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Information sources as explanatory variables for the Belgian health-related risk perception of the Fukushima nuclear accident

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ABSTRACT

The media play an important role in risk communication, providing information about accidents, both nearby and far away. Each media source has its own presentation style, which could influence how the audience perceives the presented risk. This study investigates the explanatory power of twelve information sources (traditional media, new media, social media and interpersonal communication) for the perceived risk posed by radiation released from the damaged Fukushima nuclear power plant on respondents' own health and that of the population in general. The analysis controlled for attitude towards nuclear energy, gender, education, satisfaction with the media coverage and duration of attention paid to the coverage. The study uses empirical data from a public opinion survey (N > 1,000), which are representative for the Belgian population with respect to six sociodemographic variables. Results show that three information sources are significant regressors of perceived health-related risk of the nuclear accident: television, interpersonal communication and the category of miscellaneous online sources. More favourable attitudes towards nuclear power, longer attention to the coverage, and higher satisfaction with the provided information lead to lower risk perception. Taken together, the results suggest that the media can indeed have an influence on how the audience perceives a risk.

Keywords:

Fukushima nuclear accident, risk perception, traditional media, new media, social media

Risk Analysis

1. INTRODUCTION

Fortunately, major nuclear accidents do not occur often. Unfortunately, this means that research regarding how the public perceives the risk of actual nuclear accidents, and how these perceptions are shaped, is also comparatively rare. While risk is essentially all about probabilities⁽¹⁾, people rarely use statistical methods when making judgements about risks in daily life.⁽²⁾ To form a perception of risk, people take into account various other factors, often qualitative in nature.^(1, 3, 4) This way, they can worry a lot about comparatively minor or very unlikely risks, while ignoring things that really threaten them. Major events, such as the 2011 Fukushima nuclear accident, can quickly make people aware of the prominence of a risk, and can make them more afraid even though the probabilities have not changed.

The media play an important role in risk communication.^(e.g., 3, 5, 6, 7) They provide the public with information about what happened. However, by doing so, they may also influence their audience. This can happen on purpose (with biased articles), but also unknowingly. Kasperson et al.⁽³⁾ pointed to the possibility that each transmitter of information will change the original message by intensifying, weakening and/or filtering parts of it. As such, media are not just neutral intermediaries: they will change the information in the process, and this might influence the recipients of their messages. It is plausible that the unique characteristics of different media sources (regardless of content) may lead to different effects on their audience as well - which was already articulated in the much-quoted catchphrase "the medium is the message".⁽⁸⁾

The Fukushima nuclear accident offered a unique opportunity to study the effects that different media sources can have on the risk perception of actual nuclear accidents. Previous research on this topic is rare, often uses convenience samples and generally studies only a limited number of media sources. This study, on the other hand, included eleven media sources

(including traditional media, new media and social media) and interpersonal communication, using a large sample (N = 1,002) that was representative for the Belgian population.

The present study investigated whether media use during the Fukushima nuclear disaster in 2011 had explanatory power for the long-term risk perception in 2013, several years after the accident. More specifically, it explored the risk that respondents thought the radiation released from the damaged Japanese plant would have on their own health and on that of the general population. For example, the audience might believe that the radiation from Fukushima could increase the number of cancers in Belgium, even though research on the airborne fallout of Fukushima found that there was no concern for public health due to airborne activity levels in Europe.⁽⁹⁾

Belgium is an interesting case, notwithstanding the large distance between the country and Fukushima. Nuclear energy has been on the Belgian public agenda for a while: in 2003, Belgium decided to phase out nuclear energy, but at the time of the accident it still had seven operational reactors. In the following years, the Belgian government has been looking to prolong the lifespan of three nuclear power plants with ten years, instead of decommissioning them in 2015 as originally planned.^(10, 11) The Belgian public is also divided, with 27% in favour of nuclear energy, and 32% opposing it.⁽¹²⁾ Clearly, Belgium has a mixed relationship with nuclear energy, which makes it an interesting case study. Furthermore, the distance from the site of the nuclear accident provides the opportunity to compare the media use and effects of the indirectly affected Belgian population with available data from the directly affected population.⁽¹³⁾

2. LITERATURE REVIEW

2.1. Media Sources: Fostering our Actual and Imagined Fears?

Since the mass media are by definition capable of reaching a large number of people simultaneously⁽¹⁴⁾, it is not surprising that they play an important role in risk communication.^(e.g., 3, 5, 6, 7) However, previous studies have provided some support for the hypothesis that media sources can have an influence on risk perception. Coleman⁽¹⁵⁾ studied the influence of four media sources (newspapers, magazines, books and television) on risk perception in New York State. She found that media sources have a limited influence on both personal and voluntary societal risk. Interpersonal communication had significant influence on involuntary societal risk.

