many topics or treat them in a superficial way.

At a second level, inflated entry costs put a damper on specialty knowledges as conversational topics. The importance of talk is underscored by evidence indicating that people learn more from others than from any other source of information.¹⁵ Talk, however, is a social accomplishment that is facilitated by tacit agreements not to threaten the face of others.¹⁶ Whether it deals with weighty matters or not, most talk is overlaid with expressive rituals, as people seek to negotiate compatible identities and reciprocal acceptances. But it is difficult for people to enact such rituals on topics they know nothing or next to nothing about. For the most part, they are better served by withdrawing from the conversation. The upshot is to erect *speech barriers* as more and more subjects become too specialized for ordinary discourse.

Overall, then, the specialty knowledge–ignorance paradox fosters narrowly constituted communities of experts whose arcane bubbles of shared knowledge overlap minimally with others. The sheer weight of informational pressures at work, accompanied by heightened entry costs and speech barriers in other knowledge domains, render spaces of ignorance pervasive. However, ignorance and knowledge are not just randomly distributed. Both the popular culture and technological developments endorse some kinds of information more than others do. They

also help set consensual arrangements for being ignorant. Here we examine the roles of personal and social motivations, the public culture, and technology in structuring the pool of general knowledge. The ultimate aim is to show how these processes militate against scientific knowledge in particular.

3. Motivations for knowledge and the popular culture

With specialized occupational knowledge, external constraints typically provide a strong motivation to keep up with informational demands. This is not to gainsay a sustaining role to personal motivations. However, it does throw into relief differences between occupationally based specialty knowledges and the more general pool of information. In the latter case, motivations are more diverse and often less compelling. There is also a far wider pool of information, and people must deploy their attention even more selectively. Since they need to strike a balance between knowledge and ignorance, an ecological competition for attention between different domains of knowledge can be said to exist.¹⁷ Here we examine how personal and social motivations, as well as technological developments, impact on the types of knowledge people are likely to acquire (what are termed celebrity facts) and those they are likely to avoid, resist, or overlook.

We begin with personal motivations. The Aristotelian claim that people have an innate desire to be informed is not supported by extant research. Studies reveal that less than 10 percent of the population qualify as well-informed “cosmopolitans” or highbrows.¹⁸ Even fewer appear to meet the criteria for scientific literacy.¹⁹ For most issues, the broad public is at best semi-attentive, and more often inattentive. At the bottom, there is a sizable stratum of “know-nothings.”²⁰

If sheer fascination with knowledge provides little explanatory leverage, we know less about the converse motivation: the acquisition of knowledge for its pragmatic uses. As consumers of goods and services pertaining to diet and household products, health care, insurance, investments, and so on, there are presumably good reasons to be informed. More specifically, given the costs of acquiring (pragmatic) knowledge, it is hypothesized that information is obtained on a “need-to-know” basis. Thus, asthma is not a pragmatic need-to-know issue when no one you care about is asthmatic. In this case, the cost of obtaining knowledge is generally too great given its lack of immediate relevance. Unfortunately, most research on practical issues uses representative samples and does not differentiate need-to-know learning from the acquisition of general knowledge.

A third motivation is what can be termed “good citizenship knowledge.” Whether it is a platitude or not, the citizens of democracies are expected to be informed so they can make intelligent inputs (however indirectly) into decision-making processes. Much of the extant research is cast at the level of citizenship knowledge and focuses on topics that include history, politics, science, and technology. Most studies in this domain find significant gaps between research expectations and the public’s grasp, and typically deplore public ignorance.²¹

Whatever the theory, in recent years the organizations and institutions charged with the task of upholding the model of the well-informed citizen have been increasingly under assault. Museums and art galleries, libraries, public broadcasting, the arts, and universities have suffered deep cutbacks in public funding.²² Both knowledge specialization and economic disincentives have largely driven the public intellectual out of business.²³ As public discourse points to the economic challenge of globalization and the need for job-related skills, evidence suggests that the ideal of the well-informed university graduate is being subverted by a business-school orientation and the commercialization of universities.²⁴

The fourth and most important motivation deals with the social utility of knowledge or

information. Rather than focusing on what knowledge individuals have mastered, it asks what information is in demand in particular social situations? For most persons without a calling for knowledge, the social value of information is primary. For them, information is mostly a conversational resource. In this context, Randall Collins emphasizes how much of social interaction is made up of and depends on ongoing conversation.²⁵ Social structure is animated, realized, and reproduced in talk.

