Our tempestuous times are in desperate need of Peace. We live on a small planet; threatened by common enemies such as global warming, AIDS, super-bugs, environmentally-rooted diseases, crime, suicides, school-shootings, road-rage, hate, and above all else – indifference. We are all in the same "sinking boat". No longer can we afford to antagonize one another. We need all our global human resources and skills to save the "Arc". In the same way that today's hard sciences are concerned with disease and climate change, we should also pay anxious attention to Peace. Sociologists, political scientists, and peace activists are currently struggling with the very limited scientific potions at their disposal to find a panacea for war. There has been little attempt by the hard-science community to contribute to these efforts. This paper is an attempt to apply fuzzy logic (a methodology designed to bridge across the hard- and soft-sciences) to the peace-making process.

Our universe is controlled by the Darwinian principle of "survival of the fittest". In the causal equations of events, Peace is a "trivial solution" that becomes lost, like a needle in a haystack, among war-bound "general solutions". To find Peace, we propose two routes. The first, and perhaps, preferred option is to leave the Darwinian universe of "conflict" and attempt to layout our problems in a different setting in which the ruling principle is "concord" rather than "conflict". The second path is to salvage Peace from its triviality by compromising its purity and moving into a universe that re-defines "concord" and "conflict" in a fuzzy way. We will show that the first approach (that we call "Transcendental") and the second track (that we call "Pragmatic") can overlap to define a "Pathway to Peace". The Transcendental approach provides boundary conditions without which the generation of Pragmatic rules becomes too complex and confusing.

The first idea is that of the Peace activists and spiritual pacifists. Clearly, the desire for Peace among these "purists" has not yet been achieved and remains a constant challenge. The second option is the way of the Peace diplomats who look for compromise that can create an armistice situation or a "time of quiet". It is imperative that the advocates of these two camps (i.e. Peace activists and Peace politicians) open up to a dialogue that generates real communication. To do so requires a common language and common methodology in which the language itself becomes the means of compromise. This paper attempts to fashion such a fuzzy logic-based common language to help with the mediation of Peace.

We have used the universal laws of thermodynamics as a framework to understand the nature of conflict and to bridge between the hard and soft sciences. To this framework we have added some fuzzy rules to pave the passage. We show that diversity should not be compromised for Peace.

**Prologue**

Like Russian wooden dolls, each nesting within another, trying to analyze the common features of War reveals problem upon problem inside each other. In attempting to find common threads in Wars, we must ask question such as, "what is commonness?" among others. One can begin the analysis with "facts" and numbers – size of armies, number of tanks, aircraft or battleships, length of the conflict, number of participants, etc., etc. But "facts" do not approach even closely, the need to have "experiential" knowledge of what is War. Many have studied War scientifically – to find the optimum way to wage War – the theory of how to win a battle. Others base their analyses on empiricism to tell the story of the horrors of War – the
genocide, the battle, the killing of young children and other innocents. And who has analyzed the dichotomy that is War and Peace better than Leo Tolstoy through a tome of some 1500 pages with what is, perhaps, the greatest novel ever written. As an aside, the Russian words for "peace" ("мир") and "world" ("мір") are homonyms – a different spelling in this case, but the same pronunciation. Is this coincidental or accidental? Does it stem from a desire for a peaceful world or does it express a belief in what is believed to be the natural state of the world? Tolstoy's novel begins with Napoleon's invasion of Russia in 1812 and tells the story of five aristocratic families and the entangling of their personal lives over the period 1805-1813. As events proceed, Tolstoy's subjects are systematically prevented from having any significant free choice. It is the dichotomy between individual freedom and social order that is at the very heart of understanding War and Peace.

Introduction

The forces making for clashes between civilizations can be contained only if they are recognized. In a "world of different civilizations," … each "will have to learn to coexist with the others."

Samuel Huntington

The Darwinian Principle of "Survival of the Fittest" extends from the domain of animal biology to human sociology. The link between the two universes is the term "fittest", whose meaning is fuzzy and derives from the evolution of life and/or the environment. In the human universe, survival and struggle does not remain at the biological level. It extends to economical, cultural, and spiritual planes. War, as defined in its Darwinian sense of struggle, is also subject to an evolutionary process. In a world controlled by economics, the meaning of the term "fittest" will be close to its biological sense. In such a world, conflict is settled by economic forces and, if necessary by military forces (which are themselves controlled by the economy). Warfare therefore develops with the evolution of life (in a biosphere) or lifestyle (in a homo-sphere).

According to Rummel [1], War is simply a type of behaviour among States relative to other international behaviours that derives from diverse force vectors that are reflected in the "lengths" (or sizes) of the differences in social, economic, political, cultural, and geographical factors between (or among) at least two States. The theoretical equation he proposed can be expressed as follows:

\[ C_{ij} = \sum W_{ijk} \cdot F_{ijk} \]  \hspace{1cm} (1)

where \( C_{ij} \) = probability of a conflict (or war) between States \( i \) and \( j \); \( F_{ijk} \) is a vectorial representation of the distance (or force or size) of conflict element \( k \) between the two States; and \( W_{ijk} \) is the weight vector associated with these distances that defines the relative magnitude or importance of each conflict element \( k \). Conflict elements may include land claims, religious differences, cultural mores, economic differences, natural resources, and land use options among many others.

