Fuzzy Logic at Service for a Better World: The Social Dimensions of Fuzzy Sets

VLADIMIR DIMITROV
Centre for Systemic Development
University of Western Sydney-Hawkesbury
Bourke St., Richmond 2753
AUSTRALIA
E-mail: V.Dimitrov@uws.edu.au
Home page: http://www.hawkesbury.uws.edu.au/~dimitrov/

Abstract: Fuzzy set theory, as introduced by Zadeh, has its roots in the social nature of human understanding. Our abilities to understand *up to a degree* have been developed through our *being-in-common*, that is, through an inevitable process of fuzzification of meaning, so that to make it understandable, acceptable and operational for a multitude of people with different mental, emotional and spiritual world views. Although most of the fuzzy sets based work that has received praise and rewards has been in the field of engineering, fuzzy sets have a strong presence in social science and humanist research. (1) In group decision-making, fuzzy sets approach offers viable options for avoiding indecisiveness and confrontation, and this is of enormous significance for the social practice of negotiating and dealing with conflicts. (2) As far as each agent (human being or intelligent robot) acting in chaotic field of socio-economic complexity has limited data about other's behaviour, it is the mechanism of fuzziness that moves the whole system of interconnected agents from an initially chaotic field of operation towards a dynamically stable regime of order. (3) Virtual meaning generated by fuzzy concepts acts as a powerful catalysis of human creativity by activating, propelling and helping 'materialize' people's endeavor and search for understanding of their world. (4) Fuzzy sets approach directly relates to practical applications of such vital for organizational and social survival and evolution concepts as 'level of coherence in organization', 'creative misunderstanding', and 'integrity'.

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1 Introduction

Fuzzy set theory, as introduced by Zadeh [1], has its roots in the social nature of human understanding. Our abilities to understand *up to a degree* have been developed through our *being-in-common*, that is, through an inevitable process of fuzzification of meaning, so that to make it understandable, acceptable and operational for a multitude of people with different mental, emotional and spiritual world views.

According to fuzzy set theory, meaning of words can't be precisely defined - each linguistic construct in use can be described by a set of 'degrees of freedom', i.e. ways of understanding (interpretation, transformation into actions) by individuals or groups. The larger the power of this set and more diverse its elements, the richer in

meaning is the linguistic construct related to it. Thus, *the fuzziness of a linguistic construct, far from being meaningless, represents a significant source of meaning*.

As far as the processes of creating, interpreting and understanding meanings are crucial when dealing with social complexity, fuzzy sets have a stable presence in this field research.

2 Group Decision Emergence

In group decision-making, fuzzy sets approach offers viable options for avoiding indecisiveness and confrontation. The Arrow Impossibility Theorem shows that there is no reasonable deterministic algorithm that can integrate choices made by individuals into an aggregate choice satisfactory for the entire group. *The presence of fuzziness in individual preferences immediately 'softens' the conditions of choice, thus making possible the emergence of a socially satisfactory aggregation* [2,3]. The implications of this result are indispensable for the social practice of negotiating and dealing with conflicts.

It is a challenge for those who facilitate negotiation to gently 'nudge' the group towards such context C of the discourse around the issue of consideration that maximizes possibility for emergence of decision(s) satisfactory for all participating agents. *The harder the negotiation, the fuzzier could be the context C, and the art of facilitation consists in keeping the degree of fuzziness of C at levels that not only ensure its meaningfulness for the agents but also incites and stimulates them to joint action*. Such fuzzy context can be characterized as dynamically stable; the stability emerges as a result of agents' interaction.

3 Order Out of Chaos

As far as each agent (human being or intelligent robot) operating in chaotic field of socio-economic and ecological complexity has limited data about other's behaviour, each agent acts dynamically by changing not only its own model of the other agent, but also the decision rules which govern its own behaviour. To keep the ability for prognosticating behaviour of the other agent as high as possible, given the law level of reliability of the available data, each agent builds (and deals with) a less complex model of the other's action. These less complex models are essentially fuzzy - they inevitably focus at the prognosis of less detail, and because of this they appear to be quite stable: less sensitive to the behaviour of the others, and therefore less often changed. As a result, *the mechanism of fuzziness moves the whole system of interacting agents from an initially chaotic field of operation towards a dynamically stable regime of order*.

4 Edge of Chaos

According to complexity science, complex adaptive systems are constantly driven towards the edge between order and chaos where all the really interesting 'living' behaviour occurs in complex systems. Translated into language of organizational dynamics, the above proposition states that the most adaptable, the most 'alive' complex organizations operate (most of the time) at the edge of chaos, where some fuzzy ratio, a kind of internal compromise, manifests between the degrees of organization's malleability and stability. This fuzzy ratio ensures that *the organization is flexible enough to respond even to slightest changes occurring both inside and outside it, and at the same time stable enough to keep its integrity not to dissolve in chaos*. The higher the level of coherence (synchronization, resonance) between organization's agents, the easier is for the organization as a whole to balance at the edge of chaos.

