

## The perception of flood risk and water nuisance

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### ABSTRACT

In this paper we aim to gain insight in the determinants that control the risk perception of flooding and water nuisance by developing and validating a questionnaire. We also investigate to what extent the risk characteristics of external safety risks apply to perceptions of flooding and water nuisance. We use elements from the *psychometric paradigm*: risk perception characteristics and their interrelationships have been quantified by developing statements about flooding (38) and water nuisance (12), which were rated by respondents. The state-trait anxiety inventory was applied to determine whether perceptions are related to anxiety characteristics. A focus group session was organized to further explain our findings. Factor analyzing 49 questionnaires resulted in the identification of eight flooding factors (explained variance: 74%) and three water nuisance factors (explained variance: 62%). The internal consistency of the scales measured by Cronbach's alpha ranged from 0.54 to 0.82. Like in the perception of external safety risks, 'dread' seems to be the most important concept binding different characteristics. Although dread towards both flooding and water nuisance is rather low, it seems more present in the latter case. We hypothesize cautiously that the extent of dread for water nuisance is also determined by the anxiety one experiences at that particular moment. In both cases awareness of 'increasing risks' is clearly present, and we find the characteristics '(no) dread', '(un)controllable situation' and 'does not affect me' to be related. Also the characteristic 'risk-benefit trade off' seems also to be related to 'no dread'.

## KEYWORDS

Risk perception, flooding, water nuisance, questionnaire development, psychometric paradigm, state-trait anxiety inventory

## INTRODUCTION

In our research we aim to gain insight in *the determinants that control the risk perception of flooding and water nuisance*. The research is partly embedded in the European Regional Development Fund Interreg IIIb project FLOWS. The project partners aim to develop strategies for 'learning to live with flood risk', by integrating technical and social disciplines. The project was initiated from the awareness that global climate change increases the risks of (urban) flooding and water nuisance. In anticipation to these increasing risks, many (European) countries are working on new water management strategies, often involving the integration of water into spatial plans. We argue that incorporating approaches from social science into the domain of water management is interesting from two perspectives.

First, there is a need for societies to anticipate to the difficulties in water management, which arise from global climate change. Implementing new strategies requires cooperation and communication with people living in the areas at risk. As for many people the risks of flooding and water nuisance are new, people may not incorporate these risks in their decisions. For instance, when someone decides to buy a new house which is located in a flood prone area, there is little awareness of the consequences of this decision. Second, due to a limited amount of research on risk perception of flooding and water nuisance, knowledge of how to communicate about these risks and risk reducing measures is only small. From the vast amount of research in the domain of external safety, it is well known that risk perception of potential hazards differs between public and experts. In the early 1980s, risk researchers started focusing on the determinants of public risk assessments. These researchers found often that laypersons' assessment of risks was best described with subjective risk characteristics instead of objective risk indicators. Furthermore, large groups of people judged the risk levels of many human activities or technologies as unacceptably high (Gurabardhi et al., 2004). Consequently, the 'best technical measure' (from an expert's perspective) is not always accepted easily and may even result in public opposition. Risks are then not reduced. However, according to Baum et al. (1983), man made risks are perceived differently (more controversial) from technological risks (Gutteling and Wiegman, 1996). Since it is not clear

whether flooding and water nuisance are perceived as either natural hazards, technological hazards or as a mixture of both (so-called Na-tech events), it remains also unclear whether we may assume that the risk perceptions of flooding and water nuisance have similar characteristics as the risk perceptions of these external safety hazards.