This approach is very much like that of an Artificial Neural Network (ANN) in which the \( F_{ijk} \) signals are inputs that flow between neurons to eventually exit the network as \( C_{ij} \), the output signal from the network, with \( W_{ijk} \) representing the connection strength matrix. As written, the equation represents a flat topology called a Perception Network. This architecture (in which inputs are directly connected to the outputs) has been shown to be incapable of dealing with non-separable problems that are most likely to be the case with questions of War or Peace. As such, it is probably more useful to employ at least a three-layer structure as in Fig. 1.a, with a set of hidden nodes that might represent internal positions of non-conflict within the interactions between or among the States. In addition with an ANN, the output from each neuron passes through a non-linear activation function that serves to normalize the signal onto a range from 0 to 1. A sigmoid function is the typical non-linear function used to scale the signals:

First Stage (summation)  \hspace{1cm} C_{ij}' = \sum W_{ijk} \cdot F_{ijk} \hspace{1cm} (2)

Second Stage (activation/normalization)  \hspace{1cm} C_{ij} = [1 + \exp ( -C_{ij}')]^{-1} \hspace{1cm} (3)

where \( C_{ij}' \) represents internal (or hidden nodes) between the inputs and the output.
a. A Three-Layer Artificial Neural Network.

b. Network Model of conflict/cooperation between nations.

Fig. 1. The analogy of an Artificial Neural Network and the conflict or cooperation between Nations that may result in War or Peace.

Artificial Neural Networks are similar in many ways to Fuzzy Systems. In a fuzzy system, linguistic expressions are placed into IF-AND-THEN rules that are combined in a particular instance of "facts" in a way to characterize how beliefs in the truth of certain inputs result in the belief in a particular set of outputs. Each "fact" is characterized by a series of fuzzy sets that span across a Universe of Discourse. For example, type of government could span across a scale from authoritarian to anarchic with democracy being located in the centre of the span as in Fig. 2. Any particular State could be characterized by a degree of belief in each of the different types of government. These "facts" are combined in the rule base with other variables that also are characterized by a series of fuzzy sets. The connection between the "facts" are either AND or OR. Using standard set theory, this combination results in a Net Degree of Truth for each rule that is then assigned to the output "fact" as its degree of belief. By firing all the rules, a collection of output sets result that each have their own unique Degree of Belief. These can be similarly combined together to arrive at a single output such as the probability of War or Peace.

Fig. 2. The Universe of Discourse for the Forms of Government within a State or Nation.
Here are two rules at either extreme of the Universe of Discourse that might result in War:

\[\begin{align*}
\text{IF } & \text{ government form IS Authoritarian} & \text{IF } & \text{ government form IS Anarchy} \\
\text{AND } & \text{ social unrest IS high} & \text{AND } & \text{ ethics IS low} \\
\text{THEN } & \text{ probability of a civil war IS increased} & \text{THEN } & \text{ probability of criminal activity IS increased}
\end{align*}\]

Obviously, one can formulate rules of opposite merit that could enhance the onset of Peace, as well as a spectrum of rules that characterize government forms between the two extremes.

Each rule connects specific input facts to a specific output fact usually with a certainty of 100%, so that all uncertainty in the knowledge base derives from the degrees of belief in each fact for each particular instance of interest. Connections between other facts and the particular output fact are implied to be 0%. The Artificial Neural Network extends these limitations to allow these certainties in a rule to lie at any value between 0 and 100, i.e., the correlations are allowed to be distributed in an extremely fuzzy way between all inputs and all outputs.

In an era of Artificial Intelligence (AI), where virtual realities are becoming increasingly more relevant to human lifestyle than physical realities, societal problems (with their exponentially increasing complexity) cannot be solved in a political box outside of cyberspace. Cyberspace and its so-called Artificial Intelligence have been able to reduce the distances of conflict elements (as defined by Rummel) by spreading their meaning over a distribution of values.

We believe these distances can be further diminished by translating some of the basic concepts of war (or conflict) into a language closer to that of AI, hoping that the potent modalities of cyberspace can help to bring a little more peace to our war-stricken world. To construct this bridge, we have used the universal laws of thermodynamics as a framework, to which we have added some of the fuzzy rules of artificial intelligence to pave the passage. We will attempt as well to provide a brief review of classical, modern, and post-modern philosophical ideas on War and Peace to provide the background to our understanding of the human knowledge-base in which our problems are rooted and from which our solutions spring.

