Is Belief in Rationality Rational?[1]

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The Origins of Rationality

The concept of rationality is derived from the philosophical work of Aristotle. Based on his teleological assumptions, along with his reliance on the Greek principles of non-contradiction and the assumptions that nothing can come from nothing and nothing can pass into nothing, Aristotle was forced to believe that the end state of any action must exist before the action. The essence of the oak tree must exist in the acorn; the essence of the person must exist in the sperm, the motion of a moving body must be caused by a prior motion, in an unending sequence leading back to the original "unmoved mover." A rock falls because its "proper place" is the middle of the earth, and it "wants" to go there; fire rises because its "proper place" is at the periphery of the universe. And so for all actions of all things, including people, for whom the end state of any action must pre-exist as a goal. Rationality follows from this theory insofar as people use reasoning (in this case, Aristotle's syllogistic) to maximize the likelihood of attaining their goals at minimum cost. Indeed, this is Aristotle's definition of man[2] -- a rational animal (Woelfel, 1987).

The beginning of modern science is typically dated from the rejection of this teleological model at around the time of Galileo, but leading Greek scientists such as Pythagoras, Philolaos, Archytas, Aristarchus of Samos and Archimedes never accepted Aristotle's views, and practiced advanced science two thousand years before Galileo. This second branch of Greek thought constitutes a network of scientists whose accomplishments -- initially obscured by the adoption of Platonic and Aristotelian thought by Christianity and Islam -- have eliminated Aristotle's entelechy from all branches of physical and biological science. Although Aristotle's teleology, along with its associated laws of motion and change, has been rejected in every branch of physical and biological science, it is still widely believed in the social sciences, and indeed forms the intellectual foundation of economic theory to this day.

Today, as we look back on a century of failed wars, the great depression, the rise and fall of Nazi Germany and the Japanese Empire, the collapse of the Soviet Union, genocide in Africa, Asia, the Americas and Europe, drug cartels, Wars in Korea, Vietnam, Afghanistan and Iraq, the proliferation of 2100 tons[3] of enriched fissionable material, only half of which is known to be "secure", the rise of international terrorism and the near collapse of the world economy, the fact that some social scientists continue to believe that human behavior is rational may represent, once again, the triumph of hope over experience.

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[2] Aristotle did not believe women were rational, but instead were domesticated animals.

[3] "...(T)he world today has (sic) sitting, often in poorly secured sites, on about 1,600 tonnes of highly enriched uranium. Another 500 tonnes of plutonium are stored in more than 1,000 sites in 40 countries -- enough to make 120,000 bombs." http://www.thestarphoenix.com/technology/Canada+taking+laudable+stance+nuclear+threat/2904608/story.html

Research in sociology, communication, computer science, physics and cognitive science, particularly in the last half of the 20th century and the first decade of this century, has provided substantial evidence that, while rational behavior may sometimes occur, it is not a predominant basis of human behavior.

In the middle of the 20th century, for the first time, populations in urban centers began to exceed rural populations, which led to some concern about recruitment of enough farmers to maintain a sufficient food supply for the US. This led to some organized support for research on the process of educational and occupational decision making, in part from NCT-86 regional committee of Agricultural Experiment Stations, and larger support from the National Institute of Education. Research by Sewell, Haller and Portes showed that attitudes of adolescent youth -- in particular, their educational and occupational aspirations -- had some effect on their later educational and occupational attainments, and further that these aspirations were themselves moderately predicted by an index of whether their parents, teachers and friends expected them to go to college (Sewell, Haller, & Portes, 1969).

A subsequent project initiated by A. O. Haller focused on improving the measurement of the influence of significant others on aspirations. The original Sewell, et. al. study was based on secondary analysis of data collected by another investigator for another purpose, and the significant other variable was a simple index of three dichotomous variables. Haller's intent was to detect the exact significant others for each adolescent, contact them and measure their expectations for the adolescent directly and precisely (Woelfel & Haller, 1971).

The results of this study showed that the aspirations of the adolescents were best predicted by the arithmetic mean of the expectations of their significant others, and that this variable alone explained about half the variance in the students' aspirations. This finding caused considerable excitement, since it suggested that *the adolescents weren't trying to find the level of education and occupational prestige that maximized their utility, but rather were moving toward the level of educational and occupational attainment that minimized the difference between their attainments and what their significant others expected of them.*

The Significant Other Study has been replicated successfully (Picou & Carter, 1976; Scritchfield. & Picou., 1982), and has generated a very large body of related research[4]. In it's original form, the Wisconsin Significant Other model was useful only for the unidimensional case and for continuously measured variables. The model was generalized to include discrete choices in multiple dimensions (Woelfel, 1975). By asking respondents to estimate the difference between pairs of occupations as ratios to a single standard pair of occupations, and calculating the eigenvectors of the scalar products matrix of the original pairwise dissimilarities matrix(Torgerson, 1958) the occupations could be represented as points in a high dimensional Riemann space. Saltiel (Saltiel, 1988a, 1988b, 1990, 2009) produced data showing that the

[4] A large collection of available literature can be found at http://galileoco.com/CEtestlit/literature.asp

the occupations to which students aspired lay closest to the point representing the average of the coordinates of the occupations their significant others expected them to attain. Once again, the attitudes (aspirations) of the students tend not toward a point of maximum utility, but toward the point of minimum divergence from the expectations of others.