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.⁽¹³⁾ 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. 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.⁽¹⁶⁾ Furthermore, the directly affected Japanese respondents could have 'decoded' the coverage in a different way than the Belgians, as different audiences interpret media messages in a different way, in accordance with local context or culture.^(17, 18, 19)

RQ1: Can the use of specific information sources during the 2011 Fukushima nuclear accident explain the long-term health-related risk perception in Belgium?

2.1.1 Traditional media: newspapers, television and radio

Both in times of crisis and in regular circumstances, an important role of newspapers is to provide the public with greater detail than what the other, "faster" media are able to. This was also true in the case of the Fukushima nuclear accident. Newspapers and their associated websites gave extensive coverage: they often used infographics, multimedia and explanatory articles written by experts to inform their audience.⁽²⁰⁾ The use of infographics and other kinds of visuals could influence the readers. If an article is accompanied by a visual, the audience is significantly more likely to read it, and to read it with more attention. If the image shows impending danger or damage caused by a threat, the audience recalls more information from the text.⁽²¹⁾ In covering the Fukushima story, newspapers also provided ample opinion pieces by different stakeholders⁽²²⁾, providing their audience a broader context and different perspectives on the disaster. However, research has shown that newspapers could increase personal risk perception for those who are highly dependent on newspapers for health information.⁽²³⁾

Research on a large sample of Belgians showed that television news is both the most used source of information in Belgium, and the most trusted.⁽²⁴⁾ In 2011, Belgians still largely relied on their own channels and those of their neighbouring countries. In Flanders, "Other TV-channels (non-Dutch)" only had market share of 6.5%; in Wallonia, "Other TV-channels (non-French) had a market share of 6.1%.⁽²⁵⁾ Television news differs from newspaper news in different respects that can be important for crisis communication. Frewer, Rowe and Sjöberg⁽²⁶⁾ state that while readers of newspapers have the choice not to read a certain article if it does not capture

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their interest, television viewers do not have the same freedom: if a topic is featured in television news, the audience cannot help but watch it. Henning and Vorderer⁽²⁷⁾ suggest that this "linearity" would also make it more difficult for the viewers to think autonomously, since they cannot pause the broadcast to ponder upon the content. Thirdly, due to time constraints, television is not able to give the same extensive background and context that newspapers provide.⁽²⁰⁾ Television tells the public a hazard exists, but gives little background information beyond that.^(26, p. 20) Finally, the effects of the moving images on television could be more outspoken than those of the static images in print. According to Reeves and Nass⁽²⁸⁾, the audience pays even more attention to a moving image than to a still one and attributes more importance to vivid information. Furthermore, they demonstrated that some types of movement (such as images "coming closer") could make viewers feel threatened. Aust and Zillmann⁽²⁹⁾ found that television reports featuring upset victims cause the public to rate the presented risk as more dangerous to both themselves and people in general.

After television, radio was the second most used and second most trusted media source in Belgium. Furthermore, over 75% of Belgians state they would consult radio as a news source in case of a nuclear accident.⁽²⁴⁾ Similar to television, radio news is linear, preventing the listeners from choosing what news to pay attention to. However, it misses the visuals that make television more engaging.

