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When We Don't Want to Know More: Information Sufficiency and the Case of Swedish Flood Risks

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ABSTRACT

This study investigates the phenomenon of information (in)sufficiency in the context of flood risks. Individuals' perception of how much risk information they need is a major trigger and driver of information-seeking behavior, and therefore it is an important part of creating effective preventive risk-communication campaigns. To understand factors that contribute to individuals' sense of information (in)sufficiency, the roles played by prior experiences of floods and general risk sensitivity were analyzed using survey data from residents in flood-risk zones. The findings highlight that every third respondent reported a state of information sufficiency. Residents with prior experience evaluate their information sufficiency level based on their perception of consequences of future floods. But it is general risk sensitivity that best explains need for more information.

KEYWORDS: risk perception, information insufficiency, risk sensitivity, information need

Introduction

Dealing with the risks of modern society requires information. As we are facing more and more simultaneous risks at a global scale, the amount of information that needs to be processed can exceed our cognitive and emotional capacities. It is a well-proven fact that over time people tend to experience a state of information overload caused by the "infodemics" accompanying

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the COVID-19 pandemic (Buneviciene et al., 2021; Mohammed et al., 2021; Stevens et al., 2021), health risks (Kim & So, 2018) and climate change (Olausson, 2011), for example. At a certain point we may also reach the desired level of confidence that we know enough for making decisions or forming opinions. In other words, we reach a state of *information sufficiency* and stop seeking further information. However, the state of information sufficiency poses a challenge to risk communicators in the public sector. This study argues that by exploring people's sense of information sufficiency and factors that contribute to it in a risk context, one can explain why they are reluctant to seek or pay attention to information even when they are at risk. This knowledge would facilitate the prediction of what segments of the public are likely to experience information sufficiency, which in turn can improve the understanding of what factors risk communicators should take into account when designing information campaigns and targeting different social groups or neighborhoods. Thus, the study contributes to existing risk-communication research by analyzing differences in people's sense of information (in)sufficiency.

In order to investigate the factors that may prompt information sufficiency, the case of flood risks in a Swedish context was chosen. In recent years, floods caused by climate-related extreme weather have been recurring phenomena in various parts of Sweden. The fact that most Swedes have either directly or indirectly experienced heavy rainfalls that caused flooding makes this a relevant case for the present study. The data used in this study comes from a survey that was sent to residents of Swedish municipalities located in areas prone to flooding or with a history of major floods in recent years.

Information (in)sufficiency in a Risk Context

At its most basic level, need for information consists of the process of perceiving a difference between an ideal state of knowledge and one's actual state of knowledge (van de Wijngaert, 1999). In the field of risk research, this difference between information held and information needed is referred to as *information insufficiency* (Griffin et al., 1999). This knowledge gap is considered to be a trigger and driver of information-seeking behavior (Savolainen,

2017). A number of empirical investigations showed that information insufficiency was indeed a driving force behind information seeking about health risks (Hovick et al., 2014; Trumbo, 2002), environmental (Griffin, Neuwirth, et al., 2004) and industrial risks (Huurne et al., 2009; Huurne & Gutteling, 2008), and risks related to global warming (Kahlor, 2007).

The idea of information insufficiency took its most comprehensive form in the risk information and processing (RISP) model (Griffin et al., 1999). The RISP model proposes that the individual's subjective information norms (i.e., a person's perception that relevant others believe they should [or should not] perform a particular behavior) and affective response to a risk (such as worry) can alter their confidence in the amount of information needed to take effective action (information sufficiency threshold). Besides these direct effects, information sufficiency is influenced indirectly by the individual's risk perception and set of sociodemographic characteristics as well as relevant experience (Griffin, Neuwirth, et al., 2004).

Griffin et al. (1999) measured information insufficiency mainly in terms of the amount of information people say they need to deal with a given risk and the amount of information they say they already have. To understand whether a person experiences information (in)sufficiency, two parameters can be employed: *the size of the gap* between information held and information needed and *the level of sufficiency threshold*.

When people encounter information about risks, they can process it attentively, superficially, or not at all, depending on *the size of the gap* between knowledge held and knowledge desired. The bigger the gap, the more motivated people are to pay attention to risk information, both when they encounter it in everyday situations, such as watching a risk story on a morning TV program (Dunwoody & Griffin, 2015; Trumbo, 2002), and when actively seeking information through specialized channels. In other words, people are motivated to put more effort into reaching information sufficiency when they experience a greater amount of insufficiency. Previous research suggests that some individual characteristics play a role in how people perceive this gap. For instance, women, minorities, and those who had previous experience generally

reported slightly greater information insufficiency (Griffin, Neuwirth, et al., 2004).