This generalized version of the Wisconsin Significant Other Model is referred to as the Galileo Model (Woelfel & Fink, 1980). Briefly, the model holds that social objects are recurrent patterns of stimuli identified by the culture in general. Following Blumer, "...an object is anything that can be designated or referred to. It may be as physical as a chair, or as vague as a philosophical doctrine" (Woelfel 1967). Behaviors are clearly objects. Individuals define objects in terms of their relationships to other objects, and define themselves (the self is, of course, an object) in relation to the objects of their experience. Behaviors that are consistent with (close to) the self are performed frequently; behaviors that are not consistent with the self (far from the self in the Galileo space) are performed seldom or never. In fact, the rate of performance of behaviors decreases as the distance of the behavior from the self in Galileo space increases.

The Galileo Model

The Galileo Model was originally derived mathematically from the arithmetic mean model underlying the Wisconsin Significant Other model. Subsequent research in many disciplines has provided a material substrate for the Galileo model:

Objects

The sensory information that flows through individuals and cultures is continuous and ever changing. A chair seen from above, behind, below, close, far, empty, full looks different in each case. Overstuffed chairs, rocking chairs, reclining chairs, office chairs, chairs on wheels, wooden chairs, plastic chairs, red chairs, brown chairs all look different. Each time we move, the image of the chair that falls on the eye changes. Yet we are able to recognize the continuously changing image as a single object, a chair. How does this happen?

All perception is a result of energy impinging on the human sensory system. When light energy, for example, falls onto the eye, it activates cells in the nervous system called "neurons". As the image changes, different neurons turn on and off. At any instant, the image in the brain is made up of the pattern of neurons that are "active."

If this were all that happened, human life would be an ever-changing chaos. But neurons are living things, and tend to grow connections among themselves when they are active. If we see a pattern again and again, the neurons that represent that pattern tend become connected. (Patterns that occur very seldom are quickly forgotten, as connections that are not reinforced decay.) A network of interconnected neurons is shown in Figure 1.

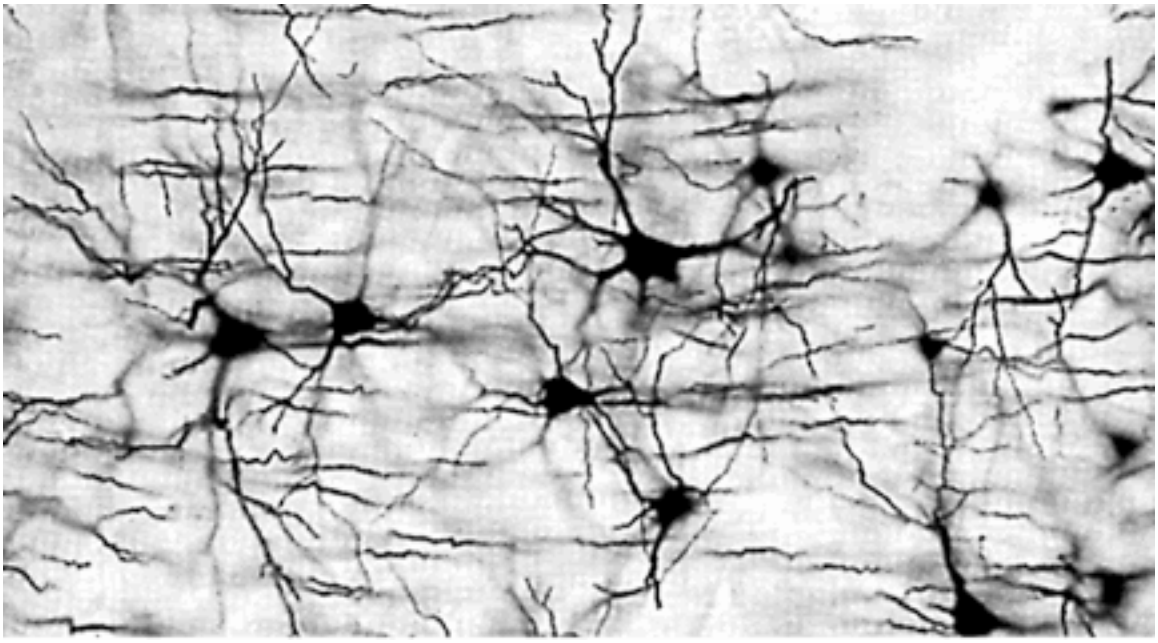

Figure 1: Golgi Stain of Neural Network in a Brain

Neurons that are connected to each other communicate with each other. If we see *part* of a chair, *some* of the neurons in our concept of chair become active. If enough of them become active, their activation flows through the connections to the rest of the neurons to activate the entire concept, and we think of a chair. In this way, our brains transform the continuous flux of experience into solid, stable objects.

