# The Narrative Aspect of Cybersecurity

I begin with the assumption that we can take the following facts for granted. The U.S. is in the midst of a cyberwar, some aspects of which are also called an information war, a narrative war, or a war of influence. Adversarial states as well as non-state actors are attempting to gain advantage by manipulating the flow of information on the Internet. These social influence operations work in concert with other cyber-operations as well as traditional (kinetic) military actions.

While it may be worth exploring exactly how and why such power struggles fit into the taxonomy of privacy and security engineering, I will not be detained by that question here, instead preferring to focus on elements of the serious, emerging consequences of cyber-enabled information operations, as evidenced by events in the U.S. as well as Myanmar, India, Syria, eastern Europe, Taiwan, and northern Europe, among other places.

Besides, the urge to classify the nature of the problem easily gives way to the urge to assign responsibility to someone else—a difficult task, given the collective consequence and interdisciplinary style of the problem. As Graham Brookie, director and managing editor of the Atlantic Council's Digital Forensic Research Lab, commented during a panel talk, "The tricky thing about disinformation is that everybody thinks of it as somebody else's problem[…]. We're all looking at social media platforms to say, 'Hey, do something about this,' or the government to say 'Hey, tell us something about this,' or looking to the media to report objectively all the time. The fact is, this is truly a collective problem."[1]

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[1] Jeff Stone, "Why Social Media Disinformation Represents such a Security Threat", 20 October 2020. Available from https://www.cyberscoop.com/social-media-disinformation-represents-security-threat/.

Like many truly collective problems, "narrative warfare" is both poorly defined and essential to understand. When I first set out to write this paper, I began with the ambitious idea that I might be able to make a comprehensive description of problem and develop a set of diagnostic metrics. Although I wrote a number of pages in pursuit of those goals, I was chastened by the incoherence and flimsiness of the arguments I made in those pages.

Here I start over, this time in pursuit of two questions:

1. How can "narrative" be defined formally and systematically, and why is it important to do so?

2. To repurpose Helen Nissenbaum's observations about privacy, how has our collective understanding of narrative been conditioned by "material assumptions about what [is] and [is] not possible" and how have these assumptions been "undermined by technical systems"[2]?

These questions are specific enough that perhaps something meaningful can be said about them in the course of a term paper, yet they are also relevant to the larger problem, preserving my dual hope that in the scope of this paper I will be able to say something that fulfills certain standards of internal consistency while also suggesting new lines of inquiry into the larger issue at hand. I can hardly promise to fulfill these hopes, but at least they are not undermined at the outset. Let's begin.

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[2] For more context, here is Nissenbaum's original phrasing: "I say the standard for privacy has not changed; rather, the threats are different. The rough cut implied by the dichotomy [between "public" and "private"] incorporated a set of material assumptions about what was and was not possible—in terms of observations, intrusions, and monitoring —in both private and public realms. As these assumptions have been undermined by technical systems, so the inadequacies of the dichotomy have emerged." Nissenbaum, Helen. 2010. *Privacy in Context.* Stanford, CA: Stanford Law Books, 118.

# 1. Defining Narrative

What's the difference between a "narrative" and a "story"? How do these terms relate to other words that attempt to categorize and evaluate public discourse (words like "fact," "lie," "false," "fiction," "toxic," etc.)?

While the words narrative and story are often used interchangeably, Ajit Maan, narrative analyst and author of *Narrative Warfare*, argues for a distinction between the terms. She cites the Hero's Journey as a "narrative," and contrasts the broad literary archetype with a "story," which would be a particular instance of the archetype—for example, *Star Wars: A New Hope*.

With Maan's observations as a guide, here I propose the following definitions, which will later lend themselves to technical implementation: *a* story *is a selection of information deemed relevant to a meaningful representation of some given subject*. *A* narrative *is a mechanism by which such information is selected*.

