

KU LEUVEN

FACULTEIT SOCIALE WETENSCHAPPEN

MASTER OF SCIENCE IN DE
COMMUNICATIEWETENSCHAPPEN

**The effect of the mass media channel
on the Belgian risk perception of the
2011 Fukushima nuclear accident**

Promotor : Prof. Dr. B. VAN GORP
Co-promotor : Dr. T. PERKO
Verslaggever : Dhr. J. FRANSENS

MASTERPROEF
aangeboden tot het
verkrijgen van de graad van
Master of Science in de
Communicatiewetenschappen
door
Bart VYNCKE

Academiejaar 2013-2014

Table of Contents

Abstract	1
Introduction	2
The media and risk perception	5
Theoretical background on variables used in the analysis.....	6
Risk Perception.....	6
Media Channel.....	8
Attitude towards nuclear power.....	15
Duration of attention paid to news.....	17
Satisfaction with the media coverage.....	18
Gender.....	21
Education.....	22
Methodology	25
Questionnaire.....	25
Sample.....	26
Operationalisation.....	27
Results	30
Media as important information sources.....	30
Influencing factors of nuclear risk perception.....	33
Satisfaction with information and duration of attention.....	38
Discussion	42
The limited effects of media channels.....	43
Other predictors of perceived risk.....	48
Implications for risk communicators.....	52
Limitations and Future Research.....	56
Conclusion	58
Reference List	60
Appendix 1: Dutch Questionnaire	

List of Tables and Figures

Figure 1: Amount of primary media channels used.....	32
Figure 2: Amount of online channels used.....	32
Table 1: Regression analysis of the primary media channels and risk perception.....	35
Table 2: Regression analysis of the online media channels and risk perception.....	37
Table 3: Bivariate correlations between primary media channels and satisfaction/duration.....	40
Table 4: Bivariate correlations between online media channels and satisfaction/duration.....	41

Abstract

The 2011 Fukushima nuclear accident has the dubious honour of being one of the two worst nuclear accidents in human history, sharing this place with the 1986 Chernobyl nuclear accident. Using linear regression analysis, this study investigates whether different media channels are significant predictors of the Belgian risk perception of the Fukushima nuclear accident, controlling for five variables that are proven to be linked to changes in risk perception. A total of 12 different media channels are studied (traditional media, new media and social media). Additionally, the correlations between the use of these different media channels and both the satisfaction with information and duration of attention paid to the media coverage are calculated. The study uses empirical data from a public opinion survey ($N = 1,002$), that used the computer-assisted personal interview technique. The data are representative for the Belgian population with respect to six sociodemographic variables. Results show that some media channels are significant predictors of the perceived risk of the nuclear accident, but that their effects are small when compared to some of the background variables, for instance attitudes towards nuclear power. Further, the use of all major media channels - with the exception of television - is related to longer duration of attention paid to the coverage. Only interpersonal communication is significantly related to satisfaction with the coverage: those unsatisfied with the information were more likely to engage in interpersonal communication. Blogs and the websites of agencies also approach a significant correlation with satisfaction. These empirical results can provide risk communicators with information that can help them to select which media to use and which information to provide to the public in case of a nuclear emergency, even beyond the directly affected zone.

Introduction

Japan is located in a very seismically active region of the world. As a result, earthquakes are quite common: each year, there are about 5,000 earthquakes with magnitude 3 or greater in Japan – this is about 10% of all earthquakes in the world (Japan Meteorological Agency, 2013, p. 2). Most of these are mild, but there have been several devastating ones as well. In 1923, a 7.9 earthquake ravaged the Kantō-region (including Tōkyō), killing about 105,000 people. On March 11th, 2011, there was a magnitude 9 earthquake off the coast of the Tōhoku-region, that caused a tsunami, resulting in 20,960 people reported either killed or still missing.

Additionally, the tsunami also damaged the Fukushima Daiichi nuclear plant, triggering a major nuclear accident. The Fukushima accident received the highest rating of 7 on the International Nuclear and Radiological Event Scale (INES), signifying “widespread health and environmental effects” (International Atomic Energy Agency, 2008, p. 3).

Three authors from the New York Times (Bradsher, Tabuchi & Pollack, 2011, p. A5) noted that the Japanese media, while usually passive, were “more aggressive” in their reporting on the nuclear accident. Indeed, while the Japanese newspapers usually tend to avoid controversies (Adriaensens & Vanoverbeke, 2004, p. 165), the chairman of the Tokyo Electric Power Company (TEPCO) was asked questions regarding the “overly optimistic” measures against tsunamis, the “tardiness” of his decisions, the “poor quality” of the communications and alleged “collusive relations” with certain mass media companies (Tōden Katsumata Kaichō Kaiken, 2011, parts 3, 6, 7 - own translation). It is not too surprising that the media are now asking these tough questions, considering that the Fukushima nuclear accident touches upon two very delicate subjects in Japan. First of all, nuclear energy is still a sensitive topic because of the atomic

bombs that hit Hiroshima and Nagasaki (Adriaensens & Vanoverbeke, 2004, p. 177). Secondly, pollution is also a delicate subject in Japan, ever since wastewater from a Chisso chemical plant caused widespread mercury poisoning in the people of Minamata in the 1950s. The incident in Minamata gave rise to the first citizen protest actions in post-war Japan, which resulted in environment protection legislation that made Japan a forerunner in this field (Vanoverbeke, 2010, pp. 216-239). As the Fukushima disaster caused widespread environmental damage due to radioactivity, it is understandable that both the public opinion and the media in Japan were not at all forgiving.

The effects of the Fukushima nuclear accident, both environmental and social, were not limited to Japan: worldwide public acceptance of nuclear energy fell significantly (Huang, Zhou, Han, Hammitt, Bi & Liu, 2013; Kim, Kim & Kim, 2013; Siegrist & Visschers, 2013), while risk perception of both nuclear power plants and nuclear disasters rose (Huang et al, 2013; Prati & Zani, 2013; Yamamura, 2012). Furthermore, several countries changed their policy surrounding nuclear power in the aftermath of the nuclear accident, including Japan, Germany, Italy, Switzerland and Belgium (Elliot, 2013, p. 97; Katchanovski, 2012, p. 3; Kim et al., 2013, p. 823).

While the important role the media play in risk communication and shaping risk perception is widely recognised (amongst others: Kasperson et al, 1988; Perko et al., 2013, p. 7; Yamamura, 2012; Yim & Vaganov, 2003, p. 227), there has been limited research on the possible effects the different media channels can have on risk perception of nuclear accidents. Most of the studies conducted on this topic have focused on comparing just a couple of different channels – for instance comparing only online newspapers and social media (Utz, Schultz & Glocka, 2013) or mediated messages and word-of-mouth (Zhu, Xie & Xie, 2012). One study, by Sugimoto and colleagues (2013), did research several different media channels, but

had a very skewed sample, that contained a large majority of women and people over the age of fifty.

In this study, it is investigated whether or not the specific media channel used to get information about the 2011 Fukushima nuclear accident had effects on the risk perception of the accident. The influence of five primary communication channels (television, radio, newspapers, Internet and interpersonal communication) will be studied, as well as several different Internet sources (the websites of newspapers, radio- and television-channels and those of (non-)governmental agencies, in addition to Twitter, Facebook, blogs and other sources, such as YouTube). The research question will be answered using empirical data from a face-to-face public opinion survey, representative for the adult Belgian population with respect to six sociodemographic variables (see the Methodology-section). A linear regression analysis was used, controlling for several variables that might influence the risk perception as well: gender, education, attitudes towards nuclear energy in general, satisfaction with the information the media provided and the duration of respondents' attention to the coverage. Furthermore, this study will explore whether there are any correlations between the media channel used and the satisfaction with the media coverage and/or the duration of attention paid to the coverage.

The media and risk perception

In order to have an effect on the risk perception of nuclear accidents, it is important to ascertain that the public does indeed use the media to get information about this topic. According to the conceptual model of Kasperson et al. (1988), the media should play an important factor in informing the public about nuclear accidents, since most people do not experience these directly (also: Yim & Vaganov, 2003, p. 227). Previous studies do lend some credit to this hypothesis: in a small longitudinal study, Prati and Zani (2013, p. 789) found that all their respondents had heard about the nuclear accident in Fukushima, and that the media were important providers of information: television was a source of information for 96.9% of all respondents, radio for 78.61% and newspapers for 65.6%. In a study conducted in China, the media were the most important source of information regarding nuclear energy and the associated risks for 84% of the respondents. Television was the most important medium, with 67.4% of respondents claiming that TV was their main source of information (He, Mol, Zhang & Lu, 2012, p. 10).

However, the media might do more than simply provide information about nuclear technology or disasters. Kasperson et al. (1988, p. 181) point to the possibility that each transmitter of information will change the original message by intensifying, weakening and/or filtering the information. As such, media are not just neutral transmitters of information: they will change the information in the process, and this might influence the recipients of the media messages. On the most basic level of influence, Iyengar, Peters & Kinder (1982) found support for the theory of Agenda Setting: the idea that people will attach greater importance to issues that receive a lot of attention from the media. The media will influence especially those who have little knowledge of the domain in question. Due to the great extent of media coverage on the Fukushima nuclear accident, this theory predicts that people would attach greater

importance to the topic of nuclear energy and safety. This does not entail that people's perceptions about nuclear energy would change.

However, there is evidence that media might have an influence on people's (risk) perception as well: for example, Yamamura (2012, p. 362) found that the more people have experienced technical disasters, the higher they perceive the risk of a nuclear disaster happening. He suggested that mass media coverage would allow people to also indirectly "experience" technological disasters in distant locations, which would have an influence on the learning process and affect perceptions, views and policies on nuclear power. If this is indeed the case, then the coverage of the Fukushima nuclear accident will result in people around the globe viewing a nuclear disaster as more probable than they did before.

If the amount of media coverage can influence risk perception, is it also possible that the channel used to convey this coverage to the public has an influence? This is the question this study investigates, taking into account several other variables that have been shown to have an influence on risk perception.

RQ1: Are the different media channels significant predictors of the risk perception of the 2011 Fukushima nuclear accident?

Theoretical background on variables used in the analysis

Risk Perception

Essentially, risk is all about probabilities (Eiser, 1998, p. 779): it is the relation between the possibility of an event occurring and the possible negative consequences of that event (Maldonato & Dell'Orco, 2011, p. 570). For example, the probability of a major accident happening at any of the operating nuclear accidents over the

next 20 to 25 years is estimated as 1 in 5,000. Based on this, the expectation is that a major nuclear accident will happen about once every 20 years (Goldemberg, 2011).

However, when humans have to make judgements about risks in daily life, they rarely use statistical methods (Verplanken, 1991, p. 262; Whitfield, Rosa, Dan & Dietz 2009, p. 427). Instead, they take into account various other factors in order to form a perception of risk, often qualitative in nature (Eiser, 1998; Kasperson et al, 1988, p. 177-178; Van der Pligt & Midden, 1990).

People take into account various (perceived) characteristics of the risk, such as how known the risk is and how much control one has over it (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978; Van der Pligt & Midden, 1990) and they use several heuristics in 'calculating' a risk (Eiser, 1998; Frewer, Rowe & Sjöberg, 1998; Kasperson et al, 1988; Verplanken, 1991, p. 262; Wåhlberg & Sjöberg, 2000). Moreover, previous attitudes (Sjöberg, 2000, p. 9) and the current emotional state (Maldonato & Dell'Orco, 2011, pp. 574-576) also influence risk perception. Furthermore, people rate risks differently depending on who the 'target' of the risk is, judging themselves to be less likely to be at risk than people in general (Coleman, 1993, p. 620; Drottz-Sjöberg & Sjöberg, 1990, p. 142; Frewer et al., 1998, p. 8; Wåhlberg & Sjöberg, 2000, p. 41) - this seems to hold true even when considering nuclear risks (for example: Perko, Turcanu, Schröder & Carlé, 2010, pp. 103-104), even though some older research had found that people would judge their own health to be more at risk from radiation, compared to the general population (Dolinski, Gromski & Zawisza, 1987).

