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BUILDING AN INFORMING SCIENCE MODEL IN LIGHT OF FAKE NEWS

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Many disciplines have addressed the issue of “fake news.” This topic is of central concern to the transdiscipline of Informing Science, which endeavors to understand all issues related to informing. This paper endeavors to build a model to address not only fake news but all informing and misinforming. To do this, it explores how errors get into informing systems, the issue of bias, and the models previously created to explore the complexity of informing. That is, this paper examines models and frameworks proposed to explore informing in the presence of bias, misinformation, disinformation, and fake news from the perspective of Informing Science. It concludes by introducing a more nuanced model that considers some of the topics explored in the paper.

SETTING THE STAGE: DEFINING BIAS, MISINFORMATION, DISINFORMATION, FAKE NEWS, AND PROPAGANDA

This paper uses these working definitions of some of the keywords as they will be used in this paper, and by doing so, to present relevant research findings.

- 1) **Informing** occurs when, as the result of the informing process, the informed has a better and stronger understanding of reality. This paper does not concern itself with fideism or psychedelic revelation, for example.
- 2) **The science of misinforming crosses disciplinary boundaries.** Lazer et al.’s (2018) study of the science of fake news, published in *Science*, explored fake news from the disciplinary perspectives of its 16 authors, crossing the boundaries of network science, social science, government, law, political science, informatics and engineering, communications, government, psychology, and journalism.
- 3) **To err is human.** Errors in informing systems are inevitable due to constraints in psychology and technology. Many occur unconsciously on the part of the informer (if there is one) or the informed. One type of these errors is due to bias. Others involve other limitations in human and technological processing of information. Cohen (2000b) outlined four major types of such honest mistakes in informing systems, from transcription errors to solving the wrong problem. Figure 1 summarizes these errors.

Editorial perspective.

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	Error Type	Name
Recording	I	inaccurate recording of data – transcription, ...
	I	inaccurate recording of data – memory
	I	inaccurate representation of data – deliberate misrepresentation
Processing	II	filtering of data – designer bias
	II	filtering of processes – designer bias
	II	filtering of data – end user bias
	II	filtering of data – data smog
Decision Making	III	decision-making – misassumption of rationality
	III	decision-making – ignoring context
	III	decision-making – misapplication of tool to context
	IV	solving wrong problem

Figure 1. Four types of errors that create misinforming systems (Source: Cohen, 2000b)

- 4) The term **Bias**, as used in this paper, is an element of human frailty and imperfection. It is an artifact of how our brains process information; brains have limited bandwidth for perception, attention, memory, and thinking. Bias is pervasive and mostly unacknowledged in science. All academic authors are biased, at the minimum in the topics they choose to explore and which to ignore. Philosophers Cailin O’Connor and James Owen Weatherall’s book *The Misinformation Age* (2019) describes the role of bias in the spread of false beliefs.

Even technology based on human bias demonstrates bias. Even artificial intelligence built on neural expert systems (learning from human decisions) absorbs bias from humans. AI trained on adult white urban males to develop best practice recommendations regarding diagnosing medical issues, for example, are biased and so of limited use for other populations, such as youth, non-white, rural residents, and women.

Marshall McLuhan (1964) titled chapter 1 of his book *Understanding Media* as “The medium is the message,” pointing out the medium used to convey a message impacts (biases) the receiver. For example, images of a crying child convey a more substantial impact on the receiver than providing statistics about children’s health.

One type of bias often mentioned in the news, confirmation bias, is the predisposition to focus our attention on and remember information that confirms our existing prejudices. It can be characterized as “*My mind is made up; don’t confuse me with facts.*” However, it is hardly the only bias problem for informing. A compendium archived at “List of cognitive biases” (n.d.) lists and describes almost 200 others, including 122 cognitive biases, 27 social biases, and 50 memory biases and effects. Figure 2 illustrates 20 of these.

20 COGNITIVE BIASES THAT SCREW UP YOUR DECISIONS

<p>1. Anchoring bias.</p> <p>People are over-reliant on the first piece of information they hear. In a salary negotiation, whoever makes the first offer establishes a range of reasonable possibilities in each person's mind.</p> 	<p>2. Availability heuristic.</p> <p>People overestimate the importance of information that is available to them. A person might argue that smoking is not unhealthy because they know someone who lived to 100 and smoked three packs a day.</p> 	<p>3. Bandwagon effect.</p> <p>The probability of one person adopting a belief increases based on the number of people who hold that belief. This is a powerful form of groupthink and is reason why meetings are often unproductive.</p> 	<p>4. Blind-spot bias.</p> <p>Failing to recognize your own cognitive biases is a bias in itself. People notice cognitive and motivational biases much more in others than in themselves.</p> 
<p>5. Choice-supportive bias.</p> <p>When you choose something, you tend to feel positive about it, even if that choice has flaws. Like how you think your dog is awesome – even if it bites people every once in a while.</p> 	<p>6. Clustering illusion.</p> <p>This is the tendency to see patterns in random events. It is key to various gambling fallacies, like the idea that red is more or less likely to turn up on a roulette table after a string of reds.</p> 	<p>7. Confirmation bias.</p> <p>We tend to listen only to information that confirms our preconceptions – one of the many reasons it's so hard to have an intelligent conversation about climate change.</p> 	<p>8. Conservatism bias.</p> <p>Where people favor prior evidence over new evidence or information that has emerged. People were slow to accept that the Earth was round because they maintained their earlier understanding that the planet was flat.</p> 
<p>9. Information bias.</p> <p>The tendency to seek information when it does not affect action. More information is not always better. With less information, people can often make more accurate predictions.</p> 	<p>10. Ostrich effect.</p> <p>The decision to ignore dangerous or negative information by "burying" one's head in the sand, like an ostrich. Research suggests that investors check the value of their holdings significantly less often during bad markets.</p> 	<p>11. Outcome bias.</p> <p>Judging a decision based on the outcome – rather than how exactly the decision was made in the moment. Just because you won a lot in Vegas doesn't mean gambling your money was a smart decision.</p> 	<p>12. Overconfidence.</p> <p>Some of us are too confident about our abilities, and this causes us to take greater risks in our daily lives. Experts are more prone to this bias than laypeople, since they are more convinced that they are right.</p> 
<p>13. Placebo effect.</p> <p>When simply believing that something will have a certain effect on you causes it to have that effect. In medicine, people given fake pills often experience the same physiological effects as people given the real thing.</p> 	<p>14. Pro-innovation bias.</p> <p>When a proponent of an innovation tends to overvalue its usefulness and undervalue its limitations. Sound familiar, Silicon Valley?</p> 	<p>15. Recency.</p> <p>The tendency to weigh the latest information more heavily than older data. Investors often think the market will always look the way it looks today and make unwise decisions.</p> 	<p>16. Salience.</p> <p>Our tendency to focus on the most easily recognizable features of a person or concept. When you think about dying, you might worry about being mauled by a lion, as opposed to what is statistically more likely, like dying in a car accident.</p> 
<p>17. Selective perception.</p> <p>Allowing our expectations to influence how we perceive the world. An experiment involving a football game between students from two universities showed that one team saw the opposing team commit more infractions.</p> 	<p>18. Stereotyping.</p> <p>Expecting a group or person to have certain qualities without having real information about the person. It allows us to quickly identify strangers as friends or enemies, but people tend to overuse and abuse it.</p> 	<p>19. Survivorship bias.</p> <p>An error that comes from focusing only on surviving examples, causing us to misjudge a situation. For instance, we might think that being an entrepreneur is easy because we haven't heard of all those who failed.</p> 	<p>20. Zero-risk bias.</p> <p>Sociologists have found that we love certainty – even if it's counterproductive. Eliminating risk entirely means there is no chance of harm being caused.</p> 

