

Towards an Exploration of Several Dimensions in Learning: Application on Crisis Management

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Abstract: A crisis is a complex situation, which actors have some difficulties to manage it. They are under stress to deal with problems that they cannot predict consequences. The human conditions (familial and life) and, the influence of the environment (politic, economic, media) pushes the actors to lose control of the crisis situation. The question we face in this paper is: “is it possible to predict stress impact situations based on experience feedback?” “Is it possible to use this type of prediction for learning?” Our main hypothesis to represent experience feedback in a situation prediction in order to show negative consequences and correctness actions is taken account. Fuzzy theory concept is used in prediction in order to generate several situations and allow learners to explore different options.

1 INTRODUCTION

During crisis management actors are submitted to different types of pressures driven by some factors (politics; time; media; environment; etc.). Those can lead to potentially dangerous or catastrophic results. Among these factors are the stress and its different impacts on the managers and actors. The purpose of this paper is to predict a stress impact situation by using fuzzy sets and knowledge management. This can help crisis management actors to learn by exploring different situations due to stress impacts. So, the main questions can be: Is it possible to predict the impact of the stress in this type of situation by using the fuzzy logic? How can prediction help in learning? In this paper, some answers to these questions are explored, especially, the representation of experience feedback with stress impact in crisis management. Firstly, a presentation of the concept of the rhizome and the learning in the organization are shown. The description of the crisis management as a cooperative situation and the impact of the stress during the crisis that can generate some uncertainty situations is studied. Then, the use of the fuzzy logic in the representation of the stress impact during a crisis situation is discussed and a representation of the structure of the fuzzy generator called “NOE” is proposed. The fuzzy set generator can predict different situations of crisis by using a kind of elements that we defined.

This study is illustrated in a real case of a terrorist attack crisis management in Algeria during a civil war.

2 CONSIDERING UNCERTAINTY IN LEARNING

Cyert and March define learning as the adaptation of the organization to its environment (Cyert and March 1963). Whereas, it is a process for creating knowledge by transforming a feedback experience (Kolb 1984). The knowledge is acquired by the combination of the transformation of the feedback experience and the prehension. The human behavior, its language, comprehension, reasoning are more complex and multiple. It is like a rhizome. This has various shapes, from the beginning of its ramifications to the bulbs and tubers. The philosophic concept of the rhizome (Deleuze and Guattari 1988) is used in learning to use virtual environments, for instance to manage crisis situations (Laurent et al. 2016). This concept is used in our approach. Uncertainty is a situation of inadequate information. It can be of three sorts: inexactness, unreliability, and borders with ignorance (Funtowicz and Ravetz 1990). It can prevail in situations where a lot of information is available (Van Asselt and Rotmans 2002). A new information or knowledge can decrease or increase

the uncertainty. Uncertainty is related to factors or determinants that may influence actions or responses. The difficulty to manage the uncertainty had brought Zadeh to use the fuzzy logic (Lotfi Asker Zadeh 1983). This reinforces our choice for the fuzzy theory. In addition, some researchers suggest that uncertainty may be an important mediator of the impact of role stressors on the stress (T. Beehr 2000; T. A. Beehr and Bhagat 1985; O'Driscoll and Beehr 1994). In the daily life and, for any problem or situation, experience feedback is used. Yet, knowledge management approaches define some techniques to promote learning from experience feedback. By including experience feedback on technical and organizational means, actors can learn how to face stress in crisis management. Then, an actor or a group of actors can adjust its approaches; policies; procedures; methods; models and its organization, guided by previous experiences, to try to obtain as possible as a nominal situation.

3 CRISIS MANAGEMENT AND THE STRESS

3.1 The Crisis Management

The crisis is an unstable and dangerous situation affecting individual, group, community and the whole society. It generated a collective stress (Rosenthal, Charles, and Hart 1989). It is an exceptional situation. One of the definitions of crisis is: "a serious threat to the basic structures the fundamental values and, norms which under time pressure and, highly uncertain circumstances necessitates making a critical decision" (Rosenthal, Charles, and Hart 1989). A crisis requests an organization to manage it and, to make pertinent decisions with the aim to request from this situation or to reduce its effect in a short time with minimal damage. The crisis situation can be represented as relations between event and states respecting this dynamicity (Sediri et al. 2013). Each state can be defined as a couple "event/consequences" (Sediri et al. 2013). A state can generate events and events can modify states and so on.

