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Transcending Simplistic Binary Contractual Relationships

What is hindering their exploration?

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Introduction

There are numerous examples of territorial and boundary disputes around the globe. These are readily described in the simplest binary form -- "that land belongs to us" and "not true, it belongs to us" (*Us and Them: Relating to Challenging Others*, 2009). The debates on these matters may last for years, typically highlighted by sporadic bouts of violence and threats of violence. Any apparent resolution may well obscure continuing resentment, ready to break out on the occasion of an appropriate excuse. The [Falklands/Malvinas sovereignty dispute](#) is but one current example.

The focus here is not the quest for solutions to particular conflicts. Rather it is **an effort to determine how generic solutions might be explored, framed and understood -- irrespective of whether they apply to any particular situation**. Clearly any general recipe may well be readily argued to be inapplicable to a particular situation. This should not however prevent the exploration of generic solutions which may lend themselves to adaptation to some particular cases.

A pioneering endeavour in this direction has been the *Bulletin of Peace Proposals*, established in 1970 at the [Peace Research Institute Oslo](#). In 1992 it became the peer-reviewed journal *Security Dialogue*. The question here is whether the format of the journal, and the contents it attracts, enables the full range of reflection which ongoing crises would appear to merit. As a subscription journal, how is it to be compared to the [open-source intelligence](#) enabled by *Wikipedia*? As with any [peer-reviewed journal](#) in the conventional sense, what gets "designed off the table"? As an interface between "mature" reflection on an option and any "naive" question as to the viability of a possibility, does such a tool exclude those who wish to understand why some proposals are either not viable or have been "filed away" for reasons which merit recognition?

To what degree is collective creativity discouraged by the conventional mindsets which are recognized as characterizing the [failures of the peer-review process](#) -- notably as now challenged with respect to the exploitative business model of academic publishing? How does that reinforce recommendations to policy makers to ignore other alternatives, or render their neglect incomprehensible (*Considering All the Strategic Options -- whilst ignoring alternatives and disclaiming cognitive protectionism*, 2009)?

The case can be made otherwise by recognizing the enthusiasm with which more complex mathematics is adopted with respect to other strategic concerns, notably those of financial management -- significant in enabling the recent financial crisis (*Uncritical Strategic Dependence on Little-known Metrics: the Gaussian Copula, the Kaya Identity, and what else?*, 2009). Another example is provided by the [Black-Scholes mathematical model](#) of a financial market containing certain derivative investment instruments -- the subject of comment by [Johan Galtung](#) (*The Face of the Crisis - And Alternatives*, *Transcend Media Service*, 26 March 2012) and by [Tim Harford](#)

(*Black-Scholes: the maths formula linked to the financial crash*, BBC News, 27 April 2012).

Enabling a context for creative consideration of possibilities

The argument developed here follows from the strategic profiling achieved in the [Global Strategies Project](#), which specifically sought to indicate [systemic relationships between strategies](#) advocated by international constituencies of every persuasion, notably in terms of mutual constraint or facilitation -- lending the result to [pattern analysis](#). Other mathematical possibilities were subsequently suggested (*And When the Bombing Stops? Territorial conflict as a challenge to mathematicians*, 2000; *Unexplored Potential of Mathematics and Geometry -- in reframing psycho-social challenges*, 2008).

What kind of database of proposals would enable the curious freely to explore the status of various envisaged possibilities, in isolation or in combination -- and the kinds of consideration they had been given, whether favourable or critical? Where can one find all the proposals for the Israel-Palestine-Jerusalem situation, with arguments as to their relative feasibility, in order to determine the credibility of statements to the effect that "every option has been assiduously explored" -- with "no stone having been left unturned"? Where can one find what proposals have been treated as ridiculous -- by whom -- and thereafter excluded from any consideration? To what extent does any checklist of [Middle East peace proposals](#), as currently elaborated, obscure possibilities through its focus on their historical context?

Potentially more interesting is the possibility that such a set of proposals could be the subject of various forms of systemic analysis. How to rank them according to their simplicity or complexity? Is a measure of "naivety" appropriate? Of educational value? Of "new thinking"? Or of "cynicism"? Even more interesting, however, is the possibility of indicating the mathematical complexity fundamental to the proposal. Associated with such an investigation would be the determination of what branches of mathematics had been considered, or neglected, in reflecting on the possibility of a solution. Pointers in that direction are offered by Johan Galtung -- the original founder of the Peace Research Institute Oslo -- in his recent work on "peace mathematics" (*Peace Mathematics - Does It Exist? Transcend Media Service*, 2 April 2012).

The question highlighted in what follows is **the nature of the "contract" which might be possible between parties in dispute in binary context** -- beyond those which are associated with what are effectively the simplest forms of mathematics, if not familiar in the Stone Age. Expressed otherwise, what forms of contract are to be found beyond a binary framework. In other words, if use was made of the more complex forms of mathematics considered appropriate to risk management on the stock market, or describing the nature of the physical universe, what viable possibilities might emerge -- if only as hypotheses which could lend themselves to simulation? Could parties then negotiate on the relative complexity of the contract they considered able to order their relationship more fruitfully?

The approach is then seen as a way of offering a richer range of possibilities than those currently placed on the negotiating table for consideration by those in dispute.

Domains of current and potential application of non-binary modalities

The concern here is to highlight domains in which **more complex "contracts" are considered necessary to the viable management of situations which do not allow of conventional simplistic solutions**. The generic question is how to elicit the nature of the mathematical approach in each case, the manner in which its complexity was rendered comprehensible, and to raise the question as to whether even more complex forms of mathematics might have been applied to enable even more viable solutions satisfying the concerns of the parties involved.

Most pertinent is whether the relative sophistication considered applicable in one domain could not be at least considered as a possibility with respect to another. Of contractual relevance to this argument is how these patterns could be fruitfully described mathematically in order to highlight their relative simplicity (or complexity) as a means of indicating more interesting options that merit attentive consideration. Examples for consideration include the following.

Ownership of territory and real estate: [Territorial disputes](#) and boundary disputes are too numerous to require comment (see [Wikipedia List of territorial disputes](#) and [Lists of active separatist movements](#)). Current examples are offered by Malvinas / Falklands, Kashmir, Tibet, Northern Ireland, and the like. Typically the argument of the other side is considered inappropriate and completely invalid. Of related current interest is the issue of whether Scotland should separate to some degree from the "United Kingdom" -- with implications for Wales and Northern Ireland (*It'll cost you: Scottish independence would come at a high price*, *The Economist*, 14 April 2012).

Another aspect of the matter is the nature of the rights of the public to "common land", pressures to enclose it, to restrict it to private ownership, or to exploit its mineral or forestry resources. This tendency may be extended to the seabed and to oil resources beneath it -- aggravating disputes such as in the case of the Falklands. Currently of "emerging" significance is the scramble to claim territory in the Arctic as a result of melting of the ice cover (Felix Lüth and Marc Sonntag, *Who Owns the Arctic? A stroctaking of territorial disputes*, *The Global Journal*, 10, March-April 2012).

The matter has proven to be especially tragic to indigenous peoples with a distinct traditional relation to the land -- as with the Aborigines of Australia or nomadic tribes. The land has not been understood as susceptible to "ownership" in any conventional legal sense. For that reason it was problematically framed as *terra nullius* -- belonging to nobody. A related tragedy is evident in the case of wildlife, most notably to species with annual migrations completely disrupted by fencing as a consequence of ownership.

It is with respect to such simplistic senses of territorial ownership and closure that there is merit in citing and elaborating other formula:

- **condominium:** As noted by *Wikipedia*: a condominium, or condo, is the form of [housing tenure](#) and other [real property](#) where a specified part of a piece of real estate (usually of an [apartment](#) house) is individually owned while use of and access to common facilities in the piece such as hallways, heating system, elevators, exterior areas is executed under legal rights associated with the

individual ownership and controlled by the association of owners that jointly represent ownership of the whole piece.