SOURCES: Brain Biases; Ethics Unwrapped; Explorable; Harvard Magazine; HowStuffWorks; LearnVest; Outcome bias in decision evaluation, Journal of Personality and Social Psychology; Psychology Today; The Bias Blind Spot: Perceptions of Bias in Self Versus Others, Personality and Social Psychology Bulletin; The Cognitive Effects of Mass Communication, Theory and Research in Mass Communications; The less-is-more effect: Predictions and tests, Judgment and Decision Making; The New York Times; The Wall Street Journal; Wikipedia; You Are Not So Smart; ZhurnalWiki

BUSINESS INSIDER

Figure 2. 20 Cognitive biases. (Source: Lebowitz & Lee, 2015)

- 5) “**Misinformation**” is Dictionary.com’s 2018 word of the year (Funke, 2018). Misinformation refers to incorrect information in general. Bias and the other errors mentioned above are inherent in informing and so can lead to misinforming. Misinformation can result from these problems. (For this series, misinformation is incorrect information spread without any intention to mislead.) The problem with misinformation is even more profound. As pointed out in Cohen (2000a, 2000b), the future will likely disprove much of that which is now disseminated as information, as has happened throughout history. All information has a half-life. For example, medical science has abandoned bloodletting and our best understandings in history, paleontology, and even programming techniques are refined or replaced throughout the ages.
- 6) **Disinformation** is misinformation disseminated with the intention to deceive. *Disinformation* is a relatively new word, meaning “*deliberately false or distorted information given out in order to mislead or deceive*” (Wilson, 1993, p. 300). *Misinformation*, a much older word, means “*inaccurate or erroneous information, usually provided without conscious effort at misleading, deceiving or persuading one way or another... The suppression of information can, of course, play a part in [both]*” (Wilson, 1993).

When disinformation is used as a weapon, the term Psyop, for Psychological Operations, is often employed. Psyops are used to influence any element of society (individual, group, government) to act in the desired way. The term black psyops is used when psyops are “laundered,” that is the source of the disinformation is disguised so as to make it seem credible. Former FBI Special Agent Asha Rangappa (2019) gave an example of black psyops in a twitter feed about how the USSR placed an article in an Indian newspaper that the USA created AIDS to kill blacks and gays. It then cited that article in a Soviet run journal as proof coming from a democratic country.

Spin. Spin can be seen in this example of one who strives to conceal the essential implications about a public hanging using words like “while attending a large public event, the individual died when the platform on which she had been standing suddenly collapsed.” In this case, the spin, while wholly accurate, hides from the reader or viewer essential facts and context. Lakoff (2008) developed a theory on the idea of “spin” in his conceptual metaphor theory. O’Sullivan (2019) reports, “*Agents of disinformation today mix factual and false information, making it more difficult for audiences to determine what is real and what is fake.*”

Spin and Terminology. Britannica defines spin in politics as “*the attempt to control or influence communication in order to deliver one’s preferred message*” (Braun, n.d.). Words possess both denotation (meanings) and connotation (feelings). They have both rational and emotional loading (Condon, 1966). In this way, the choice of words and terminology can be used as a tool of spin. Are you pro-life or pro-choice? Are you for or against a “death tax” or taxing unearned inherited wealth? In other words, the terms one selects convey one’s bias.

- 7) **Propaganda.** Lexico.com defines propaganda as “*Information, especially of a biased or misleading nature, used to promote a political cause or point of view*” (“Propaganda,” n.d.). Propaganda draws upon the public relations techniques created by the American Edward Bernays for applying techniques of psychology to influence people’s thinking. Bernays, the double nephew of Sigmund Freud, is considered a father of public relations, modern advertising, and psychological warfare, and his books, including *Crystallizing Public Opinion* (1923) and *Propaganda* (1928), delve into his ideas. His “accomplishments” include convincing the public to use disposable paper Dixie cups instead of glassware and making it socially acceptable and desirable for women to smoke cigarettes.

Propaganda works because, as Reed Anfinson (2018) points out, the truth cannot compete with it on social media. Newman (2019) found that social media is preferred as the source for news, beating out television and printed news. Fake news blossoms on social media since anyone can publish with fact-checking.

- 8) The term **Agitprop** refers to political propaganda in popular media, particularly those coming out of the USSR, including films, plays, and literature as well as on social media and fake news.
- 9) **Narratives and False Narratives.** Narratives are stories about real or imagined events. These stories may find their basis in objective facts or, for **false narratives**, are based in full or in part on artificiality.

Narratives and the words used to express them deliver both objective (denotative) and emotive (connotative) content. They can be used to convey the truth (either objective truth or a more in-depth understanding about a significant issue), spin the truth, or, in the case of false narratives, convey falsehoods.

Garry and Wade (2005) found that false narratives are potent ways to deceive. Their study found that while fake photographs lead to false memories in their experimental study's subjects, false narratives produce even stronger fake impressions.

- 10) **Fake News** is a type of disinformation circulated as truthful news. It was Dictionary.com's word of the year for 2017 (Funke, 2018). Often fake news is used to support a false narrative. It may be created and disseminated to disinform, for example, as propaganda, and for other reasons, such as using it as clickbait for gaining personal profit.

We need to be wary when defining "fake" since simply being incorrect does not make information fake. For instance, it may be just stale information. Information has a limited useful life, the period between when it is generated until it is corrected. For example, current developments make obsolete the teachings of history, paleontology, and even programming techniques. Second, honest mistakes are part of life. Eyewitnesses get things wrong; memory is malleable and fallible (Cohen, 2000a, 2000b; Garry & Wade, 2005; Loftus, 2003).

- 11) **Trust (and mistrust) of potential sources of information.** A study conducted by Newman, Fletcher, Kalogeropoulos, and Nielsen (2019) found that there is a decline in the trust given to news media worldwide. They write, "*less than half (49%) agree that they trust the news media they themselves use*" (p.5). Similarly, Newman (2019) writes, "*various forms of misinformation is helping to further undermine trust in media.*" Putting this together, alarmingly, we are seeing a spiral of fake news from social media that contradicts factual reporting of news by the media undermining trust in the fact-based news reports.
- 12) **Framing, Spin, and Selection of Terminology.** The term framing has a variety of meanings and definitions.

A simplified version of the term is seen on a website that calls itself "psychology students' best friend" ("Framing," n.d.). It defines framing as selecting how to phrase a question to elicit the preferred response. Similarly, Myers (2019) defines it as determining which facts to include in an argument and which to exclude. Likewise, Linvill and Warren (2019) write, "*Issues that have been central to important social movements like Black Lives Matter and #MeToo — they are framed to serve Russia's interests in undermining Americans' trust in our institutions.*" These definitions use the term as a synonym for spin, the deliberate and intentional filtering in the conveying (telling) of an event. (Another definition not used here is the one by psychologists and economists who follow the technical definition provided by Tversky and Kahneman, 1981. For them, framing refers to a type of cognitive bias that, when given two choices yielding identical outcomes, lead people to avoid risk when the alternatives are worded in one way but seek risk when the same alternatives are worded differently.)

