

DEFINING MEMES

Presented By:

Dr. Robert Finkelstein

President, Robotic Technology Inc.

11424 Palatine Drive

Potomac, MD 20854-1451

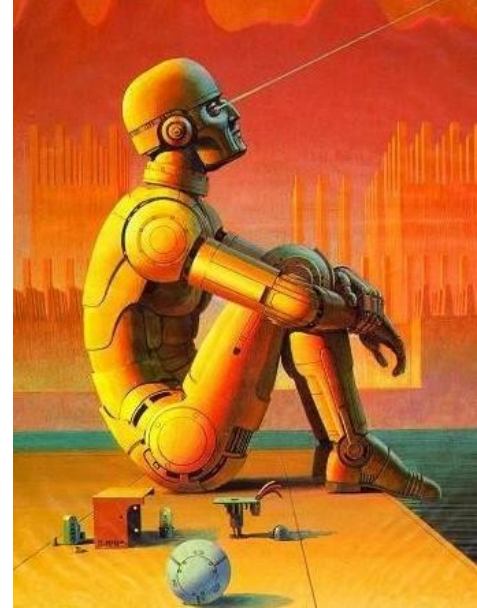
Phone: 301-983-4194 ; Fax: 301-983-3921

RobertFinkelstein@compuserve.com

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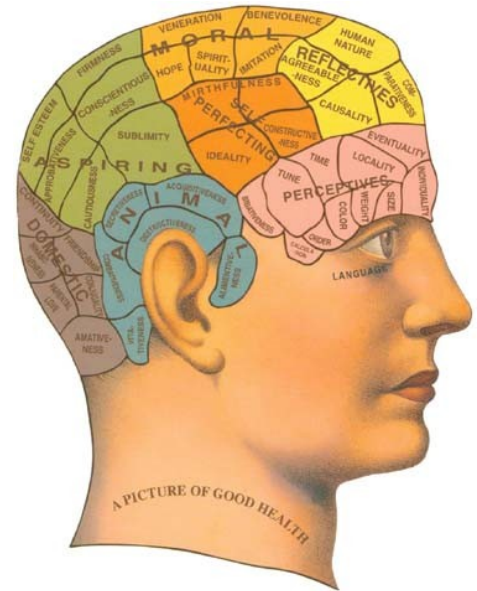
**The Second Symposium on Memetics
Memory, Social Networks, and Language
Probing the Meme Hypothesis II
Victoria College, University of Toronto**

15-17 May 2008



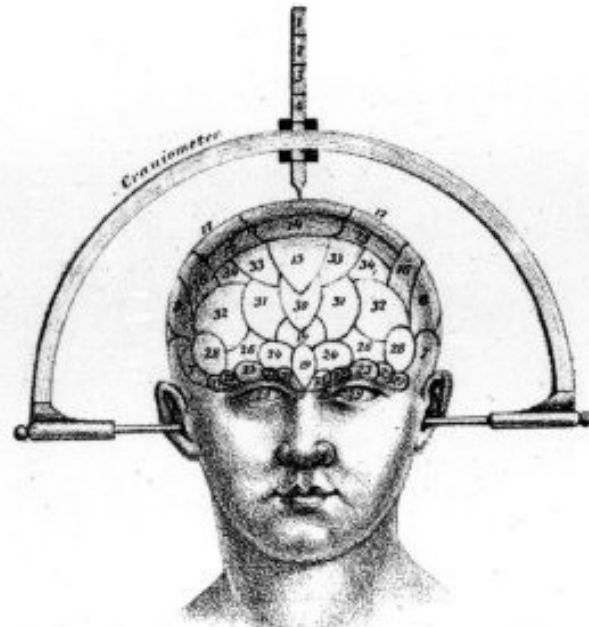
MEMETICS AS A SCIENTIFIC DISCIPLINE

- **Since Dawkins' revelation**
 - **Coterie of proponents, skeptics, opponents**
 - **No coherent, well-funded, significant development of concept**
 - **No refutation**
- **Memetics needs**
 - **A general theory – a theoretical foundation for development of a scientific discipline, not pseudo-science**
 - **Better focus, pragmatic definition**
 - **Ability to make testable predictions & falsifiable hypotheses**



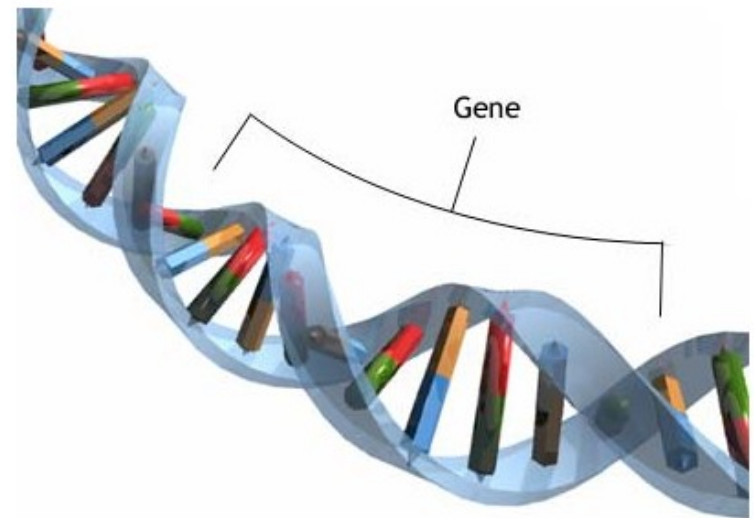
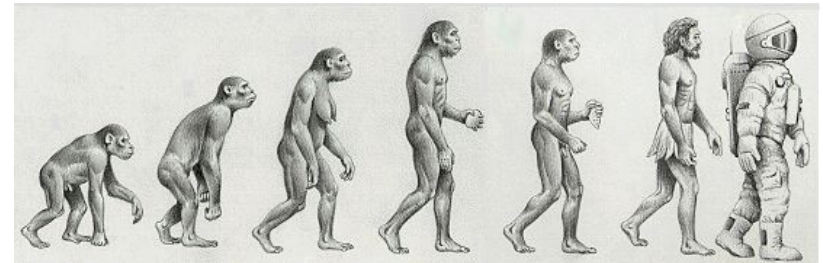
MEMETICS AS A SCIENTIFIC DISCIPLINE

- The discrete meme must be defined, identified, and distinguished in the near-continuum of information
 - Just as the discrete gene can be identified (more or less) in long string of DNA nucleotides
- Quantitative basis for memes must be established, e.g.,
 - Physiological effects
 - Information theory and entropy
 - Genetic, memetic, and evolutionary algorithms
 - Modeling and simulation
 - Neuroeconomics tools



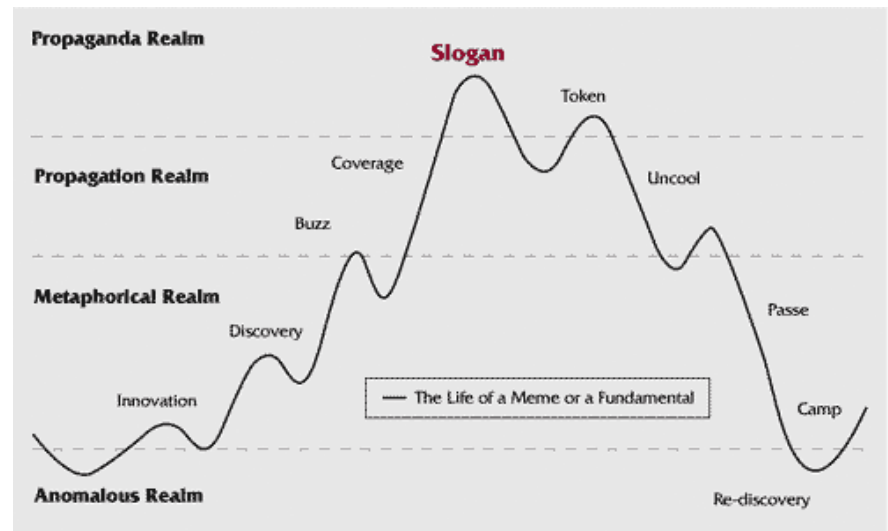
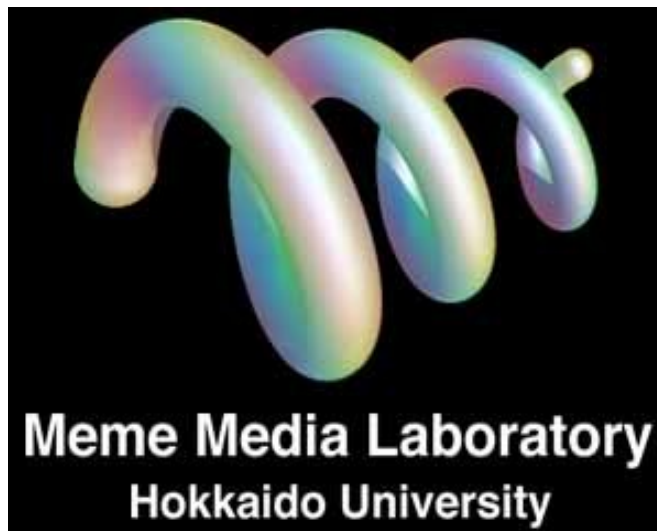
WHY DEFINE MEMES?