- **condominium in international law**: As noted by *Wikipedia*, this is a political territory (state or border area) in or over which two or more sovereign powers formally agree to share equally dominium (in the sense of sovereignty) and exercise their rights jointly, without dividing it up into "national" zones. Although a condominium has always been recognized as a theoretical possibility, condominiums have been rare in practice. A major problem, and the reason why so few have existed in practice, is the difficulty of ensuring co-operation between the sovereign powers; once the understanding fails, the status is likely to become untenable.
 - The *Wikipedia* entry provides comprehensive checklists, with numerous examples, distinguishing between: **current condominia**, **co-principalities**, and **former condominia** (including **Nauru** and **Samoan Islands** as tripartite condominia, and **New Hebrides** and **Togoland** as Anglo-French condominia). It is noteworthy that the British government held discussions with Spain with a view to putting a proposal for joint sovereignty to the people of **Gibraltar** (rejected by Gibraltarians in 2002). In the case of the New Hebrides, this was characterized by 50 years of co-sovereignty with the same territory having two governments simultaneously, with two parallel administrative structures, and corresponding citizenship arrangements
 - Much more striking is the total absence of any examination of the feasibility of a "condominium" arrangement within the context of current discussion of a two-state solution ("two states for two peoples") to the **Israeli-Palestinian conflict**. With respect to Jerusalem, it has been articulated in detail by **John V. Whitbeck** since 1988 in relation to Jerusalem (and Northern Ireland) in appropriate Middle East journals (*Middle East Policy* (December 1994, pp. 110-118) and *Jerusalem Times* (15 March 1996, pp. 8-9)), as well as being the subject of a detailed report in the *International Herald Tribune* (17 November 1994). Whitbeck's "condominium solution" for sharing Jerusalem in a context of peace and reconciliation has been published more than 50 times in various forms and languages (*Sharing Jerusalem: the condominium solution*, *Common Ground News Service*, 3 May 2007; *A condominium solution for a divided Jerusalem*, *Christian Science Monitor*, 29 May 2007; *Jerusalem: A Condominium Solution*, *Global Dialogue*, Spring 2000). It is ironic, in a period when many in international capitals possess two or more passports -- surely "irrational" in terms of purported understandings of sovereignty -- that consideration should not be given to some such formula.
- **time sharing**: Various applications of this technique are relevant to this argument:
 - **time sharing of property**: As noted by the *Wikipedia* entry, this is a form of ownership or right to the use of a property. These properties are typically resort condominium units, in which multiple parties hold rights to use the property, and each sharer is allotted a period of time (typically one week, and almost always the same time every year) in which they may use the property.
 - **job sharing**: As noted by the *Wikipedia* entry, this is an employment arrangement where typically two people are retained on a part-time or reduced-time basis to perform a job normally fulfilled by one person working full-time. Compensation is apportioned between the workers (leading to a net reduction in per-employee income).
 - **time sharing of facilities**: A variant of the time sharing of property is the use of the technique to enable limited facilities, most notably school buildings, to be used by different groups throughout the day, employing facilities which would otherwise be empty for part of the day. Other examples include car sharing and **carpooling**.
 - **time sharing of religious sites**: This process may be used where distinct religions, attaching significance to the same site, come to an arrangement such that each conducts its ceremonies on the site at times which do not conflict. The most striking example is the **Church of the Holy Sepulchre** in Jerusalem. Under the status quo, the Eastern Orthodox, Roman Catholic, and Armenian Apostolic Churches all have rights to the interior of the tomb, and all three communities celebrate the Divine Liturgy or Holy Mass there daily.
 - **time sharing of computer resources**: As noted by the *Wikipedia* entry, this is the sharing of a computing resource among many users by means of **multiprogramming** and **multi-tasking**. Its introduction in the 1960s, and emergence as the prominent model of computing in the 1970s, represented a major technological shift in the history of computing. By allowing a large number of users to interact concurrently with a single computer, it dramatically lowers the cost of providing computing capability, makes it possible for individuals and organizations to use a computer without owning one, and promotes the interactive use of computers and the development of new interactive applications.

Clearly it is computer time sharing which exemplifies the feasibility and **requisite complexity** of viable solutions. Given widespread dependency on such time sharing, any argument that such an approach is "too complex" to be understood is completely questionable in the light of the costs of failing to employ that possibility.

Token "ownership": This is a procedure in which people and groups are invited to "take ownership", "adopt" or "sponsor", as exemplified by:

- **child sponsorship**: In contrast to legal adoption, this is a process facilitated by charities, whereby a commitment is made to assist a particular individual, most notably with respect to education. It is an effort to personalize charitable giving whereby an individual, typically in a developed country, sponsors, or funds a child in a developing country -- until the child becomes self-sufficient. This could mean financially supporting the education, health or security of the sponsored child, or in some cases all of these.
- **animal sponsorship**: As with children, the process may be applied to care for particular animals, notably in shelters or in zoos.

Possibly framed as "adoption", it may also be expressed in terms of becoming a "zoo parent".

- **adopting a highway:** In this case the sponsorship procedure is applied through eliciting care for a highway, notably with respect to removal of litter.
- **adopting a village:** As a variant of child sponsorship, this could mean contributing more widely to the child's community developing without directly helping an individual child. The process of "twinning" may have aspects in which a richer community effectively "adopts" a less privileged one as a means of offering some forms of assistance

Symbolic "ownership": Potentially controversial issues implied by any particular configuration of "ownership" or "leadership" may be resolved by "rotation" over time, as in the following cases (variously related to those above):

- *rotating leadership:* This is applied in a number of contexts:
 - state-based: A state-based rotating presidency is used to ensure that no one person (or state) holds the position for an extended amount of time. It may give an equal share to all of the states involved, or it may privilege those from different continents in rotation. It is extensively applied in international organizations, as with the [European Council](#).
 - leadership in general: More generally, the process of "rotating chairmanship" is widely used. Use of a mathematical language to explore the possibility is valuably argued by Jason P. Davis and Kathleen M. Eisenhardt (*Rotating Leadership and Symbiotic Organization: relationship processes in the context of collaborative innovation*, *Administrative Science Quarterly*, October 2008):

Rotating leadership involves revolving decision control between partners to engender high-quality contributions of technologies and IP, fluctuating cascades of network activation which dynamically modify innovative team composition, and zig-zagging relationship trajectories that effectively search the broader space of potential innovations. A broader contribution is to reframe inter-organizational relationships as organizational symbiosis, a state of organization that engenders mutually reinforcing adaptive changes to partner's strategies and structures. In contrast to other images of relationships as engines of efficient exchange and endorsement, symbiotic relationships focus on engendering technology innovation, organizational adaptation, and industry transformation.

- **job rotation:** This is a management technique whereby trainees are assigned to various jobs and departments over a period of a few years to facilitate learning.
- **event rotation:** This is a very common procedure in the hosting of a sequence events in different locations, most notably internationally, such that no one location (or country) is privileged. This is most obvious in the case of sporting events.

Ownership of virtual estate: With the development of [virtual worlds](#), as [online communities](#), many of the conventional practices with respect to ownership of "real estate" are applied to ownership of cyberspace. At its simplest level this is evident in the ownership of [web domains](#) and associated addresses. Recent legal disputes also acknowledge the value of virtual property -- of property in cyberspace.

Despite the manner in which these environments engender [virtual institutions](#), notably with respect to decision-making, it remains unclear whether innovation in their organization embodies insights other than those analogous to those already developed in the "real world".

Ownership of intellectual property: [Intellectual property](#) is extremely well-recognized and does not call for further comment, other than to note the extent to which it currently reflects the restrictive patterns of ownership with respect to tangible property and real estate.

