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Risk perception of unwanted incidents: comparison of how lay people and experts evaluate societal risk

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This study explores the connection between lay people's risk perception and experts' risk assessment. To study this, a sample of 562 citizens were asked how worried they are about unwanted incidents identified through the municipality's risk and vulnerability analysis, in addition to interviewing key personnel in risk management in the municipality. Quantitative and qualitative analyses were thus performed. The results show that the citizens have the same perception of risk as that of the risk managers in the municipality. The citizens thus have a satisfactory risk picture of society. More information causes citizens to become more worried, while not having received information leads them to state that they are less concerned about the unwanted incidents. Nevertheless, the municipality does not have knowledge of the citizens' perception of risk, which indicating that they do not practice a two-way risk communication process.

Keywords: Risk perception, unwanted incidents, lay people, experts, risk communication.

1. Introduction

The research on risk perception is extensive, as is research on risk management related to communication of risk. In particular, the gap between lay people's and experts' risk assessment has been extensively studied (Sjöberg, 1999; Cohen, 1998). Risk managers (i.e., experts) use analytical risk assessments to analyse and evaluate the risk (Aven, 2020). The assessment can be qualitative or quantitative (Aven, 2014). Newer research on risk emphasizes the importance of uncertainty in risk assessment (Aven, 2016, 2020), which can be understood as a lack of knowledge about events and the consequences of these (Flage & Aven, 2009; Aven & Zio, 2018). Lay people, on the other hand, trust their intuitive perception when assessing risk (Slovic, 2000). This assessment is rooted in common sense, personal experiences, cultural traditions, and social communication (Renn, 2008; Aven & Renn, 2010), where humans actively seek information and create meaning from it, in addition to being influenced by the external (Yantis, 2013).

The difference between lay people´s perception of risk and experts' risk assessment can be explained by a lack of trust amongst the population, lack of risk understanding, and scepticism, ignorance, or disinformation (Sjöberg, 1999). Media is a central factor in this regard (Sjöberg, 1999; Fischhoff, 1985; Slovic, 2000), as the media influence the availability of risk information, with more information giving a stronger effect (Wahlberg & Sjöberg, 2000). Both traditional media and social media affect lay people´s risk perception but to different degrees (Chan et al., 2018). During the last decades, lay people's level of education and general knowledge have increased (Teichler, 2020). The growth in social media and acceleration of traditional media is a relevant factor in this regard, as information become more easily available for lay people. Now days, expert knowledge is only a

keystroke away and the newsfeed is constantly informing about risks, crises, and disasters.

Lay people´s perception of risk reflects their real concerns, and instead of focusing on the challenges of including risk perception in risk management, studies should focus on how risk perception can contribute to improving risk policies (Aven & Renn, 2010). Recent approaches to risk communication research have focused on risk assessment as an inclusive process (e.g., Rowe & Frewer, 2000), highlighting the importance of transparent risk assessment strategies (e.g., Carpenter, 2017; Dudley & Wegrich, 2016), as this fosters public trust, engagement, and compliance with the risk message (for a review, see Balog-Way et al., 2020).

In Norway, every municipality is required by law to conduct risk and vulnerability analyses and use the results of these to manage the risk and thus protect the citizens from unwanted incidents (MJPS, 2011). In this paper, we explore the connection between lay people's risk perception and experts' risk assessment, to see if the citizens have the same perception of risk as that of the risk managers in the municipality. To study this, we asked a sample of citizens how worried they are about unwanted incidents identified through comprehensive risk and vulnerability analysis from various municipalities in Norway. We further map the extent to which participants have received information about these risks, and whether information is received via the media or the municipality. The aim is, first, to assess the concordance in perceived risk between citizens and the municipality and, secondly, to see whether citizens' risk perception is affected by the source of relevant risk information. In addition, we look into how risk managers in the municipality communicate risk to the citizens, and what they focus on in this regard.

2. Method

In the present study, we examined the connection between the risk perception of lay people and the risk assessment of experts. The municipality of Bergen was chosen for our study. Bergen is one of the largest cities in Norway, with over 285,000 citizens (Statistics Norway, 2020). During the last decade, the municipality has experienced several severe unwanted incidents and crises, such as landslide, flooding, large fires, hacker attack, and terror (Bergen kommune, 2020). The local municipal administration has therefore focused more in recent years on societal safety and emergency preparedness (Bergen kommune, 2020).