- Some say a crisp definition of “unit of information” or “unit of cultural transmission” is not critical to a theory of memes
 - E.g., Darwin’s Theory of Evolution was scientifically useful before anyone knew about genes and DNA
- But a pragmatic definition and associated metrics would provide a better foundation for research and the ability to make testable predictions and falsifiable hypotheses, and control effects
 - Which DNA and genetic engineering now provides to Darwin’s Theory
 - Memetic engineering or applied memetics



MEME DEFINITIONS

- Extensive memetics literature reveals a plethora of definitions for the meme, with most being variations of Dawkins original notion
 - Most agree that a meme is a unit (whatever that means) of cultural transmission (or a unit of information - whatever that means), where culture may be defined as the total pattern of behavior (and its products) of a population of agents, embodied in thought, behavior, and artifacts, and dependent upon the capacity for learning and transmitting knowledge to succeeding generations
 - None of these definitions is sufficient to allow a meme to be clearly recognized or measured



EXAMPLE EXTANT MEME DEFINITIONS

- **A self-reproducing and propagating information structure analogous to a gene in biology**
- **A unit of cultural transmission (or a unit of imitation) that is a replicator that propagates themselves in the meme pool leaping from brain to brain via (in a broad sense) imitation; examples: “tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches”**
- **Ideas that program for their own retransmission or propagation**
- **Actively contagious idea or thought**
- **Shared elements of a culture learned through imitation from others – with culture being defined rather broadly to include ideas, behaviors, and physical objects**



EXAMPLE EXTANT MEME DEFINITIONS

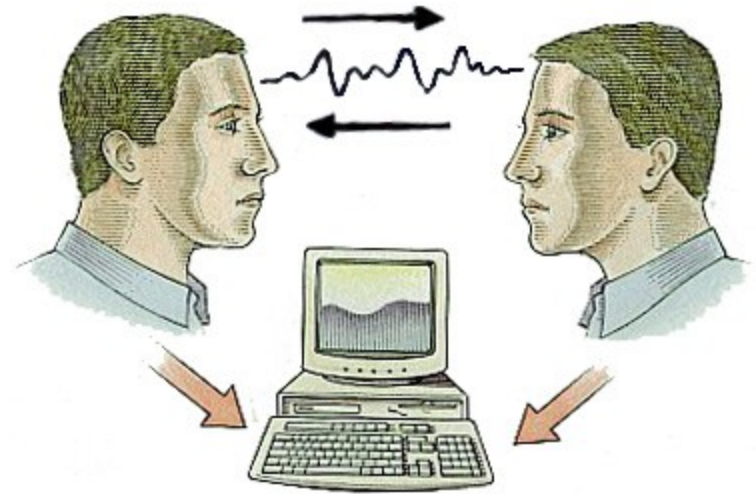
- An element of a culture that may be considered to be passed on by non-genetic means, especially imitation
- **Whatever is passed on by imitation**
- Constellations of activated and non-activated synapses within neural memory networks
- **Information patterns infecting human minds**
- While the internal meme is equivalent to the genotype, its expression in behavior (or the way it affects things in its environment) is its phenotype



"It Ain't Over 'Till The Fat Lady Sings"

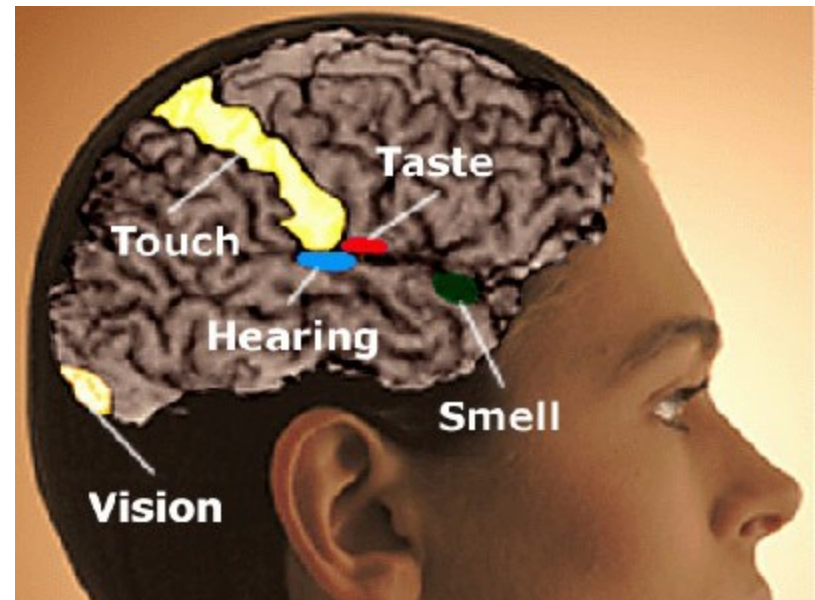
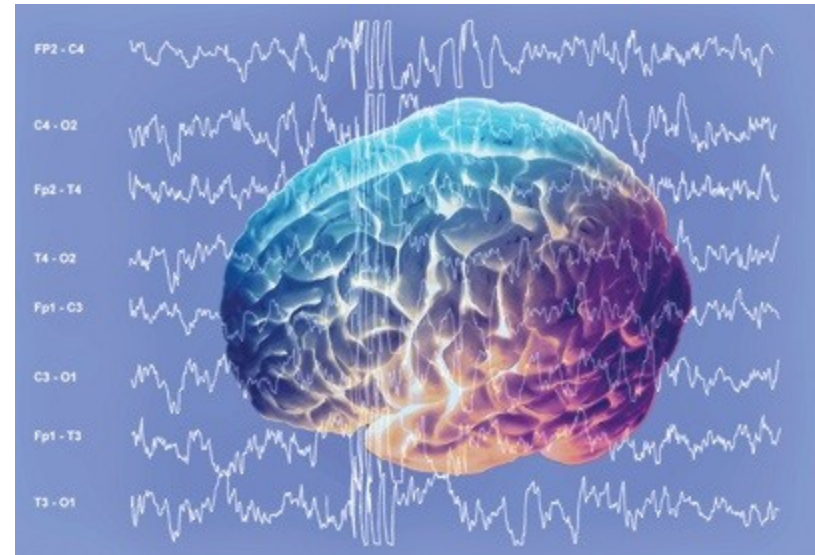
EXAMPLE EXTANT MEME DEFINITIONS

- Any information that is copied from person to person or between books, computers, or other storage devices. Many mental contents are not memes because they are not acquired by imitation or copying, including perceptions, visual memories, and emotional feelings. Skills or knowledge acquired by ordinary learning are not memes
- **A unit of cultural information; a piece of knowledge, an idea [with an anchor, carrier, and payload]**
- **Biological Definition: Basic unit of cultural transmission, or imitation**
- **Psychological definition: The unit of cultural heredity analogous to the gene; the internal representation of knowledge**



EXAMPLE EXTANT MEME DEFINITIONS

- **Cognitive definition:** An idea, the kind of complex idea that forms itself into a distinctive memorable unit, spread by vehicles that are physical manifestations of the meme
- **Working definition:** A unit of information in a mind whose existence influences events such that more copies of itself get created in other minds
- A memory item, or portion of an organisms neurally-stored information, identified using the abstraction system of the observer, whose instantiation depended critically on causation by prior instantiation of the same memory item in one or more other organisms' nervous systems



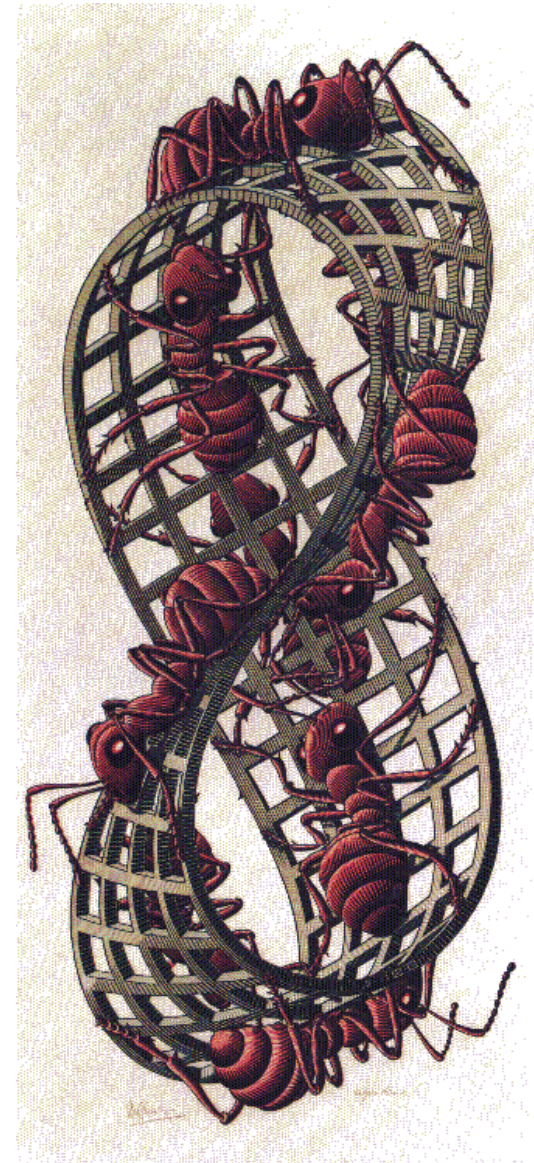
EXAMPLE EXTANT MEME DEFINITIONS

- **A heterogeneous class of entities, primarily including (observable) behavior and artifacts**
- **An element of culture that may be considered to be passed on by non-genetic means, especially imitation**
- **The least unit of socio-cultural information relative to a selection process that has favorable or unfavorable selection bias that exceeds its endogenous tendency to change**



