ON MEMES: A BRIEF INTRODUCTION TO MEMETICA,

OR A CONTEMPORARY RHETORIC OF INFORMATION

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ABSTRACT: As is widely known, memes are commonly understood as catchy items on social media – often an image with text – that "goes viral" and gets shared/spread among many people online. However, this article discusses the older, original, and more expansive sense of "meme", introduced and elaborated upon by Dawkins, Blackmore, and Dennett, among others, that initially means something like a "unit of cultural information." One way rhetorically and philosophically these days to conceive of "it all" is as a massive ecology of memes. What I call "memetica" is another way of exploring a rhetoric and conception of a totalizing ecology of information. The term "information" generally is ambiguous and may cover a massive amount of multi- and cross-disciplinary conceptual territory involving, for example, "bits" in physics, "genes" in biology, and "signs" in human sciences, humanities, and arts. This article briefly introduces the origins, rhetoric, and concept of memes as an initial way into the topic of information – arguably one of the most powerful, dynamic concepts in contemporary existence.

KEYWORDS: Memetica; Memetics; Memes; Ecology; Information; Signs

I. INTRODUCTION: MEMES

The name "Memetica" comes from the idea and language of "memes." As is widely known, memes are commonly understood as catchy items on social media – often an image with text – that "goes viral" and gets shared/spread among many people online. But I am thinking of the older, original, and more expansive sense of "meme" that initially means something like a "unit of cultural information" (e.g. Rogers 2022). A classic example of this is the "Happy Birthday to You" song (Blackmore 1999, 7). It is a tune that caught on and spread all over

the world. But also the concept of memes can be conceived to include whole complexes of things that are culturally transmitted such as religions and social customs.

One way to conceive of "it all" these days is as a massive ecology of memes. Conceiving of "it all" or "how things…hang together in the broadest possible sense" is one classic way of characterizing the task of philosophy (Sellars 1963, 1; originally 1962, 37; cf. Santayana 1910/2021, 8; Godfrey-Smith 2014, 1). From the vantage point of *writing* about things, Emerson joins the company of many others such as Whitman, Dickinson, and Ernaux (2008/2022) when he writes, "The writer…believes all that can be thought can be written…. In [writers'] eyes a human being is the faculty of reporting, and the universe is the possibility of being reported" (cited in E.L. Doctorow 2003, 1). I am a writer, and the "report" at hand here in the present article responds to big questions that some people from time to time ponder: *What's it all about?* Or: *What's going on out there (in the world)?* Of course it could be pointless to ask such questions because arguably there is no way for any one human, group of humans, or any one at all to really know. For all we humans know, all knowledge remains ultimately perspectival and limited. Yet some people still ask the question (*What's going on with it all?*) and seek some kind of a satisfactory answer. One of the most powerful answers – or call it a model or metaphor – that can be given these days is what I call "memetica": a rhetoric and conception of a totalizing ecology of "information."

But importantly the term "information" here does not simply mean "facts." I am attempting to work out what information can mean in all its ambiguous and sometimes contradictory senses, but just to give a taste of the more expansive senses, consider this classic description of it: *information is "any difference that makes a difference"* (Bateson 1979, 228; cf. 99; emphasis added). That description could sound meaningless at first take. It is so general and sounds tautological. That is initially what I thought when I first heard it. But after letting Bateson's description marinate for a while, it has grown on me. We will not get too far into the details here yet, but one thing that immediately comes to mind is that if indeed one has some "difference" in something that indeed does "make a difference", then one now has *value*. One has something valuable. And, among other things, valuable things get passed on. They get transmitted. From person to person. And from generation to generation, if possible. One of the vital things transmitted from

generation to generation is DNA, our genes. So right away – at least in a "fast" take – one may see that information transmission can be biological as well as cultural. Very quickly then, we see that the term "information" may cover a massive amount of conceptual territory, both cultural and natural.

In fact it was biology, *genes* in particular, that originally inspired the concept of memes by Dawkins in 1976. *What if,* Dawkins asked, *there was a unit of replication in culture analogous to the unit of replication in biology?* He came up with the term "meme" (rhyming with "cream" in English) as a direct analogy and counterpart to the gene.

> The new soup [of life] is the soup of human culture. We need a name for the new replicator, a noun that conveys the idea of a unit of cultural transmission, or a unit of imitation. 'Mimeme' comes from a suitable Greek root, but I want a monosyllable that sounds a bit like 'gene'. I hope my [classical studies] friends will forgive me if I abbreviate mimeme to meme. If it is any consolation, it could alternatively be thought of as being related to 'memory', or to the French word même. It should be pronounced to rhyme with 'cream'. Examples of memes are tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches. (Dawkins 1976/1989, 192)

From there, many others – most notably Blackmore (1999) and Dennett (2017) – have tried to take this original inspiration and run with it, elaborating much further on the potential for a concept of memes.

Blackmore's *The Meme Machine* (1999) may still be the most comprehensive popular science attempt to articulate the scope of memes in human cultural transmission. As she puts it,

> Everything that is passed from person to person in this way [i.e., by way of imitation] is a meme. This includes all the words in your vocabulary, the stories you know, the skills and habits you have picked up from others and the games you like to play. It includes the songs you sing and the rules you obey.…
>
> Take the song 'Happy Birthday to You'. Millions of people – probably thousands of millions of people the world over – know this tune. Indeed, I only have to write down those four words to have a pretty good idea that you may soon start humming it to yourself. Those words affect you, probably quite without any conscious intention on your part, by stirring up a memory you already possess. And where did that come from? Like millions of other people you have acquired it by imitation. Something, some kind of information, some kind of instruction, has become lodged in all those brains so that now we all do the same thing at birthday parties. That something is what we call the meme. (7)

Blackmore extends the concept into complexes of memes called "memeplexes", examples of which include societies and religions (187ff.).

More recently, Dennett (2017) has elaborated what may be the best, further developed, philosophical concept of the meme yet:

> What are memes a kind of? They are a kind of *way of behaving* (roughly) that can be copied, transmitted, remembered, taught…. There is no term readily available in [scientific language] that aptly encapsulates what kind of a thing a meme is. Leaning on…ordinary language…we might say that *memes are ways*: ways of doing something or making something, but not *instincts* (which are a different kind of ways of doing something [sic] or making something). The difference is that memes are transmitted perceptually, not genetically. (206)

As remarkable as it seems, not long ago there was no concept of a gene – and once there was, there was immense skepticism in regard to it, until Watson and Crick, along with Franklin and Wilkins, discovered the structure of DNA in the famous double helix (cf. Stent 1980; Kay 2000). Part of the dream of those who have pursued the meme as a concept is to have a similar experience as was had with the gene. Historically response to the concept of the gene moved from incredulity and offense that biological life could be reduced to information transmission through genes to then, later, becoming accepted science. Could incredulity and offense that cultural life could be reduced to information transmission through memes gain analogous power and acclaim? A few years back there was even an academic journal devoted to "memetics" (*Journal of Memetics*), and the attempt started in 1997 to go full swing into developing a science of it. But apparently it could not be done then, the journal ceased publication in 2005, and most of the academic excitement dissipated. Yet, some interest persists.

