

BACHELOR'S THESIS



RADBOUD UNIVERSITY NIJMEGEN

A systematic network-based literature review of the Social Amplification of
Risk Framework

Author: Thu Ha Nguyen

Supervisor:

Professor: Lidwien van de Wijngaert

Mrs. Nina Luran

ABSTRACT

The Social Amplification of Risk Framework (SARF) is one of the research domains in Risk Perception Analysis as many studies have examined risk events and individual's risk perception based on this framework. The aim of this study is to examine the development of this research domain regarding the constructs and relationships that have been established. In total, 12 SARF-related studies were collected and examined systematically by extracting hypotheses and constructs and assessing the operationalisation of the constructs. The finding showed that the Social Amplification of Risk Framework have been well studied as there were many constructs and hypotheses validated as shown in the network. The frequent tested constructs were also central elements of the Social Amplification of Risk Framework. Finally, further research is also suggested to focus on other constructs in the SARF that have not been examined and validated and potential relationships between constructs should be explored.

INTRODUCTION

Risk is often referred to hazard times or the situation when something bad happens to health, safety or technologies (Brown, 2014) Risk perception is a process in which the way human analyze the risk situation and act upon that depends strongly on their lifetime knowledge and experience (Brown, 2014). Due to this highly personal process, there might be a gap in risk perception among people with different experience and knowledge or between experts and public (Slovic, 1987; Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). According to Gray and Ropeik (2002), in many situations, when the public decides not to follow experts' statement with regard to risk perception, this risk perception gap could bring more risk to the situation. For that reason, scientists and researchers had seen the urge to establish a new field of study, namely risk perception, to identify and understand the factors which underlie human's risk perception process (Gregory & Mendelsohn, 1993; Slovic, 1987).

Researchers have shown great interest in risk perception, hence multiple noteworthy schools of thought and perspectives have been contributed to the field (Renn et al., 1992). Different approaches to understanding risk perception have been presented in different areas, i.e. geography, sociology, political science, anthropology and psychology in which sociology/anthropology and the psychology are the most well-known and developed schools of thoughts. To be more specific, in the sociological perspective on risk perception, Short (1984) argues that as being a part of the society and different social groups, one's idea is not one's own. In fact, one's perception of risk is processed by several social interactions and developed in groups, which involve friends, family or colleagues. That is to say, to understand the perception of risk, it is important to understand the belief of the public. Douglas and Wildavsky (1982) have supported this point of view, saying that humans have to act up to the belief of the social group and to maintain the belief of the group, sometimes the perception toward something need to be shifted, either exaggerated or minimized, to align with the belief of the group as well. The psychological perspective, on the other hand, views the mental state as a major factor in the risk perception process. In this research area, researchers try to understand the mechanism of, for example, how people assess the risk event (Edwards, 1961), the percentage that people would rate one event as risky or how the uncertainty in one individual can lead to the risk perception

(Kahneman, Slovic, & Tversky, 1982). From this point, the psychological research will thus recommend or develop strategies and models of how to effectively assess and influence the risk perception among individuals

Although it could be seen that the sociological perspective and psychological perspective has developed an undeniably valuable argument toward risk analysis and risk perception, these theories centralize only one specific concept and perspectives (Burns et al., 1993). However, in a risk event, there might be many factors playing a role in influencing the public's perception and to analyze the risk perception effectively, important factors should be integrated and analyzed as a whole (Kasperson, Renn, Slovic, Brown, Emel, Goble, R, ... & Ratick, 1988). Consequently, there was a need of "a comprehensive theory that is capable of integrating the technical analysis of risk and the cultural, social, and individual response structures that shape the public experience of risk" (Kasperson et al., 1988). In 1988, Kasperson et al. (1988) introduced an interdisciplinary approach towards understanding risk perception, which is known as the Social Amplification of Risk Framework (SARF). For many years, the Social Amplification of Risk Framework has been used as a foundation for different risk perception empirical researches among different topics, such as health, diseases, technology, safety, and hazardous events (Wirz et al.). Considering the amount of scholars that applied the SARF, this study is set out to examine how well the Social Amplification of Risk Framework has been developed and applied.

THEORETICAL FRAMEWORK

1. An interdisciplinary approach: The Social Amplification of Risk Framework

Amplification (in communication) is defined as a process of transmitting information from source to receiver through one (or multiple) transmitter(s), in which the signals or message might be altered by intensifying or attenuating during the encoding/decoding process (De Fleur, 1966). This definition of amplification plays an important role in the Social Amplification of Risk. In the Social Amplification of Risk, there are two important elements that interact with each other, namely social experiences of risk and risk consequences (Kasperson et al., 1988). Social experiences of risk are any practical interaction between individual and the society regarding the risk events, such as transmitting risk information, decoding/encoding the risk's message, involving in social groups and being influenced by social-group behavior. As the amplification involves in the process of social experiences of risk, according to Kasperson et al. (1988), these

social experiences could alter individual's perception of risk from the original level of risk and thus shape the risk perception/consequences.

In order to further understand how risk perception could be influenced by the social amplification of risk, a framework of the social amplification of risk has been developed (Kasperson et al., 1988) taking into account different (social) factors. The social amplification of risk framework consists of two major stages representing two important elements of the process – how the information of the risk events is transmitted and perceived (social experiences), and how the society takes action as a response to the events (risk perception/consequences) (Mase, Cho, & Prokopy, 2015). In the network, social experience of risk is shaped by five elements which interact with each other, namely information sources, information channels, social group behavior, individual behaviors, and institutional structures,. These subjects are shown in the social amplification of risk framework (Fig. 1), respectively.

With regard to the process of evaluating risk event and shaping risk perception, Kasperson et al. (1988) believes that once a risk event starts, it is crucial to identify the sources of amplification, which could fall into three categories: personal experience, direct communication and indirect communication. The event is thus processed by individual senses and professional information brokers to create a signal which stores all the important information of the event. This signal, known as an informal social network, is processed by social stations of amplification, such as news media, opinion leaders and government agencies. Following this stage, the information is believed to be published via multiple communications channels (media, press, telephones, direct conversations) where citizens all have access. This stage, therefore, forms individual stations of amplification where individuals could decode and evaluate the message in their own way which later result into particular behavioural group/individual responses. In this stage, the way that individual responses represents the impact of the risk events on individual and by social interaction, the impact could be spread among different groups which is shown as the 'ripple effect' in Figure 1. The 'ripple effect' demonstrates that the closer the group to the directly affected person, the easier it would be impacted.