Before discussing some of the nuances of these definitions, it's worth discussing why they matter in the first place, particularly in the context of privacy and security engineering. As a general observation, privacy and security engineering address not just how to design technical systems, but how to design technical systems given what we know about human beings. Broadly speaking, many privacy and security flaws arise from a misunderstanding not of the technical elements but of the human elements.

Narrative is one such human element. I do not intend to delve into all the evidence here, but experiments in psychology as well as studies from related disciplines like behavioral economics strongly suggest that human cognition has two modes for decision-making, and one

of those modes is governed by heuristics that are essentially narratives. These narrative heuristics influence how humans assess risk and how they interpret evidence.[3]

Even without the abundant experimental evidence, simple observations suggest both the existence of, and the importance of, mechanisms for information selection. I am surrounded by "information," including both information that I process consciously (such as the words in a book I'm reading) and information that I process unconsciously (such as biochemical signals regulating metabolism). How does information pass from unconscious regulation into consciousness, for instance, an awareness of feeling hungry? Of all the information of which I am conscious—for instance, everything in my visual field—by what mechanism does some information register as meaningful (like the face of a friend) and worthy of attention, while other information does not? As John Miller and Scott Page write in *Complex Adaptive Systems*: *An Introduction to Computational Models of Social Life*:

> [A]gents typically confront a wealth of information, and thus the scarce resource here is not information but rather attention. Given the inherent limits of information processing, agents must actively ignore most of the potential information that they encounter…It may even be the case that agents operate more effectively with less information.[4]

Of all information available, there exist mechanisms by which some information is selected; indeed, social theorist Niklas Luhmann goes so far as to reimagine the entire field of sociology in

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[3] See popular works by—for instance—behavioral economist Daniel Kahneman (*Thinking Fast and Slow*), risk analyst Nassim Nicholas Taleb (*The Black Swan*). Also see the closely related concept of paradigm in works by systems analyst Donella Meadows (*Thinking in Systems*) and scientific historian Thomas Kuhn (*The Structure of Scientific Revolution*).

[4] Miller, John H. and Scott E. Page. 2007. Complex Adaptive Systems: An Introduction to Computational Models of Social Life. Princeton, NJ: Princeton University Press, 94.

terms of information selection.[5] Rather less ambitiously, I simply name the selection mechanism *narrative*.

But perhaps the most compelling reason for computer scientists and particularly privacy engineers to consider narrative is that it's a line of thinking which bears fascinating fruit, as I hope to detail later in the paper.

With that as bait, let us return to the definitions of narrative provided earlier: *a* story *is a selection of information deemed relevant to a meaningful representation of some given subject. A* narrative *is a mechanism by which such information is selected.* What are the implications of these definitions for someone interested in the realm of cyber-enabled influence operations?

As many others have observed, information campaigns have little interest in the truth or facts. As Ajit Maan explains, "[T]his is not information warfare; this is warfare over the *meaning* of information. […] Narratives do not tell the facts. Narratives tell the meaning of the facts."[6] That the struggle to control the semantic interpretation has wandered so far afield of any reference to science or fact is a state of affairs referenced with no little despair by phrases like "truth decay" and "post-truth."

Without implying that such concerns are unfounded, it nonetheless bears noting that "narrative" has long occupied a liminal space between truth and falsehood, between the conscious and the unconscious, and between reality and unreality. Indeed, "fiction" is a category of discourse which counts this liminality as its raison d'être.

The ambiguous truth status of fiction is self-evident if one pauses to consider it. On the one hand, a fiction writer is free to invent her story whole-cloth, and yet a fiction writer cannot

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[5] See *Social Systems* by Niklas Luhmann.