2.1.2 The Internet: new and social media

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 a platform to distribute understandable information to the public, which can interact with

these experts and among themselves.^(20, 30) The International Atomic Energy Agency⁽³¹⁾ advised 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. Since the possibility of interaction and two-way communication is a main feature of social media⁽³²⁾, it is reasonable to assume that social media would be highly effective in managing risk perception. On the other hand, the Internet also helps the spread of misinformation, 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, goes viral, few bother to check its accuracy.^(20, 30) Given these potential problems, it is perhaps not surprising that the public is wary when it comes to Internet sources such as social media, judging them to be significantly less credible than other media sources.^(32, 33) This perception might not match reality when considering the case of Fukushima. Worldwide, Tweets that were tagged with #fukushima often cited highly reliable sources.⁽³³⁾

YouTube is the third most accessed site on the Internet, according to Alexa.com (1 October 2014). As such, it could play a major role in risk communication as well. However, research suggests that a majority of YouTube clips can be classified as "entertainment", with only a small amount of videos in the categories of "News & Politics", "Education" and "Science & Technology".⁽³⁴⁾ Similarly, the share of college students that had watched at least some comedy-format news shows was somewhat larger than the share of people that had watched at least some traditional news.⁽³⁵⁾ However, other studies⁽³⁶⁾ have shown that even entertainment programs can increase risk perception. As of yet, it is still unclear how YouTube clips will influence risk perception.

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2.1.2 Interpersonal communication

Although the different media sources have transformed the way in which risks are communicated, interpersonal communication still plays an important role in the diffusion of high impact stories: people will likely continue to talk with each other about important news events. Although information received from interpersonal communication might not be as detailed as information from the mass media, people still seem to attribute greater trustworthiness to information they heard from others, compared to information from a media source.⁽³⁷⁾

There has been little research on the influence of interpersonal communication on risk perception⁽³⁸⁾. However, the existing literature shows that it could have an influence on both personal risk⁽²³⁾ and societal risk.^(15, 38) For example, Binder et al.⁽³⁸⁾ found that interpersonal discussion increased the risk perception of a biological research facility: opponents or people neutral to the facility had higher risk perception when they had talked about the facility "often". Furthermore, the interlocutor also had a role on risk perception: people who had last talked with an opponent, experienced higher risk.

2.2. Duration of Attention Paid to the News

Wåhlberg and Sjöberg⁽³⁹⁾ 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 they will judge the likelihood of that event happening again. Extensive media coverage is one way in which events could become easier to recall⁽⁴⁰⁾, which would lead to people overestimating the probability of that kind of event.^(1, 7) The fact that the Fukushima nuclear accident was compared to the Chernobyl nuclear accident in both the United States⁽⁴¹⁾ and the European Union⁽⁴²⁾ can remind the public that there have been multiple large-scale nuclear accidents in the

past. As a result, the consideration that a major accident is possible would become more "accessible" to the public, increasing their estimation of the risk. This would especially be the case for people who paid attention to the news for a long period of time, since they will have heard a larger number of references to both major nuclear accidents.

H1: People who followed the news about the Fukushima nuclear accident for a longer period of time have higher risk perception than people who followed it for a shorter amount of time.

2.3. Satisfaction with Media Coverage

The role of the media in risk communication is - first and foremost - to provide the public with information. The Chernobyl nuclear accident demonstrates that a lack of information during a crisis situation creates uncertainty, which in turn exacerbates existing fear and stress.^(43, 44)

Even if information is available and accessible, the public may still not find it satisfactory. For example, during the Fukushima nuclear accident, the provided information did not suit the needs of parents in Japan, what led them to experience higher anxiety.⁽⁴⁵⁾

Even if the population is not directly affected by the nuclear accident, satisfactory media coverage would probably prevent respondents from experiencing unnecessary uncertainty, anxiety and stress, which would lower their perceived risk.

H2: Those who are more satisfied with the media coverage about the Fukushima nuclear accident have a lower risk perception of it than people who are less satisfied.

2.4. Context Variables

Based on existing literature, attitudes towards nuclear energy in general^(e.g., 46, 47, 48), gender^(e.g., 45, 49, 50, 51) and education^(e.g., 2, 15, 52, 53) can also have an influence on risk perception, so these variables were added to both analyses in order to test the influence of media sources in the wider context of risk perception.

H3: Attitudes towards nuclear energy, education and gender will have significant explanatory power for long-term health-related risk perception.