3.1.1 Crisis Management as Collaborative Activity

As indicated previously, during a crisis management actors come from different organizations. They work, communicate, cooperate, coordinate and,

exchange their own experiences. Their main common objective is how to deal with the crisis for reducing its effect? In this relationship, is noted that multiple actors are interdependent in their work. They interact each other to improve the state of their common field. In CSCW (Computer-Supported Cooperative Work), this activity is defined as: "distributed in the sense that decision-making agents are semi-autonomous in their work in terms of contingencies, criteria, methods, specialties, perspectives, heuristics, interests, motives and so forth" (Schmidt 1994). This distributed activity can be represented as Triple C (Communication, Coordination, Cooperation). Several papers in the literature mention the role of Triple C in crisis management, and their interdependence (Martin, Nolte, and Vitolo 2016). The interdependence of the 3C is affected by the regulation. Indeed, the regulation adjusting consists of sending or to receiving information, giving a warning (Communication); using means (Coordination); and to use the procedure, decision and organization (Cooperation). Experience feedback can be so represented considering these three dimensions.

3.2 The Stress in Crisis Management

3.2.1 Stress

As is noted above, the stress is an important factor in the success or the failure of the decision-making in a situation of crisis management. It is a particular relation between an actor and his specific environment. Its evaluation can be weak or exceed the actor resources and can be endangered his well-being (Richard S Lazarus and Folkman 1984). It was noticed that "Some policymakers reveal resourcefulness in crisis situations seldom seen in their day-to-day activities; others appear erratic, devoid of sound judgment, and disconnected" (Hermann 1979). Several approaches for the stress have been proposed, based on response (Selye 1974); stimulus (Hobfoll 1989); the interactionism (Jones, Bright, and Clow 2001); and the transactional approaches (Cox, Griffiths, and Rial-González 2000). In the case of this study, the transactional approach is chosen. It is related to cognitive and emotional processes, which gives interaction between a person and his environment (Boswell, Olson-Buchanan, and LePine 2004). This indicates that the individual and the demand are two components. Those define themselves in a continuous process with a retroactive loop. More concretely, the stress result from the imbalance

observed during the cognitive evaluation between the demand and, the capacity to deal with. Indeed, an actor possesses personal characteristics that differentiate him from others. He is under the influence of environmental variables. There are different studies that propose training and mental preparation methods to help actors to face the stress in crisis management (Ducrocq et al. 2000; Pauchant, Mitroff, and Lagadec 1991). This paper focus on the impact of stress on decision-making in order to promote learning from fails and guides based on experience feedback.

3.2.2 The Impact of the Stress on Decision-making in a Crisis Management

Boswel et al present four classes of indicators that influence stress conditions (Boswell, Olson-Buchanan, and LePine 2004). (1) Task conditions: workload, etc; (2) relational conditions: conflict, harassment, etc; (3) job conditions: Mobility, no promotion, etc; (4) interaction private/profession: husband, children, family, etc. Different observable indicators of the stress are considered in psychology as manifestations of stress. Some of these are mainly noted: Speech rhythm (Kanfer 1959; Siegman and Pope 2016), repetition of expressions and words (Kasl and Mahl 1965; Osgood and Walker 1959), using specific words (Kasl and Mahl 1965; Lalljee and Cook 1973; Siegman and Pope 2016) etc; super activity, inadequate movement (Dittmann 1962; Mehrabian and Ksionzky 1972) etc; silence (Aronson and Weintraub 1972; Weintraub and Aronson 1967); ambivalence, self-confidence (Aronson and Weintraub 1972; Eichler 1965; Osgood and Walker 1959); hostility and aggression (Gottschalk et al. 1966; Murray 1954); inappropriate behavior and actions (Mehrabian 1968b, 1968a). Other studies have shown some manifestations of stress impact on decision-making as: Situation and context simplification (Lazarus et al, 1966; Holsti et al, 1964); fixation on one possibility without any flexibility and alternatives (Berkowitz 1962; Holsti, Brody, and North 1964; De Rivera 1968; Rosenblatt 1964); consulting several opinions without concluding on a decision (Holsti 1972; Cooper et al, 1988); imposing a decision without measuring the impact and the consequences (Holsti 1972; Korchin 1964); missing decision-making and actions (Holsti 1972; Schlenker and Miller 1977). In this work, some of these indicators that can be measured directly from crisis management actions feedback are selected: super activity and imposing decision

without considering the impact; silence, missing decision and actions; speech rhythm, aggression, and conflict of opinions and decisions; simplification of the situation and inadequate means and actions. The stress during a situation of crisis management generates some uncertainty situations as we noted above. Fuzzy logic can be used in order to simulate this type of uncertainty.