Powerful challenges to these patterns are evident in the successful development of "open source" approaches, most notably with respect to development and licensing of [open-source software](#), [open-source hardware](#), [open source video games](#), and [open source music](#). The approach extends more generally to [open content](#), most notably with respect to directories. The issues have been well articulated by [Eric S. Raymond](#) (*The Cathedral and the Bazaar: musings on Linux and open source by an accidental revolutionary*, O'Reilly, 1999; *Homesteading the Noosphere*, 1998). A more recent articulation is offered by [Flemming Funch](#) (*Intellectual Property*, *Ming the Mechanic*, 2012)

A distinct challenge to restrictive ownership and use of intellectual property is currently emerging in the form of protest by academic writers regarding the business models adopted by academic journals -- which effectively limit access to research results enabled by public funding (Stephen Curry, *Science must be liberated from the paywalls of publishers*, *The Guardian*, 10 April 2012). As variously described by [Alok Jha](#) (*Academic spring: how an angry maths blog sparked a scientific revolution*, *The Guardian*, 9 April 2012; *Wellcome Trust joins 'academic spring' to open up science*, *The Guardian*, 9 April 2012), this arose from protest by a Cambridge mathematician leading to demands for open access to scientific knowledge. The concerns are intimately related to the dynamics of the [peer review](#) system (Michael P. Taylor, *Persistent myths about open access scientific publishing*, *The Guardian*, 17 April 2012). There has been extensive [criticism of the peer review system](#), notably with respect to [peer review failure](#).

It is appropriate to note that the framing of the reaction to conventional "closed" approaches to property is effectively binary in the advocacy of an "open" philosophy (cf. Orrin E Klapp, *Opening and Closing: strategies of information adaptation in society*, 1978). With respect to the argument here, it is especially interesting to note that the protests originated with mathematicians, although it is unclear whether they have been able to articulate distinctive alternatives benefitting from the subtler insights of mathematics -- and to simulate their use.

Non-binary approaches in financial ownership

In contrast to many of the above, the use of mathematics to elaborate and sustain more complex approaches is especially evident in the case of finance and the associated issues of risk management and its insurance. However these non-binary examples, in the patterns

discussed below, are subject to the fundamental reservation that the basic framework is binary: profit/loss, winner/loser, agreement/disagreement. This is most evident in the mathematics underlying the accounting spreadsheet -- in contrast with other possibilities (*Spherical Accounting: using geometry to embody developmental integrity*, 2004).

Ownership of financial assets: It is in the realm of finance that more complex approaches to ownership have been very extensively developed. Instances include:

- **shareholding / stockholding:** This is the process whereby an individual or institution (including a corporation) acquire legal ownership of any part of a share of stock in a public or private corporation. Shareholders own the stock, but not the corporation itself. Stockholders are granted special privileges depending on the class of stock. Stockholders have an **equity** stake in the company, thereby achieving a degree of ownership.
- **bond holding:** This is the process whereby an individual or institution (including a corporation) acquires a debt security, through which the authorized issuer owes the holder a debt and, depending on the terms of the bond, is obliged to pay interest (the coupon) to use and/or to repay the principal at a later date, termed maturity. The bond is a formal contract to repay borrowed money with interest at fixed intervals. Bondholders have a creditor stake in the issuing institution as lenders. By this process the holders acquire a form of "ownership" of the issuing party, acquiring particular significance when that party is the government of a country.
- **derivative:** This is a form of contract between two parties that specifies conditions (especially the dates, resulting values of the underlying variables, and notional amounts) under which payments, or payoffs, are to be made between the parties. They are termed "derivatives" because the value of these instruments is derived from another asset class.

Market dynamics: In particular contrast to other forms of ownership, that relating to financial assets is especially characterized by its dynamics in various markets:

- **stock market / equity market:** This a public entity (a loose network of economic transactions, not a physical facility or discrete entity) for the trading of company stock (shares) and derivatives at an agreed price; these are securities listed on a stock exchange as well as those only traded privately.
- **bond market/ credit market:** This is a financial market where participants can issue new debt, known as the primary market, or buy and sell debt securities, known as the secondary market, usually in the form of bonds. The primary goal of the bond market is to provide a mechanism for long term funding of public and private expenditures.
- **futures market:** This is a central financial exchange where people can trade standardized futures contracts. As a form of derivative, these are contracts to buy specific quantities of a commodity or financial instrument at a specified price with delivery set at a specified time in the future.

The dynamics of these markets, and the assets variously packaged and sold on them, are the subject of very extensive application of mathematical instruments. As noted by *Wikipedia*, derivatives are used by investors in the following processes, variously considered questionable by critics of what has proven to be a vulnerable system in which unsuspected degrees of systemic negligence have become evident:

- provide **leverage** (or gearing), such that a small movement in the underlying value can cause a large difference in the value of the derivative;
- speculate and make a profit if the value of the underlying asset moves the way they expect (e.g., moves in a given direction, stays in or out of a specified range, reaches a certain level);
- **hedge** or mitigate risk in the underlying, by entering into a derivative contract whose value moves in the opposite direction to their underlying position and cancels part or all of it out;
- obtain exposure to the underlying where it is not possible to trade in the underlying (e.g., **weather derivatives**);
- create **option** ability where the value of the derivative is linked to a specific condition or event (e.g. the underlying reaching a specific price level).

Risk management: Of central interest to the argument here is the sense in which there is a degree of transition beyond binary logic -- to the extent that ownership and risk is variously shared through the use of complex formula dependent on sophisticated mathematics. There is a very heavy dependence on these skills and their application in practice. This is integrated into the highly sophisticated use of computer facilities to enable the operation of markets -- with all the questionable risks associated with automated computer trading and price-setting processes in a stock exchange.

Automated trading now extends into the more questionable practices of **algorithmic trading** (algo trading, black-box trading or robo trading), namely the use of electronic platforms for entering trading orders with an algorithm deciding on aspects of the order such as the timing, price, or quantity of the order, or in many cases initiating the order without human intervention. Algorithmic trading is widely used by pension funds, mutual funds, and other buy side (investor driven) institutional traders, to divide large trades into several smaller trades in order to manage market impact, and risk.

The current financial crisis -- of globally unprecedented proportions and implications -- has been the consequence of the questionable packaging of derivatives, **junk bonds**, **toxic assets**, and the problematic calculation of risk in that connection, as separately discussed (*Uncritical Strategic Dependence on Little-known Metrics: the Gaussian Copula, the Kaya Identity, and what else?*, 2009). Another example is provided by the **Black-Scholes mathematical model** of a financial market containing certain derivative investment instruments - the subject of comment by Johan Galtung (*The Face of the Crisis - And Alternatives*, *Transcend Media Service*, 26 March 2012).

An interesting effort to elaborate a more complex approach to the current crisis is that provided through the collaboration of a group of authors: Bernard Lietaer, Robert Ulanowicz and Sally Goerner (*White Paper on All the Options for Managing a Systemic Bank Crisis*, 2008; *Quantifying Sustainability: Efficiency, Resilience and the Return of Information Theory*, *Journal of Ecological Complexity*, 2009; *Quantifying economic sustainability: Implications for free-enterprise theory, policy and practice*, *Ecological Economics*, 2009).

The fundamental question of interest here is whether mathematics has itself been used to analyze these dependencies and vulnerabilities associated with particular approaches. The impression is created that, like derivatives, "mathematical products" are used blindly. The point has been well made by [David X. Li](#), who developed the innovative risk-management formula of known as the [Gaussian Copula function](#) -- subsequently described as "[the secret fomula that destroyed Wall Street](#)". As Li indicated in 2005: *Very few people understand the essence of the model* (Mark Whitehouse, *Slices of Risk*, *The Wall Street Journal*, 12 September 2005).

It is nevertheless intriguing that, despite their complexity and unusual nature, the legality of financial transactions and contracts poses no problem. It might therefore be asked whether "complexity" is an adequate excuse for failure to explore the legal basis for more complex contracts in other situations -- as might potentially be framed by mathematical relationships.

Potential application of non-binary approaches to governance

Voting: It is only too evident that, to the extent that governance involves any form of vote, that the focus is on winning rather than losing -- namely on achieving a viable majority. This is the binary approach desired by all "parties" in their aspiration to completely control the processes of governance unchallenged by alternative perspectives. The methods of winning, by "fair means or foul", have been explored and noted for centuries (cf [Quintus Tullius Cicero](#), *How to Win an Election: An Ancient Guide for Modern Politicians*, 2012; [Niccolò Machiavelli](#), *The Prince*).

Mathematics is of course at the service of this process through statistics, psephology and the like. Matters become more complex where coalitions have to be formed to achieve a viable majority. The result is effectively a post-electoral binary resolution of the challenge of governance -- irrespective of whether the pattern is viable in the face of the complex challenges of the present times, as separately discussed (*Ungovernability of Sustainable Global Democracy? Towards engaging appropriately with time*, 2011; *The Consensus Delusion: Mysterious attractor undermining global civilization as currently imagined*, 2011).