Meanwhile, since then in the popular imagination, the idea and term meme as everyone knows has taken off and become an example of itself: "meme" now is a meme – it is a catchy concept that has spread through our languages and cultures. It includes not only funny pictures of kittens or Sponge Bob on social media but also "meme stocks" and the idea that catchy things can spread across financial markets. What happened with GameStop or AMC (meme stocks), cryptocurrencies, or NFTs (non-fungible [digital] tokens) are not simply trends at the moment. They point to something much bigger, more important, and interesting: that the language and concept of memes may help us understand the

deep and wide dynamics of how our contemporary world is currently operating.

II. INFORMATION

Of course there are many problems, criticisms, and various ins and outs of memes and especially any idea of a meaningful memetics. At worst, ridicule of memetics could compare it to alchemy or to vacuous, self-serving, capitalist propaganda. At best, criticism of it might compare it to something like Freudian psychoanalysis: not science, often wrong, but tremendously fruitful and insightful in some respects. (Among many critical handlings of memetics, consider Aunger 2000 and Kronfeldner 2011; cf. Blute 2012; Gare 2012; Botz-Bornstein 2021). In what I am trying to do right now, I am not arguing in favor of memetics or of memetica. Rather, I am primarily about the tasks of description and some analysis. If there is an argument I have for people, it might be: if you are not seeing this massive, all-permeating, information ecology, you should, because it is one of the most powerful dynamics in our current existence.

Additionally it is one of the most powerful rhetorics: *information rhetorics* range widely over many fields, disciplines, and domains, from physics to biology to anthropology to economics and art (Bennett-Carpenter 2009; 2014; 2023; cf. Seife 2006). And when I say "rhetoric" here I do not mean "mere rhetoric" as in "empty words without reality". Rather, the rhetoric I refer to here is *constitutive* – it makes up (constitutes) that of which it speaks (Bennett-Carpenter 2008; cf. Jost and Olmsted 2000). That is, the terms or words we use are *integral* to our very ideas. Information *rhetorics* are also information *concepts.* If you or I or other people are not seeing the rhetorics/concepts of information currently at play, we are missing one of, if not *the*, primary (serious, real-life) Games currently being played on the world stage, in the back alleys, on mobiles, across kitchen tables, and within 21st century minds.

By "game" here, I do not mean something trivial but, rather, something at least penultimate, and possibly ultimate. Over many fields, disciplines, and domains, "information" rhetoric is the air one breathes. As has been described elsewhere:

> The 'game' here is a serious one in the sense that it is another way of describing what Wittgenstein called *Sitz im Leben*, a form of life. This 'game' or 'form of life' is the entire semiotic and semantic system within which one 'lives and moves and has one's being.' This is one's 'final vocabulary' in Richard Rorty's (1989) sense of being

> the very terms by which one describes, narrates, imagines, and directs one's life in relation to others within a particular group. (Bennett-Carpenter 2019, 85)

It may sound a little strange that "meme" is one form, one term, of such information rhetoric. Yet, speaking about "memes" may be one way of packaging a whole discussion of information rhetorics as they play out within this or that group of people. Two key points to keep in mind are: 1) *That* people use information rhetoric – and that 2) different groups have *their own* version of that rhetoric.

To a large extent my label of "Memetica" is a useful, catchy branding or packaging for getting people into the rhetoric and conception of "information." By contrast, if the term *information* is just about "facts", it may sound to many people quite boring. So part of the educational trick here is for us to get past this narrow sense of information and into the interesting, provocative material, e.g., information is "a difference that makes a difference." Which means information is *value added* to whatever it is: art, conversation, structures, recipes, movements, machines, organisms, a song, you name it. In the midst of all this, an opportune way for many people into this discourse right now is through discussing "memes."

Simply mention "meme" and many people's ears perk up. Once we get passed the idea that memes are not only things that spread on social media but may be conceived (as they originally were) as units of cultural information that are transmitted and spread throughout culture – *historically*, from generation to generation (through cultural inheritance), and *contemporaneously*, from person to person in "real time" right now (through cultural trends) – then we are into the primary material. That is, we are into the idea of information / information transmission.

And from information / information transmission a vast expanse opens up. If we can look forward to the totality of "memetica" for a moment, we will see this. The vast expanse that opens up is all of what we humans know as our reality as we conceive it both within us and beyond us – from the physical universe to the totality of biological life into the interior "galaxies" of human minds and out again into human movements, structures, and imagination as manifested in our societies, stories, poetry, arts, music, bodies, economies, and cosmologies. *All* of these things may be spoken about and conceived in terms of information transmission.

As just a few examples of this grand perspective, take Gleick's (2011) description from his very helpful introduction to the topic in the book *The Information: A History, A Theory, A Flood*: "…information is what our world runs on: the blood and the fuel, the vital principle. It pervades the sciences from top to bottom, transforming every branch of knowledge" (8). In another excellent introduction, *Information: A Very Short Introduction,* Floridi (2010) says, "…the ultimate nature of physical reality…is informational…" (70; see also Floridi 2011/2014). Thacker (2010) adds that even "…'life' [itself] is understood as being essentially informational…" (117). Getting into our brains, Bechtel and Richardson once said (1993), "The dominant metaphor [in cognitive science] is that cognition is information processing" (210). Even more than the brain, Gleick adds, "The body itself is an information processor. Memory resides not just in brains but in every cell" (8). Meanwhile, the use of "information" extends beyond cells, brains, and bodies to human cultures and global society itself:

> *Culture is information* that people acquire from others by teaching, imitation, and other forms of social learning…[i.e.] *socially transmitted information*… (Boyd and Richerson 2005, 3, emphasis added).

The conquest of the cyber-frontier is a sequel to the grand technological narrative of space…already enshrined in the expression '*global information society*' (Mattelart 2001/2003, 1, emphasis added).

And these are only the tiniest sampling of what is out there conceptually and rhetorically regarding information. "Information" has become a buzzword with many, many associations. Minimally we can talk about information studies, information science, information technology and systems, information culture, information age, information society, and, also, information literacy, information overload, information economy, information warfare, and information poverty – not to mention misinformation and disinformation, and TMI – Too Much Information! The discussion of memes and memetica is a way to encompass all of this and allow us a way into managing and negotiating it.

Granted, how this approach sounds to each reader may depend upon one's sensibilities, personality, training, and orientation within or across various disciplines, fields, or domains. For myself, sometimes I am inspired and bowled over by such a grand vision in wonderment. Meanwhile, I question it. Other times, it all sounds vacuous and like just too much – a whole, unnecessary "cloud

of unknowing" – and then it is my job to break it down. Yes, we can talk about Everything in terms of Information, but of course then when we get into specific disciplines, fields, and/or domains, the terms and specifics change. Does physics, biology, and anthropology or psychology all mean the same thing when they say "information"? The short answer is, No. To carry on the short answer, physics may talk about information in terms of "bits"; biology about "genes"; and anthropology or psychology about "behaviors" or "representations." Meanwhile, semiotics – the study of signs (as in something like symbols) – discusses the whole matter of information in terms of "signs." It is not long then til we come full circle and start speaking again of how "memes" play into the discussion of information transmission in its variations across various arenas.