The choice of which facts to present and particularly how they are processed, sequenced, and formatted has a significant effect on what impact they will have on the informed. Framing can be used as a mask to conceal intentions. Those seeking to destroy can use framing to

mask their message as one of peace. Those seeking to divide can present messages that appear to be of solidarity. Figure 3 graphically illustrates this idea.

This definition of framing is similar to the one for political spin, which was defined in the Encyclopedia Britannica as “*the attempt to control or influence communication in order to deliver one’s preferred message*” (Braun, n.d.).

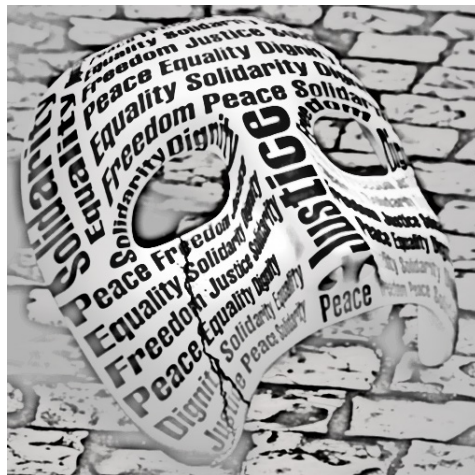


Figure 3. Spin and framing can mask the message.

(Source: Ministry of Strategic Affairs and Public Diplomacy, 2019).

- 13) **Information Dominance creates Illusory Truth.** The term information dominance refers to a source or view having a significant influence on the thoughts and opinions of the informed. The importance of this is that people tend to believe that which comes readily to mind. Adolf Hitler wrote in *Mein Kampf* that “*slogans should be persistently repeated until the very last individual has come to grasp the idea.*”

Hasher, Goldstein, and Toppino (1977) and Fazio, Brashier, Payne & Marsh (2015) empirically verified Hitler’s observation. They found in their study that subjects rated repeated statements as more probably true than new statements. Repetition gives an illogical basis for truth, the illusion of truth. More recently, Effron and Raj (2019) found similar results, and De keersmaecker et al. (2019) found that the results are valid across all types of cognition styles.

Likewise, people tend to look for information sources to confirm their existing bias. In the US, Fox News is the dominant news source for people whose beliefs place them on one end of a political spectrum, while MSNBC is the dominant source for those on the other end (Grynbaum, 2019). In countries without access to a free press, information dominance is even more pronounced. Information must be available to have an impact on beliefs.

In short, several factors influence people’s beliefs, including the availability of information, repetition, framing, including the connotation of the verbiage used, and cognitive biases. This begs the questions, does reality have anything to do with beliefs and, for that matter, what is truth?

PHILOSOPHICAL UNDERPINNING FOR TRUTH

Bernstein (2014) examined knowledge from the viewpoints of various disciplines. An even more fundamental assumption in the study of fake news and disinformation is that there is such a thing as truth and reality. If not, are not facts the same as opinions and opinions as facts?

What do philosophers think about reality? This brief exploration leads us down a Lewis Carroll rabbit hole on a difficult journey full of problems.

The three main areas of philosophy are metaphysics, epistemology, and ethics. All three relate to an examination of informing, misinforming, disinforming, and promoting fake news. The paper now looks at each in turn.

METAPHYSICS

The metaphysical field of ontology examines the nature of reality. To assert that this is true and that is false assumes a shared vision of reality. Truth and falsity rely on sharing a mutual sense of reality. Keep in mind that science, including the transdiscipline of informing science, assumes that a unique understanding of reality exists.

This point is recognized by Gackowski (2006), who relates metaphysics to the issue of informing. His paper shows how the thoughts of philosopher Arthur Schopenhauer relate to the issue of informing, particularly Schopenhauer's ideas on will, representation, and the interplay between them. Gackowski writes that Arthur Schopenhauer's concept "*is a logical equivalent to a contemporary information model of decision situations in which one takes inventory of what is already known by the decision-maker (data), what is not yet known and must be acquired (information), and the applicable rules of reasoning (knowledge)*" (p. 736).

EPISTEMOLOGY

The philosophical field of epistemology considers the nature of knowledge and so relates to distinguishing justified belief from opinion. It examines the nature of truth, belief, and justification.

Modern science imposes its own rules for accepting something as real, based on observations and experimentation. To be accepted as factual, phenomena need to be observable, replicable, and testable.

These conditions are not required for what might be called religious truth, by which truth may be revealed in the writings of sacred texts.

A related epistemological concept is skepticism, a questioning of the truth even of a commonly held, putative, belief. At a time that Socrates argued with Sophists that the goal of discourse should be the search for Truth, he identified in his *Sophistical Refutations (Sophistici Elenchi)*, thirteen fallacies used by Sophists. The relevance for today's topic is that these fallacies are used by today's sophists to argue and spin the truth. This point is particularly relevant in that few models in the informing science perspective deal adequately with deliberate disinforming.

Logic and Semantics. Logic is a tool of epistemology. Semantics is the field of study in linguistics and philosophy that studies meaning in language and, more recently, in programming languages. The theory of semantic information applies formal logic to the study of communications. See, for example, Floridi (2011).

Words can be viewed as symbols to represent information, but words have limitations: (1) inexactitude (hence specialized vocabulary) not only in denotation, but also connotation (emotive elements); (2) words contain non-verbal elements (context, tone and quality of voice used, and facially expression in oral use and placement on page, email for written, or placement in a radio broadcast, for example). Some positions attract attention while others dissuade attention.

Christopher John Fox (1983, p. 160) took the following formal logic approach of applying logic to discerning information from disinformation and informing from misinforming.

- X misinforms Y that P if
 - ✦ X informs Y that P, and
 - ✦ P is false

ETHICS

The issue of ethics in the context of informing has been explored from the viewpoint of journalism (e.g., see Borden & Tew, 2007; for survey research conducted by the Pew Research Center, see Pew Research Center (n.d.) Even ethical issues around the epidemiology of fake news has been examined (Kucharski, 2016). From the perspective of informing science, Wang and Lu (2007) looked at the issue of the ethics of misinformation on online (cyber) dating sites. On a less perilous theme, Grant and Cohen (2019) delve into the ethics in holy scriptures when the divine dissembles.

Even museums, which, like libraries, are society's bastion for knowledge collection and display of truth, are under fire for operating with policies that run counter to the changing ethical norms. Practices there were once viewed as ethical at times now raise ethical criticisms. For example, museums are now coming under fire for providing defective or politically incorrect interpretations of various subject matters, ranging from dinosaurs to the displaying of cultural artifacts. Museums must now confront the question of whether relics of ancient civilizations should be retained for display to educate their nation's public or should they be returned to the lands from whence they were collected, notes Rothstein (2019).

In sum, philosophers and philosophies do not have a definitive answer to the question if truth exists. The paper now turns to the question of "is the truth required in order to inform?"