[6] Ajit Maan, *Narrative Warfare*, (2018), 10.

be accused of lying[7]; indeed, scholars have argued for many years that fiction is truer than facts,[8] a theme that also arises within fiction itself.[9]

On the other hand, fiction does not operate without reference to the measurable, empiric world. In the words of philosopher Stacie Friend:

> Readers of fiction are adept at understanding what is "fictionally true" even though this goes well beyond what the text makes explicit. We know that Candide has blood in his veins rather than oatmeal and that Sethe cannot become invisible at will, although the relevant works never say so. We also recognize fictional truths that contradict the explicit text. We know that Huck Finn is right to help the slave Jim escape and that Lolita is not Humbert Humbert's willing partner, despite the narrators' statements to the contrary.[10]

Indeed, research by psychologists suggests that readers have a nuanced and intuitive understanding of exactly which elements of the real world should be imported into fictional world, and that this understanding is based "both on how different a story world is from the real world and on what they know to be causally central to the real world."[11]

The curious properties of fiction underscore the idea, by now well-established among academics who study disinformation, that recourse to "facts" and "truth" will not save us

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[7] For a careful dissection of the ambiguous status of fiction, see the 1975 paper by John Searle, "The Logical Status of Fictional Discourse," (*New Literary History* 6 (2): 319-332. doi:10.2307/468422. https://search.datacite.org/works/10.2307/468422.

[8] Oatley, Keith. 1999. "Why Fiction may be Twice as True as Fact." *Review of General Psychology* 3 (2) (Jun): 101-117. doi:10.1037/1089-2680.3.2.101. https://search.datacite.org/works/10.1037/1089-2680.3.2.101.

[9] O'Brien, Tim. 2009, "How to Tell a True War Story," in *The Things they Carried*, (New York, NY: Houghton Mifflin), 64-81.

[10] Friend, Stacie. 2017. "The Real Foundation of Fictional Worlds." *Australasian Journal of Philosophy* 95 (1) (Jan 2,): 29-42. doi:10.1080/00048402.2016.1149736. http://www.tandfonline.com/doi/abs/10.1080/00048402.2016.1149736.

[11] Weisberg, Deena Skolnick and Joshua Goodstein. 2009. "What Belongs in a Fictional World?" *Journal of Cognition and Culture* 9 (1-2): 69-78. doi:10.1163/156853709X414647. http://booksandjournals.brillonline.com/content/journals/10.1163/156853709x414647.

(except, perhaps, insofar as social participation in the project of fact-checking itself creates a meaningful narrative) because stories are agnostic with regard to the facts. Narrative selects for *meaning* rather than *truth* or *accuracy*.

Yet we need not greet this realization with despair. Indeed, much of the value we derive from our cognitive abilities arises in concert with, rather than in opposition to, the same imaginative capacity people display in their nuanced assessment of fiction. As Miller and Page write:

> [I]nternal models allow you to visualize what is currently behind you, even though you have had very little recent visual input about that scene; or to recognize that an object, even when it has been obscured by a curtain and cannot be seen, still exists…Another use of internally generated information is to produce "would-be" worlds that may become important in the future. [12]

One can hardly create "would-be" worlds without temporarily departing from the world as it is. Rather than despairing about our post-truth reality, we might ask ourselves instead: if narrative is valuable in its own right, and if it has long co-existed with scientific fact, what has changed such that these previously harmonious modes of information selection now seem out of balance? In other words, let's return to the second central question of this paper: how has our collective understanding of narrative been conditioned by "material assumptions about what [is] and [is] not possible" and how have these assumptions been "undermined by technical systems"[13]?

## 2. Story-Telling: Material Assumptions and Technical Realities

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[12] Miller, John H. and Scott E. Page. 2007. *Complex Adaptive Systems: An Introduction to Computational Models of Social Life.* Princeton, NJ: Princeton University Press, 95.

[13] Nissenbaum, Helen. 2010. *Privacy in Context.* Stanford, CA: Stanford Law Books, 118.

There are manifold "material assumptions about what [is] and [is] not possible" with regards to narrative. I do not aim to address them all. Rather, I hope to bring attention to a few which seem to undermine our collective response to disinformation.