**Philosophical overview**

One of the main bases for the discussions developed in this paper is the relationship between Absolutism and Pragmatism in practical philosophy. By practical philosophy, we consider both ethics and political science to be important components. The history of philosophy has seen the rise and fall of each approach. But what has never been offered before is that a single theory may be a condition to validate and apply the other. It is our position that both theories are incomplete by themselves. Only together can they provide the solution that each is seeking in isolation. We borrow a concept from Differential Equations to suggest that ethical and political Absolutism attempts to set boundary conditions to allow choosing among a multitude of possible solutions to a socio-political issue, while Pragmatism compromises the variance through averaging and comparing theoretical solutions with actual realities.. The issue with the former is that imposition of a single solution is based on rather arbitrary (or at least debatable) boundary conditions, while the problem with the latter is the risk of over-simplification and sacrifice of subtlety.

The standoff between these two trends began in Antiquity between the fathers of each school (Absolutism and Pragmatism) – Plato and Aristotle respectively – with Plato outlining the early principles of Absolutism in his seminal work *The Republic*. In our view, Aristotle, in reaction to Absolutism, broke off from the tradition established by Plato in two fundamental ways:

1. Aristotle denied that a virtuous action is (primarily) a matter of knowledge alone;
2. Aristotle provided a relative and non-absolute definition of a virtuous action.

Aristotle describes ethical virtue as a *hexis* (a state, condition, or disposition). Hexis is a tendency or disposition, induced by our habits to have appropriate feelings [2]. Defective states of character are hexeis (the plural of hexis) as well, but this is actually a tendency to have inappropriate feelings. The significance of Aristotle's characterization of these states as hexeis is his decisive rejection of the thesis found
throughout Plato's early dialogues, that virtue is simply a kind of knowledge while vice is nothing but a lack of knowledge [3].

This approach affords a higher degree of personal context for ethical disposition. Plato's approach is ignorant or at least ambivalent to personal background and feelings. The Platonist educational system leads to a more homogenized and less personalized system wherein individual differences are overwhelmed and often destroyed by the desire or mandate to educate (i.e., standardize).

In defining a virtuous action, Aristotle gives a very pragmatic answer. Every ethical virtue is a condition intermediate between two other states, one involving excess, and the other deficiency [2]. In this respect, Aristotle says that virtues are no different than technical skills. For example, a courageous person lies between a coward and a rash person. Aristotle holds that this same topography applies to every ethical virtue: all are located on a map that places each one between states of excess and deficiency. He is careful to add, however, that the mean is to be determined in a way that will account for the particular circumstances of the individual [2], i.e., there is no universal rule. Finding the mean position in any given situation is not a mechanical or thoughtless procedure, but requires a full and detailed acquaintance with the circumstances [3]. This approach, as we will see, is similar to what Post-Modernists refer to as "the context". A virtuous action is a context-sensitive affair.

Emerging on the base of such Pragmatism, Aristotle's politics also reflects non-absolute and tolerating principles toward social and political structure. Contrary to Plato, who believes a city-state is a unity, Aristotle states that as a city advances to become more of a unity, it will cease to exist [4]. In this way, Aristotle seeds the first philosophical arguments against an approach to attain social order through a "melting pot". To Aristotle, a city is made up not only of many human beings, but of human beings who differ in kind. No city comes into existence from those who are all alike – for a city is not an Alliance. An Alliance achieves its utility from its numbers, even if they are all of the same kind, for the nature of an Alliance is to provide the sort of help that a "greater weight does when it presses down the scales" [4]. An Alliance in this case is one of the Similar. To this Alliance, only the similarity of the constituents is important, since the Alliance only draws its strength from the number of its constituents. A distinction however must be drawn, specifically between a unity of Similar in such an Alliance, and a unity of dissimilar as in a city. In the case of a city, unity must be understood in terms of reciprocal equality, not unqualified unity. Aristotle poses the threat that a society will face if the idea of unity (or melting pot) prevails:

1) It will destroy the city by reducing it to a single individual; and what destroys something is not best for it;
2) More unified is less self-sufficient (and adaptable), meaning it must become more aggressive to find what it needs elsewhere.

A good Aristotelian however, should not be against unity, but should strive for the right balance of unity in a society. There are lots of occasions when the unity of dissimilar must become the unity of Similar (such as when a society must defend itself against an aggressor). But such unity should only prevail within boundary conditions, not throughout the entire spatio-temporal regions of the society. According to Aristotle, in case such conditions persist over a long period of time, the society faces a real danger of being annihilated as a city. As a result, such unity must be a short-term measure (adaptation) to deal with a boundary crisis. What is needed is a conscious action to eliminate the conditions that caused the society to face such circumstances. It is a known fact that all despotic regimes take their legitimacy from real or manufactured boundary conditions (such as enemy aggression, or national security, or War). While boundary conditions can be real, and may demand national unity of the Similar, these are exceptions and cannot be used as a basis to rule a society for very long.