Proportional representation: Extremely modest use is made of mathematics in exploring the possibilities of alternatives to the simplistic pattern of voting promoted as the essence of democracy. This is evident in consideration of [proportional representation](#) in which the voting system used to elect representatives is such that the number of seats won by a party or group of candidates is proportionate to the number of votes received.

As noted by *Wikipedia*, there are many different forms of proportional representation. Some are focused solely on achieving the proportional representation of different political parties (such as [party-list proportional representation](#)) while others permit the voter to chose between individual candidates (such as [single transferable vote](#)). The degree of proportionality also varies; it is determined by factors such as the precise formula used to allocate seats, the number of seats in each constituency or in the elected body as a whole, and the level of any minimum threshold for election. [Simulations](#) enable exploration of these alternatives -- but this credibility remains uncertain.

Confidence: Curiously, as with risk management in relation to financial investment, the underlying issue is one of credibility, trust and confidence -- of what people are prepared to believe in. Also curious is the extent to which governance is increasingly faith-based -- to the degree that major tensions can be understood as deriving from as yet unresolved centuries-old conflicts between theocracies representative of the three Abrahamic religions. This suggests the merit of exploring confidence and belief in "theological" terms (*Mathematical Theology: Future Science of Confidence in Belief*, 2011).

Comprehensibility: Of particular relevance to consideration of alternatives, informed by more sophisticated mathematics, is the issue of the comprehensibility of any advocated system, however attractive in principle. Some proportional representation systems are, in practice, already a significant challenge to voter comprehension. **The question is how mathematics might interrelate the "Four C's": confidence, credibility, comprehension and consensus** -- and how this might influence the design of simulations.

Intentional communities: It is of course the case that intentional communities have long constituted "laboratories" for experimentation with voting systems. It is seldom recognized how many current democratic processes were developed within Christian monasteries in centuries past -- as a feature of their "Rules". Recent initiatives to establish intentional communities have also offered the possibility for experimentation. It is not however evident that fruitful models have emerged from those processes, nor to what extent they have benefitted from the more complex possibilities offered by mathematics.

This consideration extends into the elaboration and governance of coalitions for social change, such as the [World Social Forum](#) or the [Stakeholder Forum for a Sustainable Future](#). Again it is far from clear whether their governance and decision-making constitute patterns that are viable, effective and sustainable in practice.

[The "Belgian Compromise" from a Cybenetic Perspective \(1998\)](#)
(as described by [Francis Heylighen](#) and reproduced from [Principia Cybernetica Web](#))

In cybernetical terms, the Belgian system might be described as highly self-organizing. The political system is based on discussion and compromise between different groups of interest, without a clear central control (the king has no real power, and the prime minister is mainly the person who is best suited for implementing the agreements). For example, socio-economical problems are mostly avoided by preparing "collective labor agreements", where trade unions and employers reach a compromise on wage increases in the coming period. Only when unions and employers cannot reach consensus, the government will intervene by proposing a compromise.

A special expression, "a Belgian compromise", has been invented to design the typical solutions derived in this way: complex issues are settled by conceding something to every party concerned, through an agreement that is usually so complicated that nobody completely understands all its implications. In spite of the apparent inefficiency of these settlements, the compromises do work in practice, because they stop the existing conflicts, and thus allow life to go on without fights or obstructions. The practical ambiguities and confusions that arise out of the compromise are usually solved on the spot by the Belgians' talent for improvisation.

The experience gained in negotiating these intricate multiparty, multilingual and multicultural problems has led to an unlikely new export product: Belgian political expertise. At a certain moment, the presidents of the four largest political groups in the European Parliament, socialists, christian democrats, liberals and rainbow, were all Belgian, as was the president of the European federation of trade unions. The Belgian prime minister, **Jean-Luc Dehaene**, demonstrated the expertise he gathered in this kind of problem-solving when he succeeded in untying the Gordian knot of assigning some dozen different European institutions to the different member states of the European Union (a problem which had eluded the previous British and Danish presidencies of the European Community) by on the spot creating a new institution, so that every country could carry something home.

Transcending the challenges of binary interpersonal relationships

The determined application of binary models is most evident in interpersonal relationships, leading from "best friend" to "marriage". This process tends of course to be strongly reinforced by religious injunctions and their reinforcement of legislative provisions -- especially in a context of faith-based governance.

Alternatives variously expressed: The pattern has been variously challenged in practice:

- **adultery:** Namely philandery or cheating, taking the form of sexual infidelity to one's spouse as also called philandery or cheating, is sexual infidelity to one's spouse, and is a form of "extramarital sex".
- **open marriage:** Namely a marriage in which the partners agree that each may engage in extramarital sexual relationships, without this being regarded as infidelity. There are many different **styles of open marriage** (such as swinging and polyamory), each with the partners having varying levels of input on their spouse's activities. Open marriages place high value on honesty, especially of needs and wants. The practice of extramarital sex is often illegal in jurisdictions where adultery is illegal, regardless of whether the partner(s) has given their consent.
- **open relationship:** Namely an interpersonal relationship in which the parties want to be together but agree to a form of a non-monogamous relationship. This means that they agree that a romantic or sexual relationship with another person is accepted, permitted, or tolerated.
 - **polyfidelity**, meaning faithful to many partners, where there is an evenly distributed rotating sleeping schedule that determined who sleeps together when -- with none sleeping with anyone outside of those originally involved in the group.
 - **swinging:** namely when both partners in a committed relationship become non-monogamous as a couple and agree for both partners to involve themselves sexually with other couples as a social activity
- **polyamory:** Where the 'open' in 'open relationship' usually refers to the sexual aspect of a non-closed relationship, 'polyamory' refers to the extension of a relationship by allowing bonds to form (which may be sexual or otherwise) as additional long term relationships. Polyamory also translates into many loves and refers to the ability to love more than a single person simultaneously
- **polygamy:** Whether as **polyandry**, in which women have multiple husbands, or as **polygyny**, in which men have multiple wives.
- **non-monogamy:** Applies to several types of interpersonal relationships in which an individual forms multiple and simultaneous sexual and/or romantic bonds
- **concubinage:** Namely the state of a woman or man in an ongoing, usually matrimonially oriented, relationship with somebody to whom they cannot be married, often because of a difference in social status or economic condition.
- **plaçage:** Historically recognized as an extralegal system in which white French and Spanish and later Creole men entered into the equivalent of common-law marriages with women of African, Indian and white (European) Creole descent. The women were not legally recognized as wives but were known as *placées*; their relationships were recognized among the free people of color as *mariages de la main gauche* or left-handed marriages.

The evolution of the dynamics of relationships frequently results in:

- **divorce:** Namely dissolution of marriage, variously justified, with a need to ensure:
 - visitation rights with respect to children
 - sharing family home
- **blended family / stepfamily / reconstituted family:** Namely one in which one or both members of the couple have children from a previous relationship. The member of the couple to whom the child is not biologically related is the stepparent, specifically the stepmother or stepfather.

Friendship: Subtler, and possibly more dynamic, forms of relationship are evident in the case of patterns of "friendship", namely relationships and concern between two or more individuals which provide a degree of emotional support, mutual care and assistance in times of need. These may involve unusual degrees of communication and loyalty. However the variety of **types of friendship**, and the **quality of friendship**, as distinguished within and between cultures, is extensive and may include (as distinguished in *Wikipedia*):

- **acquaintance:** not a true friend, sharing of emotional ties being absent. Many "friends" acquired on social networking sites are generally acquaintances in real life.
- *best friend:* a person someone shares extremely strong interpersonal ties with as a friend.
- **blood brother** or blood sister: Either people related by birth, or a circle of friends who swear loyalty by mixing the blood of each

member together.