4 “NOE” GENERATOR OF STRESS IMPACT

4.1 The Fuzzy Sets

It is a mathematical theory of Lotfi Zadeh (Lotfi A Zadeh 1996) based on intuitive reasoning. This theory considers the subjectivity and the imprecision. It may treat digital literacy; non-measurable values and for a linguistic issue (Bouchon-Meunier, Yager, and Zadeh 1995). Fuzzy sets provide techniques to represent subjective and uncertain reasoning. Its goal is to build a formal system that it can make a qualitative reasoning (Rosental 2004). The fuzzy sets are used in different domains like pattern recognition, robotics, biology, economy, medicine, ecology, etc. (Zimmermann 2010).

4.2 Representing Stress Impacts with Fuzzy Sets

The advantage of the fuzzy theory is to use the linguistic value and to give for this value a mathematical sense. The main characteristic of this theory is the quantification of the uncertainty. As we know, the human reasoning in different areas is based on uncertainty. One of our principal preoccupations is how to interpret the impact of the stress in crisis situations using the human behavior and reasoning. Our proposition is so to use the natural expression or words with fuzzy theory and especially the fuzzy sets. Our model representation is based on event/state representation. We know that state can generate events and events can modify states and so on. And also action or data and actors compose that event. On the other hand, the state is composed of actors; place; means; and data.

4.3 “NOE” Architecture

Considering all these components, and the fuzzy logic theory we imagined a fuzzy generator called “Noé” who can generate state by introducing event.

In the beginning we feed all the components mentioned above in a knowledge-base. The information contained in the event is introduced in the generator. By using the fuzzy theory and the knowledge-base, “Noé” generates the out-put state.

4.3.1 Components of the Model

As previously announced, the crisis situation can be represented by several states evolving through time and space. A state can generate events and events can modify states and so on. For the next phase of this study, we are going to give more precision about some components that will enable us to use this theory.

We define for the first time a number of the sets:

- A is a universe of three actions: $A = \{a_1, a_2, a_3\}$ (1)

Where a_1 =Communication, a_2 =Coordination and a_3 =cooperation.

- B is a universe of n actors: $B = \{b_1, b_2, \dots, b_n\}$ (2)

- C is a universe r places: $C = \{c_1, c_2, \dots, c_r\}$ (3)

- D is a universe of j data: D includes different kinds of information as weather (w); crisis-place (cp); victims (v); population (p); morphology-of-land (m); assailant (as); infrastructure (in); and crisis-situation (cs). Then the function D is represented as the intersection of r-tuples noted.

$$D(w_j, v_j, cp_j, v_j, p_j, m_j, as_j, in_j, cs_j) \quad (4)$$

- E is the universes of z places: $E = \{e_1, e_2, \dots, e_z\}$ (5)

- F is the universe of q means: $F = \{f_1, f_2, \dots, f_q\}$ (6)

- T the set of I time: $T = \{t_1, t_2, \dots, t_i\}$ (7)

- The linguistic modifier is a set of atomic terms defined and in relation to the feedback experience of the expert.

$$G = \{equal, increase, decrease, probably\} \quad (8)$$

- The State is defined as a function composed by actors (b), place (c), means (f) and data (d).

$$state = \{(b, c_1, f_1, d_1), (b, c_2, f_2, d_2), \dots, (b, c_r, f_r, d_r)\} \quad (9)$$

- The function event is composed by the couple action (1) or data (4), and by actors (2).

$$event = \{(a \text{ ou } d_1, b_1), (a \text{ ou } d_2, b_2), \dots, (a \text{ ou } d_j, b_n)\} \quad (10)$$

For all $a \in \{a_1, a_2, a_3\}$. State and event attributes are detailed in the following.

The objective is to define the impact-stress function O composed by the functions state (9), events (10), and the sets of the time (7) and the linguistic modifier (8).

$$Decision = O = \{G_i(event_i, state_{i-1}, t_i); i = 1, n\} \quad (11)$$

By using the impact-stress function O we can generate several situations during a crisis situation.

4.4 Using “NOE” for Generating Situation

To verify our generator, we called a crisis management expert. The expert is the one who has a good mastery of his activity and is considered a reference by his colleagues (Bogner and Menz 2009). Several primitives can be used (entity relations, ontologies, etc.) to model results of interviews. We choose entity-relations to illustrate the situations through events-states in order to illustrate the dynamicity of this type of situation. This interview allows us to verify our generator NOE by using the triple C actions cited above. An example for each C action is cited below in this paper.