2.1 Participants

A convenience sample of participants living in the municipality of Bergen were invited to participate in a digital survey distributed through an article on Bergen municipality´s website. The article was also shared on social media platforms (Facebook, LinkedIn, etc.) targeting citizens of Bergen (about 56,000 followers).

In total, 562 citizens of Bergen answered the survey, comprising 70% women, 28.6% men and 1.2% who preferred not to define gender. Of respondents, 0.4% were under 18 years, 12.6% were between 18 and 29 years, 20.8% were between 30 and 39 years, 25.6% were between 40 and 49 years, 21% were between 50 and 59 years, and 19.4% of respondents were over 60 years old. Those reporting themselves to be employed made up 71.7%; 11% were pensioners, 7.1% received disability benefit, 4.4% were students at university, while the remainder were unemployed, students at high school and others. When questioned on their highest completed level of education, 40.6% answered graduate university studies (more than three years), 24% answered undergraduate university studies (up to three years), 17.1% answered secondary school, 8.4% answered vocational education, 3.4% answered doctoral degree, and 2% answered that they had a different form of higher education.

2.2 Materials and procedure

We developed and distributed a questionnaire using SurveyXact. All participants received the same questionnaire, introduced as a study to investigate which unwanted incidents the citizens of Bergen are more or less worried about, and whether the citizens have trust in the municipality´s risk management. The survey was designed based on research into several comprehensive risk and vulnerability analyses from various municipalities in Norway, including Bergen. This work led to the 15 unwanted incidents listed in Table 1 being included in the survey, with the question, "How worried are you that the following incidents will occur (in Bergen) within the next five years?".

The term "worry" was chosen to explore whether the citizens was worried about the same unwanted incidents as the experts, because, to improve societal safety and preparedness, the municipality and the citizens need to have the same perception of risk and thus prepare for the same unwanted incidents. Five answer options ranged from "not worried" to "very worried". The respondents were also asked whether they had received information about the risk associated with each of the 15 incidents, with the following options: "yes, from the municipality", "yes, from the media", "yes, from others", "no", or "don´t know". Finally, respondents were asked generally how much trust they had that their municipality was prepared to deal with major incidents and crises, to which they could respond on a five-point scale from "no trust" to "very much trust". All statistical analyses were performed using IBM SPSS Statistics (version 26) with a significance level of .05.

To obtain information related to risk communication, an interview was conducted with two key personnel within risk management in Bergen municipality.

3. Results

3.1 Quantitative analyses

Risk estimates provided by the municipality´s risk and vulnerability analysis consisted of an ordinal probability dimension, quantifying, as either small, moderate or high, the degree to which an instigating cause or condition is present, and an ordinal consequence dimension, indicating potential consequences for life and health as severe, critical, or catastrophic. As can be seen in Table 1, there is some variation in reported worry among participants. A Spearman rank order correlation shows that participants' worry was positively correlated with the overall risk assessed by the municipal risk and vulnerability analysis r_s (14) = .53, p < .05, but at the same time participants' worry was more strongly correlated with the probability dimension (r_s = .47) than with the consequence dimension (r_s = .03).

Table 1. Mean and standard deviation of participants' worry associated with unwanted incidents, and probability and consequence of unwanted incidents as assessed by the municipality´s risk and vulnerability analysis (RVA).