- *Bro or Bruh*: Slang used primarily in the USA, Australia and New Zealand by teenage and young adult men to describe a male close friend. Sis being the female equivalent of "bro".
- **buddy / mate**: Males, and sometimes females, may refer to each other as "buddies". In some countries men may refer to those in their circle of friends as "mates"
- **casual relationship** or "friends with benefits": A sexual or near-sexual and emotional relationship between two people who do not expect or demand to share a formal romantic relationship.
- *family friend*: A friendship extended to family members of the friends. Close relation is developed in those societies where family setup is strong.
- **comrade**: Namely an "ally", "friend", or "colleague" in a military or political connotation.
- **frenemy**: A portmanteau of the words *fr(iend)* and *enemy*, the term *frenemy* refers to someone who pretends to be a friend but actually is an enemy.
- **internet relationship**: A form of friendship or romance which takes place over the Internet.
- *agentic friendship*: A friendship in which both parties look toward each other for help in achieving practical goals in their personal and professional life.
- **pen pal**: People who have a relationship via postal correspondence, now reframed via social networking.
- **workplace friendship**: Namely a relationship established in a workplace that goes beyond normal expected working relationships.

It is of course the case that anthropologists delight in highlighting the unusual nature and complexity of viable relationships in cultures of which the dominant worldview takes little account in its focus on binary patterns.

Network analysis and configuration building: The application of mathematics to the study of relationships has been most evident in the case of **kinship networks** and in **social network analysis**. These have been essential descriptive and analytical with a degree of emphasis on influence and communication patterns. Thus the application of topology to sexual relationships has been primarily focused on its implications for the spread of HIV. A recently published study, benefitting from the large amounts of previously unobtainable data deriving from electronic communication (mobile phone usage, texting, social networking) follows this pattern (**Robin I. M. Dunbar**, *The Science of Love and Betrayal*, 2012). There are indications that very powerful mathematical tools are applied to the analysis of communication patterns which can be interpreted as a threat to security.

As might be expected, a degree of mathematical insight has been brought to bear on team building and the effective operation of teams. This is most evident in the analysis of **passing patterns** in ball games -- effectively a metaphor for the missing analysis of how the "point" is "passed" in dialogue, even though "point scoring" is a process common to both domains (Athalie Redwood-Brown, *Passing patterns before and after goal scoring in FA Premier League Soccer*, *International Journal of Performance Analysis in Sport*, 2008; Association for Soccer Education and Teaching, *Passing Patterns and Small Sided Games*, 2008; Alan Reifman, *Network Analysis of Basketball Passing Patterns II*, 2006; Patrick Riley, *Coaching: Learning and Using Environment and Agent Models for Advice*, 2005).

The approach has been adapted to message passing in complex organizational networks. The situation is all the more curious given the widespread metaphoric use of "ball" in strategic dialogue -- as in the "ball is in their court".

There appears, however, to have been little interest in employing mathematical insight to envisage new forms of relationship and interpersonal contract. It could however be argued that social networking sites have a vested interest in this process, given the focus on extending networks of "friends", "followers", and "contacts". Seemingly this is undertaken with little interest in eliciting or proposing new forms of configuration -- as prefigured by online "clan" and "guild" formation. These can be variously imagined (*Group Questing or Twelving: Proposal for a large-scale small-group development process*, 1976; *Global Street Twinning in Polyhedral Configurations: an application of Google Earth?* 2009; *Polyhedral Empowerment of Networks through Symmetry: psycho-social implications for organization and global governance*, 2008)

This approach to interpersonal relationships raises the question as to whether there is the possibility of a "systematic" approach to their classification, as previously suggested (*An Approach to Systematic Classification of Interpersonal Relationships: Conceived as essential to alternative life styles, social and personal transformation*, 1978). Of particular interest is whether this can be framed cognitively, and meaningfully informed in some way by mathematics, as separately discussed (*Reframing the Dynamics of Engaging with Otherness: Triadic correspondences between Topology, Kama Sutra and I Ching*, 2011).

Insights from dialogue, multi-part singing and periodicity

Dialogue: Interpersonal relationships, and those between collective bodies, are informed by the nature and quality of dialogue. There is then a case for deriving insights from proposals for new forms of dialogue which in some way transcend the binary processes only too evident in dialogue. These binary processes of course take the form of a preoccupation with distinguishing right/wrong, agree/disagree, informed/misguided, and the like, as notably challenged by **Edward de Bono** (*I Am Right -- You Are Wrong*, 1990). He has offered alternatives (*Six Thinking Hats: an essential approach to business management*, 1985; *Six Action Shoes*. 1991).

Curiously, whilst there are numerous references to dialogue in relation to mathematics education, ironically the single passing reference to "mathematics of dialogue" was in relation to Kashmir (J. R. Aryan, *Kashmir and India's soft stand*, *Early Times*, 18 November 2011).

A more complex system of dialogue might then be seen as exemplifying the non-binary approach seemingly necessary in order to address more complex psychosocial situations, as variously argued separately (*Sustainable Dialogue as a Necessary Template for Sustainable Global Community*, 1995; *Transdisciplinarity through Structured Dialogue: Beyond sterile dualities in meetings to the challenge of participant impotence*, 1994; *Typology of 12 complementary dialogue modes essential to sustainable dialogue*, 1998; *Resolving the Challenge of Faith-based Terrorism: Eliciting the dynamic of two-body, three-body and n-body variants*, 2005).

The papers cited point to possibilities of a more formal description of non-binary dialogue, as does, most notably, the work of [Anthony Blake](#) (*The Supreme Art of Dialogue: structures of meaning*, 2008). A possibility extensively informed by insight from cybernetics has been articulated by [Stafford Beer](#) (*Beyond Dispute: The Invention of Team Syntegrity*, 1994) and implemented in the "syntegration" process. .

The possibilities of [structured dialogue](#) are also central to the collaborative work of Thomas R. Flanagan, Kenneth C. Bausch and [A. N. Christakis](#) (*A Democratic Approach to Sustainable Futures: a workbook for addressing the global problematic*, 2011; *The Talking Point: creating an environment for exploring complex meaning*, 2010).

Curiously it can be argued that such initiatives do not come to mathematical terms with what is so widely recognized through metaphor in dialogue itself, namely the reference to "making points", "point of view", "line of argument", and the like, as discussed separately (*Experience of Cognitive Implication in Fundamental Geometry: Unexamined metaphoric framing of strategic discourse*, 2012). This suggests that a more formal mathematical exploration follows from the implications of the work of [R. Buckminster Fuller](#) (*Synergetics: explorations in the geometry of thinking*, 1975-1979), as discussed in *Geometry of Thinking for Sustainable Global Governance: cognitive implication of synergetics* (2009) and elsewhere (*Metaphorical Geometry in Quest of Globality*, 2009; *Engaging with Globality: through cognitive lines, circlets, crowns or holes*, 2009; *Geometry of Organizations, Policies and Programmes*, 1992).

Geometry, as with topology, would seem to offer a template through which to approach the non-binary possibilities of social organization informed by dialogue. In the light of the work of Fuller, these have been partially explored through the use of polyhedra (*Towards Polyhedral Global Governance: complexifying oversimplistic strategic metaphors*, 2008; *Coherent Value Frameworks: Pillar-ization, Polarization and Polyhedral frames of reference*, 2008; *Topology of Valuing: dynamics of collective engagement with polyhedral value configurations*, 2008).

Such investigations suggest the possibility of eliciting the non-binary characteristics of dialogue from patterns of dialogue -- as exemplified by the archetypal "round table", and the inspiration that continues to offer, as separately discussed (*Enabling a 12-fold Pattern of Systemic Dialogue for Governance*, 2012). The argument was developed there through the following sections:

- [Thinking tools for dialogue](#)
- [Clues to patterns of dialogue from competing personality typing schemes](#)
- [Clues to patterns of dialogue from myth and metaphor](#)
- [Clues to patterns of dialogue from song](#)
- [Imagining a 12-fold dialogue process](#)
- [Possible procedures for a 12-fold dialogue process](#)

Of some relevance to this argument, internet fora may well explicitly clarify the nature of interventions considered unacceptable -- effectively requiring participants to agree to a code of conduct, namely a form of contract.

Multi-part singing: Of particular interest in terms of comprehending non-binary possibilities, and as a basis for engaging mathematical insight, are the [Clues to patterns of dialogue from song](#), most notably in the form of multi-part singing -- a well-recognized form of "dialogue" between distinct "voices". More generally it is of course the case that mathematics has been extensively engaged in articulating the theory of [musical harmony](#) -- itself an aesthetic exemplification of non-binary possibilities and their relationship to the binary world.