It's important to understand that concepts, or objects as they are called in Galileo theory, are not insubstantial, ephemeral thoughts, but networks of real, living cells. *It takes energy to build the clusters of neurons that make objects, and it takes energy to change them. The laws of thermodynamics apply to cognitive structures and processes just as they apply to "physical" objects and processes.*

Beliefs

We can sit on a fence, sit on a couch, sit on a chair, sit on our hands, and everything's better when it sits on a Ritz. Sitting, just like chair, is an object. All objects are defined in terms of their relationships to other objects. We can't understand the meaning of *chair* without understanding the concept of *sitting*. The relationship between any two objects is called a *belief*. Beliefs are not insubstantial, ephemeral abstract things, but are, like objects, networks of interconnected neurons. It requires energy to grow these structures, and it takes energy to change them (Woelfel & Fink, 1980).

Situations

Objects have different meanings in different contexts or *situations*. A tiger in a zoo has much different meaning than a tiger in your yard. To understand the meaning of any concept, it's necessary to consider the situation in which it occurs, and what other objects also occur in that

situation. The relationship of an object to all the other objects in the situation is the meaning of that object in that situation.

Yourself

One very special object is you, yourself. It's the only object that's present in every situation because, wherever you go, there you are. Your definition of yourself -- who and what you think you are -- is determined by your relationships to the other objects around you. These beliefs about your relationship to other objects are called *attitudes*. Attitudes are important because attitudes influence behavior.

Changing attitudes changes behavior. Reducing terrorist acts toward the US requires changing attitudes toward the US. Like other beliefs, attitudes are living physical structures -- networks of neurons in brains. It takes energy to form attitudes and it takes energy to change them.

Culture

In the long view, individual beliefs and attitudes are not very important. Individuals are replaceable, and, in fact, on a worldwide basis, individuals are replaced at a rate of about 8% per year. Every hundred years or so, all of them are replaced, yet society and culture goes on. Although individuals can and do form concepts, beliefs and attitudes, most of them by far are formed by the culture and transmitted to new individuals (children) by their parents, schools, religious organizations, media and other agencies

In the culture, as in the individual brain, concepts are networks of connected neurons, although in the culture, the connections are mediated by communication, as in social networks, face to face communications, and other media. The concept of America, or the Taliban, is made up of networks of interconnected neurons distributed across many brains. If a concept is to survive, the patterns which comprise it must be communicated to new individuals as existing individuals die, or the concept will die with them. It is the pattern that matters, not the individuals in which it exists. Mathematically, the patterns that make up human culture can be represented by an ever-changing matrix of connection strengths among neurons.

While individual beliefs and attitudes can be volatile, like individual leaves falling from trees, cultural beliefs and attitudes behave lawfully and are highly predictable, in the same way as you can track the changing color of the autumn leaves in the Adirondack Mountains day by day. Predicting the color change of an individual leaf is fraught with difficulty, but mapping the aggregate color change day by day is straightforward.

Representing Cultural Beliefs and Attitudes

Objects are networks of neurons in brains. Objects that are similar -- that "go together" -- are tightly interconnected. Those that are dissimilar have few or no interconnections. We can capitalize on this notion of "close" and "far apart" to represent beliefs and attitudes as points in

space[5]. Those that are similar or "go together" are close to each other in space, while those that are dissimilar are far apart.