SOCIAL AMPLIFICATION AND ATTENUATION OF RISK

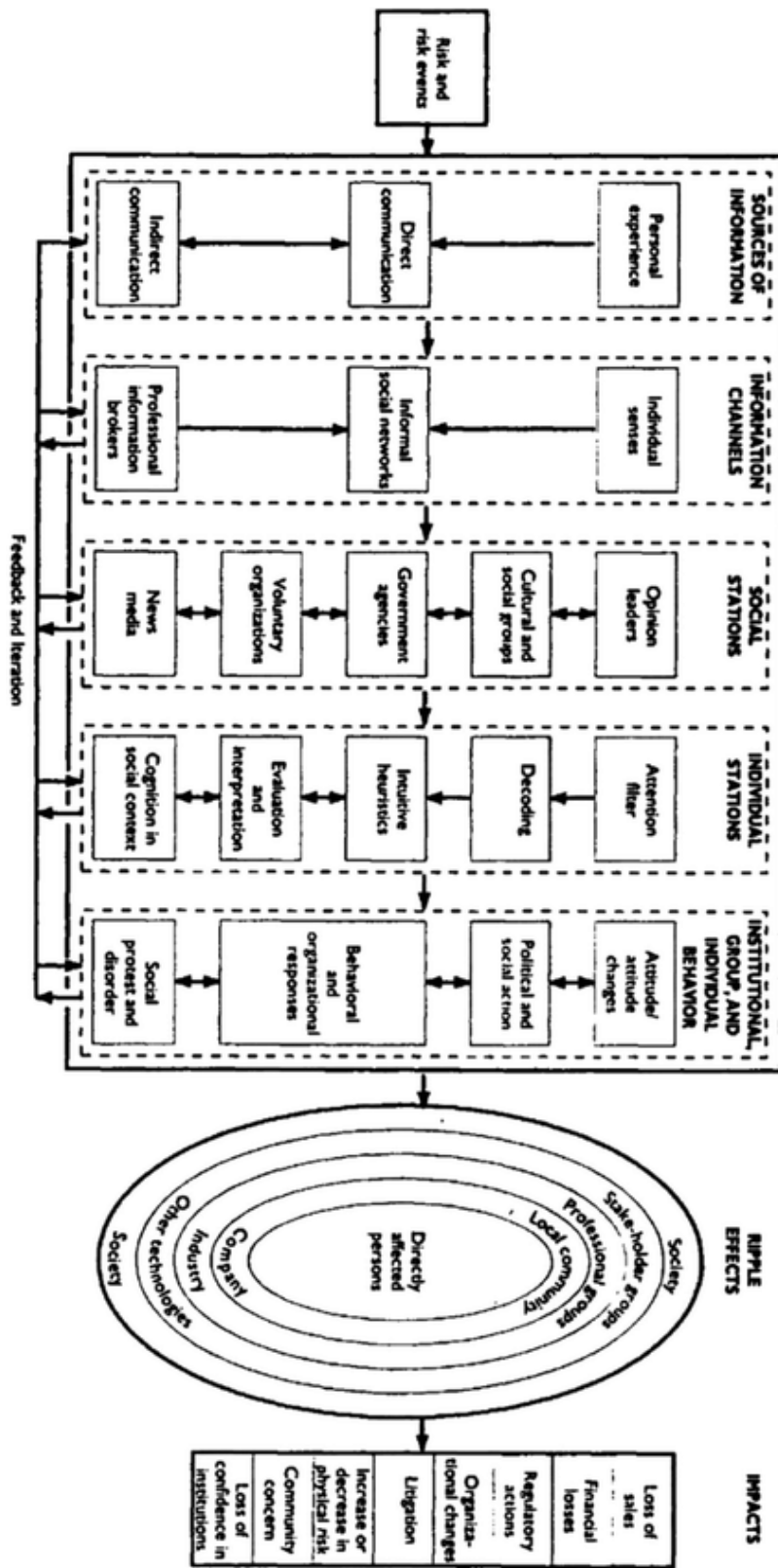


Figure 1. The social amplification of risk framework (Kasperson et al., 1988)

2. Theoretical and empirical studies on the Social Amplification of Risk Framework

For the last 30 years, the Social Amplification of Risk Framework (SARF) has shown a notable contribution to the field of risk perception research since the framework has been applied and examined frequently as a foundation to past research including theoretical development and empirical studies (Wirz et al., 2018). The Social Amplification of Risk Framework is indeed supported by several empirical studies in various risk areas, such as outbreaks (e.g. Raupp, 2014; Rossmann, Meyer, & Schulz, 2017), diseases (e.g., Rickard et al., 2013), and health-related topics (e.g. Chong & Choy, 2018), and the application of the SARF is widely investigated in different areas of risk perception (Wirz et al., 2018). Rickard et al. (2013) stated that the SARF acted as an effective framework in assessing the risk event and crisis in multiple stages, ranging from the nature of risk event, the social stations of amplification and the behavioural responses that an individual might have toward the risk events.

One of the most central stage in the Social Amplification of Risk Framework is how the risk information is transmitted. Studies have shown that media and community play a role in this process in risk event. A study by Raupp (2014) showed that during public health issue, news media and social agents played a vital role in shaping the social and individual stations of amplification. Furthermore, affected stakeholders also tend to perceive the risk event as more serious than its level of risk and the central frame of the outbreak also deviates from its original frame, as a health problem, to political economic problems (Raupp, 2014). This finding is strengthened by another study from Rossmann, Meyer, and Schulz (2017), in which the media is blamed as often framing the risk events in an extreme dramatized way. Moreover, the different effects of different types of traditional publication (i.e. press releases, quality press articles, and tabloid press articles) on the perception of risks in audiences are also tested (Rossmann, Meyer, & Schulz, 2017).

Online media have recently become an interesting research area within the SARF (Wirz et al., 2018). It is believed that online mass media are more effective than traditional mass media in reaching audience in a wider scope (Chung, 2011). The study from Chong and Choy (2018) indicated that online media could enhance the effect of the risk perception, health-related topics in particular, due to its great medium, of which Facebook was acknowledged as the effective platform on intensify emotions, compared to other online newspapers, namely *HardwareZone*

and *The Straits Times*. This is explained by the fact that while particular websites only have a limited number of frequent visitors and the risk information can only reach certain frequent visitors, different social media platforms on the Internet allows individuals to involve actively in the sharing process of the risk information and thus draw more attention on the risk event (Chung, 2011).

In addition to the role of media, within the SARF, the social station, which is the society and community that individual belongs to, also plays a crucial role in shifting an individual's perception of risk. Kandiah, Binder, and Berglund (2017) have applied the SARF to see whether the opinion of one individual could be influenced by the community and the other way around. This study has agreed upon the theoretical framework from Kasperson et al. (1988) as well as the theory from the school of sociology that it is undeniable that human and the society all rely on each other and thus interact with each other in a way that in the end, a common belief will often be negotiated.

There are also some criticisms which are worth considering within the SARF. First of all, since Kasperson et al. (1988) only provided the SARF as a starting point or foundation for analyzing and understanding any risk event, there is no hypothesis available to test the effect of risk content within the SARF (Wirz et al., 2018). On the other hand, media content is believed to have strong impact on amplifying or attenuating the risk perception (Wirz et al., 2018). Due to the lack of media-content-related hypotheses, the SARF has created a dilemma for itself which does not allow scholars to improve the framework in this area regardless of the media-content-related findings.