DOES INFORMING REQUIRE TRUTH?

The above briefly points out major philosophical areas and highlights a question for informing science regarding truth. Does informing require truth or even its existence? How have researchers in the informing science arena explored these issues?

Stahl (2006) examines how modern philosophies understand the nature of and necessity for truth. His paper examines the question from the perspectives of Jürgen Habermas and Michel Foucault and notes that these philosophers do not agree on the nature of truth. It further concludes that all research is biased based on the researcher's biases and is influenced more by the researchers' values than by truth.

As shown in Figure 4, Gill posits that some things can be useful even if they are not true (Gill, 2011). Scarantino and Piccinini (2010) and Lundgren (2019) explore the topic of value in untruth from a metaphilosophical perspective. Readers with a philosophical bent who are interested in the Bar-Hillel–Carnap Paradox and the Scandal of Deduction should read Gorsky (2018). The crux of these papers is that informing can occur in the absence of truth.

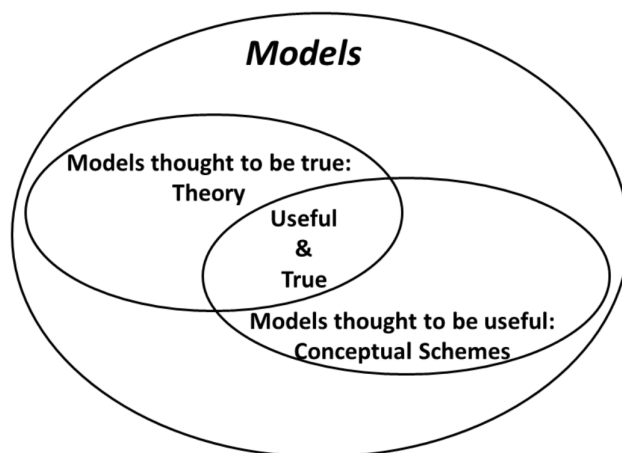


Figure 4. Models, theories and conceptual schemes
(Source: Gill, 2011).

In a related way, Bednar and Welch (2008), using a semiotic approach, derive a complementary conclusion that even those endeavoring to provide the truth can misinform. Their paper contrasts the Logical Empiricist school of thought with that of Hermeneutic Dialectics and concludes that philosophical underpinnings create what they term a 'Tyranny of 'Truth.'

Together, these two conclusions lead to the perplexing quandary that (1) one can be informed in the absence of truth, and (2) true statements can misinform. This difficulty may lead us to question the value of truth. Does truth matter or are we now living in an age of post-truth?

POST-TRUTH

If truth and falsity grow from sharing a common sense of reality, what happens when a shared sense of reality is lacking? The term for this is post-truth. The Oxford Dictionary declared "post-truth" as its 2016 word of the year, defining it as "relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief" ("Word of the year 2016 is ...", n.d.). (Likewise, in the same year Dictionary.com named it the word of the year [Funke, 2018]). Illing (2018) defines post-truth more succinctly as "the disappearance of shared objective standards for truth." Sacha Baron Cohen (2019) said in his acceptance speech upon receiving ADL's International Leadership Award, "the age of reason, the era of evidential argument, is ending ... Democracy, which depends on shared truths, is in retreat and autocracy which depends on shared lies is on the march." Martin Shovel's cartoon (2016), displayed as Figure 5, expresses this idea more playfully.

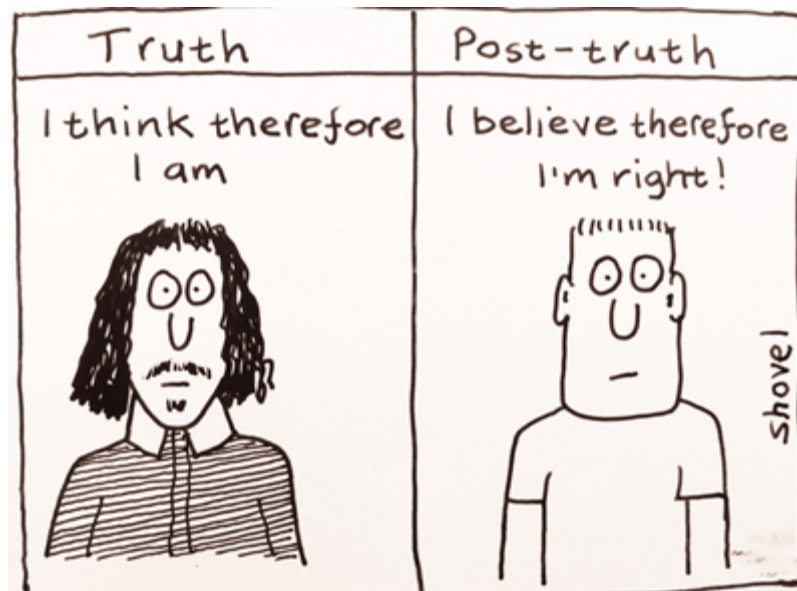


Figure 5. Truth vs. Post-Truth (Source: Shovel, 2016)

The quest then is to create a model or framework of informing considering alternative understandings of reality. For the most part, the models of informing and disinforming created so far require the assumption of a shared sense of reality; from many philosophical perspectives, this shared sense is a requirement for truth. However, as witnessed by the many religious wars throughout history, humans have argued over and gone to war over different sources for the truth. One group's sense of divine revelation is for others but a myth. Even today, members of the US Congress wage war on evidentiary reality, some denying facts or offering opinions as facts (Kroll, 2019). Linvill, Boatwright, Grant, and Warren (2019) and Linvill and Warren (2019) explore the importance of post-truth as a feature of fake news and propaganda, pointing out that adversaries create dissension via fake news to disrupt and divide us by manufacturing alternative narratives of reality.

With this in mind, the paper now explores some of the many models or frameworks put forth for informing science to date. These models require and assume a single source for truth and reality. The paper then concludes with an initial framework that removes this “truth” assumption by dealing with alternative sources for the truth. The final model further adds the dimension of competition in the informing process.

SHANNON-WEAVER BASIC MODEL FOR COMMUNICATIONS AND ADAPTATIONS FOR MISINFORMATION AND DISINFORMATION

The most common frameworks for informing are elaborations of the Shannon-Weaver communications model (Shannon & Weaver, 1949, p. 34), depicted as Figure 6, to explain the magic that occurs to get information from a source to its destination. The Shannon-Weaver model notes that this magic includes a transmitter, signal, noise, and a receiver.