The conversational utility of knowledge moves the issue from within the individual into the realm of popular culture. In tandem with the institutional devaluation of the ideal of the well-informed citizen, it has become commonplace to observe that the popular culture increasingly depreciates the intellect and fosters an egalitarian, anti-elitist conversational ethos.²⁶ Commentators note that there has been a leveling that denigrates “credentialed” talk and cultivates commonplace knowledge built on what amount to, for present purposes, celebrity facts.²⁷

While anti-intellectualism is not a new phenomenon,²⁸ it has reasserted itself in a more virulent form for economic, political, and technological reasons. Sociological analyses suggest that public resentment has increased as power and wealth have been accrued to a relatively small elite with highly specialized and valuable knowledges. This new elite has created resentment because it justifies large income inequalities on the basis of its knowledge and, unlike its predecessors, has assumed little social responsibility.²⁹

When this resentment is coupled with a growing distrust of politicians, the media, public institutions, and many experts, scientists included, for their perceived distortions and duplicities, it further diminishes the social value of the “truth” and the obligation of being knowledgeable.³⁰ As digital technology undermines the distinction between the real and the unreal, one can invoke claims of deception or conspiracy to warrant a lack of interest in many things.³¹ Not only can images be altered or fabricated in spectacular ways, but also the Internet teems with so many competing claims and myths that the public has little shared basis for assessing evidence.

Beyond such distorting effects, new technologies have had a signal impact on the types of information people are likely to encounter and to find in demand in mundane conversations. As a result of the symbiotic maturing of a number of technologies—television, video, computers, the Internet, the World Wide Web—the core constituents of the popular culture are now so prominent, omnipresent, and omnivorous that they can be considered hyper-realities. Whereas museums and other markers of cultural and scientific literacy are typically of intermittent interest and presence, through a combination of technology and social organization, “the urban surface is a continuous screen, or a series of overlapping screens, onto which representations are projected.”³² T-shirts, hats, shoes, backpacks, beach towels, billboards, posters, postcards, “collectable” cards, calendars, mugs, candy, cartoons, magazine and newspaper articles, talk shows on television, advertisements, films, the Internet, video games, toys, chain restaurants, and even schools and universities, all provide screens for displaying the celebrity facts that dominate popular culture.

By means of its unavoidable hyper-presence, the popular culture becomes familiar by osmosis. It is literally “in the air,” and all but unavoidable. Significantly, there is systematic evidence showing that highbrow Americans are increasingly imbibing elements of popular culture.³³ There has even been a “Disneyfication of Catholicism,” as the Church has signed off on joint ventures with corporations like IBM and licensed the image of the Pope for mugs and the like.³⁴

4. Science and the attention economy

The preceding analysis aims to afford a grasp of the attention economy in which scientific claims must compete. For the general public, science is likely to be relevant for two of the four knowledge motivations discussed above. Scientific knowledge has a pragmatic dimension, encompassing phenomena like diet, health, safe-sex practices and so on. Perusal of the few studies that examine scientific knowledge on a need-to-know basis reveals a limited grasp of the key facts. Specifically—and quite surprisingly—researchers have found that most smokers do not recognize that they are at increased risk for some cancers and for heart disease.³⁵ Other researchers report that few sexually active teenagers are aware of the risks of contracting a range of sexually transmitted diseases.³⁶

Scientific literacy is also central to the ideal of good citizenship. Issues like cloning, nuclear waste, fluoridation of water, and pesticides have achieved celebrity standing in public arenas. Scientific literacy for citizens is generally defined in terms of three criteria: understanding the scientific approach, understanding basic scientific concepts, and understanding scientific and technological policy issues.³⁷ As previously noted, the preponderance of the evidence suggests that the public perform poorly on all three of these criteria.³⁸ Depending on the specifics of the research, between five and 15 percent of the public qualify as scientifically literate. Researchers regard such findings as worrisome and typically raise questions about the adequacy of the education system.

