VOLUME - 12, ISSUE - 08, AUGUST - 2023 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Geography

AN INFERENTIAL APPROACH TO AGENTS OF RADICALIZATION OF TERRORISM

Mark Oxley

Mary Collins

Joe Lyons

Mario Schootman

Bill Heidbreder

Gary Higgs

Melissa Higgs

ABSTRACT Predicting the behavior of individuals and institutions in society is an important and complex task, this is especially critical in the case of potential terrorism. This importance is due to the fact that terrorism behavior is destructive to civilized societal function. The difficulty associated with terrorism is that it is the result of the interplay of invisible obscure forces & energy operating in the virtual background on the constellation of societal entities. GIS has become a major tool of visualizing the physical artifacts of the rituals and behaviors on the landscape. This paper introduces a framework for systematizing the visualization of the causes of behaviors through inferential GIS in a space time and phase space structure through Oxley's General Model operating an iterative classifier.

KEYWORDS : GIS, Geography, Causality, Space time, Phase Space, Values/Beliefs, Terrorism, Classifier Model

INTRODUCTION

The physical, cultural, and behavioral domains of the world co-exist, interact, and are always in flux as forces and energies rise and fall, exerting pressures on institutions, structures, and entities. These domains and their physical presence are subject to GIS observation, interpretation, dissection, and analysis. From its earlier days of hand-colored Symaps of computer letter character printouts to the crisp, clean, widely distributed precision spatial and attribute data of modern production GISs, these fused compilations have been giving increased vision to the reality of today's world. It is the GIS view of these domains that opens a window to the consideration and understanding of observable, yet intangible, virtual actions, occurrences, and interactions that result in physically observable artifacts on the physical earth. The advancing universe of GIS applications almost appears to know no limits, and at about this point in time, the notion of the revealed reality of GIS begins to suggest the classic questions often properly posed by geographers following the Chicago school of Geography "So what? What does it mean? What are we intended to understand from what we see?" Thus, the things we see and observable events that occur may very likely be the result of things that happened that were unobserved or things that were observable but did not express themselves in obvious physical form at the time.

Despite the existence of many human observers and/or numerous hard or soft detection and surveillance systems, the dynamics and physical comings and goings that are of interest to concerned agencies and entities regarding the radicalization of many individuals are frequently only perceived and understood when observable changes occur that are measurable only in hindsight. This after-the-fact recognition is most typically the result of occurrences about which it is not possible to *connect the dots* as they are evolving but rather after they appear and can be recognized. This shortcoming may be attributed to the fact that the forces and energies that drive radicalized physical outcomes may, to some extent, be observed through conventional surveillance and detections systems but, to a larger extent, may only be observed and recognized through soft or semantically inferential variants that are not overtly detected by traditional observation or geospatial intelligence means. The ability to anticipate occurrences in times of trouble and security threats is unquestionably critical; it is the conjecture of this research effort that these inferential variants are accessible in such circumstances by a fusion of the intangible aspects or their inferences which are operating on or through the energies and forces presented. They are also observable through actions and behaviors in these domains. These energies and forces can produce a view of an enhanced reality, an Inferential Geographic Information System. (I-GIS), on the observable GIS by incorporating not only the existence and action but also the causative agencies. This paper proposes to present a space time reference in which phases spaces of physical and conceptual neighbourhoods of action exist, and in which entities interact and influence each other, and present an illustration of synthetic hypothetical behavioural values

Space Time

The concept of Space Time provides a useful construct for considering the operational domain of human activities. Space Time is so obviously relevant, top of mind, and important to humanity as the container of physical activities that its presence, rigor, and metric is virtually ignored by many; it is taken for granted as a background condition because it simply "is". Space Time's most obvious trait is that it is there, and it contains the ordinary and customary daily order in our Space Time commonality. Despite its relative obscurity in human consciousness, the concept has been the subject of much development in the science of physics where it has been used as a framework, a source of tools, organized ideas, and understandings about the operation of the universe in general and in basic matter. Regardless of the obvious importance of the concepts in understanding human operations, utilization of the Space Time concept has been given little consideration in the domain of human activity. Although interest and attention are focused in looking beyond the first surface of observation in environmental and human behavioral issues, an increasing number of studies are using Space Time reference frames in animal, plant, and biological systems.