I begin with the acknowledgement that it is a dangerous business to discuss "material assumptions" at all. While undoubtedly many academics would be quick to admit that they likely carry around foundational assumptions about material reality, and that these assumptions influence what sorts of ideas they believe to be plausible enough to merit further inquiry, it's difficult to discuss such topics with any real precision. Instead of making sweeping claims, then, I will aim for a lighter touch here: simply an observation of the premises present in certain authoritative texts and an exploration of the consequences that result when we no longer take these premises for granted.

The first authoritative text is *The Mathematical Theory of Communication* by Claude Shannon. ("Authoritative," in this case, may be an understatement.) Warren Weaver, in his introduction to the text, describes Shannon's division of communication into "problems at three levels":

Level A. How accurately can the symbols of communication be transmitted? (The technical problem.)

Level B. How precisely do the transmitted symbols convey the desired meaning? (The semantic problem.)

Level C. How effectively does the received meaning affect conduct in the desired way? (The effectiveness problem.)[14]

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[14] Shannon, Claude E. and Warren Weaver, *The Mathematical Theory of Communication,* (Baltimore: University of Illinois Press, 1998), 4.

Notice that only Level A deals with "technical" problems. What exactly is meant by "technical" here is not entirely clear. Several pages later, in Shannon's own introduction, he makes the following preliminary observations about the "problem of communication":

> The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design.[15]

What exactly is meant by "the engineering problem" and why should the "semantic" and "effective" aspects of communication be irrelevant to it? Perhaps Shannon means simply that semantics are irrelevant to the particular engineering problem at hand, yet a broader interpretation of Shannon's meaning here seems more plausible. Shannon lived and published in the unimaginable past, when there were hardly telecommunications at all, let alone the Internet. In that context, it must have seemed quite safe to silo engineers and mathematicians in the "technical" subject of symbolic transmission, and to leave semantics and its behavioral consequences to the "non-technical" people presumably in charge of such things: poets and priests, one supposes.

Such a close examination of Shannon's word choice would be irrelevant, except for the fact that his theory continues to be a seminal text for engineers and what began as a preliminary

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[15] Shannon, Claude E. and Warren Weaver, *The Mathematical Theory of Communication,* (Baltimore: University of Illinois Press, 1998), 31.

observation about the jurisdiction of engineering has evolved into foundational assumptions in which the limits described by Shannon's framework, which were heavily influenced by Shannon's specific historical and cultural context, are mistaken for intractable material or technical limitations.

For instance, it's evident that Shannon's framework might readily bear fruit when applied to human cognition. Human interpretation, ostensibly belonging to the semantic level, could equally be an information channel subject to technical interventions. This sort of observation is hardly original on my part; many of Shannon's contemporaries, such as semiotician Roman Jakobson, circumscribed their research differently than Shannon did.[16] More recently, bio-semiotics and the emerging field of cyber-semiotics attest to alternative conceptions of information transmission.

Yet these alternative conceptions remain esoteric, whereas Shannon's influence is everywhere evident.  For instance, his three levels of information transmission, which separates information theory into "technical," "semantic" and "effectiveness" levels and situates engineering within the technical level[17] bears notable similarity to the U.S. military's own description of cyberspace as of 2012.[18]  The military has undoubtedly re-examined its understanding of cyberspace since 2012, but if it has arrived at new foundational assumptions, these have yet to be communicated to the broader public.

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[16] Waugh, Linda R. 2015. "Jakobson, Roman (1896–1982)." In *International Encyclopedia of the Social & Behavioral Sciences (Second Edition)*, edited by James D. Wright, 782-785. Oxford: Elsevier. doi:https://doi-org.ezproxy.neu.edu/10.1016/B978-0-08-097086-8.61059-0. http://www.sciencedirect.com.ezproxy.neu.edu/science/article/pii/B9780080970868610590.

[17] Shannon, Claude E. and Warren Weaver, *The Mathematical Theory of Communication,* (Baltimore: University of Illinois Press, 1998), 4.

[18] *Joint Publication for Information Operations*, 27 November 2012, I-2-I-3.

