Temporal Dynamics Modelling for Aggression Level of Victims in Disaster Evacuation Center

A.Hanis[1,2], A. A. Aziz[1,3], J. A. Bakar[5] , A. Alwi[5] and N. C. Pa[1,3]
[1]School of Computing, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[2]Internetwork Research Lab, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[3]Human-Centered Computing Research Lab, SOC, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[4]Computational Intelligent Group, SOC, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[5]M3dia Research Lab, School of Multimedia Technology and Communication,
Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
slumberjer@gmail.com

Abstract—**Natural disaster such as flood, earthquake, and typhoon poses a serious threat for humanity. However, post disaster is the hardest part to deal with. Assisting survivors who are looking for help always poses big challenges for volunteers to handle, especially when the number of victims is high. In this stage, emotional state of the victims is often unstable; and therefore, controlling them becomes a difficult task. This paper explained the idea of modelling individuals' aggression levels in evacuation centers for floods (or any other natural disasters) victims. It described the development of a formal model that can be used as a base for building an intelligent agent or other types of software that can be helpful in training volunteers to handle victim's aggressive. This will enhance the effectiveness of the volunteer work, thus improving the environment in the evacuation centers.**

Index Terms—**Aggression Model; Disaster; Flood Victims; Temporal Dynamic Mode.**

I. INTRODUCTION

Disasters such as tsunami, flood, and earthquake are some of the most common natural phenomenon that contribute to high level of mental health consequences, such as post-traumatic stress disorder and a variety of other disorders and symptoms in victims. These disasters also threaten lives, causing a lot of stress, fear, and anxiety [1]. These conditions especially in natural disasters can influence how victims feel about their self-daily activities and well-being [2]. With respect to global natural disaster occurring all over the world, Malaysia is one of the countries that is affected continuously by flooding [3]. During such events, victims are usually placed at evacuation centers that serve as a temporary shelter for them. In such extreme conditions, victims are prone to psychological instability, which result in some of them to behave aggressively. The aggression is highly undesirable in such situations since it can severely disrupt the work of volunteers and prevent them from helping the flood victims successfully. Therefore, the nature of aggression of flood victims in evacuation centers must be studied from the psychological perspective in order to provide an intelligent support that can be programmed by a computer system.

A significant amount of research has been conducted in the area of developing formal models in psychological domain, but little attention has been given to model-ling the aggression of victims after being placed in evacuation centers [1-3]. In attempt to fill this gap, a formal model that can serve as a basis for building an intelligent aid has been developed.

II. RELATED CONCEPT

Human aggression is a type of action aimed at another person and performed with a direct intention to harm the target. Moreover, the aggressor must realize that this action will harm the target, while the target of aggression must try to prevent this behavior. Thus, harm caused by an accident cannot be considered as an aggression because it is not intended. Harm that is caused as a result of positive actions is also not considered to be aggression because the person that causes the harm believes that the target does not intend to avoid the action (e.g., pain caused as a result of medical operation).

Generally, two types of aggression are identified: hostile aggression and instrumental aggression. Hostile aggression is an aggression that happens as a result of un-planned and thoughtless impulse driven by anger. Its goal is to harm the target as a response to some kind of irritant. It is also known as an impulsive or reactive aggression.

On the other hand, instrumental aggression is a planned action that is done with an intention other than harming the target and is considered to be proactive and not reactive [4].

Other researches [5] clarify the definitions of these types of aggression by distinguishing between proximate and ultimate goal. In this case, it is possible that aggression has mixed motives, and therefore, cannot be identified discretely as instrumental or affective.

A. Theory of Aggression

Researches identify five main theories of aggression [5]. These theories overlap noticeably since they have many common features, which instigate some researches to attempt to unite them in one unified theory.