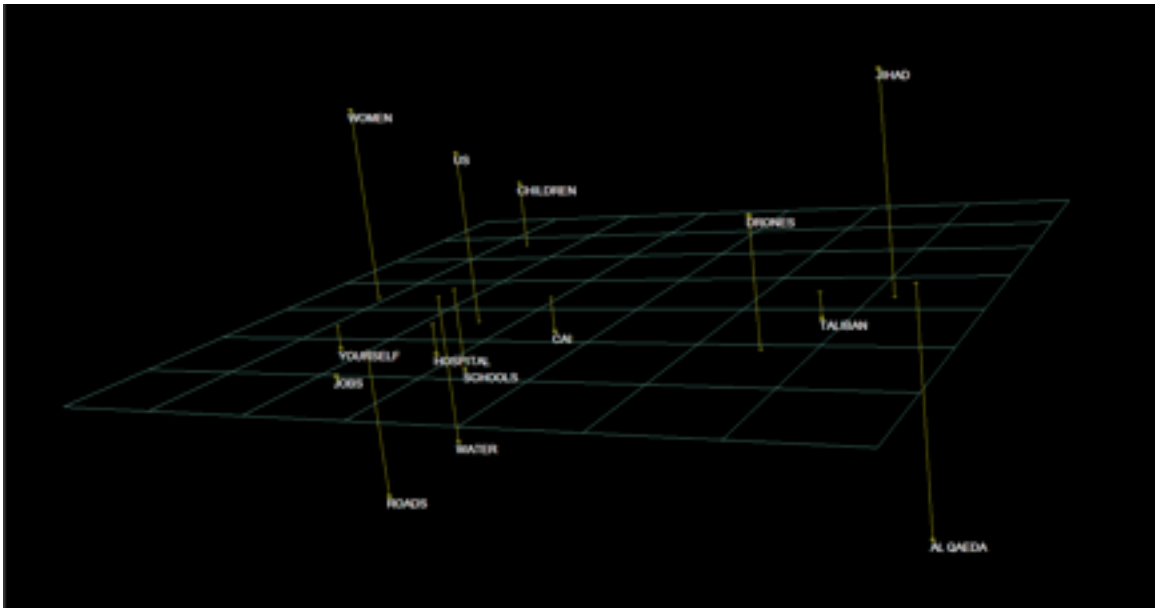

Figure 2: Beliefs and Attitudes about the US in Afghanistan

Figure 2 shows the beliefs and attitudes of three Americans toward the US, the Taliban, Al Qaeda and the Central Asia Institute, a NGO that builds girls' schools in Afghanistan and Pakistan. Their attitudes toward the US are much more favorable than their attitudes toward the Taliban and Al Qaeda, as is indicated by their distances from "yourself" in the lower left side of the space. While this space is just a snapshot in time, changes of beliefs and attitudes over time are represented by movements of the points through the space.

Messages

Messages are anything that changes the pattern of interconnections among neurons. Changes in the neural patterns moves objects through the Galileo space. Messages can be simple, such as a sign saying "The US is good," or compound, such as "The US builds roads, schools and hospitals." Or they could be actions, such as building a school, or attacking Al Qaeda personnel with a drone. Each of these, and many, many more, can result in moving objects in the Galileo space, thus changing attitudes and beliefs (Woelfel, Fink, Holmes, Cody, & Taylor, 1974; Woelfel, Holmes, Cody, & Fink, 1988).

The Galileo space can predict the effect of these or any other messages on beliefs and attitudes before the fact, and measure the actual effect after the fact. This gives planners the

[5] The space that results from actual measurements is more complicated than ordinary three dimensional space as it appears in everyday life, but the mathematics for dealing with it are well developed, and computers have no problem with it.

ability to play "what if" for various prospective scenarios. It can also calculate the most effective messages for creating a desired change in attitudes.
Figure 3 shows the likely effects of providing schools, roads, hospitals and jobs in Afghanistan.

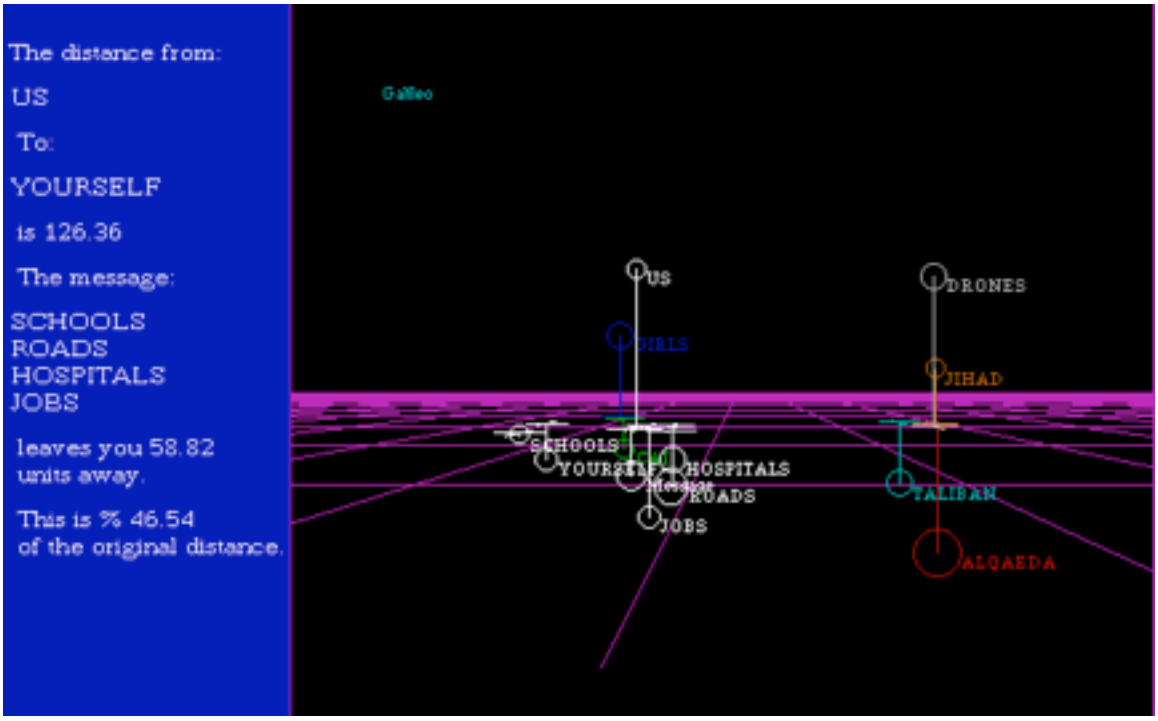

Figure 3: Predicted Effects of the Message "Schools, Roads, Hospitals, Jobs."