In the early modern times, debate between Absolutism and Pragmatism in political philosophy continued wherein Absolutism (at the time referred to as Totalitarianism) is represented in the writings of Thomas Hobbes and Pragmatism (referred to as Liberalism at the time) is found in the work of John Locke. Hobbes fundamentally views human nature as selfish and conflicted unless given appropriate conditions under which to cooperate. To avoid a society falling prey to human selfishness, there must be a bigger monster –
the government – to enforce uniformity. Unlike Hobbes who believes uniformity (in the form of religious practice) is a key to the “proper” functioning of a civil society, Locke argues that more diversity in a society (in the form of practiced religions or otherwise) actually prevents civil unrest [5]. Since proliferation is a fact of life (as what Aristotle believes in terms of “individuated habituation”), much of social unrest will come from the magistrate’s attempt to prevent or contain proliferation in social and religious affiliations. Instead of fighting it artificially, the path to prevent social unrest is to tolerate and welcome diversity. Based on what he calls the state of nature, social life is characterized by order and tolerance. Government should not be a serpent or monster (Leviathan as referred to by Hobbes), but rather a servant to naturally equal, yet diverse and autonomous individuals. Law, also, in its proper notion, is the Direction of a free and intelligent agent to his proper Interest [4]. To ensure that government does not overstep its boundaries, the right checks and balances must be in place. To that end, Locke espoused that revolution is not only a right, but an obligation in certain circumstances.

After the enlightenment and formation of the bourgeoisie states, the issue of tolerance and aggression found a new dimension – relationships between sovereign states. As Hegel points out, while each nation is defined and controlled by its internal (or essential) mechanisms (e.g., in a modern democracy through electoral systems, legislation, government, etc.), internationally there seems to be no inherent (or essential) mechanism that controls relations among states. States seem to be the ultimate autonomies in the world, which do not have to abide by any condition bound to their essence (note that by definition, "state is sovereign"). The main motivations for a sovereign state are to preserve (read as National Security) and expand (read as Economical Growth). In reaction to these dimensions of international relations, Absolutism posits the military solution as the only real answer to settle international claims. This form of Absolutism referred to as Realism had classical representations by Thomas Hobbes and Niccolo Machiavelli and more recent representations by former US Secretaries of State Henry Kissinger and Zbigniew Brzezinski. According to this type of Realism, a state, in order to follow its essential dynamic to preserve and expand, will amass resources. As also cautioned by Eisenhower accumulation of resources, mainly in the military form, will create two subsequent conditions that shape the international stage:

1) Accumulation of military resources creates powerful and influential interest groups, that alter the direction of foreign politics toward conditions that foster and strengthen their position in society;
2) Relations between states are determined by their comparative Level of Power derived primarily from their combined military and economic capabilities.

The idea behind Realism is the Hobbesian view that States as rational autonomous agents are essentially self-serving and aggressive (symmetrical to his view about humans). However, since there is no bigger Leviathan than the States themselves, the only possible stage where particularly aggressive agents can resolve their conflicts is war.

Contrary to this point of view, there is the alternative that believes the majority of people in a democratic nation would never "vote" to go to war. This belief is contrary to Realism and is the foundation of Liberal Peace Theory. In 1795, Kant posited possibly the first formulation of this theory that lays out the necessary conditions for Peace among sovereign democracies in the West as follows [6]:

1) The civil constitution of every nation should be republican meaning that states are organized internally according to the republican principles of democracy;
2) The rights of nations should be based on a federation of free states meaning that states are organized externally into a voluntary League that promotes Peace;
3) Cosmopolitan rights should be limited to conditions of Universal Hospitality meaning that states respect Human Rights, not only of their own citizens, but also of foreigners.

This fact is also ironically asserted by Herman Goering in his Nuremberg Trial: “Naturally the common people don't want war … that is understood. But after all, it is the leaders of the country who determine policy, and it is always a simple matter to drag the people along … All you have to do is to tell them they are being attacked, and denounce the pacifists for lack of patriotism and exposing the country to danger. It works the same in any country.”

Also known Democratic Peace Theory (DPT)
The first condition states that in a democracy where the majority determines national policies, it is very unlikely for people to vote in favour of staging a war. The second condition is a preventative one in that democratic nations engage in a pre-emptive dialogue to converge their interests and promote a higher understanding of each other's ideals. We believe that this step can also be viewed as one in which differences are dimmed down (by moving differences from a crisp set of demands to a fuzzy one in an attempt to find common ground that was otherwise unattainable if the domain and range of the demands remain crisp and discrete). The third condition is an international ethical ideal stemming from ethical tolerance whose foundations roots back to Aristotle.

It is important to note that Kant's notion of democracy in this context is a condition in which people experience both freedom and rationalism. We know this purist concept was rarely a historical reality in the form understood by the Enlightenment Philosophers such as Kant or the Fathers of Democracy in the United States. Now, it can hardly be contended that the large democracies of the West are or have ever been close to this purity. True democracy demands that its constituents make rational choices under absolute freedom. As a result, people must be able to reason and be free to choose at the same time. Many social philosophers think the West has never truly experienced an era when both of these conditions were satisfied. As Horkheimer and Adorno point out, Enlightenment, understood in its widest sense as the advance of thought, has always aimed to liberate humans from fear and install them as masters. Yet the wholly enlightened earth is "radiant with triumphant calamity" [7].