One of the notable anger researchers, Berkowitz [4] proposed a Cognitive Neoassociation Theory (CNT) that describes the unpleasant irritants that include frustrations, provocations, loud noises, uncomfortable temperatures and unpleasant odors (all of them can be found in evacuation centers). These irritants have a negative effect on human psycho-logical conditions. Therefore, experiencing such irritants will lead to instant stimulation of different thoughts, memories and psychological reactions connected to fight-or-flight response. Such response will lead to arousal of (fight)

instinctive feeling of anger in individuals and (flight) to instinctive feeling of fear.

In CNT, aggressive thoughts, emotions, and behavioral affinities are connected together in long-term memory [6]. Figure 1 shows a schematic diagram of an associative memory structure, in which the concept of "gun" is linked to a number of aggression concepts [7]. Concepts with related connotations (like harm and hurt) and concepts that are often triggered at the same time (like shoot and kill) tend to build strong associations. Figure 1 depicts the associations as lines between the concepts, where the thicker lines are used to illustrate stronger associations and the shorter distances illustrate more similar meanings. Every time one of the concepts is activated, it starts to propagate to the related concepts, thus increasing their activation.
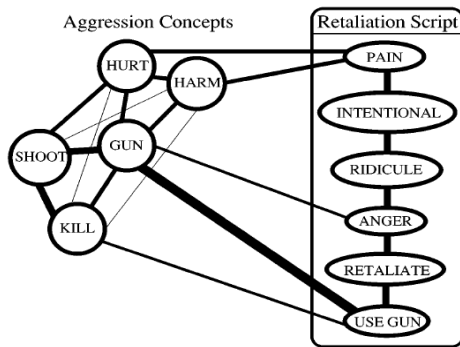

Figure 1: Simplified associative network

Furthermore, CNT takes into consideration higher-order cognitive processes, including attributions and appraisals. In case of having a motivation, individuals tend to think how they feel, make causal attributions for what led them to experiencing these emotions, and take into account potential consequences of acting on the emotions. Such intentional contemplation produces distinctly discriminated feelings of anger and/or fear. Moreover, it can suppress or enhance the action predispositions associated with the feelings.

CNT not only considers the previously proposed frustration aggression hypothesis [8], but it also provides a causal mechanism for explaining why unpleasant irritants increase aggressive tendencies, i.e., via negative affect [4].

Anderson and Bushman [7] made an attempt to improve CNT by uniting it with other theories. As a result they came up with General Aggression Model (GAM). GAM identifies

two types of inputs to aggression, namely the personal factors and the situational factors. These factors influence the final outcome behavior through the present internal state that they create. Such present internal state is identified as routes for the inputs and consist of cognition, affect and arousal. When going through such routes, inputs generate outcome, which is basically aggressive actions or thoughtful behavior. These actions have the ability to act thoughtfully instead of impulsively as depicted in Figure 2.
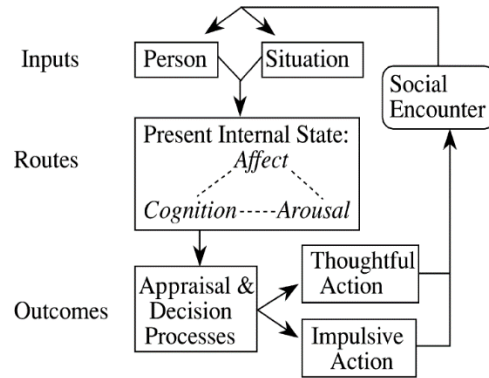

Figure 2. General Aggression Model

III. COMPUTATIONAL MODELLING

Lately, computational models are often used as tools for understanding human cognitive functions and behaviors [9]. The models have been used to investigate the fundamental nature of various cognitive functionalities and psychology through the ongoing detailed comprehension by assigning identical computational models of representations and mechanisms. In this paper, two steps have been taken to model the aggression level of flood victims in evacuation centre. The steps are the identification of properties and the formalization of properties.

A. Identification of Properties

In the first step, GAM has been used as the theoretical base for building the model presented in this paper. In total there are 16 relevant factors that eventually affect the increase or decrease of aggressiveness were identified. A summary of the factors and their formal representation are given in Table 1 below.