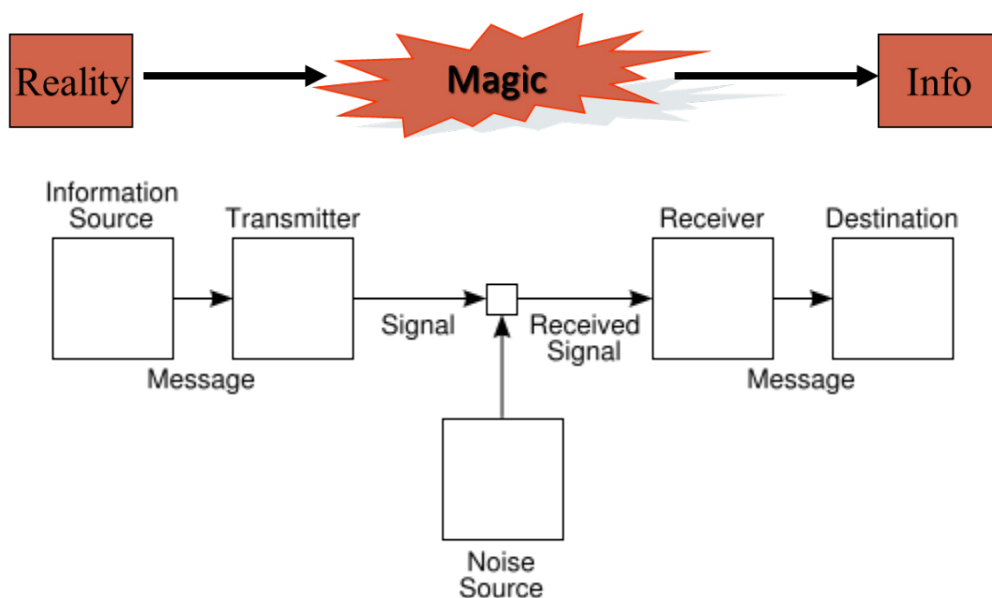


Figure 6. The Shannon-Weaver Basic Model for Communications.

The Shannon-Weaver basic model is often used to explore human communications, yet Shannon and Weaver never intended for the framework to be used outside of mathematical information theory. Carnap and Bar-Hillel (1952) quote Shannon as writing, “*These semantic aspects of communication are irrelevant to the engineering problem*” and “*It is important to emphasize, at the start, that we are not concerned with the meaning or the truth of messages; semantics lies outside the scope of mathematical information theory.*”

Nonetheless, the model is useful for explaining the “magic” that must occur between the sender and the receiver for humans to be informed. The model spawned myriads of adaptations and refinements, some of which are shown below.

For example, one team of researchers has, for over a decade, used the model to examine risk in the informing and misinforming processes. Christozov, Chuckova, and Mateev (2006) adapted the Shannon-Weaver model to account for both misinformation and interpretation and applied it to create a mathematical assessment of risk. Figure 7 displays their model. Over the next decade, the researchers continued to develop the model’s underlying mathematics.

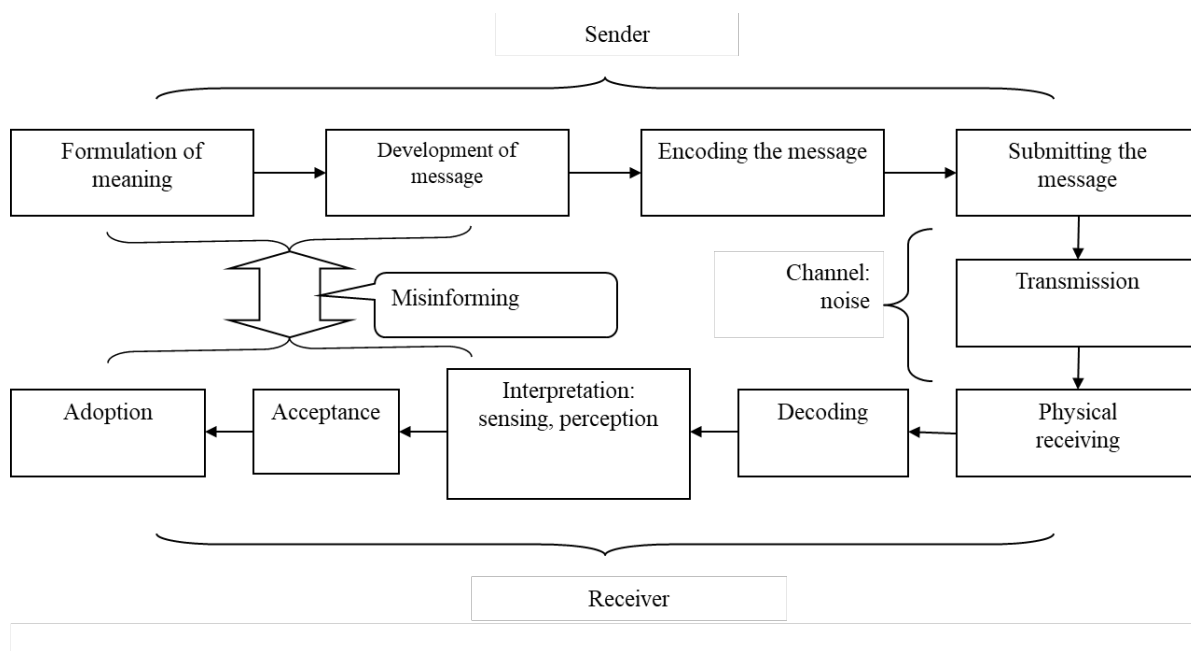


Figure 7. A model to account for misinformation in the communications process.

(Source: Christozov et al., 2006)

Cohen (2007) adapted the Shannon-Weaver model by collapsing the transmitter-signal-receiver components as “media magic” and instead focused on the people, the informer, and the client (informed) and did so from an informing science perspective, as seen in Figure 8. That paper brought forth the environment (or context) of both – their needs, and their biases.

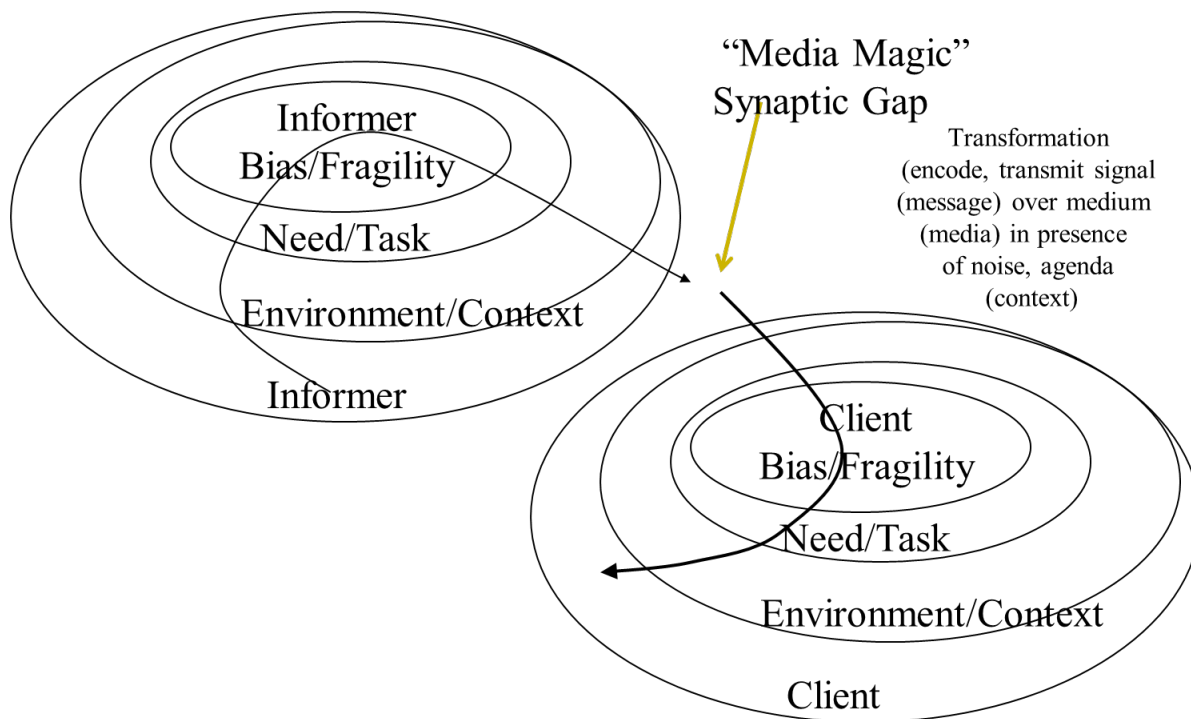


Figure 8. Cognitive aspects of an informing system.