Phase Spaces

As this Space Time structure is standing up as a reference frame, numerous sub-structures known as Phase Spaces can

be conceptualized as existing within it. These Phase Spaces are multidimensional, topically distinct systems which can express multiple possible states of the elements of their thematic environments (systems) and the contents in which their occurrences can exist. These Phases Spaces can be seen to correspond to discrete sections of earth geography, effectively a segment of territory, that is a tapestry of textured land use constituting the land cover of social and physical surfaces, complete with the activities, economies, cultures, populations, values, beliefs, and all the normal components of civilization as we know it.

In these Phase Space systems, a condition of relations of and amongst the activities, elements, and agents that make up the thematic constellation may each be considered as a counterpart of the physics entity termed a *microstate*. In the physics world, a microstate is the particular distinctive arrangement of each molecule/particle in the Phase Space system at a single instant. Similarly, in human earth and Phase Space, a counterpart microstate could be considered the physical and cognitive arrangement of every human. Considering the objective of re-visioning of the Phase Space into the human context suggests an enormously complex extension of understanding because actions and behaviors in the wilful human world are not as clearly objective as in the physics particle world. Nonetheless, this trail-breaking physics thinking can and has projected some illumination of human behavior.

The cognitive portion of human Phase Space can be considered as a thought space, or a decision space, which can be linked directly and precisely to the physical geographic earth-bound spaces of human physical action. Within the cognitive constellation of the Phase Space of an individual or group, there are widely ranging distributions of values, beliefs, ideas, objectives, and sensitivities; a population may be widely diverse in its characteristics. Additionally, individuals and associations among these Phase Space constituents can and do vary on issues of focus, intensity, and concentration. Agents or actors that are thematic members of Phase Spaces also vary in their expressions and actions because of differing sensitivities to the ambiance of varying waves of energizing understandings, information, forces, values, and beliefs. Hence, they would naturally be expected to exhibit widely varying ranges of responses, responsibilities, behaviors, and roles. In more clearly understood and objective times, these entities might be distinguished from the bulk of Phase Space components and called change agents, thought leaders, spokespersons, or institutions.

In this human counterpart Phase Space, these change agent entities can, like all other system components, be represented by a single point in the physical geography plane of existence with each possible state of components (location and movement) represented in both physical terms and in potential terms. In the cognitive domain of the Phase Space, each entity may be located in a variety of positions in thought space according to its sensitivity, focus, and interest. The curious nature of the cognitive relevance of human sensitivity is such that it evolves with time and situations and thus is not static, permanent, or consistent. This is most likely because human nature is not constant and consistent but rather is subject to variance. Thus, the temporal aspect of this Phase Space becomes an important property because change is destined to alter emerging status. Classic examples of such variance are the factors that produce cultural changers such as innovation diffusion and acculturation.

Coupling

At the microlevel, one of the behaviors that is so obvious and yet so frequently and imperfectly observed and accommodated is *coupling*. The awareness of this concept, arising again from physics studies of physical particles, not only describes the interactive, interdependence, or reciprocal behavior of physical inanimate elemental material interactions and reactions, but also gives structure to measuring observed interactions between animated and motivated behaviors typical of environmental, biological, and human actions.