For example, a cultural blindspot towards Russian influence operations is exemplified by the tagline of a 2018 article published on AFCEA's blog: "The tools needed to fight this war are available, but what's required is the will."[19] Similarly, in her conclusion to the 2020 nonfiction book *How To Lose the Information War*, author Nina Jankowicz describes social media companies' attempts at literacy awareness as "surface-level distractions, not deep-rooted attempts to change behavior…Like reminders to grab an umbrella or do your civic duty, social media platforms can empower users to be more discerning consumers of information. It is not a question of ability; it's a question of volition."[20]

Chabuk and Jonas, authors of the AFCEA post, draw a distinction between "tools" and "will," while Jankowicz makes the same distinction between "ability" and "volition": in either case, between technological implements and human agency. They share the two-parted assumption that we possess the technical capability but that we lack *will*. What do they mean by "volition" and "will"? Within the abstract social subsets to which they seem to refer (the cybersecurity community and social media platforms, respectively), who exactly do they think lacks these qualities? It's not entirely clear. In general, "will" and "volition" are intangible aspects of the human person, and in the Western tradition they're tangled up with ideas like free will, morality, and collective action as the consequence of the democratically authorized agreements of individuals.

In other words, these very recent writings on national security in cyberspace do not examine the possibility that will and volition could be subject to technical intervention, and that

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[19] Chabuk, Timur and Adam Jonas, "Understanding Russian Information Operations," 1 September 2018. Available from https://www.afcea.org/content/understanding-russian-information-operations.

[20] Jankowicz, Nina, *How to Lose the Information War,* (I.B. Tauris, London 2020), 221

if we lack the "will" and the "volition" to change what most everyone seems to agree is a problem, perhaps we do *not* have the tools. To put it another way, despite a widespread understanding of the importance of social security and the emergence of terms like "social engineering," writing published in the past two years nonetheless shares that foundational assumptions about engineering's relationship to the human person that in 1963 led Claude Shannon to assume that the engineer's limited role was to transmit symbols, and to leave the meaning and effect of those symbols to someone else.

What happens when we examine the ideas of engineering and the human perspective from a different perspective? As it happens, the history of Soviet technological development as described by Wladimir Velminski in a curious recent volume called *Homo Sovieticus* offers some insights into this question. As a first step in re-imagining "material assumptions about what [is] and [is] not possible" with regards to narrative, engineering, and influence operations, I begin with an exploration of Velminski's work.

Over the years, Soviet scientific research has aimed to discover systematic methods by
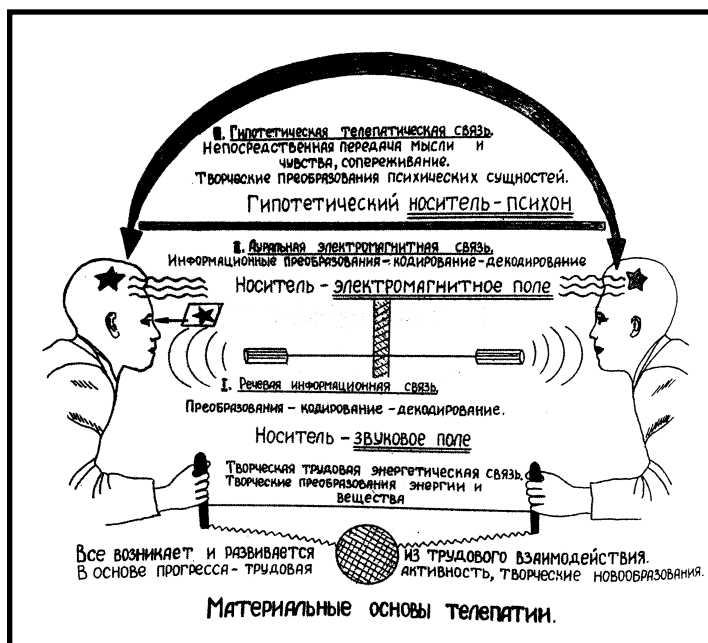
which the individual could be subsumed into the Soviet collective: the scientific means by which human "will" and human "volition" would be transformed into Soviet tools. For instance, Velminski describes a drawing that cybernetic scientist Pavel Gulyaev (pictured left) made in 1965