3. METHODOLOGY

This study was conducted using empirical data from the SCK•CEN Barometer 2013⁽¹²⁾, the fifth edition of a regular public opinion survey regarding nuclear energy, commissioned by the Belgian Nuclear Research Center (SCK•CEN). A company specialised in opinion research conducted computer-assisted personal interviews in all ten Belgian provinces, between 15 August and 12 September 2013. The Fukushima nuclear accident was still featured in the news when the fieldwork was conducted, with 196 articles featuring "Fukushima" published in all Belgian newspapers (search conducted on 26 February 2014 using academic.gopress.be).

In order to gather representative data, a list of all Belgian municipalities was first divided into a total of 44 strata. For each of these, an address was randomly selected. The data were then gathered using a random walk method, selecting each nth household.⁽¹²⁾ All interviews took place in the respondent's home, and lasted for an average of 35 minutes. The questionnaire gauged respondents' attitude towards and knowledge about nuclear energy, and trust in and knowledge about several actors in the nuclear field. Finally, a section was devoted on the Fukushima nuclear accident, with questions regarding perception of the accident, solidarity with the victims, media use, and attitude towards contaminated foods and goods. Most questions had respondents answering using a Likert scale, with an option to not answer. Within most question sets, there was randomisation of the question order to combat order effects.

A total of 1,002 respondents were interviewed face-to-face, in Dutch or French. After a weighing procedure, the sample was representative of the adult 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 made use of the weighed sample.

Of the total sample, 64 respondents (6.4%) were not aware of the nuclear accident that

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happened in Fukushima. This group contained more women, $\chi^2(1; N = 1002) = 11.37$, p = 0.001, and was more likely to have no degree or only to have finished elementary school, $\chi^2(8, N = 999)$ = 54.23, p < 0.001. They were more likely to live in Flanders, $\chi^2(2, N = 1002) = 21.65$, 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, $\chi^2(3, N = 1002) = 1.76$, p = 0.623, or their income levels, $\chi^2(2; N =$ 1002) = 3.66, p = 0.160. Since these respondents were not asked any further questions regarding their media use during the coverage of the Fukushima nuclear accident, they were not taken into account in this study. This left a total of 938 valid respondents for analysis.

3.1.Operationalisation

The designation of an *information source as important* was operationalised as a dichotomous variable. Respondents were presented with a list and they could indicate one or more information sources that had been important in informing them about the nuclear accident. Those who selected "Internet" as one of their initial choices were then presented with another list with the various Internet sources, from which they could select multiple answers. Again, these variables were operationalised as dichotomous variables.

For the dependent variable, the Belgian *risk perception* of the Fukushima nuclear accident, a scale was constructed using principal component analysis with Oblimin with Kaiser Normalisation. The factor analysis yielded a factor consisting of three items from the questionnaire. "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?" were both measured from 1 ("no risk at all") to 6 ("very high risk"). The third question, "Will the number of cancers in Belgium increase because of the accident in Fukushima?", was measured from 1 ("strongly disagree") to 5 ("strongly agree"). These questions were based on similar questions in previous editions of the SCK Barometer^(e.g., 24, 54), but were adapted so they referred to the Fukushima nuclear accident. The topics they dealt with may have been present in Belgian news, but probably only in a limited amount. Only 15% of articles about the nuclear accident that were published in two Belgian newspapers (De Standaard and Le Soir) in the first two months after the accident, had Belgium as the country of concern.⁽²²⁾

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 was measured using the factor scores. Each component in the scale of risk perception had a factor loading of 0.77 or higher (see Table I). A low score on the scale signified a low risk Pol perception of the Fukushima nuclear accident.

Table I: Factor loadings

Indicator	Loading
Risk from radiation from the Fukushima nuclear on own health	0.903
Risk from radiation in products from Japan on own health	0.845
Increase of the number of cancers in Belgium due to Fukushima	0.774

Extraction method: Principal Component Analysis

Rotation method: Oblimin with Kaiser Normalisation

The *satisfaction* of respondents with the information they got from the media was measured using a single question: "In general, how satisfied were you with the information you got about the (Fukushima) accident?". How long respondents followed the news about the nuclear accident (duration of attention), was also measured using a single question: "How long did you pay

attention to news about the Fukushima accident?". The *attitude towards nuclear power* was measured using the answers to "What is your opinion on nuclear energy?". Table II gives a more detailed overview of these variables, including the Likert scale ranges and descriptive statistics.