So one option here could be to go into every single discipline, field, or domain and ferret out what and how information rhetorics/concepts are being used. For instance, we can ask about:

"information" in physics: *bits?*
"information" in chemistry: *reactions?*
"information" in biology: *genes?*
"information" in psychology: *representations?*
"information" in sociology / anthropology: *transmission?*
"information" in history: *documentary?*
"information" in economics: *value?*
"information" in humanities/arts: *signs?*

I will not do all of that here. Instead, I am going to select three of the most prominent terms in my estimation and give them as the key examples. Beyond mere examples, they really are *exemplars* for information concepts and, as such, are some of the most prominent candidates as the most powerful word-ideas in human language. (Comparing terms and translations in non-alphabetic languages such as Japanese and Chinese are currently beyond my scope but should be done.) These exemplar/candidates are "bits" (physics), "genes" (biology), and "signs" (semiotics, humanities, and arts).

Holding the general fact that people use information rhetoric is crucial but not enough. We must also see the particular information rhetorics from group to group: from one field, discipline, or domain to other fields, disciplines, or domains. "By employing [such particular, specialized] language…the user

communicates [their] participation not only within a particular language game or final vocabulary but also with a particular group" (Bennett-Carpenter, McCallion, and Maines 2013, 18). As we bounce back and forth from the general to the specific, we begin to see the way one may conceive information in an "undifferentiated" vs. a "differentiated" manner.

undifferentiated (or 'holistic'):	"information" in general
	"memes" in general
differentiated (or 'critical'):	pick your field, discipline, or domain, & supply the term: "bits"? "genes"? "signs"?
	"representations"? "ideographs"?
	(Bennett-Carpenter 2014).

Within this very brief introduction to memes and memetica, I can only indicate that there are tremendously diverse, complicated, cooperating, and conflicting uses of the rhetorics and concepts of "information" (cf. Gare 2020; Simondon 2020) and point to the fact that these correspond to diverse, complicated, cooperating, and conflicting lines of conceptualization, practice, and inquiry. Within all this however, three terms/concepts stand out: bits, genes, and signs. The first of these is "bits."

III. BITS

Like so many information terms, "bits" is used in different ways so right away creates confusion and misunderstanding to the uninitiated. To begin, I am going to share a simple distinction that may help us start to sort out the range of uses. The distinction to highlight is between, on the one hand, "bit" as a *concept* and, on the other hand, "bit" as a precise *unit of measurement* (like an "inch").

Firstly, as a *concept*, in a basic way of understanding *bit,* one may think of it as an indication of difference formed as a binary of "*this* vs. *that*" or "Yes vs. No" (Weaver 1949, 13; Tizard 1957, 14; Florkin 1974/2010, 472; Lowenstein 1999, 5-6; Kay 2000, 99, 119; Floridi 2010, 28-29, 43-45; Hoffman 2012, 248). This sense of

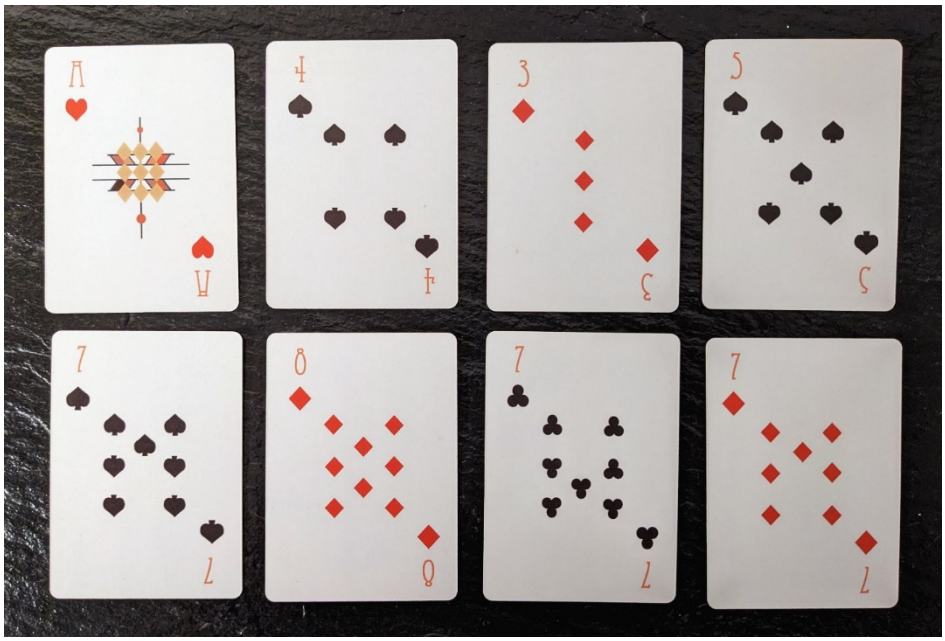
bit is as "a difference that makes a difference" in the Bateson sense of it. Going towards Yes rather than No (or vice versa) creates one path that is taken as opposed to another path. Think of Frost's (1915) famous lines: "Two roads diverged in a yellow wood, and I—I took the one… and that has made all the difference". A bit is an indication of one thing being turned on and another being turned off. In mathematical language, it is the difference of 0 vs 1. This is informational, in this sense, because one thing is happening rather than another. (It's not just "noise" or completely non-consequential.)

The *0 vs 1* way of conceiving bits then gets us, secondly, to bit as a *unit of measurement* used in advanced mathematics, physics, computer science, and information science (Shannon 1948, 380; Lowenstein 1999, xv-xvi; Kay 2000, 99, 119; Luenberger 2006, 10ff.; Floridi 2010, 28; Gleick 2011, 4). Not surprisingly, this mathematical/scientific territory gets very advanced and technical, so we turn to Luenberger (2006) who explains the basics in his helpful text *Information Science* that:

> The bit is a unit of measure frequently used in information sciences. However, it has at least two slightly different meanings [as a unit of measurement]. In its most common use, a bit is a measure of the actual number of binary digits [0 or 1] used in a [mathematical] representation. For example, the expression 010111 is six bits long. (17)

It is "6 bits" because there are 6 instances of either a 0 or a 1, and we get to saying "6" simply by counting the string of individual 0s and 1s. There also is a second, more technically expressed, meaning or manifestation of bit as a unit of measurement, but we will see those details below shortly. Before seeing that, I want to say more about our first sense of bit – as a concept.