EXAMPLE EXTANT MEME DEFINITIONS

- Cultural replicators propagated through imitation, undergoing a process of selection, and standing to be selected not because they benefit their human carriers, but because they benefit themselves
- A symbolic representation of any state of affairs, either internal and implemented in the mind or external implemented in an external (non-mental) objects such as artifacts, products, behaviors
- Replicating conceptual units – the largest reliably replicating unit within our text corpus
- A (cognitive) information-structure able to replicate using human hosts and to influence their behavior to promote replication



EXAMPLE EXTANT MEME DEFINITIONS

- Cultural information units that are the smallest elements that replicate themselves with reliability and fecundity
- **A rule of behavior, encoded by functional neuronal groups or pathways.** [Behavior is action, whether mental or physical. Ideas such as *tying shoe-laces* or *opening a door* represent rules of physical action, i.e., rules of patterned neural-muscular interaction. Concepts such as *apple*, *seven*, or *causality*, represent rules of mental action, or rules of cognition, i.e., rules of patterned neural-neural interaction. Hence, physical movement is governed by memes which represent rules of physical action and thought is governed by memes which represent rules of mental action]



EXAMPLE EXTANT MEME DEFINITIONS

- Any kind, amount, and configuration of information in culture that shows both variation and coherent transmission
- A pattern of information (a state within a space of possible states)]
- A unit of cultural information as it is represented in the brain
- An idea, behavior, style, or usage that spreads from person to person within a culture



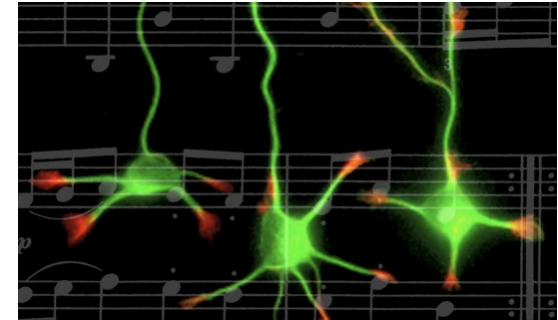
EXAMPLE EXTANT MEME DEFINITIONS

- **A unit of information residing in a brain**
- **An observable cultural phenomenon, such as a behavior, artifact or an objective piece of information, which is copied, imitated or learned, and thus may replicate within a cultural system. Objective information includes instructions, norms, rules, institutions and social practices provided they are observable**
- **A pattern of information, one that happens to have evolved a form which induces people to repeat that pattern**



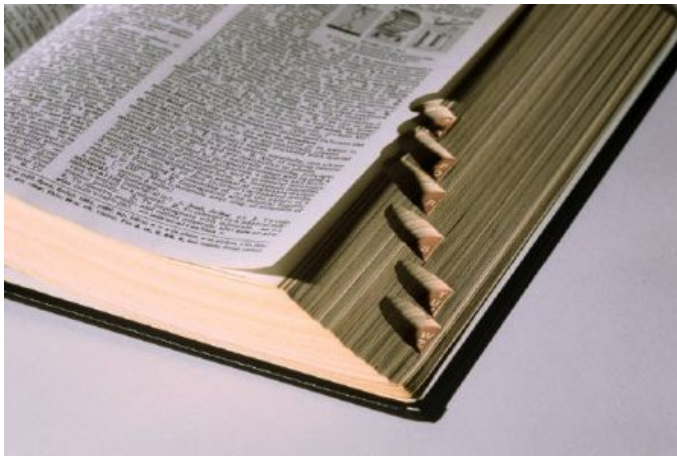
EXAMPLE EXTANT MEME DEFINITIONS

- A contagious information pattern that replicates by parasitically infecting human minds and altering their behavior, causing them to propagate the pattern. Individual slogans, catch-phrases, melodies, icons, inventions, and fashions are typical memes. An idea or information pattern is not a meme until it causes someone to replicate it, to repeat it to someone else. All transmitted knowledge is memetic
- The smallest idea that can copy itself while remaining self contained and intact ... essentially sets of instructions that can be followed to produce behavior. Instructions can be encoded in either: 1) musical notation; 2) written text; 3) visible (or vocal) action; 4) the neural structure of the brain; 5) digitized structures in a computer
- The least unit of socio-cultural information relative to a selection process that has favorable or unfavorable selection bias that exceeds its endogenous tendency to change



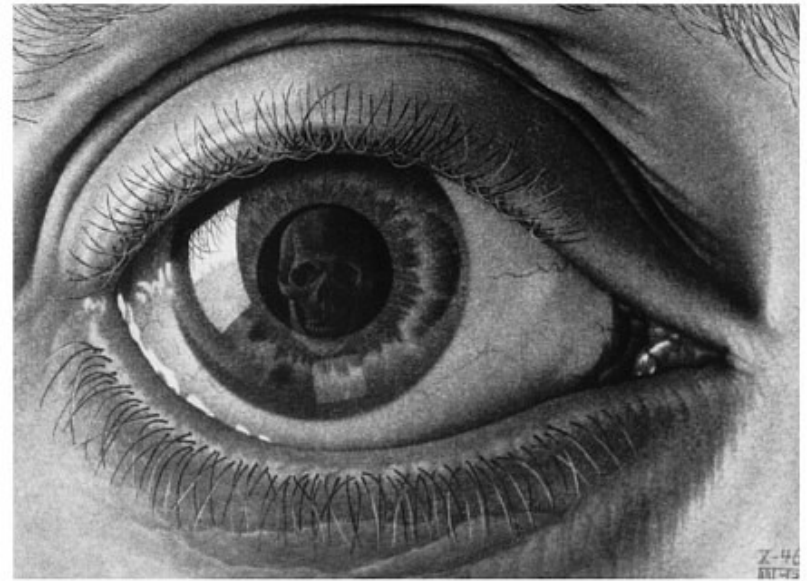
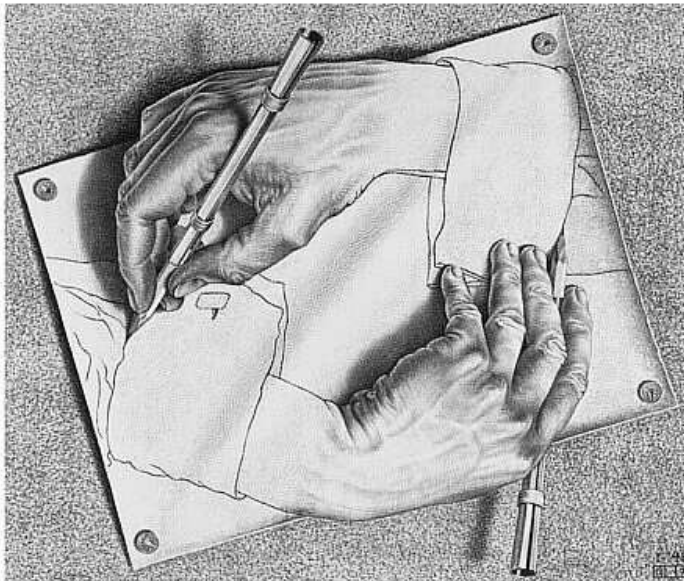
OUR PRAGMATIC DEFINITION OF MEME

- We created a pragmatic definition of a meme
 - To elicit comments and improvements
 - Eventually converge to a canonical definition that will be useful in establishing a scientific basis for memetics