How much information is sufficient varies among individuals and is defined by the *level of their sufficiency threshold*. The sufficiency threshold can be set higher or lower, and it influences how much effort one is willing to put into information seeking. In general, people with higher sufficiency threshold are more motivated seek confirmatory information from multiple sources (Anthony et al., 2013).

Although the information insufficiency concept is usually employed to predict future information-seeking behavior, we argue that it can also be used to explore differences in people's need for information and to identify the individuals who might be the least receptive to risk information. Measuring people's self-assessed knowledge and sufficiency threshold levels makes it possible to quantify their need for information and make comparisons among individuals and different social groups. In order to explore the factors that can explain why people reach information sufficiency, we will now look into existing theories on why people stop seeking more information or stop paying attention to it.

The Role of Risk Sensitivity and Previous Experience

The abundance of available information makes it crucial to decide how much information is enough and when to terminate information seeking. According to the RISP model, intrinsic factors such as worry, anxiety, and personal involvement with the risk seemingly predict people's need for further information. Worry tends to affect the degree of confidence that one wishes to have in one's knowledge, which in turn increases the information sufficiency threshold (Griffin et al., 1999; Huurne et al., 2009). However, worry and anxiety are rarely confined to one particular risk. When individuals are asked to rate their perceptions of various risks in a survey, they tend to rate all risks at a similar level—at the higher end of the scale, in the middle, or at the lower end. At the lower end we find the risk deniers (who tend to be men), and at the higher end of the scale we find a much smaller group of risk alarmists (who tend to be women) (Sjöberg, 2006). This consistent level of

risk perception across varied situations and risks is called *risk sensitivity* (Sjöberg, 2000).

Risk sensitivity has been confirmed in a number of studies where it was used to understand perceptions of risks related to nuclear power (Sjöberg, 2004), road safety (Cox et al., 2017), autonomous vehicles (Tan et al., 2021) public transport (Rundmo & Nordfjærn, 2019), food (Hohl & Gaskell, 2008), and hunting and wildlife (Needham et al., 2017). In many cases risk sensitivity explained the variance in the perception of particular risks better than other factors. And in the case of road safety, driving-related risk sensitivity influenced people's perception of hazards on the road to a greater extent than experience (Cox et al., 2017). Hence, although people can feel a legitimate worry about floods and perceive this risk as high, it is plausible that to some extent this perception is driven not by any particular concern about flooding but rather by an inherent predisposition to perceive—or rate—all risks as large (Sjöberg, 2000). For this reason, the present study examines whether people with various levels of risk sensitivity differ in their level of information (in)sufficiency regarding flood risks.

When people express worry about different risks, the extent of it will vary depending on how these risks are understood—as a personal risk that will affect them directly or as general risks affecting others. Previous research suggests that people tend to judge personal risks as much smaller than general risks (Sjöberg, 2003). There is no discussion or unanimity in the previous studies on risk sensitivity how "risk" should be conceptualized: some studies measure risk perceptions as personal risk (Needham et al., 2017; Rundmo & Nordfjærn, 2019) while others have no clear risk target (Hohl & Gaskell, 2008; Tan et al., 2021). The present study uses general risk perception to measure respondents' risk sensitivity. This allows us to get a more nuanced understanding whether it is situational worry or a general anxiety about modern risks that stipulates how much information one needs to feel safe. By using general risk as a predictor, we also want to challenge the idea that individual's need for risk information is influenced mainly by perception of floods as a personal threat. To juxtapose general and personal risk perceptions, the role of risk sensitivity will be analyzed together with individual's *previous experiences with floods.*

When making their judgments, people often draw on their *previous experiences* (Case & Given, 2016). Input from previous experiences forms an *intra*personal channel of information that is one of the highest ranked sources of information that people use when making decisions (Holland & Powell, 1995). Furthermore, empirical studies show that people with past experience of a hazard experience slightly more information insufficiency, but this past experience appears to affect the perceived knowledge gap indirectly, through worry (Griffin, Neuwirth, et al., 2004). Many other studies that tested the RISP model in various risk contexts omitted past experience of a hazard even as a control variable (e.g. Griffin, Powell, et al., 2004; Huurne et al., 2009).