as follows: "The ballpoint sketch […] shows a control circuit linking two figures. […] A red arrow arches over the figures; it points aim at their heads. In each case, a star is shining where thought occurs. A Soviet star: a neural prothesis."[21] And the purpose of such a cybernetic system? According to Velminski, "the unmediated transmission of thoughts, feelings, and sensations; at the same time, it involves the creative reorganization of the psychic substance. *Psikhon* is Gulyaev's word for the energy coursing through this circuitry; clearly its properties take shape in a *feedback* system that alternates between *control over* media and *being controlled by* media."[22]

Other Soviet scientists foreshadowed the idea of "information contagion." For instance, Soviet neurologist and psychiatrist Vladimir Bekhterev made the following claim: "The *contagium vivum* of bodily infections, whose nature and effects research is making clearer and clear, has its counterpart in a *contagium psychicum*; even if it escapes all observation, by rude sensory means, the latter, as much as the former, still threatens the human organisms with the danger of immediate infection."[23] Bekhterev conducted experiments in which he attempted to implant psychic visions in the minds of human subjects, and he found that "easily agitated, nervous personalities especially suitable" to tests in which "he sought to instill 'ideas, feelings, emotions, and other psychophysical states in the psychic sphere of subjects' by 'bypassing consciousness and the faculty of judgment.'"[24]

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[21] Velminski, Wladimir, *Homo Sovieticus,* (Cambridge, Massachussetts; London, England: MIT Press, 2017), 1.

[22] Ibid, 2.

[23] Ibid, 33.

[24] Ibid, 36.

My point here is not to suggest that morally dubious experimentation is unique to Soviet culture. Neither is it to make all-embracing, unprovable claims about "Soviet" vs. "American" thinking based on inductive reasoning from limited examples or to exaggerate Russian evil genius.[25] Rather, an observation: Soviet cyberneticians had a fundamentally different viewpoint which counted human beings themselves as information channels subject to experimental scrutiny, and therefore a fundamentally different viewpoint on what counts as "technology." What were their assumptions about engineering's role in the realms of meaning and behavior?

While Soviet scientists conducted thought control "experiments," Soviet writers described these experiments—both real and imaginary—in their work. In *The Ruler of the World*, a Soviet science fiction novel by Alexander Belyaev, a scientist learns how to subjugate others through telepathy. Wladimir Velminski comments:

> The model of communication Belyaev took up in, and disseminated through, The Ruler
>
> of the World attaches singular importance to emission and transmission [of information].
>
> The very possibility of such an exchange between fact and fiction points, over and above
>
> the book's technological themes, to the process of transfer, interference, and storage
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> identified by Claude E. Shannon.[26]

To rephrase Velminski's dense writing in simpler terms: at the same time Soviet scientists conducted para-scientific experiments with the intent of exploring modes by which they could subject Soviet citizens to centralized thought control, Soviet science fiction writers disseminated

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[25] As David Kilcullen aptly observes, "Russian planners tend to ascribe the same evil genius to us that some Westerners believe of them…[I]t's entirely possible that none of us actually know what we're doing, that far from having cunningly executed master plans we are all reacting instinctively, often incompetently, in the moment." Kilcullen, David. 2020. *The Dragons and the Snakes*. Oxford: Oxford University Press, 224

[26] Velminski, Wladimir, *Homo Sovieticus,* (Cambridge, Massachussetts; London, England: MIT Press, 2017), 48.

narratives that introduced the public to potentially objectionable ideas in an unobjectionable way. Above and beyond propaganda, *the narrative itself* constituted an experimental praxis. If science is "the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment"[27] which results in "a systematically organized body of knowledge on a particular subject,"[28] then Soviet science fiction writers were not para-scientific; they were themselves scientists. Their subject was the structure and behavior of the human information channel, and their experiments were communicative transmissions made on the human channel. The literary praxis operated in parallel with (to American eyes) traditionally scientific experiments in mind control.