In physics, two objects are said to be coupled when they are interacting with each other. However, in classical mechanics, coupling can be as basic as a connection between two oscillating systems, such as pendulums connected by a spring, and in particle physics, two particles are considered coupled if they are connected by one of the four fundamental forces such as gravitational, electromagnetic, strong, and weak forces. Coupling has also found fruitful adaptation in environmental, animal, and social human studies where environmental dynamic interactions and animal to animal response have productively applied coupling to understand animal environmental situations . These structured, systematic interactions which are often ignored and/or overlooked and insufficiently interpreted are gradually laying the foundation for the expansion of the Phase Space reference plane into social interactions, political thinking, behavioral understandings, and societal trends including seasonal cycles and individual or group action thresholds. In human relations, values, and beliefs it is consistent to consider individual and group values, beliefs, and understanding to be coupled when they alter each other. The magic of coupling, as both a reflection and a determination of the nature and status of the Phase Space and its constituent agents and actors as far as human society is concerned, begins to reveal itself when the Phase State constituents occupying their three locational coordinates of x, y, and z, and their two movement coordinates of distance and direction carrying their embedded sensitivities to the forces, energies, values, and expression of standard societal behaviors and rules as attributes, experience change over time. Contemporary examples of such coupling abound in migration behavior, the fashion industry, decorative arts, entertainment tastes, popular styles, political and social trends, and fads of behavior and actions. As coupling appears to contribute to the appreciation of the interaction of forces and energies on the human agents and actors in their daily life and routines, entanglements of behaviors and beliefs can channel into radicalizations disposed towards terrorism. These entanglements may eventually morph into self-reinforcing masses of forces and energies that no longer can be distinguished as having individually distinct origins.

The operational phase space of radicalism

A literature search of the agents, events, and causal connections involved in radicalization has identified seven classes of terrorism racializing influences as shown below that impinge on and constate Behavioral Influence's the listed in Table 1: 1) Identity, 2) Desensitization, 3) Family Honor, 4) Value Variance, 5) Isolation, 6) Anti Injustice Morality, and 7) Wealth. These, among many others, have emerged as the forces and energies that exert pressures of varying degrees on the agents and actors in the Phase Space of social behavior

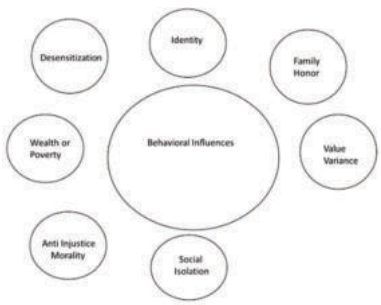

Figure 1.

The literature suggests that the elements of radicalization are dynamic social/cultural influences that conform to patterns consistent with socially constructed influences and groups in which change, events, and shifts in position can or will occur. Given the conceptualization of a multi-dimensional physical cognitive Phase Space, the graphic limits of hard copy display in this paper restrict the ability to illustrate a full range of agent dynamic interactive responses. However, the upper portion of the Figure 2 graph illustrates three axes indicating representative dimensions of these forces along which influence values have been plotted. As these forces and energies change, subsequent position values evolve with the structure of the constellation changing, and therefore reflecting and predisposing new sensitivities and dependencies. This graph represents the conceptual phase space of three of the seven values, which characterize the estimated current state of each active agent in terms of the labelled vector properties. The understanding of the physical outcomes of this behavioral state and its events are the objective of this I-GIS approach. The lower portion of Figure 2 illustrates the physical urban landscape texture on which the physical outcomes are expressed.