The specialized knowledge–ignorance paradox provides a more socially embedded explanatory approach to scientific illiteracy. The explosion of work-related knowledges not only increases the overall amount of ignorance, but also the costs of acquiring knowledge in other realms. The previous section outlined how various institutional forces—a long-standing anti-intellectualism, resentment of the educated elite, a generalized distrust of politicians and the media, and cutbacks to knowledge-bearing organizations—have helped discredit the idea of being knowledgeable. Added to this discredit is an attention economy that puts a premium on visual images associated with entertainment or, at best, “infotainment.” Both broadcast effects (television, film) and public self-selection effects (T-shirt icons, video rentals, and individual home pages on the World Wide Web) overwhelmingly favor an entertainment economy based on celebrity facts.³⁹

The screens on which the popular culture is exhibited can, theoretically, encompass almost anything. Thus computers have rendered informational graphics—maps, charts, diagrams—relatively uncomplicated and commonplace. But such graphics make up only an infinitesimal part of the content carried on these screens. Rather, the images that predominate on these screens derive from a popular culture that aims to be readily accessible to everyone. Through its relentless and “fetching” presence, the popular culture serves as a ready-made, comfortable, and relatively non-threatening resource for conversation.⁴⁰ Virtually everyone can join discussions, leaving “experts” without any trump card. And despite protestations that the elements of popular culture are debased, trivial, or short-lived,⁴¹ they provide the connective threads of information and conversation that tie us together. To take one example, AIDS soared on the public agenda following admissions by Rock Hudson and Magic Johnson.⁴²

Science is poorly equipped to compete in the attention economy that has grown up around the popular culture. As an encoded form of knowledge that needs to be decoded to be accessible to the public, scientific understanding occasions high entry costs and speech barriers. Gaining a passable level of scientific literacy is time consuming and challenging. Our analysis of the knowledge–ignorance paradox suggests that what people often lack is the motivation—a payoff for the efforts to gain literacy in a scientific domain. Conversationally, there is little return for being scientifically informed. Indeed, there is evidence suggesting that people are

not particularly impressed by scientific acumen, while little public shame attends admissions of ignorance.⁴³ Complexity (especially mathematical), uncertainty, and competing claims—what often amounts to a “bad news” syndrome—and the greater attractiveness of other, more leveling topics, places a heavy burden on anyone trying to maintain conversational interest on most scientific topics.

The potential for the popular culture to dumb-down conversation can be inferred from research on people’s performance under more ideal conditions. As elaborated below, extant evidence reveals that people have a poor grasp of climate change. But rather than examining what people know, R. Berk and D. Schulman employed quasi-experimental designs to determine the extent to which respondents can learn, assimilate, and use new information.⁴⁴ Specifically, they examined the public’s “willingness to pay” in order to prevent various hypothetical climate scenarios from transpiring. Respondents were provided an exemplar for dealing with this type of problem. The results revealed that respondents were able to digest complex information and make relatively informed decisions—results that fit reasonably with mathematical models derived for payments. In this regard, Willett Kempton and colleagues also found that their respondents could make complex policy inferences that were similar (“at such a high level of detail”) to those made by scientists.⁴⁵

The gap between such sound inferences and the seemingly intractable ignorance about climate change suggests that the underlying problem is not the capabilities of the general public as such. Research subjects, of course, perform in an artificial environment: They are given a very specific task in a context that is presumably motivating and removes competing diversions. In contrast, Russell Neuman summarizes research indicating that people approach their information environment with a “semi-attentive, entertainment-oriented mind-set.”⁴⁶ In a conversation-as-usual context, most scientific issues are fettered by numerous discursive liabilities. But most is not all; and the usual does not always prevail. Here we apply the logic of the attention economy and the popular culture developed above to explain differences in the public reception of the ozone hole and climate change.

5. Comparing the ozone hole and climate change

Research on these two atmospheric problems reveals significant differences in the public understanding of both the basic science and the scientific and technological policy issues involved. Using diverse but nonrandom samples, U.S. research reveals that people have limited scientific knowledge about global warming and tend to confuse it with the ozone hole. As one study concludes:

...our results are consistent with Kempton’s claim that “the ozone hole has arrived as a concept in the U.S. public’s consciousness, but the greenhouse effect is entering primarily as a subset of the ozone hole phenomenon, the closest model available.”⁴⁷

A similar confusion is found in New Zealand, where environmental consciousness is high and climate change portends extreme consequences.⁴⁸