Table 1
Nomenclature of Properties

No	Local Dynamic Properties	Nomenclature	Description
1.	Stressful event	*Sv*	Refers to intensity of impact of a disaster on an individual.
2.	Social support	*Sp*	Refers to psychological support and comforting of an individual by volunteers.
3.	Uncomfortable physical environment	*Pe*	Physical environment in evacuation center that is not comfortable, e.g. high room temperature,
4.	Negative personality	*Np*	Individual is naturally predisposed to aggression.
5.	Observing penalty	*Op*	Individual observes that aggressive behavior is penalized.
6.	Aggressive cues	*Ac*	Any type of objects or events that can trigger aggressive thoughts and behavior.
7.	Awareness	*Aw*	Individual becomes aware that aggressive behavior is penalized.
8.	Discomfort	*Ds*	General feeling of discomfort.
9.	Susceptibility	*Sc*	Predisposition towards aggression.
10.	Hardiness	*Hd*	Ability of an individual to deal with aggressive thoughts and intentions.
11.	Frustration	*Fs (short-term)* *Fl (long-term)*	Inability to obtain certain goal will increase aggressiveness.
12.	Irritation	*Ir*	Irritation by internal and external factors
13.	Resilience	*Rs*	Ability to handle aggressive thoughts and intentions.
14.	Stress	*Ss*	Stress caused by external and internal factors.
15.	Anger	*Ag*	Anger is emotional response, close to aggression.
16.	Aggressiveness	*As*	Aggressive behavior.

B. Formalization of Properties

This section concentrates on the details of formalizing the properties and the relations between them to develop the computational mode. In the formalization, the factors or properties discussed in Table 1 are converted into several interconnected nodes. Figure 3 shows how these nodes interact with each other.
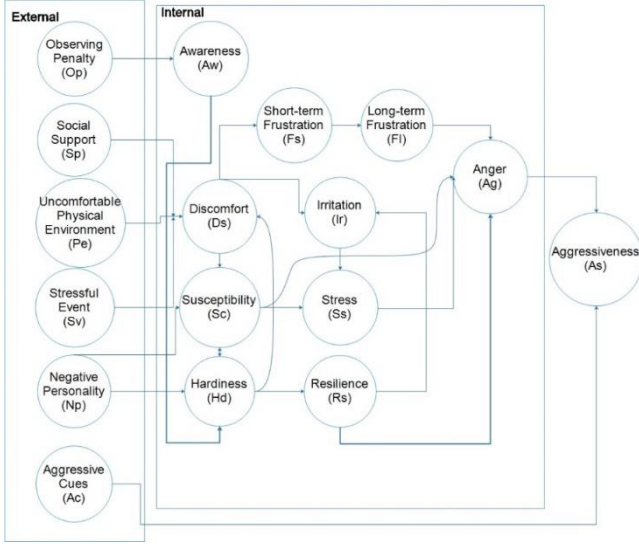

Figure 3: Formal Model of Aggressiveness

Each node in the figure represents a variable value of which ranges from 0(low) to 1(high). There are three types of nodes or properties in the model: external, instantaneous and temporal. External properties have the values that are predetermined, and these values change during the simulation. The external properties include the situational and personal factors derived from GAM [5] and the behavior modification techniques suggested in (Smith, 2012) (Snyder, 1995).

By changing the values of the external properties, it is possible to create different scenarios and see how aggressiveness and other relevant factors change over time in given conditions. The developed model has five external properties: Sv, Sp, Pe, Np, Op and Ac.

The changes in the other two types of properties have their values determined by the interaction between the nodes that can be either instantaneous for instantaneous proper-ties or happen through a series of accumulation for temporal properties. In the proposed model, there are nine instantaneous properties: Aw, Ds, Sc, Hd, Fs, Ir, Ss, Ag, and three temporal: Fl, Rs, As.