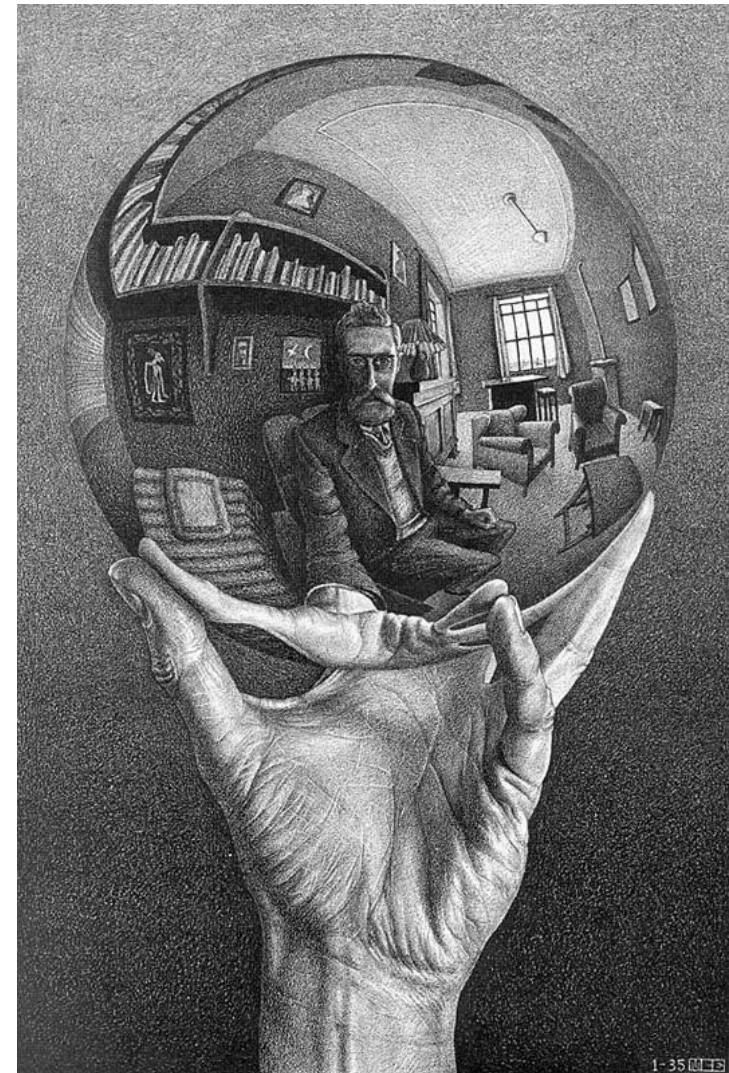
OUR PRAGMATIC DEFINITION OF MEME

- A meme is information transmitted by one or more primary sources to recipients who, as secondary sources, retransmit the information to *at least* an order of magnitude more recipients than primary sources, where propagation persists *at least* ten hours and the information has observable impact in addition to its transmission
- To distinguish a meme from other sorts of information (e.g., from common daily utterances), we invoke an **order of magnitude rule** and place an emphasis on the necessity of a **threshold for propagation and persistence**



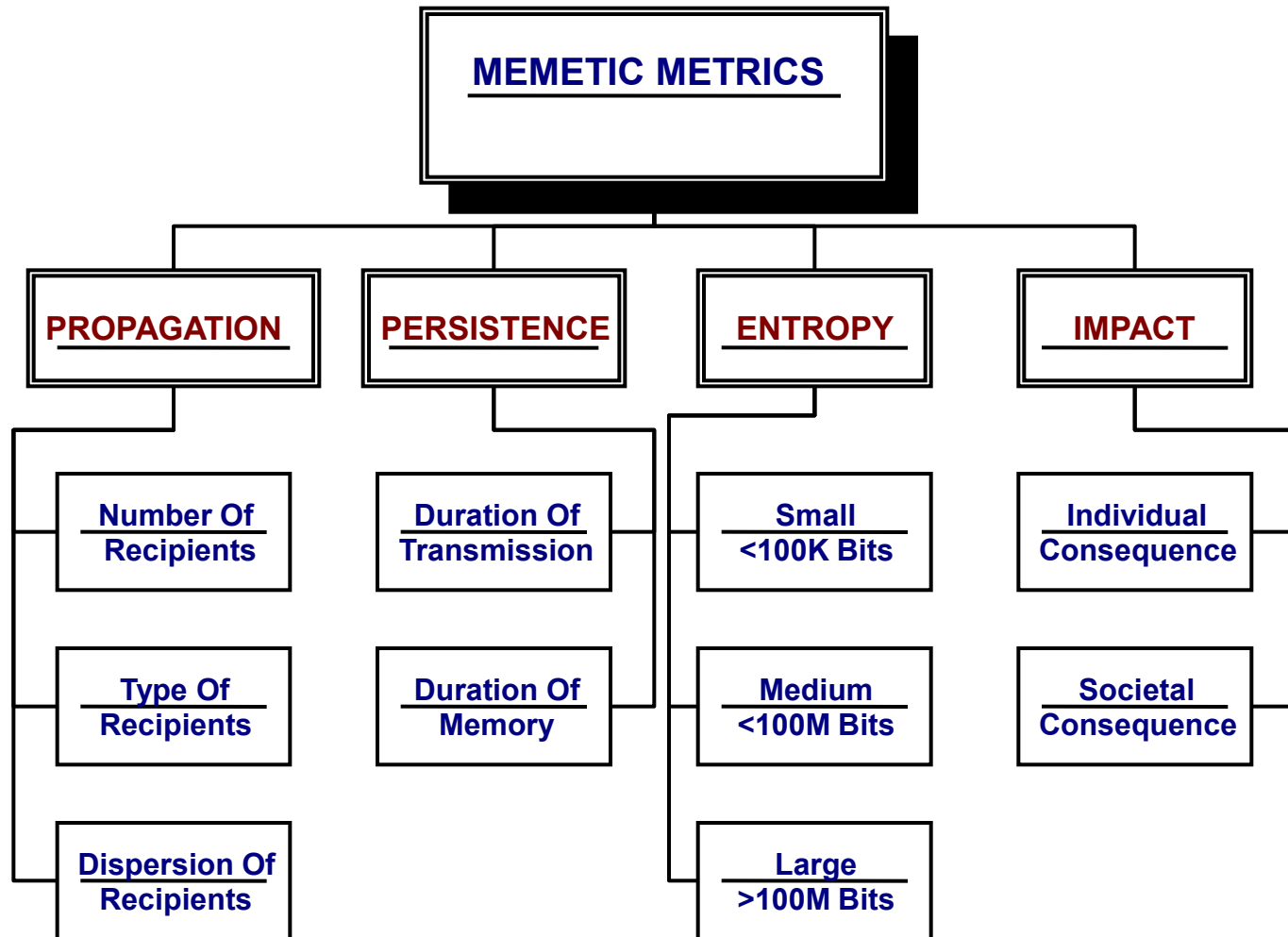
OUR PRAGMATIC DEFINITION OF MEME

- **Information:** Claude Shannon's definition: information is that which reduces uncertainty
 - The difference between two states of uncertainty before and after a message has been received
 - A message carries information inasmuch as it conveys something not already known
 - The same message can have different influence or impacts, depending on the states of the recipients; a meme, as a subset of information, could have different consequences for different recipients



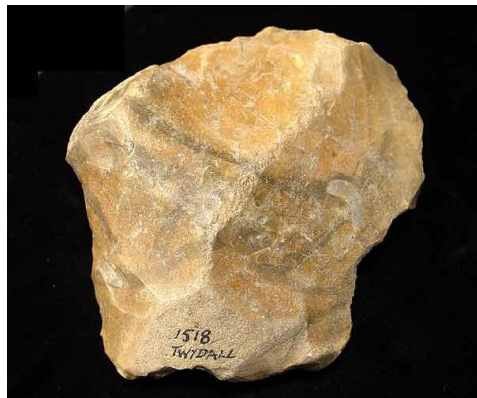
MEMETIC METRICS AND SUBMETRICS

We defined metrics and submetrics for evaluating memes



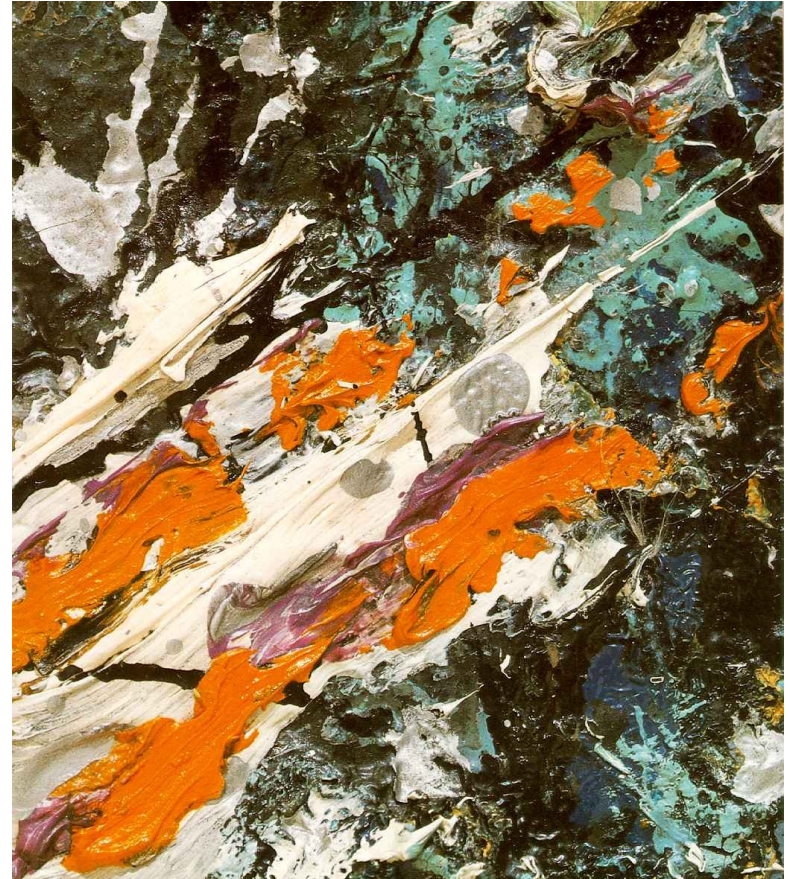
CHARACTERIZATION OF MEME PROPAGATION AND PERSISTENCE (MINIMUMS)