Instead then of simply counting how many zeros (0s) and ones (1s) you might have in a string of them such as 010111, let us move to what those 0s and 1s could signify – that is, what difference they make. In a most basic sense, a bit is a simple answer to a Yes or No question that ends in a particular result. It is an "On" or an "Off". One example of this that appeals to me most (that I get from Loewenstein [1999, 7, modified] and has helped me the most) is a simple game or card trick of "Find the Ace" with a deck of playing cards. For the sake of ease, say we have a deck of 8 playing cards. One of those cards has the Ace of Hearts. Here they are face up.

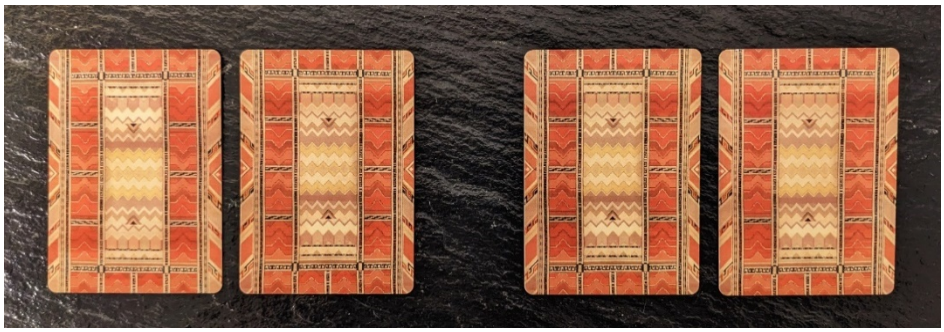


[Image credit: Original playing cards by The Center for Collections and Research, House Party 2022, Cranbrook Educational Community; photos of playing cards by Author.]

Say I shuffle them and lay them face down like the following.

I know where the ace is and you do not. I ask you to choose one of the batches -- the upper batch (the top 4) or the lower batch (the bottom 4) – the batch where you think the Ace is. Is the Ace in the upper batch or the lower batch?

Whatever batch you say (either upper or lower), I will end up removing the batch that does not have the Ace. If you say "upper batch", I remove the upper batch because I know the Ace is in the lower batch. One choice has been made. In my understanding of various uses of the term bit, we would now be at 1 bit – that is, one choice: you chose the upper instead of the lower batch. So now we have the following.



Next we repeat the same question with the 4 cards – I divide them in two and ask you to make a choice: left batch or right batch? Say for instance you say "right batch" and you are correct. (For the sake of the trick, it is irrelevant whether you are correct or not because as the card "magician" I always rule out the batch without the Ace, that is, without the pre-selected card we are going for.) The left batch is thrown out. A second decision has now been made. We now have 2 binary choices that have been made. That is: 2 bits. (Note that the choices being made are creating a certain "path" or trajectory that is different from other paths or trajectories.)

Finally we are down to two cards.

Ultimately it does not matter in this simple card trick which one you pick because the crucial thing is that one option as opposed to another is taken. Left or right? For the sake of the story, you chose the right card, which is also correct! And there it is, once we turn it face up: the Ace of Hearts.

Thus, by way of 3 binary choices – *this* or *that*; A or B; right or left – we end up with a result. In the case of this card trick, the end result is predetermined. In the case of a game, the end result is left to chance – with the particular result determined by the various decisions made. It is this difference that points to a bit as a form of information.

Another way that this example could be represented is the following.

Initial setup:	XXXX XXXX
Random choice #1:	XXXX
Random choice #2:	XX
Random choice #3:	X

Another simple illustration of the concept of bits is the parlor game of *20 Questions*. By Yes or No questions a player seeks to discover a pre-selected mystery item through process of elimination (with 20 questions being the limit). I am thinking of something, and you are allowed 20 yes or no questions to try to figure out what I am thinking of:

Q1: Yes or No: Is this a person?
A1: No.

Q2: Yes or No: Is this a place?
A2: Yes.

Q3: Yes or No: Is this place in the Western Hemisphere?
A2: No.

etc.

Again, this is a game with a predetermined end. In an open-ended context, various binary choices lead to unpredictable outcomes. For example, say we played a walking game called "Left or Right Block." You set the timer on your mobile in your favorite town and begin by walking one block. Then you either go left or right at the corner and walk for another block. Again, at that point, you choose and go either left or right and so you proceed on for one hour – and see where you end up! It is the the L or R decisions that determine the outcome. Each choice or bit is where the information is.

I will not venture into the details of *how* all this turns into a mathematical logarithm, which those in the maths and sciences may find extremely simple, while some in the arts and humanities – such as myself – could struggle with. But I will share what all this looks / "sounds" like as a mathematical formula. In the card choice example we see that

> …3 is the minimum number of correct binary choices or, by our definition…, the amount of information needed to locate a card in this particular arrangement. In effect, what we have been doing here is taking a binary logarithm of the number of possibilities (N); $\log_2 8 = 3$. In other words, the information required to determine the location in a deck of 8 cards is 3 bits. (Lowenstein 1999, 7)

So we see that bits are definitely quantifiable. And thus we return to bits not only as a concept but also as a unit of measurement. They can be quantified in a simple mathematical logarithm by simply counting the number of decisions or choices that have been taken in a given operation of things.[1] As Florkin

[1] If all this is not already interesting enough, it gets even more interesting when one considers that there may also be a qualitative aspect here. Very roughly and simply put, it can be fruitful to consider "bit" not only as a noun or quantitative "thing" but also as a verb, "action", or "activity". We somewhat have already seen this distinction in our card example. In one sense, at the end of the card choice example, one can say one has a *quantity* of something: *3* choices, i.e., 3 bits. This ordinarily registers as a noun: it is not a person or a place, but it is a *thing*. In this sense, a bit is a thing – a quantifiable result.

But then also, there is how one gets to that thing (or noun). It was through the action or activity of *choosing*. One recognizes this choice as a verb. Then it follows, in this sense, that a bit is a verb. A bit is an activity. It is a process of *differentiating* between *this* or *that*. A bit in this sense becomes the making of a *way*.

(1974/2010) spells out clearly:

> The 'elementary quantity of information' that can be transmitted by a simple 'binary' symbol (choice between two alternatives) corresponds to *bit* (binary digit)
>
> 2 bits correspond to a choice between 4 alternatives
>
> 3 bits correspond to a choice between 8 alternatives
>
> 4 bits correspond to a choice between 16 alternatives
>
> *n* bits correspond to a choice between 2^n alternatives. (472)

Each bit or choice is a particular point in a decision tree – "a difference that makes a difference" creating *qualitative significance* or "paths" that we end up with in any given situation. Put another way: *it from bit,* in the famous slogan of John Wheeler (1989/2023). Things emerge out of such choices.

Before moving to our next informational term – genes – it should be pointed out that *information in general*, and *bits in particular*, dominate the rhetorical and conceptual worlds of mathematics, physics, computer science, information science, and all related fields, disciplines, and areas of practice including technology, media, medicine, economics, and all other related information-related professions and applications.[2] In the grand scheme of things, and with other specific areas, disciplines, and fields, the general information rhetoric and concept remains, but the specifics (terms and concepts) change. Thus, not merely as a next example, but indeed as a truly *exemplar* instance, we turn to the world of biology, the world of living things, and specifically to the rhetoric and concept of the *gene*.

