ATTITUDINAL MODELING OF

AFFECT, BEHAVIOR AND COGNITION

Semantic Mining of Disaster Text Corpus

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This document presents an investigation into the attitudes of disaster experience from text corpora of narratives and reports. Attitude is made up of three components: Affect, Behavior, and Cognition (ABC). The narratives comprised personal stories obtained from Internet blogs, and the reports were research and media articles about people?s experiences derived from digital libraries. This study identifies the semantics of disaster experience for development of hybrid ontologies that may be used to model attitudes in the face of disasters. Different disaster scenarios revealed different mapping relationships of ABC.

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Executive Summary

This report presents an investigation into the attitudes of disaster experience from text corpora of narratives and reports. *Attitude* is made up of three components: *Affect*, *Behavior*, and *Cognition* (ABC). The *narratives* comprised personal stories obtained from Internet blogs, and the *reports* were research and media articles about people's experiences derived from digital libraries. The objective of the study was to identify the semantics of disaster experience for development of hybrid ontologies that may be used to model attitudes in the face of disasters. The different disaster scenarios revealed different mapping relationships of ABC.

Three disaster classes were studied: *Natural Disasters* comprising of tsunami, earthquake, hurricane/typhoon and flood; *Human Induced Disasters* comprising of terrorism, fire, industrial and transport accidents; and *Pandemic Disasters* comprising of swine flu, SARS, HIV/AIDS and tuberculosis. These disasters were selected on the basis of their significance, in particular social, economic and physical. Most of these disasters have impacted people in Asia.

The analysis involved text mining using two tools: *Latent Semantic Analysis* and *Leximancer*. The Analysis of Variance was performed on the frequency of concepts mined to determine the capability of each tool in semantic processing. Leximancer proved to be usable and produced semantic maps that were required for developing ontologies. Two types of ontologies were derived: *Attitudinal ontology* and *Disaster Situational (organizational) ontology*.

The ontologies were expressed at two levels: *generic* and *specific*. A generic ontology describes the semantics of a combined disaster class (e.g., natural disaster), while a specific ontology describes the semantics of a disaster type (e.g., tsunami for natural disaster). The ontologies were integrated to create a hybrid ontology for attitudinal modeling of disaster management.

This study departs from previous work on attitudinal research as it commenced with identification of ABC concepts using text mining of disaster corpora to develop a semantic framework for a baseline attitudinal model. The goal was to frame the central concepts within an application domain, disaster risks. The study also departs from other disaster research as the measurement of people's attitude occurs after a hybrid ontology of attitude and disaster situations has been established. This helps in a better design of disaster management system as the ontologies may be used to integrate heterogenous information on disaster as well as reducing conflicts in semantic interoperability.

Conceptualization of the model was based on secondary data alone; therefore, the next step would be to gather primary human data to validate the forecasting capability of the model.

List of Abbreviations and Acronyms

ABC	Affect, Behavior, Cognition
AIDS	Acquired Immune Deficiency Syndrome
AOARD	Asian Office of Aerospace Research and Development
DAMAI	Damai Sciences Sdn Bhd
df	degrees of freedom
DM	Disaster Management
HID	Human Induced Disaster
HIV	Human Immunodeficiency Virus
LSA	Latent Semantic Analysis
LXM	Leximancer
ND	Natural Disaster
NTU	Nanyang Technological University
PD	Pandemic Disaster
PS	Personal Stories
RA	Research Articles
SARS	Severe Acute Respiratory Syndrome
SD	Standard Deviation
TB	Tuberculosis

Contents

1

Introduction

"*The modeling of cognition and action by individuals and groups is quite possibly the most difficult task humans have yet undertaken. Developments in this area are still in their infancy*."

National Research Council, 1998, p. 8.

Various models that have emerged in the literature are useful for *forecasting* a range of outcomes, rather than making precise *predictions* (Zacharias, MacMillan & Hemel, 2008). Most research on prediction is concerned with people's ability to anticipate the occurrence of future external events (e.g., "will the price of stock go up or down?") or their own behavior (e.g., "am I likely to get divorced in the next 10 years?"). To name, but a few: decision making under uncertainty (e.g., Kahneman & Tversky, 2000; Gilovich, Griffin, & Kahneman, 2002; Nisbett & Ross, 1980), the accuracy of people's predictions about their future behavior (e.g., Osberg & Shrauger, 1986; Wilson & LaFleur, 1995), and the effects of temporal perspective on prediction (e.g., Trope & Liberman, 2010). A crucial form of prediction, people's ability to forecast their own attitudes in relation to their feelings (affect), intent (behavior) and belief (cognition) about events that may induce hazard or risk such as disasters has not been entirely overlooked, but the investigations have been in piecemeal fashion. The reason being, research in this area is still challenged by rigorous methodologies and measures.

The aim of this project is to contribute to our understanding of attitudes, in the context of risk associated with disasters. The proposed model is intended to identify important concepts that make up attitude that may be useful for forecasting possible outcomes rather than making precise predictions. Figure 1.1 illustrates a useful way for conceptualizing the components of attitude: Affect, Behavior, and Cognition (ABC), following the tripartite attitudinal model of Breckler (1984).

In Figure 1.1, **Affect** refers to an emotional response, a gut reaction, or sympathetic nervous activity. It can be measured by monitoring physiological responses (e.g., heart rate, galvanic skin response) or by collecting verbal reports of feelings or mood. **Behavior** includes overt actions, behavioral intentions, and verbal statements regarding behavior. **Cognition** consists of beliefs, knowledge structures, perceptual responses, and thoughts (Breckler, 1984). People's stories of their real life experiences provide a reliable source for understanding the interactions of ABC, while written reports of verbal statements from survivors can enhance further analysis.

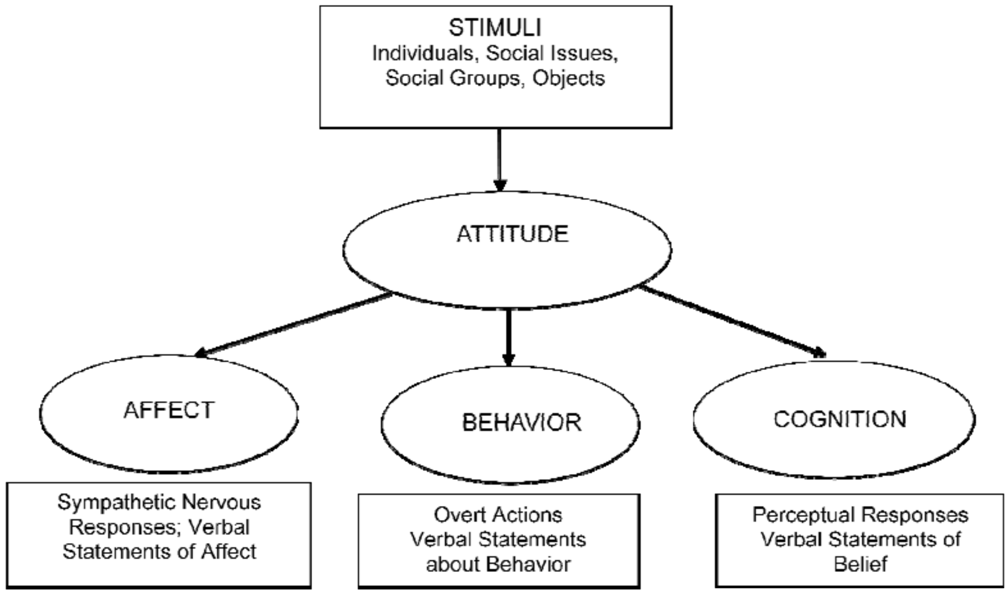

Figure 1.1 Tripartite model of attitude structure (Rosenberg & Hovland, 1960)

The relationship between the attitudinal components may be used to forecast people's behavior in disaster situations, gauged from the ***specific affect, behavior*** and ***cognition*** semantics derived from text mining. These semantics represent people's experiences in the face of disasters. Other components necessary for forecasting such as group values, situation awareness and risk assessment may not be revealed from the data. These aspects of the project may be investigated in future work.

PROJECT OVERVIEW

Figure 1.2 is an overview of the project involving two phases:

1. *Identifying the components of attitude*. This activity involved two studies: the first study was to identify a tool that has the ability to mine and visualize ABC concepts for the purpose of conceptualizing a semantic framework. The second study used the

tool to further analyze the data to develop generic and specific ontologies. Secondary data was used for this activity.

2. *Validation of attitudinal model for behavioral forecasting.* This activity has the purpose of validating the ABC concepts in the field with people who may not have experienced disaster in order to identify the role of culture in risk assessment. Other measures that are crucial for forecasting behavior such as group values and norms, ability to predict in situation awareness, and temporal perspective may also be studied.

Figure 1.2 Overview of project

The investigation in Phase 1 was a two-pronged approach. The literature on psychology and human factors were reviewed to identify concepts that relate to attitudinal components of ABC. In addition past disaster research was reviewed to provide a taxonomy of disasters for the study. A conceptual model was formulated following the tripartite model of Breckler (1984). To conceptualize the model, secondary data on three classes of disasters were gathered from digital libraries and Internet blogs. Text mining tools were used to mine semantics for development of ontologies. The derived ontologies will be used in Phase 2 to further validate the model in the context of socio-cultural of people who have not experienced disaster. This phase requires development of a tool that can measure specific ABC to enable forecasting. The database may be useful for disaster management.

Significance of the Research

Jung (1921) defined attitude as a "readiness of the psyche to act or react in a certain way" (Jung, 1971). There are two forms of attitude: rational attitude, which is subdivided into “thinking” and “feeling” psychological functions, each with its attitude. Irrational attitude subdivides into “sensing” and “intuition” psychological functions, each with its attitude. Thus, there are attitudes linked to thinking, feeling, sensation, and intuition (Jung, [1921] 1971: par. 691). Missing from Jung’s definition is the concept of behavior. Later psychologists defined attitude as comprising of three components: affect, behavior and cognition (Breckler, 1984; Solomon, 1996). Several models emerged to explain the connection between the ABC concepts. The ACT-R architecture (Anderson, 1983; 1996; Taatgen & Anderson, 2008) focuses on the relationship between the processes of cognition and behavior; the cognitive appraisal theory of emotion (Scherer, Shorr, & Johnstone, 2001) on the mapping of affect and cognition. To develop a comprehensive model of ABC requires measurement beyond subjective methods. Objective methods such as using fMRI technique confirm that affect is integrated with cognition in the output of behavior. The mapping of affect, behavior and cognition may be explored using semantic mining.

This study was an attempt to identify the semantics of attitudinal components through the use of text mining. It departs from previous text mining research (e.g., Landauer, Foltz, & Laham, 1998) as it used a relevant dataset (i.e. disaster articles) to research the problem, and with a considerable size of text corpus. The purpose is to mine ABC concepts from specific literature to enable the development of a baseline attitudinal ontology. For example, crisis workers assess crisis using types of reactions: affective (feeling), behavioral (doing), and cognitive (thinking). Assessment of the affective domain may predict the primary reaction, which could be anger, fear, or stress. Behavioral reactions include approach, avoidance, or immobility (fight, flight, or freeze). Cognitive reactions refer to the victim’s perception of the event. Individuals may perceive transgressions of their rights being violated, threats of potential for harm, or an experience of irretrievable loss. These perceptions may occur in any domain of life: physical, psychological, social, environmental, values and beliefs.

This study, therefore, departs from previous studies on attitude in that it first identified ABC concepts from people’s real life experiences to build a model that can be used in the future to measure attitudes that can be used to forecast behavior.

Scientific Innovations

From the foregoing, we note several scientific innovations in the current research:

1. The attitudinal model encompassed the components of Affect, behavior and Cognition (ABC). This is not new but the synergistic view of affect and cognition within the concept of *citarasa* is a recent interpretation of “emotional intent” that has yet to be integrated within the context of disaster experience (Khalid et al., 2010).
2. The development of attitudinal ontologies through text mining is novel.
3. The use of context-dependent word corpus for different disaster scenarios can be used to identify the semantic space. While the required number of corpus may be limited, the specimens and sources that contributed to the semantic space may be varied and many. This is a new development in semantic research.
4. ABC was conceptualized through two-tiered phases of activities; first using secondary data of people’s narratives and reports of experiences. This established the initial semantic space, besides identifying ABC concepts for the second-level activity of primary data gathering, which is planned for the future. Top-down and bottom-up approaches are necessary for refining and validating attitudinal models.

ORGANIZATION OF THE REPORT

The report is organized into nine chapters. Chapter 1 introduces the research problem and a conceptual model following Breckler (1984). The structure of the report is outlined as well. Chapter 2 is a review of the literature that is relevant to the ABC concepts, in order to contextualize the research and to conceptualize a model for the research. Chapter 3 describes the semantic framework and proposes an ontological model, and also describes the text mining tools, Latent Semantic Analysis (SA) and Leximancer (LXM). Chapter 4 outlines a taxonomic classification of disasters as documented in the literature, and identifies the types of disasters being investigated. Chapter 5 describes the methodology that guided the overall study. This methodology is one of the contributions of the study, besides the ontology model. Chapter 6 presents the first study aimed at comparing two text mining tools Latent Semantic Analysis (LSA) and Leximancer (LXM) on their capability in semantic processing, while Chapter 7 describes the second study that mined ABC and disaster situational factors. The results from this investigation were applied to the ontologies and are discussed in Chapter 8. The final Chapter 9 discusses the main findings and future work to be undertaken in the next phase.

2

Conceptual Framework

"The starting point of any theory of risk must be that everyone willingly takes risks"

Adams (1995, p. 16)

Most of us have imagined what it might be like to experience a tsunami, a fire or an infectious flu. We have ideas about what we might do or fail to do and how it might feel. We have fears that we admit to openly and ones that we never discuss. The word *disaster* connotes panic, hysterical crowds, destruction and rescuers. But our disaster attitudes can be quite different from the ones we expect to experience.

In the face of a major disaster event, many people tend to react with emotion and emotion-laden decisions (Grandien et al., 2005; Lerner et al., 2003). The 2004 East Asian tsunami disaster had a profound psychological impact on many countries, not only those that were directly hit by the tsunami waves. Sweden had an unusually high number of tourists visiting East Asia at the time of the disaster, resulting in over six hundred Swedes being killed or missing. A consequence of this tragedy, and the media attention it received (Mann, 2007), many Swedes felt deeply involved and saddened (Grandien et al., 2005). The feelings elicited by such an event may also have an impact on everyday decisions. In a famous example, Johnson and Tversky (1983) found that incidental affect (i.e., a mood state) induced by reading a newspaper article influenced subsequent risk judgments. Previous research in judgment and decision making has shown that people tend to rely on their affective reactions when making decisions (Lichtenstein & Slovic, 2006; Peters, 2006; Slovic et al., 2002).

In a disaster situation, then, people travel through 3 phases of the "survival arc" (Ripley, 2009): *denial* (affect) which can take the form of delay that can be fatal. How long the delay lasts depends on how we calculate risk. We are slow to recognize exceptions but this does not mean we waste time during this delay. Given the time to think, people need information just like they need shelter and water. Their brains lack the patterns they need to make a good decision, so they search for better data. After denial, we move into *deliberation* (cognition). We know something is terribly wrong, but we don’t know what to do about it. How do we decide? The first thing to understand is that nothing is normal. We think and perceive differently. We all share a basic fear response. There is also the effect of the group or crowd on our deliberation. Finally, we reach the third phase: the *decisive moment* (behavior). We have accepted that we are in danger, we have deliberated our options. Now we take action. Many – if not most – people tend to shut down entirely in a disaster. They seem to lose all awareness. But their paralysis can be strategic.

RELATED WORK

A review of 160 disaster studies by Norris et al. (2002) assessed the severity of psychological impairment among adults exposed to community trauma. The outcome variable was assessed by multiple measures, including psychological problems (e.g., posttraumatic stress disorder [PTSD], depression, and anxiety), non-specific distress, and health problems. Psychological impairment, described as *severe* or *very severe*, was found in almost 40% of the studies. The observed severity of impairment was most saliently associated with the extent of exposure. In addition, females, middle-aged persons, ethnic minorities, and the poor were at particular risk for psychological impairment.

Galea et al. (2005) reviewed studies conducted between 1980 and 2003 and confirm that the prevalence of PTSD among disaster victims is mostly dependent on exposure to the trauma; that is, the highest levels of PTSD were found among direct victims of the disaster, whereas the lowest levels were found among the general population. Although the catastrophic effects of terror attacks parallel those caused by other disasters, terror attacks differ from natural and technological disasters in such aspects as their randomness and their intended harm (Dougall et al., 2005). Finally, in a meta-analytic review of 68 studies encompassing a range of personal traumas (Ozer, Best, Lipsey, & Weiss, 2003), perceived life threat was found to be positively related to PTSD. A more recent review of the literature by Ben-Zur and Zeidner (2009) looked at correlational and experimental studies published between 1999 and 2009. The review was designed to shed light on the nexus of associations between threat to life and risky behaviors.

Given the massive body of literature on the topic at hand, our coverage of the material is limited to the concepts that are important for attitudinal forecasting, in particular risk perception and ABC.

Risk Perception and Risk Taking Behavior

Risk is inherent in most types of disasters. A number of risk dimensions have been identified in past research, including risk perceptions, risk assessments, risky decisions, and risk-taking behaviors. All risk concepts have one element in common; a distinction between reality and possibility (Sjöberg, Moen, & Rundmo, 2004). Rosa (2003: 56) defined risk as “a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain.” Risk assessment is based on thoughts, beliefs and constructs (Sjöberg, 1979; Plapp & Werner, 2006). It is usually identified through experience and available information, without the need to refer to data and models (Västfjäll, Peters, & Slovic, 2008). The underlying processes in perceiving risk pass unconsciously. Because risks are low probability events, the subjective probabilities are usually overestimated (Wickens & Hollands, 2000). This makes it difficult to formulate a viable theory of risk perception.

In the present study, we consider risk perception and risk-taking behavior as crucial in disaster situations. Risk perception is the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences. To perceive risk includes evaluations of the probability as well as the consequences of a negative outcome. Perception of risk goes beyond the individual; it is also a social and cultural construct reflecting values, symbols, history, and ideology (Weinstein, 1989).

Risk perception is affected by familiarity with the source of danger, control over the situation, and the dramatic character of the events (Plapp & Werner, 2006). Risk-taking behavior has been defined as “action (or inaction) that entails a chance of loss” (Furby & Beyth-Marom, 1992, p.3). If disaster situations are indeed one of the antecedents of risk taking, then the degree of risk taking should vary as a function of the level of exposure to disaster situations, the perceived severity of the event, the personal consequences of the disaster situation, or some combination thereof.

People experience risk in three ways: (a) risk as analysis, (b) risk as feelings, and (c) risk as politics (Slovic et al., 2002). Risk as analysis requires the use of logic, reasoning, and scientific deliberation. Risk as affect brings about fast, instinctive, and intuitive reactions to danger in hazard management. These approaches of perceiving risk can be used to formulate an experiential systems analysis and an analytic systems analysis (Slovic et al., 2004). The experiential system is affective and intuitive. It is fast, mostly automatic, and not very accessible to conscious awareness. The analytic system supports analysis using algorithms and rules, including formal logic, and risk assessment. Although analysis is important in some decision-making process, dependence on affect and emotion is quicker and easier. This is because affective reactions are immediate and automatic, and guide information processing and judgment (Loewenstein et al., 2001). Such reactions are the basis for decision making heuristics.

Loewenstein et al. (2001) categorized affective responses into anticipatory emotions and anticipated outcomes, including emotions. Anticipatory emotions are immediate visceral reactions such as fear, anxiety and dread. Anticipated emotions are expected to be experienced in the future (Loewenstein et al., 2001), see Figure 2.1.

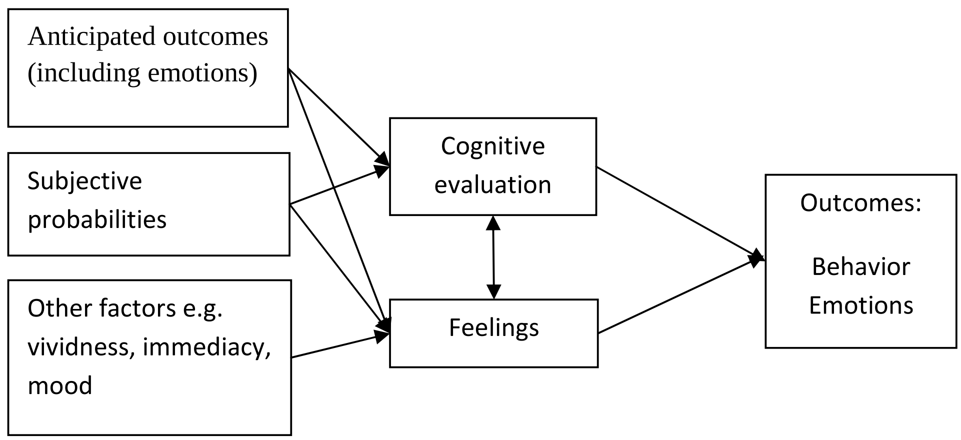

Figure 2.1 Risk-as-Feelings Perspective (adapted after Loewenstein et al., 2001)

Above all, risk perception is a construct embedded into and determined by society and culture. According to Douglas (1978), risk perception is not governed by personality traits, needs, preferences, and properties of the risk objects. It is a culturally, constructed phenomenon (Oltedal et al., 2004). What is perceived as dangerous and how much risk to accept is a function of one's culture and social learning. There are several patterns of cultural differences in communities, including: (a) communication styles, (b) attitudes toward incidents, (c) approaches to task performance, (d) decision making styles, (e) attitudes toward disclosure, and (f) approaches to learning, knowing, and knowledge (DuPraw & Axner, 1997; Banbury & Tremblay, 2004; Klein et al., 2006).

Affect, Behavior and Cognition

In Chapter 1 we provided the tripartite model of attitude (see Figure 1.1). This trichotomy of affect (feeling), behavior (acting) and cognition (knowing) can be traced back to Greek philosophers and was considered in some of the earliest social psychology writings (Breckler, 1984).

Affect refers to human emotions or instinct such as anger, happiness, sadness; it also represents sensory experiences (physical feelings). As a prime determinant of subjective well-being, affect plays a central role in many activities. Generally, people are imprecise about their feelings as they are confused between affect and cognition. Therefore, they often rely on feelings for doing or not doing something (Berger, 2002).

Behaviors are overt, observable responses and actions. They are measurable, and therefore more easily identified than affect or cognition (Berger, 2002). Consequently, an appropriate behavior needs to be in place, altered, or diminished in order to reach a particular goal, especially in managing risk. Some behaviors are much more difficult to develop or change than others, especially when the behaviors are derived from cultural values (Oltedal et al., 2004). Once identified, it becomes clearer what needs to be done and what is within a person's reach.

Cognition encompasses human beliefs, values, decision-making, and perceptions of self, others, and the world. These perceptions and beliefs include efficacy beliefs, perceptions of locus of control, and expectations.

Affect and Cognition

In situations such as a disaster, people perceive reality in at least two ways; one is affective (intuitive and experiential) and the other is cognitive (analytical and rational) (Epstein, 1994). Formal decision making relies on the analytical and cognitive abilities; unfortunately, this mode is slow. The experiential/affective system is fast. When a person responds to an event, there is an automatic search and event matching with the experiential system. This is like searching a memory bank for related events, including the emotional contents (Epstein, 1994). Figure 2.2 shows the coupling of affect and cognition.

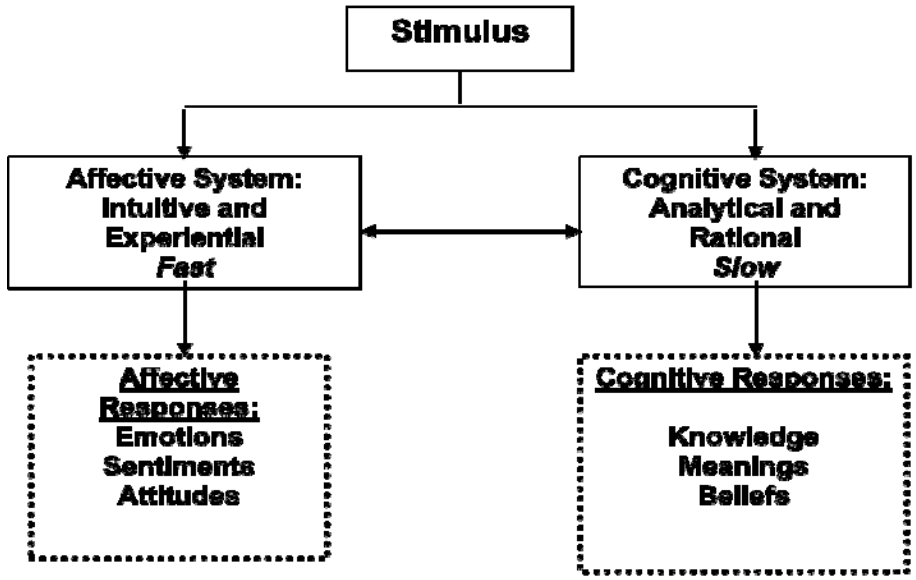

Figure 2.2 Coupling of affect and cognition

Affect is used to evaluate and judge, while cognition is used to interpret and make sense of the objects, and understand the user (Norman, Ortony, & Russell, 2003). Emotions do not cause thinking to be non-rational; they can motivate a passionate concern for objectivity. Rational thinking entails feelings, and affective thinking entails cognition. Rational thinking is more precise, comprehensive, and insightful than non-rational thinking. However, it is also emotional.