(Source: Cohen, 2007)

Jamieson and Hyland (2006) expanded the Shannon-Weaver model by adding details on the role of bias in an informing system, including information bias, cognitive bias, risk bias, and uncertainty bias, as seen in Figure 9.

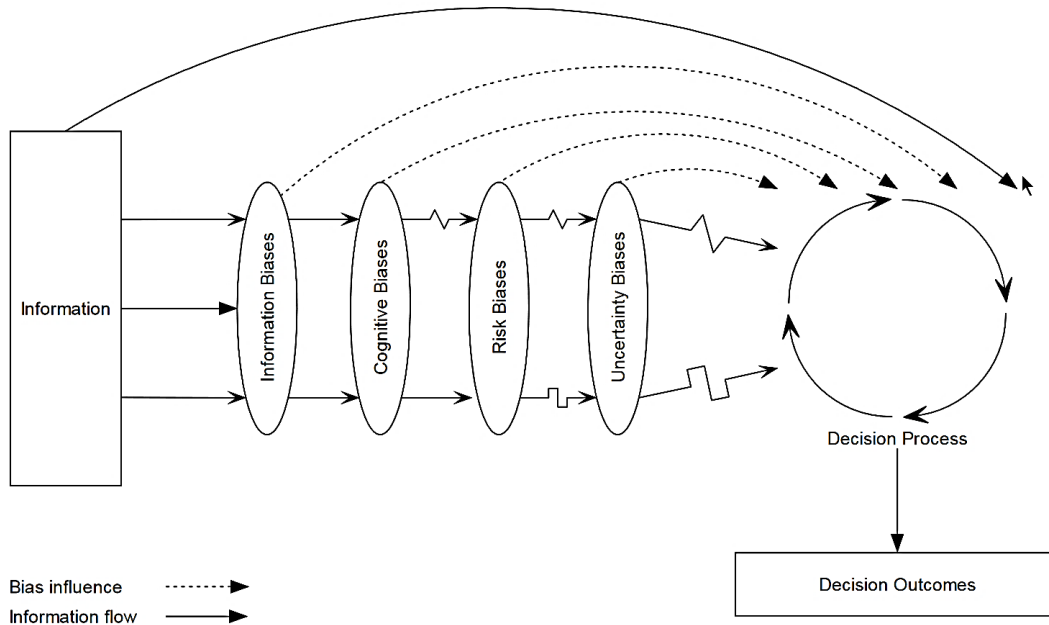


Figure 9. Bias in an informing system (Source: Jamieson & Hyland, 2006)

Building on Jamieson and Hyland, Gill (2008) further explored the filters between the sender and the client, as shown in Figure 10, in the client resonance model by explicitly including filters for the channel, attention, risk, and more.

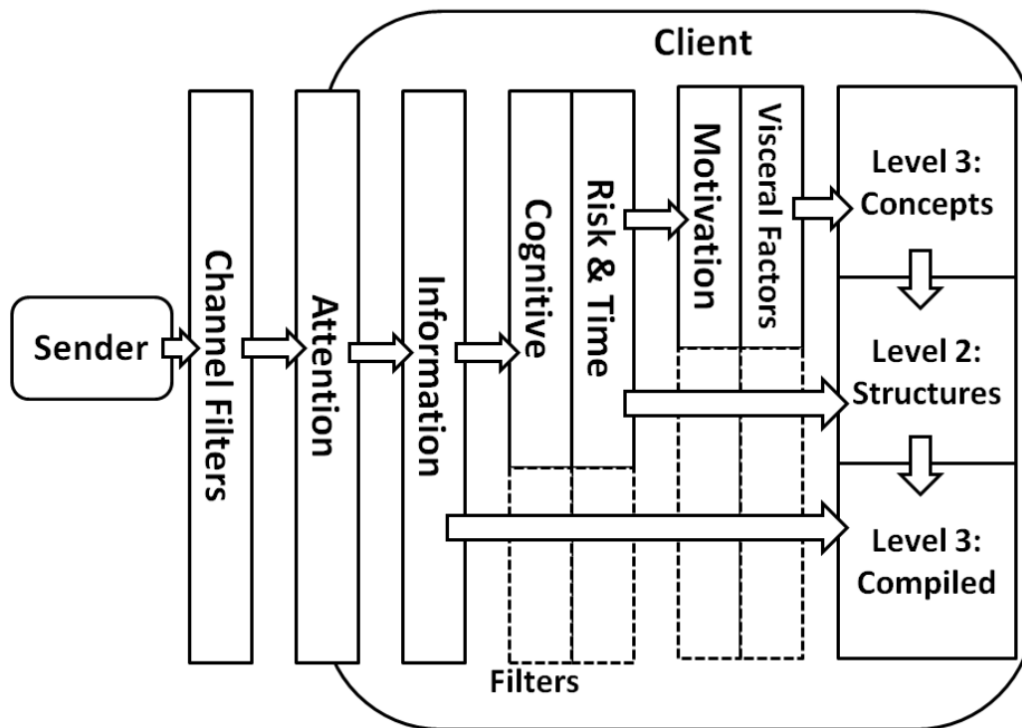


Figure 10. Gill's client resonance model (Source: Gill, 2008).