(Immediately here we may recall Dennett's description of a meme as a way and wonder what, if any, connection there may be.) For example, imagine following the path down a decision tree. Very strangely enough, bits – especially in succession or in a series – become *narrative*! They begin to tell a story. A "story" is being "told" as one moves through the tree choice by choice. Out of what seems entirely quantitative and "cold" (0 vs 1) (Y vs N) comes the *qualitative.* Bits start to "warm up"!

[2] Of course there is so much more to discuss that cannot be done in this limited space here. For example, we did not get to whether or how "information" is physical or not. (Short answer: in some sense it is physical – i.e., information is physical. But in a more accurate sense: information is *based on* the physical. Also we did not touch on quantum bits or the "qubit" – which will have to be left for another time. We also have not been able to elaborate more on the contrast and significance of *difference* – for example when you make a choice – vs. *sameness.* And particularly what such contrasts mean for patterning. (Floridi [2010]) gives an interesting example of this through a story by Poe about a raven that keeps repeating the same call over and over again (39).

IV. GENES

We all know what genes are, do we not? Or do we? In common imagination, genes are building blocks – the building blocks of life. One image could be of the immensely popular Legos play blocks. Another image that may come to mind of building blocks could be the visual units that get moved around in the popular video game Minecraft to construct a virtual world of one's own. There is also the image of genes lining up as a code, a message, or as a series of "letters" that spell out the "book" of life. In a vernacular sense of things, we may easily associate letters or a book, like genes, with the idea of conveying information.

Another starting description of a gene is "the basic unit of heredity in living organisms", and the root of the term itself originates for/from "race" or "offspring" (*Oxford English Dictionary* 2023). In the contemporary world we may hear of gene banks, gene cloning, gene clusters, gene complexes, gene expression, gene flow, gene frequency, "gene gun", gene maps, gene mutations, gene pool, gene-poor, gene-rich, gene sequencing, gene splicing, gene therapy, gene transfer, among other variations (*OED*). But what is crucial for us to see immediately is that the rhetoric and concept of a gene emerged out of, and exists within, the idea of being, as Stent (1980) put it, "an *information carrier*" – an information carrier in the form of "*symbols*, whose exact pattern of succession represents an *encoded…message*" (xiii, latter two emphases added; cf. Gamow 1955; Floridi 2010, 76). That is, the gene was/is conceived as a unit of information transmission.

Information transmission in biology emerged out of earlier thinking about "inheritance" and "heredity". How are things passed from one generation to the next? With inheritance, people commonly think of material items, money, or forms of real property as that which may or may not be inherited by the next generation. People also consider intensely how values and practices may be passed on through tradition. But also, perhaps most primal of all, people have long thought of how *life* is passed on: how life – in its commonality and variations – carries on generation after generation by way of sex and nurturance from ancestors to the present and possibly into the future. Thus, as Everson (2007) describes, ancient and medieval ideas of biological inheritance gave way to Renaissance and Enlightenment views, which set the stage for "heredity" in the 19th century, building on the work of the German-Czech monk and biologist Gregor Mendel, leading to the gene concept. The concept of the gene unified

biology, which saw continued growth in its explanatory powers (and technologies) in molecular biology and beyond (Everson 2007; see also Dunn 1965; for example, horizontal gene transfer [e.g., Quammen 2018]; and artificial life [e.g., Garrett 2013, 28, 30-31]). A pivotal moment in this historical development was shifting toward an information concept.

Leading up to this gene as information concept, the age of the microscope already had brought new breakthroughs in human ability to see and conceive of the operations of nature. In Copenhagen in 1909, the "gene" concept was introduced by Wilhelm Johannsen (Favareau 2010, 29). Remember examples from your school biology class about peas, flies, or eye color? As Starr and colleagues describe (2013), "Gregor Mendel discovered that inherited traits are specified in units. The units, which are distributed into gametes in predictable patterns, were later identified as genes." (202) What had begun from Mendel as something like genes as "inferential concepts" – perhaps a good idea but with no experimental/empirical data to show how it worked – progressed to genes as "physical entities equated with proteins, then to nucleoproteins, and finally to DNA" (Kay 2000, 39).

Famously it was Watson and Crick, along with the work of Franklin and Wilkins, that identified "*a structure*" within biological inheritance, pinpointing the "gene itself", and describing "how it might carry out the essential operation required of genetic material, that [of] *exact self-duplication*" (respectively, Watson and Crick 1953a/1980, 237; 1953b/1980, 241, 241, emphasis added). In sum,

> …we shall describe a structure for DNA which suggests a mechanism for its self-duplication and allows us to propose, for the first time, a detailed hypothesis on the atomic level for the self-reproduction of genetic material (1953c/1980, 257).

In part what had lead to this was inspiration by Schrödinger's *What Is Life?* (1944/2018), among others, and efforts by many individuals and teams that constituted a movement that arguably shifted life sciences from an "*energy-based* biology of the 19th century into [an] *information-based* biology of the 20th" (Barbieri 2008/2010, 761; cf. Gunther 1980, xiii; Kay 2000).

We may keep in mind that this information-based concept is also physical-based and does not resort to metaphysical explanation. Still, within this context, the entire discussion of heredity and/or transmission shifted from proteins to, rather, information transmission on analogy with coded messages such as one

could find in wartime communications or spycraft. In a classic *Scientific American* article, George Gamow (1955) clearly explains the "informational" transmission of life from one generation to another:

> When a cell is about to divide, each chromosome is replicated, so that each of the two daughter cells will receive an identical set of chromosomes exactly like the original. Thus each gets all the information originally contained in the nucleus of the mother cell.
>
> Sometimes because of a mistake in some step of the replication process, a daughter cell gets a gene carrying a garbled message; that is, it does not bear precisely the same message as its original counterpart. Such occasional mistakes in the copying of genes are known as mutations. They are analogous to mistakes by a draftsman or typist in copying plans and specifications for a product to be manufactured. If the modified information carried by a mutant gene is harmful to the organism in its fight for existence, as it usually is, the mutation will eventually be eliminated from the species by the Darwinian process of natural selection. If the change is helpful, the new blueprint will supersede the old and be carried on through future generations. (70)

Absolutely key to Gamow's explanation is the positioning of what could be simply a cool idea or discovery – i.e., a biological program within our bodies gets copied like a copy machine to generate new bodies! – into the larger narrative of evolution by natural selection. In evolutionary explanation, those individual organisms with traits that suit environmental challenges better for survival are more likely to survive and thus pass on these traits.[3]

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[3] Darwin had provided revolutionary, compelling explanations for how life forms evolved starting with the descriptions in *The Origins of Species* (1859/1964/2003) with breeding (artificial selection) and proceeding to natural selection.