Furthermore, Petts et al. (2000) believed that the involvement of the underlying mechanism and reasoning of one risk event was necessary in the risk perception research; however, it was unclear how the SARF has incorporated this matter. With regard to the way that the SARF evaluates a risk event, bias could be seen among the process as the framework acknowledges the amplification of risk as a negative element (Petts et al., 2000). This could, in fact, lead to the misinterpretation and thus result into an inappropriate plan for persuasive development during the risk event.

The SARF has also been criticized as the process has been oversimplified (Wirz et al., 2018). Rayner (1988) has demonstrated that the immature discipline has resulted into a lack of

anthropological knowledge incorporated into the framework, while in fact, as if individual is an important element which partially decide the impact of one risk event, better attention should be paid to understand this. In this framework, mass media and communication process acts as the element to amplify or attenuate the perception of risk, which lies in the behaviour of individual. Consequently, in the situation of generalizing the characteristics of human and lack of anthropological theory, mass media and communication process would also be oversimplified as well (Rayner, 1988).

The aforementioned studies have shown a variety of research areas and elements within the SARF. Empirical studies have also tested multiple variables that play a role in manipulating the perception of risk and theoretical studies have contributed greatly to the SARF as well as shown some difficulty regarding developing the model. However, considering both theoretical and empirical studies, it has shown that the Social Amplification of Risk Framework research has been well-developed; however, as empirical studies often focuses on different topics or case studies of health, safety, or technological development, the variable tested among these studies vary strongly and do not seem to relate to each other. Different studies that have examined the same relationship also reported differently on the results. For example, Petts and Niemeyer (2004) showed no significant relationship between the role of media and the risk perception while Raupp (2014) reported a significant relationship between the amplification of risk from the media and the perceived risk. With regard to this matter, the wider the variety of studies within the SARF, the more complex this field would be and thus, future studies could not totally consider different theoretical perspective and different contradicting results within the field and might over-studied or over-examined one aspect. Consequently, an integration of the researches in the field of Social Amplification of Risk Framework is needed.

This literature review urges to collect the existed SARF studies and examine these studies systematically so that major constructs and hypotheses which have been tested will integrate. In order to approach this, the following research questions are centralized in this study:

- *RQ1: Which constructs related to the field of SARF can be identified and what are the core constructs of the field of SARF?*
- *RQ2: How can these constructs be categorized and what are the main categories in the field of SARF?*

- *RQ3: What are the relationships between the constructs related to the field of SARF and how often have they been examined? Were these hypotheses validated?*

Regarding the integration of studies within the SARF, Wirz et al. (2018) have collected and examined 44 peer-reviewed articles and book chapters that applied SARF to either develop theoretical framework or examine the framework through case studies. This literature review has yielded two major contributions. First of all, the SARF is agreed among studies to be the starting point with regard to assessing and understanding risk events and human behaviours towards these events. Second of all, despite the starting point, SARF creates barrier to understand the underlying mechanism of the effect of content data on risk perception.

Although the overview gives some insightful conclusions within the SARF, the narrative method that Wirz et al. (2018) used to assess the results from different SARF researches might have some limitations. First of all, it is unclear how the information from these studies was processed and how the researchers drew the conclusion regarding the link and the variety of information among different studies. Second of all, considering the 44 articles and book chapters studied, only two conclusions have been drawn. This questions the existence of the subjectivity of the literature review as if the reviewers attempted to generalize the results qualitatively and only assessed the literature as of their convenience. Finally, the narrative method could also shift the findings and the integration of the SARF in this case as reviewers' interpretation and understanding might play a role, as Card (2015) has criticized. As a result, it is important to consider another literature review method to examine these studies systematically.

3. Research approach: A network approach toward literature review

The network analysis is an approach to review different studies systematically based on its hypotheses (Van De Wijngaert, Bouwman, & Contractor, 2014). The network analysis approach could consider multiple relationships among different studies and could give better insight into the interrelatedness of these relationships (Van De Wijngaert et al., 2014). With regard to a high number of relationships between different constructs posed and tested in the Social Amplification of Risk domain, the network approach is suitable for this literature review, compared to other approaches, i.e. the meta-analysis approach, which only focuses on a single relationship that has been tested among different studies (Card, 2015).

In network analysis, variables and the direction of the relationship are the most important elements to examine studies. These variables are known as nodes in network analysis while the direction of the relationship is the tie that connect nodes together (Van De Wijngaert et al., 2014). Other than that, the characteristic of variables are also clarified as in-degree (independent variables) and out-degree (dependent variables). The network could also be adjusted accordingly to the research's objective. For example, in order to simplifying the network and be able to gain more insight into the interrelatedness among different aspects of the research domain, these variables could also be merged into one category if they have the same (or similar) operationalization and definition. The categorization of different concepts will be shown in the network by different colours and size of nodes. By carrying out this network analysis , a general overview of a particular domain of research will be systematically addressed as it does not only assess the hypotheses of related studies but also able to demonstrated the frequency that a hypothesis has been tested. Consequently, the analysis could have better accuracy and reliability and the findings could be applied by future research.

Considering these advantages of the network analysis, this literature review uses the network analysis to assess SARF articles systematically.

METHODOLOGY

Following the method guidelines from van de Wijngaert et al. (2014), the research procedure of this study included three steps. First of all, papers was collected. Secondly, hypotheses from selected paper were extracted and put into a coding sheet. Finally, the coded hypotheses were analysed and a network of relationships was drawn to demonstrate the relationship visually. The procure is clarified as follow.

1. Paper selection

As discussed previously, the purpose of this literature review is to assess the literature in the SARF research domain. Considering the limitation of the literature review from Wirz et al. (2018), this paper, first of all, re-assessed the 44 peer-reviewed articles and book chapters which were listed in the literature review in Wirz et al. (2018) as these articles were related to the SARF domain of research. Among 44 peer-reviewed articles, only studies that had a quantitative research method and explicit hypotheses were chosen. The reasoning of this criteria was to ensure that hypotheses were available for extracting and coding as network could not be emerged

if there were no hypothesis involved. This assessment were done in two steps. The first step was identifying explicit hypotheses by scanning hypothesis-related keywords in these papers, such as ‘hypothesis’, ‘hypotheses’, ‘H1’, ‘H2’, ‘H3’, etc. However, some quantitative studies might not have any hypothesis-related keyword but they could be found in difference forms, such as explanatory sentences or questions. Therefore, if hypothesis-related keywords cannot be found, the papers were assessed thoroughly again to find any tested relationship among variables in the papers.