In order to formalize the identified properties and to build the model, a number of mathematical equations that demonstrate the relations between the properties were derived. A mathematical equation that explains the different types of relations based on the underlying theory of aggression is explained below..

a. Instantaneous Relations

The following are the equations for the instantaneous relations:

$$Aw(t) = \beta.Op(t) \qquad (1)$$

In the proposed model, awareness refers to the awareness of a victim being punished for inappropriate behavior.

Hence, awareness value rises when a victim observes other victim being penalized for aggressive behavior. This can happen if a volunteer responsible for handling victims in an evacuation center chooses to enforce strict discipline on victims.

$$Ds(t) = [\ \alpha.Sv(t) + (1-\alpha).Pe(t)].(1-Sp(t)).(1-Hd(t)) \qquad (2)$$

Discomfort refers to physical and emotional feeling of discomfort. High discomfort will contribute to victim's irritability and frustration and as a result will increase the chances of victims acting aggressively. There are four properties in the proposed model that contribute to discomfort, namely the social support, uncomfortable physical environment, stressful event and hardiness. Hardiness and social support will decrease discomfort, whereas stressful event and uncomfortable physical environment will increase it.

$$Sc(t) = [\gamma.Ds(t)+(1-\gamma).Np(t)].(1-Hd(t)) \qquad (3)$$

Susceptibility is predisposition of a victim towards aggressive behavior. An individual with high susceptibility will tend to get angry and become aggressive more easily; hence, he/she will have a lower tolerance to stress. Susceptibility is affected by the following properties: hardiness, negative personality and discomfort. Hardiness will decrease susceptibility, whereas negative personality and discomfort will increase it.

$$Hd(t) = [\zeta.Aw(t)+(1-\zeta).(1-Np(t))].(1-Sc(t)) \qquad (4)$$

Hardiness is an ability of individual to deal with aggressive thoughts and intentions. Hardiness will contribute to victims' resilience and help them to manage their aggression. Hardiness is affected by the following properties: negative personality, susceptibility and awareness. Negative personality and susceptibility will decrease hardiness' value, while awareness will increase it.

$$Ir(t) = Ds(t).(1-Rs(t)) \qquad (5)$$

Irritation is a feeling that directly contributes to frustration and stress and caused by high level of discomfort. Irritated individuals will tend to behave more aggressively if provoked. In the model irritation is influenced by the following properties: discomfort and resilience. Discomfort will increase its value and resilience will decrease it.

$$Fs(t) = \theta Fs.Ds(t) + (1-\theta Fs).Ir(t) \qquad (6)$$

Frustration is an emotional response of an individual to inability of achieving a certain goal, or in other words, perceived opposition of fulfillment of individual desire. Frustration leads propensity towards aggression. In the model, frustration is influenced by two properties: discomfort and irritation. Both of them increase the frustration value.

$$Ss(t) = \eta.Ir(t)+(1-\eta).Sc(t) \qquad (7)$$

Stress is a biological response of a human body to perceived challenges. Stress factor is necessary to consider

in the model since stressed individuals are less likely to possess full control of their emotions; hence, they are more prone to become angry and aggressive. The properties that have impact on stress in the model are irritation and susceptibility. High values of both properties increase stress level.

$$Ag(t) = [\omega a1.Fl(t) + \omega a2.Sc(t) + \omega a3.Ss(t)].(1-Rs(t)) \quad (8)$$

where $\Sigma i=3\omega a\iota = 1$.

Anger is a human emotion that is most closely connected with aggression. Anger could be defined as a reaction of anxiety and antagonism which arises because of threats and injustices. In other words, anger is experienced in the state of frustration, attribution to blame and a failure of control or power over events. Anger has positive correlation with the following properties: frustration, susceptibility and stress, and negative correlation with resilience.

b. Temporal Relation

In addition to instantaneous relations, we have the temporal relations that can be described by the following mathematical formulas (note that variable Δt is used to identify time step):

$$Fl(t+\Delta t) = Fl(t) + \theta Fl.[Fs(t) - Fl(t)].(1- Fl(t)).Fl(t).\Delta t \quad (9)$$