I conclude the exploration of Velminski's *Homo Sovieticus* with a return to Claude Shannon. If we repurpose Shannon's three levels of communication while shedding his assumptions about the jurisdiction of engineering in favor of a more "Soviet" perspective, the result might be something similar to the following:

Level A: To what extent is the information-contagion altered during the process of transmission?

Level B: How can we control the semantic interpretation of the information, that is to say, how does information communicate narrative?

Level C: How does narrative affect behavior?

What would be the consequences if we adopted this perspective on socio-technical systems and assumed that engineering principles applied to all three levels? How would principles of noise

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[27] "Science", *New Oxford American Dictionary*, version 2.3.0

[28] "Science," *New Oxford American Dictionary*, version 2.3.0

and redundancy apply? I harbor suspicions that doubt is a kind of noise on the human information channel, but as yet I do not have a firm enough grasp of the literature to make any such claims authoritatively, so I will leave further speculation to the reader and instead move on to describing an additional discrepancy between "material assumptions" and "technical realities" in the realm of narrative and technology.
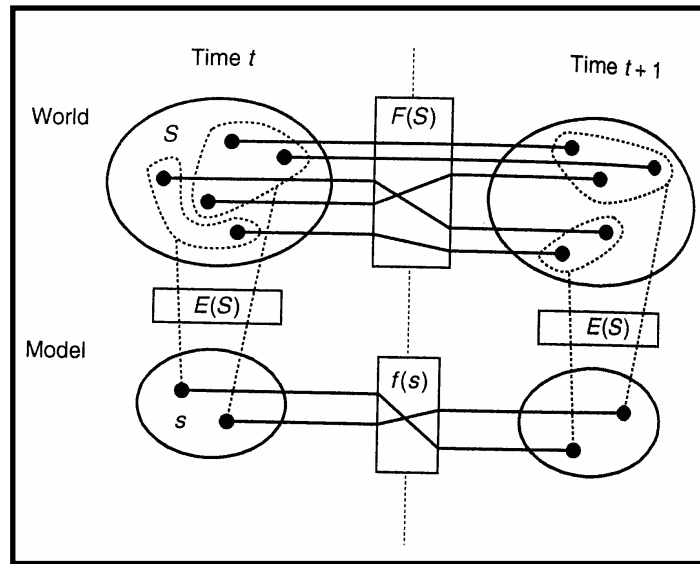
It's widely assumed that narrative is technically difficult, or even impossible, to generate by computational means, and therefore narrative influence operations will at least be limited by the material cost of the human labor involved with, for instance, sophisticated sock poppet campaigns designed to disseminate particular political narratives. Given the earlier formal definition of a story as *the selection of information deemed relevant to a meaningful representation of some given subject* and narrative as *a mechanism by which such information is selected*, it's not clear that there exists any immovable material or technical obstacles preventing the direct development of a precise mathematical model of narrative and the application of this model to the development of new software, even if one discounts machine learning as a route by which one might arrive at a similar destination. Indeed, bio-semiotician John Oller proposed a mathematical model for "meaningful sign systems without any exceptions" including "any meaningful fictions" in a paper he published a full ten years ago.[29]

Even without a mathematical theory specific to "narrative," as long as we accept narrative as a mental model, there already exist many theories of modeling which might be applied with the aim of understanding narrative more formally. For instance, on page 38 of *Complex Adaptive Systems,* John Miller and Scott Page present the following diagram of a "model of models":

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[29] Oller, John W. 2010. "The Antithesis of Entropy: Biosemiotic Communication from Genetics to Human Language with Special Emphasis on the Immune Systems." *Entropy (Basel, Switzerland)* 12 (4) (Mar 31,): 631-705. doi:10.3390/e12040631. https://search.proquest.com/docview/1537808624.