Incident	*M*	*SD*	*Probability RVA*	*Consequence RVA*
Pandemic	3.33	1.31	3	3
Cyberattack	2.62	1.25	3	1
Contamination of drinking water	2.61	1.33	1	1
Transport accident	2.52	1.25	2	2.33
Supply crisis	2.48	1.57	1	2.33
Fire	2.47	1.30	1	1
Pollution from hazardous substances	2.42	1.29	1	2
Landslides	2.30	1.31	3	1
Prolonged power failure	2.26	1.30	2	2
Terrorist attacks	2.19	1.18	1	1.5
Acts of war and security crisis	2.10	1.23	n.a.	n.a.
Accident with mass injury	2.04	1.10	2	2
Flood	2.02	1.25	2	1
Nuclear accident	1.89	1.19	2	1
Earthquake	1.26	0.67	1	3
Mean all	2.30	0.76	3.79	1.7

To assess the relation between participants' worry and demographic information, a multiple regression analysis was run, regressing overall worry on demographic information about gender, age, district, living situation, education, and occupational status. The model did not significantly predict worry, F (6, 528) = 1.47, p = *.186, adj.* R^2 = *.01*, indicating that demographic information does not seem to be associated with participants' overall level of worry.

Table 2 shows an overview of whether and from where respondents have received information about the risks associated with each of the adverse incidents. Here, it can be seen that more than 30% of the respondents reported not having received information about the risks from any source, apart from the risk of pandemic. In the event of a pandemic, more than 50% of the respondents reported that they had received

information from both the municipality and the media, related to the risk. In the other 14 incidents, the respondents mainly received information from the media rather than from the municipality. Furthermore, it is reported that less than 2% of the respondents had received information from the municipality about risks associated with transport accidents, pollution from hazardous substances, terrorist attacks, acts of war and security policy crises, accidents involving mass injury, nuclear accidents, and earthquakes. In four out of 15 incidents, more than 10% reported that they had received risk information from the municipality. This related to the risk of floods, pandemics, fires, and loss / contamination of drinking water, respectively.

Table 2. Overview of whether participants report having received risk information from municipality, media, or other sources regarding different risks. Frequencies are presented as percentages.

Incident	Received information			
	Municipality	Media	Other	No information
Pandemic	56.3%	57.3%	26.8%	6.7%
Cyberattack	6.20%	27.8%	17.7%	33.7%
Contamination drinking water	19.6%	26.6%	9.1%	35.9%
Transport accident	1.9%	24.7%	8.9%	44.5%
Supply crisis	7.3%	24.4%	13.1%	41.6%
Fire	16.7%	26.2%	19.1%	32.2%
Pollution hazardous substances	1.6%	23.6%	11.2%	42.1%
Landslides	6.2%	31.3%	9.1%	38.6%
Prolonged power failure	6.2%	13.6%	11.3%	46.7%
Terrorist attacks	1.1%	22.8%	9.6%	47.2%
Acts of war and security crisis	1.1%	20.3%	8.1%	46.7%
Accident with mass injury	1.0%	12.6%	7.8%	51.2%
Flood	10.2%	24.2%	9.9%	41.5%
Nuclear accident	2.1%	13.7%	8.0%	53.9%
Earthquake	0.6%	10.2%	5.6%	58.9%

As can be seen in Table 3, there is a significant overall negative correlation between participants' worry and not having received risk information from any source (r_s = - .21). This is supported by the overall positive correlation between worry and having received risk information from the media (r_s = .16) or other sources (r_s = .12). There is no significant correlation between overall worry and having received risk information from the municipality.

Table 3. Pearson's correlations between participants' worry and source of risk information.

	Info municipality	Info media	Info other sources	No info
Cyberattack	.03	.23**	.06	-.15**
Terrorist attacks	.04	.18**	.10*	-.21**
Flood	.23**	.17**	.22**	-.28**
Landslides	.10*	.23**	.21**	-.27**
Earthquake	-.03	.10*	.12*	-.20**
Transport accident	.04	.19**	.16**	-.24**
Prolonged power failure	.12*	.11*	.16**	-.19**
Nuclear accident	.13*	.22**	.12*	-.25**
Acts of war / security crisis	-.04	.16**	.03	-.22**
Pandemic	.16**	.14*	.03	-.15*
Supply crisis	.12*	.21**	.24**	-.24**
Pollution from hazardous substances	.10*	.16**	.14*	-.18**
Fire	.03	.16**	.17**	-.16**
Accident with mass injury	.05	.10*	.10*	-.17**
Contamination of drinking water	.05	.15*	.10*	-.14*
Combined worry	.07	.16**	.12*	-21**

Note. *N = 526, *p < .05, **p < .001*

We were further interested in the relation between participants' trust in the municipality's capability to mitigate unwanted incidents and the source of risk information. As can be seen in Table 4, there is a significant relationship between having received information about risk associated with adverse incidents and how much trust the respondents reported having in the municipality. Conversely, there is no significant relation between trust in the municipality and other sources of risk information, indicating that receiving specific risk information from the municipality is related to trust.