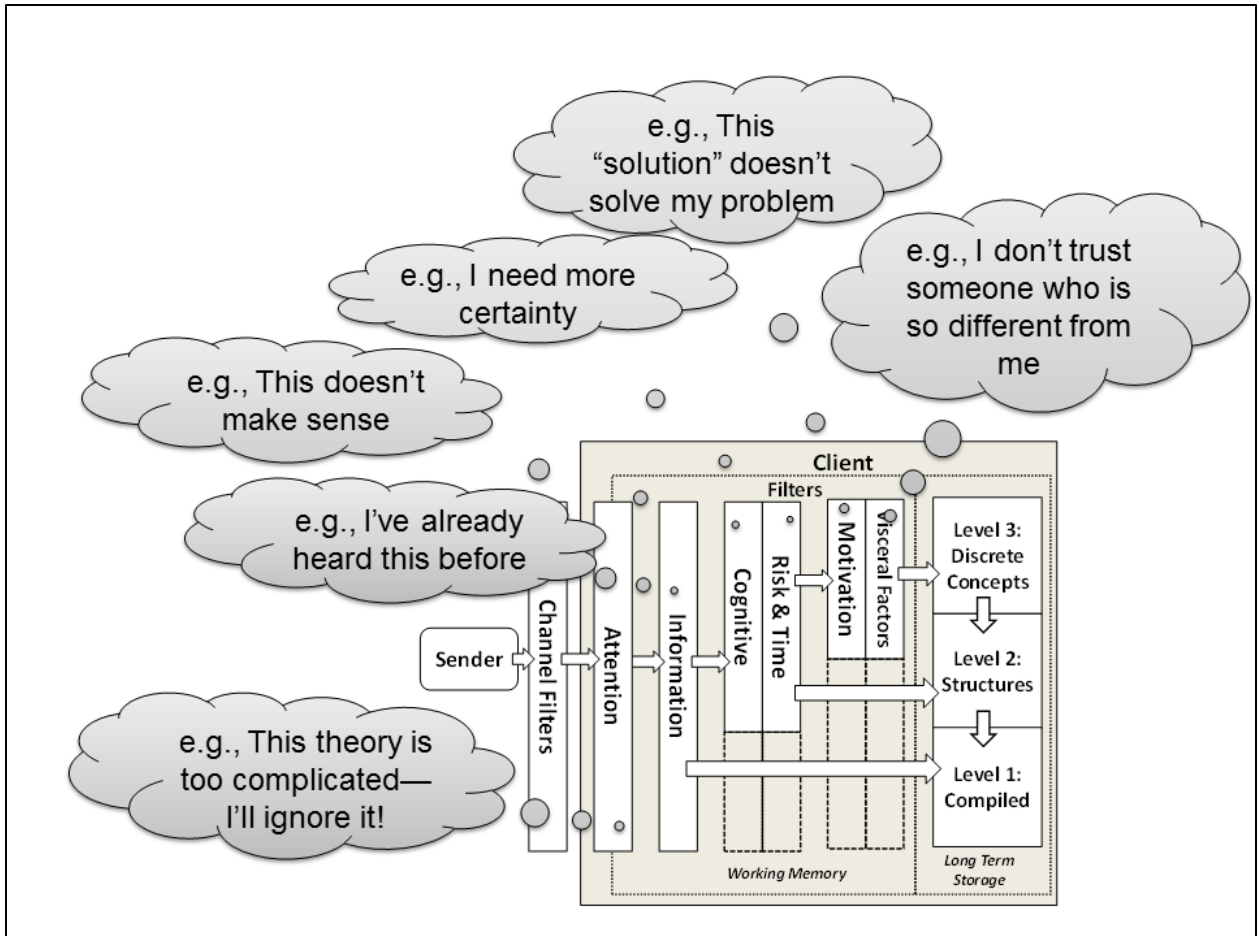


Figure 11. Single client resonance model mapped against the SUCCEs framework. Fake news often addresses these questions. (Source: Gill, 2019)

In 2019, Gill added balloon explanations to combine the single client resonance model he created in 2008 with the SUCCEs framework of Heath and Heath (2007). Fake news purveyors often comply with the specifications of this model, he writes. See Figure 11

The above models are but a representative sampling of efforts to adapt the Shannon-Weaver model to the complexities of human communications. The paper now presents yet another attempt. This latest attempt adds the complexity derived from earlier in this paper, that there is no single source for truth and untruth and that there is a competition of informational sources.

THE COMPETITION FRAMEWORK

The paper now provides creating a fuller model that deals with some of the elements addressed above. The models above rely on a single source for information and use a single sender. In life, there are multiple sources of messages (informers, misinformers, and disinformers), and there are multiple channels for obtaining information. The following adaptation recognizes multiple, alternative information sources all in competition for attention.

The fuller model recognizes the following:

- a) **Facts and artifacts.** Both objective truth and false narratives present artifacts that compete for attention, to inform or misinform. Some messages use artifacts drawn from objective truth while others use artifacts drawn from false narratives

- b) **Objective truth is not necessarily reflective of reality.** As philosopher Vladimir Mokiy (personal communication) points out, even objective observed truth does not always reflect reality. As shown in Figure 12, objectively, the spoon in water appears to be bent, yet in reality, it is not. Only an appropriately bent spoon will appear straight when placed in water.
- c) **Honest and dishonest reporters.** Some informers, even those who make an honest effort to convey objective truth, are influenced by numerous biases and agendas that filter and bias their endeavors. Other informers strive to advance a false narrative through spin and disinformation.
- d) **Trust affects information's impact.** Trust in the source is important, but even friends and others who are trusted will, from time to time, convey messages (rumors, gossip, retweets of fake news, and such) that have no or limited objective basis.
- e) **Filtering occurs throughout the informing system.** All informers and informees (the ones who receive the message) operate under the limitations of various filters. These filters include biases and agendas, the strength of the signal, and trust.

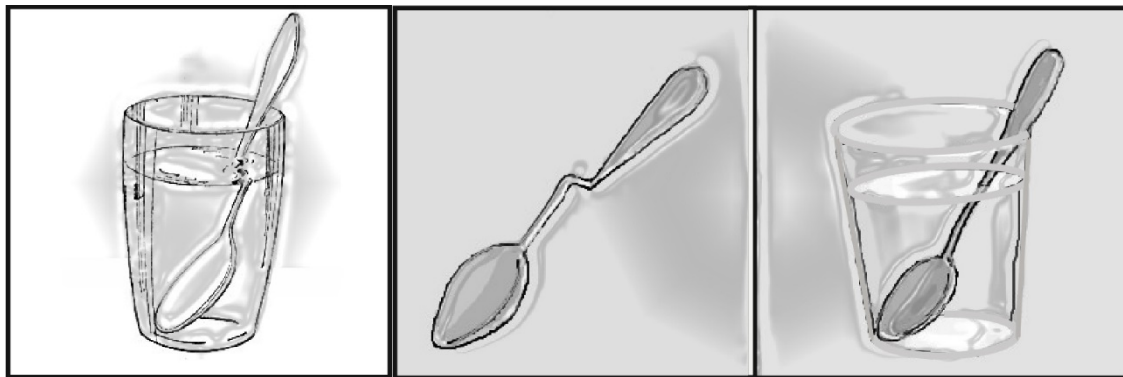
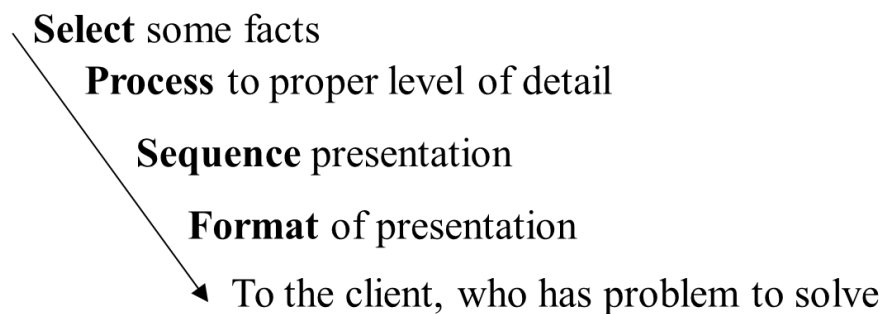


Figure 12. Vladimir Mokiy (personal communication)



To Select, Process, Sequence, and Format,
we need to understand

1. client's problem
2. client's current knowledge, uncertainties
3. client's information seeking preferences

Figure 13. A Framework for Informing (Source: Cohen, 2000b).