The first step in our research is therefore to select a suitable approach from the risk perception approaches in the domain of external safety risks and to see whether the concepts from that domain also apply to risk perception of flooding and water nuisance. In domain of external safety, many approaches exist which can be classified from different perspectives. Renn (1992) gives a broad overview of risk perspectives grounded on academic disciplines. Sjöberg (2000) describes four ‘traditional’ concepts. In the technical approach (1) risks are defined from statistical data. The heuristics approach (2) concerns the subjective probability estimates of risk events: biases in laymen’s judgments discriminate between the statistical risk and perceived risk. In the cultural theory approach (3) it is hypothesized that different ‘types’ of people tend to have a ‘preference’ for different kinds of hazards, which are assumed to be governed by a person’s beliefs which in turn are controlled by the social context. The psychometric paradigm (4) is regarded as the leading theory in the field of risk perception. Within this theory – which was founded in the 1970’s by Paul Slovic, Baruch Fischhoff and others – ‘risk’ is a subjective concept: a ‘risk’ does not exist ‘out there’, independent of our minds and cultures, waiting to be measured. Instead, the concept ‘risk’ has been invented to help people cope with the dangers and uncertainties of life (Slovic, 2000b, p. 390–412). The paradigm assumes that many characteristics of risk perception and their interrelationships can be quantified and modeled (Slovic, 2000). Quantitative judgments of the characteristics are obtained by developing statements about potential hazards, which are rated by respondents. Many of the risk characteristics correlate with each other across a wide range of hazards (Slovic, 2000a, p. 220 – 231). Performing factor analysis to these characteristics has shown that they can be organized on a higher level into two factors:

1. a factor interpreted as ‘dread risk’ consisting of the characteristics: uncontrollable risk, dread towards risk, global catastrophic, consequences fatal, not equitable, high risk to future generations, not easily reducible risk, increasing risk, involuntary exposure; and
2. a factor interpreted as ‘unknown risk’ consisting of the characteristics: not observable risk, unknown to the exposed, delayed effects, new risk, risk unknown to science.

In some analyses a third factor was found which was interpreted as the characteristic ‘number of people exposed’. Most important is the first factor: ‘dread risk’. The higher a hazards score on this factor, the higher its perceived risk.

In this paper, we will apply elements of the psychometric paradigm, first, since it is regarded as the leading theory in the field of risk perception (according to Gurabardhi et al. (2004) Slovic and Fischhoff are the most productive authors between 1988 and 2000 in the risk perception domain of technological and environmental hazards). Besides assessing these risk characteristics, we will investigate two other concepts that gain much attention in current communication research: ‘trust in authorities’ and ‘risk management’. Second, we need valid and reliable measurement instruments to apply in later phases of our research, where we will focus on a relative new and promising theory to describe and explain sudden changes in attitudes: catastrophe theory (Hartelman, 1997; Van der Maas et al., 2003).

So, in this paper we have three aims:

1. To develop and validate a questionnaire which is able to measure characteristics of risk perception of flooding and water nuisance;
2. To investigate to what extent the characteristics found with the psychometric paradigm for the risk perception of external safety risks, also apply to the risk perception of flooding and water nuisance; and
3. To present and explain our first data on the risk perception of flooding and water nuisance.

In the subsequent sections we describe our methods and present and discuss the results. Finally we draw some first conclusions.

## **METHODS**

### **Measurement instruments**

Quantitative measures of the risk perception of flooding and water nuisance have been obtained by developing a questionnaire. The questionnaire was construed by developing statements (also called: ‘items’) for both the risks of flooding and water nuisance. Each of the risk perception characteristics has been addressed by multiple statements. A list of instructions and clear explanations preceded both the flooding as the water nuisance statements. Respondents were asked to ‘respond to each statement by ticking off the answer category that best fits your opinion or feelings’, ranging on a five point scale from ‘very disagree’ to ‘very agree’. The perception of flood risk was assessed by 38 statements addressing 16 risk perception characteristics. In order to prevent the questionnaire from becoming too vast, we assessed the risk perception of water nuisance with only 12 statements addressing 6 risk perception characteristics. For the formulation of these statements, we used