It shows that the present distance between the US and "yourself" -- a measure of attitudes toward the US -- is 126.36 units. The message "schools, roads, hospitals, jobs" can move the US to within 58.54 units, an improvement of over 53%.

Figure 4 shows the predicted effect of the message "drones" on attitudes toward the US.

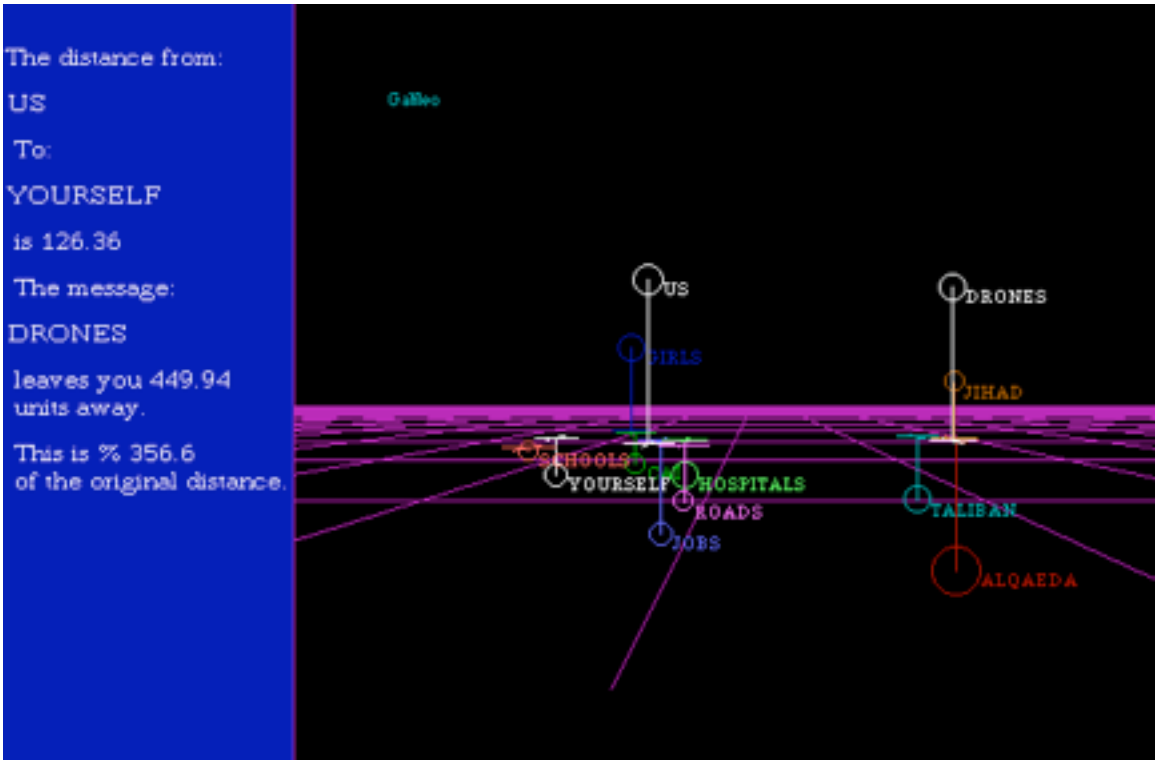

Figure 4: Predicted Effect of the Message "Drones" on Attitudes Toward the US.

Such a message might occur when a village is attacked by a US drone. The predicted effect is to move the US from its present distance of 126.36 units from "yourself" to 449.6 units, and worsening of attitudes toward the US of more than 355%. Whatever the military advantages of such a strike, there is a severe penalty to be paid in attitudes toward the US. Four hundred forty-nine units is far enough to move "yourself" all the way to "jihad."

Dynamics

Human beliefs and attitudes constitute a dynamic system. With a system in place to provide continuous inputs of data, Galileo can provide a useful and easy to understand method for tracking changes in attitudes and beliefs. Figure 5 shows the distances between the presidential candidates in the last US presidential election over a six-week period (Anderson, et. al., 2009)