	Likert scale range	M (SD)	N
Satisfaction with media coverage	1 (Very unsatisfied) 5 (Very satisfied)	3.31 (0.92)	923
Duration of attention	1 (Did not follow at all) 6 (Still following)	3.73 (1.57)	931
Attitude towards nuclear power	1 (Totally in favour) 5 (Totally against)	3.12 (0.97)	922

Table II: Descriptive statistics of the variables measured by Likert scales

3.2. Analysis Procedures

The explanatory power of the information sources for the long-term health-related risk perception was calculated using two linear regression analyses. The first analysis was limited to the broad categories of information sources (i.e., television, radio, newspapers, Internet and interpersonal communication - hereinafter referred to as "primary information sources"). Due to the range of online sources, a second analysis was run focusing on the different sources on the Internet. This second analysis was not combined with the first, because only 280 respondents answered the contingency question, compared with 938 responses for the primary information sources. Combining the two analyses would therefore result in significantly lower statistical power.

Satisfaction with the coverage and duration of attention were included in both analyses, as were attitude towards nuclear energy, gender and education. The sample contained slightly more women (50.2%) than men. Education was recoded to have three levels. The lowest level of education consisted of respondents with no degree, an elementary level degree or a lower

secondary degree (27.9% of the sample). The intermediate level (40.7%) consisted of people with a higher secondary level degree, whereas respondents in the high level (31.4%) held a higher education degree, either from a university or non-university higher education.

4. RESULTS

4.1. Media as Important Information Sources

The media played an important role in informing the Belgian public about the nuclear accident in Fukushima. Which information sources were most widely named as important, is shown in Tables III and IV. The existence of a multimedia society is also apparent from the results: 66.6% of respondents indicated more than one important source of information about the accident. On average, people indicated 2.56 important information sources (SD = 1.42) in their search for information about the accident. However, 25.04% of the total sample indicated that television was their only important source of information.

Table III: Percentage of respondents that indicated the primary information sources as

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having been important for them (multiple answers possible)

	Percentage
Television	93.4
Radio	49.6
Newspapers	48.5
Internet	29.8
Interpersonal Communication	16.2
N = 938	

Note: Measured as a percentage of all valid respondents; non-exclusive options

Similar results appear for the online media sources: 63.9% of Internet users named more than one important online information source, with an average of 2.10 (SD = 1.07). However, the distribution is skewed: none of the respondents answered that all seven response options had been important to them, and only 10.2% of the audience had used more than three.

Table IV: Percentage of internet users that indicated the online information sources as

having been important for them (multiple answers possible)

	Percentage of Internet Users
Online Newspapers	84.0
TV and radio station websites	49.9
(Non-)governmental agencies websites	27.6
Facebook	26.4
Blogs	10.2
Others (for example: YouTube)	8.9
Twitter	3.3
<i>N</i> = 280	

Note: Measured as a percentage of all Internet users; non-exclusive options

4.2. Influencing Factors of Long-Term Health-Related Nuclear Risk Perception

The relationship between the information sources and risk perception was analysed using linear regression analysis, $R^2 = 0.171$, F(10,817) = 16.86, p < 0.001 (see Table V for results). The 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.

The factor score could not be calculated for 90 cases. As a result, these could not be included in the analysis. Compared to the cases for which the factor score could be calculated, these missing cases did not differ significantly in their attitude towards nuclear energy, $\chi^2(4, N = 924) = 4.98$, p = 0.290; education level, $\chi^2(2, N = 940) = 0.80$, p = 0.670); duration of attention paid to the coverage, $\chi^2(5, N = 931) = 4.88$, p = 0.431; or satisfaction with the coverage, $\chi^2(4, N = 922) = 4.81$, p = 0.308. There was, however, a significant difference in gender, $\chi^2(1, N = 938) = 4.73$, p = 0.030): the group for which the factor score could not be calculated, contained

significantly more women than expected.