New breakthroughs in neuroscience using functional Magnetic Resonance Imaging (fMRI) validate the assertions that cognition and emotions are unified and contribute to the control of thought and behaviour conjointly and equally (LeDoux, 2003; 1995). Additionally, cognition contributes to the regulation of emotion. Contemporary views in artificial intelligence are also embracing an integrated view of emotion and cognition. There is evidence to suggest that affect and cognition interact in many ways, as revealed in behavioral, psychophysiological and neural measures (Ben-Zur & Zeidner, 2009; Västfjäll1, Peters & Slovic, 2008; Clore & Huntsinger, 2007; Lerner, & Gonzalez, 2005).

Studies of formal risk analysis have viewed affective responses to risk as irrational (Slovic et al., 2004). However, analytic reasoning too cannot be rational unless it is guided by emotion and affect. This is because the analytic and the experiential systems operate in parallel and each depends on the other for guidance (Levine, 2009). Separate circuits and structures are responsible for more emotional versus more cognitive functions (LeDoux, 2000).

Several studies also examined the relationships between positive and negative affect and cognitions in those with anxiety and mood disorders (Yamokoski, 2006). The cognitive correlates of negative and positive affect were studied, and it was hypothesized that worry was related to negative affect since worry is a cognitive component of both anxiety and depressive disorders (Beck et al., 2001).

There is also evidence to suggest that emotions, far from being an obstacle to appropriate decision-making (as they have been viewed from the rationalist perspective), are indispensable for decision making (LeDoux, 1995). Current neurobiological research is confirming that the heart has reasons that reason ignores. This does not mean that the emotions cannot make mistakes. Nor does it mean that certain very strong emotions (specifically those more primary ones which, due to the nature of the stimulus) may not give rise to unpremeditated acts with disastrous implications for the person's life. It is precisely in such cases that the decision process does not take place, as it is swept aside by more primitive mechanisms (direct routes from the thalamus to the amygdala) that hijacks the capacity for decision (Damasio, 1995; Davis, 1992; Simón, 1998). Table 2.1 distinguishes between affect and cognition, and their influences in stimuli evaluation.

Table 2.1. Distinctions between Affect and Cognition

Affect and Emotions	**Cognition**
Judge the preferences	Evaluate the correctness
Instigation to action	Less linked to behaviour
Expression are fairly universal across cultures	Restrict to certain language, not cross-culture
Reactions are primary and could happen without cognition awareness	Required sufficient and subjective information input, and accompanied by affect
Affective evaluation of stimuli involves a low level of arousal	Cognitive interpretation involves a deeper understanding of stimuli and human behaviour

The new frontier of knowledge about emotions is modifying our view of the relationship between the cognitive and affective worlds of the human being. The integrated view is further explored in the concept of *citarasa* (Khalid et al., 2010a). Originated from Sanskrit, the term is widely used in the Malay culture and worldview to explicitly express emotional intent. The word "cita" means 'hope, desire,' and "rasa" means 'taste, feelings.' Citarasa, in the context of human experience, synergistically integrates emotions and cognition in manifesting behavior intent. While there is insufficient evidence in the literature to support citarasa as a concept, there is ample evidence from fMRI studies of the emotion-cognition connectivity (LeDoux, 2003; Dolan, 2002).

Affect and Behavior

Fear causes fleeing and thereby saves lives: this exemplifies a popular and common sense view. However, it is increasingly untenable that the primary function of emotion is the direct causation of behavior. Instead Baumeister et al. (2007) proposed a theory of emotion as a feedback system which has an indirect influence on behavior. The word *emotion* suggests a conceptual link between affect and action control (behavior): etymologically, *emotion* is from the Latin *ex* (away, out) and *movere* (to move) (Reis & Gray, 2009). Emotions provide feedback and stimulating retrospective appraisal of actions, and thereby promote learning and change behavior.

Behavior may also be chosen to pursue (or avoid) anticipated emotional outcomes. Rapid, automatic affective responses (in contrast to the full-blown conscious emotions) inform cognition and help to guide behavior. Automatic affective responses may also remind a person of past emotional outcomes and will help in predicting the emotional outcomes of an action.

Empirically, a link between at least some emotions and some actions is unequivocal—in facial expressions of joy, fear, sadness, for example. Emotion theorists have long posited a major role for affect in the control of behavior more generally (e.g., Frijda, 1986; Lang, Bradley, & Cuthbert, 1990; Carver, Sutton, & Scheier, 2000; Schneirla, 1959). Action-control theorists have equally noted the relevance of affect for action control, including motivation and volition (Gollwitzer, 1999).

Cognition and Behavior

The theory of reasoned action (Ajzen, 1985) assumes that individuals consider a behavior's consequences before performing the particular behavior. As a result, intention is an important factor in determining behavior. Intentions develop from an individual's perception of a behavior as positive or negative together with the individual's impression of the way their society perceives the same behavior. Thus, personal attitude and social pressure shape intention, which is essential to performance of a behavior (Ajzen 1985).

Recognition-Primed Decision model (Klein, 1997) suggests that decisions in naturalistic situations, characterized by high uncertainty, time pressure and high stakes, trigger appropriate action schema. If recognition fails initially, humans resort to greater situation assessment until recognition can occur, eventually constructing a new sequence of actions if an appropriate schema is not available.

Attitudinal Forecasting Model

Affective, cognitive and behavioral forecasting models exist in the literature as standalone models (e.g. Dunn et al. 2007; Hoerger et al., 2009). Attitude forecasting model that encompasses all three components has yet to be developed since Breckler (1984). Solomon (1996) conceptualized ABC components as simultaneous occurrence, as illustrated in Figure 2.3. His model is built upon Albert Ellis' model (see Wirga & Bernardi, 2008), to explain the relations between the environment situation with emotional and behavioral reactions.

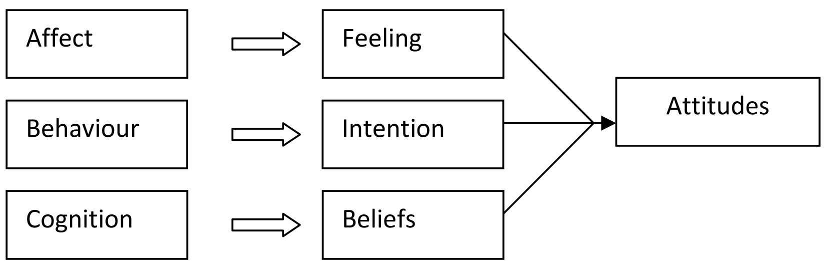

Figure 2.3 ABC Model of Attitude (Solomon, 1996). The three components are simultaneous.

The challenge is measuring these components that impact on attitude. Various measurement tools have been constructed to obtain attitude information. Measures may include the use of physiological cues like facial expressions, vocal changes, and other body rate measures (Breckler & Wiggins, 1992). For instance, fear is associated with raised eyebrows, increased heart rate and increase body tension (Dillard, 1994). Other methods include concept or network mapping and using primes or word cues (Shavelson & Stanton, 1975).

Human Factors in Disaster Management

The literature on disaster management (DM) identifies several factors that are involved in disaster response and recovery, but we classify them into four, namely: People, Equipment, Task, and Environment (PETE) factors:

- **People** may be individuals or groups that are involved in the disaster either directly as survivors, or indirectly as members of a service team. The latter may be involved in changing the evolving situation, but at the same time they are exposed to the consequences of the situation. People may be trained to apply existing plans (e.g. medical personnel, policemen, soldiers, firemen), but some are not (e.g. volunteers, citizens, journalists), and their actions are usually reactive rather than anticipatory. Survivors may be proactive if trained or reactive if not.

- **Equipments** include tools and methods for managing the crisis (e.g. communication networks, transportation means and infrastructures, tools and spare parts for repair and first aid). These resources are limited and may be seriously damaged in the disaster. Objects used by survivors to save their lives may be classified as endurance tools.
- **Tasks** are actions undertaken by people using available technologies (e.g. inform public, remove public, provide first aid, remove injured people, stop spread of the danger or its consequences, repair infrastructures). These tasks may be interdependent and coordination between people is required. Furthermore, some pre-planned tasks may be difficult to carry out due to damaged equipment and limited resources; equipment may also need to be modified for the purpose. Actions of survivors may be categorized through their Affect, Behavior and Cognition (ABC).
- **Environments** include physical and social conditions. Physical environment refers to natural elements such as water, earth, fire, while social environment refers to organisations implicated in the disaster management system (e.g. police, fire brigade, army, government, hospitals). They may be public or private. Survivors, for example, interface with both natural and social environments for life-saving support.

In the present research, the focus was People and Environment, as illustrated in Figure 2.4. The model is also called *Citarasa* Behavioral Model (Khalid et al., 2008). There are two sub-systems: Environment and People.

Figure 2.4 People-Environment Systems model

- **Environment.** This subsystem documents information derived from sources that are associated with hazardous risks, namely, *Disaster Situations*, *Service Organizations* and *Risk Culture*. The Disaster Situation comprises various disaster types (e.g., natural disaster – tsunami, earthquake, etc, human induced disaster – terrorist attack, fire, etc., pandemic – swine flu, HIV, etc) that trigger the organization of Services (e.g., emergency, rescue) efforts that can be driven by experts (e.g. medical doctors), teams (e.g., military aid), and/or community. The Cultural values of people in terms of their risk assessment and situation awareness play important roles in influencing their risk attitudes. However, these measures are not available in the present study.
- **People.** This subsystem describes the interaction between affect and cognitive systems, resulting in behavior. The *cognitive system* follows a human information processing model. Perception of risks triggers the belief system that includes cognition and memory recall, which involves appraisal and action (Sjöberg, 1996). The *affective system* generates a variety of emotional feelings such as fear, despair, anxiety and disorientation, depending on the threat to life (Ben-Zur & Zeidner, 2009). The resulting emotional experience predisposes the person to act. There may be also positive emotional reactions including generosity towards others and cooperation to help in teamwork (Ebata, 1995). The *behavior system* forms intention and outputs overt action that may avert the risk.
- **Analytical Tools.** To analyze the relationship between the Environment and People subsystems, several methods may be used. Many studies have used psychometrics to analyze risk perception (Johnson & Tversky, 1984; Lichtenstein, et al., 1978; Slovic, 1987; Slovic, et al., 1985). People expressed their understanding of diverse hazards through quantitative judgments of current and desired riskiness (Slovic, 1987). Using multivariate analysis, relationships are revealed to produce "cognitive maps" or risk attitudes. Shiloh, Guvenc, and Onkal (2007) studied cognitive and emotional aspects of terror attacks using semantic differential scale to measure risk perception on 10 negative affect: fear, helplessness, hopelessness, anger, intolerance, pain, loneliness, insecurity, sadness, and anxiety.

  In the context of the present study, text mining was used to identify semantics that constituted ABC of risk attitudes. In the next study, a Web tool and projective technique will be used to measure risk attitudes on dimensions such as group culture (e.g. values, norms), risk assessment, and situation awareness, to be gathered in online and field studies.

ABC Conceptual Model

The conceptual ABC model guiding this research may be described as follows:

1) Disaster situations may influence attitudes of people, including those directly affected and those not directly affected by the disaster. The first component for attitude forecasting is to

identify the specific affect, behavior, cognition (ABC) concepts associated with specific disasters. This will be based on text mining that result in semantic ontologies.

2) Their affect (feelings) and cognition (thoughts) may impact behavior (actions) they might take. The effects may be evaluated through experimental manipulations of diagnostic information such as group cultural values, situation awareness and risk perception using projective technique and why-why-why probe. This aspect of the model will be explored in future to enhance the forecasting capability of the attitudinal model.

Research on affective forecasting found that forecasters tend to adopt a relatively analytic approach in imagining their emotional responses to future events. They extracted the focal event from the noise of its background and break up the event into its most important parts, devoting careful attention to those parts that distinguish it from similar events. Problems arise because the emotional experiences that forecasters are trying to predict may stem from a more holistic response to events. The impact bias effect, i.e., overestimating the intensity and duration of their own emotional responses to events is a common problem (Gilbert, Gill, & Wilson, 2002; Hoerger et al., 2009).

For the purpose of the present study, Figure 2.5 illustrates a conceptual framework for understanding ABC.

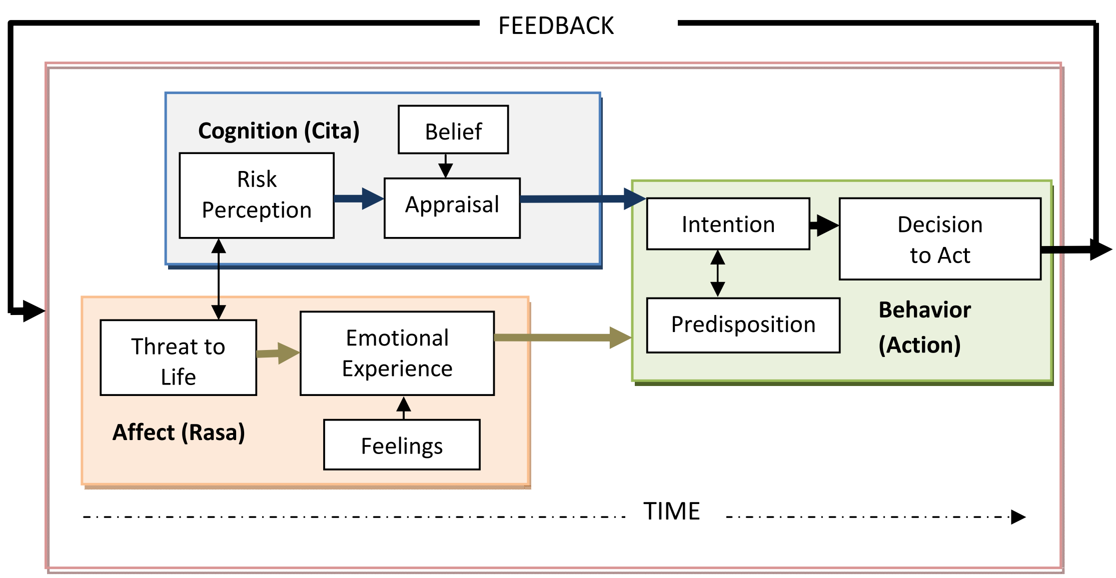

Figure 2.5 Conceptual ABC framework

In Figure 2.5, the occurrence of affect, behavior and cognition is contingent upon the type of disaster and time perspective. For example, with natural disasters such as earthquake there is time to perceive the risk of behavior which may lead to a delay in action. Therefore, affect (e.g., anxiety) and cognition (e.g., thoughts) occur before behavior. But with human induced disasters, the suddenness of the event (e.g. terrorist attack) may induce coping behavior with mixed emotions such as fear.

The above model is the basis for mapping the relationship of ABC in ontology development. It is assumed that the relationship varies with the type of disaster experience, with human induced disasters such as terrorist attack inducing people to act due to trauma, while natural disasters may induce people to reflect and delay reactions. In the next chapter, the characteristics of disaster types are described to understand their impact on people.

3

Disaster Taxonomy

> *"Disasters are non-routine events in societies or their larger subsystems (e.g. regions and communities) that involve conjunctions of physical conditions with social definitions of human harm and social disruption."*
>
> National Research Council, 2001, p. 3718.

There are many definitions of a disaster (e.g. Turner and Pedgeon, 1997, Denis, 1995, Keller and Al-Madhari, 1996). The definition used seems to be tied up to the discipline using the term. Turner and Pedgeon (1997) pointed out that no definition of "disaster" is universally accepted. The Asian Disaster Reduction Center (2003) defines disaster as: *A serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of affected society to cope using only its own resources.* Parker (1992) suggested that the preferred definition of disaster is: …*an unusual natural or man-made event, including an event caused by failure of technological systems, which temporarily overwhelms the response capacity of human communities, groups of individuals or natural environments and which causes massive damage, economic loss, disruption, injury, and/or loss of life.* This definition encompasses medical-related disasters such as tuberculosis and HIV/AIDS cases.

DISASTER CLASSIFICATION

Disasters may result from *natural* causes (floods, earthquake, hurricane, climatic changes, etc.), *human-made* acts (nuclear reactor meltdowns, terrorist attacks, fires, etc.) as well as *pathogenic virus* (swine flu, SARS, HIV, tuberculosis). These disasters often have catastrophic consequences, as evidenced by the grave, immediate, and long-term effects of the tsunami that impacted the coasts bordering the Indian Ocean in 2005 or the terror attacks on the Twin Towers on September 11, 2001 (hereafter, 9/11). Such high magnitude disasters often lead to grave loss of life among members of the community, severe damage of private and community property, and direct physical injury to survivors and their families, friends, and neighbors (Ben-Hur & Zeidner, 2009).

Disasters may be classified as shown in Figure 3.1.

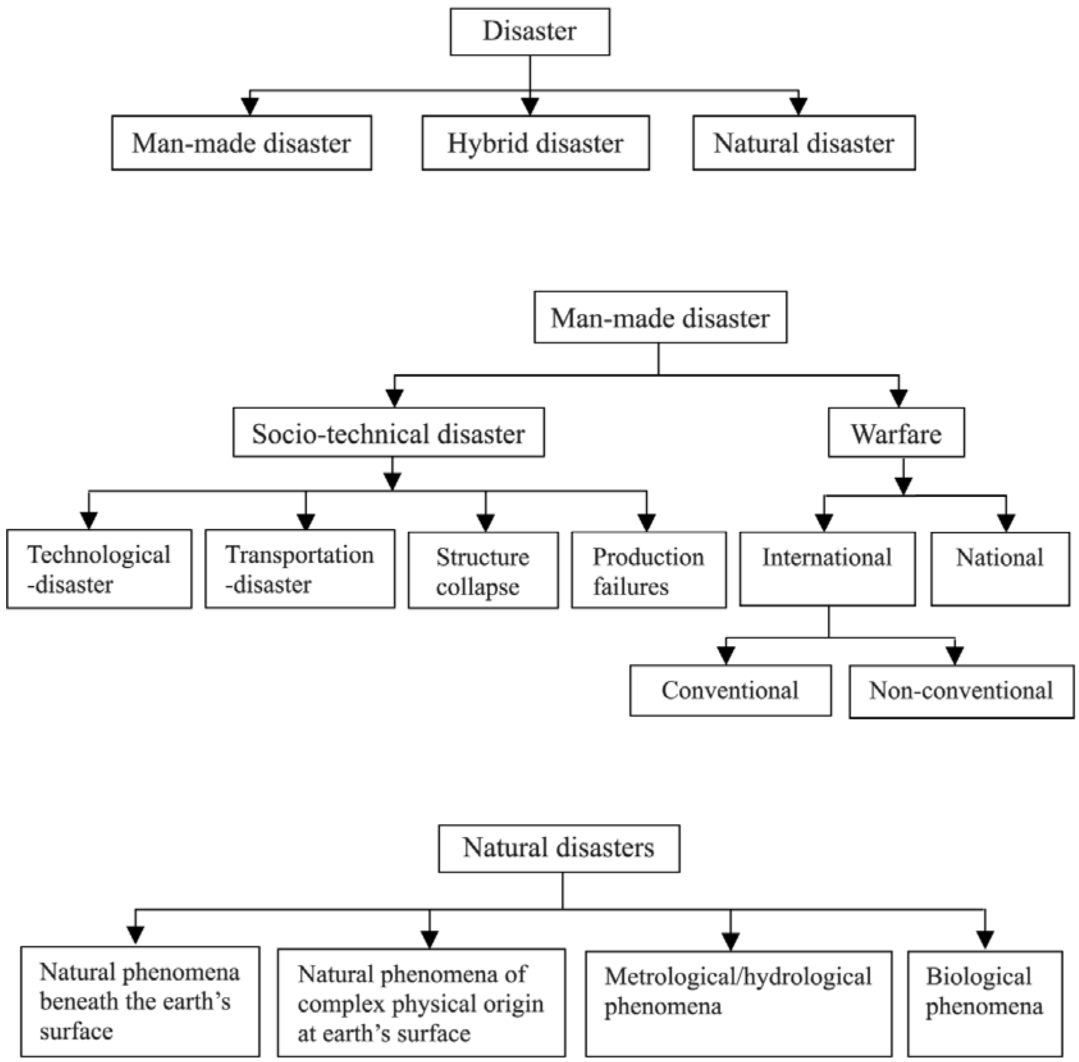

Figure 3.1 Classification of disasters (Shaluf, 2007)

The World Health Organization (2010) and World Health Organization/EHA (1998) classified disasters as follows:

(1) Natural (physical) disasters: Weather-related disasters (meteorological):

- hurricanes, cyclones, tornados, typhoons;
- heavy rains, thunderstorms, floods, snowstorms;
- drought and famine; and
- heat waves, cold waves.

External (topographical):

- landslides; and
- avalanches.

Internal (tectonic and telluric):

- earthquakes; and
- volcanic eruptions.

Natural (biological):

- infestations; and
- epidemics.

(2) Man-made/technological disasters:

- industrial disasters;
- nuclear accidents;
- chemical accidents;
- fires;
- wars, civil strife; and
- structural failures (dams, mines).

To ensure adequate coverage of disaster types, in this research we classify disasters into 3 main classes: Natural Disasters, Human Induced Disasters and Pandemic Disasters.

Natural Disasters

A natural disaster (ND) is a consequence when a natural hazard (e.g., volcanic eruption or earthquake) affects humans and/or the built environment. Human vulnerability, caused by the lack of appropriate emergency management, leads to financial, environmental, or human impact. The resulting loss depends on the capacity of the population to support or resist the disaster, that is, their resilience. Therefore, a natural hazard will not result in a natural disaster in areas without vulnerability, e.g., strong earthquakes in uninhabited areas.

Earthquakes

An earthquake is a sudden break within the upper layers of the earth, sometimes breaking the surface, resulting in the vibration of the ground, which strong enough will cause the collapse of buildings and destruction of life and property (Centre for Research on the Epidemiology of Disasters, 2003). Earthquakes sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis) (Federal Emergency Management Agency, 2003a, b). Powerful aftershocks frequently occur, causing further damage and increasing psychological stress (International Federation of Red Cross and Red Crescent Societies, 2003).

Earthquakes strike with no early warning and can be devastating. Quakes are measured according to the Richter scale – the most devastating effects are seen at Level 6 and above and if the epicenter of the earthquake is located in highly populated areas. Earthquakes can cause high mortality from trauma, asphyxiation, dust inhalation (acute respiratory distress), or exposure to the environment (i.e. hypothermia) as well as serious destruction of buildings and infrastructure

(International Federation of Red Cross and Red Crescent Societies, 2003; Songer, 200; Schneid & Collins, 2001).

Tsunami

Tsunamis are a series of large waves generated by sudden displacement of seawater by earthquakes or volcanic eruption, capable of propagation over large distances and causing a destructive surge on reaching land (Centre for Research on the Epidemiology of Disasters, 2003). Tsunamis can originate hundreds or even thousands of miles away from coastal areas. Local geography may intensify the effect of a tsunami. The areas at greatest risk are less than 50 feet above sea level and within one mile of the shoreline. Tsunamis reaching heights of more than 100 feet have been recorded. As the waves approach the shallow coastal waters, they appear normal and their speed decreases. Then as the tsunami hit coastlines, it may grow to a great height and smash into the shore, causing much destruction.

On 26 December 2004, an earthquake measuring 9.0 on the Richter scale struck the area off the Western coast of Northern Sumatra, triggering massive tidal waves, or tsunamis, that inundated coastal areas in countries all around the Indian Ocean rim, from Indonesia to Somalia. At least 150,000 people died in the disaster, with over 525,000 injured, 1,600,000 displaced and over 1,000,000 homeless (International Federation of Red Cross and Red Crescent Societies, 2005).