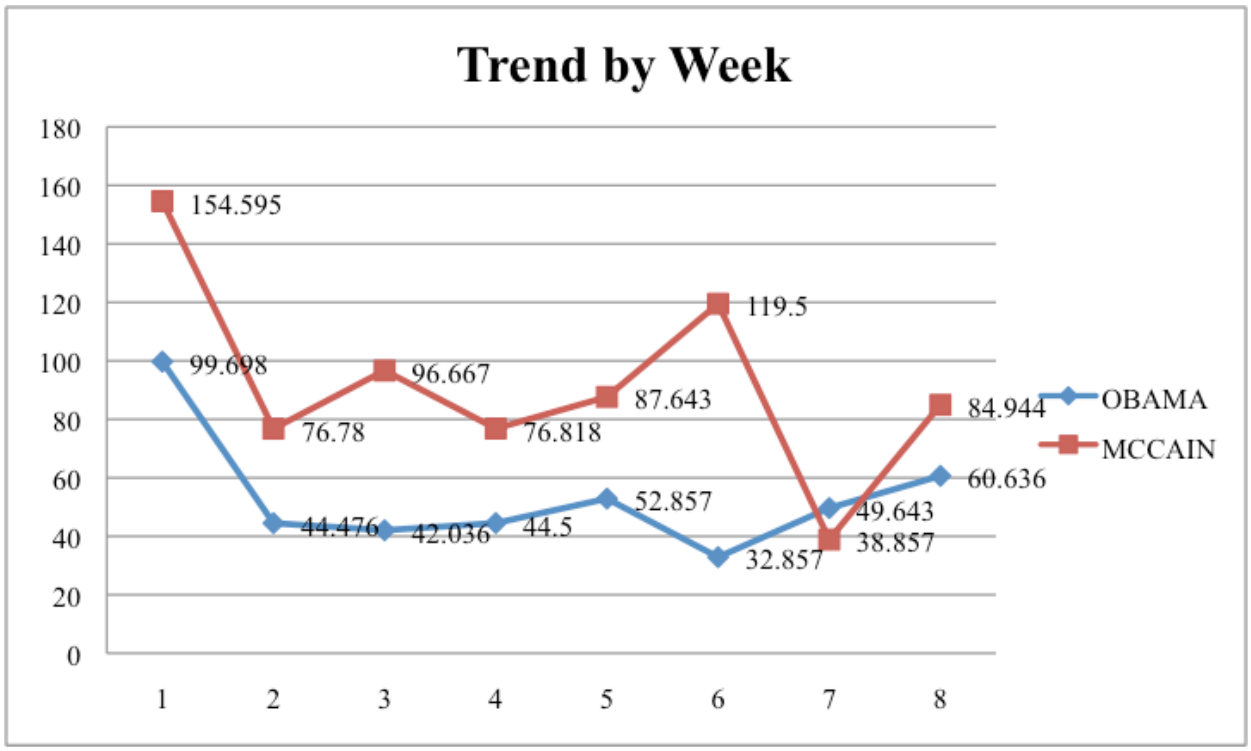

Figure 5:Distances from "Yourself" for Obama and McCain over Eight Weeks

Experience with elections shows that the candidate closer to the self wins elections (Barnett, et. al., 1976; Barnett, 1978), and the last presidential race was no exception. Unlike traditional polling, which can tell who's leading and by how much, Galileo can tell what has to be said to move closer -- or to move your opponent further away -- on a continuing basis.

Consistency with the Self Concept as a Determinant of Behavior

The underlying message of the Galileo model is that human behavior is determined not by a calculus of means and ends, but by a pattern-matching algorithm. People perform those behaviors which best fit their conception of what kind of person they are in the situation in which they find themselves. Their conception of who they are is itself determined by information about themselves provided by two sources: other persons (including mediated others) and their own self-reflexive perception of their relationship to the objects surrounding them. In every case known, the self-consistency model outperforms the rational actor model, even in situations where the rational actor model works well. In auto sales, for example, based on a (proprietary) national sample of purchase intenders, the correlation between how much potential buyers like a car and the market share of the cars is a respectable .82, which accounts for an impressive 67% of the variance. But the correlation between the distance of the car brand from the self of the same respondents measured by the Galileo model has a correlation of -.998, and an explained variance of .996% (Woelfel & Stoyanoff, 2007).

In a recent study by Cheong, et. al., the distance between the self an various communication media (e.g., radio. TV., email, etc.) predicts the number of hours of use of each medium per day with a correlation of -.90.