4.4.1 For the Communication Action

Communi- cation	Silence	Speak quickly
The Chief	Weather: probably Victims: increase Means: equal Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably	Weather: change Victims: increase Means: equal Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably
The subordinate	Weather: probably Victims: increase Means: equal Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably	Weather: probably Victims: increase Means: equal Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably
The population	Weather: probably Victims: increase Assailant: probably Situation of crisis: probably Infrastructure: probably	Weather: probably Victims: increase Assailant: probably Situation of crisis: probably Infrastructure: probably

4.4.2 For the Coordination Action

Coordination	Inappropriate	Aggression
The Chief	Weather: probably Victims: increase Means: decrease Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably Place of crisis: probably	Weather: probably Victims: increase Means: decrease Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably Place of crisis: probably
The subordinate	Weather: probably Victims: increase Means: decrease Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably Place of crisis: probably	Weather: probably Victims: increase Means: decrease Population: probably Assailant: probably Situation of crisis: probably Infrastructure: probably Place of crisis: probably
The population	Weather: probably Victims: increase Assailant: increase Situation of crisis: probably Infrastructure: probably	Weather: probably Victims: increase Assailant: increase Situation of crisis: probably Infrastructure: probably

4.4.3 For the Cooperation Action

The cooperation action affects only the subordinate actors and the population.

Cooperation	Simplification of the situation	Imposing a decision
The subordinate		
The population	Weather: probably Victims: increase Assailant: increase Situation of crisis: probably Infrastructure: probably	Weather: probably Victims: increase Assailant: increase Situation of crisis: probably Infrastructure: probably

5 CASE APPLICATION

5.1 Case Observed and Studied with the Stress

A real case study in a situation of crisis management. The author's observation can reveal some aspects of the impact of the stress during this event. It also provides, a timeline for actors reaction with a general view on errors committed, means used, the places where the event was reported and, different information and data known. For this, a retired officer of the Algerian Army has been interviewed (as an expert) about one of crisis situations he dealt with.

5.1.1 Case Description

A lieutenant of Algerian Army explains, in this case, his experience about a terrorist attack on two villages "Ramkaa and Had El Chekala", in the Algerian mountain. In fact, the army had to deal with a group of terrorists in the area. The tactical command post was installed near the mountain, in order to prepare their track. In the morning (6h AM) of a day in February, some soldiers had been awake by a young man running to the camp and crying: "They killed them, they killed them." Soldiers tried to calm the young man and conducted him to the nursery. The crowd woke colonel and lieutenant. The young man explained then that the terrorists were killed all people in his village. Colonel asked the lieutenant to prepare three cars, and they directly went to villages with only simple guns. They drove on a winding road. Terrorist cloud is everywhere and could be attacking them. Arriving at the village, they discover horrible landscape, "everywhere dead bodies, disembowelled women, blood, etc." They were shocked and did not believe their eyes. One of the Chief starts to talk nonsense words. Soldiers removed his weapon, they were afraid about his safety. The Colonel decided then to visit the nearby village with the lieutenant and some soldiers. They discovered the same horrible situations, adding that, the school was burned with the nursery and the post-office. The colonel sat on the ground without moving. Soldiers and Lieutenant did not have any idea on how to react and what to do. Their radio did not work. There was no network. They stayed in this state more than one hour and a half. Then, other soldiers arrived at the base of ambulances and radio-communication post. Because they guess that their colleagues needed help after two hours of silence. After that, the colonel recovered his senses and

called the government crisis cells. He called the tactical command post to send him fire fighters and medical emergency resources. It was about 10h AM. Crisis Cells were installed at Ramkaa village. Dead Bodies were gathered. They discovered some survivals. They received first aid on site. Helicopters arrived and first evacuations started at 1 PM.

5.1.2 Case Analysis

The case analysis shows us some impact of the stress: (I) Imposing a decision without measuring the impact and the consequences: The colonel took three vehicles with simple guns and went to the village. He decided then to visit the nearby village with the lieutenant and some soldiers; (II) Repetition of expressions and words: One of the Chiefs started spelling nonsense words; (III) Silence, missing decision and actions: The colonel sat on the ground without moving. Soldiers and Lieutenant did not have any idea on how to react and what to do. (IV) Simplification of the situation and inadequate means

and actions: With simple guns, they went to villages. Their radio did not work. There was no network. The impact of this stress during this situation is: time-lost; wounded died (waiting from 6h AM to 1h PM); the first soldiers can be attacked and killed by terrorists on the road and in the villages; no communications between operational and tactical teams. This analysis, show us, how the stress can cause considerable damage during a crisis situation.

5.2 Using NOE to Generate Situations from the Case Studied

We use the generator NOE for the same situation example, we noted that for the same state and for the same action, cooperation, the fuzzy generator can generate a variety of situations (Figure 1). Otherwise, for the same state we can use other actions and with the fuzzy generator, we can generate a considerable number of state.