Hurricane

Hurricanes are large-scale closed circulation systems in the atmosphere above the Indian Ocean and South Pacific with low parametric pressure and strong winds that rotate clockwise. There is a maximum wind speed of 64 knots or more for the Western Atlantic and Eastern Pacific (Centre for Research on the Epidemiology of Disasters, 2003). The primary health hazard from hurricanes lies in the risk of drowning from the storm surge associated with the landfall of the storm. Most deaths associated with hurricanes are drowning deaths. Secondarily, a hazard exists for injuries from flying debris due to high winds.

Hurricanes can be predicted several days in advance. Their onset is extensive and often very destructive. These disasters are usually more destructive than floods (International Federation of Red Cross and Red Crescent Societies, 2003). Hurricanes are expected within 24 hours or less. In regions where hurricanes may occur (e.g. Miami, Florida, in the USA), the National Weather Service issues information concerning the hurricane. The National Hurricane Center monitors hurricanes and broadcasts the information needed to track storms. The primary prevention strategy in the event of a hurricane is to provide early warning and evacuation.

Floods

A flood is a significant rise in the water level in a stream, lake, reservoir or coastal region (Centre for Research on the Epidemiology of Disasters, 2010). Floods can be predicted in advance, except in the case of flash floods. Flash floods are a sudden and extreme volume of water that flows rapidly and causes inundation. Because of their rapid nature flash floods are difficult to forecast and give people little time to escape or to take food and other essentials with them (International Federation of Red Cross and Red Crescent Societies, 2010).

The impact of flooding can include the destruction of housing, crops, cattle and people. The primary hazard from flooding is drowning. This is particularly evident for flash floods. A longer-term health concern from flooding is the development of disease from inundated sanitation stations. Large floods pose a hazard to existing sanitation and drinking water systems (Shaluf, 2007). Factors influencing the severity of the hazard are the depth of water, the duration and velocity of the flood, the rate at which the water rises, and the frequency of occurrence and season (World Health Organization, 2010).

Human Induced Disasters

A human induced (HID) or human-made disaster has an element of human intent, negligence, or error that causes the disaster or involving a failure of a human-machine system.

Terrorist Attacks

Terrorist attacks or terrorism acts describe a variety of violent acts which are intended to create fear, to carry out holy duty, political or ideological goal, and to get immediate publicity for their causes. Acts of terrorism can range from threats to kidnapping, airline hijacking, suicide bombers, explosions, mailings of dangerous substances, assassination, cyber attacks and the use of weapons of mass destruction such as chemical and nuclear. In various definitions of terrorism, the common thread is politically motivated, often directed at non-combatants and committed by sub-national groups or underground agents (Ruby, 2002).

Militant groups seeking to overthrow authority have frequently used exemplary violence such as hostage-taking and bomb scares to intimidate political opponents. These violent acts are also often directed at non-combatants, that is, people who are not members of the military services or military members who are not actively involved in military hostilities (Borum, 2004). This criterion identifies terrorism as violence directed toward civilian populations or groups who are not prepared to defend against political violence. This also includes military members who are attacked during peacetime (Ruby, 2002).

In addition to the political motivation of the acts, terrorism is intended to create an extremely fearful state of mind. This fearful state is not intended for the terrorist victims but it is actually intended for a group or individual who may not have any relationship with the victims (Kaplan, 1981). Therefore, terrorist attacks can be without warning to the general population.

Fire

Although a fire disaster need not necessarily reach catastrophic proportions, it will present some of the characteristic aspects of a disaster because of the highly destructive action of fire and of the considerable number of victims. The surviving casualties will have mainly serious and extensive burns requiring immediate rescue procedures that cannot always be provided by local resources. A fire of vast proportions can moreover cause damage to the surrounding environment by the massive production of heat and the emanation of burn gases and fumes.

One factor that makes all fire disasters dramatic is panic. Anybody close to a sudden fire is affected by panic. This is due to the realization that the fire can kill within a few moments, cause injuries and permanent disfigurement, and inexorably destroy everything in the vicinity. When a violent fire breaks out, there is an initial moment of psychological paralysis, generally followed by total incapacity for logical thought, and this leads to instinctive behavioral reactions whose one aim is to save oneself and reach safety.

Industrial Accidents

Industrial accidents are mishaps in an industrial or manufacturing setting, possibly caused by improper work practices, negligence or incompetence, which results in personal injury and/or property damage. The accidents can also originate from technological failures, dangerous procedures, infrastructure failures, certain human activities which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Technological disasters include accidental release of pollutants that pollutes the environment, chemical explosion, nuclear explosion, mine explosion and oil spills.

Transport Accidents

Transport accidents are incidents involving mechanised modes of transport. It comprises of four disaster subsets: accidents involving air, boat, rail transport and accidents involving motor vehicles on roads and tracks. An estimated 30 million people have been killed in road crashes since the invention of the motor vehicle over a century ago. The World Health Organization (WHO) forecasts road crashes will be the third most important cause of death and disability worldwide, by 2020.

Pandemic Disasters

A pandemic is an epidemic of infectious disease that is spreading through human populations across a large region, for instance a continent, or even worldwide.

Swine Flu

Swine influenza (also called pig influenza, swine flu, hog flu and pig flu) is an infection by any one of several types of swine influenza virus. Swine influenza virus (SIV) or S-OIV (swine-origin influenza virus) is any strain of the influenza family of viruses that is endemic in pigs. As of 2009, the known SIV strains include influenza C and the subtypes of influenza A known as H1N1, H1N2, H3N1, H3N2, and H2N3.

Swine influenza virus is common throughout pig populations worldwide. Transmission of the virus from pigs to humans is not common and does not always lead to human influenza, often resulting only in the production of antibodies in the blood. Symptoms of swine flu in humans are similar to those of influenza-like illness in general, namely chills, fever, sore throat, muscle pains, severe headache, coughing, weakness and general discomfort. In August 2010 the World Health Organization declared the swine flu pandemic officially over.

SARS

Severe Acute Respiratory Syndrome (SARS) is a respiratory disease in humans which is caused by the SARS coronavirus (SARS-CoV), characterized by fever and coughing or difficulty breathing or hypoxia which can be fatal. It is new and highly contagious form of atypical pneumonia. Between the months of November 2002 and July 2003, there were 8,096 known infected cases and 774 confirmed human deaths (a case-fatality rate of 9.6%) worldwide. Rapid action by national and international health authorities such as the World Health Organization helped to slow transmission and eventually broke the chain of transmission. However, the disease has not been eradicated; it may still be present in its natural host reservoirs (animal populations) and may potentially return into the human population in the future. This warrants monitoring and reporting of suspicious cases of atypical pneumonia.

HIV/AIDS

HIV/AIDS (Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome) is a disease of the human immune system caused by the virus. Since the AIDS epidemic began, 25 million people have died and more than 40 million are now living with HIV and AIDS. In 2001 alone, five million people became infected worldwide. HIV/AIDS has an unprecedented negative impact on the social and economic development of nations. While 70 per cent of HIV-infected people live in sub-Saharan Africa, AIDS is a global problem. HIV infection is also spreading rapidly in South East Asia.

AIDS can be prevented. Individuals and communities can cope with the spread of HIV/AIDS by being properly informed, assessing accurately the factors that put them at risk of infection and by subsequently acting to reduce those risks. The problem, according to the World Bank, is that there has not been sufficient amount of coordinated activities to slow and eventually reverse the spread of the disease. Individuals, governments, civil society, private sector groups, international and non-governmental organizations have to fully commit and participate in scaling up response.

Tuberculosis

Tuberculosis (Tubercles Bacillus, TB) is a common and often deadly infectious disease caused by mycobacterium, characterized by the expectoration of mucus and sputum, fever, weight loss, and chest pain. Tuberculosis usually attacks the lungs but can also affect other parts of the body. Tuberculosis (TB) is the single most deadly infectious disease and kills two million people each year. Of the eight million new cases annually, 95 per cent are in developing countries. Asia and sub-Saharan Africa are the hardest hit, but Eastern Europe has recently seen a major increase in the incidence and deaths related to TB after many years of steady decline.

In 1993, the World Health Organisation (WHO) launched the Stop TB initiative in response to the growing crisis. Since 1998, the International Federation of Red Cross and Red Crescent Societies has been working closely with National Societies and the WHO to control the TB epidemic. These efforts were to provide assistance to patients and their families and have shown for an urgent need to scale up activities in order to have a greater impact on the epidemic worldwide.

Consequences of Disasters

Today, researchers have sought to understand the sources of *disaster vulnerability*, in terms of the societal processes that create vulnerability, how vulnerability is distributed unequally across societies, communities and social groups, how vulnerability changes over time, and how and why these changes come about (Tierney at al., 2001: 22). There are two types of vulnerability: physical vulnerability represents threats to physical structures and infrastructures, the natural environment, and related economic losses. Social vulnerability represents threats to the well-being of human populations (e.g. deaths, injuries, other medical impact, disruption of behavior and system functioning) and related economic losses (Cutter et al., 2003; Buckle, 2004).

A recent United Nations report (2008) suggests that natural disasters have devastating outcomes in terms of loss of human life. Between 2001 and 2005, 483,322 deaths were reported worldwide as being caused by natural disasters (e.g., tsunamis, earthquakes). Other serious outcomes of disasters include the property loss, forced dislocation, and instant poverty of the survivors.

Over the past years, terror attacks ─ constituting a grave threat to an entire community or nation ─ have become a salient and pernicious form of communal disaster situations (Raviv, et al., 2000). Terrorism and related acts of political violence are responsible for the suffering and death of thousands of people across the globe. The RAND and MIPT analyses identified 19,828 terrorist acts worldwide for the period beginning 1968 and ending 2004. These acts of political violence resulted in 86,568 injuries—of which 25,408 were fatal (Bogen & Jones, 2006). Such acts of violence have also been reported as having indirect, vicarious effects on the populace via the mass media (Dougall, Hayward, & Baum, 2005).

Research has shown that humans have a natural capacity to recover and even to enhance their individual adaptive capacities under adverse conditions (Miller, 2005). There is evidence to show that resilient responding is a common, if not predominant, response pattern to disaster (Bonanno, 2004, 2005). It would be valuable for disaster management to more formally build on this knowledge. Resilience implies the ability to bounce back and even to grow in the face of threats to survival. Three core principles of resilience are: control, coherence, and connectedness (Reich, 2006).

People need to believe that they have control in their lives, and those who have higher levels of personal control beliefs have higher life satisfaction (Rodin et al., 1985), morale (Brown & Granick, 1983), lower levels of depression (Lachman & Weaver, 1998), and they tend to live longer (Dalgard & Haheim, 1998).

Disasters destroy the familiar, creating behavioral disruption and cognitive disorganization both for the individual and the society. A sense of coherence, is perhaps less readily apparent on the surface but may be even more fundamental to individual resilience. People wanted answers. This drive for knowledge is a fundamental principle in the motivation of all organisms (Fiske & Maddi, 1961; Berlyne, 1963).

A notable characteristic of the behavior of people in disasters is to band together, to seek out others, to establish bonds even with strangers. A major part of the stressfulness of disasters is the breaking of stable bonds with other people. Survivors seek to re-establish social bonds as quickly as possible and suffer anxiety if they cannot. This is one reason why the loss of a family member, or even the loss of a family pet, is so harmful.

Scope of research on disaster

In the present study, disaster is defined as a crisis where demands exceed capabilities (Khalid et al., 2010b). Disasters are non-routine events that occur in societies or their larger subsystems (e.g. regions, communities). They involve conjunctions of physical conditions that create human harm and social disruption (Quarantelli, 1998). This means that for disasters to occur in time and social space, both conditions are individually necessary and collectively sufficient.

In general, disasters are characterized by being:

- *sudden*, the onset usually is unforeseen and happens without warning,
- *serious*, the functioning of a community or a society is disrupted,
- *overwhelming*, the human, material, economic and/or environmental losses exceed the ability of the affected community or society to cope within its own resources,
- *swift*, the development of events following the onset is so rapid that it exceeds the ability to respond, and finally
- *surprising*, events often develop in unexpected directions, thereby challenging the readiness and resources of the responding organizations.

The impact of disasters may be loss of life, injuries, displacement of large groups of people, disease, disability, food insecurity, damage or loss of infrastructure and basic services, serious societal and environmental threats, weakened or destroyed public administration and reduced public safety and security.

Orasanu and Connolly (1993) identified eight factors that are common to disasters: (1) ill-structured problems, (2) uncertain dynamic environments, (3) shifting, ill-defined, or competing goals, (4) action/feedback loops, (5) time stress, (6) high stakes, (7) multiple players, (8) organizational goals and norms. All of these characteristics put demands on the ability to communicate and inform people so that they can organize themselves and respond to the situation in an orderly fashion.

Therefore, effective management of disasters requires a common understanding of the situation among the principal groups of people involved. These are: (1) the formal organizations at the national, regional and international level, comprising of disaster management teams, rescue teams, and government authorities on the one hand, and (2) the public at the individual or community levels on the other. Since the two principal groups are likely to respond in different ways, there is a need to understand them in order to build a resilient community (Hollnagel, Woods & Leveson, 2006). Understanding how this "social capital" can be effectively developed and managed can result in efficient life saving operations (National Research Council, 2006).

Besides the negative impacts of disaster on lives and properties, lessons learnt from them have led to development of safety laws and establishment of specialized functional organizations and bodies. Even more significant have been the changes in **attitudes** regarding the inevitability of disasters (Toft & Reynolds, 1994), from fatalistic resignation to intervention at gaining human control over fate (Aini & Fakhrul-Razi, 2010).

The focus in our study is on risk attitudes of people as they narrate or report their experiences in the following disaster categories:

- *Natural disas*ters **-** tsunamis, earthquakes, hurricane, and floods;
- *Human-induced disasters* **-** terrorist attacks, fire, industrial accidents, and transport accidents;
- *Pandemics disasters* **-** swine flu, SARS, HIV/AIDS, and TB.

The next chapter presents a semantic framework for understanding the relationship of attitudes and disaster situations.

4

Semantics Framework

This chapter presents the semantics for development of ontologies that enable analysis of attitudes during disasters. The semantics were mined using text mining tools and these are described in the sections below.

SEMANTIC MAPS FOR VISUALIZING INFORMATION

Semantic maps are graphic representations of the relationships between key concepts. We assume that there are multiple relations between a concept and the associated knowledge structures. For any concept there are at least three types of associations (Estes, 1999):

- associations of *class* – the order of things the concept falls into (e.g., themes);
- associations of *property* – attributes that define the concept (e.g., requirements, classifier);
- associations of *example* – exemplars of the concept (e.g., attitudinal constructs, data type).

Semantic processing involves an integration of information in a semantic map. The semantic value of the map becomes apparent when it is relevant to a personal experience, so that the information can be processed in a meaningful way. By using a semantic map, an individual can map data onto a visual structure (Card, 2003).

In this study we used semantic maps derived from meaningful personal experiences, to develop ontologies that would lead to attitudinal forecasting for disaster management.

Ontologies

In modeling attitude for disaster management, there is a need to integrate information from various heterogenous sources. The use of ontology helps to reveal the implicit and hidden knowledge that are crucial for model development (Wache et al., 2001). Ontology is an explicit formal specification of a shared conceptualization (Gruber, 1995; Sheth, 1999; Xu & Zlatanova, 2007). Conceptualization is an abstract model of the real world phenomenon, by which the real world is identified as a set of concepts (Studer et al., 1998); shared means that the notions are accepted by a certain group as consensual knowledge (Uschold & Gruninger 1996).

In defining ontologies, the meanings of the types of concepts that are used in the conceptualization and the constraints of their usage are made explicit (Studer et al. 1998, Uschold & Gruninger, 1996). In addition, the ontology is defined formally in an artificial and well-defined language so that it is machine-readable (Uschold & Gruninger, 1996). As such, ontology could be defined explicit or implicit, with different degrees of being formal and being shared (Audi, 1995).

In this project, we define ontology as a way of explaining reality by breaking it down into concepts, relations and rules, to share it with others. In this phase of the project, we will only specify the ontology architecture for attitudinal modeling using a hybrid approach.

Ontologies approaches

Ontologies may be built from top-down or bottom-up approach. Top-down ontology is constructed by first examining the domain of interest at an abstract level and then constructing it based on top levels concepts. Therefore, an abstract model of the domain of interest is built first and extending the model further to map more specific concepts from low levels. The result is a generic model of the domain of interest, and it contains the relations between concepts within the domain of interest.

The bottom-up approach looks at existing text data sources from low levels (themes, seed concepts, maps, labels, etc.), and develops ontologies for specific disaster and attitude types, and combining them as a whole. The resulting ontologies from a bottom-up approach focus on the specifications of the data sources, and capture the relationship between the data sources.

Both approaches have their advantages; we examined the semantics from text corpuses of narratives and research reports, and we also identified abstract concepts associated with human behavior in disaster scenarios on the basis of the people-environment systems model (also known as citarasa behavioral systems model, see Khalid et al., 2008). The resulting ontologies are general enough to exchange domain information as well as contain enough information for mapping among different datasets.

Ontologies architecture

Figure 4.1 shows the architecture of attitudinal modeling for disaster management, comprising generic ontologies of Risk Attitude and Disaster Situations. Within the generic ontologies are specific ontologies for each ABC type within the risk attitude class and each disaster situation type within a disaster class. The architecture provides a shared vocabulary for specifying the semantics.

Figure 4.1. Ontology architecture for attitudinal modeling

For the purpose of modeling, the ontology architecture maps the generic attitude ontology and the generic disaster situational (organizational) ontology.

- Attitudinal type ontologies are those that describe Affect, Behavior and Cognition data sets that are needed for Risk Assessment, to enable prediction on the basis of Situation Awareness and Cultural Values.
- Disaster type ontologies are those that describe the datasets (e.g., tsunami datasets, terrorism datasets, SARS datasets, and so on) that are needed for disaster situational forecasting. Besides being useful for the disaster domain, the datasets could also be used for other domains such as environmental domain, security domain, and so on. With the specific disaster type ontologies, one data set can be mapped with another (e.g., from tsunami data to hurricane data, from swine flu to SARS, etc) or several datasets can be combined (e.g., the combination of tsunami, earthquake, hurricane, flood data) in a disaster class. In disaster situational forecasting, we have data not only from the existing

databases but also from the field (e.g., culture valence, intensity of values, time perspective, etc.) that need to be processed and combined.

Generic Ontologies

Attitudinal ontology

Figure 4.2 illustrates a generic attitudinal ontology.

Figure 4.2. Generic attitudinal ontology

In the context of disaster, the attitudinal ontology expresses the following concepts:

- **Attitudinal** components of Affect, Behavior and Cognitive describe the emotions, feelings (affect), intent, action (behavior), perception, thoughts (cognition) through descriptors or concepts. Examples of affective descriptors are Fear, Trauma, Anger; behavioral descriptors are Anticipation, Coping, and cognitive descriptors such as Perceive, Sense.

- **Emotion** expresses subjective feelings toward the perceived risk. This may range from low to high intensity, depending on risk assessment and situation awareness, that may induce a threat to life. The semantic interpretation of Emotion is based on Affective

Descriptors derived from the dataset in conjunction with a level of description or conformity.

- **Perception** expresses how the risk situation is perceived. This is an entirely subjective element which can only be interpreted as a conjunction between perceiver and perceived risk situation. Cognitive Descriptors derived from the datasets enable semantic interpretation of Perception. The level of description or conformity, such as importance, severity, determines the requirements.

- **Action** expresses how the risk situation should be acted upon. Action uses Behavioral descriptors to enable their semantic interpretation. A level of description or conformity can be defined to give different weight to different Action output.

Disaster situational ontology

Figure 4.3 shows a generic ontology of disaster situation.

Figure 4.3. Generic disaster situational ontology

In Figure 4.3, the disaster situational ontology expresses the following concepts:

- **Disaster Situation** which is described by the descriptors in conjunction with its level of importance based on the disaster dataset.

- **Situational Needs** expresses the requirements in conjunction with the level of conformity of the dataset. This may range from low to high need, depending on the disaster situation.

- **Services** describe the requirements of help facilities in relation to situational needs and level of conformity of dataset. The services may be at the level of local, regional and/or international, depending on the importance of situational requirements.

- **People** describe the actors involved in a disaster situation. They include rescue agencies, medical team, military, community and the public. Their level of participation is determined by the nature of the service descriptor and situational needs.

The Requirements express the relationship between the situation and needs, while the Classifiers define the level of conformity to the requirements.

In sum, the attitudinal ontology describes the attitudes of the people at risk (e.g., victims, survivors), while the disaster situational ontology describes the organization of services and the actors (e.g., relief team) involved to support the needs of the people at risk. These ontologies form the architecture for a disaster management system. To identify the semantics for the ontologies, the next section describes the process of text mining.

Text Mining

Text mining is a process of extracting meaningful information from a large number of free-from documents. It uses techniques from data mining, machine learning, natural language processing (NLP), information retrieval (IR), and knowledge management.

Traditional data mining used highly structured data represented in numbers. However, text is a highly unstructured data format and difficult to deal with algorithmically. But it does not mean that the two concepts are distinctive. This is because text can be processed and transformed into a numerical representation in the mining process, and the same mathematical techniques can be applied.

Latent Semantic Analysis (LSA)

Latent Semantic Analysis (LSA) is a theory and a method for capturing and analyzing the similarity of words and text passages by statistical computations applied to a large corpus of text (Landauer & Dumais, 1997). The baseline theory of LSA is that the aggregate of all the word contexts in which a given word appears or does not appear provides a set of mutual constraints that largely determines the similarity of meaning of words and sets of words to each other (Landauer, Foltz & Laham, 1998).

The similarity estimates derived by LSA are not simple co-occurrence counts, but are based on Singular Value Decomposition (SVD), which is capable of correctly inferring much deeper relations within text passages. Singular Value Decomposition (SVD) is closely analogous to factor analysis. LSA believes that the choice of dimensionality in which all of the local word-context relations are represented can be of great importance and that reducing the dimensionality – the number of parameters by which a word of passage is described, from the number of initial contexts to a much smaller number, will often produce much better approximations of human cognitive relations. It is this dimensionality reduction step, that surface information is captured into a deeper abstraction and the latent relationship between words and passages is revealed (Landauer, Foltz & Laham, 1998).

LSA has been applied to a wide range of problems for identifying the contextual meanings of words and documents, including information retrieval (Dumais, 1994; Foltz, Kintsch, & Landauer, 1998) assessing learning (Landauer, Laham & Foltz, 2000; Landauer & Dumais, 1997), modeling knowledge acquisition (Landauer & Dumais, 1997), identifying shared understanding in design (Landauer, Foltz & Laham, 1998, characterizing design team performance (Dumais, 1998) and predicting team performance on simulated military mission (Foltz, Kintsch, & Landauer, 1998).

A typical latent semantic approach involves five steps: capturing the language-based communication, transcribing and text processing, creating word-by-document matrix and log-entropy matrix, applying LSA to log-entropy matrix and constructing the approximate matrix, and finally computing semantic coherence between team members and visualizing. Figure 4.4 summarizes the flow of the LSA approach.

In the present study, we adapted the typical semantic approach to fit our research purpose. There were three steps in our approach as outlined in Figure 4.5. After gathering text-based narratives and written reports (i.e. text corpuses), the text was processed by the Stanford POS tagger (Toutanova, et al., 2006) to assign parts-of speech to each word. This software used the Penn Treebank corpus annotation set developed by University of Pennsylvania. This step generated words that only carried content-bearing information. The meaningful words with parts of speech information were used to construct the word-by-document matrix. The essential words were retained, including nouns, verbs, and adjectives. Only words which appeared more than twice in the utterances were extracted to form the word-by-document matrix, which counted the frequency of occurrence of each unique word in each utterance.