While not explicitly stated in Figure 13, the informer selects, processes, sequences, and formats the artifacts to best meet informee's needs. That is, the word model of informing science shown in Figure 13 remains useful. It suggests that to understand informing we need to analyze the selection of artifacts, the processing applied to the artifacts (in light of the various filters), how these artifacts are presented (their sequence and formatting), and the problems the clients (informee) face given their current knowledge and uncertainties and their biases and filters.

Filters and Noise. The informer is biased, not the least of which as to which artifacts (such as news item) to notice (perceive) and attend. That is both a perceptual issue as well as an issue of attention (perception and memory), and so the research on these areas bears consideration. Other filters are trust, context, aspirations, and personal history. Similarly, the receiver (informed or informee) has its own set of filters.

The channel itself imposes filters. Also, the channels themselves impose their own filters. For example, in newspapers the selection of the news is made in light of the biases of the editor and the headline writer, the placement of the article in the newspaper, what other news is competing for this space, the amount of space given the article, and, if available space is limited, what to omit. Advantageous placement, amount of space/time given, and repetition strengthen a message's impact. These same types of filters exist in stocking groceries in stores, listing news on websites, and beyond. News programs on radio and TV are of fixed length, so their editors select which news items to include and exclude and how much length to provide to each.

With this in mind, Figure 14 offers the following; an initial Informing Science framework that removes the assumption of the singularity of truth and reality and that provides a multi-source framework for understanding informing, misinforming, and disinforming. To save space, this rendering of the framework omits the lines connecting boxes to boxes from left to right. Each box on the left connects to the box on its right. This figure shows only one set of boxes for the filtered informer, channel, and informee but understand that these boxes with a white background are replicated for each information source. For example, the New York Times newspaper has its own filters, channel filter, and informee filter as does each news radio source and each email source.

The models in this paper all reflect an idealized framework for understanding how information and disinformation sources influence people. Researchers are now endeavoring to understand how disinformation impacts people and their decision making. An upcoming paper by Brashier and Marsh (2020) affirms that people more readily accept information that fits their biases and to which they have ready access; repetition of lies makes them more believable. A recently published paper by Coronel, Poulsen, and Sweitzer (2019) shows experimentally that people tend to believe as true information provided to them, but their biases affect what they remember. In the experiment, subjects told others what they had just learned. The study found that people can and do generate their own misinformation. People's biases impact not only which messages hold their attention, but also how they remember those messages. People's biases garble how people remember the message and also on how people tell the message to others. Via this process, people self-generate misinformation.

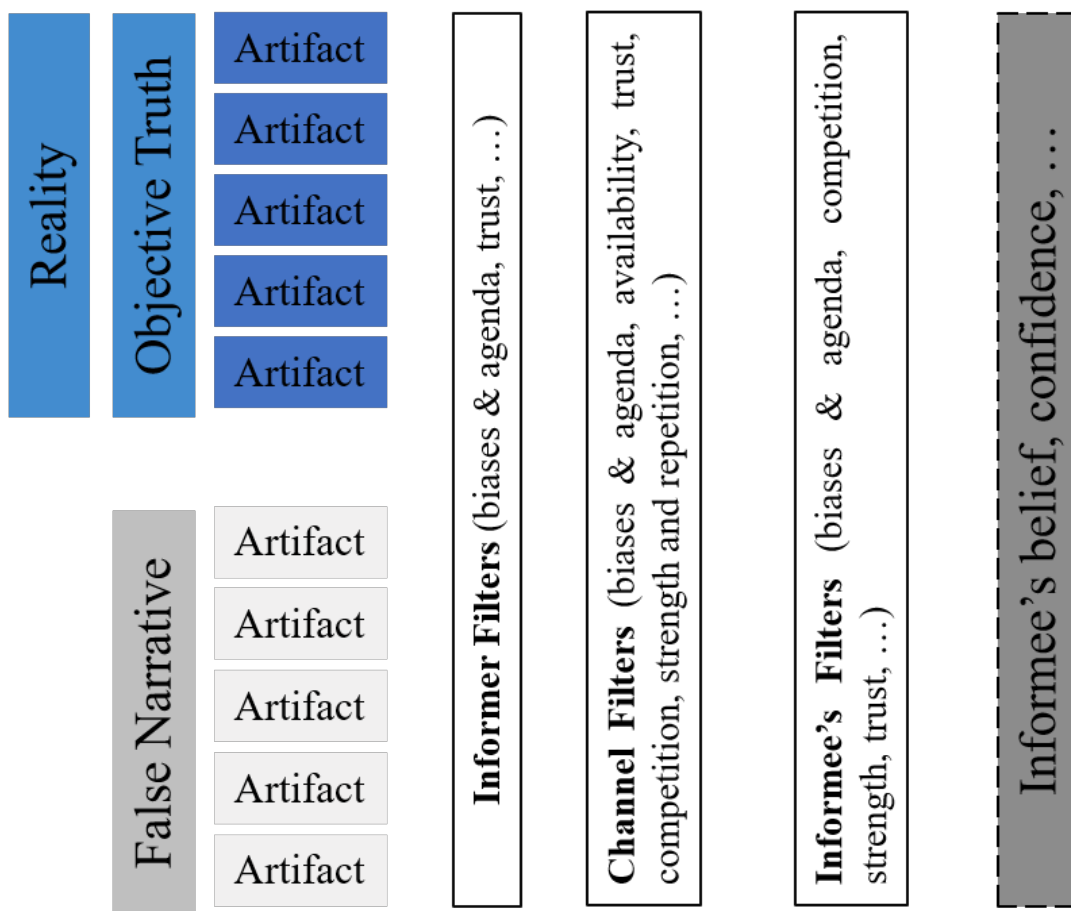


Figure 14. Multi-source competition framework for understanding Informing, Misinforming, and Disinforming. An array of informing artifacts, only some drawn from objective truth, are available to the informer. The informer's filters impact which artifacts receive attention when packaging a message and placing it into one or more informing channels. Channels themselves have filters often based on limited bandwidth (space) and channels compete for the attention of the informee. Informees have their own filters for what messages they will receive and which will impact their beliefs.

CONCLUSION

The issue of informing and disinforming crosses many disciplinary perspectives. Each discipline puts on blinders that limits what it can contribute to its understanding of research topics. It is like trying to study a forest by seeing only the trees and not the animals or the animals but not the trees. Research perspectives that cross disciplinary boundaries are needed to more fully understand complex phenomena.

This paper lays out some fundamental cross-disciplinary issues including how errors find their way into informing systems, the issue of bias, and the frameworks used to model this phenomenon.

Future Developments. This paper is just a start. The elements of the competition model need to be fleshed out and then tested to determine their explanatory power.

Limitations: The concluding framework offers insights into understanding informing and disinforming. But this framework offers no insights into other forms of informing that are less well explored, such as song, dance, physical art, and architecture. Likewise, this framework does nothing to help the understanding of informing via fideism or psychedelic revelation.

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BIOGRAPHY



Eli Cohen serves as a governor and Executive Director of the Informing Science Institute. He focuses his current research on bias, misinformation, disinformation, and propaganda.