Even when verbally labelling numerical probabilities, people include these kinds of qualitative judgements in their 'translation': in one study, the probabilities of catastrophic risks were always deemed as significantly larger than those of non-catastrophic risks, even though they both carried the same numerical value (for example: 10^{-6})

(Verplanken, 1991, p. 263-265). The probability phrase selected is not only a function of chance, but also of the level of perceived catastrophically of a risk (Verplanken, 1991) and of judgements about how justifiable and reasonable it is to take that risk (Eiser, 1998, p. 786).

To accurately study the influence of something on risk perception, it is important to control for these other factors that might influence risk perception as well. This study will control for pre-existing attitudes, satisfaction with media coverage, duration of attention paid to the coverage, gender and education when attempting to determine the influence of the media channel on risk perception.

Media Channel

The central question of this paper is whether or not a media channel (regardless of its content) can have an influence on risk perception. From previous studies, it does seem plausible that the unique characteristics of different media channels may lead to different effects on their audience.

Coleman (1993) researched the influence that four media channels (newspapers, magazines, books and television) and interpersonal communication had on risk perception in New York State. She found that media channels have a limited influence on both personal and voluntary societal risk. For involuntary societal risk, however, interpersonal communication with spouses or neighbours was the only communication channel that had significant influence.

Zhu, Xie and Xie (2012) researched the effects of the media channel and ambiguity tolerance on risk perception of earthquakes and willingness to buy earthquake insurance. Their results showed that in China, the message source (either news media or word-of-mouth) indeed had a significant effect on seismic risk perception ($\beta = -0.21$, $p < 0.05$). Furthermore, the media channel interacted with ambiguity

tolerance: the authors concluded that ambiguity tolerant individuals would determine the value of the content by judging the source that delivered the message, while ambiguity intolerant people would only focus on the content itself.

The media channel was also found to be significantly more important than the framing of the crisis on people's post-crisis attitudes towards TEPCO, the owner of the Fukushima Daiichi nuclear power plant. If participants read crisis communication on social media (Facebook or Twitter) instead of in newspapers, they had better attitudes towards the power company, regardless of how the Fukushima nuclear accident was framed. The authors of this experiment (Utz et al., 2013) concluded that the medium was more important than the message.

Research conducted in Japan regarding the Fukushima nuclear accident found that there were pronounced differences in the fears people had, depending on the kind of media they used as their source of information. Those who listened to rumours were more fearful of the possible effects of radiation on their health. Readers of regional newspapers were more worried about the prospects for the future, while those who read the national newspapers were less worried. Respondents who listened to radio news were more fearful of social disruption breaking out in the aftermath of the accident. Neither television nor Internet use showed any significant correlations with either of these concerns (Sugimoto et al., 2013, pp. 1-6). It is important to note, however, that these particular results are inherently linked to the Japanese context: for example, it is known that Japanese national newspapers tend to avoid controversies, in order to protect the consensus and the harmony of Japanese society (Adriaenssens & Vanoverbeke, 2004, p. 165). Furthermore, the Japanese news media in general do not often report on anything concerning nuclear energy, in part because of the emotions that are coupled with the memories of the atomic bombs that hit Hiroshima and Nagasaki. The operators of nuclear power plants themselves do

not report dangerous accidents in their plants to news outlets, or only deliver incomplete information. The Japanese news media also do not attempt to incite a debate on the topic of nuclear energy and self-censor themselves in this way (Adriaensens & Vanoverbeke, 2004, p. 177).

Most of the research on the influence of the media channels on risk perception is generally limited to just a couple of different channels. This study will investigate the effects of newspapers, television, radio, the Internet (both in general and different online resources) and interpersonal communication on the audience's risk perception of Fukushima.

Newspapers are judged as highly trustworthy by the public: in studies conducted shortly after the 2011 Fukushima nuclear disaster, both Japanese consumers (Thomson et al., 2012, p. 2) and Japanese parents (Tateno & Yokoyama, 2013, p. 15) ranked them as the second most trustworthy source of information, immediately after NHK (*Nippon Hōsō Kyōkai*, Japan's public broadcaster). It has also been experimentally demonstrated that newspapers are perceived as more credible than social media, which results in more people being willing to share their content online (Utz et al., 2013). On the other hand, fewer Belgians (47%) rated newspapers as (very) trustworthy, as compared to television (70%) and radio (65%) (Perko et al., 2010, p. 45).

Because the printed newspapers have a rather slow news cycle, they are not often the medium through which the public first learns of a news event. The most important role of newspapers is to provide the public with greater detail than what the other, 'faster' media are able to (De Fleur, 1987). In the case of the Fukushima nuclear accident, newspapers and their associated websites indeed gave extensive coverage of the nuclear disaster: they often used infographics, multimedia and explanatory articles written by experts to inform their audience (Friedman, 2011, p. 60-61) and they also provided

ample opinion pieces by different stakeholders (Cantone et al., 2012, p. 5). In this way, newspapers were able to give their public a broader context and different perspectives on the disaster. Therefore, it is to be expected that people who read newspapers would be well informed of the disaster, and thus, have a more accurate perception of possible risks associated with nuclear accidents. However, readers of newspapers also have the choice not to read a certain article if it does not capture their interest (Frewer et al., 1998, pp. 19-20).

The public also deems television to be highly trustworthy, both in Belgium (Perko et al., 2010) and in Japan in the aftermath of Fukushima. Especially the public broadcaster was seen as highly trustworthy (Tateno & Yokoyama, 2013; Thomson et al., 2012). Television news differs from newspaper news in different respects. Firstly, it draws a greater audience. Secondly, since television news is linear, the audience does not have the same freedom in choosing what topics to watch: if a topic is featured in the news, the audience can not help but to watch it (Frewer et al., 1998, pp. 19-20). Henning and Vorderer (2001, p. 104) suggest that this “linearity” would also make it more difficult for the viewers to think autonomously, since they can not pause the broadcast to ponder upon the content. Thirdly, while television news also used a variety of ways to inform their audience of the Fukushima nuclear accident, due to time constraints, it was not able to give the same extensive background and context that newspapers provided (Friedman, 2011, p. 61). In a study about media reporting on the 10th anniversary of the Chernobyl accident in five European countries, the authors came to the same conclusion: television tells the public a hazard exists, but gives little background information beyond that (Frewer et al., 1998, p. 20). Similarly, Elliot (2013, p. 88) notes that most TV programmes in the United Kingdom covering the first anniversary of the Fukushima nuclear accident did not provide analysis of the accident, but limited themselves to giving an overview of the events during the disaster, while some UK newspapers and magazines did take a clear position in the debate. Finally, television has two characteristics, which Reeves and Nass

(1998) point to as able to influence how the audience reacts to the presented content, namely “motion” and “cuts”. People pay more attention to a moving image than to a still one, which would suggest that people would pay more attention to television news than to newspapers. Furthermore, some types of movement (such as something coming closer to the viewer) would make viewers feel threatened, even though they are fully aware that they are simply watching an image on television. This could very well lead to an increased risk perception, compared to still images in the newspaper. Verplanken (1991, p. 263) notes that the public attributes more weight to vivid information, which is in accordance to Reeves and Nass’ argument. Because the public feels like vivid information is more important, it might influence risk perception more than ‘dull’ information.

Secondly, the correct use of cuts in the narrative helps people process and remember the content, by signifying when one section of information is finished and another begins. This could also mean that information provided by television was better stored in the respondents’ memory than what they have read in newspapers. Indeed, when Price and Zaller (1993) studied the effects of different media channels on recall, television was the only form of media that was a significant predictor of recall (in about half the cases). While the effect of television was small when compared to the effects of prior political knowledge and education, the other media channels studied (radio, newspapers and interpersonal communication) were generally non-significant. According to the availability theory, which will be discussed later, better recall could also have implications for risk perception.

H1: Television use is associated with a higher risk perception of the Fukushima nuclear accident, compared to non-use of television.

Public broadcast radio was also deemed highly trustworthy by the public in Japan, while the results on private channels were more mixed: Japanese consumers thought them to be highly trustworthy as well, but Japanese parents did not share this favourable view (Tateno & Yokoyama, 2013; Thomson et al., 2012). The Belgian public rated the radio as the second most trustworthy media channel, after television (Perko et al., 2010). Similar to television, radio news is linear, preventing the listeners to choose what news to attend to. However, it misses the visuals that make television more engaging.

The Internet gave rise to both great opportunities and problems for risk communication. It all but nullified the gatekeeping function of the traditional media, and gives unconventional experts (such as graduate students) a platform to distribute understandable information to the public. On the other hand, it also helps the spread of misinformation, both due to the very rapid news cycle it demands – with little room for fact-checking – and by giving a voice to people who may not have the necessary knowledge to accurately discuss complex issues. Additionally, once information, correct or false, went viral, few bothered to check its accuracy (Friedman, 2011, p. 56; Pierpoint, 2011). Given these potential problems, it is perhaps not surprising that the public is wary when it comes to Internet sources such as social media. In an experimental design, both Facebook and Twitter were judged significantly less credible than newspapers (Utz et al., 2013), with Facebook scoring a little better than Twitter. In other research, Twitter was deemed remarkably untrustworthy as well. The Japanese public gave Twitter a reliability score of only 58.2%, the lowest score among all the media channels surveyed. However, this perception might not match the reality: of all the tweets tagged with #fukushima, the researchers found none that contained false rumours, and 46.64% cited highly reliable sources. This is 67.5% of all tweets that passed on third-party information in some form or another (Thomson et al., 2012). Finally, the International Atomic Energy Agency (2012) advises public information officers that, in the case of a nuclear emergency, risk

communication is most likely to succeed when communication is a two-way process (p. 50). Since the possibility of interaction and two-way communication is a main feature of social media (IAEA, 2012, p. 64; Utz et al., 2013, p. 41-42), it is reasonable to assume that social media would be highly effective in managing risk perception.

YouTube is the third most accessed site on the internet (Cheng, Liu & Dale, 2013, p. 1184). As such, it could play a major role in risk communication as well. Cheng et al. (2013) analysed over 5 million YouTube clips, and found that “Entertainment” (25.4%) was the largest category of videos, followed by “Music” (24.8%) and “Comedy” (8.7%). In contrast, only 3.6% of their sample fell into “News & Politics”, 1.1% in “Education” and 1.0% in “Science and Technology”. The authors concluded that YouTube is mainly an entertainment site (p. 1186). Hanson and Haridakis (2008) conducted exploratory research on college students and found that their sample used YouTube for both information and entertainment purposes. However, the share of people that had watched at least some comedy-format news shows (74%) was somewhat larger than the share of people that had watched at least some traditional news shows (69%). The sharing rate was also higher for “comedy” news (57%) than for traditional news (42%).

Both these studies suggest that YouTube is more likely to be used for entertainment purposes. However, other studies (for example: Leiserowitz, 2004) have shown that even entertainment programs can increase risk perception. As of yet, it is still unclear how YouTube clips will influence risk perception.

Although the different media channels have transformed the way in which risks are communicated, the role of interpersonal communication has certainly not been nullified. Even though most research on news diffusion is quite old, one of the more replicated findings is that interpersonal communication still plays an important role in diffusion of high impact stories. In such cases, a good percentage of the population will hear about the story first through

interpersonal communication, although there are several variables that will affect this, such as when the story breaks. Furthermore, people will continue to talk amongst each other extensively about important news events (De Fleur, 1987). Although information received from interpersonal communication might not be as detailed as information from the mass media, people might still attribute greater trustworthiness to information they heard from others rather than from a media channel (Price & Zaller, 1993, p. 137). After the Fukushima nuclear disaster, parents in Japan indeed judged family and relatives as highly trustworthy: in fact, they were the second most trusted group, with only academic scientists deemed more trustworthy (Tateno & Yokoyama, 2013, p. 14). Even so, research has shown that if interpersonal communication consists of rumours, this could make people more anxious (Sugimoto et al., 2013), especially those who are intolerant to ambiguity (Zhu et al., 2012, p. 962).