However, if people have experienced flooding, this will influence how they perceive this risk in the future—what damages to expect and what measures to take. This phenomenon is called the "prison of experience" and implies an expectation that the future will be a replication of the past (Kates, 1976). For instance, experiencing minor floods may reduce risk perception of future flood damage (Hopkins & Warburton, 2015) and lead to optimism bias (Dufty, 2021). Yet for others, previous experience of flooding might be linked to increased concern about future floods (Lechowska, 2018).

However, experience-based judgments tend to get the probabilities wrong. When people draw on their experience, they often underestimate the probability of a rare event occurring. For instance, residents of coastal areas, though aware of the risks, tend to underestimate them and neglect to prepare for potential crises (Costas et al., 2015). Contrarily, when people's actions are prompted by information about risk events, they tend to give rare events more weight than they deserve (Green et al., 1991). These psychological patterns are described as a "description-experience gap" (Hertwig & Erev, 2009). Thus, existing research suggests that past experience of a hazard plays an important role not only in how individuals will perceive similar risks in the future, but also in how they will perceive information about these risks. Therefore, the present study examines whether people with various past experiences of floods differ in their level of information (in)sufficiency regarding flood risks.

Research Questions

Although information (in)sufficiency is often connected to risk perception (e.g., in the original RISP model), some empirical results show no linear relations between the two (Huurne & Gutteling, 2008). Nevertheless, risk perception provides an important context for understanding information (in)sufficiency, and therefore, we will first investigate what patterns of high/low flood risk perception and varying levels of information (in)sufficiency exist among respondents. We then proceed by testing how well previous experience and risk sensitivity can explain and predict various patterns of flood risk perception and need for additional information. The following research questions guide the empirical inquiry:

1. How do people differ in their information (in)sufficiency in relation to their risk perception?
2. What role does previous experience of a hazard play in how much information people need?
3. What role does risk sensitivity play in how much information people need?

Thus, on the one hand, this study zooms in on one part of the RISP model, namely factors that predict information (in)sufficiency, to gain a more nuanced understanding. On the other hand, instead of predicting relationships between these variables, we aim to identify different groups of individuals with various combinations of these characteristics.

Method

Data

The study employs survey data collected in January 2021 through the Swedish citizen panel, an online panel survey run by the Laboratory of Opinion Research (LORE) at the University of Gothenburg. The panel includes over 75,000 mostly self-recruited participants. This sample consists of 2,234 respondents (57% gross participation rate) from 11 Swedish municipalities. Several coastal municipalities in the sample are vulnerable to climate change (Kristianstad, Sölvesborg, Karlskrona), some are at risk from both

rising sea levels and local rivers (Gothenburg Halmstad, Laholm). More than two-thirds of the sample were affected by floods in February 2020, 1 year prior to data collection (Halmstad, Laholm, Hylte, Karlshamn, Ronneby), in summer 2020 (Kristianstad, Olofström) or had a history of major floods with life loss and extensive damage (Karlstad).

Respondents were recruited with non-probability-based methods and therefore do not represent the Swedish population as a whole or residents of the chosen municipalities. In this sample males (61.3%), elderly persons (65% are above 50 years of age; 4% are under 30) and highly educated persons (57% have a university degree) are slightly overrepresented; 93% of respondents were born in Sweden. Among the respondents, 17.4% had experienced floods and 37% knew someone who had experienced floods.

While a probability-based sample would have been preferable for estimating exact effect sizes, the panel data allows us to test the outlined idea that individuals' experience and perception of risks shape their level of information (in)sufficiency. In other words, the goal of the study is to make a process inference—whether the data are consistent with the prediction that our theory makes—rather than a population inference (Hayes, 2020).

Measures

The key concept of *information (in)sufficiency* was measured by two variables: (1) current knowledge about flood risk ("How much do you think you currently know about risks from floods and necessary preparations?") and (2) sufficiency threshold ("How much information about flood risk and necessary preparations do you think would be sufficient for you to feel safe?"). These variables were assessed by self-reported ratings on a scale from 0 to 100, as originally suggested by Griffin et al. (1999). The scale was created to reflect everyday usage of 0 meaning "nothing" and 100 meaning "all" or "100%."

To estimate *the size of the gap*, difference scores were created by subtracting the current knowledge score from the sufficiency threshold score for each individual. Difference scores have been criticized for a number of shortcomings, such as unreliability and a ceiling effect. However, this critique is usually directed at

difference scores that are based on independent measurements taken at two different points in time (Edwards, 2001). In the case of current knowledge and sufficiency threshold, the latter is dependent on the former, as the question about current knowledge served as a reference point for the respondents to locate their sufficiency threshold.