Table 4. Pearson's correlations between risk information source and trust in the municipality.

Received information	Trust in municipality
Municipality	.27**
Media	.06
Other sources	-.02
Not received information	-.07

Note. *$p < .05$, **$p < .001$

Pearson's correlations were calculated to assess the relation between participants' trust in the municipality and their worry concerning different unwanted incidents. As can be seen in Table 5, there was a weak but significant negative correlation between trust and the overall worry of participants. Looking at correlations for individual incidents, trust appears to be particularly related to worry concerning a supply crisis and loss of drinking water. There were also small negative correlations between trust in the municipality and cyberattacks, terrorist attacks, landslides, earthquakes, transport accidents, power outages, acts of war and security policy crises, and accidents involving mass injury.

Table 5. Pearson's correlations between participants' worry and trust in the municipality.

Worry	Trust in municipality
Cyber attack	-.10*
Terrorist attacks	-.10*
Flood	.01
Landslides	-.10*
Earthquake	-.15*
Transport accident	-.12*
Prolonged power failure	-.10*
Nuclear accident	-.07
Acts of war / security crisis	-.15*
Pandemic	-.06
Supply crisis	-.23**
Pollution from hazardous substances	-.08
Fire	-.03
Accident with mass injury	-.13*
Contamination of drinking water	-.22**
Unwanted incidents	-.18**

Note. *$p < .05$, **$p < .001$

3.2 Qualitative analysis

With the last risk and vulnerability analysis published in 2014, the risk managers in the municipality focused on making the report pedagogical, concise, and as easily accessible for the citizens as possible. The formal risk communication to the citizens, however, was anchored by presenting and handling the report in the city council.

Regarding the revised risk and vulnerability analysis, completed in 2020, the risk managers explained that it was a bit more technical and "hard to read". The reason was that the main target group was changed from the citizens to the professionals in the municipality's various service areas (e.g. technical services, health and welfare service, and urban development). This made it possible to do a more thorough and detailed analysis, presenting a more correct risk picture that would be more useful for the service areas' work on risk management.

According to the risk managers in the municipality, the media is mostly concerned with what goes wrong. If there have been incidents in the municipality over the years, the media has referred to what the municipality has done in the risk assessments related to the specific incidents. Nevertheless, it emerged through the interview that the media has evolved in recent years: from disaster thinking to illuminating several factors contributing to the incidents, which are in accordance with the description of the incidents in the risk analysis. Furthermore, the municipality is concerned that the citizens should have an understanding of the risks in the urban community, rather than that the municipality should use the citizens' perception of risk in the risk management work.

4. Discussion

The municipality have assessed six events as having a 'high degree' of probability, including extreme weather, failure in information security, pandemics, contamination of drinking water, and disease outbreaks on passenger ships (Bergen kommune, 2020). The results from the quantitative analyses show that the citizens reported being most concerned about pandemics, cyberattacks and failures in information security, and loss/contamination of drinking water. This indicates that citizens' worry about unwanted

incidents matches with the municipality´s risk assessments. Further, the citizens reported that they were least worried about earthquakes, which were assessed as "catastrophic" by the municipality. This may indicate that the citizens consider probability above consequences in their calculations of what they are worried about, which is not what has usually been seen in previous research (Rohrmann & Renn, 2000). Nevertheless, the previous studies do not include the value of having received risk information, which has been shown in this study to have significant importance for the citizens' risk perception. It may thus appear that receiving risk information affects the citizens´ perception of risk more than if they only had knowledge of possible consequences and probabilities.