Attitude towards nuclear power

According to Van der Pligt, Eiser and Spears (1984, pp. 304-305), attitudes towards nuclear energy should be seen in the broader context of the (relatively stable) attitudes considering other social issues. Therefore, it is assumed that it would be hard to change people's attitude towards nuclear power.

A model regarding risk perception by Sjöberg (2000, p. 9) attributes a great explanatory role to attitudes in explaining risk perception. He poses that supporters of nuclear energy would only see its upsides and perceive it as being risk-free, while opponents would focus on the downsides and consider the technology to be very risky. Later research lends credit to this idea: in explaining his results regarding the Tōkai nuclear accident, Katsuya (2001, pp. 1044-1045) hypothesizes that opponents of nuclear energy see disasters as proof of the inevitability of nuclear accidents, while supporters judge them to be one-off events, that will not repeat themselves – in this way, both groups are reinforcing their own opinion. Siegrist and Visschers

(2013, pp. 114-118) found that attitudes towards nuclear energy just before and just after the Fukushima nuclear accident correlated strongly with one another ($r = 0.79$, $p < 0.001$). The attitudes immediately after the accident also correlated strongly with those of a third wave, conducted six months after the incident ($r = 0.86$, $p < 0.001$). Their conclusion was that these attitudes were stable. The authors assumed that individuals probably interpret a nuclear accident in such a way as not to conflict with their pre-existing beliefs, which is in line with Sjöberg's conclusion.

However, some research shows that this relationship is not strictly linear. Kubota (2012) found that the group who strongly supports nuclear energy, even though they feel that the probability of a nuclear accident is very high, is larger than expected. Furthermore, when including all background variables in his model, the risk perception of nuclear power plants and nuclear accidents lost their significance as predictors of attitude towards nuclear power. Even so, following the majority of the literature, it would make sense that:

H2: Respondents with more positive attitudes towards nuclear power in general, have lower risk perception of the Fukushima nuclear accident.

The theory of selective exposure could be used to explain the long-term stability of opinion that most researchers found: if people only pay attention to those messages that are in line with their previously held views and beliefs, then it is logical that, in the long term, even the way in which a major nuclear accident is judged, will be in line with the attitudes regarding nuclear power the person already had before. Because of today's rich media landscape, people do have the potential to find a channel, blog or newspaper that (perfectly) fits their views. However, Mutz and Young (2011) state that, due to the enormous amount of possible sources, it is improbable that people will actively search that one source of information that exactly matches their views, or be able to find it even if they do look for it.

Instead, they argue that recommendations from friends, both in real life and via social media, or filtering from technology are the more likely ways in which people are exposed to viewpoints that are like their own. Mutz and Young call this mechanic “passive selective exposure”.

Duration of attention paid to news

In a review of research about media and risk perception, Wåhlberg and Sjöberg (2000) point to the availability heuristic as a theory often used in explaining risk perception: the easier one can recall a certain event happening, the more probable he or she will judge the likelihood of that event happening again. This theory could be used to explain what Yamamura (2012) found: if a person has more experience with technological disasters, he will judge the likelihood of a nuclear disaster happening as higher because the information of technology failing is very available in his mind.

Extensive media coverage is one way in which events could become easier to recall (Verplanken, 1989, p. 389), which would lead to people overestimating the probability of that kind of event (Eiser, 1998, p. 781; Yim & Vaganov, 2003, p. 226). The fact that the Fukushima nuclear accident was compared to the Chernobyl nuclear accident in both the United States (Katchanovski, 2012) and the European Union (Perko, Valuch, Nagy, Lammers & Mays, 2013), would make both of these accidents more ‘accessible’ to the public, resulting in higher risk perception of the accidents.

The availability heuristic also implies some volatility of risk perception: once the amount of coverage decreases, the availability of information decreases, which would result in lower estimates of risk (Wåhlberg & Sjöberg, 2000, p. 40). In a study conducted in the aftermath of the Chernobyl nuclear accident, de Boer and Catsburg (1988, p. 254) found that the impact of the accident on perception of safety of nuclear plants was rather temporary in Great Britain. A year

after the accident, public opinion regarding the safety of nuclear power plants had returned to the levels in the years before the nuclear accident.

Since the data used in this study were gathered more than two years after the accident in Fukushima, it is likely that, overall, risk perception of the accident has become less extreme. However, the Fukushima nuclear accident was still featured in the Belgian press at the time the data were gathered (see Methodology-section). The public still had the opportunity to attend to news about the situation in and around the Fukushima Daiichi nuclear power plant, so the availability heuristic might still have been active, at least to some extent.

H3: Respondents that followed the news about the Fukushima nuclear accident longer, have higher risk perception.

As stated before, due to the ‘linearity’ of radio and television news, consumers of these media channels do not have much choice whether or not to attend to segments about Fukushima if they are featured. Whereas readers of newspapers or Internet users can decide not to read a certain article if they are not interested in it, radio and television consumers do not have this ‘luxury’. Apart from changing the channel, they have no choice but to listen to the news item.

H4: The duration of attention paid to the news about the nuclear accident depends on the media channel used.

Satisfaction with the media coverage

Two different issues with the media coverage could influence both the public’s satisfaction and anxiety. First of all, if the public does not get enough information during a crisis situation, they might feel more anxious and experience more stress (Manoj & Baker, 2007).

This happened after the Chernobyl nuclear accident: the lack of information caused fear and rumours (Rahu, 2002, p. 296).

Secondly, even if information is available and accessible, the public may still not find it satisfactory. Parents in Japan were not satisfied with the information they got, not because of the amount of information, but because the content did not suit their needs. This led them to experience higher anxiety (Tateno & Yokoyama, 2013). The same two mechanisms could very well apply to the risk perception in Belgium, which is why it is important to control for the satisfaction with the media coverage.

Furthermore, the IAEA (2012, p. 68) warns that a lack of (satisfactory) information is one possible reason for the appearance and spread of rumours. The results of a study on rumour activity in the workplace (DiFonzo & Bordia, 2002) did indeed show that both anxiety and uncertainty lead to more rumour activity. Furthermore, the feeling of uncertainty further strengthened the anxiety in people, because they felt that they are no longer in control of the situation. Research in Japan has shown that using rumours as a source of information about the nuclear accident in Fukushima, was associated with people having a higher risk perception of the effects of radiation on their health (Sugimoto et al., 2013, pp. 3-6). By having satisfactory media coverage, it is probable that respondents would experience less anxiety and uncertainty, which would lower the rumour activity, which in turn would result in lowered risk perception. So, even though some specialists were of the opinion that the media coverage only served to increase the public's fear of nuclear technology (Friedman, 2011, p. 62), this conclusion seems rather unlikely. Obviously, there might have been instances where incorrect information may have caused unnecessary panic, but overall, it is to be expected that if people were satisfied with the media, they will have lower risk perception.

H5: Those who are more satisfied with the media coverage, have lower risk perception of the Fukushima nuclear accident.

According to the theory of Uses and Gratifications, people seek different gratifications in different media channels. The media channel could thus also influence the level of satisfaction, depending on what expectations users had of the reporting and how well the channel in question satisfied this need. In an exploratory study on communication students in the Netherlands, Van der Wurff (2011) found results that gave support to the theory of Uses and Gratifications: amongst other factors, the use of a certain media depends significantly on the number of gratifications one seeks and receives from that medium. This held true for radio, newspapers, freesheets, online news and teletext, but oddly enough, not for television. Another exploratory study examined the gratifications that users of social media seek, using a limited number of in-depth interviews. The most important gratification sought unsurprisingly turned out to be social contact (88% of the respondents). However, social media were also often used for seeking information and self-educating (80%) and for expressing one's opinion (56%) (Whiting & Williams, 2013). Clearly, social media could also be used for sharing and commenting on the news. Finally, Utz et al. (2013) found partial support for their hypothesis that by using social media, organisations can meet the stakeholders' demands for swift and accurate information. Not only could this result in less negative word-of-mouth, as the researchers found, it is also plausible that users of social media are more satisfied with the media coverage. Therefore, it is to be expected that:

H6: The level of satisfaction with the information depends on the media channel used.

Gender

In an overview about the influence of gender on risk perception, Gustafson (1998, pp. 806-808) shows that men and women differ on at least three different levels: two of which are of note for this study. Firstly, women appear to consistently have a higher risk perception than men, and secondly, men and women usually frame risks differently. For example, women view (the risks of) nuclear power mainly as an environmental problem, whereas men regard nuclear energy more as a scientific and technical matter.

Brody (1984, pp. 220-227) found support for the hypothesis that women have more negative attitudes towards nuclear energy compared to men. Even though there were no sex-based differences on the perception of the possible advantages of nuclear energy, women judge the possible problems as being more problematic. This difference was most pronounced in problems that pose a threat to human life and health. According to the author, this was due to the more nursing and caring roles women have traditionally assumed. This explanation was also found in Gustafson's literature review. In a study in Sweden, conducted after the Chernobyl accident, women were more worried than men, were more negative to nuclear energy and nuclear risks, and attributed more importance to the issue of nuclear energy (Drottz-Sjöberg & Sjöberg, 1990). Males, and especially white males, view the world as less dangerous and technology as more beneficial, possibly because they hold positions of power and (perceived) control more often than the other gender and races. This could explain why they are significantly less likely to rate a nuclear power plant as "very risky", are more trusting of technological hazards and are less worried about potential stigma from exposure to nuclear waste (Finucane, Slovic, Mertz, Flynn & Satterfield, 2000). Tateno and Yokoyama (2013, p. 12) found that significantly more mothers than fathers were worried in the Fukushima prefecture (64.6% versus 30.8%), but this difference disappeared in the rest of the surveyed regions. Finally, Whitfield et

al. (2009, p. 433) found that, in the United States, gender only indirectly influenced risk perception of nuclear power. However, the conclusion from the majority of the literature is that:

H7: Women have significantly higher risk perception of the Fukushima nuclear accident.

Education

In its essence, education simply provides people with the facts, and gives them the opportunity to draw their own conclusions (Yim & Vaganov, 2003, p. 222). Not everyone will come to the same conclusion, however, since people process information very selectively (Renn, 2008, p. 258; Yim & Vaganov, 2003, pp. 224-225, 228): which information is remembered and how it is interpreted will vary according to the interests, beliefs and values the individual holds.

However, the expectation is that, as people get better educated, they are better able to select and analyse relevant information, and weigh this new information against already gathered knowledge (Yim & Vaganov, 2003, p. 223). Better knowledge of science and probabilities could also result in better understanding of risk communication, thereby (hopefully) improving risk literacy (Renn, 2008, p. 258) and decreased dependence on heuristics when evaluating risks (Renn, 1990, p. 164).

Finally, higher educated people also learn from the news at a faster rate and pay more attention to political issues (Price & Zaller, 1993, p. 138). The Fukushima nuclear accident quickly became a thoroughly political issue, since a large share of the media coverage focused on the safety and risks of nuclear energy and its future, both in international and domestic context (Cantone et al., 2012, p. 3; Perko & Turcanu, 2013, p. 39). Because of this political angle, it is very likely that higher educated people did pay more attention to the

coverage of Fukushima, and learnt more about the context, which perhaps enabled them to make a more accurate judgement of the risks posed by the accident.