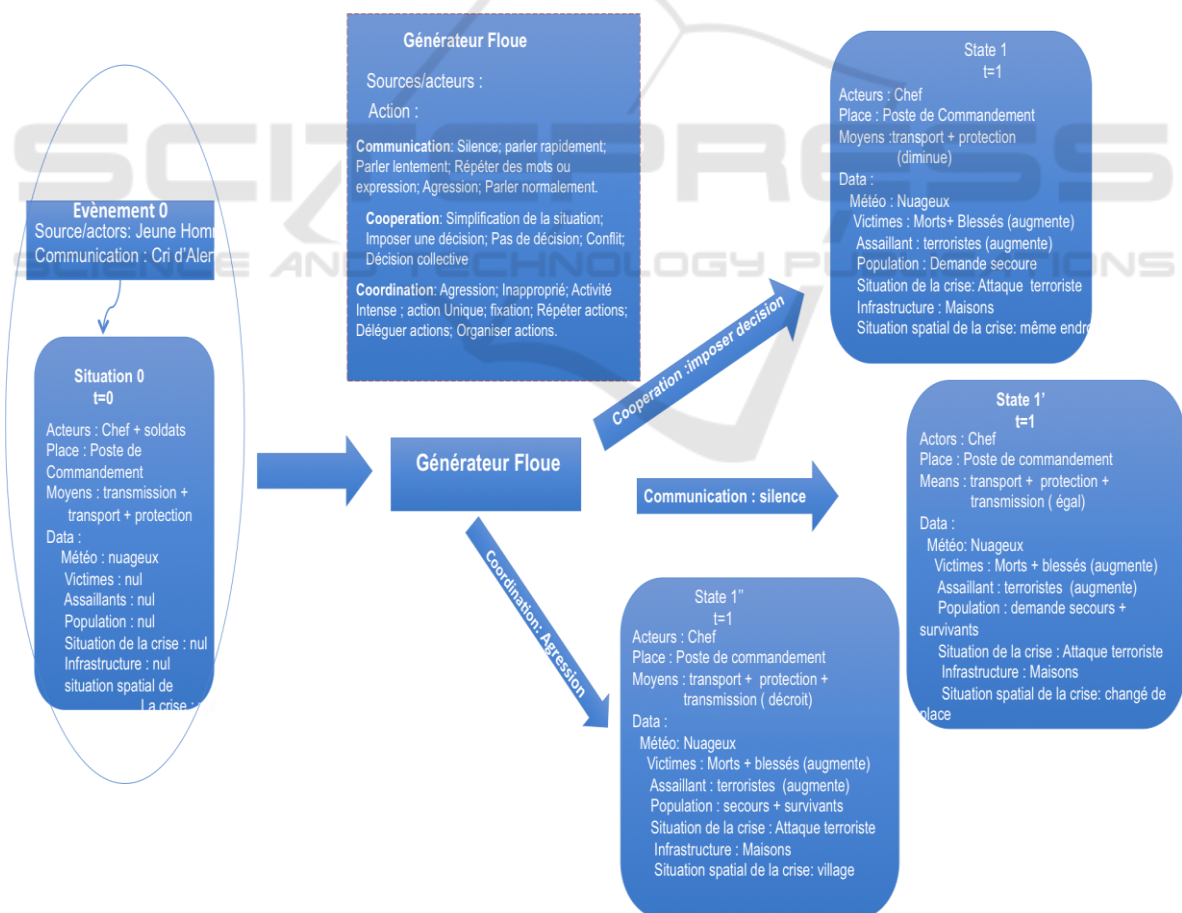


Figure 1: The NOE generation

6 CONCLUSIONS

The present study is to determine the stress impact including the experience feedback in the situation of the crisis management. It suggests a Stress Impact predicts situations, which generate a number of very useful states for crisis management training actors. Based on that, we answer the main question about the possibility to represent stress impact in crisis management and by using experience feedback in order to show consequences of stress behavior. Experience feedback is also used in our system to show actions to avoid stress consequences.. Actions are defined under three dimensions: cooperation, coordination, and communication-related to the representation of collaborative crisis management activity. This representation is illustrated in a real case study in order to verify its applicability. The situations predict system is based on the Fuzzy set theory that helps to deal with uncertainty and dynamicity of situations. So, for the same state and for the same action, the predict-system can generate a variety of situations. We discover that we can generate lived situation and non-lived situation. The natural progression of this study is to develop the algorithm of the stress impact prediction in order to test in other crisis cases. This type of environment can illustrate the rhizome principle and be used for learning when integrated in simulation. This can help the crisis manager to explore different situations of the crisis and discover stress consequences to deal with.

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