Based on the selection criteria of this literature review, 12 papers which carried out quantitative research method and applied the Social Amplification of Risk Framework were selected and 32 papers were left out as most of them were case study and did not test any relationships. Most of the papers were published between 2011 and 2018 and two papers were published in 1993 and 2003. There were five papers published in the Risk Analysis Journal, while other papers were published in the Society and Natural Resources Management (2), Environmental Science (2), Communication & Society (1), and Health Communication (2).

Among 12 papers, there were two research methods used, survey (6) and corpus analysis (6). Studies that used surveys were carried out by handing participants paper to fill in the answers (3), asking participants question via telephone (1) or providing an online link to the online questionnaire (2). The sample sizes of these studies were adequate considering the population with an average sample size of 1,300 in studies ranging from wildfire risk perception, the impact of citizen discussion on perceptions of risks to light pollution perception in Korea. Multiple data-analyses have been used among these studies, such as multiple regression analysis, ordinary least-squares (OLS) regression, SEM and ordinal logistic regression.

The corpus analysis studies, on the other hand, collected different types of content for its analysis, such as press releases during H1N1 outbreaks (1), social media posts (3), organisation content (1) and risk events content (1). The sample size of these corpus analyses were relatively high, in which four corpus analyses had a sample size of over 2000 and only two corpus analysis with a sample size of 652 and 108.

2. Coding

Data gathering

Two coders coded the 12 papers. Based on the guideline from van de Wijngaert et al. (2014), after the first assessment and having compiled an adequate amount of qualified papers, the information from these papers was extracted, coded, and stored in an Excel file. The Excel file was used as a coding sheet and consisted of four major tabs, which were references, theoretical information, hypotheses and operationalization. The references tab includes following information: title, author(s), year of publication, reference, research method, sample information and model fit. The theoretical information stored the relevant theory, direction of hypotheses, independent and dependent variables and results. Beside this, it was also important to code the significant statistics in these papers in terms of p- values for re-assessing the hypotheses. The third tab – hypotheses presented all the information regarding the theory, hypothesis related, and independent as well as dependent variables of the hypothesis. Finally, the operationalization tab noted down how the independent and dependent variables were operationalized. The information must be coded exactly the same as the operationalization of these variables in the papers so that the unification and aggregation process would not have any cluster. It was also important to re-state the general information of each paper regarding its title, author(s), year of publication or reference in the first column of each tab to ensure the accuracy of the information coded and the convenience of coders.

Unification and aggregation

Van de Wijngaert et al. (2014) have demonstrated some problems regarding the coding process. Different studies indeed consist of different concepts; however, these concepts might only have different names or different variables but the underlying mechanisms and the definition are the same. Another problem is that sometimes, the number of variables might get to large which make it difficult to analyse the network. Consequently, there is a need for the unification of similar variables and aggregation of different concepts and variables that are close together.

The operationalization coding sheet were used as the starting point of the unification and aggregation process. The variable names and its operationalization were gathered. The variables which had similar operationalization were put into the same categories. Different coders coded independently and came together after the coding to discuss the difference as well as agree upon

the final result and the new name of these categories. One category might have multiple variables which have similar operationalization; however, there might be variables that have more similar and specific operationalization in that category which could form a sub-category. In that case, coders discussed whether it's necessary to form subcategories in the concerned category and how these subcategories should be named. The new categories and sub-categories for these variables were put together in one coding sheet called "VarNames". This coding sheet included four columns: Key column with the key letters of the authors, original variable name, name of the category that the variables belong to, and the sub-category that the variables belong to.

3. Data analysis

The central of this literature review is identifying the examined constructs and relationship between constructs in the SARF research domain, which could be analysed by creating a network of relationships. As explained previously in the network approach toward literature review section, such visualization involves nodes (constructs/variables) and ties (hypothesis) and the size as well as the colours of the nodes for the visualization of the frequency of these constructs. To reach such conclusion, a data set of variables and hypothesis and the frequency that a hypothesis/construct was examined was needed. Once these information was retrieved from the papers and formed into a data set, the data analysis phase can be started.

Among several data visualizing tools, which could generate network visualization, Gephi was chosen as the analytical tool in this network approach. There are few reasons for choosing this software according to Heymann and Le Grand (2013). First of all, Gephi is specialized in presenting a network with the presence of nodes and strings. Second of all, the unification and aggregation of variables can be presented in Gephi as the software is able to group nodes and filter data. Finally, nodes in the network could be categorized better by colors and sizes, which supports effectiveness of the analysis in presenting different groups and frequency of constructs/hypothesis. For example, the out-degree or in-degree of one variable could be shown by different colours in Gephi and the frequency that one hypothesis or construct could also be presented by the size of the nodes.

RESULTS

As mentioned previously in the method section, the following information of the 12 papers was coded: references, hypotheses, independent and dependent variables, theory and the

operationalisation of these variables. This section reports the result of the final coding with regard to constructs and relationship between constructs coded.

1. Constructs

In the final coding sheet, a total of 116 individual constructs were found from the 12 papers that empirically studied in the field of SARF. For a more concrete network, the unification and aggregation of variables were carried out. This process resulted in a total of 39 sub-categories, which fell into 13 main categories. Table 1 presents the sub-categories and the main categories that they belonged to. Among 13 main categories, the number of sub-categories in each main category differ slightly. For example, ‘Messages’ characteristic’ and ‘perception’ categories had the most sub-categories with a number of seven sub-categories while other categories such as ‘frequency of receiving information’, ‘personal prior knowledge’, ‘degree of debate’ had only one sub-category.

Table 1: Name of main categories and sub-categories with regard to constructs found in SARF paper.

	Main category	Sub-category	Meaning
1	Action	Attitudes, belief, involvement, political involvement, recognition	Different types of action that individual take with regard to the information received and the risk event
2	Degree of debate	Degree of debate	Degree of debate between opposing opinions/thoughts
3	Demographic	Age, gender, geographical region, income	
4	Event characteristic	Event characteristic	Characteristic of risk events, such as level of risk, scale, controllability

5	Frequency of receiving information	Frequency of receiving information	Frequency of receiving or having exposed to risk information from the media
6	Messages' characteristic	Emotional expression, framing, general characteristic, media richness, message's length, risk-related messages	Characteristic of message that often involve risk-related content
7	Perception	Affected emotion, benefit perception, perceived consequence, perceived probability, risk perception	Perception or emotion that individual have as a result of exposing to the risk information
8	Personal current opinions	Personal concern, personal experience, personal view	Any opinion that individual have toward the concerned risk
9	Personal prior knowledge	Personal knowledge	Personal knowledge that obtained previously
10	Risk consequences	Direct risk consequences, indirect risk consequences	Consequences such as property damage, economic impact, political impact
11	Sources' characteristic	Information availability, information sources, information's characteristic, response time	Sources' characteristic (differ from message-content characteristic)
12	Transmitter's characteristic	Geographical difference, transmitter's characteristic	Any characteristic of transmitter including the difference between transmitter and receiver

13	Trust	Level of trust, trust in the government, trust in the industry, perceived incompetence	Level of trust for a general or specific organization
----	-------	--	---

Figure 2 was created in order to gain insights regarding the role of these constructs in the field of SARF research such as which constructs were used to explain other constructs or which constructs could only be explained by other constructs. The 39 constructs fell into five categories, namely dependent only, mostly dependent, equal dependent and independent, mostly independent, and independent only. Constructs that were used to explain other constructs are independent constructs while constructs that were explained by other constructs are dependent constructs. The types of constructs were categorised based on the ratio between the number of times a construct is used as dependent or independent variables. For example, ‘belief’ was used as dependent variables four times and used as independent variables two times, therefore, it fell into the mostly dependent category.