At the policy level, the ozone threat again fares better than climate change. With the former, people grasped the link between ozone loss and both Styrofoam and aerosol cans. Concern generalized to action, as Americans voluntarily switched from aerosol cans, causing a 50 percent drop in their sales even before legislation was enacted.⁴⁹ There were also a number of successful consumer boycotts, notably of McDonalds and of Styrofoam packaging. Still, policy understandings remain limited. Data collected 15 years after the problem first emerged reveal that few Americans connect ozone depletion with air conditioning and refrigeration.⁵⁰

Climate change has fared much worse. Kempton et al., observe that “lay informants had virtually no knowledge of the policies for global warming actually being debated.”⁵¹ Thus not a single respondent mentioned energy efficiency as a possible solution. They also misunderstand the idea of energy efficiency and its ramifications. Indeed, the public has, in tandem with industry, steadily eroded conservation measures created in response to the two oil crises. Statistics reveal that people are driving more, using more gas, and getting lower mileage.⁵² The last statistic is particularly significant, for the fastest growing segment of vehicle sales is in low-mileage vans, sport utility vehicles, and pickup trucks.

The greater public understanding and response to ozone depletion requires explanation. One explanatory candidate that must be considered comes from the agenda-setting hypothesis. More than 25 years of research on this hypothesis demonstrates that the amount of media coverage of an issue is a major determinant of public awareness.⁵³ The public relies on the media for information about scientific issues, and greater coverage heightens the salience of the issue and increases fear of and opposition to the specific environmental hazard.⁵⁴ Events that figure prominently in the media seem to be more “available” or retrievable from memory and are regarded as more “representative” than events that attract less coverage.

Quantity of coverage does not appear to be decisive here. Data presented by Ungar reveal that over the peak of their overlapping issue attention cycles (1987–1991), climate change attracted more than twice as many stories as ozone depletion in the *Readers' Guide to Periodical Literature* and on the evening news broadcasts of the three major U.S. television networks.⁵⁵ While they received about the same amount of coverage in the *New York Times*, climate change averaged more than twice as many congressional hearings and publications as did ozone depletion. Finally, Ungar observes that more prominent scientists and scientific organizations have come out over climate change than ozone depletion. Statements pertaining to the former have been signed by a majority of living Nobel Laureates, and the Royal Society of London broke 300 years of official silence on public topics to issue a warning about climate change. Ozone depletion did not attract laureates or create media stars like Stephen Schneider.

Given this reversal of the conventional media agenda-setting effect, we are left with Kempton et al.'s, explanation for the differential public reactions to the two social problems:

In sum, it appears that Americans are now familiar with ozone depletion, an earlier and simpler concept with fewer causes and fewer consequences than global warming. The assimilation of the greenhouse effect to a model of ozone depletion is an example of *syncretism*, a process often documented by anthropologists in which new information is assimilated to fit existing familiar concepts. . . . But regardless of how we describe it, this lay conceptual problem leads to inappropriate inferences.⁵⁶

While we agree with the general thrust of this analysis, the question of why ozone loss is “simpler” is not addressed. Certainly the public's level of scientific illiteracy is sufficiently high that the chemistry of ozone depletion is no more accessible than the chemistry of global warming. In other words, while global warming is undoubtedly more complex than ozone depletion,⁵⁷ no reason or evidence is adduced to show that the ozone problem is simple—and not just somewhat simpler but still largely incomprehensible.

Given the knowledge–ignorance paradox, the evidence showing low levels of general scientific understanding, and the limited grasp of the ozone problem (i.e., ignorance of the role of refrigeration and air conditioning), the claim that the ozone hole has arrived in the public consciousness cannot be taken as self-explanatory. Rather, such an arrival can be considered an anomaly in the broader context of demonstrated scientific illiteracy. Hence it is necessary to provide an account of how the ozone threat broke through the veil of ignorance, became reasonably understood, and engendered consumer boycotts and other actions. Here we

examine two processes. Consistent with, but more radical than Kempton's use of syncretism, we argue that the availability of cogent templates from the popular culture rendered the ozone problem potentially understandable. These bridging metaphors lowered entry costs and speech barriers, especially since the social problem created the conditions for a hot crisis that served as a beacon and gave rise to a sense of everyday relevance.