Of specific interest is the recognition of the many different [voice types](#) used by vocal pedagogists and variously clustered in [voice classification](#) systems. The challenge in dialogue and in psychosocial organization would seem to be admirably clarified by recognition of the different "voices" which seek expression -- as only too evident in political discourse.

It is from this perspective that the separate discussion (noted [above](#)) highlighted the widespread recognition of polyphony and multi-part singing as being indicative of widespread understanding, across cultures, of non-binary possibilities through which the relationship between contrasting "voices" could be explored. There is the particular possibility of the relevance of this understanding in cultures otherwise challenged by the dominant mindset (*Knowledge Gardening through Music: patterns of coherence for future African management as an alternative to Project Logic*, 2000).

Although interpreted otherwise -- from a semiotic perspective -- it is appropriate to note that "polyphony" was a main theme of the 2009 Conference of the [International Association for Dialogue Analysis](#). The 2010 Conference had as its theme [Political Dialogue Analysis](#). Very limited use is made of mathematical techniques -- despite the innovative mathematical approach to semiotics initiated by [Rene Thom](#) (Per Aage Brandt and Wolfgang Wildgen (Eds.), *Semiosis and Catastrophes: Rene Thom's semiotic heritage*, 2010).

Periodicity: Widespread understanding of music scales, tuning systems and [musical rounds](#) is consistent with recognition of periodicity as providing a richer context for binary preoccupations. This has been partially illustrated by the fictional exploration of relationships in terms of a chemical metaphor by [Johann Wolfgang von Goethe](#) (*Elective Affinities*, 1809). The novel is based on the metaphor of human passions being governed or regulated by the laws of chemical affinity, and examines whether or not the science and laws of chemistry undermine or uphold the institution of marriage, as well as other human social relations. The novel pre-dates the development in 1869 of the [periodic table of chemical elements](#) credited to [Dmitri Mendeleev](#), which illustrated the periodic trends in the properties of the then-known elements. That has in turn been used as a metaphor for an ordering of his interpersonal relationships by the chemist [Primo Levi](#) (*The Periodic Table*, 1975). The relevance of the chemical metaphor has notably been explored by [Johan Galtung](#) (*Chemical Structure and Social Structure: an essay on structuralism*, 1977).

The struggle to detect order in an elusive pattern is well-highlighted by the history of that periodic table and its [representational imagery](#) ([J. W. von Sponson](#), *The Periodic System of Chemical Elements: a history of the first hundred years*, 1969). With respect to the latter, this struggle continues regarding understanding and representation of that pattern of qualitative properties in the light of more sophisticated understandings of relationships from mathematics ([Denis H. Rouvray](#), et al, *The Periodic Table: Into the 21st Century*,

2005; *The Mathematics of the Periodic Table*, 2005). The synthesis represented by that table continues to be upheld as one of the most fundamental achievements of science.

In a separate discussion of the binary challenge of social relationships (*Us and Them: Relating to Challenging Others: patterns in the shadow dance between "good" and "evil"*, 2009), reference was made to the possibility of a *Periodic table of relationships between "us" and "them"* (2009). This might be understood as consistent with efforts to classify "plots" characteristic of the dynamics of human relations (Georges Polti, *The Thirty-Six Dramatic Situations*, 1916). The historical (and continuing) debates regarding the numbers of chemical elements in groups, or their attribution to such groups, provides an admirable indication of the nature of such a process of distinction in pursuit of some form of closure. Ironically the challenge is one shared by both the "two cultures".

Following this possibility, in a related exploration (*Periodic Pattern of Human Knowing: implication of the Periodic Table as metaphor of elementary order*, 2009), the cognitive challenge of comprehending distinctions in a complex pattern was addressed in the light of the structure of the Periodic Table.

Enabling a review of the applicability of branches of mathematics

The argument here is that the immense riches of the many forms of mathematics have been elaborated as a means of exploring relationships of some kind. This creativity has been a response to a sense of possibility, typically explored for its own sake. The issue is whether these riches can be "mined" for insights of relevance to other domains. Where the feasibility is questionable, there is then a case for articulating this unambiguously -- potentially as a challenge to others who may in future contest that assessment and may see opportunities which have been ignored.

A key to enabling such a review would be a presentation of the whole domain of mathematics. This poses an interesting challenge in its own right. Ironically mathematics as a subject is "ordered" using one of the simplest "mathematical" techniques, namely the nested hierarchy -- as in the *Mathematics Subject Classification* (MSC). Curiously there is seemingly no effort to explore the possibility that other modes of order, characteristic of other branches of mathematics, might offer richer insights into the order implied by a domain with an inherently rich pattern of connectivity. It might be said that mathematics is not applied to ordering the "House of Mathematics". It is curiously unself-reflexive with the exception of the focus on [metamathematics](#).

An interesting example of higher than habitual forms of order is offered by the periodic table of chemical elements, necessarily of more complex order than a nested checklist of such elements. Alternatives to its "tabular" form have long been explored, as noted above, together with the possibility of a higher ordering to the relationship between the chemical elements in the light of more recent mathematical advances.

Whether as a checklist, or represented through various alternative orders (reducible to a checklist as required), the argument is for an indication in each case of the relevance, or not, of the branch of mathematics to psychosocial relational issues, notably of significance to governance at every level. Of particular interest is that any "periodic" classification of mathematics would make apparent that its branches imply, metaphorically, disparate insights into relationships -- potentially valuable to wider society (*Towards a Periodic Table of Ways of Knowing -- in the light of metaphors of mathematics*, 2009; *Tuning a Periodic Table of Religions, Epistemologies and Spirituality: including the sciences and other belief systems*, 2007).

It is of course the case that mathematics has a long tradition of resistance to any preoccupation with relevance or applications to the psychosocial world in which its activities are embedded and in which most people dwell. The question is whether in the present circumstances such a posture is justified -- especially when mathematicians are to a large extent funded by sectors of society exacerbating the current crisis of crises.

Simulation of non-binary psychosocial configurations

As indicated above, very extensive resources are now being allocated to psychosocial simulation, variously associated with environmental and security considerations, and enhanced by data mining ([FuturICT Living Earth Platform](#); [Synthetic Environment for Analysis and Simulations](#), [Sentient World Simulation](#)).

It is therefore extremely curious that there is no indication whatsoever that such simulations are being applied to the exploration of new psychosocial structures and configurations of potentially greater relevance to global governance and the challenges with which it is faced (*Superquestions for Supercomputers: Avoiding terra flops from misguided dependence on teraflops?* 2010). Simulations of this kind potentially offer a more fruitful context in which to reflect on the possibilities of collective intelligence and the emergence of coherent comprehension of situations (*Enabling Collective Intelligence in Response to Emergencies*, 2010; *Massive Elicitation of Psychosocial Energy: Requisite technology for collective enlightenment*, 2011).

Specifically a case could usefully be made for a context in which multiple "alternatives", variously inspired by more complex forms of mathematics, could be simulated. Examples of relevance might include:

- alternative voting systems and forms of representation
- more complex coalitions, as suggested by the rich range of polyhedra
- local currency systems (*Simulation Possibilities for Complementary Currencies*, 2005)
- alternative modalities for (intentional) community organization
- alternative structures for formal declarations (*Structure of Declarations: challenging traditional patterns*, 1993)
- operation of a "global brain" (*Simulating a Global Brain: using networks of international organizations, world problems, strategies, and values*, 2000)

However, of greater relevance than such a checklist, is what kinds of simulations could usefully be envisaged to trigger imaginative

responses to crises and the repeated request for "new thinking".

Significant applications: anti-social behaviour and inter-faith dialogue

In the light of the above argument it is useful to speculate on the possible relevance of mathematics in these two extreme cases.

Regulation of anti-social behaviour: Instances and forms of "anti-social" behaviour are of increasing concern as disruptive of law and "order". This framing implies a binary understanding of the situation and the possibilities of response.