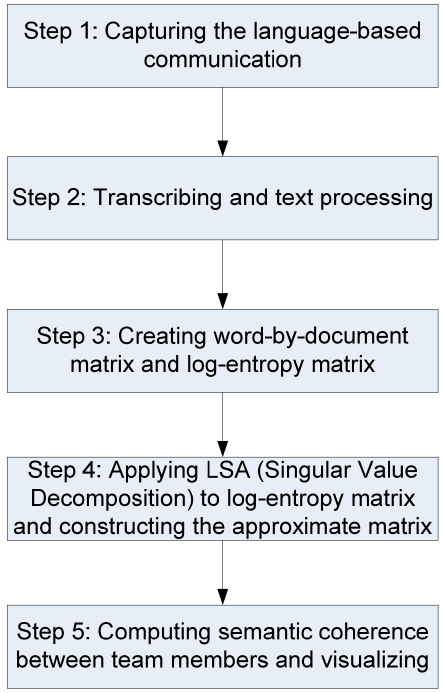

Figure 4.4. Flowchart of a typical latent semantic approach

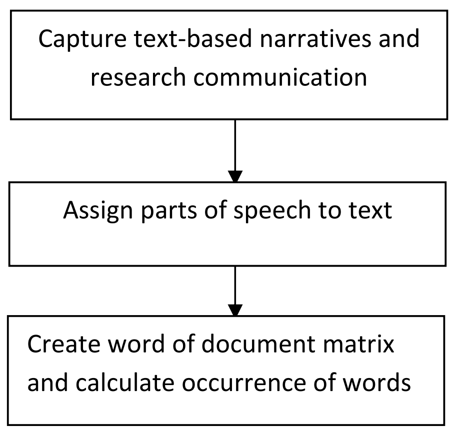

Figure 4.5 Latent semantic approach of the study

The third step was to represent the text in a matrix format as shown in Figure 4.6. The rows of the matrix represented all unique words found within the text corpus, and the columns represented each individual utterance. Each cell contained the frequency of each word as it appeared in the utterance denoted by its column. The result was expressed in a word-by-document matrix. From the word-by-document matrix, the number of occurrence of each word was then calculated.

$$X = \begin{bmatrix} & Doc_1 & Doc_2 & ... & Doc_n \\ Word_1 & 0 & 0 & 1 & 1 \\ Word_2 & 1 & 0 & 1 & 0 \\ Word_3 & 1 & 2 & 1 & 1 \\ ... & 2 & 3 & 1 & 0 \\ Word_m & 2 & 0 & 0 & 2 \end{bmatrix}$$

Figure 4.6 Representation of word-by-document matrix

Leximancer Analysis (LXM)

To analyze the text corpus for developing a semantic framework, we used Leximancer, a text mining tool. Leximancer is a software system for conceptual analysis of text, with the ability to map text using a set of conceptual dimensions. Leximancer used a classification system of learned lexical concepts, rather than keywords. It provided automatic analyses (through machine learning) as well as customized content analyses using pre-defined concept classifiers. This allowed efficient classification and quantification of large text documents (Smith, 2005).

Themes or concept groupings were identified in the textual data. They represented clusters of keywords such as phrases and name-like concepts. Using a word coherence technique, relationships between concepts, within and between different data sources, were identified. The output was a visual representation of these concepts and relationships, which were used to quantify and display the conceptual structure of a set of documents.

Although Leximancer can support .pdf and .html files, all the data were converted into a single .doc format to ensure that all data were analyzed thoroughly. After a set of data was selected, the data were pre-processed to convert the raw documents into useful format for further processing by identifying sentences and paragraphs. Once the data had been pre-processed, important concepts were automatically identified from the text.

The concepts in Leximancer were collections of words that travel together throughout the text. Therefore, thesaurus learning identified clusters of words that traveled together. Once the concept identification had been learned, each block of text was located to identify the location of the concept from the data set. The last phase of processing in Leximancer was mapping, whereby the conceptual map of the data set was displayed. Figure 4.7 summarized the Leximancer Analysis process.

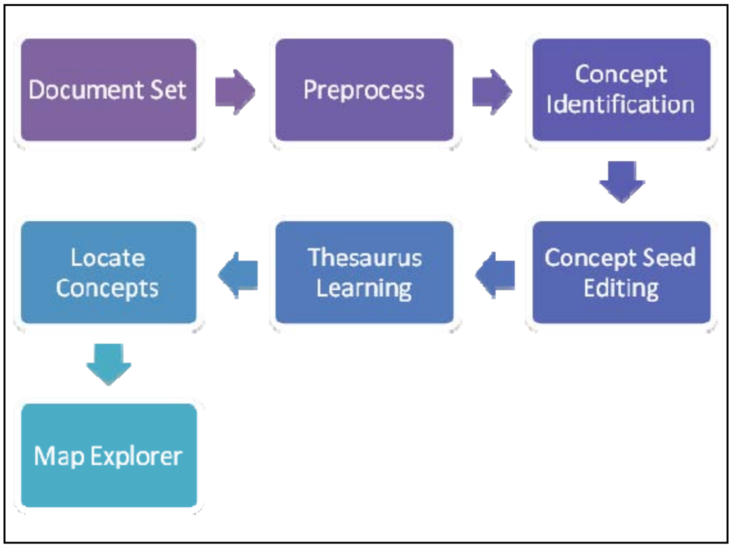

Figure 4.7. The process of Leximancer analysis

In essence, the text mining was conducted in three stages:

Stage 1: Data Exploration. To understand the content of the data set, Leximancer analyzed the data freely, producing an initial exploratory map. In this initial analysis, the duplicate text sensitivity setting was increased to its maximum in order to avoid spurious results, and the number of concepts function was set at 400, using the default threshold value of 14. At this stage, no variables were added or removed. The resulting semantic map was then analyzed, and concepts that were deemed irrelevant to the disaster context were removed from the map.

Stage 2: ABC Classification. The derived concepts from Stage 1 were converted into a spreadsheet for identification of ABCs by three classifiers with a background in cognitive science and human factors. Non-ABCs were removed during this stage.

Stage 3: Final analysis. In this stage, concepts that had been identified as ABCs were further processed by the tool. This time, the Automatic Concept Identification was turned off; instead the Concept Seed Editing was turned on. This enabled generation of themes and concepts that are meaningful to the context. In order to generate an overview of the main themes and their groups of concepts, the theme size was set at 50% and the concept size at 0%. Semantic maps of each disaster type were compared to identify consistencies in concepts across disasters as well as variables that differed between contexts.

5

Research Methodology

This chapter describes the methodology for data preparation and analysis. The tools that were used in the study and their processes have been described in Chapter 4. A pilot study to test the tools was undertaken and reported in this chapter.

TEXT PREPARATION

The procedure for gathering of secondary data and preparation is summarized below.

1. Text corpora were gathered from digital libraries and Web sources. They came from two sources: personal stories and research articles. The personal stories were obtained from blogs, while the research articles from e-journals. Appendix A provides a listing of the files that were used in the study.
2. The material was screened for ABC criterion. This means that only text containing information about people's affect, behavior and cognition in relation to a disaster situation was used.
3. The material was converted to txt format for processing by both tools. This is because LSA could not read files in .pdf format, unlike Leximancer.
4. The specimens were cleaned to remove words that were not relevant to semantic processing. This included titles of document, names and affiliations of authors, source of publication, and so forth.
5. Each data file was recorded into a specimen template and the number of words was counted for each text specimen. Appendix B gives an example of data recording template for a disaster from each disaster class.

Corpus sample

Table 5.1 summarizes the text corpora used in the study. The total number of words from narratives (i.e. personal stories) is 308,168 words, while the total from Research Articles is 350,189 words.

Table 5.1. Text Corpus by Disaster Class

Disaster Class	**Disaster Type**	**Narratives/People's Stories**		**Research Articles**	
		No of articles	Corpus count (no. of words)	No of articles	Corpus count (no. of words)
Natural Disasters	Tsunami Earthquake Hurricane Flood	27 29 38 31	39,409 77,430 31,742 52,857	13 15 30 14	42,034 59,984 16,521 24,655
Human Induced Disasters	Terrorism Fire Transport Industrial	17 16 9 14	23,936 25,821 10,824 9,618	15 17 11 12	40,205 41,084 23,983 12,311
Pandemic	Swine Flu SARS HIV/AIDS Tuberculosis	8 6 19 12	16,108 5,471 7,918 7,034	10 17 18 6	14,656 14,027 32,447 28,912
Total		**226**	**308,168**	**178**	**350,819**

Example of Disaster Text Corpus

Below we present an example of text for each of the disaster type within a disaster class.

Natural disaster

Tsunami Personal Stories	**Tsunami Research articles**
*A cresting wave knocked Sujith down, and he felt pain shoot through one of his hands. He staggered up and, wading through the wash, came upon his father, who had been swept into a ditch and was waist-deep in water. Sujith pulled him out and screamed, "Run! Run!" The words were barely out when another wave carried them both away, hurtling them along like tree stumps caught in rapids. Sujith tried to grab hold of a concrete post that whipped past him, but missed. Instead the wave wrapped him around a palm tree, which he struggled to climb. Reaching the top, he could see that his little community of 11 houses was cut off from the rest of Weligama by a sewage canal that was now transformed into a raging river. He desperately tried to get a glimpse of his family, but all he could see was his house. The water covered the windows and front door. He feared the worst (*Dobbs, 2005, p. 4).	*Entrusting children to orphanages irrespective of whether they lost only one or both parents has become a source of emotional confusion for some children who cannot come to terms with the idea that poor coping on the part of surviving parents and/or their poor financial situation should be grounds for placing them in orphanages (ICMH, 2006; India Info, 2005). Among the many child psychosocial implications that have emerged in the wake of the tsunami, eating and sleep disorders and fear of the sea have been the most pervasive. Survivor guilt also remains problematic. In the Maldives, for example, children are reported to have become obsessed with feelings of guilt at what they see as their personal failure to hold younger siblings aloft in the water or to keep hold on them when the sea swept back.* (Carballo et al., 2006, p. 3)

Earthquake Personal Stories	Earthquake Research articles
On Monday, December 22, 2003, at 11:15 am, we experienced an earthquake of 6.5 magnitude, for somewhere between 30 -- 45 seconds, which, for an earthquake, is a long time. I was sitting in front of the tv in the den, watching the news and enjoying a bowl of soup. Stephanie was primping in the bathroom, and Carrol was doing something on her computer in her room. I knew instantly what was going on. Then I heard Stephanie and Carrol, and that brought me to their reality. I went to see what was happening with them, and I found Stephanie on the floor, crying and freaked out, with Carrol hunkering over her, protecting her. As it turned out, Carrol knew right away what was going on -- we are both old hands at this, we both have experienced earthquakes before -- but Stephanie has never had such an experience, and she basically went into a panic. She was in the bathroom, disoriented and scared, and was going to run out the back door, but Carrol got to her (Ballew, 2008, p. 1).	*The association between fear and earthquake-related psychological distress is consistent with findings from a previous study of survivors of the 1981 earthquake in Athens which compared survivors who had returned in their homes to those who still lived in tents 2–3 months after the earthquake. In that study the survivors who still lived in tents were more anxious and reported (retrospectively) significantly greater fear during the earthquake. The association between fear and post-earthquake psychological distress is also consistent with results from studies based on survivors of the 1999 Marmara earthquake in Turkey* (Livanou, 2005, p. 6).
Hurricane Personal Stories	**Hurricane Research articles**
I learned just how rude when a tornado hit my city of Tuscaloosa, Alabama, Dec. 16, 2000, killing 11 people and leaving hundreds homeless. It was my first - so far, my only - occasion covering a disaster, and I was ill-prepared for the emotional states the newspaper's staff went through as the tornado and its aftermath unfolded. This isn't one of the topics you usually cover in journalism school: treating victims with respect and sensitivity, while at the same time getting the information you need (Lee, 2001, p. 1).	*Findings extend the previous research on disaster reactions by examining contextual differences and have a number of potentially important implications for social policy. For example, evacuation distance was negatively associated with symptoms and traumatic experiences. Residents of the Mississippi Gulf Coast in this study were less likely than the other groups surveyed to evacuate more than 100 miles away from their residences and were subjected to a greater number of immediate events. These residents also had a greater number of PTSD symptoms. Although the relationship of evacuation distance to symptoms was not uniquely associated when controlling for the number of events experienced, this finding suggests that evacuation, not just to a safer dwelling, but far from the area of projected landfall might be a good public mental health policy* (Weems, 2007, p. 3).
Flood Personal Stories	**Flood Research articles**
On the first floor I have a view of the entire village and then really realize the magnitude of what has happened. Everywhere you look is water, water and more water. There are people at the townhall who are not too sure about their relative's fate. There are also people, almost sure about their relative's fate but still have hope. There are people who know for sure about their relative's fate and are not hoping any longer.The Reverend Enkelaar is busy trying to supply everybody with food as far as that may be possible. How it happened I don't know, but there was food, as far as I can remember. Water however was a different story. We had no drinks for 12 hours	*Many residents living in drainage areas (such as the Shinkawa River area in Nagoya City) anticipated a flood before the Tokai flood. It is often suggested that Japanese people are very concerned about disasters. However, other studies have found that the level of preparedness of the Japanese for disasters is insufficient. Thus, flood perception and the actual level people take to prepare themselves for floods are not always in agreement. To enhance residents' preparedness for floods, it is necessary to examine the causes of the disagreement between flood perception and practical measures undertaken by residents* (Takao, 2002, p. 5).

(Oeveren, 1997, p. 2).	

Human Induced Disaster

Terrorism Personal Stories	Terrorism Research articles
As we prayed, my first instinct was to pray for the victims — both the living and the dead; to pray for the firefighters and police officers on the scene; to pray for the families of the victims; to pray for President Bush and the members of Congress; to pray for my fiancée who was in New Jersey at a seminar, a mere 15 miles from my daughter and I as a bird would fly, but she may as well have been 1,000 miles away; to pray for my children and ex-wife in the Midwestern U.S.; and to pray for the safety of everyone else in the United States, with an emphasis on those in New York City. I heard someone talking, and since we were at CBS Studios and supposed to be getting interviewed, it shook me back to reality, I guess. Looking quickly at my watch, it was now 9:20 a.m. This was one hell of a way to start a day, I thought (Jackson, 2007, p. 3).	*Finally, by virtue of their scale alone, collective traumas become the center of media attention. This not only contributes to the collective nature of the event but also has the effect of putting the field of psychology itself in the spotlight. Psychologists are called on to contribute to the public's understanding of the trauma through the media, dispersing the apparent word of science to a wide audience. The damage caused by misstatements and faulty conclusions drawn from intuition rather than empirical data can thus multiply beyond an individual client. Such statements may be the only contact many people have with psychology, especially if they experienced the trauma through media coverage. Even brief sound bites could guide the public's expectations for how they and those around them should be responding, including expressing thoughts and feelings* (Seery et al., 2008, p. 4).
Fire Personal Stories	**Fire Research articles**
I have to mention that I have always been a very heavy sleeper. The fire alarm went off, I did not hear it and my Mom thought that it was my Dad's alarm clock before smelling the smoke, so it wasn't good. Outside the house there was a man he was delivering the newspapers to the delivery-boy when he spotted the flames and smoke. He quickly rushed over to the house and found my Mom outside panicking, screaming, "MY BABIES ARE IN THERE, MY BABIES ARE IN THERE!!!" He then ran into the house, (keep in mind that this man has never before been inside that house), directly to the room in which my sister and I were in. He picked both of us up and went to go out the door (Thompson, 2002, p. 2).	*In the early stages of a fire, the people in a building typically have to either rely on themselves, or be rescued by others in their immediate vicinity. The assistance of the professional emergency services, for example in the form of rescue operations by firefighters and emergency treatment by paramedics, can only be provided after the first and most important stage of a fire. Human behaviour during this initial phase is, therefore, an important factor in terms of survival. It can be defined as the actions that people take based upon their perception of the situation, their intention to act, and the considerations involved before these actions are carried out. Accordingly, how people behave during an escape is referred to as evacuation behaviour* (Kobes et al., 2010, p. 2).
Industrial Accidents Personal Stories	**Industrial Accidents Research articles**
You probably wouldn't let us out of here if you had your way, you'd put up a police cordon, that would calm you down. Stops. Don't try to tell me it's not like that. I lived through it. In those first days… I took my daughter and ran off to Minsk, to my sister. My own sister didn't let us into her home, she had a little baby she was breast-feeding. Can you imagine that? We slept at the train station. I had crazy thoughts. Where should we go? Maybe we should kill ourselves so as not to suffer? That was just in the first days. Everyone started imagining horrible diseases, unimaginable diseases. And I'm a doctor. I	*Contrary to the researcher's expectations, the current findings do not support the notion that mineworkers are more susceptible to fatalistic and defensive attributions than their counterparts in non-mining industries. There was no difference of statistical significance between the two cate-gories of accident victims on their perception of supernat-ural forces and environmental factors as causal factors. Generally, accident causality factors were attributed to workers' dispositional factors, which implicated workers' incompetence and/or failure, and thus indicating that both groups of*

can only guess at what other people were thinking (Block, 2006, p. 2).	*victims perceived worker dispositional characteristics as primarily responsible for accident occurrences* (Gyekye, 2003, p. 5).
Transport Accidents Personal Stories	**Transport Accidents Research articles**
I unbuckled my seat belt and took my turn in a line that formed spontaneously in the central aisle. I did not even try to pick up my brief case that was lying underneath the front seat because every second mattered. By that time, the entire plane was on fire and I could even feel the heat through the floorboards and soles of my shoes. I was one of the first to reach the exit. But to my dismay, I soon discovered that there was no chute for anyone to slide down. I jumped out without any hesitation, but just like the way the plane came down, mine too was not a smooth landing! I went sprawling on the ground the same way a few other passengers did. Fortunately, the height from which we had to jump was not much (Abeyagunawardene, 2008, p. 2).	*"This was the most perfect emergency landing I ever saw in my life," sanitation worker Danita Johnson told a local New York news channel, who had watched it from a nearby pier. Mr Kolodjay, who said that people went silent and started praying when the captain told them brace for impact, hit his head on impact with the water, but said he was "fine." "You've got to give it to the pilot he made a hell of a landing," he added. Some eyewitnesses admitted it could have been much worse, reminiscing about Flight 90 in 1984, when an Air Florida flight crashed into Washington DC's 14 Street Bridge immediately after take-off because of heavy snow, killing all but five of its 79 occupants* (Quinn, 2009, p. 2).

Pandemic Disaster

Swine Flu Personal Stories	**Swine Flu Research articles**
My family has a long history of vaccine injuries that are not reported as vaccine injuries. The list includes three cases of GBS in same family. My mom got her H1N1 shot on Monday of last week. She is high risk health care worker..I begged her not to get shot. But she did anyway to protect her residents. She thought she may be getting a cold on Wed. She went into resp and cardiac arrest on Sat. She has been on life support for the last five days. She is not breathing on her own, she is in medically induced heavy sedation/coma. One has something to do with the other..what does it take to get medically advised not to take these damn shots? (Derrico, 2009, p. 1)	*The latest reports I have seen seem to indicate that the H1N1 flu is not as virulent as initially feared. Apparently though, the early infections during the 1918 flu epidemic were also not particularly virulent. At this point we don't know how this H1N1 virus will evolve, so it makes sense to keep taking sensible precautions. These facts give us another reason not to overreact: it is possible that infection with the H1N1 virus currently circulating will provide resistance against a possibly more virulent later version* (Pennebaker et al., 2009, p. 1).
SARS Personal Stories	**SARS Research articles**
For a week, I was so weak I struggled to make it to the bathroom. I had to hang onto things because I was in a room by myself with the door closed, and if I fell, no one would see me. I couldn't shower; I was just too worried that I might fall. I joke now that my hair had a week-long oil treatment. I knew I wasn't going to die. I'm young, in great health, I've never smoked and I never get sick, so I was optimistic throughout the ordeal. . The only tense moment was when my 15-year-old daughter, Nicole, who was under quarantine at our house with her older sister and my husband, came down with a fever and cough. When I heard about Nicole, I cried. We could talk on the telephone, but I felt so helpless. I couldn't be	*For example, one participant said, ''They took me to that quarantine room, only asked me to lie down on the bed, and not to go outside except to the toilet by following the yellow line on the floor. You never knew about the next step and how long you would wait.'' Struggle with possible SARS diagnosis. Each participant mentioned feeling very afraid of being diagnosed with SARS during the quarantine period and were burdened by this shadow. Finally, all of them were completely relieved when SARS was ruled out. At the same time, they were informed of the quarantine ending. Many participants used ''big stone'' to describe their laden worry about being diagnosed with SARS* (Lan Lin et al., 2004, p. 3).

with her. I panicked. She turned out to be fine but it was very frightening (McClelland, 2003, p. 1).	
HIV/AIDS Personal Stories	**HIV/AIDS Research articles**
Today, I am celebrating an Anniversary. I don't recall the exact day I found out I was infected with HIV, it was sometime in 1984. The day that stands out most for me is November 28th 1985. On November 28th 1985, I was told by my doctor to inform my family, arrange my finances and funeral, I had six months to live! Soon after, I left my job, friends and family and moved far away so that no one would see me get sick and die...but I didn't die. Twenty-five years later I'm still here. The point is that I missed out on so much during those years when I hid my HIV status and lived far away from family and friends. Years, when I could have been close to those I love but instead I lived in isolation (McIntyre, 2009, p. 2).	*The challenges that older persons face as a consequence of being caregivers and losing their adult children are manifold. Financially, older adults struggle as their adult children are no longer able to provide them with support. Furthermore, old age pensions in South Africa are commonly the only source of household income and are unable to cover all living, medical, and schooling expenses for themselves and their dependents. Emotionally and psychologically, older adults suffer from feelings of distress, anxiety, depression, helplessness, and hopelessness as a result of their caregiving responsibilities and loss of loved ones* (Boon, 2009, p. 3).
Tuberculosis Personal Stories	**Tuberculosis Research articles**
As we had gathered for a party with colleagues and friends, a phone call came from my doctor. She had a simple message; "you can't leave the country because it has been noted that you have MDRTB". I honestly had no idea what that was all about! As I woke in the morning, there was an ambulance outside waiting for me. As the rest of team was on their way to the airport, I was on my way to the hospital, two extremes again. *That was marking the beginning of another chapter in my life* (Ocaya, 2007, p. 2).	*His wish centered on spreading awareness of this deadly form of TB and the images are borne out of Nachtwey's frustrations with the underreporting of what is potentially a global health crisis. His photos tell the grim stories of impending death. In one, a man's suffering is so palpable that it is almost impossible to tear your eyes away from him. Another image shows a woman in a Thai hospital staring vacantly, as if resigned to the fact that death is soon approaching. Yet another shows the look of helplessness on a mother's face faintly reflected in the terrified eyes of her ailing child. And so the images continue, revealing with each click of the mouse a photo that is more haunting than the last* (Poltzer, 2008, p. 1).

DATA ANALYSES

The data analyses were performed in 5 stages.

1. Frequency analysis using text mining tools, LSA and Leximancer, was performed on the prepared data. This generated a listing of words mined by each tool, and analysed with Analysis of Variance (ANOVA) to determine if the tools differed in semantic processing. A pilot study was conducted to test the feasibility of the tools on text format.
2. The words were counted in terms of the number of similar and dissimilar words mined. Cohen's kappa (1960; 1968) was performed on the data set.

3. The words derived from Leximancer analysis only was classified manually into ABC by 3 classifiers with background in cognitive science, and human factors.
4. The classified data were screened by a confederate to resolve conflicting results in the classification.
5. The inter-classifier reliability, Fleiss Kappa (1971; 1981) test was performed on the ABC counts.

Pilot study

A pilot study was conducted on a specimen of text from a chapter of the book "Unthinkable" (Ripley, 2008). The purpose of the pilot was to understand the nature of text preparation for analysis by both tools. The text was derived from a chapter "FEAR" which contained 11,559 words. The text was scanned and converted to .txt format for analysis by both LSA and LXM. An extract of the text is shown below.

> *The Physiology of Fear*
> *What does it feel like to face death? What happens in our brains as the ground buckles under our feet? Fear guides our reactions in every stat ion of the survival arc. But we'll consider its effects here, in the beginning of the deliberation phase, because fear is typically at its peak once we've grasped the danger we face. Any deliberation that follows will happen through the prism of fear. People's behavior in a disaster is inexplicable until we understand the effect of fear on the body and mind.*
>
> *The human fear response looks a lot like the fear response of other animals. So scientists understand fear better than, say, guilt or shame. - Fear is so fundamental," says brain expert Joseph LeDoux. "There are key environmental triggers that will turn it on and well-worked-out responses that help you cope with it. These things have stuck around through zillions of years of evolution."*
>
> *The first rule of fear is that it is primitive. Consider the fact that our hair stands on end in a terrifying situation. What purpose could that possibly serve? Well, none for us. But scientists believe it may be related to the flashing of feathers in birds or fin extensions in fish, all of which aid in the survival of those creatures. Over the long arc of history, fear has served us very well, and it still does, with some exceptions (Ripley, 2008, p.)*

The results of the pilot run are summarized in Table 5.2.