Indeed, based on the Elaboration Likelihood Model, Yim and Vaganov (2003, p. 223) reasoned that higher educated people are more able to ground their perceptions in critical analysis and cognitive reasoning, with a minor role for peripheral cues and heuristics. However, one will only use this ability to analyse information extensively if they are motivated to do so. Therefore, the role of interests should not be overlooked.

In conclusion, from the theory, it would be reasonable to assume that people with higher education would have a more accurate perception of risk, compared to people with lower education. Some empirical studies lend credit to this idea: while the risk perception of German university students towards three technologies (genetic engineering, nanotechnology and ICT) differed between academic disciplines, there was a significant trend in time: the risk perception of advanced students was significantly lower than the risk perception of beginners, in all academic fields that were studied (Weisenfeld & Ott, 2011, p. 494), hinting at the possibility that education lowers risk perception. A study conducted in the United States found that education directly influenced perceived risk of nuclear power: respondents with lower education had higher perceived risks of nuclear power ($\beta = -0.14, p < 0.05$) (Whitfield et al., 2009, p. 432-433).

However, it is important to remember that if higher education indeed increases accuracy of risk, this does not necessarily imply that the risk perception will be lower. The results of Coleman's study (1993) show that higher education significantly lowered personal risk perception, but increased the risk perception for voluntary societal risks. For involuntary societal risks – the category that nuclear radiation would likely fall under – education failed to reach

significance as a predictor. Renn (1990, p. 159) reported that a minority of the West-German population, which was in general higher educated and more aware of environmental issues compared to the average citizen, was extremely worried about radioactivity from Chernobyl. This minority of German people took various protective actions, which the author previously defined as “overreactions”.

To summarise: while it is entirely possible that some higher educated groups would be more worried about the nuclear accident in Fukushima, most empirical studies would predict that:

H8: People with a higher education level have significantly lower risk perception of the Fukushima nuclear accident, compared to those with a lower level of education.

Methodology

This study was conducted using empirical data from a public opinion survey, more specifically the SCK•CEN Barometer 2013 (Turcanu & Perko, 2014), which was conducted with computer-assisted personal interviews. This was the fifth edition of a regular study, commissioned by the SCK•CEN since 2002 in order to study Belgian public opinion on nuclear energy and risks associated with it. Ipsos Belgium Public Affairs carried out the data collection for this edition, between August 15th and September 12th 2013.

The Fukushima nuclear accident was still featured in the news at this time. GoPress, a database of all Belgian newspapers, yielded 196 articles featuring “Fukushima” that were published in this timeframe. Additionally, the keyword “Fukushima” also appeared in 145 tweets sent by major Belgian publications (both searches were conducted on February 26th, 2014).

All analyses reported in this study used a significance level of $\alpha = 0.05$ to determine statistical significance.

Questionnaire

Respondents had the choice to answer the questionnaire in either Dutch or French. The Dutch version of the questionnaire has been included in Appendix 1. The questionnaire gauged respondents’ attitudes towards and knowledge about nuclear energy, trust in and knowledge about several actors in the nuclear field. Finally, a section was devoted on the 2011 Fukushima nuclear accident.

Most questions had respondents answering using a 5- or 7-point Likert scale, with an option to not answer. Within most question sets, there was randomisation of the question order to combat order

effects.

Only two sets of questions gave respondents the opportunity to select several answers: these questions asked respondents to tell which media channels had been most important to them to get informed about the Fukushima nuclear accident, and which media channels they would use in case of a nuclear accident in a Belgian nuclear power plant.

Sample

In order to gather representative data, the following procedure was used. First, a list of all Belgian municipalities was divided into a total of 44 strata (11 regions x 4 levels of urbanicity). Of these strata, 7 ended up being empty. The data were then gathered using a random walk method: within each stratum, a starting address was chosen at random and interviewers selected the following households by adhering to predetermined rules (Turcanu & Perko, 2014).

A total of 1,002 respondents were interviewed face-to-face, in Dutch or French, using the computer-assisted personal interview-technique. After a weighing procedure, the sample was representative of the Belgian population with respect to gender, age, region, size of locality, education, professional activity and the size of household. All results reported in this paper will make use of the weighed sample.

Of the total sample, 64 respondents (6.4%) were not aware of the nuclear accident that happened in Fukushima. This group contained more women ($\chi^2 = 11.37$; $df = 1$; $p = 0.001$) and was more likely to have no degree or only to have finished elementary school ($\chi^2 = 54.23$; $df = 8$; $p < 0.001$). They were more likely to live in Flanders ($\chi^2 = 21.65$; $df = 2$; $p < 0.001$) and to have less members in their household ($M = 2.46$, $SD = 1.34$) compared to those who were aware of the accident ($M = 2.82$, $SD = 1.35$), $t(1000) = 2.09$; $p = 0.037$. There were no significant differences with respect to age ($t(68.662) =$

0.779; $p = 0.439$), the level of urbanisation of their municipality of residence ($\chi^2 = 1.76$; $df = 3$; $p = 0.623$) or their income levels ($\chi^2 = 19.1$; $df = 12$; $p = 0.086$).

Since these respondents were not asked any further questions regarding their media use during the coverage of the Fukushima nuclear accident, they will not be taken into account in this study. This leaves a total of 938 valid respondents for analysis.

Operationaliation

For the dependent variable, the *risk perception* of the Fukushima nuclear accident, a scale was constructed using principal component analysis with Oblimin with Kaiser Normalization. A total of 848 respondents were used in this analysis. The factor analysis yielded a single factor, consisting of three items from the questionnaire. The first item, “Will the number of cancers in Belgium increase because of the accident in Fukushima?”, was measured using a Likert-scale, ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). The other two items included in the factor were “In the near or far future, how high do you deem the risk that the radiation from the Fukushima nuclear accident poses to your own health?”; and “In the near or far future, how high do you deem the risk that radiation in food products or other products from Japan poses to your own health?”. These items were measured on a Likert-scale from 1 (“no risk at all”) to 6 (“very high risk”).

The obtained factor accounted for 70.95% of the variance and had good internal consistency (Cronbach’s alpha = 0.794). Since the items used different scales, internal reliability had to be measured using the factor scores (C. Turcanu, personal communication, April 1st, 2014): the variables were multiplied with their component score coefficients and the reliability analysis was then conducted on these weighted variables. Each component in the scale of risk perception had a factor loading of 0.77 or higher. A low score on the scale signifies a low risk perception of the Fukushima nuclear accident.

To measure the *satisfaction of respondents* with the information they got from the media, another scale was constructed, again using principal component analysis with Oblimin with Kaiser Normalization. Three items were entered into the analysis, namely “In general, how satisfied were you with the information you got about the (Fukushima) accident?”; “Did the Belgian government agencies always tell the truth during the Fukushima accident?”; and “Did scientific reports from international organisations always tell the truth about Fukushima?”. All three items were measured from 1 (“very unsatisfied” or “strongly disagree”) to 5 (“very satisfied” or “strongly agree”), and thus, a low score on the scale signifies a low satisfaction in the reporting. The data of 846 respondents could be used for this analysis. The analysis yielded a single factor, which accounted for 61.05% of the total variance. Despite that, the question regarding the general satisfaction with the information had a rather low factor loading with the rest of the factor (0.581) and the internal reliability went up significantly without it (from 0.678 to 0.782). If this question was deleted, however, the factor would probably measure satisfaction with the information from governmental agencies instead of satisfaction with the information in general. Therefore, the answers to the question “In general, how satisfied were you with the information you got about the (Fukushima) accident?” were used instead of the obtained factor.

The *attitude towards nuclear power* was measured using a single question from the questionnaire: “What is your opinion on nuclear energy?”. Respondents had to indicate their overall attitude towards nuclear power on a Likert-scale, ranging from 1 (“totally in favour of nuclear power”) to 5 (“totally against”). There were 922 valid answers to this question. Almost four in ten (38.1%) respondents had no clear stance on nuclear energy. The group of opponents was the second largest, with 26.4% somewhat against and 8.1% completely against nuclear energy. Finally, the group of supporters consisted of

3% who were completely in favour and 24.4% who were somewhat in favour of nuclear energy.

How long respondents followed the news about the nuclear accident was also measured using a single question: “How long did you attend to news about the Fukushima accident?”. Respondents had to answer using a 6-point Likert-scale. The lowest score on this scale signifies that the respondent “did not follow the news about Fukushima at all”, while the highest score signifies that they “are still following the news about Fukushima”. 931 respondents answered this question.

Two sociodemographic variables were also included in the analysis, namely *gender* and *education*. The sample contained 49.8% men and 50.2% women. Education was recoded to have three levels. The lowest level of education consists of respondents with no degree, an elementary level degree or a lower secondary degree. The intermediate level consists of people with higher secondary level degree, whereas respondents in the high level have a higher education degree, either from university or non-university higher education. Most of the respondents had an intermediate level of education (40.7%). 31.7% had a high level of education, while 27.9% fell into the lowest category. All respondents answered the questions about their gender and education level.

Results

Media as important information sources

As expected, the media played a very important role in informing citizens about the 2011 Fukushima nuclear accident. Television was the most widely used medium as an important source of information: 93.4% of respondents in the weighed sample used television to get information regarding the accident. For 26.8% of television viewers, television was the only medium they used to get news about the accident – which amounts to 25.04% of the total sample. 49.6% of valid respondents used the radio and 48.5% used newspapers. In contrast to television use, the use of radio and newspapers was rarely exclusive. Only 3% of radio listeners and 0.7% of newspaper readers indicated not having used any other medium.

About one in three respondents (29.8%) used the Internet to get informed about what was happening in Fukushima. Internet use was seldom exclusive: only 4.3% of all Internet users reported not having used any other forms of media. The websites of the newspapers (84% of the people using Internet; 25.1% of the total sample) and those of television- and radio-channels (49.9% of the people using Internet; 14.8% of the total sample) were the most prominent online sources of information. Websites of both governmental and non-governmental agencies (27.6% of the Internet users), Facebook (26.4%), blogs (10.2%) and Twitter (3.3%) were less popular choices. 8.9% of the Internet users reported having used other online sources than the ones listed.

Compared to the widespread media use, a rather limited amount of people engaged in interpersonal communication to get news about the accident: 13.9% of respondents answered that interpersonal communication with friends, family or neighbours was an important source of information and only 6.9% relied on information or

rumours they heard in public places such as streets, pubs and shops. In addition, interpersonal communication was mainly an addition to other information sources: only 0.8% used interpersonal communication exclusively and just 1.5% of respondents only used information from the street.

From these results, it is obvious that Belgium has become a multi-media society: as shown in Figure 1, two out of three respondents (66.6%) used more than one media channel to get informed about the Fukushima nuclear accident. On average, people used 2.56 media channels ($SD = 1.42$) in their search for information about the accident. 8.2% of the respondents even answered that they had used all five primary media channels covered in this study (TV, radio, newspapers, Internet and interpersonal communication). The majority of the single-medium users are people who exclusively watched television (accounting for 25.04% of the total sample).

Similar results appear for the online media channels: 63.9% of Internet users consulted more than one online source to get information about the nuclear accident. On average, they used 2.10 online media channels ($SD = 1.07$). However, the distribution is skewed: none of the respondents answered to have used all seven response options the questionnaire offered and only 10.2% of the audience used more than three.