a selection of the flood risk statements and adjusted them for the theme 'water nuisance'. By this strategy we are able to compare between the risk perception of flooding and water nuisance for these particular statements. Furthermore, 'flood risk' was defined as 'a flood from the North Sea, Wadden Sea, Lake IJssel or one of the large rivers, for as far as these waters are present in or adjacent to the region or province you live in'. Water nuisance was defined as 'abnormal amounts of water in the streets or on the land due to heavy rain fall, maximum a few decimeters'. A third part of the questionnaire was developed for the purpose of bench marking. We hypothesized that risk perception of flooding and water nuisance might be related to the individual's anxiety characteristics. To measure anxiety we used the Dutch version of the State Trait Anxiety Inventory (STAI-DY) of Van der Ploeg (2000). State anxiety is a temporary, momentary, emotional condition of an individual characterized by subjective, consciously experienced feelings of tension, as well as an increased activity of the autonomous nerve system. State anxiety varies in intensity and fluctuates in time. Trait anxiety reflects the relative stable individual differences in anxiety tendency, i.e. it refers to differences between individuals in their tendency to respond to situations, experienced as threatening, with an increased intensity of state anxiety. Both the state and trait anxiety scales consist of 20 items. The answer categories were provided on a four point scale. Van der Ploeg (2000) reports a high internal consistency of the STAI-DY: Cronbach's alpha for the state scale is reported between 0.87 and 0.96 while for trait anxiety similar values were found for different groups of Dutch respondents. The validity of the STAI-DY is supported by diverse Dutch research (Van der Ploeg, 2000). Furthermore, respondents were asked to answer some additional questions and they registered their sex, education and profession. The results of the questionnaires have been analyzed using the Statistical Package for Social Sciences (SPSS). In order to gain a better understanding of the results of the questionnaires, we organized a focus group session. We consulted story tellers who developed an imaginary story about a water nuisance event and an imaginary story about a flood risk event. During the group interviews, a mediator implicitly addressed the risk perception characteristics that had been assessed in the questionnaire. We use statements from the participants as illustrations that support or contradict results from the questionnaire.

### **Sample and procedures**

The questionnaire has been sent by mail to about 100 respondents during the last two weeks of August 2004 and the first week of September 2004. In this period, the Netherlands experienced large amounts of rain; water nuisance was reported frequently in the news papers.

Respondents were primarily employees of the province houses of Flevoland, Friesland, Groningen and the water board of Friesland (Wetterskip Fryslân). At the time of analysis, 69 questionnaires were returned. Only completely filled in questionnaires were drawn into analysis: 49 questionnaires. The focus group consisted of 14 people from the province Flevoland (5 men and 7 women). The selected people had different back grounds and ages varied widely among them. The stories endured about 15 minutes; the group interviews after each story endured 30 – 45 minutes. The water nuisance story was told first. The focus group was organized at the 15<sup>th</sup> of December 2004.

## **RESULTS AND DISCUSSION**

Our measurement instrument – the questionnaire – has been new developed. As explained, the questionnaire contained for the risk perception of flooding and water nuisance respectively 16 and 6 characteristics. However, statements addressing these characteristics may still be interpreted otherwise, i.e. respondents may not recognize the characteristic we aimed for and respond to another concept which is evoked by the same statement. Moreover, some of the characteristics may not even play a role in the risk perception of flooding or water nuisance. To identify the characteristics that are appreciated by the respondents, we applied factor analysis (Principle Components with Varimax Rotation) and searched for pronounced factors representing characteristics in the dataset, i.e. eigenvalues  $> 1$ . Furthermore, we aimed to obtain scales (factors consisting of sets of items) that are able to measure these characteristics in a reliable manner. The reliability of a scale has been indicated by calculating Cronbach's Alpha, which is a measure for its internal consistency. In case items in a scale/factor could not be interpreted well or in case an item substantially lowered Cronbach's alpha, we decided to withdraw it from the data set. A new factor analysis was then executed and results were analyzed again. This procedure was repeated until we arrived at a satisfying set of factors, i.e. factors/scales with high values for Cronbach's alpha and which could be interpreted in a clear manner. Table 1 shows the statistics of the analyses applied to the risk perceptions of flooding and water nuisance. The items to which is referred in the table, are listed in the appendix .

**Table 1:** results of the analyses for the risk perceptions of flooding and water nuisance. N=49.

<i>Risk</i>	<i>Factor</i>	<i>Eigen value</i>	<i>% of Cumulative Explained Variance</i>	<i>Items</i>	<i>Alpha *</i>
Flooding	1	3.31	14.41	7, 13, 15, 17, 27	0.82
	2	2.31	24.47	6, 22, 30, 36	0.69
	3	2.27	34.35	4, 5, 8	0.73
	4	2.13	43.59	24, 25, 29	0.62
	5	2.07	52.60	12, 20, 33	0.68
	6	2.00	61.27	31, 32	0.56
	7	1.56	68.04	1, 3	0.58
	8	1.32	73.80	18	-
Water nuisance	1	2.17	24.13	40, 41, 42, 46	0.72
	2	1.71	43.12	39, 47	0.65
	3	1.67	61.62	45, 48	0.54
	rest	-	-	50	-

\* Cronbach's Alpha ranges from 0–1; the higher its value the better the internal consistency of the corresponding scale.