Table 5.2 Summary of LSA and LXM functions

Functions	LSA	LXM
Text format	Operational on .txt format only. Can be used to analyze characters, e.g. Mandarin characters.	Operational on .txt, .doc, and .pdf formats. Cannot be used on language characters.
Text count	Generated a word count of 849 words from a total of 11,559 words. But the words are a mixture of relevant and irrelevant words.	Generated concept count of 190 concepts from a total of 11,559 words. A threshold can be set for concept generation.
Analytical	Assigned parts of speech to word, e.g. Fear/NN (noun), take/VB (verb), etc. This is useful in identifying the semantic type.	Provided a semantic map of the main themes produced by seed concepts.
Relationship	Computed correlation of target word to other words in the list.	Computed likelihood (%) of concept, mapped to target word.

From the above, it can be concluded that both tools supported functions that are helpful in semantic processing, but the text had to be converted to .txt format in order to run on both tools. This necessitated advance preparation of material in the actual study.

6

Study 1. Comparison of Tools in Semantic Mining

This chapter presents Study 1 on determining the ability of Latent Semantic Analysis (LSA) and Leximancer (LXM) in semantic mining.

RESEARCH DESIGN

Aim and Hypothesis

The objective of this study was to determine if the tools mined the same concepts from the same corpus. On the basis of the tool's main task, it was hypothesized that both tools should not differ in their semantic mining capabilities. However, to develop ontology architecture (see Chapter 4) requires visualization capability beyond semantic mining.

Method

Text corpus

The data for this analysis was selected to represent each corpus type and disaster class. Table 6.1 shows the word count.

Table 6.1. Word count by text corpus and disaster type

Disaster type	Personal Stories	Research Articles
Natural: tsunami	39,931	52,694
Human induced: terrorism	16,485	63,317
Pandemic: swine flu	17,096	19,022
Total words	73,512	135,033

Although there was a difference between the total counts for each disaster type, the number of ABCs mined from each disaster class from the combined corpus remained the same as shown in Table 6.2.

Table 6.2 Total ABC count in Text Corpus by Disaster type

	Affect	Behavior	Cognition
Tsunami	82	175	42
Terrorism	84	149	46
Swine Flu	60	98	25

Data analysis

Univariate ANOVA was performed on the frequencies of ABCs, while Cohen's Kappa on inter-classifier reliability and evaluated at the 5% probability level.

Results

Cohen's Kappa for Inter-classifier reliability

Two classifiers were given three set of derived concepts from three types of disasters namely tsunami, terrorism and swine flu. Each set contains two type of corpus to be rated which are research & media articles and personal stories. They were asked to code each concept word as: 0 = Non ABC, 1 = Affect, 2 = Behavior and 3 = Cognitive. The codes from each classifier are represented as separate variables in the data set for SPSS analysis.

Tsunami

Table 6.3 provides a summary of classification by two classifiers for tsunami personal stories (PS).

Table 6.3 Classification of ABC for Tsunami Personal Stories

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	14	9	0	23
	Behavior	0	72	0	72
	Cognition	0	7	12	19
Total		14	88	12	114
Kappa value					.701

The kappa results for PS Tsunami revealed r = 0.701, suggesting substantial agreement. Table 6.4 gives the results of classification for tsunami research articles (RA).

Table 6.4 Classification of ABC for Tsunami Research Articles

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	20	2	1	23
	Behavior	0	25	1	26
	Cognition	1	2	15	18
Total		21	29	17	67
Kappa value					.841

The kappa results for RA Tsunami revealed r = 0.841, indicating almost perfect agreement between them.

Terrorism

Table 6.5 is classification for terrorism PS. The kappa results for PS Terrorism revealed r = 0.722, suggesting substantial agreement.

Table 6.5 Classification of ABC for Terrorism Personal Stories

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	23	13	0	36
	Behavior	0	75	0	75
	Cognition	0	7	16	23
Total		23	95	16	134
Kappa value					.722

Table 6.6 is the summary for Terrorism RA.

Table 6.6 Classification of ABC for Terrorism Research Articles

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	23	2	0	25
	Behavior	0	25	0	25
	Cognition	1	14	13	28
Total		24	41	13	78
Kappa value					.676

The kappa results for RA Terrorism revealed r = 0.676; also indicating substantial agreement between the classifiers.

Swine Flu

Table 6.7 is the results of classification for swine flu PS. The kappa results revealed r = 0.803, that there is almost perfect agreement.

Table 6.7 Classification of ABC for Swine Flu Personal Stories

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	17	5	1	23
	Behavior	0	54	0	54
	Cognition	0	3	9	12
Total		17	62	10	89
Kappa value					.803

The classification for swine flu RA is summarized in Table 6.8.

Table 6.8 Classification of ABC for Swine Flu Research Articles

Count		Classifier 2			Total
		Affect	Behavior	Cognition	
Classifier 1	Affect	14	0	0	14
	Behavior	0	27	0	27
	Cognition	2	2	17	21
Total		16	29	17	62
Kappa value					.900

The kappa results for Swine Flu RA revealed r = 0.900, also almost perfect agreement.

ANOVA analysis

The effect of the analysis tools on the frequency of ABCs was determined using ANOVA. Similar concepts in LSA and LXM were identified and used, where N for Affect = 42, Behavior = 52, Cognition = 14. Table 6.9 summarizes the mean and standard deviation (SD) for each ABC type.

Table 6.9 Mean and SD of ABC mined by LSA and LXM.

TOOL TYPE	ABC TYPE	Mean	Std. Deviation	N
LXM	Affect	16.14	16.829	42
	Behavior	17.56	14.927	52
	Cognition	17.00	16.072	14
	Total	16.94	15.701	108
LSA	Affect	16.45	17.892	42
	Behavior	15.85	14.041	52
	Cognition	16.50	17.253	14
	Total	16.17	15.902	108
Total	Affect	16.30	17.264	84
	Behavior	16.70	14.446	104
	Cognition	16.75	16.363	28
	Total	16.55	15.770	216

In Table 6.10, the ANOVA results revealed $F(1, 216) = 0.06$, n.s. This means that the tools were equal in semantic mining capability.

Table 6.10 Effect of tool on semantic mining

Source	Sum of Squares	df	Mean Square	F	Sig.
TOOL	15.802	1	15.802	.062	.803
ABC	8.871	2	4.435	.017	.983
TOOL * ABC	48.032	2	24.016	.094	.910
Error	53380.644	210	254.194		
Total	112639.000	216			

Semantic mining of similar and dissimilar words

To illustrate that both tools could mine similar words, Table 6.11 provides a listing of select words from both analyses, and Table 6.12 dissimilar words.

Table 6.11 Similar ABC words mined from a sample of disaster class

		Affect			Behavior			Cognition		
			LXM	**LSA**		**LXM**	**LSA**		**LXM**	**LSA**
Natural Disaster	**PS Tsunami**	Feel	30	32	Aid	19	19	Decided	23	24
		Hope	8	4	Asked	14	14	Planned	8	8
		Lost	31	31	Damage	10	9	Thought	65	67
		Loved	10	10	Brought	11	12			
		Normal	11	12	Experience	9	8			
		Relief	22	23	Lead	4	3			
		Safe	10	10	Reports	6	6			
		Strong	8	8	Take	24	24			
					Used	9	9			
					Work	24	16			
	RA Tsunami	Feel	23	27	Aid	29	38	Decisions	13	13
		Hope	12	11	Asked	39	38	Planning	15	13
		Lost	80	98	Damage	18	20	Thoughts	14	15
		Loved	12	12	Bring	10	10			
		Normal	11	11	Experience	48	51			
		Relief	29	37	Lead	7	8			
		Safe	11	13	Reports	10	14			
		Strong	17	16	Take	17	19			
					Use	52	20			
					Work	45	44			
Human Induced Disaster	**PS Terrorism**	Calm	7	8	Act	5	4	Sense	5	5
		Fear	5	4	Attack	20	15	Thoughts	8	7
		Slow	3	2	Respond	2	2			
		Concern	3	3	Changed	4	3			
		Feeling	5	3	Use	9	9			
		Lost	4	4	Work	36	28			
		Personal	4	3						
	RA Terrorism	Calm	48	28	Act	10	12	Sense	35	38
		Fear	73	59	Attack	51	64	Thoughts	19	18
		Slow	8	7	Respond	48	40			
		Concern	12	12	Change	36	34			
		Feelings	34	40	Use	49	22			
		Lost	7	13	Work	23	29			
		Personal	26	36						
Pandemic Disaster	**PS Swine Flu**	Care	8	9	Cough	6	5	Mind	4	4
		Severe	8	7	Take	34	29	Thought	13	9
		Sick	12	15	Sneezing	3	3			
		Fear	5	5	Confirmed	4	4			
		Feeling	16	16	Provided	3	3			
		Feels	3	3	Reports	5	4			
					Treating	3	3			
					Work	29	32			
					Use	4	5			
					Taken	10	10			
	RA Swine Flu	Care	18	20	Cough	14	11	Mind	6	5
		Severe	12	13	Take	14	11	Thought	10	5
		Sick	6	6	Sneezing	26	16			
		Fear	10	9	Confirmed	7	8			
		Feelings	10	5	Provide	11	7			
		Feel	6	6	Report	4	5			
					Treat	3	3			
					Work	17	13			
					Use	11	3			
					Taken	7	5			

Table 6.12 Dissimilar ABC words mined

		LXM			LSA		
		Affect	Behavior	Cognition	Affect	Behavior	Cognition
Natural Disaster	PS Tsunami	Felt 27	Started 30	Knew 30	Lucky 23	Manage 25	Recall 12
			Looked 29			Waiting 24	
			Trying 24			Washed 24	
			Told 23			Wanted 24	
			Tried 22			Arrived 23	
			Heard 20			Kept 23	
			Coming 18			Ran 23	
			Look 18			Shake 23	
	RA Tsunami	Emotion 44	Study 40	Mental 80	Feeling 37	Seek 41	Mind 23
		Affect 30	Impact 37		Loss 33	Asked 39	
			Support 37		Needs 31	Wait 35	
			Risk 21		Trauma 27	Provide 35	
			Behavior 19			Used 52	
			Report 8				
Human Induced Disaster	PS Terrorism	Glad 16	Goes 36	Belief 16	Feel 11	Asked 15	Knew 14
			Walking 31			Kept 15	Decided 12
			Work 28			Waiting 13	
			Told 25			Started 12	
			Heard 22			Walked 12	
			Hit 22			Called 11	
			Looked 17			Tell 11	
			Taken 17				
	RA Terrorism	Trauma 53	Study 42	Mental 42	Coping 51	Fight 60	
		Stress 52	Report 31		Worst 42	Support 57	
		Distress 46	Called 19		Loss 40	Adjust 55	
		Afraid 45	Risk 7		Trauma 34	Attack 51	
		Fear 30			Fearful 21		
Pandemic Disaster	PS Swine Flu	Told 27	Closed 18		Concern 8	Woke 9	
		Felt 21	Receive 17		Scared 6	Given 7	
		Fine 10	Pain 16			Wait 7	
			Sore 14			Stay 6	
			Stay 14			Walked 6	
			Bad 12			Waited 6	
						Called 6	
						Saying 6	
	RA Swine Flu	Stress 41	Learned 36		Emotion 11	Grab 16	Perceive 14
		Scare 32	Stand 34		Panic 10	Threat 11	
		Emotion 20	Respond 34			Lay 10	
			See 28			Dying 10	
			Studies 23			Asked 10	
			Seek 21			Contact 10	
			Report 20			Keep 10	

Word correlation

On the basis of a target word ‘People’, we examined the correlation between it with other words. Table 6.13 is the results for LSA of tsunami PS. It can be seen that there were several behavioral words such as find, screaming, help, waiting, see and running that correlated with people. There were few cognitive and affective words, such as know and lucky, respectively.

Table 6.13. Correlation of target word ‘people’ with other words in LSA for tsunami personal stories

people/NN	1
find/VB	0.51344
cause/VB	0.44078
many/JJ	0.43643
hours/NN	0.43056
know/VB	0.41381
other/JJ	0.41094
screaming/VB	0.40707
help/VB	0.40697
Alan/NN	0.4039
cause/NN	0.4021
lucky/JJ	0.4
helping/VB	0.39474
much/JJ	0.39094
hotel/NN	0.38378
happened/VB	3.83E-01
something/NN	0.38021
waiting/VB	0.37705
see/VB	0.37592
crying/VB	0.374
going/VB	0.36169
give/VB	0.36014
whole/JJ	0.35937
come/VB	0.35918
running/VB	0.35755
worried/JJ	0.35133
cars/NN	0.34936
lot/NN	3.48E-01
thai/NN	0.34754
office/NN	0.34648

Concept mapping

Table 6.14 shows the percentage of likelihood between target word ‘people’ and concepts in the same text corpus of tsunami PS. Likewise in LSA, there were more behavioral words such as injured, died, killed, crying, screaming, bought, and floating. Affective words to describe the people are chaos and lucky, while there was hardly a cognitive word that mapped to the target word ‘people’.

Table 6.14 Likelihood of word mapping for theme ‘people’ in
Leximancer for Tsunami Personal Stories

Related Word-Like	Count	Likelihood
injured	6	75%
died	7	70%
killed	6	67%
plastic	2	67%
region	5	62%
crying	6	60%
chaos	3	60%
cause	8	57%
prayers	4	57%
countries	5	56%
screaming	11	52%
bought	2	50%
tourist	4	50%
women	3	50%
hundreds	4	50%
milk	2	50%
harbour	4	44%
airport	7	44%
lucky	10	43%
including	3	43%
destruction	3	43%
floating	3	43%
major	3	43%
stairs	5	42%
threw	2	40%
worse	2	40%
look	11	39%
food	5	38%
emergency	3	38%
happy	3	38%
care	3	38%

Semantic maps

The LXM analysis generated semantic maps that may be used to analyze the mapping relationships of various concepts. Figure 6.1 illustrates a semantic map of the ABC of tsunami.

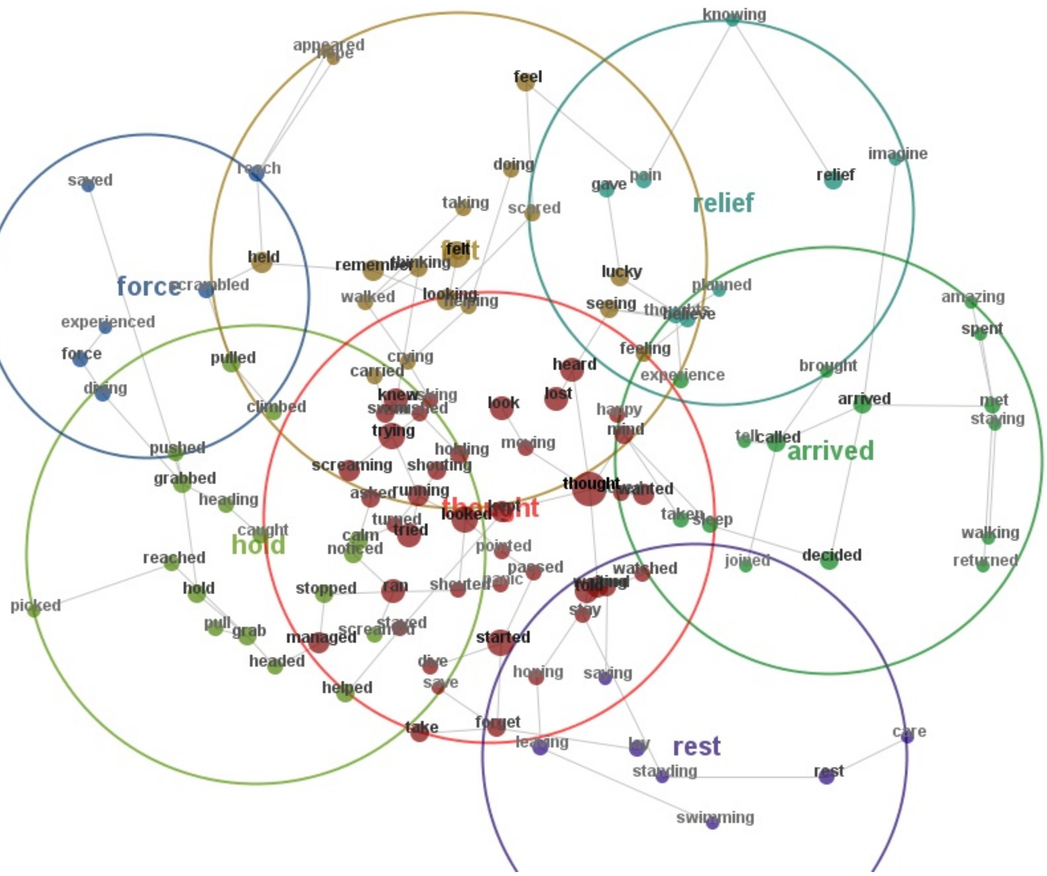

Figure 6.1 ABC themes and seed concepts of Tsunami Personal Stories

The circles denote the central themes that emerged. The central theme is a collection of correlated words that are discovered through a learning process of the tool, LXM. The theme is determined by the strength of the likelihood of the concepts to the theme. The color denotes the theme ranking, based on the strength of concept counts within the theme. For example, red for ‘thought’ has the highest no. of counts per concept that made up thought, followed by ‘felt’, then ‘hold’. The size of the circle denotes the overall number and density of concepts within the theme. Each concept is mapped to another to form a map or network of concepts. The mapping relationship between the concepts is determined by the likelihood value, expressed as percentage (Leximancer, 2010).

In Figure 6.1 there are several behavior concepts within each central theme. The concept *thought* (largest collection of words) is linked to mind and wanted (cognition), heard, look, moving, kept, looked (behavior). Other behavior words include: running, shouting, screaming, crying, helping, grabbed, pushed, and so forth. These words described the experience of people during a tsunami that occurred suddenly. Overall, there were few affective words such as pain, calm, lucky and happy.

Figure 6.2 represents the map for terrorism. There are 7 central themes, with “told’ being the dominant theme. Likewise tsunami, in terrorist attacks, people tend to act. There are considerable number of behavior concepts such as told (to stop), stopped, take, moving, work, attack, escape, walking, running, screamed, looked, called, and so forth. The cognitive concepts were few such as thought, mind, remember, sense and wanted. There were negative affective concepts such as fear, shock, lost, sick, horrible, and positive affective experience such as cool, calm, comfort, and hope.

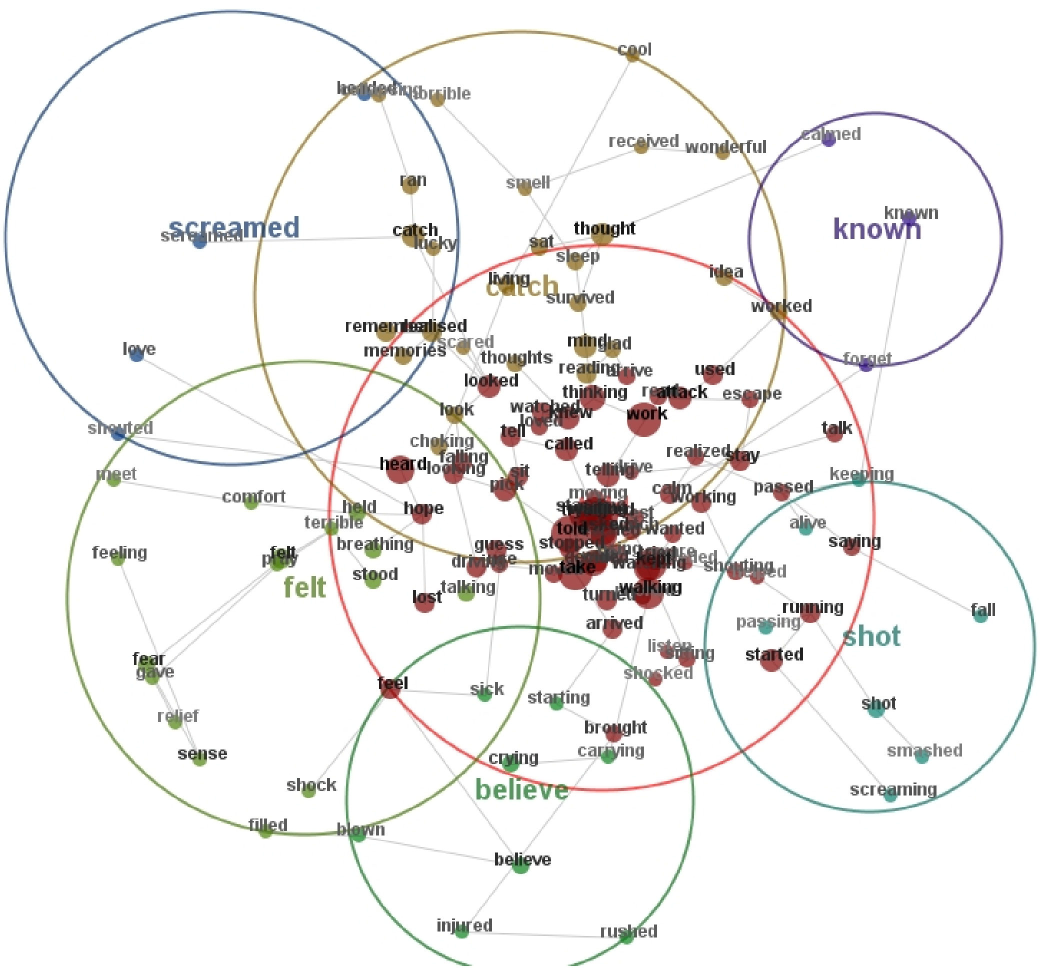

Figure 6.2 ABC themes and seed concepts of Terrorism Personal Stories

Figure 6.3 shows the semantics of swine flu.

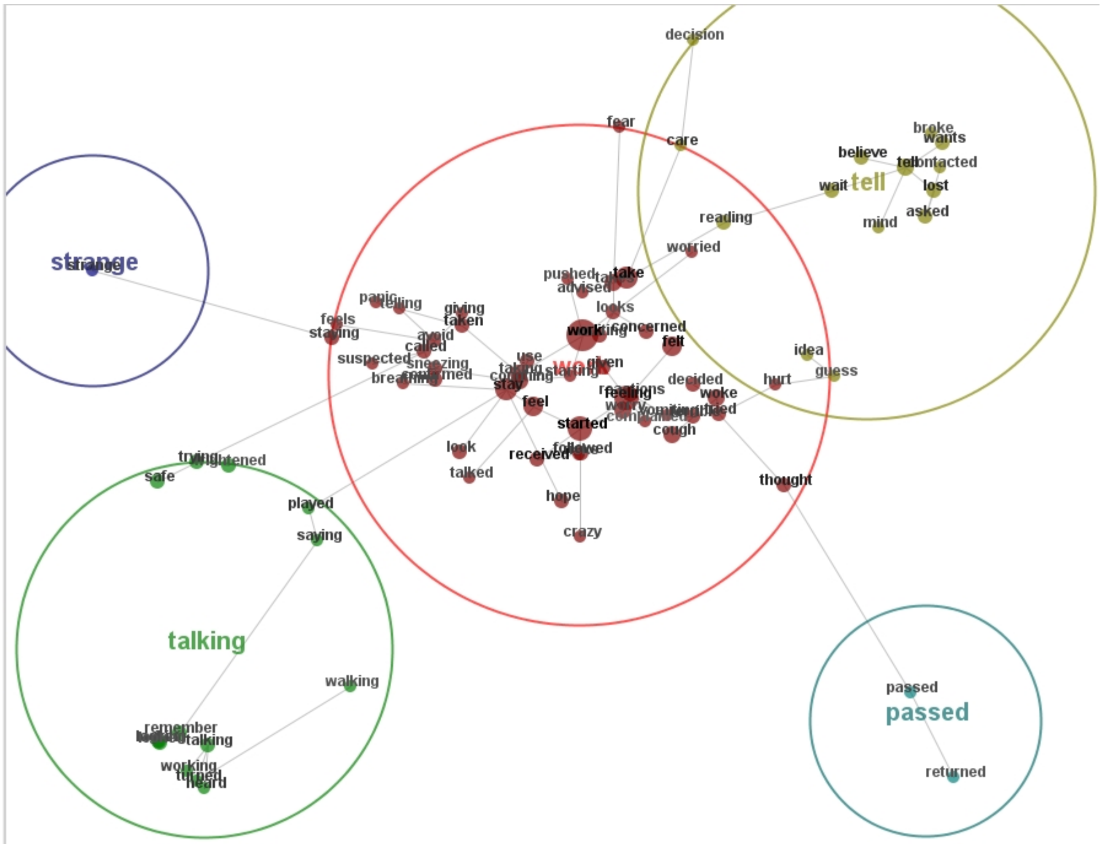

Figure 6.3 ABC themes and seed concepts of Swine Flu Personal Stories

In Figure 6.3, the information differed greatly from the previous maps of tsunami and terrorism where the central themes are relatively sporadic. The dominant central theme is 'work' followed by 'tell'. The ABC concepts are quite distributed within the main themes, such as use, taking/take, sneezing, coughing, started, received (behavior), felt, worry, panic, weary, crazy, hurt (affect), and thought, decided, suspected, guess, idea, believe (cognition).