Figure 1: Amount of primary media channels used ($N = 938$)

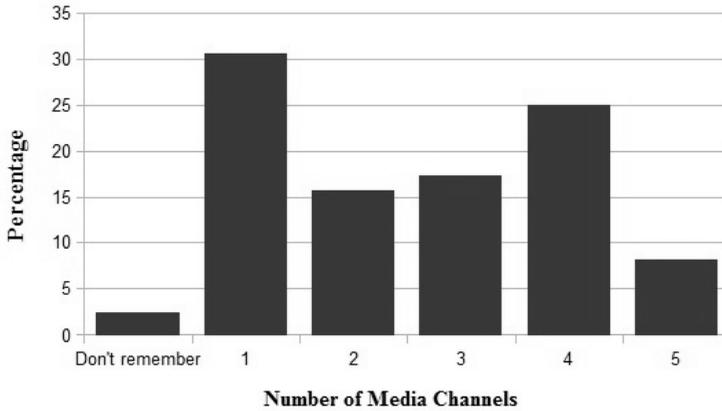
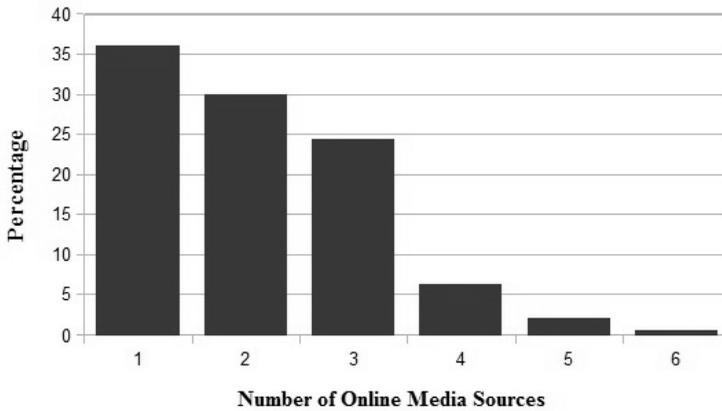


Figure 2: Amount of online channels used ($N = 280$)



A majority of the 923 respondents was satisfied with the information they got from the media: 44.7% reported being “rather satisfied” and 4.9% were “very satisfied”. About one in three respondents (30.3%) was neither satisfied, nor dissatisfied, while one in five (20.1%) was not satisfied (of which 3.4% were very dissatisfied).

931 respondents answered the question about the length of time they followed the news about the Fukushima accident. 25.8% of respondents still followed the news about the nuclear accident at the moment that the interview was conducted, while 3.9% reported not having attended to the news at all. 20.3% followed it for some days, 29.8% for some weeks, 16.8% for some months and 3.4% attended to the news for the first year after the accident.

Influencing factors of nuclear risk perception

The relationship between the media channels and risk perception was analysed using linear regression analysis ($R^2 = 0.171$, $F(10,817) = 16.86$, $p < 0.001$; see Table 1 for results). The five independent variables were all entered in the analysis at the same time. The dependent variable was the factor scale of the risk perception of the Fukushima nuclear accident.

Out of the five primary media channels studied, only two turned out to be significant predictors of the Belgian risk perception of the Fukushima nuclear accident: both watching television ($\beta = 0.064$, $p = 0.048$) and engaging in interpersonal communication ($\beta = 0.117$, $p < 0.001$) were significant predictors of risk perception. These results are in accordance with **H1**, which predicted that watching television was associated with a higher level of perceived risk. However, it is important to note that the influence of both these media channels was rather small when compared to the most influential predictor of risk perception: the pre-existing attitudes towards nuclear energy ($\beta = 0.291$, $p < 0.001$). Since high scores on the question measuring attitudes signify strong opposition against

nuclear energy, the results are in line with **H2**: people who are supporters of nuclear power indeed had lower risk perception.

With the exception of gender, all other variables included in the analysis were significant predictors of the Belgian risk perception of the 2011 Fukushima nuclear accident. Education had the second highest regression coefficient ($\beta = -0.139$, $p < 0.001$), in the direction predicted by **H8**: people with a higher level of education did have lower risk perception, compared to those with a lower level of education. As predicted by **H5**, higher satisfaction with the media coverage was associated with lower risk perception ($\beta = -0.120$, $p < 0.001$). Finally, the duration of attention paid to the media coverage was a significant predictor, but in the opposite direction than **H3** predicted ($\beta = -0.076$, $p = 0.024$): those respondents who attended to the news about Fukushima longer, had lower risk perception.

Table 1: Regression analysis of the primary media channels and risk perception

Model: Risk Perception of the 2011 Fukushima Nuclear Accident			
Predictor	β	<i>p</i>	<i>SE</i>
Gender	0.052		0.064
Attitude towards nuclear energy	0.291	***	0.034
Education	- 0.139	***	0.044
Duration of attention paid to media coverage	- 0.076	*	0.022
Satisfaction with media coverage	- 0.120	***	0.035
TV	0.064	*	0.138
Radio	0.022		0.068
Newspapers	- 0.051		0.070
Internet	- 0.020		0.074
Interpersonal Communication	0.117	***	0.088
Constant			0.269

N = 828

*Adjusted R*² = 0.161

Note: Linear regression analysis; Dependent variable: factor scores of risk perception of the 2011 Fukushima nuclear accident

****p* < 0.001, ***p* < 0.01, **p* < 0.05

Since the Internet is host to various kinds of different information channels, from online newspapers to social media, an additional regression analysis was run for the different Internet sources ($R^2 = 0.211$, $F(12,244) = 5.46$, $p < 0.001$). Again, all variables were entered at the same time. The detailed results of this analysis are shown in Table 2.

Only one Internet source had significant predictive power. “Other sources, such as YouTube” had a highly significant negative β -coefficient (-0.186 , $p = 0.002$). However, once again, pre-existing attitudes towards nuclear energy turned out to be the most important predictor of the risk perception of the Fukushima nuclear accident ($\beta = 0.229$, $p < 0.001$); thus the data support the prediction of **H2**: people in favour of nuclear energy had lower risk perception of the nuclear accident. The second most important predictor was satisfaction with media coverage ($\beta = -0.204$, $p = 0.001$). As expected by **H5**, higher satisfaction with the media coverage resulted in lower risk perception. Online, gender became a significant predictor – as predicted in **H7**, women had a significantly higher risk perception than men ($\beta = 0.151$, $p = 0.01$). Both educational level and duration of attention paid to the media coverage lost their predictive power, but educational level did come close to significance ($\beta = -0.114$, $p = 0.058$).

Table 2: Regression analysis of the online media channels and risk perception

Model: Risk Perception of the 2011 Fukushima Nuclear Accident			
Predictor	β	<i>p</i>	<i>SE</i>
Gender	0.151	**	0.113
Attitude towards nuclear energy	0.229	***	0.059
Education	-0.114		0.082
Duration of attention paid to media coverage	-0.100		0.040
Satisfaction with media coverage	-0.204	***	0.061
Online newspapers	0.040		0.160
Websites of TV- and radio-channels	-0.021		0.116
Websites of (non-)governmental agencies	0.094		0.131
Twitter	0.021		0.328
Facebook	0.042		0.136
Blogs	-0.066		0.195
Others (for example: YouTube)	-0.186	**	0.208
Constant			0.417

N = 257

*Adjusted R*² = 0.173

Note: Linear regression analysis; Dependent variable: factor scores of risk perception of the 2011 Fukushima nuclear accident

****p* < 0.001, ***p* < 0.01, **p* < 0.05

Satisfaction with information and duration of attention

In order to test **H4** and **H6**, two bivariate correlations were conducted: the first analysing the correlations between the primary media channels and the satisfaction with and the duration of attention paid to the media coverage; the second analysing these correlations with the online sources. Detailed results are presented in Tables 3 and 4.

The data supported **H4**: with the exception of television, all other primary media channels were significantly associated with duration of attention paid to the media coverage. Newspapers had the strongest correlation ($r = 0.196$), followed by the Internet ($r = 0.187$), radio ($r = 0.140$) and finally, interpersonal communication ($r = 0.113$). All of these correlations were significant at the 0.001-level (two-tailed).

Three online sources were significantly correlated with the duration of attention as well, each at the 0.01-level, two tailed: those who answered having used the websites of agencies (both governmental and non-governmental) ($r = 0.175$) and those who followed the news on a blog ($r = 0.194$) were more likely to have paid attention to the coverage for longer. On the other hand, people who used Facebook ($r = -0.158$) were more likely to stop paying attention to the news sooner.

H6 was not supported: only interpersonal communication was significantly correlated with satisfaction with media coverage ($r = -0.113$, $p = 0.001$), signifying that people who were not satisfied with the media coverage were more likely to engage in interpersonal communication. All other sources failed to reach significance. However, two sources came very close to significance: both the use of websites of (non-)governmental agencies ($r = -0.114$, $p = 0.058$)

and blogs ($r = -0.117$, $p = 0.051$) had a negative correlation with satisfaction.

Table 3: Bivariate correlations between primary media channels and satisfaction/duration

	Duration	Satisfaction	TV	Radio	Newspapers	Internet	Interpersonal communication
Duration	1						
Satisfaction	-0.071*	1					
TV	-0.006	0.021	1				
Radio	0.140**	-0.033	0.043	1			
Newspapers	0.196**	0.042	0.136**	0.312**	1		
Internet	0.187**	-0.26	-0.82*	0.185**	0.219**	1	
Interpersonal communication	0.113**	-0.113**	0.034	0.189**	0.135**	0.209**	1

** $p < 0.01$, * $p < 0.05$

Table 4: Bivariate correlations between online media channels and satisfaction/duration

	Duration	Satisfaction	Newspaper sites	TV/Radio sites	Agencies' sites	Twitter	Facebook	Blogs	Other
Duration	1								
Satisfaction	-0.71*	1							
Newspaper sites	0.85	-0.029	1						
TV/Radio sites	0.39	-0.036	0.036	1					
Agencies' sites	0.175**	-0.114	0.094	0.290**	1				
Twitter	-0.66	0.027	0.035	-0.001	0.090	1			
Facebook	-0.158**	-0.034	-0.029	0.025	0.031	0.252**	1		
Blogs	0.194**	-0.117	-0.162**	-0.127	0.021	0.121*	0.086	1	
Others	-0.015	-0.011	-0.252**	-0.024	-0.054	-0.054	0.036	0.143*	1

** $p < 0.01$, * $p < 0.05$

Discussion

This study set out to investigate the influence of twelve communication channels on the risk perception of the 2011 Fukushima nuclear accident. Additionally, some correlations were studied: on the one hand, between the use of these media channels and satisfaction with the information and, on the other hand, between the use of the media channels and the duration of attention paid to the media coverage.

This master's thesis aimed to contribute to the theoretical understanding of the relation between media and risk perception in several different ways. Firstly, a representative data set was used instead of a convenience sample. Therefore, the results would be perceived as more generalisable. Secondly, this study considers the effects on perceived risk of an actual nuclear accident, rather than a hypothetical one. Finally, a whole range of media channels was included in the analyses, instead of focusing on just a couple. Especially the role of radio has rarely been studied, even though the medium is used by about one out of two people in Belgium.

RQ1 asked whether media channels would be predictors of the risk perception of the 2011 Fukushima nuclear accident. To briefly answer this question: yes, even when controlling for five background variables, some communication channels emerged as significant predictors of the Belgian risk perception of the nuclear accident. More specifically, television and interpersonal communication were both related to higher risk perception, while various minor online sources (with YouTube as probably the most important) were related to lower risk perception. As expected, more favourable attitudes towards nuclear energy and a higher level of education were both linked to reduced perceived risk. Additionally, people who were satisfied with the information they got from the media had lower risk

perception as well. Contrary to expectations, people who attended to the news about Fukushima longer had lower risk perception. Gender was only a significant predictor of risk perception for the online sources.

The limited effects of media channels

Television was the most widely used medium to get informed about the accident: as many as 93.4% of the valid respondents indicated television to be an important medium to get informed, and for about one in four, TV was the only medium they used. As Sugimoto et al. (2013, p. 5) concluded, television is an ubiquitous medium and a great way to provide information to the public. However, in contrast to what Sugimoto et al. found in Japan, television use in Belgium was significantly related to higher risk perception, as predicted by **H1**.