6. Bridging metaphors

The signal advantage of the ozone hole is that it can be encapsulated in a simple and widely familiar "penetration" metaphor. Stated succinctly, the hole leads to the increased bombardment of the earth by lethal rays. The idea of rays penetrating a damaged "shield" meshes nicely with abiding and resonant cultural motifs, including "Hollywood affinities." These range from the shields on the Starship Enterprise to Star Wars, which encompasses both the "megahit" movies and the Strategic Defense Initiative. The penetration model is also ubiquitous in video games and children's television shows. In addition, it is allied with a theory that has arguably spawned more public interest than any other recent scientific idea: the claim that an asteroid striking the Earth 65 million years ago caused the disappearance of dinosaurs.⁵⁸

It is these pre-scientific bridging metaphors built around the penetration of a deteriorating shield that render the ozone problem relatively simple. That the ozone threat can be linked with Darth Vader means that it is encompassed in common sense understandings that are deeply ingrained and widely shared. The linkages are also neat, direct, and tightly coupled. The importance of mundane metaphors that ordinary people are able to think with can be seen in a comparison with climate change. The difference can be first grasped in the fundamental metaphor used to frame each problem. It is apparent to anyone that the "hole" is an aberration, something that a protective shield should not have. The greenhouse effect, in contrast, is a benign and essential natural phenomenon. Global warming (or climate change) is an extension of this phenomenon, creating the problem of finding the human "fingerprint" amidst highly variable and complex natural processes.⁵⁹

At a more fundamental level, there are apparently no ready-made metaphors in the popular culture that mesh with and provide a simple schematic for understanding the science of climate change. Even a minimally coherent account of why climate change is a threat involves a series of loose postulates that span several scientific fields and transcend both the public's understanding of science and the information carrying capacity of most of the mass media.⁶⁰ Thus, the model begins with an excess accumulation of various chemicals in the atmosphere (the main culprit, carbon dioxide, was already present at lower levels of concentration); these chemicals lead to the excess trapping of the sun's rays after they rebound from the earth's surface; this leads to forecasts of a several-degree rise in temperature over the first half of the next century; rising temperatures, in turn, lead to predictions of sea level rise and an increase in extreme weather events; and finally, these events are expected to impact on forests, agriculture, and so on, with the bulk of the impacts—but not necessarily all of them—expected to be negative.

In the absence of a bridging metaphor that encapsulates a streamlined version of this model, it is hardly surprising that greater media coverage of climate change noted above has not brought dividends in understanding. Whereas practically every space-based video game deals with the direct and typically dire consequences following from the penetration of shields, there are no games that are even remotely linked to the indirect rebound effects of climate change. To put it somewhat differently, ozone has clear affinities with core elements of the popular culture, while climate change is an "outsider."

7. Hot crises

The greater comprehensibility of the ozone hole probably would not have mattered much if the problem did not operate as a beacon. That is, the attention economy suggests that people are highly selective in the information they take time to process. Bridging metaphors linked to the popular culture afford an opportunity to learn about an issue; but they do not provide the effective motivation to do so. Here we argue that the signal advantage of the ozone hole was that it created the conditions necessary for a hot crisis. As a result of timing and luck, as well as the cultural framing of the problem, the ozone loss gave rise to sense a personal threat with everyday relevance. Climate change, in contrast, is not amenable to bridging metaphors and is sufficiently future-orientated that it is unlikely to create or sustain a hot crisis.

The concept of hot crisis was developed to explain the reaction to Ebola Zaire:

Whereas journalists tend to view crises as any kind of trouble at all, hot crises entail dread-inspiring events that are developing in unpredictable ways and are seen as having the potential to pose an imminent personal threat to specific populations. Hot crises are startling, as presumed invulnerabilities appear to be challenged. A palpable sense of menace puts the issue "in the air," as unfolding events are watched, discussed and fretted over.⁶¹

Ebola engendered a hot crisis as a result of its potent dread factor (gruesome and almost certain death with blood oozing from every orifice) coupled with a sense of personal threat due to the much-touted menace of "instant-distant infections." That is, claims-making about emerging diseases stresses that boundaries are porous and we are just "a plane ride away" from a "chain of lethal transmission." As a result of the coupling of dread and personal relevance, the ozone hole also lent itself to a hot crisis with fertile practical and conversational overtones.

Scientists concerned with the impact of ozone depletion generally hold that the most serious potential impacts of increased ultraviolet radiation are on the human immune system, plant life, and aquatic ecosystems. But these threatened impacts have made little headway in public arenas.⁶² Fortuitously for creating a hot crisis, the principle threat that came to be associated with ozone depletion plays itself out in daily life and the public culture. That is, leakage through the shield is tied to skin cancer, especially melanoma, its most deadly form. The special significance and dread potential of cancer in the public culture is clear. It has garnered a "war," authorized the Delaney Clause banning all food additives that are found to be carcinogenic in laboratory tests, and is the source of exaggerated fears.⁶³ In this instance, timing was superb, as President Reagan had skin cancers removed in 1985 and 1987. These presidential cancers parallel the previously noted AIDS impacts of Rock Hudson and Magic Johnson.