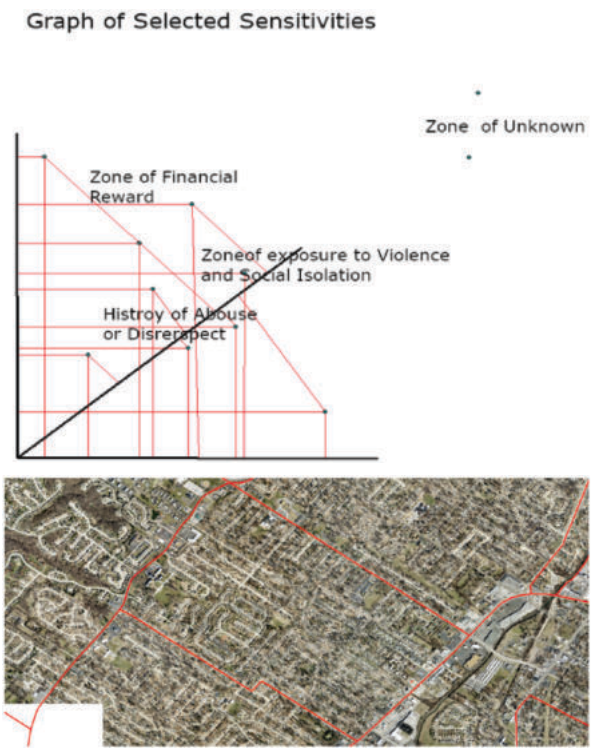

Figure 2

These graph and aerial images reference the physical earth section of a city and a portion of the cognitive attitudinal thought map values of hypothetical microstate members associated with this area. In this sense the constellation of values in Figure 2 top portion represent a view of the thought or decision space of the agents and actors composing the microstate of the phase space whose potential behavioural disposition we seek to understand.

A Preliminary Proof of concept

Building on the framework of figure 2 as a reference and accepting that there is no shortage of information on terrorism, radicalization, and security events. The challenge becomes sorting through detailed data on the possible causes, sources, and methods related to specific occurrences. Normally such data would be expected to be scarce/absent to discourage copycat events, but this does not always appear to be the case. Apparently such data is abundant although it is often fugitive, incomplete, only partially available, distorted or conflicting. There appears to be adequate data and analysis especially in the discussion of lone wolf incidences. Manipulating such data is sensitive when it is available, and for that reason, in the instance of this paper , surrogates or synthetic data are the only option to approach such delicate issues. Naturally, reliance on such compromised data renders any outcomes or understandings as merely conjecture. However, conjectures that point or align with logical consistency and known facts can make contributions and lay foundations for further explorations. The public domain literature does contain a significant volume of reference material and apparently useful components concerning backgrounds, conditions of radicalism, incidents of terrorism, and security, and there are active user interest groups dwelling and writing on such topics. Although these unstructured fugitive references and sources may be only partially accurate and difficult and/or awkward to use, they may amount to the only real publicly available materials.

Figure 2 top image illustrates plotted values for three of these radicalizing terrorism background energy forces, Identification, Isolation, and Desensitization, These estimated values (points) were scaled for illustration by generalizing the maximum and minimum values associated with each behavioural characteristic in the hypnotical community associated in the bottom of figured 2. Estimated values of these properties were approximated in the potential continuum range on a basis of regional consensus in the neighbourhood and are intended for illustration only.

On the basis of the values along the axes presented in Figure 2, the Ducasse (1969) model of events, agents, causal connections, and outcomes and a general variation of the Oxley Attribution Model as a series of symbolic statements and measurements, it is possible to produce a potential projection of both radicalization and outcome. The symbolic statements are mathematical expressions which provide a logic structure to identify and test persistent patterns of semantic variance or invariance which are inherent in the background causative energies of the radicalization source. The focus here is to structure a logic mimic of the racialization to terrorism process. Simply put, the question to be answered is: "Can the values of Identification, Isolation, and Desensitization (and the other 4 identified elements of radicalization of figure 1) account for a physically observable occurrence or increase the accuracy of our understanding and intelligence of the terrorism occurrences?"

Within the scope of the Ducasse structure and the Oxley Attribution Model which are situated in a Phase Space as discussed above, where the Phase Space is defined by the framework of ubiety as a property of place, the causation is a change which can be detected. Given that the Ducasse defines "causation, (change), i.e., proximate causation (change) is the triadic relation which obtains between three factors that together constitute an experiment. They are 1) a concrete state of affairs S in which only two changes, whether simple or complex, occur (2) one of these changes a change C occurring at a time T; and (3) the other a change E that begins to occur after chance C has begun to occur." This triadic event 'S' is the causation itself that may or may not be physically visible but that will be a part of a similar chain of causes that will eventually produce a physical outcome with which we will have an interest and with we are concerned. This physical event is the occurrence observed through the lens of a GIS system manifest themselves on the landscape of figure 2. These manifestations may not be appropriately understood from a geospatial intelligence security perspective without the enhanced reality of the projected Oxley Attribution Model and its associated contextual GIS.