Furthermore, table 2 presents the mean item scores for both the flooding and water nuisance statements, and compares the mean item scores of flooding statements with the mean item scores of their corresponding water nuisance statements. This table also lists the interpretations of the factors.

### **Risk perceptions of flooding and water nuisance**

In the validation process the number of items concerning 'flood risk' has been reduced from 38 items to 23 items (see the appendix). These items seem to reflect 8 different concepts (factors) with scale reliabilities ranging from 0.55 to 0.82. These factors explain nearly 74% of the total variance. From the items 7, 13 and 15 in the first factor, the respondents expressed to be well aware of (globally) increasing risks of flooding. In item 27 a causal relation between 'climate change' and 'increasing flood risk' was made. With a mean item score of 4.14 on this item respondents expressed clearly to believe that flood risks will increase due to climate change. Item 17 addresses flood risk reducing measures. Removal of this item even increases the scale reliability from 0.82 to 0.87. During the focus group people also clearly believed that climate is changing. However, some were not sure whether that will increase flood risks. Others reacted like: "(..) *but there will be a trend (...) sea level is rising.*" Respondents also seem to believe that floods are somewhat unpredictable, as indicated by the items 22 and 30 in factor 2. This finding seems to be related to their judgment on their dissatisfaction with information about flood risks (item 36): they disagree clearly with the statement that authorities inform them well about flood risks. We can not explain yet how

**Table 2:** Factor interpretations, mean item scores and mean differences of item scores of flooding statements and their corresponding water nuisance statements. N = 49

<i>Interpretation of flooding factor</i>	<i>Flood risk item</i>	<i>Mean item score*</i>	<i>Corresponding water nuisance item</i>	<i>Belonging to water nuisance factor</i>	<i>Mean item score*</i>	<i>Mean difference</i>
Factor 1 (Global) increase of flood risk	7	3.96				
	13	3.73	48	Future increase in water nuisance (3)	3.78	-0.05
	15	3.84	48		3.78	0.06
	17	3.31	46	Dread (1)	3.18	0.13
27	4.14					
Factor 2 Unpredictability and no dread	06	2.22	40	Dread (1)	2.43	-0.20
	22	3.55				
	30	3.59				
	36	3.80	50		3.84	-0.04
Factor 3 No dread, Affects me	04	2.06	41	Dread (1)	2.35	-0.29
	05	1.94	42	Dread (1)	2.53	-0.59
	08	3.27	47	(2)	3.02	0.25
Factor 4 (Un)known risk	24	3.06				
	25	3.31				
	29	2.24				
Factor 5 Risk benefit trade off	12	2.39				
	20	3.14				
	33	3.29				
Factor 6 People exposed	31	3.80				
	32	3.53				
Factor 7 (Un)controllable situation	01	2.34				
	03	3.30	39	(2)	2.96	0.36
Factor 8 Public commitment	18	3.18				
Removed items with a water nuisance counterpart	35	3.02	49		3.38	-0.36
	9	4.06	43		3.73	0.33
			44		2.35	
	10	2.61	45	Future increase in water nuisance (3)	3.10	-0.49

\* higher mean item scores correspond with a higher/stronger perception

item 6 fits in this factor, since it concerns anxious feelings. A focus group participant did relate 'dread' and 'unpredictability': "(...) on the one hand you think: 'there is being thought about this [flood risk protection] pretty well', (...) and then you have a comforting feeling, but on the other hand, unexpected things or combinations (...). It is not that one thing goes wrong, but ten things at the same time. And then you start thinking about living behind a dike