How can the progress of modern science and medicine and industry promise to liberate people from ignorance, disease, and brutal, mind-numbing work, yet also help to create a world where people willingly swallow fascist ideology, knowingly practice deliberate genocide, and energetically develop lethal weapons of mass destruction [8]. For Adorno and Horkheimer, within the transformation of organized and hi-tech capitalism, modes of Enlightenment become domination, culture becomes a pop culture industry, democracy becomes a form of mass manipulation, and science and technology form a crucial part of an apparatus of social domination [9].

Foucault shows how milder versions of hegemony and punishment can be more effective than more obvious versions: "to punish less, perhaps; but certainly to punish better". Foucault further argues that the new mode of punishment becomes a way to control an entire society with factories, hospitals, and schools modeled on the modern prison. We should not, however, believe that deployment of this model is due to the explicit decisions of some central controlling agency. In typically genealogical fashion, Foucault's analysis shows how techniques and institutions, developed for different and often quite innocuous purposes, converge to create the modern system of disciplinary power [10]. Foucault discusses that, more than anything else, control demands observation of people. Society has become like a large prison, and people like inmates, whose actions are always under surveillance by authorities. Baudrillard expands on this view by examining how the cynical and seductive power of media and the information society has turned passive control into an active one in which peoples' minds and needs are directly manipulated and changed by external stimuli [11].

Furthermore, such control has become globalized. For Baudrillard, globalization is fundamentally a process of homogenization and standardization that crushes "the singular" and heterogeneity [9]. Baudriallard distinguishes between the global and the universal, linking globalization with technology, the market, tourism, and information contrasted to identification of the universal with human rights, liberty, culture, and democracy [11]. While "globalization appears to be irreversible, universalization is likely to be on its way out". Elsewhere, Baudrillard writes: "...the idea of freedom, a new and recent idea, is already fading from the minds and mores, and liberal globalization is coming about in precisely the opposite form – a police-state globalization, total-control, a terror based on "law-and-order" measures. Deregulation ends up in a maximum of constraints and restrictions, akin to those of a fundamentalist society" [12].

This paper offers the idea that increased control has eroded the conditions required for a democracy (the first condition of Kant's perpetual Peace theory) in the following two ways:

1) Society is unable to engage in rational debate over important issues that have become tainted by interest groups that control the media and through that, control the minds of agents in the society;
2) Homogenization attained through this increased control and manipulation has created Chaos in society where agents who otherwise would be willing to participate in a democracy prefer instead to attempt to destroy the democratic institutions of the society.

Furthermore, and without denying or even belittling the positive effects of globalization on the promotion of democracy and peace in the world, what we are attempting to establish is that the controlled hegemony over the society as explained by Horkheimer and Foucault is operating today on a global level. This paper offers that:

1) Similar to Baudrillard, we believe that globalization, as controlled only by market forces, is fundamentally a process of homogenization and standardization that crushes "the singularities" and the heterogeneity of a democratic and free society. As discussed later, this homogeneity (or Chaos) will compromise the kinetics of the society unless some degree of order (or polarization) is put in place. This artificial generation of order will necessarily create waste (that otherwise would manifest itself as internal marginalization and/or external warfare).

2) The Chaos generated by forced symmetry is already occurring on a global basis. The current worldwide Chaos is possibly the indirect result of increased market homogeneity controlled by virtual or real patrons of a global economy.

War, Peace and the Second Law
The second law of thermodynamics is expressed in a variety of forms for different applications. In a socio-political context, the second law can be viewed in terms of Chaos and Order. While societies need Order to function, individuals desire Freedom to grow. Must Freedom be a dichotomy of Order? The compromise between a civil society and individual freedom is very difficult to achieve in all cases. Conservative states tend to favor social order, while liberal societies aim to accommodate individual liberties within their social order. On the two extreme poles of the conservative-liberal spectrum, autocratic and anarchic regimes can be placed (one favoring social order with total denial of individual freedom and the other championing individual freedom while rejecting any form of social order). The liberal/conservative division in most democratic societies is based on a fundamental principle of compromise between "freedom" and "structure".

This principle can be expressed in terms of the efficiency of transitioning from Chaos to Order. The second law of thermodynamics tells us that the efficiency of such a transition can never be 100%. For more clarity, let's scale the Universe of Discourse called "Social Order" between 0 (for complete Chaos) and 100 (for rigid Order), and assume a society that is positioned at the 50% point on this range. Now, based on the second law, increasing the order of this society (say from 50 to 80), comes at a cost (meaning that one cannot increase Order in one part of a system without creating some Chaos in another part).

This is indeed true for a closed society in which an increase in Order in certain parts of a society will lead to increased Chaos somewhere else. This newly-created Chaos is known as "waste" to adopt an environmental term. In an open society, one can reject this waste by exporting the physical waste or chaotic and sociological waste to some other society in the form of pollution, war, or poverty. In a closed society, the inefficiency of Order enhancement stays within the society in the form of increased disease, crime, or other injustices or inequities.