Previous experience of floods was measured with one question: "Have you ever experienced flooding?" with a clarification that the question concerned the respondent's own home or holiday home.

The concept of *risk sensitivity* comprises 11 variables measuring respondents' worry about various risks ("How worried are you about the following risks?") on a scale from 0 "not at all" to 7 "worried a lot" ($\alpha = 0.88$). Worries about the following risks were included: storms, heat waves, forest fires, nuclear accidents, exposure to dangerous chemicals, pandemics, terrorist attacks, water shortages, power outages, landslides, IT disruptions, and data breaches. These are listed as potential risk-events for which Swedish citizens should be prepared, according to the Swedish authorities' main crisis-information channel krisinformation.se.

In order to explore the independence of risk sensitivity as a concept from worry about floods, this study also employed a separate measurement of *worry about flood risk*. It was measured with the question "How much worry do you feel about the possible risks posed to you from flooding?" on a scale from 1 "not at all worried" to 7 "very worried" and captured personal risk in contrast to risk sensitivity that implied a general risk.

Risk perception regarding floods was operationalized with individual's *perception of probability of floods* and *severity of consequences*, just as it was conceptualized in the original RISP model (Griffin et al., 1999). The questions "How likely are you to experience flooding in the future?" and "If you were to experience flooding where you live today, to what extent do you think you will be affected by it?" were measured on a scale from 1 ("highly unlikely" and "to a very small extent," respectively) to 7 ("highly likely" and "to a great extent," respectively).

Because previous research suggests that age and level of education strongly correlate with risk judgments, these sociodemographic characteristics are used as control variables (Chauvin,

2018). Age was measured on an ordinal scale with categories representing decades (e.g. "30 to 39," "40 to 49"). The level of education was measured on a scale from 1 (incomplete elementary school) to 9 (having a PhD).

Analytical Strategy

To understand how people differ in their risk perception and need for risk information (RQ1), we classified respondents into subgroups based on their perception of the probability of future floods, severity of consequences, and level of information sufficiency threshold. To detect naturally occurring groups, a two-stage cluster procedure was used. First, the variables were standardized to make sure that the differences in standard deviation did not affect the distances in forming clusters as the variables were measured on different response scales. A hierarchical cluster analysis using Ward's method was carried out to form the initial clusters without restricting their number. The number of clusters was then determined from (1) the size of the total error sum of squares (should preferably exceed 67%); (2) a subjective decision as to whether smaller clusters were meaningful in further analysis and whether they could be adequately represented in the solutions with fewer clusters (Bergman & Magnusson, 1997). With the information about the number of clusters from the first stage, the final groups were identified with *K*-means clustering in the second stage.

To explore the role of previous experience in how people perceive future risks and how much information they need (RQ2), a cross-tabulation analysis was performed between the identified groups and previous experience of floods. Another cross-tabulation was carried out to examine whether previous experience was associated with the size of the knowledge gap.

To investigate whether the identified groups differed in their level of risk sensitivity as well as personal worry about flood risk (RQ3), two analyses of variance (ANOVA) were performed.

To analyze whether these two factors—the role of the previous experience and risk sensitivity—can predict belonging to various groups with different risk perceptions and levels of sufficiency thresholds, a multinomial logistic regression was carried out with sociodemographic controls.

Results

RQ1. How do people differ in their information (in)sufficiency in relation to their risk perception?

A hierarchical cluster analysis aiming to classify respondents into groups based on their risk perceptions and information sufficiency threshold produced a nine-cluster solution that explained 70% of the error sum of squares. The variations that these nine clusters presented in the subsequent K-means cluster analysis can be seen in Table 1. Although the number of clusters is high, which adds complexity to further analysis, they describe rather large groups of people (from 119 up to 451 per cluster) and provide meaningful insights into how people perceive flood risks and how this perception relates to their level of information (in)sufficiency. For easier visual navigation among the groups, higher scores were replaced with "+" and low scores with "–" (see the top of Table 2). The largest group (#6) consists of 451 individuals with low risk perception and low sufficiency threshold. These are followed by a group (#7) of 321 individuals with somewhat ambiguous risk perception and moderate sufficiency threshold (all three scores are very close to zero, and therefore this group is seen as having a neutral position). Thus, 35% of all respondents find the risk of floods and information about it rather irrelevant to them. Members of group #8 (185 persons), which represents people who assess the risk of floods as rather high and the consequences as severe, have a high sufficiency threshold, confirming previous findings that high risk perception is associated with need for further information (Neuwirth