Frewer et al. (1998, p. 14) assumed that any impact that television has on risk perception, would most likely be through the availability heuristic. While the data used in this study do not allow to see how long Fukushima was covered in television news (compared to other media), it is important to note that TV was the only primary medium not significantly related to the duration of attention the public paid to the news. Even if there was significantly more coverage on television news, the public did not seem to have paid attention to it for a longer time compared to those that did not watch television.

Coleman (1993, p. 635) assumed that it might be the visuals and structure of television news that cause heightened risk perception: the more vivid presentation and the less in-depth content (compared with written reports) could convey greater danger to the public.

There might be an alternative explanation for the finding regarding television's influence on risk perception: the group of respondents (6.6%) who did not indicate that TV was a major source of information for them, might have unique characteristics that caused

them to have a lower risk perception of the nuclear accident. For example, Henning and Vorderer (2001) found that students with a high need for cognition watch less television. People with a high need for cognition will also be more motivated to think, and thus, to base their opinion on facts. Possibly, this will make them less dependent on heuristics, similar to what Yim and Vaganov (2003) think the effect of education could be. If these 6.6% of Belgians indeed have a higher need for cognition, then this could also be an explanation for TV being a significant predictor of risk perception.

Even though interpersonal communication was only used by 13.9% of the people, it yielded several significant results. Not only was it the only channel that was significantly correlated with both satisfaction with the media coverage and the duration of attention paid to it, it was also a significant predictor of risk perception. The influence of interpersonal communication on risk perception is in line with previous research. Coleman (1993) also found that talking with others heightened the risk perception of involuntary social risks, the category nuclear accidents would most likely belong to. Sugimoto et al. (2013) found that listening to rumours increased the worries about the effects of radiation on health. While it would obviously be an overstatement to say that all interpersonal communication consists of nothing but rumours, interpersonal communication is probably the communication channel that is most prone to spreading rumours.

However, the results of this study conflict with those of Zhu et al. (2012), who studied the effects of message source and ambiguity tolerance on risk perception. They found that people who do not feel uncomfortable with ambiguous situations, had higher risk perception if they got their information from the news media, compared to when they got their information from interpersonal communication. On the other hand, people who feel uncomfortable – and even threatened – by ambiguity, had high risk perception regardless of the message source. Possibly, those results are due to their respondents being the

actual victims of a very recent earthquake. Both mediated messages and interpersonal communication informed this public of a realistic and close danger: strong aftershocks and a government that would be unable to compensate the damages. Given their personal experience with the devastation (32% lost friends or relatives), it is no surprise that both groups would have high risk perception. The real question is why ambiguity tolerant people had lower risk perception if they got information from peers: theoretically, both personal experience and direct information from others about their experiences would influence risk perception more than the media could (Wählberg & Sjöberg, 2000, p. 44). Perhaps the ambiguity tolerant people dismissed the interpersonal communication because it was not presented to them directly, but rather in a scenario involving “Ming Wang, an average victim”, who “happened to hear this information around him” (Zhu et al., 2012, p. 956): there are at least two degrees of separation between the respondent and the (fictional) peer providing the information.

The significant negative relationship between the miscellaneous online sources and risk perception is hard to explain because of the vagueness of the category. However, since YouTube is the third most accessed site on the internet (Cheng et al., 2013, p. 1184), it is quite likely that this was the most important component in the category of miscellaneous online sources. The literature suggested that YouTube is more likely to be used for entertainment (Cheng et al., 2013, p. 1186; Hanson & Haridakis, 2008). While even entertainment programs can increase risk perception (Leiserowitz, 2004, p. 28), this does not seem the case with YouTube. A possible explanation could be that YouTube clips differ greatly from the traditional videos (Cheng et al., 2013, p. 1193) that were used in previous studies on the link between entertainment and perceived risk. Clearly, more research is needed on the influence YouTube can have on risk perception. Unfortunately, the present study can not contribute to this field of research, as YouTube was not a separate option in the

questionnaire that this study used. Instead, it was included with other miscellaneous online sources.

All other media channels studied failed to reach significance as predictors for the risk perception.

The lack of effect of newspapers on risk perception is perhaps attributable to the balanced reporting on the subject. Media content analyses of the Belgian press revealed that a majority of newspaper articles were neutral towards nuclear energy. This was the case both for the first two months after the accident (Cantone et al. 2012, p. 5) and a year after the accident (Perko & Turcanu, 2013). Even though newspaper readers have the option to ignore articles that do not capture their interest (Frewer et al. 1998), they apparently did not use this option with regard to the topic of Fukushima: on average, the readers of newspapers followed the coverage for a longer time than those who did not read newspapers.

Radio failed to reach significance as a predictor of risk perception in Belgium, even though it was an important predictor for the fear of social disruption in Japan. Sugimoto et al. (2013, p. 4) attributed their results to the position that radio holds as a central element in an individual's disaster plan in Japan. Therefore, people who fear social disruption are more likely to own and use a radio in Japan.

Whereas over 70% of the Belgian population assume that they would use the radio in case of a nuclear emergency, television would be the most important media channel, with over 85% of Belgians stating they would consult television (Perko et al., 2010, p. 44). Considering radio apparently does not hold the same function as the central risk communicating channel in Belgium, the difference with Japan is not too surprising. The lack of effect on perceived risk may simply be because Belgian radio owners are not more likely to have fear compared to owners of other media channels. Alternatively, the difference could also be related to the observation that the Belgian respondents were not directly affected by the nuclear accident, whereas the respondents of Sugimoto et al. all lived fairly close to

the nuclear power plant of Fukushima. Another possible explanation could be the lack of visuals when compared to television: even though radio news is similar to television news with respect to its linearity and structure (brief segments, that are too short to give a broad context of the disaster), visuals are one major aspect in which it differs.

Finally, the Internet as a whole was also not a significant predictor of risk perception, possibly because of its heterogeneous nature. Further, while Internet use was significantly positively correlated with the duration of attention paid to the news about the Fukushima nuclear disaster, there are large differences between the various online sources: the duration of attention was positively correlated with the use of both blogs and the websites of agencies, but it was negatively correlated with Facebook use. Remarkably, Facebook was the only media channel in this study whose usage was significantly correlated with a shorter time of paying attention to the coverage. While the results of Whiting and Williams (2013) gave leeway for the interpretation that social media users also talk and comment about the news on social media, the results of this study suggest that Facebook users quickly moved on to other topics (compared to non-users). Perhaps this is due to the gravitas of the topic: passing the time, entertainment and relaxation were also important uses and gratifications of Facebook, and these activities might be difficult to combine with topics dealing with destruction and possible health hazards.

Even though a lot of research has been conducted on Twitter use during and after the 2011 Fukushima nuclear accident, Twitter did not turn out to be an important source of information, at least not for the Belgian population: only 0.3% indicated Twitter as an important source of information. Although Facebook did a little better (7.4%), all in all it also was not a major source of information in Belgium. Apparently, traditional media and their associated websites are still the most widely used information sources for the Belgians. These

results are in line with the findings of Sugimoto et al. (2013), who found that, in Japan, only about 15% of their sample used social media. While the authors assumed that these results were due to the composition of their sample (64% of which was over the age of fifty), this does not seem to be the case in the present study, as the gathered data were representative of the Belgian population in regard to age. Apparently, social media just are not being used as an important information source by the people – at least not yet. Perhaps this is because they do not perceive social media as being as credible as for example newspapers (Utz et al., 2013). Just like in Japan, though, the use of Twitter and other social media was not related to a significant increase or decrease in risk perception.

In conclusion, media channels are not major factors in influencing risk perception. Most media channels are not significant predictors, and even though television, interpersonal communication and miscellaneous internet sources do have significant influence, it is important to note that their β s were small when compared to some of the other variables entered in the analysis, such as attitudes towards nuclear power and satisfaction with the information the media provided.

Other predictors of perceived risk

Attitudes towards nuclear power were the most powerful influencer of risk perception of the Fukushima nuclear accident: as **H2** predicted, proponents of nuclear energy perceived the risk of the accident to be lower, while opponents deemed it to be higher. This result lends support to the hypotheses of Sjöberg (2000), Katsuya (2001) and Siegrist and Visschers (2013): proponents and opponents are likely to interpret a nuclear accident differently, in such a way as to fit with their previous held beliefs and attitudes. Worth noting, however, is that almost four in ten Belgians (38.1%) did not have a clear stance on nuclear energy. According to Van der Pligt et al.

(1984, p. 305), this neutral group is most likely to change their stance on nuclear power after an accident. Comparing the distribution in 2013 with data of the Belgian population from 2009 (Perko et al., 2010, p. 90), the size of the neutral group did in fact decrease while the opposing group increased – even so, only statistical analysis can say whether this change was significant and a panel study would be needed to study exactly how people's opinions shifted.

Education was the second most influential predictor for risk perception in the first regression analysis, with only attitudes towards nuclear power having a higher β -coefficient. Although it failed to reach significance in the regression analysis for online channels, it did come rather close ($p = 0.058$). Education did seem to have an influence on risk perception, in the direction **H8** predicted: people with a higher level of education had lower risk perception of the nuclear accident in Fukushima, compared to those with a lower level of education. This result supports the findings of Whitfield et al. (2009), who also found education to have a significant direct influence on nuclear risk perception.

The concrete dynamic behind this finding is unknown, however, as the literature offered many different explanations, ranging from people with higher education being able to select more relevant information, to them having less dependence on heuristics when making judgements. Since most of these explanations are qualitative in nature, there is no way to test for them in study.

This study also shows the importance of distributing satisfactory information regarding nuclear accidents. People who did not find the information satisfactory, were more likely to have higher risk perception of the accident – in accordance with **H5**. Additionally, they were also more likely to engage in interpersonal communication about the matter, and interpersonal communication was also significantly related to heightened risk perception. Possibly, this is because of the spread of rumours, that appeared in order to reduce

the uncertainty that the (unsatisfactory) official information created (DiFonzo & Bordia, 2002, p. 3; Rahu, 2003, p. 297).

Two other media channels came close to being significantly related to satisfaction with the information: blogs and the websites of (non-)governmental agencies. Even though correlations do not give any information about the causality of the relationship between the variables, it seems more likely that people who are dissatisfied with the media coverage turn to blogs for information – rather than people becoming disillusioned with the coverage as a result of reading blogs. Pierpoint (2011, pp. 56-57) noted that the success of some of the blogs about Fukushima was due to them providing the public with accurate and objective information, that was also easily understandable.

In the same vein, the negative correlations between satisfaction and the reported use of the websites of (non-)governmental agencies could be interpreted in two ways. The negative explanation would be that respondents did not find the information on the websites of agencies satisfactory. However, as with blogs and interpersonal communication, once again it seems more likely that a more positive explanation is true: if people are dissatisfied with the media coverage, they turn to the agencies for more reliable information.

Contrary to what **H3** predicted, duration of attention paid to the primary media channels actually had a (small but statistically significant) negative correlation with risk perception. In the regression analysis regarding online media channels, however, it failed to reach significance as a predictor. Even so, the results of both analyses are in the same direction: apparently, people who attended to the news longer had lower risk perception of the accident. At first sight, this is rather odd, seeing as the problems in and around the nuclear plant in Fukushima were (and are) far from over. For example, out of 196 Belgian articles containing the keyword “Fukushima” published in the timeframe when the data were

gathered, GoPress deemed the following five the most relevant: “More children with cancer in Fukushima”, “Japan wants to freeze the ground below Fukushima”, “More bodge jobs happening in Fukushima”, “New high-radiation spots appear in Fukushima” and “Agreement to monitor Fukushima and Chernobyl from space” (search conducted on April 3rd 2014). It is unlikely that the lowered risk perception can be attributed to the media publishing more reassuring news about the accident.