Table V: Explanatory power of primary information sources for risk perception

Model: Risk Perception of the 2011 Fukus	Model: Risk Perception of the 2011 Fukushima Nuclear Accident				
Explanatory variable	β	р	SE		
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		
Media Source: Television	0.064	*	0.138		
Media Source: Radio	0.022		0.068		
Media Source: Newspapers	- 0.051		0.070		
Media Source: 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

Out of the five primary information sources studied, only two turned out to be significant regressors of the risk perception of the Fukushima nuclear accident: having used television ($\beta = 0.064$, p = 0.048) or interpersonal communication ($\beta = 0.117$, p < 0.001) as an important source of information in 2011 lead to higher risk perception in 2013.

With the exception of gender, all other variables included in the analysis were significant regressors. The duration of attention paid to the media coverage was significant, but in the opposite direction than **H1** predicted ($\beta = -0.076$, p = 0.024): respondents who paid attention to

the news about Fukushima for a longer period of time had a lower risk perception. As predicted by **H2**, higher satisfaction with the media coverage was associated with lower risk perception (β = -0.120, p < 0.001). Attitude towards nuclear energy was the most influential regressor (β = 0.291, p < 0.001): people who have a positive attitude towards nuclear power had a lower risk perception. Education had the second highest regression coefficient (β = -0.139, p < 0.001): people with a higher level of education did have lower risk perception, compared to those with a lower level of education. This provides limited support for **H3**, with two out of three context variables being significant regressors.

An additional regression analysis was run for the different Internet sources, $R^2 = 0.211$, F(12,244) = 5.46, p < 0.001 (see Table VI for results). Once again, all variables were entered at the same time.

Only one Internet source had significant explanatory power. "Other sources, such as YouTube" had a highly significant negative β -coefficient (-0.186, p = 0.002). Attitude towards nuclear energy turned out to be the strongest regressor ($\beta = 0.229$, p < 0.001), followed by satisfaction with media coverage ($\beta = -0.204$, p = 0.001), providing support for **H2**. Gender became a significant regressor online: women had a significantly higher risk perception than men ($\beta = 0.151$, p = 0.01). Both educational level and duration of attention lost their explanatory power, but educational level did approach significance ($\beta = -0.114$, p = 0.058). Again, **H3** received limited support, with two out of the three context variables being significant.

Table VI: Explanatory power of online information sources for risk perception

Model: Risk Perception of the 2011 Fukushima	Nuclear Ac	cident	t
Explanatory variable	β	p	SE
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
Media Source: Online newspapers	0.040		0.160
Media Source: TV and radio station websites	- 0.021		0.116
Media Source: (Non-)governmental agencies websites	0.094		0.131
Social Medium: Twitter	0.021		0.328
Social Medium: Facebook	0.042		0.136
Social Medium: Blogs	- 0.066		0.195
Media Source: Others (for example: YouTube)	- 0.186	**	0.208
Constant			0.417
<i>N</i> = 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

5. DISCUSSION

This study set out to investigate the explanatory power of twelve information sources on the Belgian long-term risk perception of the Fukushima nuclear accident, about two and a half years after it occurred, and aimed to contribute to the understanding of the relationship between media and risk perception in several different ways. Firstly, because a representative data set was used, the results would be perceived as more easily generalised. Secondly, this study considered the effects on perceived risk of an *actual* nuclear accident, rather than a hypothetical one. Finally, a whole range of information sources was included in the analyses, instead of focusing on just a couple. In particular, the role of radio has rarely been studied, even though the results showed that it was an important source of information for about one out of two Belgians.

The first research question dealt with the extent to which information sources would be good regressors of the Belgian risk perception of the 2011 Fukushima nuclear accident. Even when controlling for five background variables, some sources – when used as an important source of information – emerged as significant regressors of risk perception. Television and interpersonal communication were both related to higher risk perception, while various minor online sources (with YouTube as probably the most important one) were related to lower risk perception.

In Belgium, television was the most widely used medium to get informed about the accident. As many as 93.4% of the valid respondents identified television as an important medium for informing themselves, and for approximately one in four Belgians, television was the only medium they named as an important information source. As Sugimoto et al.⁽¹³⁾ concluded, television is ubiquitous 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.