LEVEL (Order of Magnitude)	PROPAGATION (NO. OF PEOPLE)	PERSISTENCE		EXAMPLE CHARACTERIZATION (Minimal Meme)
		No. Hours	No. Years	
0	1	1		Origin of meme
1	10	10		Neighborhood gossip
2	100	100		Newspaper article
3	1,000	1000	0.1	Urban legend
4	10,000	10000	1	Cookbook
5	100,000	100000	10	Fundamentalist insurgency
6	1,000,000	1000000	100	Political ideology
7	10,000,000	10000000	1,000	Major religious canon
8	100,000,000	100000000	10,000	Instructions on growing wheat
9	1,000,000,000	1000000000	100,000	Human burial ritual
10	10,000,000,000	10000000000	1,000,000	Instructions on making flint cutting tool



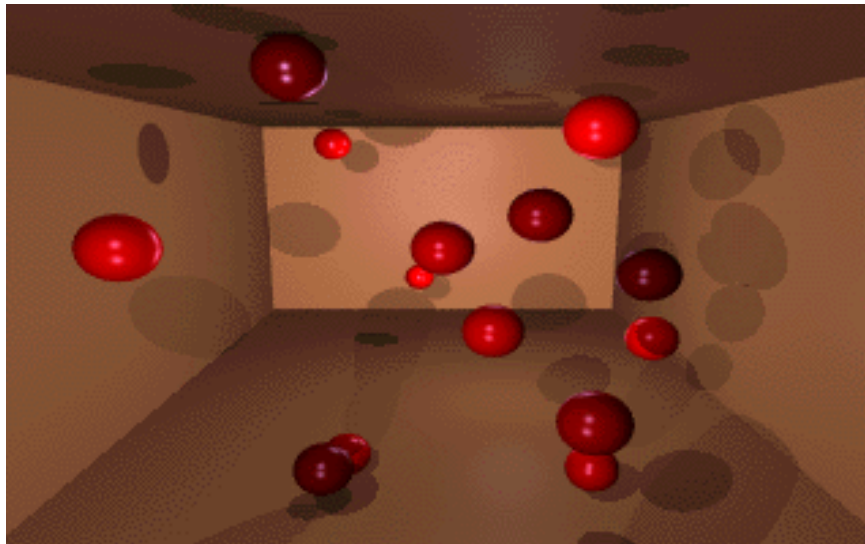
ENTROPY AND INFORMATION

- **Entropy as a metric of information:** Claude Shannon's mathematical theory of communication measures the amount of information in any message using a function identical to that of Boltzmann's formulation of entropy
 - The use of this entropy is noncontroversial as long as it is used to measure the freedom of choice in messages and not semantic content (i.e., a specific message is selected from a larger set)



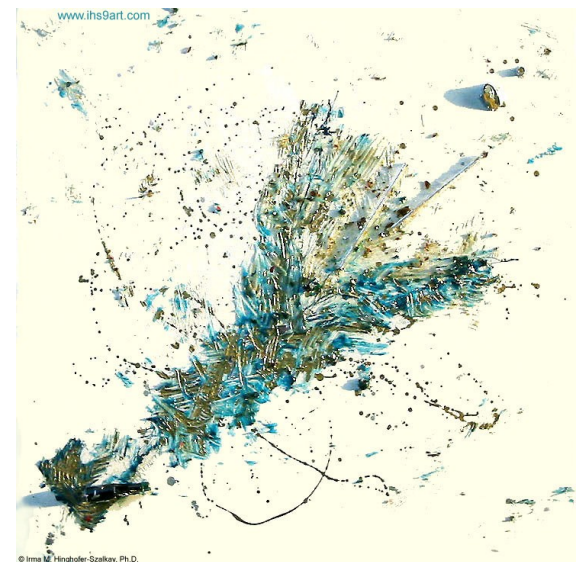
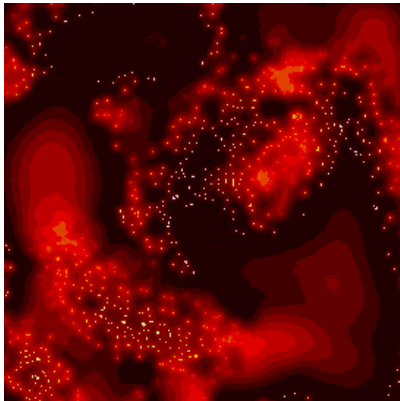
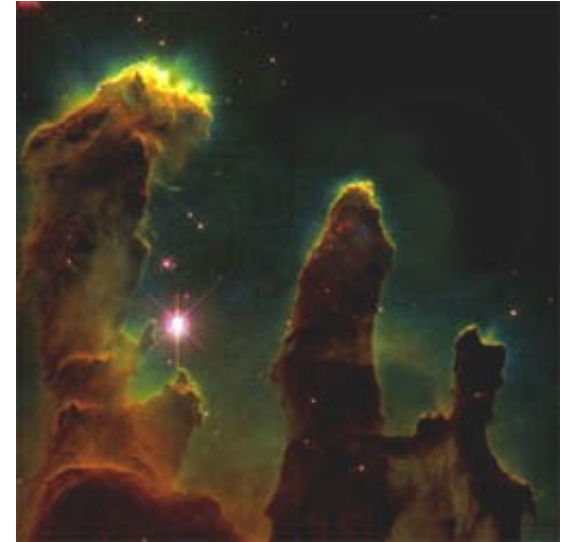
ENTROPY AND INFORMATION

- **Example:** information (entropy) needed to select one word out of a vocabulary of 200 words is 7.6 bits ($S = \log_2 200 = 7.6$ bits)
 - That is, the word is within the first 100 words or the second 100 words
 - It takes one bit to determine that, or one guess to as to which of the two sets it was in - if the word is in the first 100 words, it takes another bit (guess) to determine which of the two sets of 50 words it is in; and so on
 - It takes between 7 and 8 bits (guesses) to find the one word in 200 words
 - Likewise, a 50-word meme requires 380 bits (for a 200-word vocabulary). Nothing is indicated about the meaning or significance of the message that results from selecting and stringing together the 50 words



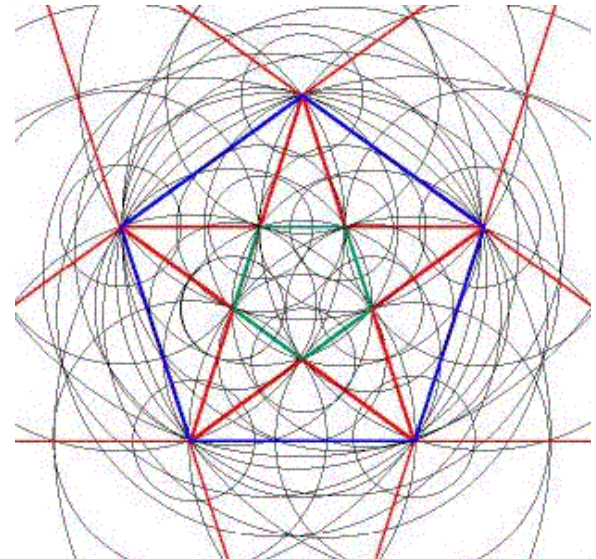
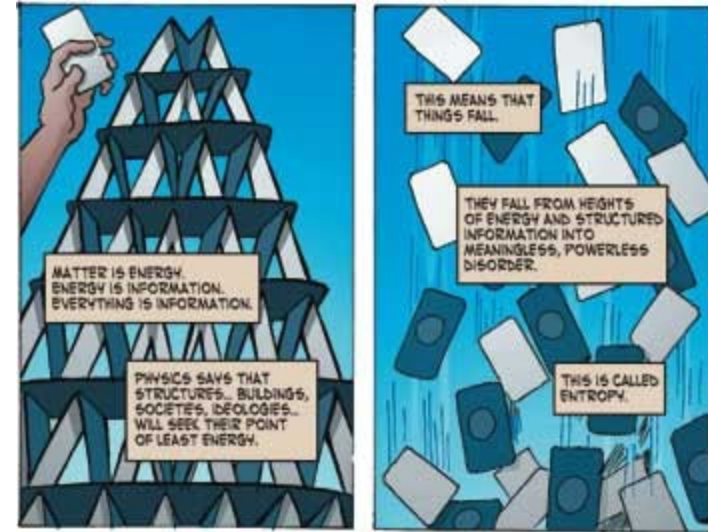
ENTROPY AND INFORMATION

- Because of its logarithmic nature, the quantity of information (entropy) needed to isolate one item remains very modest as the total set of items increases enormously
 - If, for example, the sample space is a 20,000-word vocabulary, a 50-word meme requires only 714 bits



ENTROPY AND INFORMATION

- A problem arises when entropy is used as a measure of informational order and disorder
 - For example, a manager has a desk with mounds of paper covering it - is this a high or low entropy case?
 - The manager's associate cannot find a paper he is searching for until he has made a large number of guesses, separating the piles of papers – a very high entropy case
 - But the manager knows exactly where every paper is located – the mounds of paper are quite organized in her mind; it would take her no guesses to find the crucial paper – a very low entropy case
 - Both cases concern the same set of items, but two different observers
 - Entropy then becomes a subjective measure of information (or a measure of the information contained in the brain of the observer), and this can be a disturbing concept to some