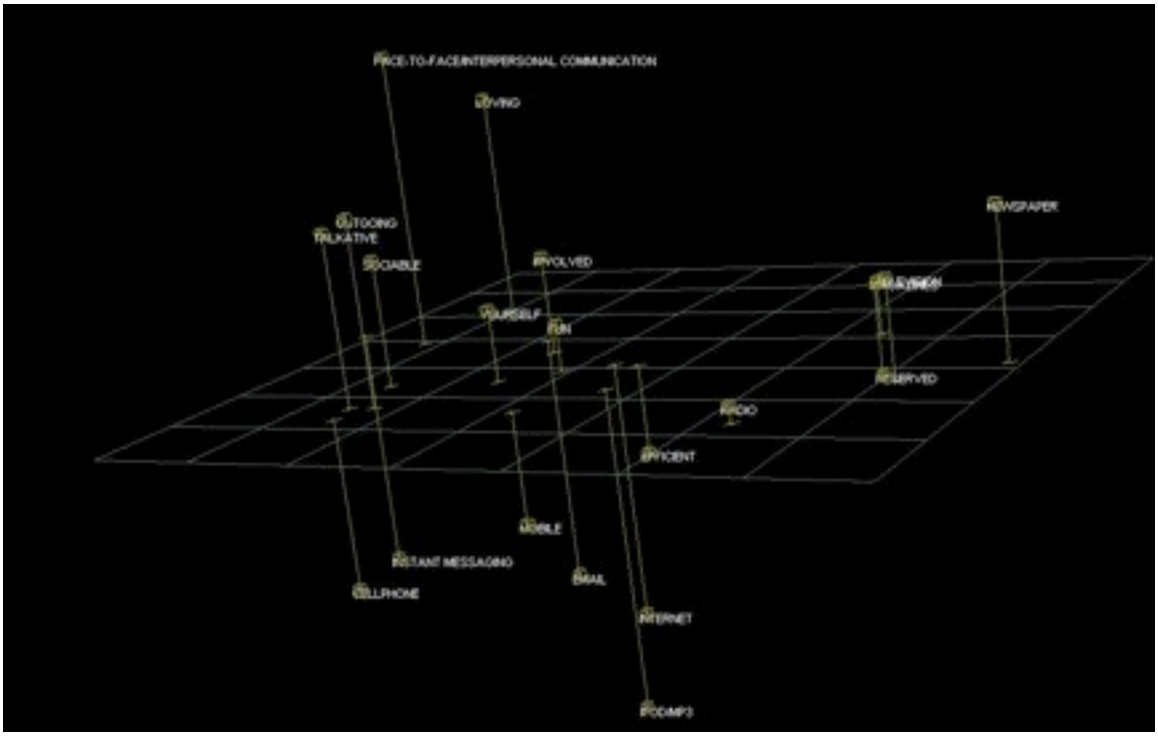

Figure 6: Galileo plot of media and their attributes

For each unit closer to the self in Galileo space a medium was located the rate of use went up about 12 minutes per day (Cheong, et al., 2010).

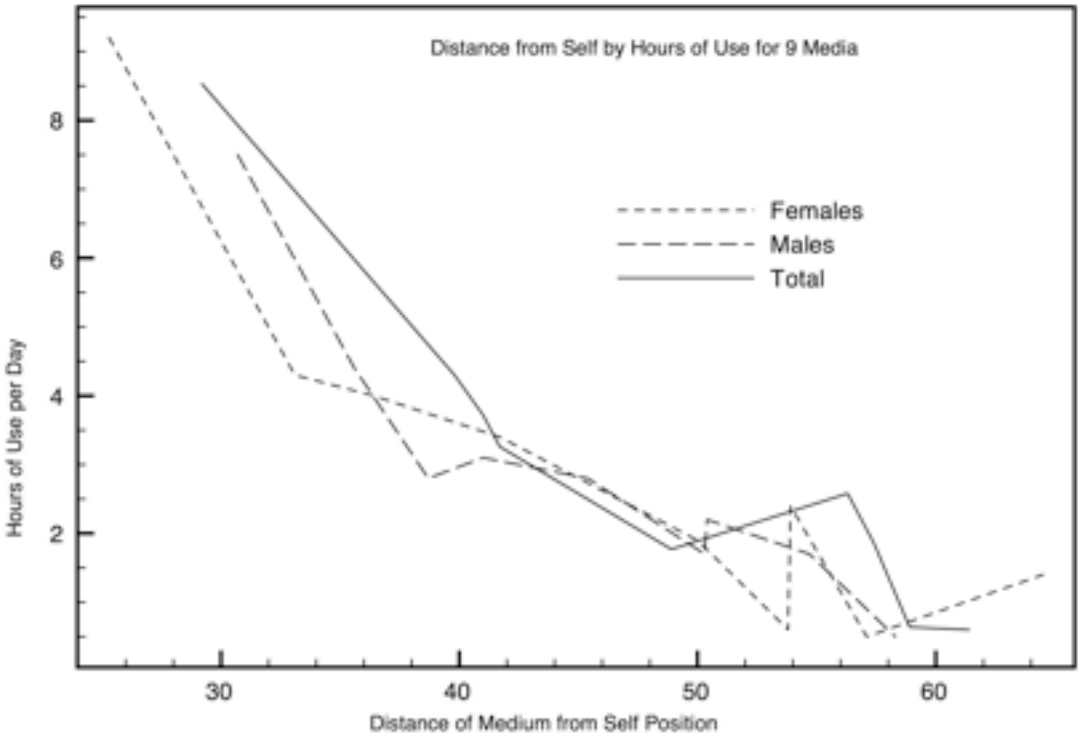

Figure 7: Distance from media to the self concept by hours of use per day

Although studies of the factors which predict media use are among the most frequently conducted studies in the Communication literature, explained variance base on the "rational actor" model, or "uses and gratifications" model as it is referred to in Communication, never approach these levels (Cheong, et al., 2010).