In thermodynamic terminology, wealth (equating to prosperity) in a society can be represented by enthalpy (Q), chaos by entropy (S), and economic kinetics defined by the system temperature (T). Applying the basic entropy definition:

$$\Delta S = \Delta Q/T$$ (4)

This equation shows that Chaos will increase with wealth (or prosperity) in a closed-society. A good example of such a relationship is the famous (or infamous) gold-rush story in which a group of poor prospectors travel together in friendship to discover "Eldorado" and then kill each other on their way back once they had become rich.
What connects the steps along this infernal trend is economic kinetics (or the speed of economic transactions). An economically lethargic society will find their wealth converted to more Chaos than in one that operates at a higher rate of equalization (or temperature). It should be noted that disorder (or Chaos) is only "stable" in an anarchic society. Orderly societies (or civil societies) cannot (and will not) tolerate high degrees of Chaos. The process of creating order in an anarchic society involves production of sociological waste. So a portion of the society is wasted or marginalized (i.e., becomes more Chaotic) in order for the rest of the society to become more orderly (or civilized!). Maintaining some highly chaotic pockets in an orderly society is very costly as it goes against the natural homogenization process (or entropy trend).

There are two ways to correct this situation. The first is to increase the temperature (i.e., the speed of economic interaction). A high economic velocity creates more jobs (and therefore more satisfaction) and helps contain marginal pockets of Chaos. This solution is often an "escape to the future" (since you cannot constantly increase economic fever). Once the temperature stops rising, the consequence is a recession and ultimately, a depression.

Some wars happen as a consequence of depression (such as the Second World War) or as a mechanism to avoid depression. War can be an artificial machination to keep the social temperature high. Another function of War is to deplete enthalpy, \( Q \) (or internal energy) of the society as a whole. Thus, a degree of order is imposed by war while the overall society may become impoverished through a loss of diversity and individual freedom. This trend goes against democracy (i.e., "freedom coupled to wealth). Austerity measures (levied against democratic freedom) are deemed necessary to create desired order in times of war.

We do not mean to imply that all wars are generated through this single thermodynamic process. Note, there are two types of war:

Type A - Wars artificially generated to prevent or counteract depression, and

Type B - Wars generated by a natural homogenization inside a highly polarized society (civil war) or among highly polarized nations (e.g., the Middle East conflict).

Type A wars are often initiated by wealthy states, while Type B wars are often generated by marginal nations (or marginal segments of society within a nation).

The Middle East example

It can be said that the Middle East wars are a combination of Type A (for international players such as the US and Russia) and Type B (for the Middle-Eastern nations themselves). The conflict in the Middle East is related to a great extent to the economic polarity between Palestinians and Israelis. As opposed to the international players, the state of Israel desires Peace while the Chaos in the region may provide order and stability for some wealthy nations (or groups) located elsewhere. One reason for the high degree of complexity in Middle Eastern conflicts relates to the combination of two agendas – one regional and one international.

With this diagnosis, Middle East peace advocates should push to decrease the complexity of the problem. This can be achieved by confining the issues to a regional conflict and getting the international forces (most importantly, the United States) off the battlefield. The US can always maintain its indirect support for the "stability" of the State of Israel. Yet, direct siding in the conflict combined with the presence of US forces, simply adds more Chaos to the complexity of an already highly complex conflict. Once the complexity is reduced, the conflict has a better chance to be understood and resolved by regional forces, whose agendas (despite often being cruel) are more obvious and blunt.

Simplicity and Complexity

It should be noted that peace is "simple" while war is "complex", i.e., complexity increases the probability of conflict. In any conflict resolution, problems must be simplified to their most mundane (and often vulgar) fundamentals. Once the basic desires of the conflicting parties are understood and translated into a
common language, a Peace model can be designed to satisfy the needs (if not the desires) of all parties. This common language should be designed in a way to receive conflicting desires as input, while generating a set of harmonized needs as output. To achieve that, a peace-making language must possess two basic properties, intimately connected to one another:

1- flexibility
2- non-linearity

While the need for flexibility is often well-understood, one may question the relevance of non-linearity. As discussed in our thermodynamic model of war and peace, a degree of non-linearity is necessary to account for the irreversibility of the process. It should be noted that a productive peace is an order-making process, not simply one of homogenization. So, to satisfy some of the desires, some others must be wasted (or sacrificed). **To satisfy the thermodynamic conditions, one should either marginalize people or marginalize their desires.** If the desire of the two main conflicting parties (say, the Palestinians and the Israelis) are denoted by $P_i$ and $I_j$ respectively (where $i$ and $j$ represent any two elements of conflict), the language for peace can be modeled in a general form as:

$$[ P_i ] = [ I_j + c_{ij} ]$$  \hspace{1cm} (5)

where $c_{ij}$ is a non-linear factor that can establish a compromise position between $P_i$'s desire for element $i$ and $I_j$'s desire for element $j$. If this term equals 0, then no conflict exists in the equation and a trade-off may possibly contribute benefit to avoiding or ending the overall conflict. The relationship between $P_i$ and $I_j$ elements represent a matrix in which the $c_{ij}$ values are placed (see Fig. 3 for an example of this matrix).