A vivid illustration of this process comes from my own family. Part of my family for many years was our greyhound Lacey. You should have seen her run! (Seeing a greyhound run makes some people think of a cheetah.) Before anyone sees a greyhound run, they may observe a rather odd looking animal. The massive chest in front with, by contrast, the slender, almost tiny haunches in the back make a greyhound's appearance striking. With an odd combination of elegant and comical, we may ask ourselves – if it isn't already obvious – how did she get to looking that bizarre way? Of course if we pause for a second we know it was through deliberate breeding: that is, through artificial selection. Over many generations, those dogs that exhibited desirable traits (of some amiability, some intelligence, and of maximum speed) were mated with each other to provide offspring that would be closer to the breeder's ideal of top speed for the hunt or race track.

As artificial selection goes, roughly speaking, so goes natural selection, with some important caveats. Nature has no identifiable end goal like winning a race unless we suppose it is simply continuing *to be* rather than *not be*. Ultimately we humans really don't know the answer to ultimate teleologies; what we do know is that, in a given moment of a life, the criterion for selection is survival – at least long enough to reproduce

Importantly, while individual bodies may be the criterion for selection – i.e., what does or does not survive long enough to reproduce – "the fundamental unit of selection," as Dawkins (1976) famously argued, "is *the gene*, the unit of heredity" (11, emphasis added). It is the gene that gets passed down. And, even as as Dawkins has admitted "there is no universally agreed definition of a gene", he proceeds thus:

> …The definition I want to use comes from G.C. Williams. A gene is define as any portion of chromosomal material that potentially lasts for enough generations to serve as a unit of natural selection. In [other] words…a gene is a replicator with high copying-fidelity. (Dawkins 1976, 28; cf. Griffiths & Stotz 2007)
>
> …the properties that a successful unit of natural selection must have…are longevity, fecundity, and copying-fidelity. We then simply define a 'gene' as the largest entity which…has these properties. The gene is a long-lived replicator.… (Dawkins 1976, 35)

At this point, this is not the place to get into the ongoing heated debate over possible levels of selection whether at species level, population or group levels, or even individual level in distinction from the gene.[4] The immediate important point again is thinking about the gene as an informational "unit" of transmission in which we may imagine genes as blocks: "the building blocks of life."

Still, some alteration in our thinking may also be required as was the case with "bits" – as we did from shifting from bits as "things" (albeit possibly little, tiny things) to bits as actions/decisions/choices (from noun to verb; from quantitative to qualitative). This is not to say that bits and genes are not things

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and in some cases provide enough nurturing for the next generation to survive long enough, again to reproduce, and so on.

It is commonplace in our lives that we live with products of artificial selection all the time: large-uddered milk-producing cows; huge, sweet, juicy breakfast grapefruits; and nearly all the produce in your grocery market. But then -- less often noticed and "disappearing into the background" – we also live with the products of natural selection all the time: the entire living world all around us (and in us), including our very bodies and brains – our selves.

[4] The story of the building blocks of life is a very powerful and highly romantic one in the sciences, no less so because it is mostly true. Still, while novices in science like myself and even most scientists probably think of a "gene" as a highly stable concept, it remains somewhat contested and as a term functions in various ways among biologists (Godfrey-Smith 2007, 103; see also Griffiths & Stotz 2007, 85ff.) Dawkins (1986/1996) rightly points out that "Bodies don't get passed down; genes do" (79), however bodies are the "criterion" for selection (1976, 11). Nevertheless, Dawkins (1976) admits, "It is not easy, indeed it may not even be meaningful, to decide where one gene ends and the next one begins" (22). This is not the place, either, to get into the crucial discussion of phenotypes and environmental contexts.

but rather to shift the emphasis so that, roughly speaking, *things* are seen in terms of *actions*. (Recall: *it from bit*.) As Donald Favareau (2010) highlights from Emmeche and Hoffmeyer: "'Biological information is not a substance'" (63). Instead, biological information is instruction, recipe, command:

> …genes are instructions, and instructions are a type of predicative and effectual/procedural information, like recipes, algorithms, and commands. So genes are *dynamic procedure structures* that, together with other indispensable environmental factors, contribute and guide the development of organisms. This is a perfectly respectable sense in which biological information is indeed a kind of information. Dynamical procedural structures are a special type of informational entities [sic], those that are in themselves instructions, programs, or imperatives. (Floridi 2010, 79-80, emphasis added)

Thus, genes are within themselves their own templates with the ability to replicate (Barbieri 2008/2010, 760). Inspired by the work of Dawkins, among many others, genes have come to be seen as the quintessential replicators. And such self-replication is integral to what is described as life. As Starr and colleagues (2013) put it, "Life is no more and no less than a marvelously complex system for prolonging order. Sustained by energy inputs, it continues by a defining capacity for self-reproduction. With energy and the hereditary codes of DNA, matter becomes organized, generation after generation." (70) That *matter becoming organized* is an "in-form-ational" process. In this sense, we can more clearly hear the resonance of *form* coming to be in in-*form*-ation.

Generically then, in popular imagination, if a bit is *a difference that makes a difference*, a gene is difference that makes a difference as *a copying machine*: that is, a *dynamic procedural structure* that includes the procedure of replicating – thus perpetuating – that structure. While for bits we may think of their use/application within physics, mathematics, or computer science (and all related areas in technology, media, economics, etc), for genes we think of them within the living world of biological life.

In short, genes are conceived and articulated as informational transmission machines. And if we are looking for other terms or concepts that engage the grand and powerful idea of information transmission – other than memes, but alongside bits and genes – perhaps there is no other ideal place to go next as our final exemplar of information rhetoric than to the world of "signs".

V. SIGNS

At first the term "signs" may sound metaphysical, like Hamlet's father's ghost appearing to him intoning, "List', list', o list"' (that is, *listen* to me) (Act 1, Scene 5). However, a concept of signs remains very much within a thoroughly natural world. Another direction some may go to more immediately as thinking of a sign as something like a "symbol", and, while not entirely wrong, that idea can be quite misleading. To cut to the chase, we turn to a classic description of a sign, which is as "something which stands to somebody for something…." (Peirce 1897/1932, vol 2., 228; cited in Salvatore 2012, 245).[5] Roughly speaking, signs are a form of informational units which stand in for things or for other informational units.

The sources for thinking about signs are extensive and have a long history (Bennett-Carpenter 2018, 18, here and following) beginning in such places as symptomology in ancient medicine and in scriptural hermeneutics (also see Favareau 2010, 7ff; and Eco and Marmo 2000). For example, a rash appears on my skin – what is that a sign of? What "information" does that give us? i.e., What is that a symptom of? The *sign* of the rash signifies *something else*: a condition to be identified.

Yet beyond physical symptoms, "signs" may be seen in clothing, words, or numbers. For example, if you look closely at what clothes I am wearing (or someone within your eye-shot), what do those clothes "tell" you about me. What do the clothes "say"? What information are they providing? There may be a meaningful message in the materials, form, and markings of the clothing – or at least, these wearable textiles *do* something of some significance as others encounter them. Or take a word like my (or your) *name.* The name "Benjamin" in my case stands for me. Your name stands to other people for you. Your name is of course not you literally but in fact does stand for you yourself. Money is another example. The dollar bill or peso or yuan is understood as a sign for exchange of monetary value.