A possible explanation for the decrease in risk perception is suggested by Wählberg and Sjöberg (2000, p. 40). If the amount of media coverage decreases, so does the risk perception. Cantone et al. (2012, p. 3) noted that there was a significant decrease in the number of articles published regarding Fukushima, even in the first 9 weeks after the accident. There are indications that this trend continued. Just two Belgian newspapers published over 180 articles in the month following the accident (Cantone et al., 2012). Although the accident was still prominently featured in the news at the time of the data gathering, all Belgian newspapers together published ‘only’ 196 articles related to Fukushima, indicating that the amount of coverage did indeed decrease, when compared to the initial coverage.

For the primary media channels, gender was not a significant predictor of risk perception, while the literature suggested it could be. Possibly, the gender difference in risk perception of an actual nuclear accident only appears in areas close to the site of the accident. Tateno and Yokoyama (2013, p. 12) found that a significant difference in anxiety between mothers and fathers only appeared in the Fukushima prefecture, but not in the rest of Japan. Drottz-Sjöberg and Sjöberg (1990) also found a significant gender effect in Sweden after the Chernobyl nuclear accident, and Sweden was one of the countries particularly affected by the accident (Van der Pligt & Midden, 1990, p. 97; Verplanken, 1991, p. 254). The other studies in the literature review regarding gender and risk perception asked respondents questions regarding their fears of either

the technology of nuclear power or of a hypothetical nuclear accident. Even then, Brody (1984, p. 214) noted that the gender difference is more outspoken for the local items, compared to the general items. Perhaps Belgium is located too far away from Fukushima to have outspoken gender differences in the general population.

In the analysis regarding online sources, however, gender did become a significant predictor of risk perception, with women perceiving the risk to be significantly higher than men, as predicted in **H7**. A possible explanation for this difference can be extracted from the study of Drottz-Sjöberg and Sjöberg (1990, p. 146). They found that young men were the least risk averse group. The group that used the internet was indeed significantly younger (year of birth: $M = 1972.75$, $SD = 14.93$) than the group that did not ($M = 1961.61$, $SD = 17.30$), $t(603.474) = -9.956$, $p < 0.001$. Perhaps the significant difference is a result of the significantly lower risk perception of the younger males that use the Internet.

Implications for risk communicators

The results of this study do not only contribute to the theoretical understanding of the relation between media and risk perception, but can also provide risk communicators with some practical guidelines. First and foremost, the results indicate that media channels are not simple equivalents. Even though all can be (and were) used to obtain information, some channels have significant effects on risk perception. Furthermore, if one is not satisfied with the media coverage, he or she turns to very specific channels, namely interpersonal communication, blogs and the websites of agencies. Better understanding of why people use a certain media channel and how this affects them, can help risk communicators improve their messages.

The results show that Belgium is a multi-media society, in which only a minority of people used a single media channel to get informed about the nuclear accident. During and after emergencies, a large proportion of the population will receive messages from different channels; risk communicators have to make sure that these messages are consistent and that they make use of the distinct characteristics of the different media channels. For instance, television news needs short segments with visuals, containing only the most important information. Conversely, newspapers want to (and are able to) provide a broad context to their readers.

A very large share of the Belgian population used television to get information. For one in four Belgians, it was also the *only* major source of information, establishing television as a critical channel for risk communicators, as it is the only way to inform this large group of people. However, in contrast to what Sugimoto et al. (2013, p. 5) concluded, the results of this study imply that television coverage is not free of problems: television is one of the few channels to have a significant influence on risk perception. To set the stakes even higher, Frewer et al. (1998, p. 14) stated that most television news reports are shorter than four minutes. As a result, risk communicators should be especially careful when determining what information to convey during this limited time, in order to avoid increasing the perceived risk. Communicating risk via television should therefore receive a lot of attention and time.

Radio was the second most used medium, followed closely by newspapers – both of these media channels were used by about 50% of the total population. Radio and newspapers seem to be the safe option for risk communicators, at least in the Belgian context: not only do they have a large reach, the usage of both channels was not a predictor of heightened risk perception. Additionally, both media channels were correlated with longer attention paid to the messages, which has been shown to slightly lower risk perception.

The traditional media (television, radio and newspapers) are all apparently still very important resources for the Belgians, which is why risk communicators should allot the majority of their time and attention on messages for the traditional media.

The literature points to several (possible) advantages to risk communication through social media, such as providing information to the public when the main website is down or the ability to engage in dialogue with the public (IAEA, 2012, p. 64). While these opportunities are real, risk communicators should be aware that only a limited proportion of the public actually uses social media as an important source of information. Instead, social media are probably perceived as being complementary to traditional news media. Since the human resource cost of social media is high (IAEA, 2012, p. 64), it seems more cost-effective to focus on traditional media outlets: even the best of social media coverage will not reach as many people as television news or a newspaper article. Furthermore, the traditional media coverage is often echoed in Twitter (Thomson et al., 2012), which further strengthens the suggestion that traditional media coverage should be the focal point for risk communicators, as it will be reflected in the online discussions, at least to some extent.

Furthermore, this study empirically demonstrated that providing the public with satisfactory and sufficient information is of the utmost importance, as respondents with higher satisfaction with the information had a significantly lower risk perception of the nuclear accident. Seeing as about one in five respondents was dissatisfied with the media coverage regarding the Fukushima nuclear accident, there are obviously some improvements that can be made. The public will be more satisfied with information if it is provided to them in a timely manner, suits their needs and is presented in a language that can be easily understood (IAEA, 2012).

People who are dissatisfied with the media coverage, will most likely turn to the following three information sources: interpersonal

communication, blogs and the websites of (non-)governmental agencies. While it would probably be almost impossible for risk communicators to directly influence what people talk about amongst themselves, blogs and the websites of agencies can become valued partners of risk communicators, that can help tailoring messages to different audiences. To be able to do this, however, it is important that they have access to sufficient information.

Bloggers with expertise in the field of (for example) nuclear energy, can translate this information into understandable and reliable messages (for examples, cfr. Pierpoint, 2011). Well-written and knowledgeable blogs could be promoted or endorsed by risk communicators in order to give them a greater reach, as not too many Belgians made use of them during and after the Fukushima nuclear accident. Of course, risk communicators could also start their own blog, but it should be noted that any kind of social media involvement, including blogs, requires a large human resource cost from the organisation (IAEA, 2012, p. 64). Supporting third party blogs seems to be the better option, considering the lower costs and possible improved credibility through their impartiality.

Maintaining good relations with both governmental agencies and NGOs and supplying them with sufficient information is just as important, as these agencies are another source people turn to if they are not satisfied with the information from the mass media. Just like bloggers, the different agencies can help risk communicators in translating their message to a larger audience: whereas blogs could provide (rather) concise and understandable information, the agencies could specialise in providing complete information for those audience members who wish to know more details than what was provided by the mass media. The authority of the agency could possibly help to further increase the credibility of the message. The reach of the websites of agencies – while already one in four internet users – could be further improved. Risk communicators

could help in making these agencies more familiar to the public, for example by mentioning links to their websites in press releases.

Perhaps not surprisingly, a major nuclear accident is something the public is very interested in for a very long period of time: over one in four Belgians was still attending to the news about Fukushima when the data for this study were gathered. Risk communicators should be aware that communication regarding nuclear accidents is more akin to a marathon than to a sprint. It is important for them to keep communicating status updates and their efforts to control the damage, in order to prevent other stakeholders from taking control of the communication process. The need for continued communication apparently holds true even when things are not going completely according to plan: the risk perception of the Fukushima nuclear accident went down with longer duration of attention paid to the media coverage, even though the problems in the plant continued. At the same time, however, one should certainly make sure to avoid sending out too many messages, as the bulk of the literature finds that more media coverage leads to higher risk perception. Thus, risk communicators should keep the public informed of major developments, not only of progress but also of setbacks. However, avoid communicating every minor event separately.

Limitations and Future Research

Although the data set that was used in this study was representative of the Belgian population with respect to six sociodemographic variables, it still had some limitations. Firstly, it was impossible to control for how much exposure a respondent actually had to a certain channel. It is very plausible that some respondents indicated that television (for example) was an important source of information for them, even though they did not watch much of it in absolute terms. Additionally, the content of the different media channels was also not known, which made it impossible for this study to control for this

factor. It is possible that it was the (amount of) content and not the channel as such that altered risk perception, if – for example – television news stories were more numerous or alarming in nature than the news in newspapers. Therefore, further research could look into the quantitative and qualitative differences in content between different media channels.

Because not all factors could be controlled for, the results of the regression analyses can not be interpreted as conclusive indications of causality. An experiment would be needed to find out whether there is a causal relationship between media channel and risk perception. A possible experiment would be to show the same news clip about a risk on television or on YouTube, and see whether or not the difference in risk perception found in this study is replicated.

The fact that the data were gathered over two years after the accident could also be considered slightly problematic. For example, Tateno and Yokoyama (2013, p. 11) thought that, if they conducted their study more than a year after the accident, changes in perceptions would have disappeared again. While it is impossible to rule out the possibility that the influences of the media channels on risk perception might have been stronger if the data were gathered sooner after the accident, the fact that the data still yielded several significant results, even after more than two years after the accident, indicates that the effects on risk perception are quite resistant to change.

Finally, seeing as YouTube is the third most accessed Website worldwide, it seems warranted to include YouTube as a separate option in questions regarding media usage and choice in future studies. The use of “miscellaneous online sources” significantly decreased the risk perception of the Fukushima nuclear accident, and while YouTube is probably the major component of this category, its influence can never be truly known if it is not studied as a category of its own.

Conclusion

To conclude, the results of this study demonstrated that even though most media channels did not predict risk perception in any significant way, some media channels did have significant influence on risk perception. This is remarkable since the analysis controlled for five background variables, most of which were also (highly) significant predictors. However, the effects of these media channels were rather limited when compared to the background variables. The media channels do not possess overwhelming persuasive power (also: Coleman, 1993, p. 624).

The pre-existing attitudes towards nuclear energy were the strongest predictor of perceived risk, with people favourable towards nuclear power perceiving less risk. People with higher education also had lower risk perception, as did people who were very satisfied with the media coverage. The media channel will not cause people with low risk perception to suddenly experience high risk. In this sense, media channels are indeed not major factors in determining risk perception.

However, the other significant predictors are all rather stable variables: the attitudes towards nuclear power are difficult to change, and evidence suggests that even after a nuclear accident, attitudes quickly bounce back to pre-accident levels (de Boer & Catsburg, 1988; Siegrist & Visschers, 2013). Raising the educational level of a population is certainly possible, but it requires time and effort. The same is true for satisfaction with the media coverage: although it is perfectly possible for journalists and risk communicators to improve their messages to better suit the needs of their audience, this will not happen overnight.

In comparison, which media channel one uses is something that is more volatile. Of course, there are practical limitations (for examples, cfr. Van der Wurff, 2011, pp. 152-153) that prevent

everyone to have access to *all* media channels, but as the results show, most people in Belgium already use more than one medium to get informed. Depending on which medium gets the most weight in the media mix of a person, their risk perception might change. For example, if one has access to both television and radio, using more television would likely increase risk perception, while using more radio would not. Although this change would be subtle at best, it is still remarkable that such a minor difference can indeed significantly influence risk perception.