Among 39 constructs, the number of independent only constructs is the highest with a number of 19 constructs, followed by dependent only constructs with a total of 8 constructs. Mostly independent constructs, mostly dependent constructs and equal dependent and independent constructs, however, have a relatively small number of constructs, with a number of 5, 4, 3 constructs, respectively.

Although there were many independent only constructs, these constructs were not analysed frequently by different researchers as most of the constructs were only analysed once to three times and only three of these constructs were analysed six times. In fact, ‘risk perception’, which belongs to the mostly dependent category, was the most frequently analysed construct. In different studies, ‘risk perception’ had been studied as a dependent construct 16 times and as an independent construct twice. Another construct that was intensively examined in the field of SARF research was ‘frequency of receiving information’ as it was analysed 12 times in total. Some other fundamental constructs are ‘perceived probability’, ‘perceived consequences’, ‘attitudes’, ‘indirect risk consequences’ and ‘event characteristic’ with approximately seven times analysed.

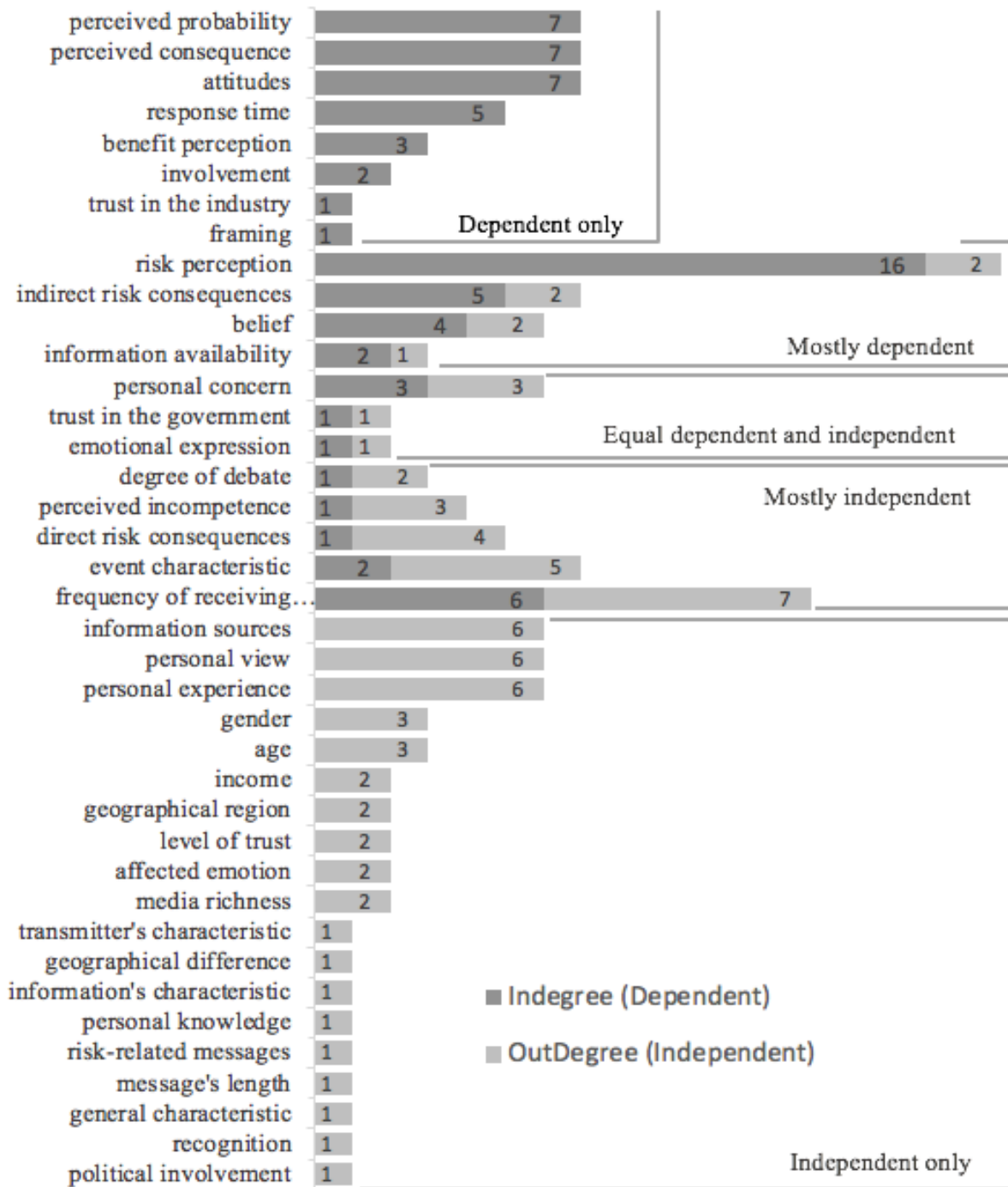


Figure 2: Descriptive statistics regarding sub-categories (constructs).

2. Relationships between constructs

In total, there are 45 explicit hypotheses that were proposed among 12 papers with an average of 3 hypotheses in each paper. However, many hypotheses proposed more than one relationship

between multiple constructs. For example, in Brenkert-Smith, Dickinson, Champ, and Flores (2013), H3 was proposed as “Fire-specific social interactions will increase perceived wildfire risk more than generic social interactions” but ‘fire-specific social interactions’ is a vague variable which could not be challenging to operationalise and measure. As a consequences, the researchers had to transfer this to nine measurable variables which belong to four main categories, namely generic formal interaction, generic informal interaction, fire-specific formal interaction, and fire-specific informal interaction, which results in 9 proposed relationship between constructs.

In order to create an informative network, every proposed relationship among 45 explicit hypotheses of the 12 articles was considered and coded. The final coding sheet resulted in a total of 170 hypotheses, of which 138 hypotheses were significant, two hypotheses was partly significant, and 30 hypotheses were not significant. After the aggregation and unification process, it appeared that there were many similar hypotheses proposed in different papers as some constructs proposed in different research papers have the same operationalisation. For this reason, different hypotheses were compared with regard to independent and dependent variables which resulted in a total of 76 unique hypotheses. In the 76 unique hypotheses, 46 hypotheses were supported, two hypotheses were partly supported and 28 hypotheses were rejected.