TABLE 1 Cluster Solutions after K-Means Cluster Analysis Using Respondents' Perception of Probability of Floods Happening, Severity of Consequences, and Information Sufficiency Level; Mean Values

	1	2	3	4	5	6	7	8	9
Probability	–0.61	1.40	1.58	–0.53	1.03	–0.63	–0.01	1.52	–0.69
Consequences	1.04	0.98	–0.61	1.07	–0.40	–0.99	0.15	1.06	–0.96
Sufficiency threshold	–0.94	–0.82	–0.32	1.01	1.04	–0.95	0.02	1.03	0.70
N (2224)	276	119	146	255	148	451	321	185	323

et al., 2000). However, other groups demonstrate that some people who deem the risk of floods as highly probable and potentially damaging have a rather low information sufficiency threshold (#2—119 individuals) and, on the contrary, some who assess flood risks as very low express a high sufficiency threshold for flood-related information (#9—323 individuals). The identified patterns show that individuals' perceptions of flood risks are rather diverse. The fact that six out of nine groups (57% of respondents) do not follow the expected positive association between risk perception and information sufficiency threshold suggests that other factors play a more important role in understanding people's motivation to seek risk information. To probe more deeply into this, we first explored how the identified groups differed in terms of previous experiences.

> **RQ2.** What role does previous experience of a hazard play in how much information people need?

A chi-square test of independence was conducted between the identified clusters and previous experience of floods, χ^2 (8) = 126.74, $p < 0.001$ (Table 2). All expected cell frequencies were greater than five. The association was moderately strong (Cohen, 1988), with Cramer's V = 0.239. Individuals with previous flood experience do not fall under a certain identified type; they have varying perceptions of future flood risk and various levels of information sufficiency thresholds. Of those who had experienced floods, 48% evaluated the probability of future floods as high (#2, 3, 5, and 8) but only one in four people also expected severe consequences in the event of future floods (#2 and 8). In other words, three-quarters of the people with experience formed rather optimistic evaluations of the likelihood of future floods. These findings confirmed the argument put forward in this study that experiencing floods does not necessarily mean experiencing severe consequences; based on that, people form very different perceptions of future risk. People affected by past floods also differed in their information sufficiency threshold. Most of the people with a high sufficiency threshold never experienced floods (739 out of 908 individuals, 82%). And only 43% of those who were affected by

TABLE 2 Cross-Tabulation of Previous Experience of Floods and Nine Clusters Identified

	1	2	3	4	5	6	7	8	9
Probability	–	+	+	–	+	–	≈	+	–
Consequences	+	+	–	+	–	–	≈	+	–
Sufficiency threshold	–	–	–	+	+	–	≈	+	+
Previous experience (N = 388)	21 (–4.6)	33 (3.0)	52 (6.0)	22 (–3.9)	45 (4.3)	63 (–2.1)	50 (–1.0)	59 (5.4)	43 (–2.1)
No previous experience (N = 1834)	255 (4.6)	86 (–3.0)	94 (–6.0)	233 (3.9)	103 (–4.3)	386 (2.1)	271 (1.0)	126 (–5.4)	280 (2.1)
N (2222)	276	119	146	255	148	449	321	185	323

Note. As naming the identified clusters proved to be cumbersome, the upper part of the table describes the clusters with mean scores of risk probability, consequences of risk event happening and information sufficiency threshold—low ($M < -0.03$), high ($M > 0.03$), moderate ($-0.03 < M < 0.03$). Adjusted residuals appear in parentheses below observed frequencies in the lower part of the table.

floods in the past reported a high sufficiency threshold for flood risk information. Out of 189 persons who perceived the probability of floods as high and had previous experience of floods (#5 and 8), roughly half (45%) reported a low sufficiency threshold (i.e., did not feel that they needed a lot of flood-related information). Hence, previous experience can shape individuals' information sufficiency threshold very differently—by providing confidence that no more information is needed or by making people realize that they are not well-informed.

A comparison between the observed and expected frequencies revealed one pattern in the data. Among the groups who evaluated the probability of future floods as high, there were many more people with previous experience than would be expected if the variables were independent. The most plausible explanation of this trend is that those who experienced floods live in flood-prone areas, will be likely to experience flooding again, and are aware of it.