Reference List

- Adriaensens, E., & Vanoverbeke, D. (2004). *Op zoek naar het nieuwe Japan: de Japanse politiek na 1945*. Roeselare, Belgium: Globe.
- Bradsher, K., Tabuchi, H., & Pollack, A. (2011, April 12th). Japanese officials on defensive as nuclear alert level rises. *New York Times*, p. A5. Retrieved on 16.12.2013 from <http://www.nytimes.com/2011/04/13/world/asia/13japan.html>
- Brody, C. J. (1984). Differences by sex in support for nuclear power. *Social Forces*, 63(1), 209-228.
- Cantone, M. C., Perko, T., Turcanu, C., Prezelj, I., Tavola, F., Sturloni, G., ... Van Rooy, L. (2012, May). *Content analysis of the media reporting on the Fukushima nuclear accident in three European countries*. Paper presented at the 13th International Congress of the International Radiation Protection Association, Glasgow, United Kingdom.
- Cheng, X., Liu, J., & Dale, C. (2013). Understanding the characteristics of internet short video sharing: a YouTube-based measurement study. *Multimedia, IEEE Transactions on Multimedia*, 15(5), 1184-1194.
- Coleman, C. L. (1993). The influence of mass media and interpersonal communication on societal and personal risk judgments. *Communication Research*, 20(4), 611-628.
- de Boer, C., & Catsburg, I. (1988). The impact of nuclear accidents on attitudes toward nuclear energy. *The Public Opinion Quarterly*, 52(2), 254-261.

- De Fleur, M. L. (1987). The growth and decline of research on the diffusion of the news, 1945-1985. *Communication Research*, 14(1), 109-130.
- DiFonzo, N., & Bordia, P. (2002). Corporate rumor activity, belief and accuracy. *Public Relations Review*, 28(1), 1-19.
- Dolinski, D., Gromski, W., & Zawisza, E. (1987). Unrealistic pessimism. *The Journal of Social Psychology*, 127(5), 511-516.
- Drottz-Sjöberg, B. M., & Sjöberg, L. (1990). Risk perception and worries after the Chernobyl accident. *Journal of Environmental Psychology*, 10(2), 135-149.
- Eiser, J. R. (1998). Communication and interpretation of risk. *British Medical Bulletin*, 54(4), 779-790.
- Elliot, D. (2012). *Fukushima: impacts and implications*. Hampshire, United Kingdom: Palgrave Macmillan.
- Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000). Gender, race, and perceived risk: the 'white male' effect. *Health, Risk & Society*, 2(2), 159-172.
- 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.
- Frewer, L., Rowe, G., & Sjöberg, L. (1998). *The 10th anniversary of the Chernobyl accident: the impact of media reporting of risk on public risk perception in five European countries*. Reading, United Kingdom: Institute of Food Research.
- Friedman, S. M. (2011). Three Mile Island, Chernobyl, and Fukushima: an analysis of traditional and new media coverage

of nuclear accidents and radiation. *Bulletin of the Atomic Scientists*, 67(5), 55-65.

- Goldemberg, J. (2011). Have rising costs and increased risks made nuclear energy a poor choice? [Blog post]. *Oil Price Blog*. Retrieved on 10.03.2014 from <http://oilprice.com/Alternative-Energy/Nuclear-Power/Have-Rising-Costs-And-Increased-Risks-Made-Nuclear-Energy-A-Poor-Choice.html>
- Gustafson, P. E. (1998). Gender differences in risk perception: theoretical and methodological perspectives. *Risk Analysis*, 18(6), 805-811.
- Hanson, G., & Haridakis, P. (2008). YouTube users watching and sharing the news: a uses and gratifications approach. *Journal of Electronic Publishing*, 11(3). DOI: 10.3998/3336451.0011.305
- He, G., Mol, A. P. J., Zhang, L., & Lu, Y. (2012). Nuclear power in China after Fukushima: understanding public knowledge, attitudes and trust. *Journal of Risk perception*, (ahead-of-print), 1-17. DOI: 10.1080/13669877.2012.726251
- Henning, B., & Vorderer, P. (2001). Psychological escapism: predicting the amount of television viewing by need for cognition. *Journal of Communication*, 51(1), 100-120.
- Huang, L., Zhou, Y., Han, Y., Hammitt, J. K., Bi, J., & Liu, Y. (2013). Effect of the Fukushima nuclear accident on the risk perception of residents near a nuclear power plant in China. *Proceedings of the National Academy of Sciences*, 110(49), 19742-19747.
- International Atomic Energy Agency. (2008). *International nuclear and radiological event scale (INES)*. Retrieved from <http://www.iaea.org/Publications/Factsheets/English/ines.pdf>

- International Atomic Energy Agency. (2012). *Communication with the public in a nuclear or radiological emergency*. Vienna, Austria: International Atomic Energy Agency.
- Japan Meteorological Agency 気象庁. (2013). *Jishin to tsunami - bōsai to gensai no tame ni* 地震と津波－防災と減災のために [Earthquakes and tsunamis - disaster prevention and mitigation efforts] [Brochure]. Retrieved from <http://www.jma.go.jp/jma/kishou/books/jishintsunami/jishintsunami.pdf>
- 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.
- Katchanovski, I. (2012, August). *Fukushima vs. Chernobyl: coverage of the nuclear disasters by American and Canadian media*. Paper presented at the Annual Meeting of the American Political Science Association, New Orleans, LA, United States of America.
- Katsuya, T. (2001). Public response to the Tokai nuclear accident. *Risk Analysis*, 21(6), 1039-1046.
- Kim, Y., Kim, M., & Kim, W. (2013). Effect of the Fukushima nuclear disaster on global public acceptance of nuclear energy. *Energy Policy*, 61, 822-828.
- Kubota, Y. (2012). Facing a crisis with calmness? The global response to the Fukushima nuclear disaster. *Japanese Journal of Political Science*, 13(3), 441-466.
DOI:10.1017/S1468109912000187
- Leiserowitz, A. A. (2004). Day after tomorrow: study of climate change risk perception. *Environment: Science and Policy for Sustainable Development*, 46(9), 22-39.

- Maldonato, M., & Dell'Orco, S. (2011). How to make decisions in an uncertain world: heuristics, biases, and risk perception. *World Futures*, 67(8), 569-577.
- Manoj, B. S., & Baker, A. H. (2007). Communication challenges in emergency response. *Communications of the ACM*, 50(3), 51-53.
- Mutz, D. C., & Young, L. (2011). Communication and public opinion: plus ça change?. *Public Opinion Quarterly*, 75(5), 1018-1044.
- Perko, T., & Turcanu, C. (2013). Reporting on Fukushima. *Nuclear Engineering International*, 58(704), 38-40.
- Perko, T., Turcanu, C., Schröder, J., & Carlé, B. (2010). *Risk perception of the Belgian population: results of the public opinion study in 2009* (SCK•CEN-BLG-1070). Mol, Belgium: SCK•CEN.
- Perko, T., Valuch, J., Nagy, A., Lammers, P., & Mays, C. (2013). *Overview of mass and new media treatment of ionizing radiation topics: the case of Fukushima*. Retrieved on 22.11.2013 from: <http://eagle.sckcen.be/en/deliverables>
- Pierpoint, L. (2011). Fukushima, Facebook and feeds: informing the public in a digital era. *The Electricity Journal*, 24(6), 53-58.
- Prati, G., & Zani, B. (2013). The effect of the Fukushima nuclear accident on risk perception, antinuclear behavioral intentions, attitude, trust, environmental beliefs, and values. *Environment and Behavior*, 45(6), 782-798.
- Price, V., & Zaller, J. (1993). Who gets the news? Alternative measures of news reception and their implications for research. *Public Opinion Quarterly*, 57(2), 133-164.

- Rahu, M. (2003). Health effects of the Chernobyl accident: fears, rumours and the truth. *European Journal of Cancer*, 39(3), 295-299.
- Reeves, B., & Nass. C. (1998). *The media equation: how people treat computers, television, and new media like real people and places*. Cambridge, United Kingdom: Cambridge University press.
- Renn, O. (1990). Public responses to the Chernobyl accident. *Journal of Environmental Psychology*, 10(2), 151-167.
- Renn, O. (2008). *Risk governance: coping with uncertainty in a complex world*. London, United Kingdom: Earthscan.
- Siegrist, M., & Visschers, V. H. M. (2013). Acceptance of nuclear power: the Fukushima effect. *Energy Policy*, 59, 112-119.
- Sjöberg, L. (2000). Factors in risk perception. *Risk Analysis*, 20(1), 1-12.
- Sugimoto, A., Nomura, S., Tsubokura, M., Matsumura, T., Muto, K., Sato, M., & Gilmore, S. (2013). The relationship between media consumption and health-related anxieties after the Fukushima Daiichi nuclear disaster. *PLoS ONE*, 8(8), 1-7. DOI:10.1371/journal.pone.0065331
- Tateno, S., & Yokoyama, H. M. (2013). Public anxiety, trust, and the role of mediators in communicating risk of exposure to low dose radiation after the Fukushima Daiichi nuclear plant explosion. *Journal of Science Communication*, 12(2), 1-22.
- Thomson, R., Ito, N., Suda, H., Lin, F., Liu, Y., Hayasaka, R., ... Wang, Z. (2012, April). *Trusting tweets: the Fukushima disaster and information source credibility on Twitter*. Paper presented at the 9th International ISCRAM Conference, Vancouver, Canada.

- Tōden Katsumata Kaichō Kaiken 東電・勝俣会長会見 [Interview with Katsumata, chairman of TEPCO]. (2011, March 30th). *Sankei Shimbun*. Retrieved on 10.12.2013 from <http://sankei.jp.msn.com/affairs/group/affairs-15489-g1.htm>
- Turcanu, C., & Perko, T. (2014). *The SCK•CEN barometer 2013. Perceptions and attitudes towards nuclear technologies in the Belgian population* (SCK•CEN-BLG-1097). Mol, Belgium: SCK•CEN.
- Utz, S., Schultz, F., & Glocka, S. (2013). Crisis communication online: how medium, crisis type and emotions affected public reactions in the Fukushima Daiichi nuclear disaster. *Public Relations Review*, 39(1), 40-46.
- Van der Pligt, J., Eiser, J. R., & Spears, R. (1984). Public attitudes to nuclear energy. *Energy Policy*, 12(3), 302-305.
- Van der Pligt, J., & Midden, C. J. (1990). Chernobyl: four years later: attitudes, risk management and communication. *Journal of Environmental Psychology*, 10(2), 91-99.
- Van der Wurff, R. (2011). Are news media substitutes? Gratifications, contents, and uses. *Journal of Media Economics*, 24(3), 139-157.
- Vanoverbeke, D. (2010). *Recht en instellingen in Japan: actuele thema's in een historische context*. Leuven, Belgium: ACCO.
- Verplanken, B. (1989). Beliefs, attitudes, and intentions toward nuclear energy before and after Chernobyl in a longitudinal within-subjects design. *Environment and Behavior*, 21(4), 371-392.
- Verplanken, B. (1991). Public reactions to the Chernobyl accident: a case of rationality? *Organization & Environment*, 5(4), 253-269.

- Wählberg, A. A., & Sjöberg, L. (2000). Risk perception and the media. *Journal of Risk Research*, 3(1), 31-50. DOI: 10.1080/136698700376699
- Weisenfeld, U., & Ott, I. (2011). Academic discipline and risk perception of technologies: an empirical study. *Research Policy*, 40(3), 487-499.
- Whitfield, S. C., Rosa, E. A., Dan, A., & Dietz, T. (2009). The future of nuclear power: value orientations and risk perception. *Risk Analysis*, 29(3), 425-437.
- Whiting, A., & Williams, D. (2013). Why people use social media: a uses and gratifications approach. *Qualitative Market Research: An International Journal*, 16(4), 362-369.
- Yamamura, E. (2012). Experience of technological and natural disasters and their impact on the perceived risk of nuclear accidents after the Fukushima nuclear disaster in Japan 2011: a cross-country analysis. *The Journal of Socio-Economics*, 41(4), 360-363.
- Yim, M. S., & Vaganov, P. A. (2003). Effects of education on nuclear risk perception and attitude: theory. *Progress in Nuclear Energy*, 42(2), 221-235.
- Zhu, D., Xie, X., & Xie, J. (2012). When do people feel more risk? The effect of ambiguity tolerance and message source on purchasing intention of earthquake insurance. *Journal of Risk Research*, 15(8), 951-965.