Furthermore, it’s worth considering that different researchers tested the same relationships between the same construct but the statistical results might be different. To be more specific, hypotheses in both articles proposed that ‘frequency of receiving information’ would influence ‘the perception of risk’ and one article reported a significant result for this relationship; however, the other article concluded that this relationship was insignificant. Excel thus processed this information and kept both similar relationship but with different result. Consequently, Excel filter was used to consider the number of unique hypotheses and unique results at the same time. The result showed a total of 84 unique relationship results were recorded with 75 % of significant unique results. The number and percentage of statistical results in comparison to the number and percentage of unique statistical results could be found in Table 2.

Table 2: Number and percentage of results and unique results of analysed relationships.

Results	Number of unique results	Percentage of unique results	Number of results	Percentage of results
Significant	63	75 %	138	81,1 %
Not significant	19	22,6 %	30	17,7 %
Partly significant	2	2,4 %	2	1,2 %
Total	84	100 %	170	100 %

As many hypotheses were proposed in different scholars, the time that each relationship was proposed was coded for a clear overview. Table 3 shows the information with regard to the time that unique relationships were analysed. In general, more than half of unique relationships were analysed only once and only approximately 20% of unique relationships were analysed more than 3 times. The most analysed relationship was ‘information sources’ → ‘perceived probability’ as it was analysed thirteen times among different articles, followed by ‘personal knowledge’ → ‘risk perception’ and ‘personal experience’ → ‘risk perception’ with twelve times analysed and finally, ‘personal experience’ → ‘perceived probability’ with ten times analysed.

Table 3 : Number and percentage of relationships and unique relationship between constructs regarding time analysed.

Time analysed	Number of unique relationships	Percentage of unique relationships
1x	46	60,5 %
2x	15	19,7 %
3x	4	5,3 %
4x - 6x	6	7,9 %

8x - 10x	2	2,7 %
12x - 13x	3	3,9 %
Total	76	100%

3. Relationship between posed hypotheses and validated hypotheses

As the next section only includes the validated hypotheses in the network, this section compares and presents the relationship between posed hypotheses and validated hypotheses for a better overview of the relationship between constructs in the field of SARF.

In order to compare the relationship between posed hypotheses and validated hypotheses, for each unique hypothesis posed, the number of significant results and the number of times a hypothesis was posed were coded. This data was then processed by Excel and resulted in a linear graph as in Figure 4. Overall, the hypotheses posed correlated strongly with hypotheses validated ($r = 0,9$). In other words, the more often a hypothesis was posed, the more often it was validated. Among different constructs, personal current opinions seems to be a great predictor for perception as the hypothesis between two constructs was posed 25 times and validate 22 times. Other relationship such as sources' characteristic -> perception, personal prior knowledge -> perception were also a strongly related as they were posed more than 20 times and validated more than 18 times.

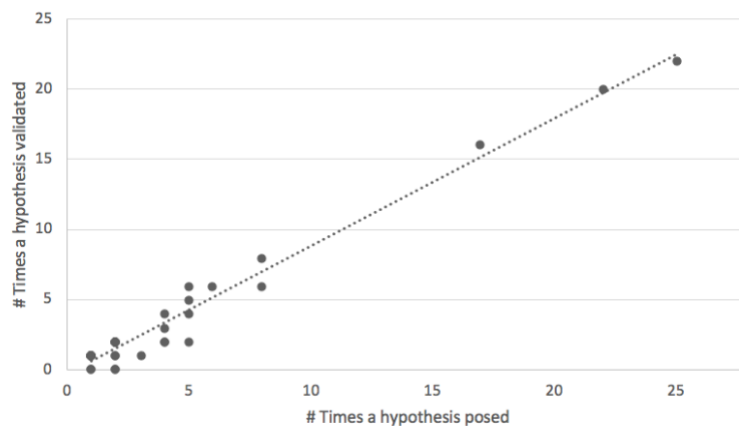


Figure 4: Comparison of hypotheses posed versus hypotheses validated.

4. Network model

In order to see the relationships between different constructs, the final Excel coding sheet and were used to import data to Gephi. From the coding sheet, three main columns were extracted as the main source of information to import into Gephi, namely independent sub-categories, dependent sub-categories and result. In the end, the data only included 140 hypotheses that were validated, therefore, hypotheses that were not significant had been left out. After importing the information into Gephi, an overview of the network was created using Force Atlas layout. The network overview was also adjusted by the attraction distribution in order to put bigger nodes more central and drive the smaller nodes more to outer edge for a better visualisation (Gephi, 2019).

Figure 5 shows the final visualization of the validated relationship between constructs. The network includes nodes (circles) and edges (arrows). The nodes represent different constructs. Node's sizes depend on the number of times it played a role as in(dependent) variable in a validated hypothesis (degree). As different constructs were unified to different categories, the colour of node give information about the category that each node belongs to (see Appendix 1). Edges, on the other hand, are the ties between nodes or the relationships between constructs. The independent and dependent constructs in a relationship are distinguished by the direction of the edges, with the arrow pointing toward the dependent constructs. The colour of the each edge is similar as the colour of its independent construct. With regard to the size of the edges, the more frequent one relationship is validated, the thicker the edge is.

In general, considering the number of 12 papers, this network is quite dense with multiple connections among different nodes levels. Considering the node level, 'Risk perception' is the most central construct among different papers as it was analysed and validated most frequently. Another construct is 'frequency of receiving information' as it involved in multiple relationships with different categories in the network, ranging from 'risk consequences', 'action' to 'trust'. Other nodes which had many relationships within the network are 'direct risk consequences', 'indirect risk consequences', 'attitudes', 'belief', 'personal experience', 'personal view' and 'personal concern'.