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[5] Portions of this section are taken, adapted, and expanded from portions of the ""<J> Operates as A Sign in Semiotic Systems" section of Bennett-Carpenter (2019, Ch. 8) and portions of "A Rhetorically Oriented Phenomenology Applied to Documentaries" section of Bennett-Carpenter (2018, Introduction).

"Semiotics" is the study of such myriad signs, and is primarily identified with the arenas of the arts, humanities, and all forms of cultural studies. In short, *anything* which *stands to somebody for something* may be reckoned as a "sign." Among humans, this could be a word, an image, an artifact, or *any item that takes on value as providing information that makes a difference to someone*: what we call "significance."

Historically, as early as the 4th century CE, Augustine outlined a hermeneutic and theory of signs in *De doctrina christiana* that served as foundational for reflection on signs in the West for centuries. Augustine distinguished "signs" from "things"; and "literal" from "figurative" signs. Among many contributors over many years to what a concept of a sign could mean, Peirce's work (1894/1998; 1897/1932; 1897/1940) on semiotics around the turn from the 19th to 20th century is foundational, especially with the idea that signs must *relate* to some-*one* in relation to an *other* (cf., e.g., Favareau 2010, 18, 19, 30). Meanwhile, de Saussure, especially *Course in General Linguistics* (*Cours de linguistique générale*) (1916/1959), singled out the illuminating insight that a sign may stand not for some "thing" but for *another sign*. That is, signs may operate *within the context of other signs* within their own signifying "universe".

Many, many other contributors from a variety of fields and movements have brought their thinking to bear on the sign, sign relations, and/or semiotics. I think of and myself draw upon structuralist and especially poststructralist thinkers, including Kristeva, Derrida, Foucault, Baudrillard, Eco, and Mieke Bal. In my understanding, semiotics is study, research, and analysis of "the effective exchange of signs" (Bennett-Carpenter 2018, 19). I understand this *exchange of signs* as a form of *information exchange.*

In its deepest and broadest scope, semiotics attempts to deal with not only everything in human culture, but also with consciousness and nature – and thus it extends to, at the very least, biology, but also possibly beyond biology even to physics, although this extension to physics is highly debatable (and would be contested by many, if not most, physicists and biologists). As Innis (2012) describes:

Semiotics is the study of *signification* in the most general sense of that term. It is an essentially transdisciplinary study of processes of meaning-making and the meaning systems and sign systems in which they are embodied and expressed. Because of the transdisciplinary nature of semiotics, it can and does function as

a kind of 'big tent' within which different types of reflections and investigations take place. Philosophers, biologists, cultural theorists, psychologists, linguists, art historians, literary theorists, and many more find its conceptual tools helpful, indeed indispensable, for carrying out their studies. The central concept of semiotics is *the sign*. (255)

Simply within the context of human culture alone, the scope of signs is vast.[6] Diachronically, human-employed signs may be identified as originating at least by the time we have the first human-made cultural objects possibly 200,000+ years ago – though proto-human signs probably, or most certainly, were used much sooner than this among pre-human ancestors. Synchronically, human-used signs are manifold across the globe, including what one has on one's shelf (a book, a knick-knack, a photograph) and what appears in one's dreams (images, narratives, sounds). *Any item*, whether word, image, sound, artifact, or what-have-you, that *makes a difference to somebody* as it runs into other items (words, images, etc.) means we have a sign. The chains and networks of all these signs that are formed as they bump into each other may be thought of and described as *semiotic systems.*

The scope of such significant communication, or signs, most certainly includes non-human animal species (e.g., see Hoffmeyer 1993/1996; Godfrey-Smith 2013; Stegmann 2013) and Artificial Intelligence. Among non-human animals, take as a very easy and interesting example the study in West Africa that showed chimpanzees using stone piling as what appears to be "ritualized behavioral display" (Kühl et al. 2016). Several species in fact are known to signal the loss of a close relative through various forms of display. That is, in this case, the chimps are signalling as a form of messaging or information-sharing to each other over time with physical stones being used as symbols, semiotic markings, or signs among themselves. For Artificial Intelligence (including robotics), I wonder what comes to mind for the reader in this regard – and what is coming in the future.

Meanwhile, far beyond one or two particular examples from animal behavior or AI/robotics is *biosemiotics* -- an entire field of study that merges biology and semiotics. Biosemiotics has emerged over the last 30+ years into a potential

[6] This and some portions of the following adapted from Bennett-Carpenter 2019.

proto-science of understanding life as a semiotic process. Biosemiotics is a prime example of the extent – and difference – of information concepts in and across biology. As Favareau (2010) helpfully describes, biosemiotics begins by juxtaposing two fundamental observations for contemporary thought:

> (1) Biological being is a form of physical organization that has evolved in nature.
> (2) A sign is something that stands for something other than itself. (2)

How might these two observations merge (if they can)? As Hoffmeyer put it (1993/1996), a fundamental premise of biosemiotics is that "Life is based on semiosis, on sign operations" (24). That is, life is not "only" physical in a most minimalist, reductionist sense only (although it is *also* that); rather, "life" is identified by biologists as physical *organization* and *interaction* at a "level" where, for example, physical entities may reproduce. All of this organization, interaction, and reproduction may be described and discussed within a context of sign relations.

Very importantly, as Favareau describes, biosemiotics does not seek to overturn or replace physicalist or naturalistic science. Rather, "the goal of biosemiotics is to *extend* and to *broaden* modern science, while adhering strictly to its foundational epistemological and methodological commitments" (3). Within a context of *methodological naturalism* (cf. Drees 1996; cf. Slingerland and Bulbulia 2011, 308, 312), biosemiotics seeks to conceptualize the inherent informational dynamic taking place within physical systems. To some extent, this simply means opening our eyes to what is already there but has not yet been seen – or conceptualized – as such. Specifically, biosemiotics (and semiotics more generally) is a "logic of relations" (Favareau 2010, 30) where signs are not simply understood as (mere) objects but, rather, as "sign relations" (18). For biosemiotics specifically, and semiotics more generally, it is crucial to understand "…the sign as being a phenomenon that is in its very essence" not simply one-thing-to-another (as in x *to* y) but, rather as a "triadic relation of x *as* y *to* z" (19; cf. Hoffmeyer 1993/1996, 17ff.). Or: *this* as *that* to the *other*. Or, in other words: *something* makes *a difference* to *something else.* Thus we have value; thus we have information.