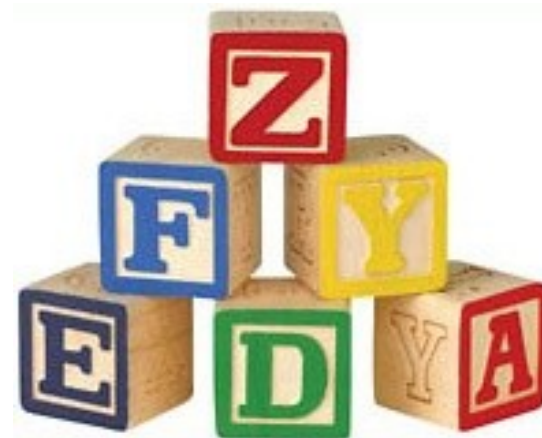
ENTROPY AND INFORMATION

- The entropy of a meme, whether long or short, can be estimated and calculated from the individual letters or symbols
 - Based on the total number in the originating set, or from the individual words, based on the vocabulary in the originating set
 - Example: the Oxford English Dictionary contains 616,500 words and spelling bee contestants study perhaps 614,000 of those words; but, in reality, the average vocabulary of an American English speaker is estimated by various linguists as between 10,000 and 20,000 words, or optimistically between 50,000 and 70,000 words)
 - The average American would actively use only a fraction of that vocabulary



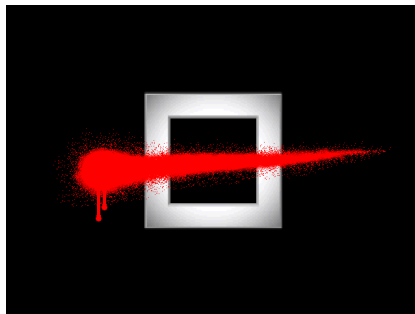
ENTROPY AND INFORMATION

- Typically, there are about 800 words per page with 12-point Times Roman font, although publications vary considerably in the number of words, based on page size, format, and number of pages
- Shannon calculated the entropy per letter of an 8-letter chunk of English as 2.3 bits per letter, using a 26-character set (although a 76-symbol, including 26 letters, set might be generally more appropriate)
- Assuming a vocabulary of 30,000 words the entropy of a single word is about 15 bits ($S = \log_2 30,000 = 15$ bits)
- The following Table shows the entropy as a function of the number of (English) words in memes
 - Most memes of military worth are 10 – 100,000 words, or an entropy of 150 – 1,500,000 bits



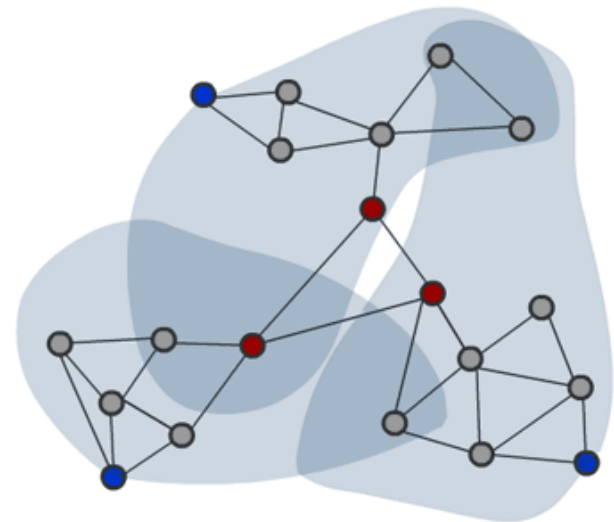
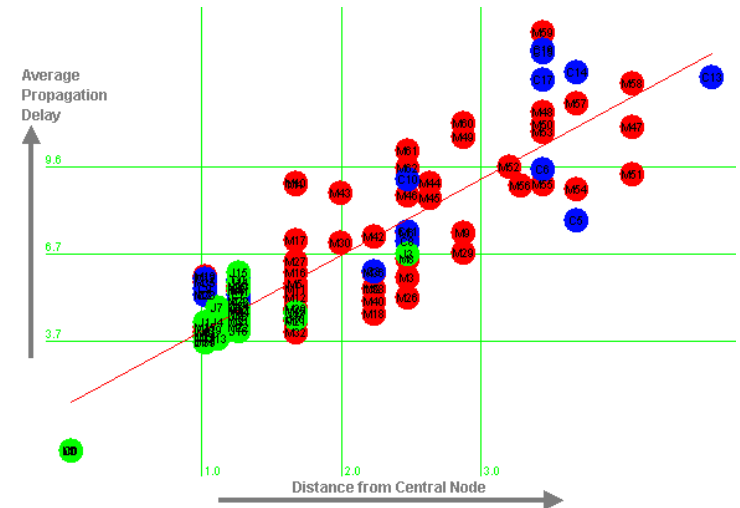
ENTROPY AS A FUNCTION OF MEME SIZE

MEME SIZE (Words)	MEME SIZE (No. of Pages)	ENTROPY (Bits)	EXAMPLE CHARACTERIZATIONS (Approximate)
1	0.001	15	Exclamation (Hooah! Oorah! Allah!)
10	0.01	150	Catchphrase, Slogan, Exhortation (Remember the Maine! Death to America! Jesus loves you! When it absolutely, positively has to get there overnight! You'll wonder where the yellow went when you brush your teeth with Pepsodent!)
100	0.1	1,500	Sound-bite, Prayer, Incitement, Joke
1,000	1	15,000	Flyer, Poster, Advertisement, Notice, Propaganda
10,000	10	150,000	Political speech, Sermon, Polemic, Article, Blog
100,000	100	1,500,000	Field manual, Ideological indoctrination, Manifesto
1,000,000	1,000	15,000,000	Bible, Koran, Abridged dictionary
10,000,000	10,000	150,000,000	Unabridged dictionary, Religious canon
100,000,000	100,000	1,500,000,000	Federal Register, Encyclopedia Britannica, Wikipedia
1,000,000,000	1,000,000	15,000,000,000	Instructions for building nuclear submarine or Apollo spacecraft



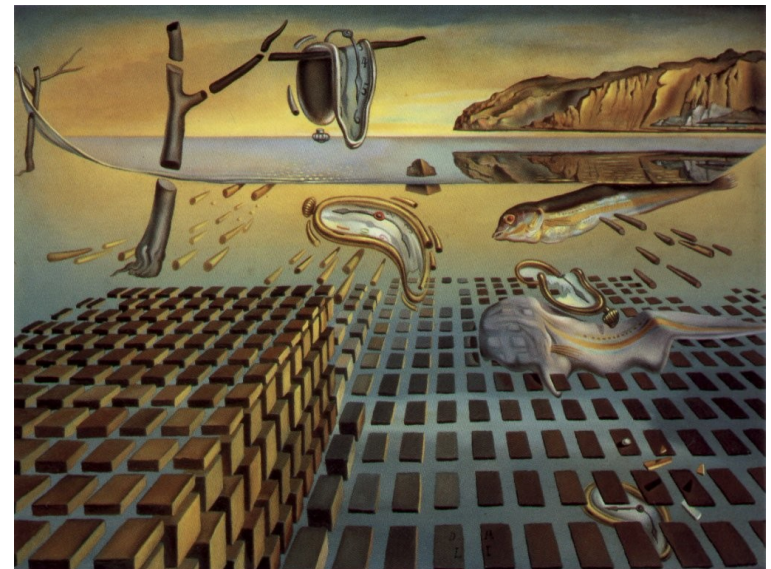
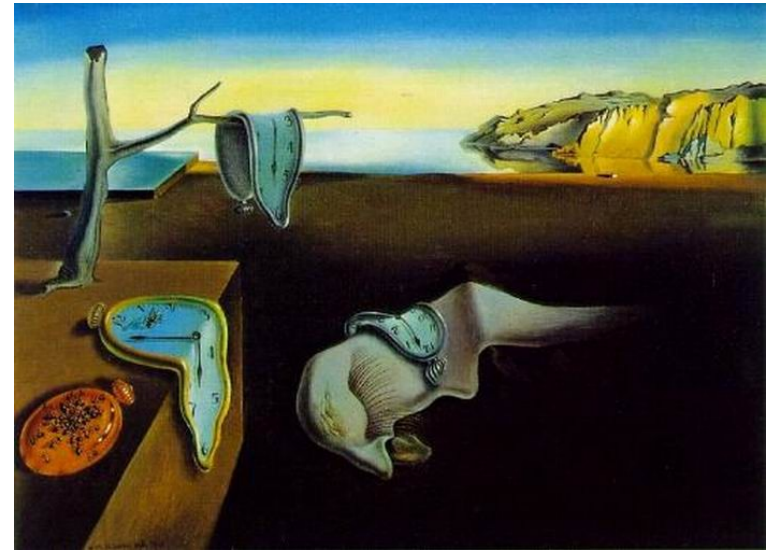
MEMETIC METRICS AND SUBMETRICS

- **A Threshold Metric is Propagation**
 - **The submetrics for Propagation are**
 - Number of Recipients
 - Type of Recipients and
 - Dispersion of Recipients
 - Depending on the problem under consideration, the type of recipients might be characterized or categorized by their economic, social, or educational class, ethnicity or culture, religion, gender, age, tribe, politics, etc.
 - Depending on the problem under consideration, the dispersion of recipients might be categorized as local, tribal, familial, regional, national, global, etc.