Time *t*   Time *t* + 1

World

S   F(S)

E(S)

Model   E(S)

f(s)

s

According to Miller and Page, models simplify the complexity of the "real world" by transforming a subset of actual world states into an equivalence class. The model's success, therefore, is "tied to its ability to capture the behavior of the real world."[30] Miller and Page explain:

> Suppose we begin with real-world state S'. The model transforms this state into s' = E(S') and then predicts that we will find ourselves in state f(s') in the next time period. In the real world, state S' becomes state F(S') in the next time period. Thus, the model "coincides" with the real world if f(E(S')) = E(F(S')), that is, if we end of up at the same model state regardless of whether we (1) first transform the initial real-world state into its equivalence class and then run it through the model's transition function, or (2) first allow the real-world state to be transitioned to its next state and then map this state, via the equivalence class, to the model.[31]

[30]Miller, John H. and Scott E. Page. 2007. Complex Adaptive Systems: An Introduction to Computational Models of Social Life. Princeton, NJ: Princeton University Press, 39.

[31] Ibid, 39.

Miller and Page refer to this commutative property of successful models as "homomorphism" and consider "the goal of modeling," if one agrees with this view of models, "is to find a set of equivalence classes and a transition function that results in a useful homomorphism."[32]

These are few examples of possible formal frameworks for narrative that may impact strategy for cyber-enabled influence operations. Besides the fact that these theories may impact the "informational strategy" of nation-states in some abstract sense, narrative as a facet of information security is an idea with immediately applicable implications.

For instance, many scientists working at the intersection working of computer science and social science have written about the effects of network characteristics. Additionally, many psychologists have written about the well-known cognitive bias known as the Einstellung effect, which "occurs when an idea that comes immediately to mind in a familiar context prevents alternatives being considered."[33] Yet without bridging these two facts with the concept of narrative as a mechanism for information selection, one would be unlikely to arrive at the idea that flooding a network with stories that familiarize people with particular "would-be" contexts might be an effective way to weaponize the Einstellung effect against particular knowledge networks. These sort of specific intuitions are crucial as practitioners in the emerging field of social cybersecurity attempt to apply broad frameworks, such as the BEND framework, to the analysis of particular influence campaigns.[34]

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[32] Ibid, 39.

[33] Merim Bilalić, Peter McLeod, and Fernand Gobet. 2010. "The Mechanism of the Einstellung (Set) Effect: A Pervasive Source of Cognitive Bias." *Current Directions in Psychological Science : A Journal of the American Psychological Society* 19 (2) (Apr 1,): 111-115. doi:10.1177/0963721410363571. https://www.jstor.org/stable/41038551.

[34] Carley, Kathleen M. 2020. "Social Cybersecurity: An Emerging Science." *Computational and Mathematical Organization Theory* (Nov 16,): 1-17. doi:10.1007/s10588-020-09322-9. https://search.proquest.com/docview/2463602489.

## Conclusion

I begin my conclusion with the sense that I have barely scratched the surface--even the rather limited surface circumscribed by the two guiding questions I proposed at the start of this paper. I've omitted many topics related to the "material assumptions" that condition our understanding of narrative—including the economic impact of the Internet on American media and publishing, the CIA's involvement in the formation of the nation's literary culture, the neuro-scientific study of literary structure, and the application of Nissenbaum's "contextual integrity" to the evaluation of privacy standards for narrative and story-telling—as well as many unrelated pages I wrote in pursuit of metrics for influence operations. Despite these shortcomings, I hope the paper demonstrates some of the ways that an interdisciplinary approach to questions of privacy and security engineering can be fruitful.

As new revelations about the dangers of influence campaigns continue to pile up, it is worth acknowledging that we are entering new territory. Rapid changes in the material conditions governing information transmission have left many people in a state of anxiety as we face the post-truth reality. These fears are far from unfounded. But it is worth remembering that the same narrative power which is abused in pursuit of geopolitical ambition is also available to us as a tool for remediation.