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**Fig. 3.** Theoretical Matrix of Compromise Positions that can equate the desires of the Palestinians to those of the Israelis. ($n$ and $m$ = maximum demands or desires of the Israelis and Palestinians respectively)

We can simplify this system of equations somewhat by taking a weighted summation:
\[ \Sigma W_{Pij} \cdot P_i = \Sigma W_{Iij} (I_j + c_{ij}) \] (6)

where \( W_{Pij} \) and \( W_{Iij} \) represent the weights assigned to each desire or demand of the Palestinians and Israelis respectively. A similar set of matrices to that shown in Fig. 3 can be prepared for these weights. The weighted summation provides a way to trade-off one issue against another in a manner such that each side receives an equitable total with respect to all of the elements of conflict.

The solution to Eq. 6 provides an answer to achieving Peace (or resolving the conflict). The values of the respective weight matrices can be chosen by each side involved in the conflict. Then, the international community together with the two parties can examine the values of the Compromise Matrix in Fig. 3 to determine if a feasible solution exists. Each required Compromise can be made by one of the parties or offered by the international community if the value is considered a reasonable payment for Peace.

If an Artificial Neural Network approach is used, the values of the weights and the compromise positions will be numerical and an "exact" or mathematically trivial solution may be derived. However, one may find an acceptable compromise cannot be achieved which forces the system to take on a more flexible or "fuzzy" approach. A major advantage of this method is that the \( c_{ij} \) factors can be masked by fuzzy inputs and outputs in the matrix in Fig. 3 which can give the appearance that nothing is being compromised. Similarly the weights assigned by each side to the elements of conflict can be assigned in a "fuzzy" way so that some elements are given a low priority, some are assigned a medium priority, while others are of high priority, i.e., the focus of attention can be brought to bear on the real underlying elements of conflict.

It should be mentioned that the purpose of masking the compromises is not one of deception, but rather to create an environment for constructive dialogue. Let us remember that the language of Peace is similar to that of Romance in which a degree of ambiguity is vital as a prelude to the "symphony of intimacy".

**Linearization of the Peace Process**

It is obvious that compromise is a key element in simplifying (or linearizing) the Peace process. Conflicting parties are not often prepared to compromise, especially on the key issues. The challenge of Peace diplomacy is therefore to linearize the process by converting non-compromising issues into pseudo-terms (i.e. terms that remain in the form of the equation, but are non-existent in the reality of the solution). In other words, we need a Peace process in which the non-compromising terms become irrelevant. For example, some of the Israeli-Palestinian non-compromising issues can evaporate with a re-definition of the virtual ethno-cultural physical or social boundaries that separate the two groups. This is where fuzzy logic can contribute enormously to the process. Most of the conflicts are rooted in a crisp definition of ethno-cultural or geographic boundaries. Samuel Huntington’s seminal paper "Clash of Civilizations" [13] is based on crisp definitions of a multitude of so-called civilizations. Over-emphasizing the importance of boundaries was the trend in the era of Modernity. In these times of Post-Modernity, the world is moving towards redefining boundary conditions (even in politico-geographic domains). Boundary fuzzification has already happened in North America through trade agreements (NAFTA) and in Europe (the formation of the E.U.) as well as in other concepts (such as home-rule for Scotland, Northern Ireland and Basque Country). We must caution however, that while boundary fuzzification is a necessity of our times, it should not be confused with the fascist ideology of unification nor with the American "melting-pot" concept, since these ideas both lead to homogenization that is doomed to failure (or more chaos) by the second law of thermodynamics. The fuzzification of boundaries is a daunting challenge, as it must retain individual identities while softening transitional movement on differing core values.

**Both Sides of the Issue**

In the Israeli-Palestinian conflict, it is easy to describe the combatants as belonging to one of two camps – the Palestinians and the Israelis. However, if one drills down into these two supposed polarized groups, one will find a spectrum of peoples – some of whom share "common values" across the great divide. A suggested representation of such a spectrum is shown in Fig. 4.
In Fig. 4, we have characterized three different groups between the two highly polarized groups called the Palestinians and the Israelis. These groups have been arbitrarily dubbed "Partial Palestinians", "Partial Israelis" and "Moderate Israeli-Palestinians". What is needed is to find the common values and attributes of people in the region that would allow them as individuals to be described as having membership in any of these designations. For example, a person who lives in Palestine (the West Bank, Gaza) and works in Israel could be characterized as a Partial Palestinian. On the other hand, an Israeli who lives in Israel, but has ties to a settlement in the West Bank could be described as a Partial Israeli. Finally those people in the region who are simply interested in Peace and do not hold strong polarized views on either side of the issues could be categorized as Moderate Israeli-Palestinians. Each individual may find that they have partial membership in adjacent categories. The extent of this individual distribution spread is unlikely to extend from the Pure Palestinian to the Pure Israeli sets, but then one never should speculate – perhaps there are common attributes that span across the full universe of discourse.