Frewer, Rowe and Sjöberg⁽²⁶⁾ assumed that any impact that television has on risk perception would most likely be through the availability heuristic. Coleman⁽¹⁵⁾ 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. An alternative explanation could be the possible unique characteristics of the group of respondents who did not identify television as a major source of information. For example, Henning and Vorderer⁽²⁷⁾ 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 factual information. This will possibly make them less dependent on heuristics, similar to what Yim and Vaganov⁽⁷⁾ argued the effect of education could be.

When used as an important source of information, interpersonal communication was also a significant regressor of risk perception. As the dependent variable *risk perception* was made up of both personal and societal risk judgement, this result is in line with previous research, which had found that interpersonal communication has significant influence on both personal risk⁽²³⁾ and societal risk.^(15, 38)

The significant negative relationship between the miscellaneous online sources and risk perception is hard to explain, especially due to the vagueness of the category. Given YouTube's prominence online, it is quite likely that it was the most important component in this category. While even entertainment can increase risk perception⁽³⁶⁾, this does not seem to be the case with YouTube, perhaps because YouTube clips differ greatly from traditional videos.⁽³⁴⁾ Unfortunately, the present study can only indicate the possible importance of YouTube.

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⁽²²⁾ and a year after the accident.⁽⁴²⁾

Radio failed to reach significance as a regressor of risk perception in Belgium, even though it was an important regressor for fear of social disruption in Japan. Sugimoto et al.⁽¹³⁾ attributed their results to the position that radio holds as a central element in an individual's disaster plan in Japan. In Belgium, however, more people assume they would use television in case of a nuclear emergency, compared to radio.⁽²⁴⁾ Apparently, radio does not hold the same function as the central risk communicating medium, which could explain the lack of effect. Alternatively, the difference could also due to the audience^(17, 18, 19): 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 in Fukushima. A third 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 was not a significant regressor of risk perception, possibly because of its heterogeneous nature. Even though a great deal of research has been conducted on Twitter use during and after the 2011 Fukushima nuclear accident, the studied population did not use Twitter as an important information source at that time. Sugimoto et al.⁽¹³⁾ found similar results in Japan. They assumed that their results were due to the composition of their sample (64% of which was over the age of fifty), but this does not seem to be the case in the present study. Perhaps the rather low usage was due to the audience not perceiving social media as being as credible as newspapers⁽³²⁾, for instance.

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In conclusion, when they were used as important sources of information, three information sources have significant explanatory power for long-term health-related risk perception in Belgium: television, interpersonal communication and miscellaneous Internet sources. Even so, their β s were small when compared to some of the other variables entered in the analysis, such as attitudes towards nuclear power. However, combined with the significant explanatory power of satisfaction with the media coverage, it is evident that the media indeed play a role in explaining risk perception.

5.1. Other Regressors of Perceived Risk

Contrary to what the first hypothesis predicted, duration of attention paid to primary information sources actually had a (small but statistically significant) negative correlation with risk perception. While it failed to reach significance in the regression analysis regarding online media sources, the results of both analyses point in the same direction: people who paid attention to the news for a longer period of time had a lower risk perception of the accident. Wåhlberg and Sjöberg⁽³⁹⁾ suggested a possible explanation: if the amount of media coverage decreases, so does risk perception because the risk loses its accessibility in the minds of the audience's members. Cantone et al.⁽²²⁾ noted that there was a significant decrease in the number of articles published regarding Fukushima, even in the first nine weeks after the accident. Just two Belgian newspapers published over 180 articles in the month following the accident⁽²²⁾, while at the time of the data gathering (15 August - 12 September 2013), all Belgian newspapers together published 196 articles related to Fukushima. While this is still a fair amount, it does indicate a decrease in coverage.

People who did not find the information satisfactory were more likely to have a higher risk perception of the accident, in accordance with the second hypothesis. However, from the current

data it is not clear if this higher risk perception is because of a lack of (accessible) information^(43, 44), because the provided information did not suit the needs of the Belgian population⁽⁴⁵⁾, or because of another reason.

The third hypothesis received limited support, with only attitude towards nuclear energy being a significant regressor in both analyses. Gender and education each reached significance in only one analysis.