In short, the ABC semantics differed with the type of disaster, with significant behavior concepts in tsunami and terrorist attack compared to swine flu. This suggests that people act in the face of high risk situations, and their behavior may be governed synergistically by both affect and cognition.

Discussion

The purpose of this study was to examine the capability of LSA and LXM in semantic mining. From the ANOVA findings, it was confirmed that both tools mined similar words and dissimilar words. In other words both have similar basic capability and there was no need to use both tools in the next study.

There were differences between the tools in the following aspects:

- First, LSA took a longer time to process (about 2 hours) for the same text corpus, compared to LXM that took only 20 minutes.
- Second, LSA applied parts-of-speech to refine words, but LXM filtered words to identify meaningful concepts only. This generated a list of concepts rather than mere words.
- Third, LSA misclassified some words, while LXM did not. This may be due to the algorithms used by LSA that could not distinguish some words clearly, especially affective and cognitive words.
- Fourth, LSA generated correlations between target word and other words. LXM indicated the likelihood of occurrence between target concept and other concepts. For forecasting purposes, the likelihood value is useful.
- Fifth, a major difference is LXM produced semantic maps in the form of themes at the first level, and seed concepts maps at the node level that can be analyzed further to develop ontology.

Overall, LXM was easy to use with features that proved useful for developing semantic framework. The semantic maps, represented by the three examples of tsunami, terrorism and swine flu, revealed visually the ABCs inherent in these disaster situations.

Conclusion

Both tools mined the same word from the corpuses, but the frequency may differ slightly due to filtering and calculation algorithms of the tool. On the basis of its added value in terms of usability, LXM was used in the remaining conceptual mining described in the next chapter 7, and further validation of ABC concepts.

7

Study 2. Attitudinal Semantic Mining

RESEARCH DESIGN

Aim and Hypothesis

The aim of this study was to determine the nature of relationship between attitudinal components (ABC) and disaster situational factors derived from different corpora. It was assumed that the attitudinal semantics derived from disaster types correlate significantly with the disaster class. Since the ABC classified data was a count, Pearson Chi Square analysis was performed on the combined disaster data within each class, and tested at the 5% significance level. Semantic processing was performed using Leximancer only in light of its utility, as discussed in Chapter 6.

Method

Text corpus

The sample used in this analysis was the full corpus set as outlined in Table 5.1 (see Chapter 5). The size of the corpus was 308,168 words from narratives and 350,189 words from research articles, with a total word count of 658,357. This corpus size was considered sufficient for semantic mining. Personal information and references in the text were deleted.

Procedure

There were five stages of analysis: First, a frequency count was used to derive a listing of about 400 concepts per disaster type. Second, the concepts were classified manually into ABC by three classifiers. Third, a confederate checked the outcome to resolve conflicting classification across classifiers. Fourth, Fleiss Kappa analysis was performed to obtain inter-classifier reliability. Fifth, Pearson Chi Square was used to test the relationship between ABC and disaster class or corpus type at 5% significance level.

Results and Discussion

Fleiss Kappa inter-classifier reliability

Fleiss Kappa analysis was performed on the manual classifications made by three classifiers. The purpose was to evaluate the reliability of their ABC classifications prior to using the data in the semantic analysis.

On average, the results of Fleiss Kappa revealed almost perfect agreement with r = 0.80. Table 7.1 provides a summary of the results. The individual Fleiss Kappa results for each disaster type may be viewed from Appendix C.

Table 7.1 Fleiss Kappa Results by Disaster and Corpus type

Disaster type	Fleiss Kappa Value, r		Agreement Result
	Personal Stories	Research Articles	
Natural disaster			
Tsunami	0.785	0.794	Substantial agreement
Earthquake	0.819	0.835	Almost perfect agreement
Hurricane	0.799	0.751	Substantial agreement
Flood	0.709	0.722	Substantial agreement
Human Induced			
Terrorism	0.761	0.695	Substantial agreement
Fire	0.656	0.860	Substantial agreement
Industrial	0.881	0.902	Almost perfect agreement
Transport	0.710	0.835	Substantial agreement
Pandemic			
Swine flu	0.869	0.865	Almost perfect agreement
SARS	0.853	0.810	Almost perfect agreement
HIV/Aids	0.898	0.758	Almost perfect agreement
Tuberculosis	0.855	0.773	Almost perfect agreement

ABC association within disaster class

The data in this analysis was based on a combined data set for each disaster class across corpus type. In other words the four types of disasters were combined within each disaster class. The hypothesis for test stated that ABCs associated significantly with disaster class. The results showed mixed associations as summarized in Table 7.2. Therefore, the hypothesis was partially supported.

Table 7.2 ABC Association within Disaster Class

Disaster Class	Pearson Chi Square	Significance level	Cramer's V	Association
Natural disaster	$\chi 2$ = 2.98, df =6	n.s.	0.05	-
Human Induced	$\chi 2$ = 20.72, df =6	p=0.002	0.12	very weak positive
Pandemic	$\chi 2$ = 13.16, df =6	p=0.04	0.10	very weak positive

From Table 7.2, there was highly significant association for human induced disasters and significant relationship for pandemic, but not for natural disasters. Figures 7.1, 7.2 and 7.3 show the counts for natural, human induced and pandemic, respectively.

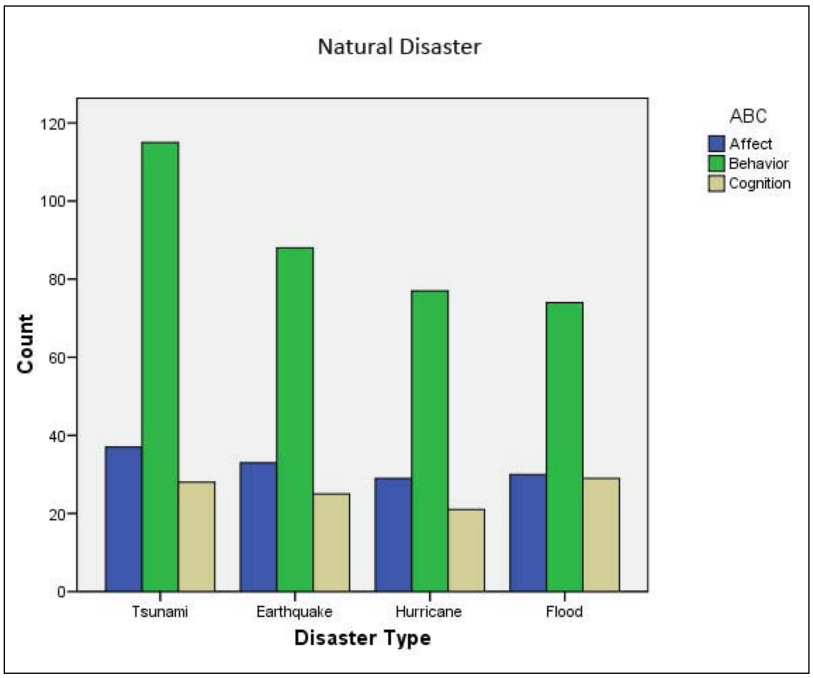

Figure 7.1 ABC count within Natural Disaster class

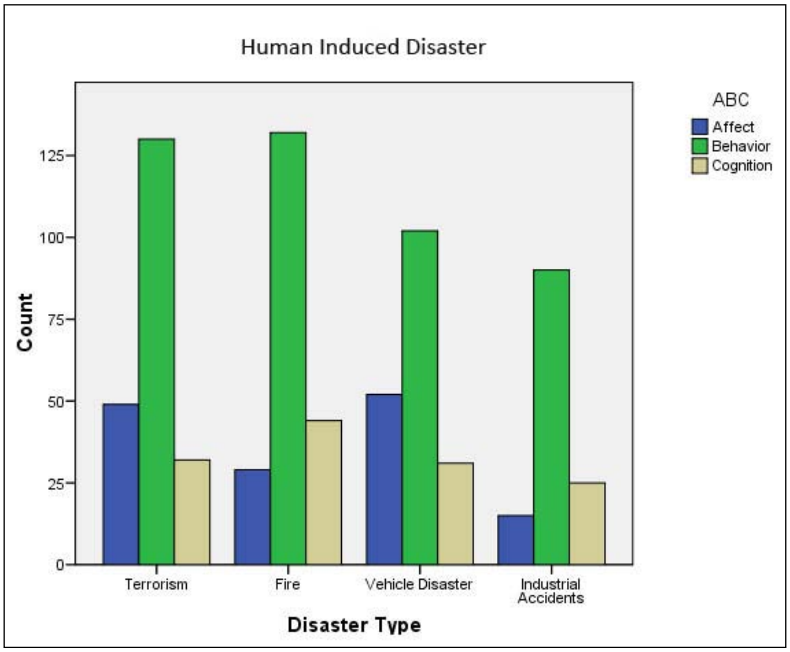

Figure 7.2 ABC count within Human Induced Disaster class

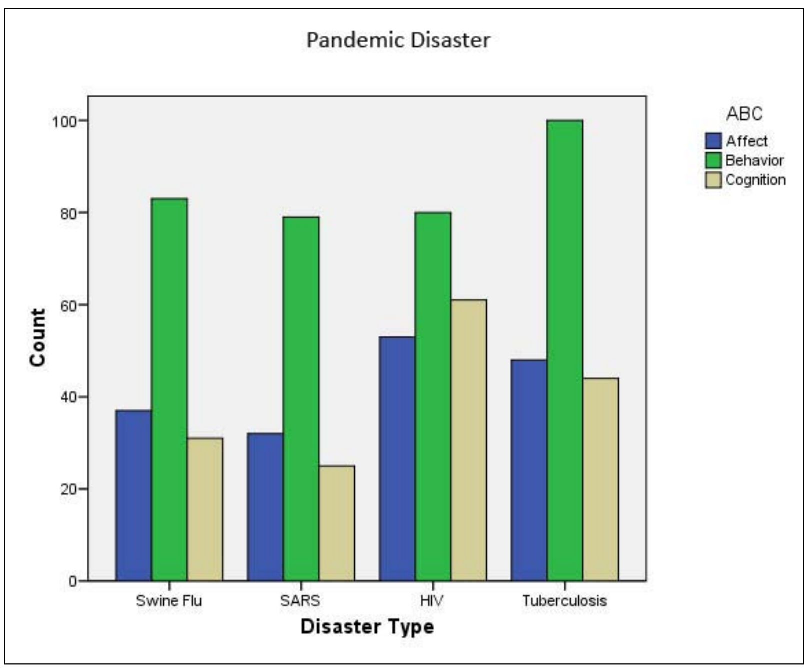

Figure 7.3 ABC count within Pandemic disaster class

The cluster of disasters within Natural disasters (tsunami, earthquake, hurricane, flood) are quite similar to Human induced disasters (terrorism, fire, vehicle accidents) and pandemic (swine flu, HIV, TB), see chapter 3 for description of disaster type. For example, the common physical elements that characterize tsunami, hurricane and flood are water and wind. The only difference is earthquake. These natural disasters are announced with warning signs including tsunami. Other disaster classes such as human induced may be sudden with little warning. Therefore, the ABCs have little in common across disaster types, unlike natural disasters.

Across the disaster classes there were more behavior concepts than cognitive or affective. In tsunami, people tend to act more, than in the other the disaster types. This could be due to the suddenness of the phenomena, which leave people with little choice and time to think (Carballo, Heal & Horbaty, 2006). Earthquake, hurricane and flood enable people to prepare (Griffin et al., 2008). Terrorism and fire demand greater action from the victims than industrial or transport accidents (Altheide, 2006). With pandemic, the behavior is quite similar except for TB.

Concerning emotion, the feelings associated with natural disasters are almost the same. This could be due to attribution to “Act of God” (Somasundaram et al. 2003, Grandjean et al., 2008). Therefore, there is little allocation of blame to others. With human induced disasters, the emotions are greater for terrorism and vehicle accidents where the source of disaster may be attributed to humans (Lerner et al., 2003). Human-caused events such as dam collapses and industrial accidents “represent in the eyes of victims a callousness, carelessness, intentionality, or insensitivity on the part of others” (Bolin, 1985).There is a greater tendency for people to blame others for causing a disaster. In this regard the attribution of HIV victims are higher followed by TB. This may be due to the stigma associated with the disease (Gonzalez et al., 2009).

The cognitive concepts across disaster classes differed greatly for pandemic, especially with HIV and TB. In the case of latent TB, even without any symptoms, but knowing that an illness lies dormant in the body has an impact on perceived health (Nyamathi, et al., 2005). Fire also induced people to think about the traumatic loss of home and loss of extended self after the fire (Lollar, 2010).

ABC association within corpus type

The four types of disaster within a corpus type were combined to generate a single data set. Thereby tsunami, earthquake, hurricane and flood were combined within the natural disaster class for PS, and likewise for RA. The hypothesis stated that ABCs correlate significantly with corpus. The results revealed highly significant associations as summarized in Table 7.3. Therefore, the hypothesis was supported. Figures 7.4, 7.5 and 7.6 illustrate the ABC distribution for corpus and disaster class.

Table 7.3 ABC Association within Corpus Type

Disaster Class	Pearson Chi Square	Significance level	Cramer's V	Association
Natural Disaster	$\chi 2$ = 62.14, df=4	p<0.0001	0.33	weak positive
Human Induced	$\chi 2$ = 15.32, df =4	p<0.0001	0.15	very weak positive
Pandemic	$\chi 2$ = 18.71, df =4	p<0.0001	0.18	very weak positive

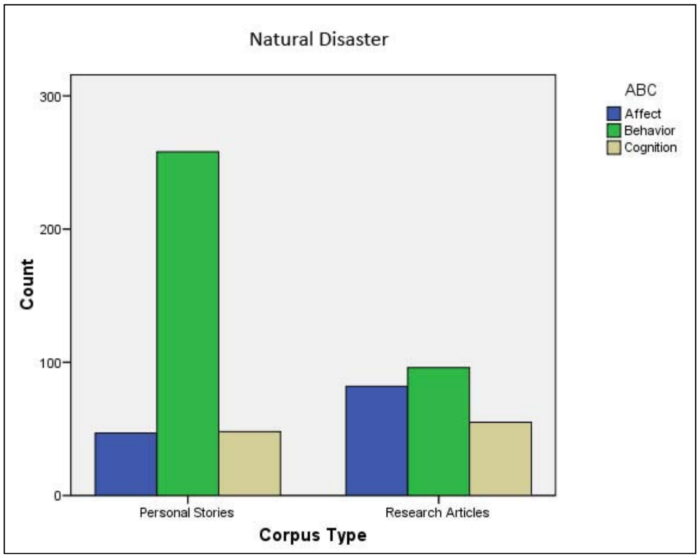

Figure 7.4 ABC count within Corpus for Natural disaster

From Figure 7.4, it can be seen that PS produced more behavior concepts than RA. PS describe real experiences of the survivors. The affect and cognition counts are almost the same in PS. RA produced more affective concepts, perhaps because the research was aimed at understanding PTSD (Ben-Zur & Zeidner, 2009).

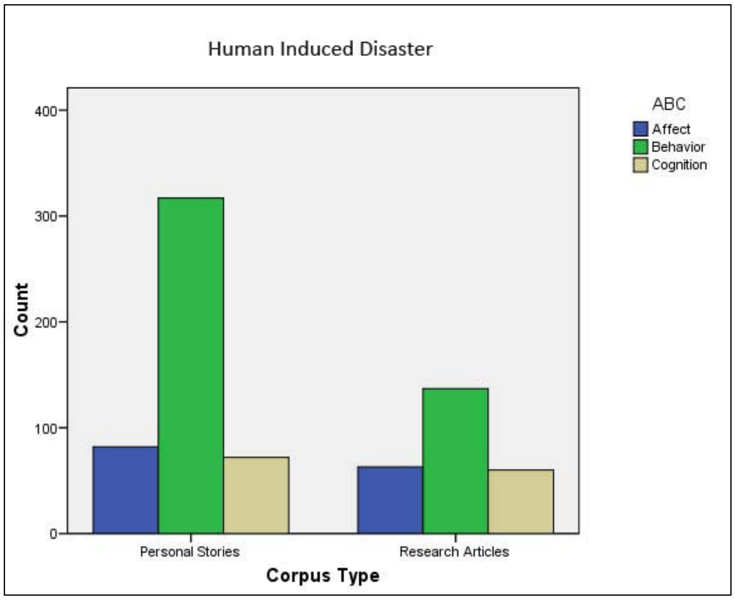

Figure 7.5 ABC count within corpus for Human Induced disaster

A much greater number of personal stories was generated for Behaviour then for Affect and Cognition. There was no difference between the number of affective and cognitive concepts.

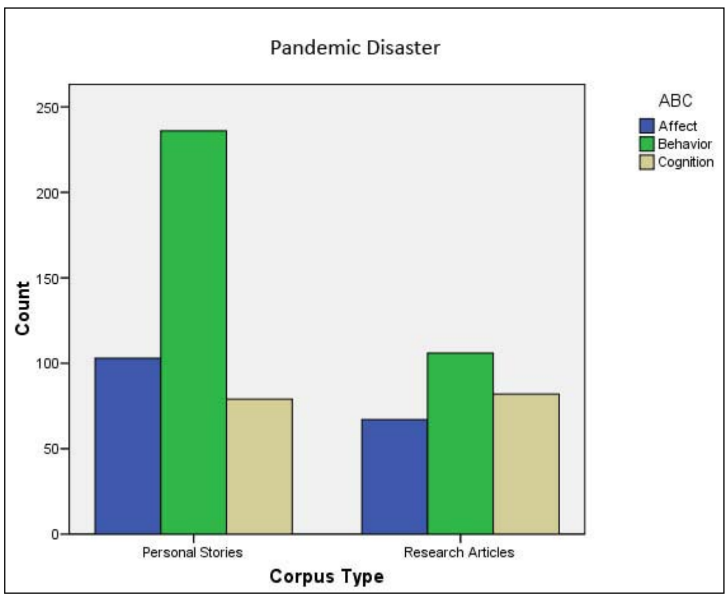

Figure 7.6 ABC count within corpus for Pandemic disaster

Figure 7.5 shows more behavior concepts with pandemic PS than RA. It can be concluded that PS is a good source for understanding human behavior in disaster. Since there was highly significant associations between corpus and ABCs mined, using both types of corpus is important in the study of behavior for forecasting attitude.

ABC semantics of natural disaster corpus

The ABC data from PS and RA corpora were combined to evaluate the central themes and underlying concepts. Figure 7.7 shows the central themes that emerged from the analysis.

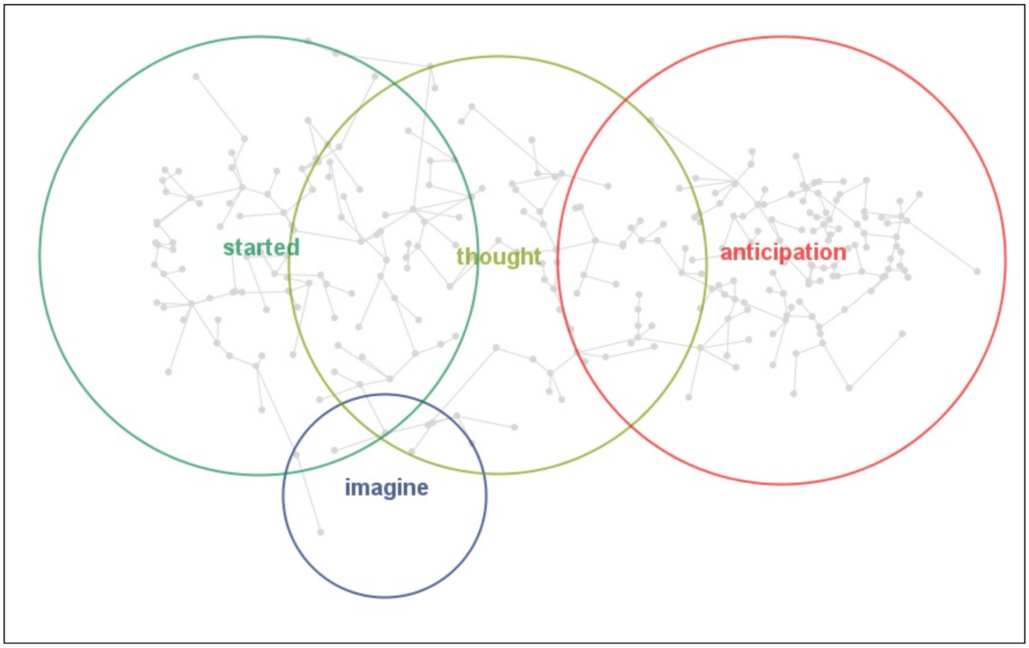

Figure 7.7 ABC themes of natural disaster class

Four central themes emerged from the ABC concepts, namely*: Anticipation, Thought, Started* and *Imagine.* The dominant theme 'Anticipation' suggests that natural disaster situations such as hurricane and flood come with some pre-warning, and there is opportunity to anticipate the incident. But in other natural disasters such as tsunami and earthquake, which may be sudden and surprising, the anticipation may be in the form of assistance provided by service organizations to the survivors. Figure 7.8 represents the concepts that contributed to the 'Anticipation' theme.

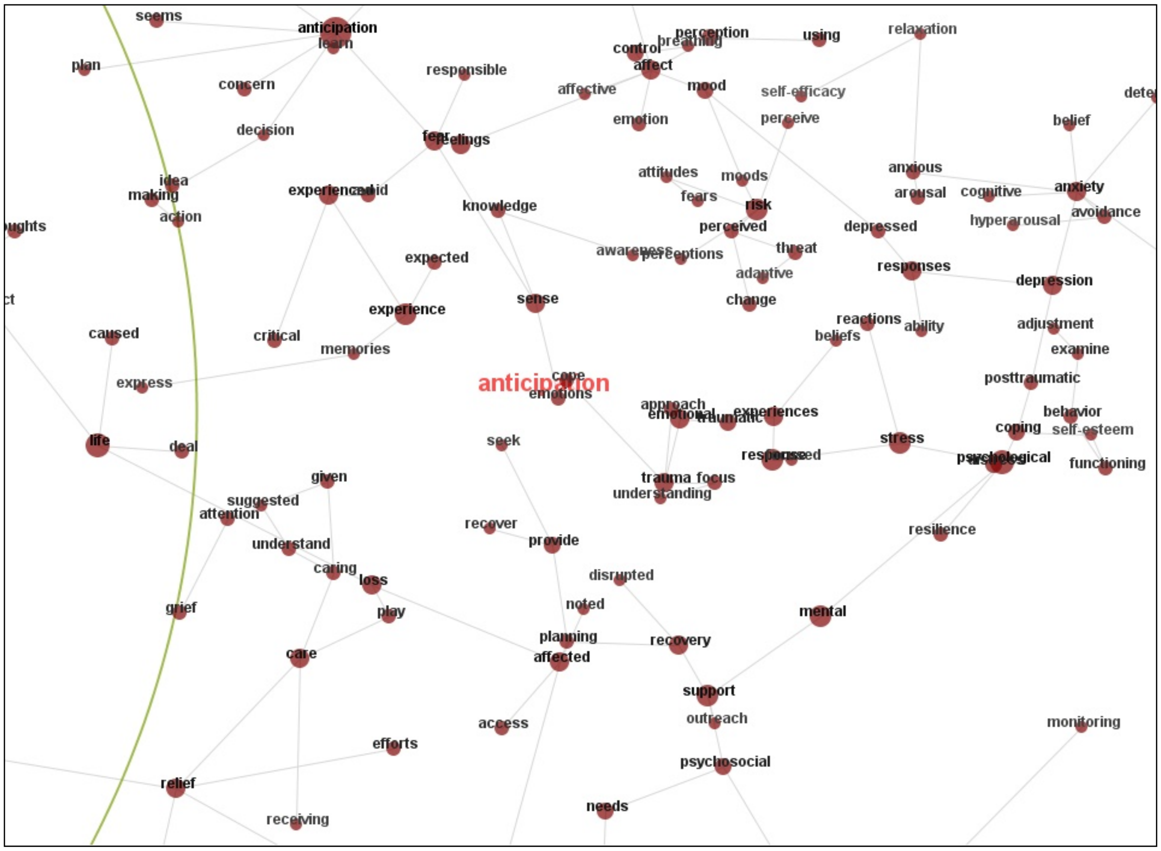

Figure 7.8 ABC concepts of “anticipation” theme for natural disaster class

In Figure 7.8, the concepts that make up ‘Anticipation’ may be classified as follows: behavior concepts such as anticipation, concern, and plan; affective concepts such as trauma, fear, and relief; and cognitive concepts such as memories, perception and decision.