7 Oxley Attribution Model

This radicalization model variation is based on the Individual

Exposure Health Risk Profile model, or *IEHRP*. The model will result in a vector in $\mathbf{R}^7$, meaning the vector will contain seven variables that are all real numbers. This vector will be a quantitative way to organize and express an individual's behavioral standing in terms of risk forces and energies. The vector will be inserted into a classifier, an algorithm that bundles like items, that would then label the individual as "at risk" with a value of 1, or "no risk" with a value of 0.

In this terrorism application, the statement formulation expresses the Individual Exposure (the unknown variable X) as IEXRP, which, in turn, is re-specified for general behavior terms as B (Behaviour Risk Profile) as IEBRP, where B is substituted for X or H in the original expression. The restatement is adapted because, in this application, the exposure is to behavioural factors rather than health factors. The expression can then be written as:
IEBRP = [IEBRPI$_1$, ..., IEBRI$_j$]

where each term in IEBRP represents a particular exposure that a person could have, and j is the total number of exposures. In the case of the seven forces mentioned in Section 5 Table 1, there would be seven components that comprise the Individual Exposure Behaviour Risk Index (IEBRI), with each IEBRI composed of values that reflect the specific exposure being investigated. The definition for a generic IEBRI is as follows:

$$IEBRI = [(\alpha_1)(W_1)(N_1)(C_1) + \ldots + (\alpha_i)(W_i)(N_i)(C_i)]. \quad (1)$$

In equation (1) for $k \in \{1, 2, \ldots, i\}$, α_k represents whether or not the particular person has that attribute, implying that $\alpha_k \in \{0,1\}$, (W_k), (N_k), and (C_k) represents a series of the weight factors, normalization factors, and correction factors respectively. The weight factor represents the degree to which each attribute affects the exposure. Since the exposure is a risk factor, it needs to be between zero and one, indicating that the weights for each attribute must sum to one. The normalization factor represents the constants used to scale the attributes such that the final product is between zero and one. The correction factor represents the values that account for any known systematic error that can occur in the collection of data. Therefore, if a risk profile is composed for three exposures, each with two attributes, the profile would be written as,

$$IEBRP = [[(a_{1,1})(W_{1,1})(N_{1,1})(C_{1,1}) + (a_{1,2})(W_{1,2})(N_{1,2})(C_{1,2})]$$
$$,[(a_{2,1})(W_{2,1})(N_{2,1})(C_{2,1}) + (a_{2,2})(W_{2,2})(N_{2,2})(C_{2,2})] ,[(a_{3,1})(W_{3,1})(N_{3,1})(C_{3,1})$$
$$+ (a_{3,2})(W_{3,2})(N_{3,2})(C_{3,2})]].$$

An example of one possible IEBRI is the Identity Index Exposure. Assume that one's Identity make up consists of three variables: Isolation, Desensitization, and Identity of familial honor. It can be presumed that the individual in question is an isolated person living alone without influential external reference values or influence, is strongly averse to violence, and physical resolution of disputes, and strongly devoted to a sense of family cultural honor. Then the numbers for each of the attributes would be 1, 0, and 1, respectively. In this test case, it can also be assumed that there is no error in collecting the data and that the values are already scaled, letting the normalization and correction factors equal one, such that these data quality factors will have no effect on the final product. Additionally, for simplicity's sake, constraining the total possible sum to 1 the weights are 1/4 for Identity, 1/4 for Desensitization, and 1/2 for Family Honor. Then this individual's exposure behavioral risk for identity would be:

$$IEBRI_{Identity} = (\text{Isolation})(W_1)(N_1)(C_1) + (\text{Desensitization})(W_2)(N_2)(C_2)$$
$$+(\text{Familial Honor status})(W_3)(N_3)(C_3)$$
$$= (1)\left(\frac{1}{4}\right)(1)(1) + (0)\left(\frac{1}{4}\right)(1)(1) + (1)\left(\frac{1}{2}\right)(1)(1)$$
$$= .75$$

meaning they have a high identity exposure, assuming the threshold for a high exposure is anything above 0.5. With the expanded definition of an IEBRI, the formula for the IEBRP can expanded for j exposures, with i attributes in each exposure:

$$IEBRP = [[(a_{1,1})(W_{1,1})(N_{1,1})(C_{1,1}) + \ldots + (a_{1,i})(W_{1,i})(N_{1,i})(C_{1,i})] \quad (2)$$
$$,\ldots,[(a_{j,1})(W_{j,1})(N_{j,1})(C_{j,1}) + \ldots + (a_{j,i})(W_{j,i})(N_{j,i})(C_{j,i})]]$$

where (q,k) for $k \in \{1,2,\ldots,i\}$ and $q \in \{1,2,\ldots,j\}$ represents the individual attributes for each exposure, thus creating the full model for the risk profile.

Given this full definition of the IEBRP, an example of the IEBRP for 5 individuals with heuristic synthetic data follows in Table 1. Note that the actual weights and other factors would need to be determined by literature reviews, actual calibrated events, or data extracted from simulations. However, in this example, weights and values have been chosen with a heuristic background. For clarity, let Id = Identity, Des = Desensitization, Fam = Family Honor, Val Var = Value Variance, Iso = Isolation, AJM = Anti Justice Morality, and Weal = Wealth.

Table 1

Individual	Id	Des	Fam	Val Var	Iso	AJM	Weal
1	.75	.5	.8	.95	.68	.7	.2
2	.35	.65	.75	.95	.34	.15	.3
3	.57	.25	.4	.3	.8	.5	.6
4	.78	.79	.8	.05	.4	.39	.25
5	.2	.15	.08	.25	.3	.45	.21

Since the values for each exposure have been chosen, the IEBRP can be determined for each individual and reduced to scalar value. The process of finding the scalar value consisted of multiplying each exposure in the IEBRP by a given weight, then summing the product of the seven terms.

Table 2

Individual	IEBRP
1	[0.75, 0.5, 0.8, 0.95, 0.68, 0.7, 0.2]
2	[0.35, 0.65, 0.75, 0.95, 0.34, 0.15, 0.3]
3	[0.57, 0.25, 0.4, 0.3, 0.8, 0.5, 0.6]
4	[0.78, 0.79, 0.8, 0.05, 0.4, 0.39, 0.25]
5	[0.2, 0.15, 0.08, 0.25, 0.3, 0.45, 0.21]
Individual	Scaled IEBRP
N1	0.707
N2	0.445
N3	0.5399
N4	0.6734
N5	0.2022

As seen in the table, there is a list, N1 through N5, of scalar values that can be used to evaluate whether or not the person is a risk. For this example, people with higher values are considered to have a higher behavioral risk (i.e., someone who has a higher value for family honor may be more likely to have a sense of duty and responsibility, giving them a greater obligation to action). Looking at the data, assume the boundary point to be 0.5 such that people who fall below 0.5 are not at risk. We see that individuals N1, N3 and N4 are labelled to have behavioral risk, while individuals N2, and N5 are labelled to be not at risk. With this model, real data, and psychological reasoning, this template should be able to present a good laboratory mimic of the forces operating in the radicalization process and display the cause-effect relationship between conceptual ideas and values and the physical manifestations resulting from actions of individuals. These physical manifestations that the Oxley approximations and classification models produces far each individual for each exposure shown in table 2, and table 3 are in effect measures of the inferences that close the loop on the prospective inferential GIS with which this paper initially

begins. These inferential values measures are attached to individuals who have physical spatial existences and occupy real world physical locations in which they express values and behaviors which in turn can present these inferences as properties of either point of polygon features classes. In this way the illusive properties of inferences can occupy space in a GIS and present an additional layer in the spatial information fabric of place