5 Level of Coherence in Organization

Fuzzy set approach directly relates to the operational definition of *level of coherence* - a degree to which agents perceive their togetherness, interdependence and friendship within the organization. When the level of coherence in organization is low, its power differential (degrees of power concentration) immediately increases, and the organization can be easily transformed into dictatorial one - it loses its flexibility and capacity for adaptation and self-organization. The development of a dictatorial organization is imposed 'from above', and as a result of this the delicate compromise between organization's malleability and stability can not emerge - there is simply no enough 'space' for such an emergence. As a rule, the words used in commands lack fuzziness - every individual is forced to comprehend them in one and the same way.

6 Virtual Meaning

Fuzzy concepts are usually impregnated with *virtual meaning* that provides space for extension, elaboration and negotiation of the core meaning carried by each of the words used to construct the concept. Virtual meaning acts as a catalysis of human creativity by activating, propelling and helping 'materialize' people's endeavor and search for understanding of their world [4]. For example, the concept describing the endeavor of an organization to heighten the level of its coherence provides enough 'space' to include both the promotion of shared values in organization and minimization of possibility for rising feelings of threat among people. This concept opens space also for creating events of shared group experience and thus enhancing the interdependence and need of one another. Once the mutual need is there, a magnetic force naturally emerges that attracts people to one another; this force can grow in intensity, providing people with a kind of *collective identity* - another fuzzy concept saturated with virtual meaning for the research in social systems.

7 Creative Misunderstanding

A phenomenon called *creative misunderstanding* [5] manifests when communicating fuzzy concepts in society. If A conveys some fuzzy concept to B and B misunderstands it, that is, interprets it not in the way as A expects this does not destroy the communication process. On the contrary, the way of interpretation provided by B extends the virtual meaning of the concept, hence stimulates creativity of A. Instead of being only a source and a receiver of meanings conveyed by fuzzy concepts, A and B become *co-creators* of meanings. The ability for meaning co-creation is of great importance not only for the flow of every day social interactions but also for the survival and evolution of society as a whole.

8 Fuzzy Granules and Fractals

In social studies there has been always a kind of tension between the *unifying* and *differentiating ways of thinking*. Unifying thinking tends to generalize and homogenize while neglecting diversity of the phenomena and processes under study; differentiating thinking tends to go into details while neglecting the ways they interconnect and unite. Fuzzy logic helps to transcend this duality as naturally as does the logic of life: the procession of life is always from the known to the unknown. Differentiating thinking is used to go deeper into the known phenomena so that to characterize them as precise as possible. Unifying thinking is used to approach processes in their integrity, keeping in mind that the knowledge available about the wholeness is inevitably fuzzy. However fuzzy the knowledge of the

wholeness, it always conveys meaning to those who are able to zoom into the *fuzzy granules* of its description, releasing their intellectual, emotional or spiritual contents. "Microcosm reflects Macrocosm" - repeat the philosophers since time unmemorable. The theory of fractals developed by Mandelbrot allows us to see this reflection: "parts have the same form or structure as the whole, except that they are at different scales and may be slightly deformed" [6].

Through his curvy fractals Benoit Mandelbrot reveals astonishing creativity of nature when 'computing' with forms and structures. Through his fuzzy granules Lotfi Zadeh reveals astonishing creativity of brain when 'computing' with words and concepts [7]. Fractals and granules enrich the ability of social researchers to go deeper into the enigmas and paradoxes of social complexity. At the source of these enigmas and paradoxes is the bottomless complexity of human individuality. Society is only an abstract word. What really exist are the individuals with their physical, emotional, mental and spiritual fractality, granularity and above all, *integrity*. With each other and with the universe.

9 Towards Integrity

It is difficult for mind to grasp the concept of integrity. To classify and separate is much easier: this is A and that is not A. And there is no bridge between them. A mind that is filled with the notions of "I" and "my" is almost deprived of ability to 'compute' with words like *integrity*, *unity* and *wholeness*. These words are equally meaningless for a mind that thrives mostly on control, power, prestige, possession, and search for selfish pleasures. Unfortunately, the mental space of to-day's humanity is filled with such type of minds. We are forced to live in an exhaustive competition that inevitably strengthens the selfishness of our thinking. We are forced to live in a continuous comparison that tends to emphasize much stronger what separates rather that what unite us, hence making difficult to see how A can be linked with not A. Being permanently engaged in building plans for future or worrying about what we haven't realized in past, we are missing the experience of the present. And it is only in the experience of present when words like *inseparability*, *togetherness*, *compassion*, *love* can unfold their meanings.

Fuzzy Logic helps both human and machine intelligence to link A with not A. All the powerful apparatus of fuzzy mathematics has been created to explore how this link manifests and works in natural systems, and how to make it work efficiently in artificial systems. Once we know how to link polarities like "yes" and "no", "chaos" and "order", "simplicity" and "complexity", "words" and "numbers", "subjective" and "objective", "attachment" and "detachment", "inner" and "outer", we are on the way to find out how to transcend much more complex dualities of life, such like "mine" and "yours", "ours" and "theirs", "we" and "they". It is a hard task - unique for every one. Still there is no fuzzy methodology explaining how to do it. Yet we must create it, if we want the life on Earth to continue.

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