![Fig. 4. Fuzzy Sets to Represent the Spectrum of Peoples involved in the Israeli-Palestinian Conflict.](image)

Fig. 5 is drawn for illustration purposes only. It describes a possible distribution spectrum of the number of people in each category with respect to the category that has the greatest number. Note that in this case, we have arbitrarily assigned both poles as being equal in size (or impact) in order to emphasize the intensity of the dichotomy. In reality, there are about 10 million Israelis (about half of whom are of Islamic or Christian background) while there are about 5 million Palestinians (about 1 million of whom are of non-Islamic heritage). The peak positions along the horizontal scale correspond to those in Fig. 4, while the heights of each distribution are strictly for reference purposes. We suggest that the numbers of each of these three intermediate groups are relatively equal, yet much smaller relative to those of the two extremes.

![Fig. 5. Possible distribution of different categories of people impacted by the Israeli-Palestinian Conflict relative to the size of the two poles.](image)

Two things to bear in mind: first, the scale on the Universe of Discourse that defines a Palestinian or an Israeli is not simply numerical (although it could be set to a range between 0 and 100%). There are likely an infinite number of combinations of variables that could be derived to position any single person along
this scale. In fact, as we attempt to characterize single individuals, we may find they have a membership value that forms its own distribution function describing instead the degree of membership in each of the five categories. That is, a person may fall into the category of Distinct Israeli when considering certain issues and then into the category Moderate Israeli-Palestinian when examining other attributes.

Now, were it possible to change this set of distribution functions so that the number of people in the three intermediate sets would increase while those in the two extreme sets would decline, then we might be able to find commonalities on which to base the negotiations for Peace. There would be less extreme views in the society and reduced impact of the Chaos. While this reduction in polarity may lead to an increase in Chaos somewhere else in the world or in some other field of endeavour, by trying to find such common groups, Peace in the Middle East may be possible in the short run, never mind the possibility of a lasting Peace. Note that a fuzzy approach to depolarization of the Israeli-Palestinian fabric can be formulated to blur the clashing identities at the borders, while keeping core values and attributes preserved. This level of identity compromise will not lead to homogeneity but to a lasting and productive Entente within diversity.

Fig. 6 shows such a transformation in which there is a significant reduction in the numbers of people in the two extreme groups and an accompanying increase in the numbers in the three moderate groups. This type of change is not easy to accomplish, but is considered to be more likely than to move someone from one extreme to the other. A slightly different approach is shown in Fig. 7. While the number of people moving from one group to another is more or less the same as in Fig. 6, part of this exercise is now accomplished by redefining the function of what it is to be a Palestinian or an Israeli or a Neo-Israeli-Palestinian. By widening the overlap between the categories, the difficulty in convincing someone to modify their views is eased and the distribution functions move up or down respectively as they widen or narrow.

**Fig. 6.** A positive change in the distributions of different categories of people impacted by the Israeli-Palestinian Conflict – obtained by convincing people to share values with a neighbouring group.

**Fig. 7.** A positive change in the distributions of different categories of people impacted by the Israeli-Palestinian Conflict – obtained by blurring the definition of each group so the overlap between adjacent groups is increased.
This fuzzy logic modeling of a complex issue such as the Israeli-Palestinian conflict shows that the boundaries that separate us in reality can be very porous. This porosity can be either a reason for security concerns (if we are in a war mode) or a valuable tool for conflict resolution and regional collaboration (if we are in a peace mood).

Epilogue

**Common concerns and diverse resources**

There is another factor that can be addressed by fuzzification of otherwise crisp boundaries - "Common Concerns" (or "Common Interests") such as regional or global environmental issues. Consider the Global Warming (or Climate Change) issue: this problem has developed through the chaotic way in which the world has evolved its use of available energy systems by focusing almost completely on exploitation of fossil fuels to the detriment of the atmosphere's ability to maintain its temperature (In this case, temperature is not the kinetics of the system, but rather represents its chaos). Increasing the mean climate temperature leads to pockets of turmoil related to sea level rise and increased frequencies of "bad" weather conditions such as ice or snow storms, or hurricanes or tornados.

By growing a system (or society) in size such that shared "Common Values" are contained within the system, it is necessary for a cooperative approach to deal with these problems. Other issues include Acid Rain from sulfur emissions; Mercury emissions (from industrial and forest-razing activities); Tsunamis created by earthquakes; and over-fishing activities that deplete available fish stocks. Other ecological and societal issues may also spring to mind. The mere fact that the entire humanity may be in a single sinking boat could serve to bring us together. If we understand that we have a common destiny, our diversity in culture, religion, mode of thinking and life-style, will no longer be a reason to fight, but rather could represent a priceless store of novel approaches to find a solution that can redeem us from an otherwise "Common Calamity".

**References**