It might first be asked what forms of mathematics are applied to the detection of "disorder". Clearly increasingly sophistication is being brought to bear on data extracted by mining internet and telephone communications, and of banking transactions. It is reasonably clear that this has been far from adequate to the challenge of corruption as it is regularly revealed. It might of course be suspected that those perpetrating any fraud would employ more sophisticated mathematics to design it. [Carousel fraud](#) offers an interesting example. The argument here might be reversed to ask what branches of mathematics might prove to be valuable to perpetrate "higher orders" of fraud or tax evasion? How could mathematics be used to recognize them and render them comprehensible? Can higher orders of fraud and exploitation be defined mathematically?

Evasion of legislative provisions is frequently phrased in terms of detecting "loop holes" -- evoking the need to "block" them. It is interesting that this terminology resembles so closely the "feedback loops" which are so vital to viable governance and the effort to contain systemic negligence. Ironically, this topological framing suggests that the art of anti-social behaviour lies in finding a way through the "hole" defined by the feedback loop. This possibility suggests a particular need for mathematics and a challenge to reframe the "maths race" between those defining the checks and balances provided by feedback loops and those seeking to exploit them. This is partially evident in a degree of complicity between computer hackers and cyberspace security forces.

Presented in this way the question becomes **can the "order" framed by legislative provisions be articulated in a subtler manner appropriate to the dynamics of society?** Within such a reframed "order", how is "anti-social" to be understood when the associated behaviour may well be sensitive to failures of "order" characterized by repressive measures? There is however also the sense in which the social order is exploited by those claiming innocence in ways for which provisions are not made. A simple, but striking, example is offered by passengers with children on airlines (*Guidelines in Response to Degrees of Anti-social Behaviour*, 2011).

Arguably it is the binary framing of "anti" which is at the root of the inability to address complex patterns of behaviour. Within that framing the only response is to require that the behaviour cease -- and imposing penalties or sanctions for failure to do so, as is currently evident on a larger scale in the case of Iran. The remedy is framed as being "positive" in contrast to the "negative" framing of the failure to do so. Again well-recognized examples are offered by substance abuse, whether alcohol ("binge drinking") or drugs. The response offers no provision for any alternative behaviour of equivalent complexity in which people could otherwise engage. In effect people are being called upon to restrict themselves to simplistic patterns of order without opening the opportunities of a spectrum of more complex forms of order. Arguably this has in effect been achieved through the entertainment offered by extremely violent online gaming in which large-scale massacre can be indulged on a daily basis by millions -- a facility dependent on a degree of mathematical sophistication.

The deficiencies of the simplistic binary approach are evident in a range of petty offences, most notably relating to traffic. As an alternative possibility the logic of the financial market could be used to reframe the provisions of the penalty code. Rather than the provision of fixed penalties, these could be defined dynamically by the incidence of such offences in a given period (even in a given locality). The greater the number, the higher the penalty -- as with the manner in which the share prices are fixed on the stock market. Moves in this direction are evident in the use of [penalty points](#) for traffic offences, with some making provision for "double demerit points" in peak accident periods and/or according to the speeding excess. Others weight the penalty for offences according to the income of the offender and/or the repetition of the offence. There are clearly many more possibilities in a world in which the "public debt" has been vulnerable to the sale of "derivatives" and other highly complex financial packages.

However, beyond particular instances, the argument here is for the exploration of more responsive measures. **The challenge is to provide mathematical descriptions of current procedures as an indication of their relative simplicity compared to other approaches for which mathematical models could well exist.**

Inter-faith dialogue: It is extraordinary that, after centuries, the different religions seem to be no closer to a viable mode of dialogue. Ironically their dynamics might well be recognized as one of the more extreme forms of "anti-social behaviour". Given their involvement in faith-based governments -- increasingly to be recognized as theocracies -- their differences are arguably the primary drivers of global conflict. The situation of Jerusalem is an only too evident example (*Reframing Relationships as a Mathematical Challenge: Jerusalem: a Parody of Current Inter-Faith Dialogue*, 1997). And yet it is the religions which have been at the origin of the development of mathematics, and religion has been a primary inspiration for the greatest of mathematicians.

Curiously however there is no detectable effort to apply mathematics to reframe the relations between religions. Mathematicians have however recognized their discipline to be the science of relationships. Mathematical theology is a well-recognized branch of theology, but again there would seem to be little effort to use that approach to explore the differences of perspective which are such powerful drivers of conflict. A remarkable exception to this is the work of Sarah Voss (*What Number is God? Metaphors, Metaphysics, Metamathematics, and the Nature of Things*, 1995), notably in a chapter on *God the Definitive Integral and Cantorian Religion* in which she describes a religion of pluralism:

Further, I have argued that the structure of this new global religion parallels the structure of [Cantorian set theory](#) and, therefore, lends itself to a metaphorical interpretation that is fundamentally mathematical.... One area left conspicuously undeveloped in this essay is the whole realm of the ethical implications of religious pluralism.... Another area of concern that requires further thought lies in resolving differences that appear (sometimes even in murderous ways) between people from different religious

communities (different parts of the Cantorian cover set) who believe, quite passionately, that theirs is the one true religion. My personal opinion is that resolution of this problem lies in adoption of a Canprian view: however, I recognize that even in so saying I am contributing to the dilemma of those who *believe their way is the way*. Clearly this problem needs to be addressed at some point. (p. 145)

"Inter-faith dialogue" can then be understood as symptomatic of a more general challenge. More generally this can be framed to encompass the contrasting "beliefs" which inform ideologies of different secular persuasions -- each potentially with their own "deities", "dogma" and ritual methodology. It is in this sense that there is scope for the development of a more general form of "mathematical theology", as separately discussed in terms of a self-reflexive global reframing of the implications of faith-based governance (*Mathematical Theology: Future Science of Confidence in Belief*, 2011).

A relatively simple symbolic challenge for the religions engaged in inter-faith dialogue is the use of mathematics to identify a mutually acceptable "order of service" in which readings from their respective scriptures, or chants from their respective repertoires, could be shared. In musical terms this is the challenge of how different "voices" can be fruitfully interwoven to enhance the quality of the whole.

More intriguing, in the light of the astrophysical detection of an [Interplanetary Transport Network](#), is the possibility of detecting mathematically a pattern of transition between different faith perspectives, as separately discussed (*From an "Interplanetary Transport Network" to an "Inter-other Transition Network"?* 2012). To the extent that all the academic disciplines can be understood as "beliefs" or "faiths", the argument applies equally to the currently unfruitful nature of interdisciplinary dialogue.


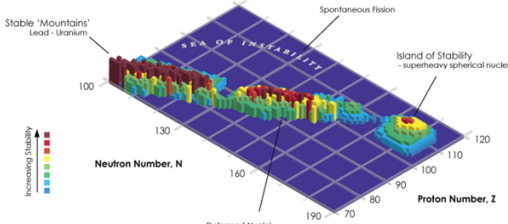
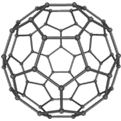
Presumably it is in the exploration of "mathematical theology" that a degree of "uncommon ground" can be found between the subtle explorations of both religion and mathematical logic of "non-duality" and "alternative logics" -- variously capable of enabling comprehensible engagement with ever more integrative patterns.

Conclusion

The argument was introduced by reference to the Malvinas / Falklands dispute which the future may well perceive as corresponding to a conceptual framework only too readily comprehensible in a kindergarten. Where are the 30 possibilities for a non-binary resolution? Where are the 50 possibilities for a resolution to the pathetic situation of Jerusalem -- epitomized by the pattern of behaviour within the Holy Sepulchre? Where are the simulations to explore and render comprehensible their relative merits? Would each of these call for comprehension through quite distinct relational metaphors which mathematics could offer? Could Malvinas / Falklands be inspired by an "open marriage" -- or a more complex pattern?

How complex might need to be a solution to such territorial disputes in order to take into account all of the factors? Would such complexity be inherently incomprehensible, or are there solutions which, despite their complexity, have degrees of symmetry enabling their comprehension -- as with the ["islands of stability"](#) in the creation of new chemical elements (*A factory for elements that barely exist*, *New Scientist*, 21 April 2012)? Perhaps more striking is the example offered by the [fullerenes](#), as with the discovery of a new form of carbon, a molecule in the form of a hollow sphere. The structure of spherical fullerenes (also called buckyballs), has been recognized to resemble the balls used worldwide in [association football](#), as separately discussed (*Understanding Sustainable Dialogue: the secret within Bucky's Ball*, 1996). This resemblance is perhaps the greatest irony of the times in relation to any discussion of comprehension of "complexity".