In the end, biosemiotics – along with other forms of scientific semiotics – seeks "a complete understanding of how and in what scientifically examinable way

matter can come to 'stand for' something other than itself in and to a system" (Favareau 2010, 54). Of course, in the midst of this powerful ambition, it can also be helpful to recall that semiotics may be considered a model (or even a metaphor) – and various thinkers from across the sciences, socials sciences, arts, and humanities may evaluate such models in various ways. For example, while Kristeva (1970/1986) highlights that "…the sign [is] the fundamental ideologeme [sic] of modern thought", semiotics "harbours a principle of *transformation*: within its field, new structures are forever generated and transformed" (72). Semiotics may be both critical and creative. That is, Kristeva insists (1969/1986), "semiotics is…a mode of thought where science sees itself as (is conscious of itself as) a theory"; it is "a constant critique that turns back on itself and offers its own auto-critique" (77). As I have described elsewhere (Bennett-Carpenter 2019):

> It is also possible to conceptualize models or systems of signs as not only synchronic and diachronic (through contemporary space and historical time) but also as a "fluid" "surface" that may ebb and flow, jump, appear and disappear, and absorb "closed systems" defined by linear patterning and non-relative schemas. One may conceive of an infinite "play" of signs within a play or semiotic "game" space that may or may not fit either mechanistic or organic metaphors. (117n4, revised/adapted)

Having said that, in the end though, some biosemioticians are seeking something quite specific. To take one potentially very powerful example, some "biosemioticians will see a neuron firing and say that it is a 'sign' whose vehicle is this [particular] chemical-electrical event" (Favareau 2010, 65). That is, the neuron is seen as a sign in a biosemiotic system (of the brain). And as Favareau articulates,

> Precisely analogous to [the historical situation of researchers coming to conceptualize a 'gene'] is the current status of *the 'sign' as a legitimate 'unit of analysis'* in biology, and particularly in neurobiology. (63, emphasis added)

As it turns out, this very idea and language about the sign – in relation to the gene as somehow analogous – is exactly what we find in relation to the term that orients this whole present article at hand: that is, the *meme*. Could signs be analogous to genes and bits? Could all of these terms come under the term meme – or memetica?

VI. MEMES AGAIN

In this article, we have surveyed three exemplar information terms – bits, genes, signs – to now wrap them up under the term meme. Or, all together with everything, *memetica*. As we do, recall that one may simultaneously hold two crucial things in mind: 1) *that* informational terms are being used; and 2) *how* they are being used. In light of those two thoughts being held in mind, we also may *do* two crucial things, toggling between them when needed or desired: 1) we may use informational terms (including "information", "bits", "genes", "signs", "memes", among others) in a "holistic", undifferentiated sense that may cover "it all" – the totality of our reality as we may conceive of and describe it; and 2) we may use specific informational terms within one's own particular field, discipline, or domain in a "critical", differentiated way (including how, e.g., a particular physicist might use the term "bit", a specific biologist "gene", a semiotician "sign", among other terms). As we consider these possibilities, I strongly suggest that there remains high value in pursuing both of these conceptual and rhetorical lines, at least for those who seek to have both the insights of particular, specialized pursuits (and results) and, also, a sense of the "larger picture" of how "everything" may "hang together" in a coherent, unified/integrated fashion.

Thus we return full circle to "memes". If we infuse what a *meme* could mean with our entire discussion above, we end up with some potentially rich results. We observe both difference and commonality in different informational terms such as bit, gene, and sign. What is common to all is revolving around what many specialists and experts across many fields, disciplines, and domains think is fundamental or primary: i.e., information. "Information" as a rhetoric and concept is profoundly rich heuristically – that is, in its operation for us – across many professions to discover (or invent) new insight and applications to things.

As has already been pointed out, memetics as a potential scientific activity appeared to fail a couple decades ago. Is that the end of that story? In closing here in this article, I will suggest two alternatives for memetics. One is that it may yet be revived in some form. The other alternative is that it remains a non-scientific, popular source of inspiration.

In the first alternative, memetics may remain currently a proto-science that one day may have quantifiable, experimental support. If this seems completely impossible, one need only reflect on the history of the gene, which faced tremendous skepticism and mockery until the physical, experimental data came

to be for it. On analogy one may think of the current status of biosemiotics as a potential proto-science (Favereau 2010, 2). In this context, one potential advance in thinking about memes has been Dennett's (2017) shift in thinking of memes less in terms of "units" (i.e. units of information) and more like *ways of behaving* (206). How may "ways" be quantified at their most fundamental level?

Off the top of one's head, one might be tempted to say, *as bits*. Thus one might be looking at a quantification of memes in terms of bits. Is that possible? Is it already being done? Or is it impossible? Is it hopelessly naïve and misguided? And already failed? Dennett (2017) has insisted, in the very effort to continue the project to make memes a scientific object of study, that they are *not* bits (rather, they are *ways*) (210-211). His effort in this context is to delineate memes within the world of *perception*. Memes, he attempts to clarify, are "not instincts…memes are transmitted perceptually, not genetically" (206). So, following this, memes are not genes either. The difficulty in identifying exactly what a meme is and how it could be measured has long been, at least as early as 2000 (Aunger et al.), the reason for stalling any research program in memetics.

Yet, if it were all over, I would not be writing this and you would not be reading it. At the very least, what are substitutable memes/memetics terms (for other terms) that *are* making scientific headway? Can meme or memes not be used in any way within a discussion of bits? We have seen briefly *that* and *how* bits *are* measurable. Either way – skipping over genes for now – how about "signs"? Can meme be another name for sign (and vice-versa)? What is gained and lost in such substitutions? Do we end up with a similar problem in semiotics – where the goal, e.g. among some biosemioticians, of measurable units or measurable actions remains elusive? For instance, within biosemiotics, what about the rhetorical and conceptual status of the "neuron"? No matter what the answers to these questions turn out to be, I think at least one thing is certain, as Botz-Bornstein (2021) has pointed out, "First of all, memetics can learn a few things from semiotics" (138).

Additionally, and finally, even if all efforts at scientific quantification of memes fail and in fact memes are not bits, not genes, and not even signs (although I think they are at least this, i.e., signs), then the rhetoric and concept of memes in a popular imagination still, I assert, remains highly valuable at this point in time. To be able to conceive of "it all" in terms of "memeplexes" (Blackmore 1999; cf.

Hoffmeyer's "semiosphere"; Kull's "umweb", 2023) is a way for us humans to use our "fast", intuitive (non-differentiated) holistic thinking (cf. Kahneman 2011) to get a handle on the vast, embedded complex systems that constitute our very existence. We can invoke "memetica" and have this whole, integrated sense of things, and simply leave it at that. Or, for the more curious, thoughtful, analytical, and specialized among us, we may then toggle into the "slow", differentiated, particular informational terms that operate in their own way within particular domains – bits? reactions? genes? representations? documents? value scales? signs? neurons? your-term-here? Yet having done that, one is not lost in the minutiae or isolated within one's silo – but, rather, also may return to being a human among other humans, along with non-human animals and post- or para-human A.I., all within what now I think could be called powerfully and aptly Memetica.

Our relation to "it all", or memetica, of course has a sense that it ultimately is not all, that somehow there is, in some sense, something more; that each time we try to grasp memetica, we only get a part of it, and much more of "it" gets away. (Because it does.) Yet reflection on such themes only enhances our sense of things as we *live, move, and have our being* within this massive, all-permeating information ecology.

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