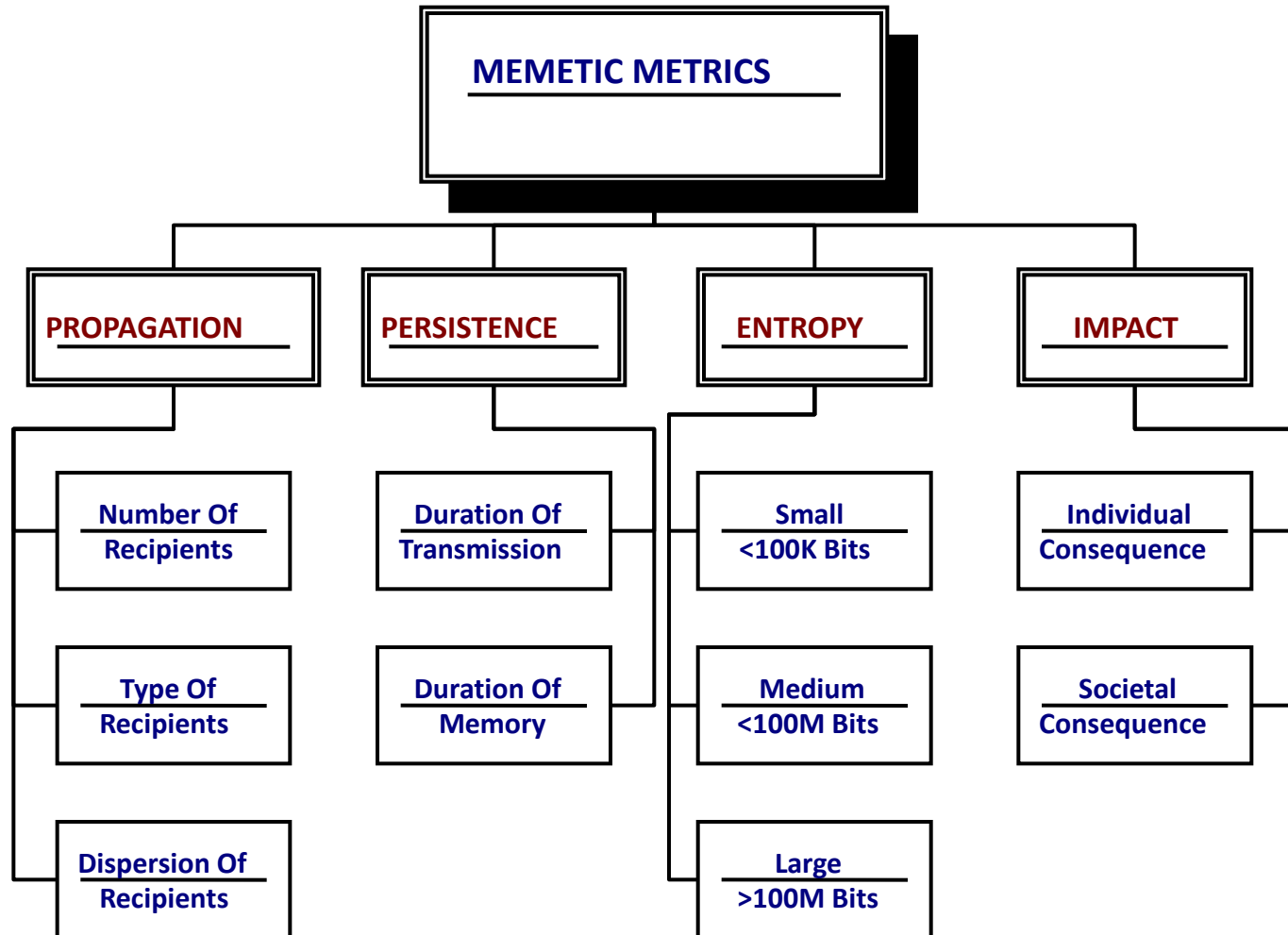


MEMETIC METRICS AND SUBMETRICS

- **Another Threshold Metric is Persistence**
 - The submetrics for Persistence distinguish between the Duration of Transmission of the meme and Duration in Memory or storage
- **Submetrics for metric Entropy (or size)**
 - Distinguish among Small, Medium, and Large, which are (using an order of magnitude rule) characterized as less than or equal to 100K bits, less than or equal to 100M bits, and greater than 100 M bits, respectively
- **Submetrics for metric Impact**
 - Distinguish between the impact (or potential impact) of the meme on the individual (individual consequence) and its impact (or potential impact) on society as a whole (societal consequence)

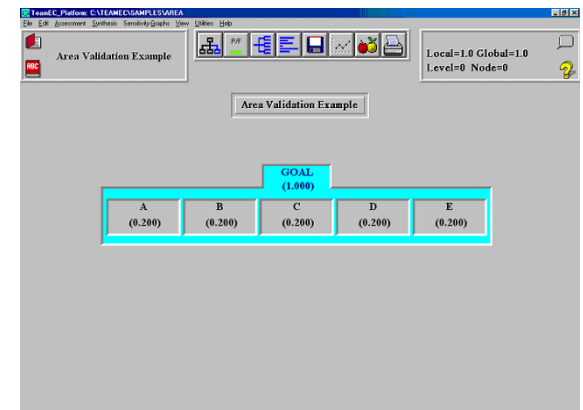
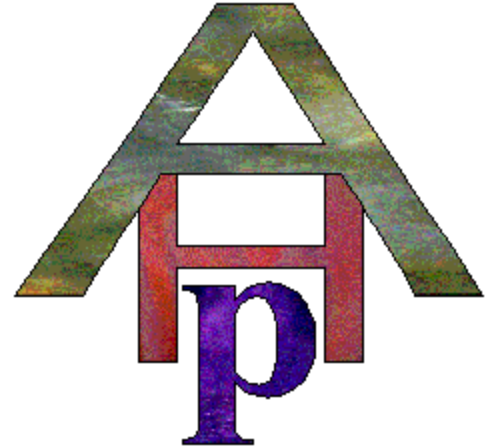


MEMETIC METRICS AND SUBMETRICS

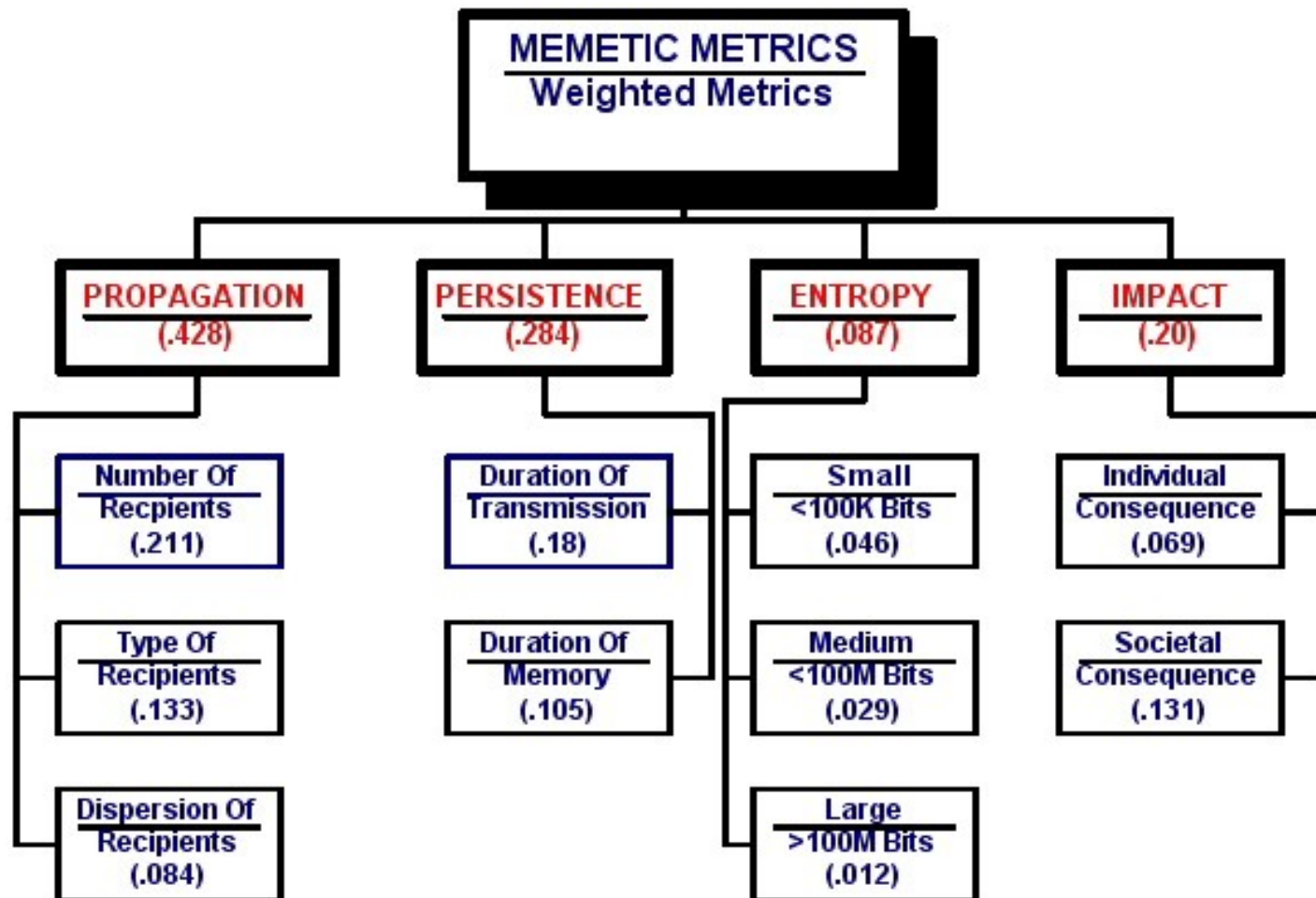


MEMETIC METRICS AND SUBMETRICS

- **Memetic metrics were weighted using the Analytic Hierarchy Process (AHP)**
 - **The AHP is used to determine the relative importance (weights or priorities) of the metrics, and can be used to evaluate (score or prioritize) alternative memes and then rank-order them**
 - **The AHP simplifies decision processes through problem structuring, decomposition and pairwise comparisons and can accommodate both quantitative and subjective inputs, merge them into single overall measure for ranking alternative choices (the underlying mathematics mostly involves solving for matrix Eigenvalues)**
 - **After defining metrics and submetrics, pairwise comparisons and a numerical scoring system are used to weight the metrics and submetrics, then evaluate and rank alternative memes against the weighted metrics and submetrics**