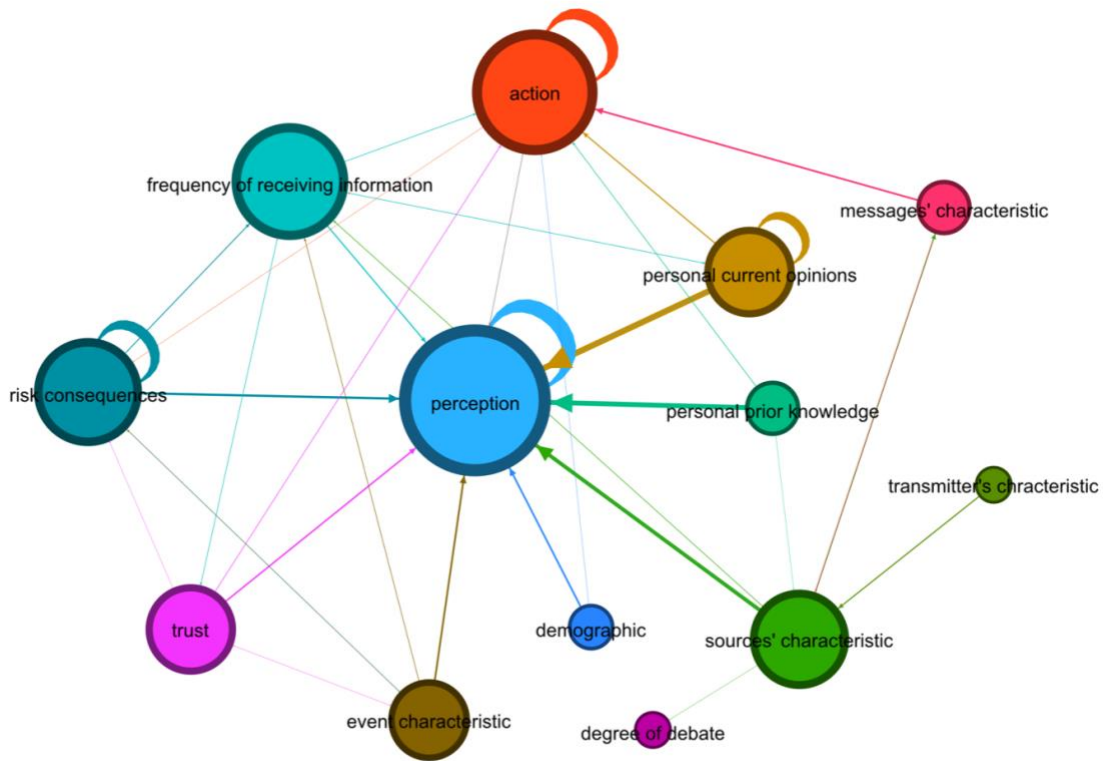


Figure 6: General network overview regarding relationship between main categories.

DISCUSSION AND CONCLUSION

This study was set out to examine the development of the Social Amplification of Risk Framework research domain as well as integrate and analyse the results of different SARF studies. Regarding this purpose, three research questions were introduced in this study. The first question aimed at pointing out different (core) constructs that were examined in the field of SARF. As constructs among different studies might have different names but the definitions and operationalisation of these constructs might be the same, the second question asked how different constructs could be categorised and what were the main categories in the research domain. Constructs are often linked to each other by a relationship, therefore, the final question aimed to gain more insights to the relationships among different constructs and the relationship have been validated.

The finding of this study showed that for more than 20 years, the research domain of the SARF has been developed greatly due to a tremendous number of 116 constructs and 170 hypotheses among 12 examined studies. The review also showed that there were an overlap between constructs of different studies since many constructs happened to have similar definition and operationalisation. As a result, the 116 constructs fell into 39 unique sub-categories, which were categorised into 13 main categories. The finding revealed that the constructs frequently examined and validated among different studies were also the central elements to the Social Amplification of Risk Framework, namely risk perception, frequency of receiving information, information sources, risk consequences, risk events and action (attitudes). This means that the Social Amplification of Risk Framework has been an effective framework in supporting the foundation of the assessment of risk events and crisis in different scholars, which is also in-line with the evaluation of Rickard et al. (2013) with regard to the effectiveness of the Social Amplification of Risk Framework in practice.

Considering the 170 hypotheses proposed, 138 hypotheses were significant, two hypotheses were partly significant, and 30 hypotheses were not significant. It was shown that different studies also tested the same relationships which reduced the number of originally proposed hypotheses to 76 unique relationships. It was also found that the number of proposed relationships correlated strongly with the number of validated relationships. This means that the more frequent a hypothesis was posed, the more frequent a hypothesis was validated.

From the review, the most examined and validated relationships are the ‘personal knowledge’ → ‘risk perception’, ‘personal experience’ → ‘risk perception’. The possible explanation for this could be that risk perception is a highly personal decision-making process (Brown, 2014). This cognitive process uses the previously acquired knowledge and experience of the individual to analyse the situation and result in individual’s perception of risk (Slovic, 1987). As individuals have different personal knowledge and personal experience, the level of risk perception might also differ as such (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978).

Another relationships which have been validated approximately 10 times among different studies were ‘information sources’ → ‘perceived probability’ and ‘personal experience’ → ‘perceived probability’. ‘Perceived probability’ is defined as a type of perception of individual about the chance that the risk events could happen (Brenkert-Smith, Dickinson, Champ, Flores,

2013). These strongly validated relationships could be considered as a support to the Social Amplification of Risk as in the SARF, information sources, such as direct communication, indirect communication, are the first element to influence the perception of risk. Furthermore, personal experience, such as having encountered similar risk events or participating in training regarding risk events, could also amplify or attenuate either the perceived probability or risk perception.

Despite the fact that different main categories within the SARF research domain connected to each other strongly, there was one main category that did not seem to connect to the rest of the network well, which was the ‘message’s characteristic’ and could be found on the right side of the network in pink. This category consisted of ‘risk-related message’, ‘framing’, ‘emotion expression’, ‘media richness’ and ‘involvement’. In other words, the operationalisation of these sub-categories often related to the risk content of the message (Strekalova & Krieger, 2017; Zhang, Xu, Zhang, 2017), which was believed to play a crucial role in amplifying or attenuating the risk perception (Wirz et al., 2018). The reason that different studies were not able to examine the relationship of risk content and other variables in the network, especially risk perception, frequency of receiving information, or perceived probability, could be due to the lack of media-content-related hypotheses (Wirz et al., 2018). As such, scholars might not be able to develop further or validate this matter.

Regarding the limitations of this study, there are some remarks that should be considered. First of all, considering the number of 44 studies examined by Wirz et al. (2018) and the number of SARF-related studies, this literature review is relatively small as it only examined 12 articles. For the representativeness, future literature review is also recommended to collect more studies with variety of aspect/topics within the SARF. Secondly, it is also questioned that whether the two coders extract the same hypotheses and coded the same variables from the literature as during the process, two coders accessed each other work and decided upon one final coding. Furthermore, two coders also discussed during the unification and aggregation process but did not do this independently, there might be a chance that the opinion of one coder was shifted during the process. There was no inter-coder reliability test in this study. It is also suggested that future research should have more coders to code the collected studies independently in every stage of the coding.

In conclusion, this literature review aimed to examine the development of the Social Amplification of Risk Framework research domain and integrate the results of different SARF-related studies. The finding implies that this research domain has been developed well with different constructs and hypotheses validated. The Social Amplification of Risk Framework seems to be an effective research foundation for studies which focus on assessing risk perception and variables related. From a theoretical perspective, as the result of this study this study aligns with previous studies within the SARF, it could also be used as a reference for future research to look at different aspects of the SARF that need more investigation or if there would be any potential aspects that could be developed. Other than that, reflecting on the results, future research is also suggested to examine the constructs within the SARF that were not examined frequently and re-assess relationships that only validated once as well as pay attention to potential relationships among different constructs.