Since the ending of the Cold War erased the major source of anxiety in American society, the public culture has embraced a variety of disasters.⁶⁴ Starting with the revived fascination with the Titanic and extending through new diseases (e.g., mad cow disease), as well as earthquakes, volcanoes, hurricanes and tornadoes, disasters have been commercialized and mythologized in books, movies, CD-ROMs, displays, and artifacts for sale.⁶⁵ Ozone loss meshed nicely with this disaster boom. Not only is it linked to the popular theory that a comet striking earth extinguished the dinosaurs, but it transforms routine exposure to sunlight into a potentially dangerous activity. When the gradual depletion of the ozone layer was supplanted by the unearthing of an unexpected crater, it rendered the progression of the peril unpredictable and ominous. Could the shield disintegrate?⁶⁶

The ozone threat, then, was solidified and concretized by the widespread belief that the thinning of the ozone layer holds everyday relevance for curbing exposure to the sun. Warnings

about (over) exposure became commonplace, especially in family and women's magazines. The problem became a fertile source of interest, anxiety, and practical knowledge and action as it redounded on the need to protect children.⁶⁷ Warnings to avoid the sun between 11:00 a.m. and 4:00 p.m. are obviously unrealistic for children (as well as outdoor workers, boaters and so on). Hence metaphors about "safe sun" were boosted by the growth of a companion industry encompassing sunscreens, lip gloss, sunglasses, UV-safe hats, clothing, umbrellas, awnings, and so on. This commercialization of the threat, with its direct links to advertising, serves to drive home the need for continual vigilance. The inclusion of an UV index in daily weather reports further augments the presence, relevance, and staying power of the threat.

Thus, ozone depletion became an intrusive problem, motivating knowledge on an imperative, need-to-know basis. While no direct evidence is available, it seems likely that the issue of exposure to the sun is one that the public can discuss without feeling overwhelmed or stupefied. Certainly articles and advertisements pertaining to safe sun are concrete and comprehensible, often comparing the ozone layer to a sunscreen for the planet. The sun's rays can often be "felt," and tans and sunburns afford palpable evidence of their (now dangerous) effects. Noticing unexpected tans or burns (following cool or seemingly overcast days, when the sun's rays are not readily felt) brings home the need for vigilance. So too do reports of increased rates of skin cancer plus dire warnings to watch for skin changes and inspect moles.

One indicator of the extent to which this threat insinuated itself into the public consciousness is reflected in the firestorm that the Reagan administration blundered into. Interior Secretary Donald Hodel misjudged the public mood when he advocated a "personal protection" plan in the place of international action on the issue.⁶⁸ Not only was his suggestion immediately mocked (fish don't wear sunglasses), but the gaffe is frequently referenced and is an available tool for building a case for protection of the ozone level.

Climate change, in contrast, is not readily tied to concrete events capable of operating as a beacon or sustaining a hot crisis. Scientists customarily define global warming as a future-oriented problem, with effects predominately predicted for the middle or end of the next century. From the point of view of the attention economy, a future-orientation creates a clear liability. Specifically, concern about the future is discounted in institutional thinking and in virtually every public arena.⁶⁹ So stable and recurrent is this effect that economists routinely devalue the future in their econometric models.

Efforts, of course, have been made to reverse this future orientation and to claim that "strange weather" and the attendant increases in insurance losses are signs that climate change is already occurring.⁷⁰ While extreme weather events serve as the principal public "sign" of climate change, they do not make good candidates for attention-commanding beacons. For the most part, human beings lack the anchoring concepts required to follow and comprehend the scientific logic underlying extreme weather impacts.⁷¹ Scientific predictions that the average temperature may rise two to three degrees Celsius over the course of the next 50 years do not appear overly threatening to North Americans who often experience far larger swings in temperature over the course of a single day.