MEMETIC METRICS AND SUBMETRICS



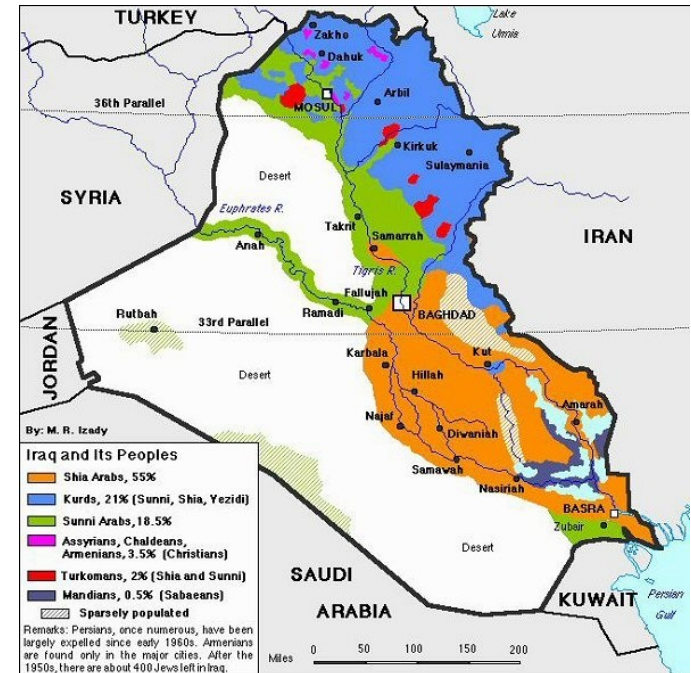
WEIGHTED METRICS AND SUBMETRICS

- The **Propagation** metric is deemed more important (weighted more) than **Persistence** (and the other metrics) because it is more easily measured or estimated and more relevant concerning memes of military worth, especially in the near-term
- The **Impact** metric is deemed somewhat less important than **Persistence** because it is more difficult to measure, especially in the real-world, in the near-term (in a model, with a God's-eye view, **Impact** might be considered the most important metric)
- The **Entropy** metric is deemed least important because the size of the meme, while influential, is not critical in its ability to propagate, persist, and impact (alter behavior), especially for digital media (e.g., images and videos)



WEIGHTED METRICS AND SUBMETRICS

- For the **Propagation** submetrics, the **Number of Recipients** is more heavily weighted than the **Type** or **Dispersion of Recipients** submetrics because it is more easily measured than the other submetrics and it alone can serve as a useful crude indicator of successful propagation
- The **Type** and **Dispersion of Recipients** are demographic details which refine the efficacy of the meme's dispersion but are not as important as the sheer **Number of Recipients**



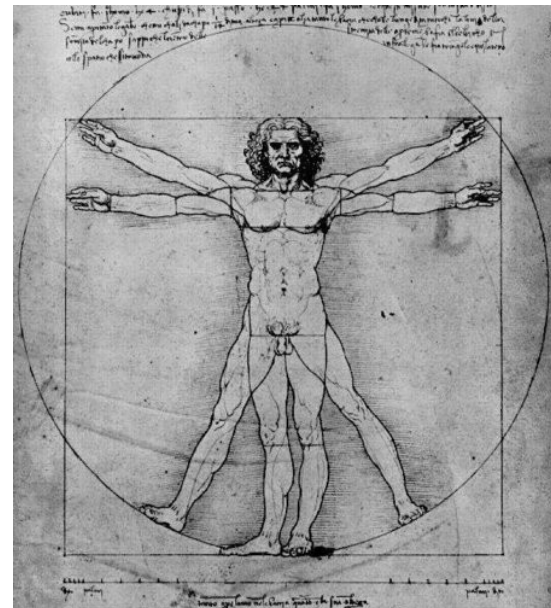
WEIGHTED METRICS AND SUBMETRICS

- For the **Persistence** submetrics, the **Duration of the Transmission** of the meme is deemed somewhat more important than **Duration of the Memory** of the meme because
 - It is easier to measure and more important for meme's of immediate military worth



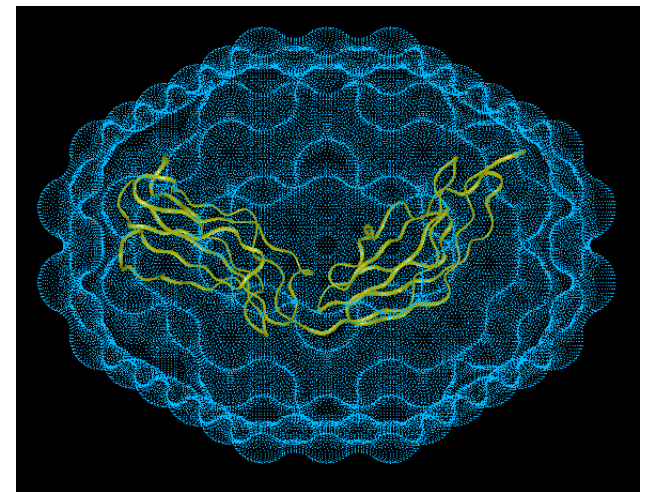
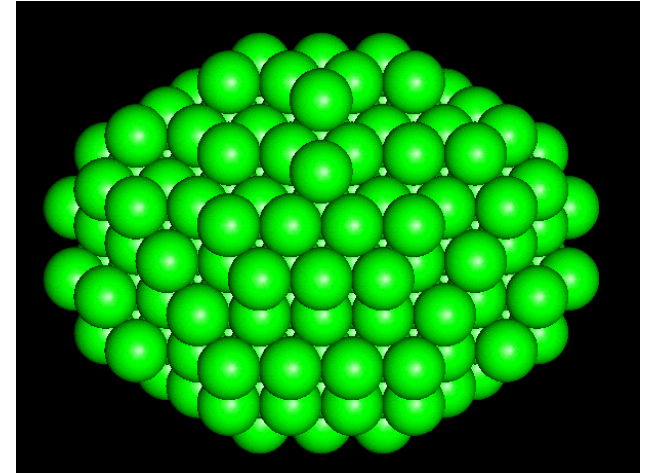
WEIGHTED METRICS AND SUBMETRICS

- For the **Entropy** submetrics, the **Small** categorization is deemed more important than **Medium**, which is deemed more important than **Large**
 - Despite meme size being less important with digital media, the human brain is still size and retention limited and is generally more responsive to briefer memes
- For **Impact** submetrics, the **Societal Consequences** of memes are deemed more important than the **Individual Consequences** (e.g., the altered behavior of many is generally of greater consequence than that of a single person, even if a single person may sometimes alter history)



PROSPECTIVE EXPERIMENTAL TOOLS AND TECHNIQUES

- Surveys and interviews
- Viral (buzz) marketing
- **Information theory and entropy**
- Genetic, memetic, and evolutionary algorithms
- **Modeling and simulation**
 - Rumor propagation models (e.g., NSF program); epidemic-like models
 - **Rumor and gossip theory and psychological models (e.g., Naval Postgraduate School)**
 - Rumor propagation dynamics on networks
 - **Modeling theory of mind with decision-theoretic agents (e.g., PsychSim)**
 - Agent-based simulation of geo-political conflict
 - Internet and cellphone networks



PROSPECTIVE EXPERIMENTAL TOOLS AND TECHNIQUES

- **Neuroeconomics tools**
 - **Neuroimaging**
 - Functional Magnetic Resonance Imaging (fMRI)
 - Positron Emission Tomography (PET)
 - Genetic profiling
 - Psychopharmacological manipulations
 - Psychophysiology (electromyography (EMG), event related potential (ERP), and electroencephalogram (EEG))
 - Behavioral measures
 - Psychological testing
 - Blood chemistry (and hormone) analysis
 - Single neuron recording
- **Example: FMRI scans have revealed:**
 - Political disparities in brain areas
 - Mirror neurons reflecting social cues and behavior of others and related to empathy and altruism; lie detection