These associations offer curious echoes to the elaboration of a "game of spheres" by [Nicholas de Cusa](#) (*De Ludo Globi*, 1463), written as a contribution to both a literature and a practice of moral game-playing. This formed part of the tradition of the forgotten chess-like game [Rithmomachia](#) ("The Battle of Numbers"), which combined the pleasures of gaming with mathematical study and moral education. Intellectuals of the medieval and Renaissance periods who played this game were not only seeking to master the principles of [Boethian mathematics](#) but were striving to improve their own understanding of the secrets of the cosmos (Ann E. Moyer, *In The Philosophers' Game*, 2001). This was undoubtedly an inspiration to the magnum opus of Nobel Laureate [Hermann Hesse](#) (*The Glass Bead Game*, 1943), as noted by Todd R. Harris (*The Interplay of Opposites, the Language of Experience, and the Geometry of Ascent: a comparison of Hermann Hesse's "Das Glasperlenspiel" and Nicholas of Cusa's "De Ludo Globi"*, 2001).

Standard football	Possible islands of stability amongst transuranium elements (reproduced from <i>Wikipedia</i>)	Simplest fullerene (C60)
		

Can it be claimed that the derivatives at the centre of the financial crisis were packaged in a way to render their toxic nature comprehensible -- or was rendering them relatively incomprehensible a deliberate strategy to ensure competitive advantage?

The argument here is in favour of relating the spectrum of mathematical tools available to their possible applicability to various psychosocial situations. Of particular importance is an indication of whether the feasibility has been explored, with what success, and whether such relevance has been credibly demonstrated not to be feasible. The most difficult problems of mathematics have been framed as a challenge to mathematicians -- with [prizes](#) awarded for their solution. The question is whether some intractable psychosocial

problems could be defined mathematically as a focus for such rewards. Where is the prize for a mathematical solution to the situation of Jerusalem? If a "Belgian compromise" is valued in practice, and from a cybernetic perspective (as [noted above](#)), how much more valuable would be a "Jerusalem compromise"? Or is that to be understood in terms of an analogous degree of muddle -- about which neither mathematicians nor theologians have as yet anything creative to offer?

Has consideration of a non-binary solution been prevented and undermined by the same conceptual framework that has enabled expenditure of a trillion dollars in a fruitless decade-long territorial dispute -- only to be succeeded by a global financial crisis of unprecedented proportions? There is surely a case for envisaging other ways to apply some of the mathematical skills which enabled those events.

Despite the prevalence of faith-based governance, does the predilection for binary responses derive ironically from a form of cognitive panic in relation to the quality of "non-duality" which it is claimed is at the very core of Abrahamic faiths? How does this possibility relate to the current reframing of "nothing" by physicists? (*Epistemological Panic in the face of Nonduality: does nothing matter?* 2010).

The avoidance of non-dualistic perspectives is evident in a striking range of psychosocial processes, to the point that the requirement for binary thinking is assumed to be self-evident: right/wrong, guilt/innocence, winning/losing, believer/unbeliever, good guy/bad guy, wealth/poverty, agreement/disagreement, and the like. Their dynamics are the focus of entertainment and sport of every kind. The point might be provocatively made in pointing to the absence of experimentation with respect to football -- perhaps with four teams and four goals, the second set playing orthogonally to the first, with various rules for their relationship. Can a dramatic plot be rendered "interesting" without a binary outcome?

Is this the challenge of "peace" and "equality"? Are none of these static -- as can be asked of *Freedom, Democracy, Justice: Isolated Nouns or Interwoven Verbs?* (2011). Are they conditions more complex than we would like to think? Does mathematics suggests creative ways of using "disagreement" (*Using Disagreements for Superordinate Frame Configuration*, 1992; *Coherent Patterns of Schism Formation, Bifurcation and Disagreement -- and the associated bonding, encounters and agreements they evoke* , 2001)?

Is it possible to be more conceptually irresponsible than by framing the current financial crisis as a form of "natural disaster" -- an "Act of God" beyond human control -- excluding all implication of those who sustained the framework from which it was engendered? Is that pattern in process of being repeated -- unchallenged?

What mathematical tools would highlight and reframe the conceptual gerrymandering by which psychosocial systems are currently defined? What factors undermine a healthy approach to systemic crisis (cf *Map of Systemic Interdependencies None Dares Name: 12-fold challenge of global life and death*, 2011).

Given the widespread criticism of the economic model which engendered the ongoing global financial crisis, there is similarly a case for applying some of the mathematical skills which enabled it in order to clarify the viability of alternative models. It is of course the case that efforts to do so are themselves considered questionable. The argument here might be caricatured as: *if you cannot do better than "casino capitalism" then at least apply that mathematical sophistication to other domains which call for it.* (cf *Susan Strange, Casino Capitalism*, 1997).

In what must now be considered an "early" paper, [Ubiratan D'Ambrosio](#) dealt specifically with the global responsibility of mathematicians and mathematics educators. For him, the guiding question was then: *How do we, as mathematicians and mathematics educators, fulfill our commitments to mankind?* (*Mathematics and Peace: Our Responsibilities*, ZDM, 1993)

In a rare preoccupation by a mathematician with the social responsibility of mathematics, [Paul Ernest](#) concludes:

I have argued that in the social construction of mathematics we act as gods in bringing the world of mathematics into existence. Thus mathematics can be understood to be about power, compulsion and regulation. The mathematician is omnipotent in the virtual reality of mathematics, although subject to the laws of the discipline; and mathematics regulates the social world we live in, too... But in accepting this awesome power it also behooves us to strive for wisdom and to accept the responsibility that accompanies it. (*Values and the Social Responsibility of Mathematics, Philosophy of Mathematics Education Journal*, 2007)

At that time, an editor of the *Notices of the AMS*, [Susan Landau](#) argued:

We can't pretend on the one hand to be protected from the mundane day-to-day, and on the other, argue that mathematics is fundamental and deserves wide support. Without doubt, these broadening efforts distract from the business of proving theorems; there are only twenty-four hours in a day. But as mathematicians, as scientists, we have an obligation to give back. Society has given us a marvelous freedom to pursue flights of fancy and call it work. Mathematicians are in a unique position of being able to understand and critique many complex social problems and solutions... We have a responsibility to do so. (*Mathematicians and Social Responsibility*, 1997)

There is a curious sense in which "we" are trapped in a cognitive prison cell with a large locked box of tools -- and a hammer on top. As companion in the cell one has a curious individual, a genius, possibly to be well-characterized as somewhere on the autism/asperger spectrum -- the Mathematician. As in the caricatured preoccupation with the *One Ring* by the *Gollum* in *Lord of the Rings*, this person has a key to the box and guards it jealously, as separately explored (*Relevance of Mythopoetic Insights to Global Challenges*, 2009). The question for others is whether to focus on the use of the "hammer" to which they have ready access -- with every strategic possibility then framed as a "nail" to which it might be applicable. Or is there some means of engaging with the Mathematician to ensure the box of precious tools is opened -- so as to consider the potential value of each to the challenge of getting out of the cognitive prison?

An interesting twist to this caricatural framing is that the Gollum of the tale has a very special "telepathic" relationship to the all-powerful, secretive, malignant [Sauron](#) -- to whom he is beholden and by whom he is frequently controlled. Gollum of course denies that. In the real world it is of course the financial, defence and security communities which have found the most effective ways to engage with the Mathematician -- to the cost of society as a whole, as has proven to be only too evident. Like Gollum, the Mathematician would deny that.

Is it time to bypass proven theocratic deficiencies by crowdsourcing via a web-based process -- an [International Institute of Advanced Studies in Mathematical Theology](#) (2011)?

- papers: Richer polarization / sin / liminality / partial comprehension / inexplicable / self-reflexive
- switch metaphor A to B
- zoomable -- Google Mathematics

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