The fact that the citizens´ risk perception matches with the municipality´s risk assessments may further indicate that the citizens have emphasized knowledge about the risks, rather than emotions and personal experience, when reporting how worried they are about the occurrence of unwanted incidents. At the same time, the similarity between the citizens´ risk perception and the municipality´s risk assessments can also be explained by the results on trust: the citizens reported that they have some trust in the municipality´s handling of major incidents and crises. This is also supported by previous research, where trust and credibility in risk managers are found to affect lay people´s risk perception (Sjöberg, 1999; Rohrmann & Renn, 2000).

Furthermore, the results showed that the citizens reported receiving most information about risk from the media. This is also supported by previous research, which indicates that we live in a time where we receive continuous information about news and knowledge through digital media (Renjith, 2017). The results thus show a clear connection between having received information from the media and the municipality about the various risks, and how worried the citizens are about the occurrence of each of the incidents. The tendency is clear; more information refers to an increase in worriedness. At the same time, the results show that not having received information leads to citizens reporting that they are less worried about each of the incidents. These findings are interesting, as they may indicate that, when you receive information about something, you become more worried and correspondingly less worried if you have not received any information. For the citizens to get as accurate risk picture as possible, they must receive information. This is also supported by previous research, which states that providing information to the public is an important part of risk communication (Lundgren & McMakin, 2009).

Whether the information comes from the media, the municipality, or others appears to be less important. The distinction between receiving information from the municipality or from the media is in any case difficult to see, as the municipality often uses the media as an information channel. The respondents may thus have thought that the information came from the media, when the media has actually written excerpts from the municipality´s findings in the risk and vulnerability analysis. The media then functions as a channel that conveys risk from the municipality to the citizens. This highlights the importance of the media when it comes to risk perception (c.f. Sjöberg, 1999; Fischhoff, 1985; Slovic, 2000, Wahlberg & Sjöberg, 2000).

The results from the quantitative analyses also showed that the citizens have some trust in the municipality, and that the more trust they have, the less worried they are about the unwanted incidents. Furthermore, the results show significant correlations between having trust and having received information from the municipality. It can thus be argued that citizens´ trust in the municipality increases along with the more information they receive and, conversely, that lack of information may lead to mistrust. The results are consistent with previous research that points out that lack of, or misleading, communication can lead to breaches (Lundgren & McMakin, 2009), and that trust in, and the credibility of, risk managers may affect risk perception (Rohrmann & Renn, 2000).

Demographic factors were previously found to affect risk perception and trust (see, e.g., Sjöberg, 1999; Chauvin, 2018; Nordfjærn et al., 2021). However, the results in our study showed that socio-demographic factors do not affect risk perception or trust. Risk perception was instead impacted more by whether citizens had received information or not, than by whether they had a higher education, only completed secondary school, or are young or old. This is supported by

Wahlberg and Sjöberg (2000) and Lundgren and McMakin (2009), who both emphasize the importance of transmitting and receiving risk information.

Finally, the results showed that the municipality does not have knowledge about the citizens´ perception of risk. Hence, they do not have the opportunity to control whether the citizens´ perception of risk is satisfactory in relation to the municipality´s risk assessments. The municipality could, therefore, benefit from implementing a two-way risk communication process to ensure that the citizens´ perception of risk also remains satisfactory in the future (cf. Lundgren & McMakin, 2009).

The study has some limitations. One limitation is related to the number of interview subjects, as we only interviewed two individuals from the municipality. However, these two are key personnel, having extensive knowledge about the municipality's work on risk management. Another limitation is the use of a digital survey. The survey was mainly distributed via Bergen Municipality´s Facebook page, which may limit the data material. In addition, we used a single item (worry) to measure risk perception, as we focused on whether the citizens were worried about the same unwanted incidents as the experts in the municipality. To get a more nuanced understanding of the citizens risk perception of unwanted incidents, a multidimensional approach could be beneficial (cf. Wilson et al., 2019).

5. Conclusion

This study shows that there is an agreement between public´s risk perception and expert risk assessment, which indicates that the citizens have the same perception of risk as the risk managers (experts). This connection can be explained by information received through risk communication. There is a clear connection between the citizens´ risk perception and having received information. Trust also showed some effect, as the citizens have some trust in the municipality's handling of major incidents and crises, whereas demographic factors did not show any effect on risk perception. Future studies may thus benefit from studying in more detail the effect of receiving risk information.

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