In the proposed model, two types of frustration were introduced: short-term, mentioned above, and long-term. The long-term frustration is a temporal property, and it increases or decreases over time depending on its previous value and the value of short-term frustration.

$$Rs(t+\Delta t) = Rs(t) + \psi.[Hd(t) - Rs(t)].(1- Rs(t)).Rs(t).\Delta t \quad (10)$$

The concept of resilience was introduced to the model in order to explain a process of resisting negative emotions, such as anger and irritation, in given conditions. Resilience is directly affected by hardiness property.

$$As(t+\Delta t) = As(t) + \varepsilon.[Ag(t) - As(t)].(1-Ac(t)).(1- As(t)).As(t).\Delta t \quad (11)$$

Aggressiveness is a final output of our model. All of the local dynamic properties that were defined have influence on the level of aggressiveness as it is a final outcome. However, only two of them have direct effect to its value: aggressive cues and anger. Both properties have positive correlation with aggressiveness.

The parameters α, β, γ, ζ, θFs, θFl, η, $\omega a1$, $\omega a2$, ωa, ψ and ε are used for balancing the equations; thus, their default values for simulations are 0.5, except for $\omega a1$, $\omega a2$, ωa that are used to balance three properties. Hence, considering the sum of their values is equal to 1, each individual value for them is 1/3 or 0.3(3).

IV. CONCLUSION

Modelling human behavior is a difficult task as there are various variables that need to be considered. In this paper, we had described a mathematical modelling of temporal dynamic model for aggression level for flood victims. Several related theories related to human aggression model have been elaborated. Prominent theories, such as CNT proposed by Berkowitz and enhanced CNT by Anderson and Bushman have been used as the foundation of the model. The modeling of the temporal dynamic began with an identification of the properties that affect aggressiveness. 16 properties had been identified for the temporal model. After that, the formalization of the identified properties has been conveyed. A formal model has been presented as a result from formalization process. Instantaneous and temporal relations also have been deduced from the formal model.

REFERENCES

[1] Nasir R., Zainah A., and Khairudin R., "Psychological Effects on Victims of the Johor Flood 2006/2007," Asian Social Science, vol. 8, (2012) 126.
[2] Johari J. and Marzuki N. A., "Relating Stress, Anxiety and Depression among Flood Victims' Quality of Life in Malaysia: A Theoretical Perspective," Depression, vol. 8, p. 9.
[3] Bushman B. J. and Anderson C. A., "Is it time to pull the plug on hostile versus instrumental aggression dichotomy?," Psychological review, vol. 108, (2001) 273.
[4] Berkowitz L., "Pain and aggression: Some findings and implications," Motivation and Emotion, vol. 17, (1993) 277-293.
[5] Anderson C. A. and Bushman B. J., "Human aggression," Psychology, vol. 53, (2002) 27.
[6] Collins A. M. and Loftus E. F., "A spreading-activation theory of semantic processing," Psychological review, vol. 82, (1975) 407.
[7] Anderson C. A., Benjamin A. J., and Bartholow B. D., "Does the gun pull the trigger? Automatic priming effects of weapon pictures and weapon names," Psychological Science, vol. 9, (1998) 308-314.
[8] Miller N. E., "I. The frustration-aggression hypothesis," Psychological Review, vol. 48, (1941) 337.
[9] Bosse T., Hoogendoorn M., Klein M., Van Lambalgen R., Van Maanen P.-P, and Treur J., "Incorporating human aspects in ambient intelligence and smart environments," Handbook of Research on Ambient Intelligence and S,mart Environments: Trends and Perspectives, IGI Global (in press, 2010), 2011.
[10] Smith S. W., Taylor G. G., Barnes T., and Daunic A. P., "Cognitive-behavioral interventions to prevent aggression of students with emotional and behavioral disorders," Advances in Learning and Behavioral Disabilities, vol. 25, (2012) 47-70.
[11] Snyder J. J. and Patterson G. R., "Individual differences in social aggression: A test of a reinforcement model of socialization in the natural environment," Behavior Therapy, vol. 26, (1995) 371-391.