In addition to the strong empirical support for the "pattern matching" model over the "rational actor" model, the Galileo model has the additional advantage of fitting with the known behavior of neural networks. Unlike previous "brain metaphors", such as the notion that the brain is like a hydraulic system, or a telephone switchboard, or a computer, the idea that the brain is composed of neural networks is no metaphor -- it is a fact.

Why Does the Rational Actor Model Survive?

In spite of the poor empirical record of the "rational actor" model, it continues to attract strong support from social scientists and lay persons alike. In the field of Communication, one of the oldest and most widely accepted models of media usage is the "uses and gratifications" model, which is Communication's term for the "rational actor" model. After a half century of research, the amount of variance accounted for by this model is vanishingly small, particularly in contrast to the much more successful pattern matching model of the Galileo model. Yet it is much more widely believed than the more successful model. Why is this?

The Galileo model itself provides a plausible reason. Even from the earliest days of the Wisconsin Significant Other study, evidence supported the idea that individual attitudes were determined by two main factors: the information provided by other persons, including media, and information one could gain oneself from self reflexive activity. When self-reflexive activity is blocked -- including collective self-reflection, as in the case of science -- attitudes of new generations will be the same as the attitudes of previous generations, since they will converge on the mean of the previous generation. The methodology of the social sciences provides a substantial barrier to learning through self-reflexive activity (woelfel, 2010). When the ability to learn from observation is blocked, old attitudes and beliefs will prevail.

In the absence of empirical self-reflexive information, individuals can be expected to converge on the attitudes of the people with whom the communicate the most. Followers of Minsky (Minsky, 1986) and the Expert System community of artificial intelligence will believe most strongly in the "rational actor" model. Followers of Sejnowski and Hinton (Hinton & Sejnowski) will lean strongly toward the pattern matching model of the Galileo model, although these convergent forces will not be strong, because their position in the social network will mean that they have never heard of the Galileo model.

Galileo theory also suggests that beliefs in human rationality will be extremely massive. As Saltiel and Woelfel showed, concepts exhibit an inertial mass that is directly proportional to the amount of information out of which they are formed. (Saltiel & Woelfel, 1975) This is consistent with the understanding that synaptic links among neurons are, in fact, masses of organic tissue which require energy to form and require energy to dismantle. The rational actor model is not only the basis of economic theory and much social science theory, but lies at the root of religious systems like Christianity, Islam, Buddhism and others where free economic choice forms the basis of judgements of virtue and guilt. The same model forms the core of Western literature. Since there are about 2.3 billion Christians (33%) and a billion and a half Muslims (22%) the magnitude of the task involved in revising the rational actor model becomes apparent. The amount of energy needed to restructure this massive system is likely to be much greater than the amount of energy needed to dislodge, for example, the geocentric model of the universe. According to the AAAS, in 2007 there were 5.8 million science and engineering researchers in the world, about 8.3-08% or 0.000000008% of the world population, so even the total work of all the world's scientists has only a small effect on world culture.(http://www.aaas.org/spp/rd/guiintl.htm)

Summary

Galileo is a theory and method that represents beliefs and attitudes as distances among points in space. It is consistent with the model of measurement practiced in the physical sciences and engineering. It rejects the alternative model of measurement adopted by the social sciences. This makes it possible to measure beliefs and attitudes, and changes in beliefs and attitudes with great precision. Empirical results show that the Galileo model always produces measurements

more precise than those produced by traditional social science methodologies. It also makes it possible to calculate the predicted effects of messages and other events on beliefs and attitudes, and to track these changes over time. In the words of the Rand Corporation:

> In many ways, Woelfel's theory was the closest that any social science approach came to providing the basis for an end-to-end engineering solution for planning, conducting, and assessing the impact of communications on attitudes and behaviors. This theory appears to provide a generalized framework for
>
> • measuring attitudes,beliefs, cultural factors, and other psychological or cognitive phenomena through the use of paired comparisons of distances between objects using a standardized metric
> • visualizing attitude structures in a multidimensional space in which the distance between attitude objects connotes their similarity or dissimilarity, with attitude objects that are judged to be similar closer together and those judged to be dissimilar farther apart
> • assessing the degree of similarity in attitude structure within subgroups based on the dispersion around the average positions of attitude objects in multidimensional space
> • assessing the level of crystallization, stability, or inertia in attitudes by comparing the average position of attitude objects in space at different time intervals and ascertaining whether differences are accountable to a lack of crystallization in beliefs about the objects or whether they actually reflect the movement of these objects in response to persuasive messages or other factors
> • identifying the most effective and efficient campaign themes and messages for changing attitudes in a target audience by identifying where in multidimensional space an attitude object (e.g., "the United States") is relative to other concepts, such as "good" and "evil," and what other attitude objects (e.g., "England") might be associated with "the United States" to move it to a more favorable position (Larson, et. al., 2009)

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