Attitude towards nuclear power was the most powerful regressor of risk perception of the Fukushima nuclear accident. 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⁽⁴⁸⁾, Katsuya⁽⁴⁶⁾ and Siegrist and Visschers⁽⁴⁷⁾: 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.

Education was the second most influential regressor for risk perception in the first regression analysis and it approached significance in the regression analysis for online sources. Education did seem to explain risk perception: people with a higher level of education had a lower risk perception of the Fukushima nuclear accident, compared to those with a lower level of education. This result supports the findings of Whitfield et al.⁽²⁾ The concrete dynamic behind this finding is unknown, however, as the literature offered many different explanations.^(cf. 7, 37, 52, 55)

Gender was not a significant regressor of risk perception for the primary information sources, 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⁽¹³⁾ found that a significant difference in anxiety between mothers and

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fathers only appeared in the Fukushima prefecture, but not in the rest of Japan. Drottz-Sjöberg and Sjöberg⁽⁵⁰⁾ also found a significant gender effect in Sweden after the Chernobyl nuclear accident, bearing in mind that Sweden was one of the countries particularly affected by the accident.⁽⁴⁾ Even when respondents are asked questions regarding their fear of nuclear power technology or of a hypothetical nuclear accident, Brody⁽⁴⁹⁾ 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 regressor of risk perception, with women perceiving the risk to be significantly higher than men. A possible explanation for this difference can be extracted from the study by Drottz-Sjöberg and Sjöberg.⁽⁵⁰⁾ They found that young men were the least risk aversive group. In the present study, the group that used the Internet as an important information sources 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 difference is a result of the significantly lower risk perception of the younger males that use the Internet.

5.3. Limitations and Future Research

Although the data set used in this study was representative of the adult Belgian population, it still had some limitations. Firstly, since not all factors could be controlled for, the results of the regression analyses cannot be interpreted as conclusive indications of causality. As the media use of 2011 explained the risk perception in 2013, this correlational data can nevertheless provide some time ordering. A longitudinal study would have provided more definitive clues on causality, but because of the unpredictability of nuclear accidents, it is very difficult to gather a representative data set of this size before and after the accident. Secondly, the data did not reveal

how much exposure a respondent had to the sources in absolute terms, or the specific newspapers, television channels or radio stations they had used. Further, it is possible that it was the content in itself, or the amount of coverage, that altered risk perception, instead of the source as such. Perhaps television simply devoted more attention to the nuclear accident, or used different words to describe it. Future research should look into the differences and similarities of the coverage between different sources, both qualitatively and quantitatively. Furthermore, it could be considered problematic that the data were gathered over two years after the accident. For example, Tateno and Yokoyama⁽⁴⁵⁾ thought that changes in perceptions would have disappeared if they conducted their study more than a year after the accident. However, this study still yielded several significant results, indicating that the effects on risk perceptions are quite resistant to change. Finally, while a large-scale survey can offer a general outlook on the effects on the audience, it cannot show how different audiences interpret the same even from the same source.⁽¹⁸⁾ More qualitative forms of research are needed to investigate this issue.

In future studies, YouTube should be a separate option in questions regarding media usage, seeing as it is the third most accessed Website worldwide. While YouTube is probably the major component of "miscellaneous online sources", which significantly decreased the risk perception of the Fukushima nuclear accident, its influence can never be truly known if it is not studied as a separated category.

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6. CONCLUSION

The results of this study demonstrated that information sources can help explain the variance of long-term risk perception in Belgium. This is remarkable since the analysis controlled for five variables, most of which were also (highly) significant regressors.

The attitude towards nuclear energy was the strongest regressor 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 satisfied with the media coverage. The information sources will not cause people with low risk perception to suddenly experience high risk. In this sense, the source of information is indeed not a major factor in determining risk perception.

However, the other significant regressors are all rather stable variables: 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.⁽⁴⁷⁾ 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 sources are important for an individual is something that is more volatile. Of course, there are practical limitations that prevent everyone from having access to *all* media sources. However, as the results demonstrated, most people already have more than one important source of information. Depending on which medium gets the most weight in a person's media mix, their risk perception might change. Although this change would be subtle at best, it is still remarkable that such a minor difference can indeed significantly influence risk

perception.

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