Conclusion? Implications for future work

The data at this point supports no firm conclusions, but it does suggest some conjectures. First, there is a relationship between the catalogue of force and energy agent input values and the output radicalization risk profile. Secondly, the output risk profile appears to have an internal consistency with respect to the patterns of internal agent input values. This second observation regarding an internal consistency and the model's ability to attribute, classify, and label the agent's collective influence, begs the effort of refining and tuning the model parameters to dissect the knotty entanglements of the coupled agent forces and reveal a mimic of these forces and their operations. The design of an approach to such a future dissection effort appears to be extremely important because it could lead to answers regarding the pre-emption of the radicalization process. Such future work will require, as a first step, validation and replication of this effort using actual real event data and iterative cycles of the Oxley Attribution Model classifier over the data inputs, varying the weights, energies, and force values. The cycles should be run and refined until they generate a spectrum of radicalization risk parameters that predict the known test event observable outcome. The associated energy and agent exposure values and weights that finally produce a prediction with the actual terrorist event will be the model that describes conditions that produced the terrorist outcome and can serve as an early warning benchmark and a model for future events. This set of harbingers can be tested and refined against other actual real terrorist event data to improve and perhaps tune the model's success in providing operational insight into the basket of data, weights, and associated outcomes.

REFERENCES

1. http://www.agcol.arizona.edu/software/symap/v4.2/UserGuide.html
2. Roepke Howard G, The Traditions of the Chicago School of Geography, Presentations, 23 January 1969
3. Carroll, Sean From Eternity to Here, Dutton Penguin Group USA 2010 pg. 14
4. https://writings.stephenwolfram.com/2015/12/what-is-spacetime-really/
5. http://www.sscnet.ucla.edu/comm/haselton/ papers/downloads/Pillsworth Proofs.pdf)
6. Czégel, D., Balogh, S.G., Pollner, P. et al. Phase space volume scaling of generalized entropies and anomalous diffusion scaling governed by corresponding non-linear Fokker-Planck equations. Sci Rep 8, 1883 (2018). https://doi.org/10.1038/s41598-018-20202-w.)
7. Hartford. James, James R. Wright, Kevin Leyton-Brown Deep Learning for Predicting Human Strategic Behavior 30th Conference on Neural Information Processing Systems (NIPS 2016), Barcelona, Spain.
8. Dalege, Jonas, Denny Borsboom, Frenkvan Harreveld & Han L. J. van der Mass (2018) The Attitudinal Entropy (AE) Framework as a General Theory of Individual Attitudes Psychological Ininquiry, 29:4, 175-193. DOI: 10.1080/1047840X.2018.1537246
9. Nhathai Phan, Dejing Dou, Brigitte Piniewski David Kil A deep learning approach for human behavior prediction with explanations in health social networks: social restricted Boltzmann machine (SRBM) Soc Netwef Anal Min. 2016 December; 6: . doi:10.1007/s13278-016-0379-0
10. A micro state is position (X,Y,Z) and direction and momentum of every single constituent particle in the phase space, as we evolve from strict classical mechanics of physics micro state can be considered to refer to the precise state of a system while the term macro state refers to the phase space features macroscopically accessible
11. Carroll pg. 158
12. Dalege Jonas,Borsboom, D,vanHarreveld,F and HanL.J. van der Mass The Attitudinal Entropy (AE) Framework as a General Theory of individual Attitudes Psychological Inquiry pg176
13. Gleick James, Chaos, Penguin BooksNY.,1987 pg134
14. https://www.youtube.com/watch?v=q1DKtiwvT4A
15. Coupling Constants for the Fundamental Forces - Hyperphysicshyperphysics.phy-astr.gsu.edu
16. https://science.sciencemag.org/content/305/5687/1138.abstract
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5784197/
18. Manuel-Navarrete, D. 2015. Double coupling: modeling subjectivity and asymmetric organization in social-ecological systems. Ecology and Society 20(3): 26.
19. https://www.sbsheriff.org/wp-content/uploads/2016/10/13-Terrorism-Early-Warning-Signs.pdf
20. https://www.colorado.gov/pacific/dhsem/eight-signs-terrorism
21. http://www.global-language.com/CENTURY/
22. Ducasse, C.J. Truth Knowledge and Causation pg. 27 International Library of Philosophical and Scientific Method, Routledge and Kegan Paul Humanities Press London UK 1968
23. Oxley, Mark. Hartman in "The Individual Exposure Health Risk Profile: Turning Information Into Insight for Health Policy." I need help on this citation