The concept ‘anticipation’ is mapped to concern (behavior), fear (affect), and decision (cognition). This means that in natural disasters, people do have concern over the situation, which may induce fear; therefore they need to decide for an action. The fear may increase their vulnerability that caused them to make decisions.

Another concept ‘risk’ is mapped to perceived (cognition), fears and moods (affect). People perceive the risk induced by the physical nature of the disasters and it affects their mood as well as making them fearful of the situation. There is indeed evidence to suggest that people experienced psychosocial health effects as a result of disasters such as tsunami (Carballo, Heal, & Horbaty, 2006; Raholm, Arman & Rehnsfeldt, 2008).

ABC semantics of human induced disaster corpus

For Natural disaster, the ABCs were combined for Human Induced Disaster. Figure 7.9 shows the central themes of four disaster types: terrorist attack, fire, industrial and transport accidents.

Figure 7.9 ABC themes of human induced disaster class

In Figure 7.9, seven themes emerged from the analysis of ABC concepts, namely: *Trauma, Work, Escape, Screaming, Received, Feels* and *React*. Further analysis of the concepts that contributed to theme 'Trauma' (see Figure 7.10) revealed behavior concepts such as seeking, express, adjustment; affective concepts such as loss, stress, and coping; and cognitive concepts such as thoughts and beliefs.

The concept 'Trauma' is mapped to express (behavior), stress (affect), and thoughts (cognition). In order to cope with the stressful situation, people expressed their thoughts, especially in disasters such as fire. Studies have shown that in order to prepare people for making judgements in hazard situations such as bushfire (Paton et al., 2006) and terrorist attack (Lasker, 2004), they need to have (1) An intention to prepare and (2) An intention to seek information. The latter form of intention requires people to express their needs for help, information and so forth.

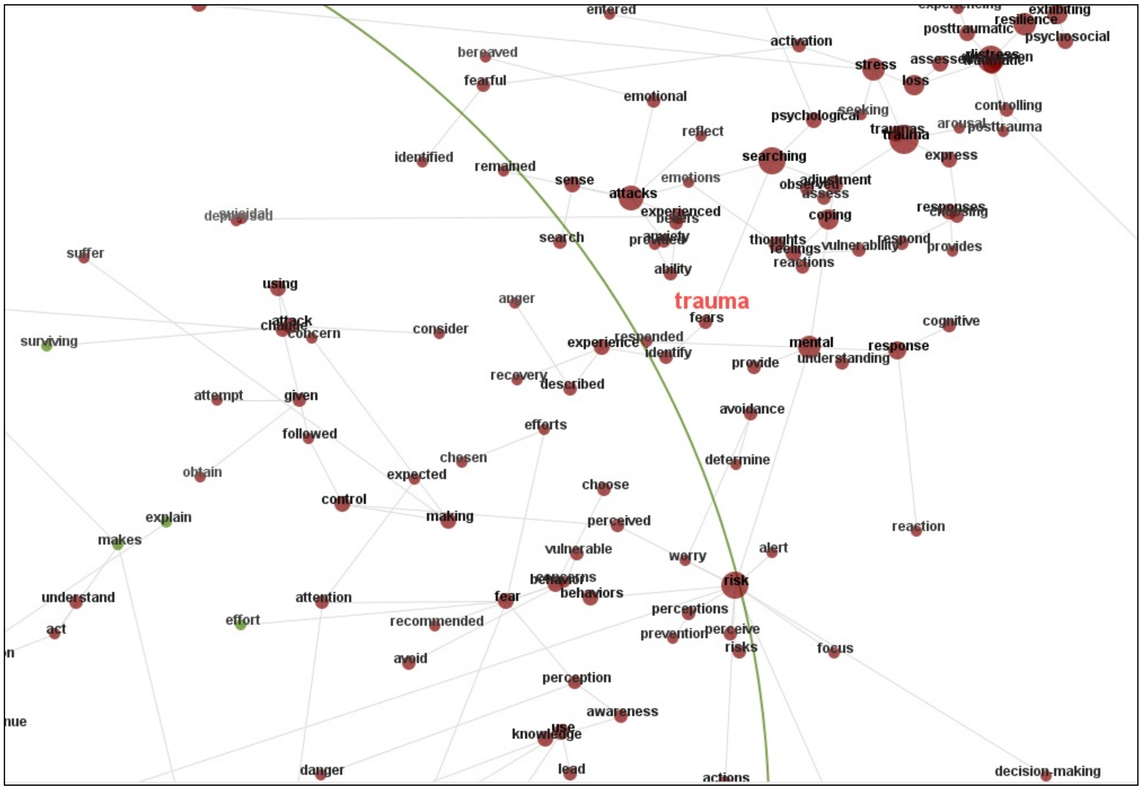

Figure 7.10 ABC seed concepts of "trauma" theme for human induced disaster class

In Figure 7.10, the concept 'risk' is mapped to worry, mental (affect), perceive, alert, focus (cognition) and decision making (behavior). There is a possibility that disaster situations such as industrial accidents cause people to worry about the risk and they remain focused on the problem. Miletti (1999) claimed that in order to mitigate industrial hazards, there is a need for people and organizations to accept responsibility for the disaster so that losses may be curtailed through change initiatives such as improved warning system, engineering design, building codes and insurance coverage.

Attacks such as terrorist acts induce anxiety and people become emotional, sometimes angry (affect), as they sense (cognition) the fears of those who experienced (behavior) the attacks. These concepts mapped closely to each other in Figure 7.10.

In recent years, there have been several studies on terrorism (e.g. Sjoberg, 2005), but the focus has been on the perpetrator rather than the victims. Jindapon and Neilson (2009) found that citizens' risk attitudes, such as anger expression, can affect the strategies of the terrorists and the government. They claimed that a risk-averse population in a target country can induce terrorists to commit more damaging, but less frequent, attacks.

ABC semantics of pandemic disaster class corpus

Figure 7.11 shows the central ABC themes of pandemic disaster. Eight themes emerged from the analysis, namely: *Behavior*, *Told*, *Woke*, *Passed*, *Broke*, *Saying*, *Complained* and *Wanting*.

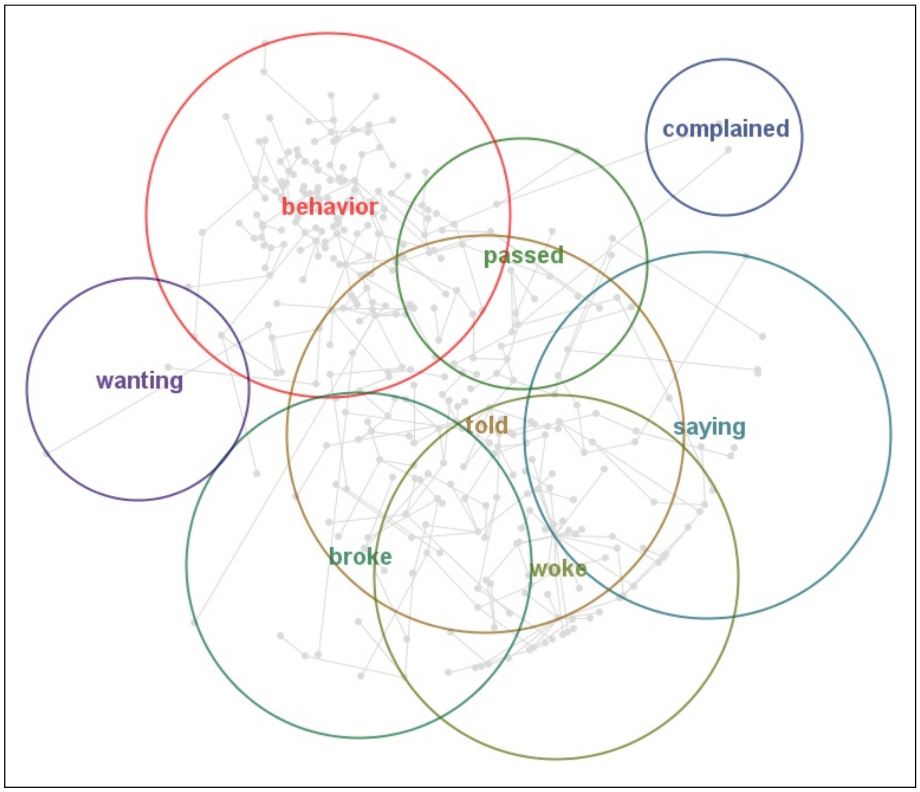

Figure 7.11 ABC central themes for pandemic disaster class

In Figure 7.12, 'Behavior' is the most dominant theme with concepts such as: action, planning, change (behavior); arousal, emotions, panic (affect); risk, perception, and understanding (cognition). The concept 'behavior' is closely mapped to risk and risk-taking and action (behavior), spiritual (affect) and perception (cognition). The action includes educating themselves about the risk.

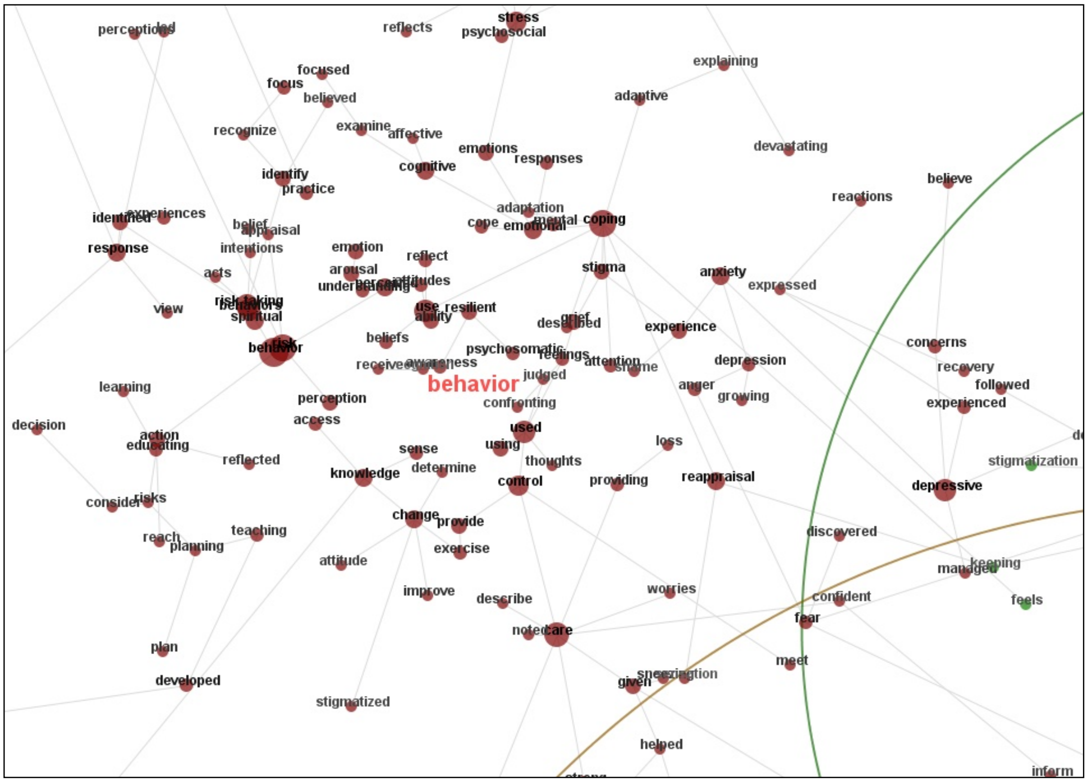

Figure 7.12 ABC concepts of “behavior” theme for pandemic disaster class

Another concept that emerged from the analysis is ‘coping’, that is mapped to stigma and emotional (affect), resulting in reappraisal (cognition) and adaptation (behavior). This situation is true of HIV/AIDS and SARS patients who have to endure the stigma and discrimination of the disease (Parker & Aggleton, 2003; Siu, 2008).

Disaster situation semantics of natural disaster class corpus

The corpora from personal stories (PS) and research articles (RA) were combined to evaluate the central themes and seed concepts that emerged from the analyses. Figure 7.13 shows the themes for natural disaster. Four central themes emerged from the natural disaster situation, namely: *Disaster, Earthquake, People* and *Water* in the order of dominance.

In the ‘Disaster’ theme, as visualized in Figure 7.14, the most frequent concepts were ‘emergency’, ‘assistance’, ‘relief’, and ‘agencies’. This describes the situation as an ‘emergency’ where it required ‘assistance’ and ‘relief’. The ‘agencies’ in a natural disaster situation may be represented by the people who provided aid and assistance to the victims and survivors.

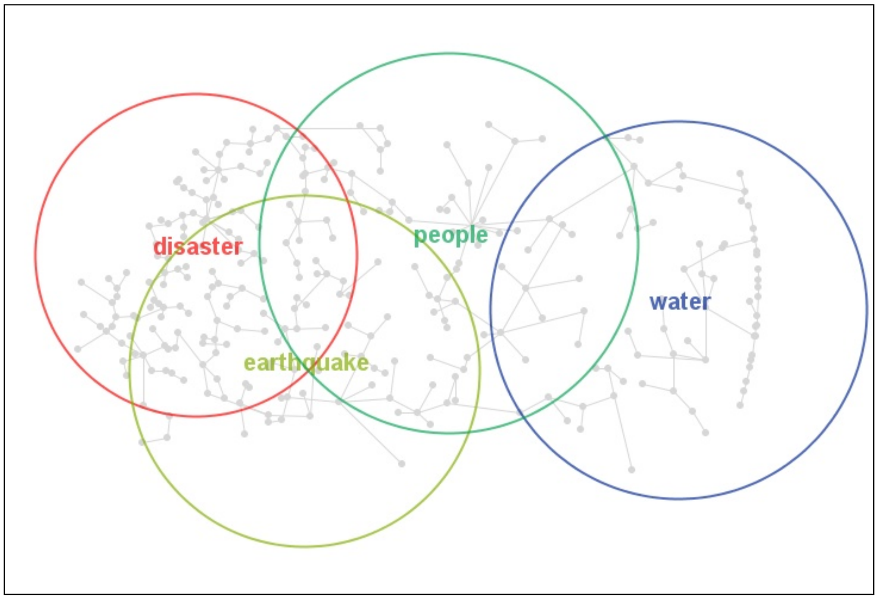

Figure 7.13 Disaster situation themes for natural disaster class corpus

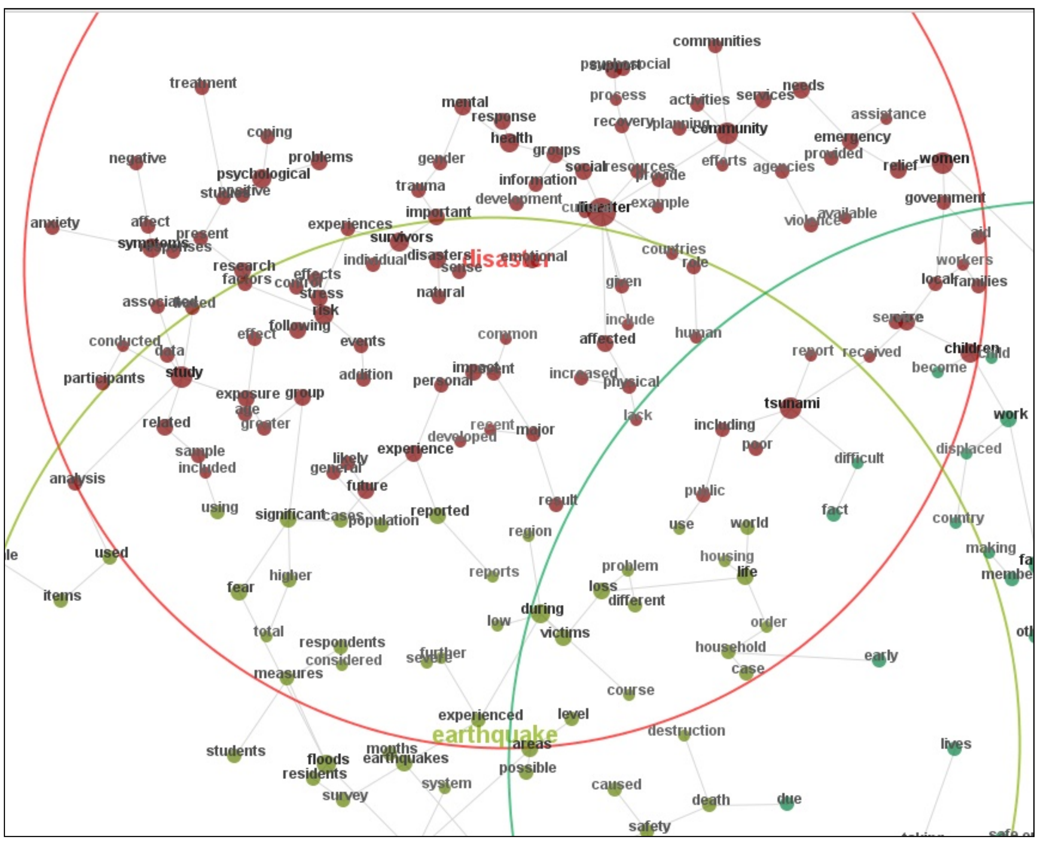

Figure 7.14 Disaster situation concepts of “disaster” theme for natural disaster class corpus

Disaster situation semantics of human induced disaster class corpus

In Figure 7.15, there were nine themes produced by the underlying concepts namely: *Fire*, *People*, *Smoke*, *Doorway*, *Morning*, *Sleeping*, *Called*, *Concern* and *Given*. These themes described the scenarios of the disaster rather than the attitudes of people.

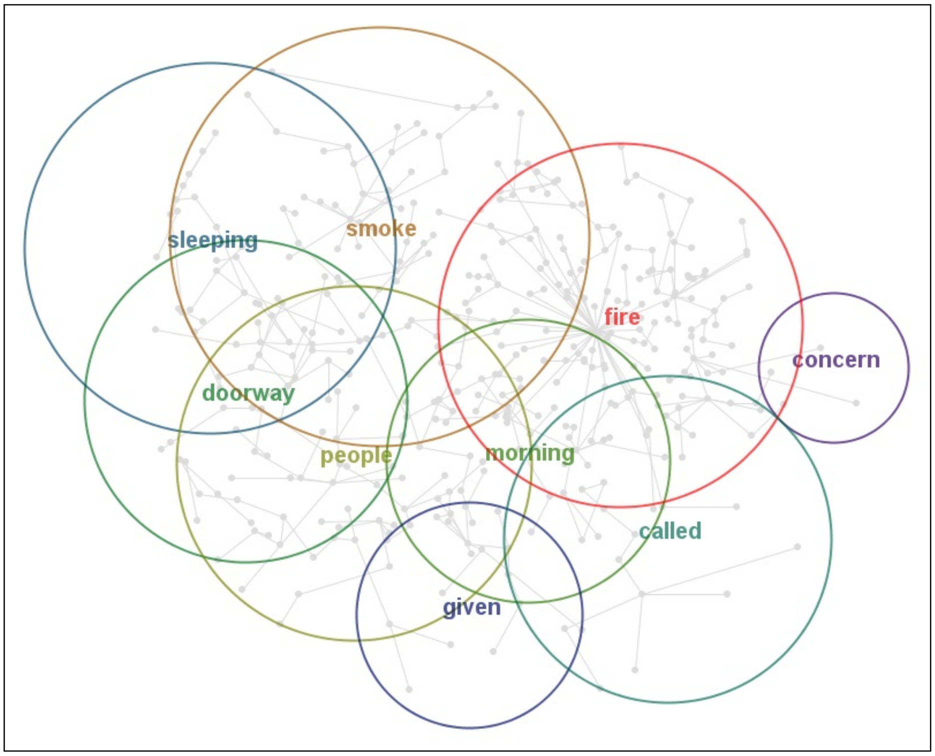

Figure 7.15 Disaster situation themes of human induced disaster class corpus

In the 'Fire' theme (Figure 7.16), concepts such as 'tunnel', 'attack', 'conditions', 'truck' and 'helicopter' were prominent. The concept 'tunnel' was used widely to describe the conditions in human induced disaster. In some incidents, the disaster happened in subways or tunnels. In others, the rescuers had to build a tunnel to save the victims. Most of the incidents such as terrorist attack also resulted in fire. Trucks in the map referred to fire engine trucks and helicopters to provide support during the disaster.

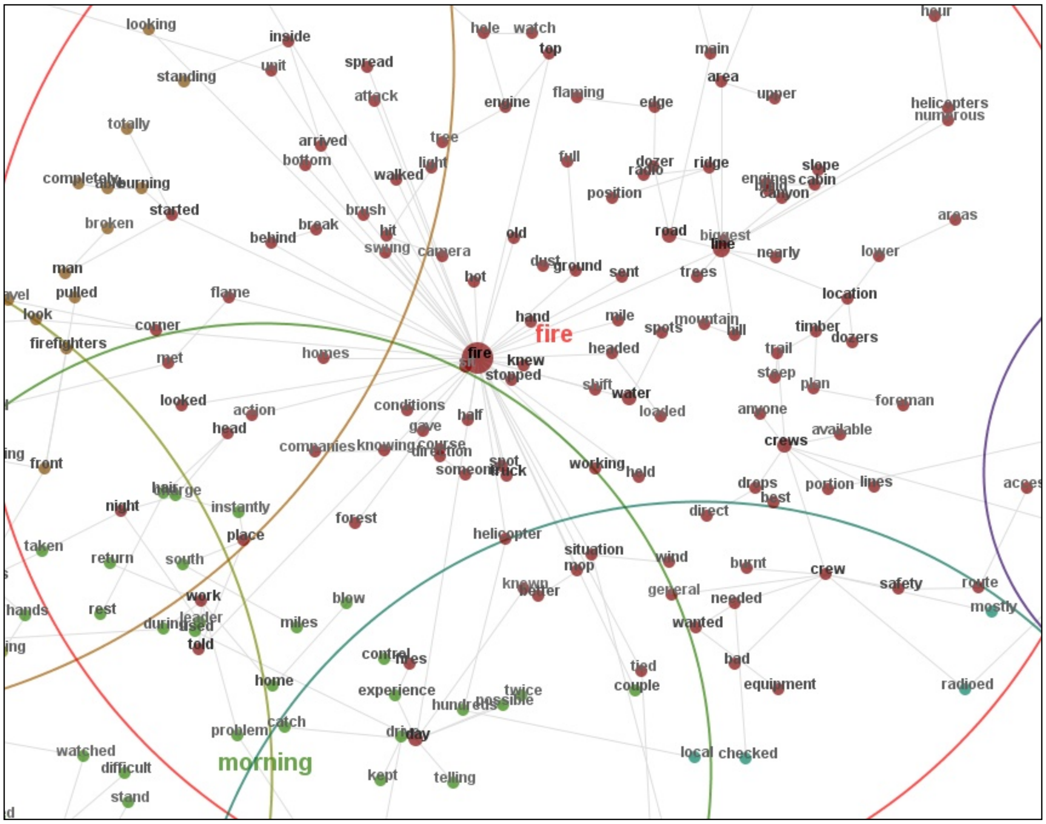

Figure 7.16 “Fire” concepts of disaster situation for human induced disaster class corpus

Disaster situation semantics of pandemic disaster class corpus

Figure 7.17 shows the central themes of this disaster class. Nine themes were produced from the analyses of the combined pandemic disaster class corpuses. These are: *Factors*, *Health*, *Study*, *People*, *Flu*, *Women*, *Global*, *Government*, and *Sick.* The dominant theme is ‘Factors’. Given that this concerns epidemic of diseases, it is not surprising for this theme to emerge. Figure 7.18 shows the underlying seed concepts for theme ‘Factors’.