REFERENCE














- Brenkert-Smith, H., Dickinson, K. L., Champ, P. A., & Flores, N. (2013). Social amplification of wildfire risk: the role of social interactions and information sources. *Risk Analysis*, 33(5), 800-817.
- Brown, V. J. (2014). Risk perception: It's personal.
- Burns, W. J., Slovic, P., Kasperson, R. E., Kasperson, J. X., Renn, O., & Emani, S. (1993). Incorporating structural models into research on the social amplification of risk: Implications for theory construction and decision making. *Risk Analysis*, 13(6), 611-623.
- Card, N. A. (2015). *Applied meta-analysis for social science research*. Guilford Publications.
- Chong, M., & Choy, M. (2018). The social amplification of haze-related risks on the Internet. *Health communication*, 33(1), 14-21.
- Chung, I. J. (2011). Social amplification of risk in the Internet environment. *Risk Analysis: An International Journal*, 31(12), 1883-1896.
- De Fleur, M. L. (1966). *Theories of Mass Communication*. McKay, New York.
- Douglas, M., & Wildavsky, A. (1982). How can we know the risks we face? Why risk selection is a social process 1. *Risk analysis*, 2(2), 49-58.
- Edwards, J. H. (1961). The recognition and estimation of cyclic trends. *Annals of human genetics*, 25(1), 83-87.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy sciences*, 9(2), 127-152.
- Gray, G. M., & Ropeik, D. P. (2002). Dealing with the dangers of fear: the role of risk communication. *Health Affairs*, 21(6), 106-116.
- Gregory, R., & Mendelsohn, R. (1993). Perceived risk, dread, and benefits. *Risk Analysis*, 13(3), 259-264.

- Heymann, S., & Le Grand, B. (2013, July). Visual analysis of complex networks for business intelligence with gephi. In *2013 17th International Conference on Information Visualisation*(pp. 307-312). IEEE.
- Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases*. Cambridge University Press, New York.
- Kandiah, V., Binder, A. R., & Berglund, E. Z. (2017). An Empirical Agent-Based Model to Simulate the Adoption of Water Reuse Using the Social Amplification of Risk Framework. *Risk Analysis*, *37*(10), 2005-2022.
- Kasperson, R. E., & Kasperson, J. X. (1996). The social amplification and attenuation of risk. *The Annals of the American Academy of Political and Social Science*, *545*(1), 95-105.
- Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., ... & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk analysis*, *8*(2), 177-187.
- Mase, A. S., Cho, H., & Prokopy, L. S. (2015). Enhancing the Social Amplification of Risk Framework (SARF) by exploring trust, the availability heuristic, and agricultural advisors' belief in climate change. *Journal of Environmental Psychology*, *41*, 166-176.
- Metz, W. C. (1996). Historical application of a social amplification of risk model: Economic impacts of risk events at nuclear weapons facilities. *Risk Analysis*, *16*(2), 185-193.
- Petts, J., & Niemeyer, S. (2004). Health risk communication and amplification: learning from the MMR vaccination controversy. *Health, risk & society*, *6*(1), 7-23.
- Petts, J., Horlick-Jones, T., Murdock, G., Hargreaves, D., McLachlan, S., & Loftstedt, R. (2000). Social amplification of risk: the media and the public. *Health and Safety Executive, London*.
- Raupp, J. (2014). Social agents and news media as risk amplifiers: a case study on the public debate about the E. coli outbreak in Germany 2011. *Health, risk & society*, *16*(6), 565-579.
- Rayner, S. (1988). Muddling through metaphors to maturity: A commentary on Kasperson et al., the social amplification of risk. *Risk Analysis*, *8*(2), 201-204.

- Renn, O., Burns, W. J., Kasperson, J. X., Kasperson, R. E., & Slovic, P. (1992). The social amplification of risk: Theoretical foundations and empirical applications. *Journal of social issues*, 48(4), 137-160.
- Rickard, L. N., McComas, K. A., Clarke, C. E., Stedman, R. C., & Decker, D. J. (2013). Exploring risk attenuation and crisis communication after a plague death in Grand Canyon. *Journal of Risk Research*, 16(2), 145-167.
- Rossmann, C., Meyer, L., & Schulz, P. J. (2018). The mediated amplification of a crisis: Communicating the A/H1N1 pandemic in press releases and press coverage in Europe. *Risk Analysis*, 38(2), 357-375.
- Short, J. F. (1984). The social fabric at risk: toward the social transformation of risk analysis. *American sociological review*, 49(6), 711-725.
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280-285.
- Špirtović, O., Aćimović, D., & Joksimović, A. (2012). Differences in the level of situational-motor abilities of football players of different level competitions. *Sport Mont Journal*, 10(34-36), 391-394.
- Strekalova, Y. A., & Krieger, J. L. (2017). Beyond words: amplification of cancer risk communication on social media. *Journal of health communication*, 22(10), 849-857.
- Van De Wijngaert, L., Bouwman, H., & Contractor, N. (2014). A network approach toward literature review. *Quality & Quantity*, 48(2), 623-643.
- Wirz, C. D., Xenos, M. A., Brossard, D., Scheufele, D., Chung, J. H., & Massarani, L. (2018). Rethinking Social Amplification of Risk: Social Media and Zika in Three Languages. *Risk Analysis*, 38(12), 2599-2624.
- Zhang, L., Xu, L., & Zhang, W. (2017). Social media as amplification station: factors that influence the speed of online public response to health emergencies. *Asian Journal of Communication*, 27(3), 322-338.
- Zhou, M., Wang, M., & Zhang, J. (2017). How are risks generated, developed and amplified? Case study of the crowd collapse at Shanghai Bund on 31 December 2014. *International journal of disaster risk reduction*, 24, 209-215.

APPENDIX

1. Categorisation and colour coding of different categories in the network

	action	(13.89%)
	perception	(13.89%)
	trust	(11.11%)
	sources' characteristic	(11.11%)
	messages' characteristic	(11.11%)
	demographic	(8.33%)
	personal current opinions	(8.33%)
	transmitter's characteristic	(5.56%)
	risk consequences	(5.56%)
	event characteristic	(2.78%)
	degree of debate	(2.78%)
	frequency of receiving information	(2.78%)
	personal prior knowledge	(2.78%)

STATEMENT OF OWN WORK

Student name: Thu Ha Nguyen (Klaudia)

Student number: S4822153

PLAGIARISM is the presentation by a student of an assignment or piece of work which has in fact been copied in whole or in part from another student's work, or from any other source (e.g. published books or periodicals or material from Internet sites), without due acknowledgement in the text.

DECLARATION:

a. I hereby declare that I am familiar with the faculty manual

(<http://www.ru.nl/stip/english/rules-regulations/fraud-plagiarism/>) and with Article 16 "Fraud and plagiarism" in the Education and Examination Regulations for the Bachelor's programme of Communication and Information Studies.

b. I also declare that I have only submitted text written in my own words

c. I certify that this thesis is my own work and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication.

Signature: Thu Ha

Place and date: Nijmegen, 07-06-2019