To follow up the independence test, a cell-by-cell comparison approach was used that allows for identifying cells that help us

understand the nature of the evidence for chi-square statistics by analyzing adjusted standardized residuals (Agresti, 2003). Cells with large adjusted standardized residuals indicate where the association is occurring within the cross-tabulation (Kateri, 2014). A guideline for determining when a cell deviates significantly from statistical independence is when the standardized residuals are greater than 2 or 3 (standard errors) depending on the size of the table (Agresti, 2003). The two largest positive standardized residuals (indicating that there were more observed frequencies than expected) were for groups #3 and #8. Group #3 represents those who find future floods highly likely but who do not deem the potential consequences for themselves to be severe and have a low sufficiency threshold. Group #8 unites those who find future floods highly likely and the consequences severe, and have a high sufficiency threshold. This result is very indicative of the different "paths" that people with previous experiences of flooding and high risk perception may take. Depending on how they perceive the consequences of floods, they may feel very differently about how much risk information is sufficient for them. Hence, understanding people's previous experience is crucial for anticipating their information needs.

The level of sufficiency threshold helps us understand how much information a person needs but does not tell us anything about the existing knowledge gap—how much more information one needs. When the knowledge gap histogram was plotted, we discovered not only that people needed more information about flood risk (a positive knowledge gap) but also that a substantial number of respondents felt they knew more than they needed (a negative knowledge gap). That made this variable meaningless for further analysis of how identified clusters differ in gap size, as mean values will render the important difference between a positive and a negative gap invisible. Therefore, the knowledge gap variable was dichotomized, with negative and zero values labeled as a state of information sufficiency and positive values as information insufficiency. The frequency analysis showed that 691 individuals (31.9%) reported a state of information sufficiency. To investigate how previous experience relates to the knowledge gap, a chi-square test of independence was conducted between flood

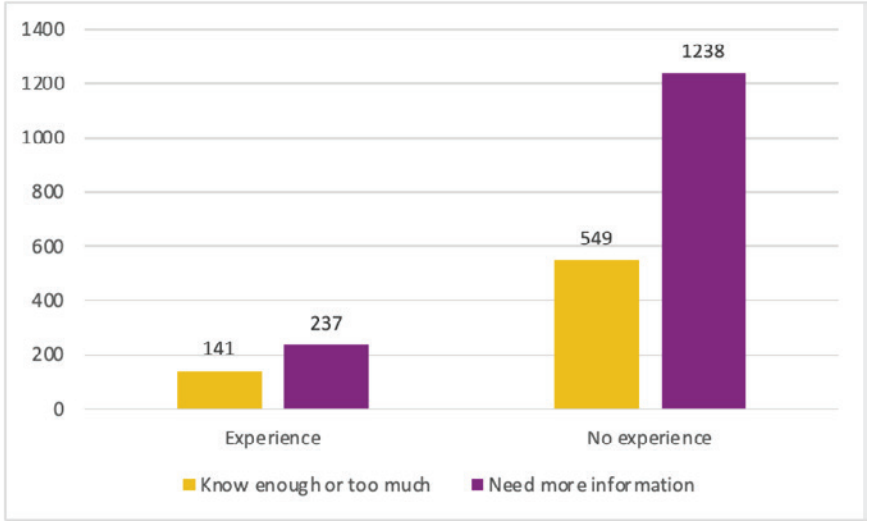

FIGURE 1 Differences in Information Need among Those with Prior Flood Experience and without It

experience and dichotomized knowledge gap, χ^2 (1) = 6.22, p = 0.013 (see Figure 1). All expected cell frequencies were greater than five. The association was very small (Cohen, 1988), with Cramer's V = 0.05. Of those with previous experience of floods, 37.3% reported information sufficiency. The share of people with information sufficiency among those without prior experience is only slightly lower, 30.7%. Thus, we can conclude that previous experience of floods is not associated with the size of the knowledge gap. It would be reasonable to assume that those who experienced floods may have already gathered enough information, made necessary preparation, and therefore reached a state of information sufficiency. Yet, the results show that the share of those who reported enough knowledge is rather low.

Thus, the findings suggest that the information sufficiency threshold of those with prior experience of floods varies depending on how they perceive the consequences of this risk. In general, a majority of the residents with flood experience need more information about flood risk and preparations than they have.

> **RQ3.** What role does risk sensitivity play in how much information people need?