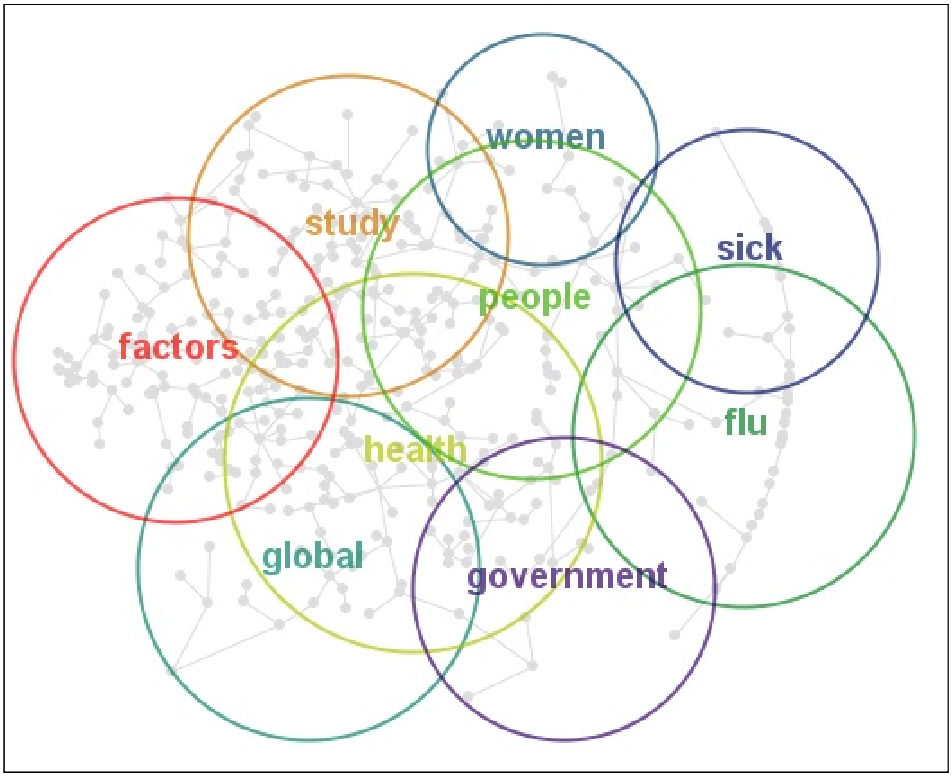

Figure 7.17 Disaster situation themes of pandemic disaster class corpus

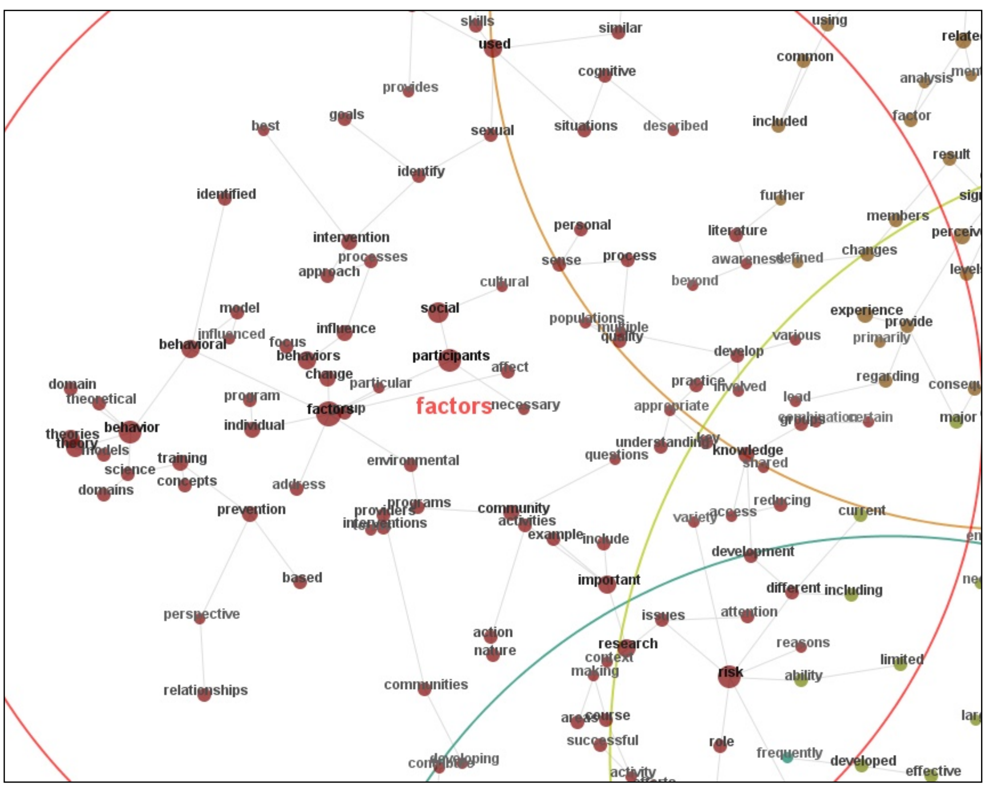

Figure 7.18 “Factors” concepts of disaster situation for pandemic disaster class corpus

In Figure 7.18, the concepts derived from the analysis include ‘environmental’, ‘behavioral’, ‘influenced’, and ‘prevention’. ‘Environmental’ factors refer to the source that contributed to the spread of diseases, including the surroundings. For example, in the case of swine flu and SARS, the animal conditions that contributed to the epidemic. The spread of disease through human populations across countries and worldwide turned the situation to become pandemic.

The ‘behavioral’ factor refers to people’s behavior such as sneezing, coughing, and so forth. The pandemic scare may also influence their behavior, such as to be more careful of their environment and to prevent from contracting the disease.

Conclusion

Natural and human-induced disasters affect everyone in their path. Some people are nevertheless more vulnerable than others and suffer in different ways and to different extents. The analysis of tsunami, for example, identified pre-existing factors that made people vulnerable, while others became vulnerable as a result of disaster. Gender (e.g. women), age (e.g. children), personal experience (e.g. loss, grief, fear) emerged as factors from the semantic analyses of disaster experience text corpora.

In general, the maps are useful for understanding the nature of ABC and organizational impact of services during disaster situations. The utility of the concept depends on its selection as a leading concept in the dominant theme. There are many important concepts within the maps, but suffice it to say that the maps represent the state of the scenario and that they summarize the disaster data.

On the whole, the maps visualized the attitudes of people during different disaster situations, and the kinds of services that could be rendered to manage the disaster. Since the articles that made up the corpora vary in quality and quantity within and between disaster classes, the resulting map is representative of the generic disaster class. To analyze specific disaster types, it would be informative to scrutinize the semantic maps in Appendix D for ABC and Appendix E for disaster situations. These maps are more detailed and explain each disaster type.

8

Hybrid Ontologies for Attitudinal Modeling

In this chapter we discuss the results of the study. The purpose of this study was to analyze ABCs of disaster situations. Three classes of disasters were explored with four disaster types in each class. The ABCs were derived from narratives and research articles of individual events. However, they were analysed to construct a group attitudinal ontology.

ABCs, as modelled in Figure 2.1, are components of attitude. Understanding how people behave, think and feel in the face of disaster provides an opportunity to forecast the behavior of others who have yet to experience a disaster situation. The semantics derived from text mining were mapped to the generic ontologies of attitude and disaster class in Chapter 4 to reveal the concepts and requirements of people in disaster situations.

Hybrid Ontologies

Initially, ontologies are introduced as an explicit specification of a conceptualization (Gruber, 1993). Therefore, ontologies can be used in an integration task (e.g. developing a disaster management system) to describe the semantics of the information sources and to make the contents explicit. As such, they can be used for the identification and association of semantically corresponding information concepts (Wache et al., 2001).

In the present research, we use a hybrid approach to integrate the attitudinal and organizational (or disaster situational) ontologies to describe the semantics of people's ABC and disaster information framework for understanding the relationship between various concepts of interest. A generic attitudinal and disaster situation ontology is given in Figure 4.1. Applying this to the semantics derived from the Leximancer analysis, we can evaluate the ABC and the requirements to prepare people for future risk-related situations.

Attitudinal ontologies

Natural disasters

Figure 8.1 represents the ontology for **natural disaster** based on combined data for tsunami, earthquake, hurricane and flood. The semantics (seed concepts) were derived from the analyses of the main theme, *anticipation*. The percentage values indicate the likelihood of mapping between the linked concepts, and indicate the strength of the relationships that may be used in forecasting.

In anticipation of a natural disaster such as earthquake, hurricane and flood, people **perceived** (cognition) the **threat** (risk perception) posed by the disaster situation and this induced a level of **fear** (affect). The threat created **concern** (behavior) that may lead to action. The **anticipation** dataset provides information about the level of concern, while the **perception** dataset influences the perception level. The **arousal** dataset moderates the strength of emotion. The threat level is determined by the anxiety dataset.

Figure 8.1 Attitudinal ontology for natural disaster

From Figure 8.1, the strength of the mapping relationship between perceived and threat (19%) is relatively strong, followed by fear and threat (11%), then threat and concern (9%). This suggests that cognition, in conjunction with affect, are at work during natural disasters, while behavior occurs when the perceived threat is high. People tend to anticipate and demonstrate concern as evidenced by 30% of concept mapping.

In other words, affect and cognition are equally important attitudinal components of natural disasters, while behavior is present in all four disasters (see Chapter 7 – Figures 7.1 to 7.4), but the degree of action is greater in tsunami than in the rest of the disasters. A study by Iemura, Takahashi and Pradono (2006) found that survivors of tsunami held to floating objects, climbed on house roofs, swam, climbed up trees, either intentionally or unintentionally. The survivors felt that more could have survived if they ran immediately after the big earthquake. Since tsunami occurs suddenly, the need to act is spontaneous; the element of fear sets in afterwards.

Human Induced Disasters

Figure 8.2 illustrates the ontology of 4 disaster types: terrorism, fire, industrial and transport accidents. These disasters are different in character as described in Chapter 3. But in general, they tend to induce greater reactions in people.

Figure 8.2 Attitudinal ontology for human induced disaster

In Figure 8.2, for the central theme *trauma*, it can be seen that **trauma** (affect) from the **stress** dataset (26%) mapped strongly to **vulnerability** (risk perception) at 52%. People **sense** (cognition) revealed from the **belief** dataset (10%) the **risk** which affected their vulnerability (17%). This caused them to be **desperate** (behavior) which triggered action (33%) that is confirmed by the dataset **ran** (33%).

In HID, it can be forecasted that people would act quicker than in a ND situation. This means that behavior occurs before cognition, while affect in the form of fear or panic is the triggering factor (Craske, 1999). This is because people feel vulnerable to the traumatic experience, and they sense the approaching threat, as illustrated in Figure 8.3.

Figure 8.3 Relationship of worry, anxious apprehension and fear (or panic) (Craske, 1999).

Industrial accidents may also create the same reaction in victims. For example, a German weekly, Der Spiegel, described the behavior of engineers and the fire department when electrical cables caught fire in a Spanish nuclear power plant. Panic broke out in the control room, and the engineers were all screaming at the same time and scrambling to get out. When the fire department arrived, not a single engineer was willing to direct the efforts to extinguish the blaze (Fietkau, 1990).

Pandemic disasters

In Figure 8.4, the **stigma** (risk perception) associated with the disease caused victims to worry (affect). This is evident from the **emotion** dataset (18%). The stigma is learnt from **knowledge** (13%) of the disease. There is a tendency to **perceive** (cognition) the stigma which might lead to **confront** (behavior) the situation through **coping** (25%) behavior.

With pandemic disasters, affect plays a greater role than cognition or behavior. Central to the problem is the task of managing the negative emotions (e.g. shame, sadness, helplessness, fear, worry) associated with serious illness and its consequences (Siegel & Schrimshaw, 2000). People tend to worry more than taking action, especially in the case of HIV/AIDS. Depending on the severity of the emotion induced by the risk, action may be slower than expected. This includes seeking medical treatment (Finkenauer & Rimé, 1998).

Figure 8.4 Attitudinal ontology for pandemic disaster

Disaster situational ontologies

Natural disasters

Figure 8.5 illustrates the mapping of concepts in natural disasters. The **emergency** (disaster situation) created by the disaster type requires **assistance** (situation need), which in turn requires **rescue aid** (services) in the form of **agencies** (people). The type of rescue aid may be **food** (15%). The agencies comprise of **workers** (10%), the type of assistance depends on the **needs** (12%), and the **relief** effort (17%) will comply with the nature of the emergency situation.

Figure 8.5 Disaster situation ontology for natural disaster

This ontology represents the organizational aspects of disaster management in natural disaster situations.

Human induced disasters

Figure 8.6 presents the concepts of HID. Due to **safety** (18%), a **fire emergency** (disaster situation) would require the search of **tunnels** (situational need), depending on the **risk** (18%). The tunnel requires the effort of **rescue** (services) **workers** (17%). The rescue services will work with the **users** (people) in the tunnel who were identified by **families** (11%).

This scenario is typical of fire disasters and also for terrorism. People may be trapped in tunnels (e.g. subways) due to fire or bombing (97%). Firemen also might be required to look into tunnels or make tunnels as a way of controlling the outbreak of fire (31%). The relationship between tunnel and rescue services is also moderately high, 26% (Associated Press, 2008; Lindley, 1997).

Figure 8.6 Disaster situation ontology for human induced disaster

Pandemic disasters.

Figure 8.7 presents the ontology for pandemic. An **outbreak** (disaster situation) caused by **infectious virus** (26%) requires **management** (situational need), and this depends on the **crisis** created by the outbreak (11%). The management requires a **medical network** (services) to provide treatment (24%). The network may include **government or medical staff** (people) of **hospitals** (11%) to manage the problem.

This scenario is typical of disease outbreak where the organization of teams requires networking among countries and medical staff.

Figure 8.7 Disaster situation ontology for pandemic disaster

Summary

From the semantic framework it may be summarized that attitudinal ontologies are useful in describing the ABC of people, while disaster situational ontologies are relevant in understanding the organization of services that meet the needs of the disaster situation. For disaster management, both attitudinal and organizational (disaster situation) ontologies are required, as they inform about the attitudes of people in relation to their environment, see Figure 2.4. Most disaster management systems focus on recovery plans without understanding people’s attitudes. Clearly, people’s affect, behavior and cognition vary with the type of risk, and the response has to match their ABC requirements.

9

Summary and Future Work

This chapter summarizes phase 1 activities. It also outlines the proposal for future work that takes the present research as a point of departure.

SUMMARY OF FINDINGS

The goal of the project was to model risk attitude in the context of disaster experience. Following Breckler (1984), attitude is made up of its tripartite components: Affect, Behavior and Cognition (ABC). Affect is feeling, Behavior is doing and Cognition is thinking. A conceptual attitudinal model was used to map the relationship of ABC components (see Figure 2.5, Chapter 2). This relationship was further mapped in a semantic framework specified in Figure 4.1 (Chapter 4). The semantics of risk perception, ABC was used to build several ontologies for attitudinal modeling. In addition, organizational ontologies became necessary to map the relationship of entities for disaster management. A hybrid ontology architecture that combined attitudinal and organizational ontologies is shown in Figure 9.1 below.

Figure 9.1 maps the disaster situation ontology to attitudinal ontology at the risk perception node. Understanding people's risk attitudes alone is inadequate to support relief effort and vice versa. For disaster management, it is important to identify the attributes of people and environment, so that a comprehensive risk attitude model may be developed. This is to enable better forecasting of group behavior.

Guiding the research activity is a methodology that specified the process for ABC classification, data preparation and analysis (Chapter 5). To contextualize the model, a taxonomy of disasters was provided in Chapter 3. In Chapter 6, we confirmed the semantic processing capability of LSA and LXM. Given the greater usability of LXM and visualization of results in concept maps, it was used for the semantic mining.

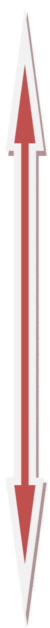

Figure 9.1 People-Environment Ontology Architecture

Chapter 7 investigated ABC using text corpora from personal stories and research articles. Both generic and specific attitudinal and disaster situational ontologies were derived for natural disasters, human induced disasters and pandemic disasters. Attitudinal ontology describes people's risk attitude, while disaster situational ontology describes the environment as illustrated in Figure 2.4 of the People-Environment systems model (Chapter 2).

Chapter 8 discussed the relevance of the semantics findings in relation to ABC. The mapping of concepts at the node indicates the likelihood that these concepts are strongly linked. Overall, there were more concepts for Behavior than for Affect and Cognition. To forecast socio-cultural attitudes in disaster risk situations, Table 9.1 presents some expectations of ABC that may be uncovered in future work.

Table 9.1. Attitudinal forecast as a function of disaster type, pre-warning and risk perception

Disaster type	*Pre-warning*	*Risk Perception*	*Expected ABC of people*
Natural Disasters			
Tsunami	Sometimes no pre-warning	High risk	**Behavior** – rushed, shouting, screaming, swim, climbed, diving, crying, pulled, held, grabbed **Affect** – calm, lucky, loved, scared, happy **Cognition** – thinking, feel, decided, remember, forget
Earthquake	None – but people are used to it	High-Moderate risk	**Behavior** – breathing, avoidance, used, coping, planning, given **Affect** – relief, traumatic, fear, depression, suicidal **Cognition** – perceived, focus, reactions
Hurricane	Yes - through mass media	Moderate risk	**Behavior** – avoid, approach, seek, cope, helped, stress **Affect** – fear, traumatic, emotional, stress **Cognition** – self-efficacy, focus, perception, learn
Flood	Yes - gradual build-up	Low-moderate risk	**Behavior** – cope, work, provide, support, take, checking, control **Affect** – feel, threat, trauma, concern, depression, emotional **Cognition** – believe, sense, perception, adaptive
Human Induced			
Terrorism	None	High risk	**Behavior**- provide, responded, choose, coping, searching, making **Affect** – anxiety, anger, fear **Cognition** – attention, identify, beliefs thoughts
Fire	None	Moderate risk	**Behavior** – evacuate, rescue, calling, pick, wait, drive **Affect** – happy, panic, fear, anxiety **Cognition** – decision- making, perceive, knowledge
Industrial Accidents	Immediate or gradual build up	Moderate risk	**Behavior**- explain, avoid, obtain, working, gathered, observed **Affect** - danger, lost, fatalistic **Cognition** – perceived, attention, decisions
Transport accidents	None	Moderate risk	**Behavior** – driving, breathe, entered, looked, crying, working, ran **Affect** – distress, shock, fear **Cognition** – described, thought, realised

Pandemic			
Swine flu	Relatively slow build-up	Low risk	**Behavior** – breathing, avoid, sneezing, practice, examined, using **Affect** – anxiety, distress, fear **Cognition** – thought, decision, emotions, ability
SARS	Relatively slow build-up	Low risk	**Behavior** – coughing, spitting, ordered, told, called, glanced, laying **Affect** – helpless, frightened, scary **Cognition** – thought, knows, experiencing
HIV/AIDS	Ignore caution	High risk	**Behavior** – care, cope, confront, provides, reflects, stands, control **Affect** – anxiety, fear, anger, stress, arousal **Cognition**- decide, believe, emotion, perceived, attention
Tuberculosis	Relatively slow build-up	Moderate risk	**Behavior** – coughing, eating, share, working, travel, stay **Affect** – sick, suffering, afraid, sad **Cognition** – focus, thinking, known

FUTURE WORK

The next phase of activities involves gathering data from human subjects. This will be done experimentally in the field. The aim is to measure people's attitudes that can lead to behavioral forecasting.

Research Design

The objectives of this study are:

1) To develop the attitudinal model for behavior forecasting. Data will be collected directly from people in four cultural settings in Southeast Asia;
2) To validate the ABC concepts that was mined in Study 1 using: (a) leximancer analysis. (b) ANOVA to compare the risk attitudes of cultural groups, and (c) correlation to assess the relationship of concepts. The results will be used to analyze risk taking behavior for various hazards in natural and human induced disasters.

The approach involves an experimental design using a risk attitudinal board, akin to the citarasa elicitation system (Khalid et al., 2009) to measure risk perception, situational awareness and cultural values. A control group will be used to compare the outcome of the risk evaluations.

Risk attitudinal board

Figure 9.2 provides a summary of the process used for assessing risk attitude.

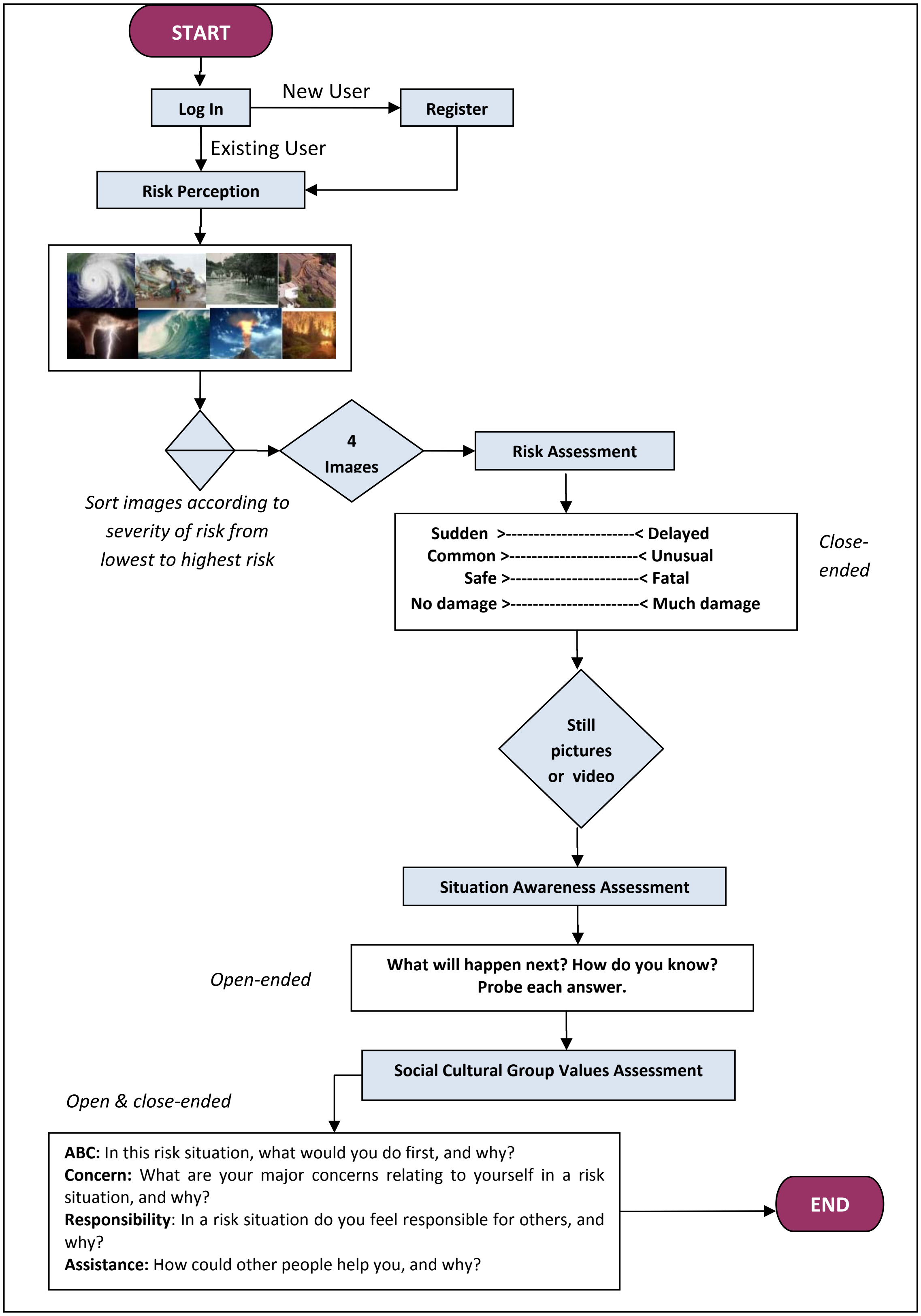

Figure 9.2. Flow diagram of risk attitudinal board

The first part of the process in Figure 9.2 involves perception of risk through three steps:

1. Sort disaster images according to risk perceived,
2. Rank severity of risks from low to high risk, and
3. Rate the level of threat as perceived.

The second part of the process requires assessment of situational awareness of the disaster scenarios. Participants will be shown a disaster situation to react to, and to predict what would happen next. They will not be given responses to select. A control group will be provided with answers most appropriate to the situation. This will make it possible to compare forecasting ability as a function of the presence or absence of diagnostic information.

The final part of the evaluation process measures group values in relation to their ABC, concerns, responsibility, and assistance required in disaster situations. Examples of questions:

- *ABC.* In this risk situation, what would you do first, and why?
- *Concern.* What are your major concerns relating to yourself in a risk situation, and why?
- *Responsibility.* In a risk situation do you feel responsible for others, and why?
- *Assistance*. How could other people help you, and why?

Both projective and why-why-why probe techniques will be used to elicit forecasting information (Khalid et al., 2010a). An outline of the study is given in Appendix F.

In conclusion, we have demonstrated, in the present study, the importance of building ontology for attitudinal modeling that identifies ABC semantics across heterogenous sources of disaster information. The semantics may be applied to forecast risk attitudes of people in different cultural settings so that a more comprehensive model of attitude may be developed for disaster management.

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