An even more disastrous problem comes from scientific predictions for the winter. Recent models of climate producing mechanisms lead to predicted increases at both extremes of the climate distribution: Summers could be hotter and dryer, winters colder and wetter. But public understandings are limited to warming, not climate change as such.⁷² Thus, colder winters are thought to belie predictions about global warming, when in fact they are consistent with current models of climate change. Data collected by the author reveal that cartoons pertaining to climate change routinely use examples of extreme cold or snowstorms to mock scientists' claims.⁷³ Similar attitudes are found in articles in *Time* magazine and the *New York Times*.

Confusion about scientific predictions is rendered worse by the efforts of most scientists

to do good science. If global warming was put on the map by the concatenating weather impacts of the summer of 1988, these events also brought a cautionary tale.⁷⁴ Specifically, James Hansen, a leading scientific advocate for climate change, evoked a concerted reaction from the scientific community when he claimed with more than 90 percent certainty that the events of 1988 were the effects of climate change. Since that summer, reputable scientists routinely claim that any extreme impact or extreme weather season cannot be attributed to climate change. Whether intentional or not, this dissociation effect has been abetted by the media. In a study of the U.S. network news, Ungar found no correlation between coverage of extreme weather events (heat waves, droughts, hurricanes, and floods) and stories on climate change.⁷⁵

The hedging and uncertainty that have congealed around climate change contrast sharply with the treatment of ozone loss and skin cancer. The tightly coupled schematic built around the latter is generally presented in the media without qualifications or caveats.⁷⁶ However, the ozone schematic is not immune to criticism. Besides difficulties in measuring levels of ozone loss, the link between it and rates of skin cancer remains unproven.⁷⁷ Indeed, ozone depletion does not provide a unique or indisputable explanation for any increases in skin cancer, since these can also be attributed to changes in lifestyle. But problems in measurement and the use of correlations that might be spurious are disregarded. Overall, it seems that the Hollywood affinities with ozone depletion are so simple, lucid, and tangible that they come close to being regarded as an ontological reality. Altogether, then, ozone depletion seemingly fulfilled the conditions for a hot crisis. With global warming, a future orientation and the absence of bridging metaphors and threats linked to the popular culture effectively preclude such a crisis.

8. Conclusion

This paper develops around the knowledge–ignorance paradox. It starts with the claim that the quantity of specialized information is exploding. The inverse, that ignorance is increasing (or the degree of grasp decreasing), also follows. However, the manner in which this ignorance is socially constructed and distributed is not a given, and the paper goes on to outline the factors that appear to affect the costs and benefits of different types of knowledge. The upshot of these processes is to create an attention economy that favors celebrity facts and militates against the acquisition of scientific knowledge.

Science is an encoded form of knowledge that requires translation in order to be understood. While there is some evidence that people can make reasonable scientific inferences under ideal conditions, there does not appear to be sufficient payoff in day-to-day events and conversation to endure the costs of scientific literacy. Hence—and this is consistent with the bulk of the extant evidence—the paper takes scientific ignorance as the norm and suggests that it is pockets of knowledge that require explanation. To break through the veil of ignorance, scientific knowledge must be motivated.

Taking ignorance as a starting point has a number of research implications. Since this approach assumes that most of the public is not motivated to be scientifically literate, general surveys of scientific literacy are likely to be less informative than studies that approach scientific knowledge from a need-to-know perspective. That is, researchers can identify sub-populations with pragmatic reasons for acquiring a specific body of knowledge and then examine variables related to knowledge. The need-to-know is itself a variable (heart attack victims presumably have more need and motivation for knowledge than those with some history of the disease in their family), allowing researchers to further search for amplification and dampening effects on knowledge acquisition.

The paper also underlines the importance of a comparative approach. The ideas of bridging

metaphors from the popular culture and hot crises seem to apply not only to the two atmospheric issues discussed here, but also to Ebola. The latter spawned an outburst of attention and concern, while diseases like malaria and the resurgence of tuberculosis go largely unnoticed. In the same vein, there has been a strong resistance to genetically modified foods in Europe, with barely a whimper in North America. Again, differences in bridging metaphors and the sense of a hot crisis (encompassing mad cow disease, trust in regulatory authorities, as well as the public roles of celebrities, scientists, and the media) would appear to offer a reasonable start for explaining the differential reactions. Finally, the focus on ignorance raises the question of the extent to which the public actually understands the issues that achieve celebrity standing in public arenas? Since bridging metaphors can be inappropriate or misapplied, the public could very well be concerned but relatively ill informed about such issues.

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