The next factors connected to people's information (in)sufficiency that we explored were worry about floods and general risk sensitivity. Two one-way ANOVAs were conducted to compare how identified clusters differed in worry about future floods and general risk sensitivity (Table 3). For risk sensitivity, there was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = 0.382$). Risk sensitivity was statistically significantly different for the identified clusters, $F(8, 2214) = 49.88$, $p < 0.001$, $\omega^2 = 0.15$. For worry about floods there was heterogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p < 0.001$ in both cases); Welch's $F(8, 717.06) = 135.19$, $p < 0.001$, $\omega^2 = 0.35$.

The results suggest that the highest level of worry about floods was reported by those groups that also assessed the probability of flood risk as high (the highest two values belonging to those groups that also fear severe consequences).

If worry about floods was associated with perception of high probability of future floods, the highest risk sensitivity was observed among the groups with high information sufficiency thresholds. This ANOVA was followed up by a post-hoc SNK test

TABLE 3 Mean Values of Worry about Floods and Risk Sensitivity for Nine Cluster Solutions on a Scale from 1 to 7

	1 M (SD)	2 M (SD)	3 M (SD)	4 M (SD)	5 M (SD)	6 M (SD)	7 M (SD)	8 M (SD)	9 M (SD)
Probability	–	+	+	–	+	–	≈	+	–
Consequences	+	+	–	+	–	–	≈	+	–
Sufficiency threshold	–	–	–	+	+	–	≈	+	+
Worry about floods	1.72 (0.92)	3.39 (1.34)	2.68 (1.23)	2.29 (1.32)	3.03 (1.16)	1.43 (0.73)	2.40 (1.09)	4.16 (1.44)	1.66 (0.95)
Risk sensitivity	3.31 (1.07)	3.90 (0.99)	3.77 (0.98)	4.12 (1.02)	4.31 (0.95)	3.16 (1)	3.67 (1.02)	4.56 (1.02)	3.81 (1.08)

Note. The upper part of the table describes the clusters with mean scores of risk probability, consequences of risk event happening and information sufficiency threshold—low ($M < -0.03$), high ($M > 0.03$), moderate ($-0.03 < M < 0.03$).

to evaluate which groups differed significantly from each other. Group #8 (high risk perception and high information sufficiency threshold) showed the highest level of risk sensitivity. This group was followed by groups #4 and #5 (differing in risk perception but both with high sufficiency thresholds). These findings suggest that strong worry about future floods is typical of groups with perception of high probability of floods, while high risk sensitivity is observed among groups with high information sufficiency thresholds (i.e., those who need a lot of risk information to feel secure).

So far, we have looked at how people with different risk perceptions and information sufficiency thresholds differ. In the next step, a multinomial logistic regression was performed to ascertain the effects of previous experience and risk sensitivity, controlling for age, level of education, current knowledge, and worry about floods, on the likelihood that participants belong to a certain identified group (Table 4). Group #7 (neutral risk perception and moderate sufficiency threshold) was chosen as a reference group. The final model statistically significantly predicted the dependent variable over and above the intercept-only model, $\chi^2(56) = 678.32$, $p < 0.001$, indicating that the model was a good fit to the observed

TABLE 4 Multinomial Regression of Factors Predicting Belonging to One of the Identified Clusters, Odds Ratio

	1	2	3	4	5	6	8	9
Probability	–	+	+	–	+	–	+	–
Consequences	+	+	–	+	–	–	+	–
Sufficiency threshold	–	–	–	+	+	–	+	+
Age	1.17**	0.97	0.80**	1.09	0.90	1.29***	0.87*	1.20**
Education	1.21***	1.03	1.13	0.98	1.02	1.01	1.03	0.96
Self-assessed knowledge	0.99	0.99	1.00	1.00	1.01*	0.99**	1.01*	1.01***
Risk sensitivity	0.71***	1.12	1.19	1.49***	1.81***	0.62***	2.34***	1.16
Experience	0.47**	2.28**	3.15***	0.47**	2.28***	0.89	2.50***	0.80

Note. The upper part of the table describes the clusters with mean scores of risk probability, consequences of risk event happening, and information sufficiency threshold—low ($M < -0.03$), high ($M > 0.03$), moderate ($-0.03 < M < 0.03$). *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

data. The model explained 27% of the variance (Nagelkerke R^2). The results of the regression showed that an increase in risk sensitivity was associated with an increase in the odds of belonging to a group with a high information sufficiency threshold. And previous flood experience was associated with an increase in the odds of belonging to a group with perceived high probability of future floods. These results confirm the conclusions drawn from the ANOVA and cross-tabulation analyses that were performed.

Discussion

The incredible amount of information that we are asked to contend with on a daily basis presents a challenge even under non-crisis conditions. In times of crisis, the boundary between having well-informed and prepared citizens and subjecting them to information overload can quickly disappear, making people unwilling to learn more. This study investigated people's need for risk information in relation to a less imminent yet still relevant threat, namely floods in several Swedish municipalities. When our respondents were approached with this survey, they had been living with the pandemic for almost a year (i.e., had been exposed to a constant flow of risk information). Because global interconnectedness is producing increasingly frequent global crises, we find these conditions highly relevant for future risk communication, especially preventive communication efforts.

The results of the study brought our attention to the fact that a great number of people (roughly one-third of the sample) have already reached a state of information sufficiency regarding flood risk. This means that every third person in the sample is unlikely to actively seek flood risk information or pay attention when encountering it through what Moore (2002) calls environmental scanning—absorbing bits of information from media, friends, family, or colleagues, or even by overhearing conversations on a bus (Trumbo, 2002).

The group of residents with flood experience was split roughly in half between those who reported high and low sufficiency thresholds. Although having personal experience with floods increased the odds of perceiving risk probability as high, it is

people's perception of the severity of consequences of future floods that was associated with high sufficiency threshold among those with prior experiences. These findings fall in line with the "prison of experience" hypothesis (Kates, 1976) that claims that people base their perceptions of future floods on prior experience. Hence, we can assume that those who suffered minimal damage in previous floods do not feel much of a need for extensive risk information. Another study carried out in the Swedish context concluded that homeowners that have implemented private measures for reducing the risk of floods had to a larger extent been exposed to floods in the past and believed they had considerable knowledge on how to deal with them (Maidl & Buchecker, 2015). Yet, the fact that only one-third of this group reported that they had enough or more than enough information to deal with this risk, suggests that personal experience with risk does not explain well the individual's information need.

Indeed, the findings imply that risk sensitivity—a general anxiety about modern risks—better explains why some people need more information than others. Previous research that used the RISP model focused on establishing connection between worry and need for information. This study demonstrates that it was not worry about floods that was associated with high information sufficiency threshold, but rather existential anxiety (a general risk sensitivity in relation to the whole range of modern risks), while worry was associated with perception of high probability of floods. These findings underscore the importance of personality and attitudes toward risk in general in how much information one needs to feel secure. Further research is needed to understand what individuals or social groups are more sensitive to modern risks as they can be a core target group for communication campaigns aiming to build community resilience and risk preparedness.

Practical Implications for Risk Communicators

One of the main reasons why people do not implement risk mitigation measures is lack of knowledge, according to Maidl and Buchecker (2015). This was also confirmed in the similar analysis carried out on this study's data outside the scope of this study.

Yet, when people report that they do not have enough knowledge it does not necessarily imply that they are motivated to seek it. Introducing the concept of information sufficiency showed that risk communicators have to take into account not only their audiences' risk perception but also their judgmental confidence in how much information they need to deal with a given risk. The identified patterns in this study demonstrated that there is a great number of people who perceive flood risk as high but do not feel they need extensive knowledge on the matter (low information sufficiency threshold). Hence, focusing on changing people's risk perception may not help in getting a message across.

To be able to design an effective information campaign, risk communicators also need to take into account people's experiences and the extent to which the warning may be at odds with these experiences. When communicating to people who experienced floods in the past, one needs to show special considerations for those who suffered minor damages and may deem the consequences of future floods as mild. They tend to have a low sufficiency threshold and are less motivated to seek additional information.

Conclusion

This study has shown that contrary to a number of previous studies, high risk perception or affective response to risk do not necessarily result in high need for risk information (Huurne & Gutteling, 2008; Neuwirth et al., 2000). Neither did personal experience with floods necessarily make people feel well-informed to deal with this risk in the future. Many risk communication practices are designed with an ambition to change public risk perception (Demeritt & Nobert, 2014). However, what contributes to our judgmental confidence in how much information we need to a much greater extent than risk perception and worry is our risk sensitivity. As risk sensitivity is not pertained to a specific risk, it may be more difficult to manipulate with communication efforts than perception of a particular risk. Hence, turning up the volume of risk messages or adjusting the message to alert more people may not be the answer for reaching those who are convinced that they do not need more information.

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