(...)"'. Removal of either item 36 or item 6, will lower the internal consistency of the scale from 0.69 to 0.66. The concept 'dread' is the most important determinant of risk perception (Slovic, 2000). We aimed to measure 'dread' directly by operating three items. However – as already reported – factor analysis attributed item 6 to factor 2. The remaining two items 4 and 5 showed a significant positive correlation (0.60). Their mean item scores indicate clearly that respondents do not experience feelings of dread with regard to flooding. A focus group participant said: *"when the story was told [about a flood event]<sup>1</sup> you think: 'I must take that into account'. But I just don't see it happen"*. Furthermore, respondents disagreed slightly that a flood has merely consequences for their future. According to the factor analysis this item also belongs to the concept 'no dread' (factor 3), but expresses more something like 'does not affect me'. Removal of item 8 will increase the scale's internal consistency from 0.73 to 0.74. Factor 4 reflects the concept '(un)known risk'. The items 24 and 25 of factor 4, address respondents' knowledge about flood risks. The mean item scores suggest that they doubt their own knowledge slightly. Furthermore, respondents did express confidence in experts' knowledge, reflected in item 29. Removal of item 29 increases the scale reliability from 0.62 to 0.70, suggesting that item 29 does not clearly contribute to the concept '(un)known risk'. During the focus group, participants often expressed lack of knowledge: *" (...) when you are talking to a meteorologist [about climate change], he will say: 'I don't know either'. It may as well be that we are in an ice age in 20 years from now, but the chances that we are facing a temperature increase are just as plausible (...)"*. Within the fifth factor, a risk-benefit trade off seems to be the central element. From the results can be inferred that respondents find that the risks of flooding do not weigh against the benefits of their residential situation (item 12). Item 20 indicates that they are only slightly willing to move out in case that becomes necessary from a flood risk perspective (item 20). In responding to item 33, people expressed slightly that the media do not exaggerate the risks of flooding. From these two latter findings we speculate that respondents can hardly imagine a flood to happen: the benefits of their residential situation exceed the risks of flooding by large. The internal consistency of this scale is 0.68. In general, the focus group participants did not believe either that they will experience flooding. However, they did see the risk and expressed they do have choices: *"when you are frightened (..) move somewhere else"*. But some participants thought moving out is not really a solution: in other countries you may be exposed to other risks like earthquakes and flash floods. The three remaining concepts consist each of respectively 2, 2 and 1

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<sup>1</sup> Between brackets [...] is from the authors to clarify the context

item(s). The items 31 and 32 together seem to reflect the concept ‘people exposed’ (factor 6), although their inter-item correlation is only 0.39. From the mean item scores we infer that respondents think that the ‘number of people exposed’ to a single flood event is large. The items 1 and 3 are interpreted as the concept ‘(un)controllable situation’ (inter-item correlation 0.43). In case of item 1, they expressed that they can bring themselves into safety in case of a flood while – when responding to item 3 – respondents expressed also slightly to stand powerless against a flood, in a sense that they cannot protect themselves against them. Although the judgments of these two items may seem contradictory, we speculate that their response to item 1 reflects that they assume to have control over their safety or life, while their response to item 3 reflects that they cannot control the flood itself or prevent it from happening. The participants of the focus group expressed similar beliefs: “*you will never have real control [over the situation], that is why it is a disaster*”. In this context participants also expressed not to have confidence in rescue plans: “*(...) rescue plans are often not working (...), first something must happen*”. Factor 8 explains the least amount of variance and consists of just one item. This item addresses ‘public commitment to risk reducing measures’. Respondents slightly disagreed that there is sufficient support for such measures. Although we also tried to measure the concept ‘trust in authorities’, the items assigned for this purpose showed inconsistent results. However, during the focus group, people often expressed to be concerned about how flood risks are managed. Most striking was the moment that we showed them a citation about a Dutch water engineer who warned just six months before the flood in 1953 (almost 2000 casualties in the province of Zeeland) that the Dutch coast had many weak points which were likely to fail during a big storm. Nobody listened to his warning, neither his engineering colleagues, nor the politicians, nor journalists; the interview was never published. The first reaction during the focus group was: “*and I believe that it is still the same*”, many people shared this view.

Since the water nuisance statements are a direct derivation of the flooding statements, we are well able to compare between the risk perceptions of flooding and water nuisance. After the validation process of the water nuisance statements, three of the twelve statements were removed. Factor analysis resulted in three distinguishable factors explaining nearly 62% of the total variance. The scale reliabilities of the factors 1 to 3 are respectively 0.72, 0.65 and 0.54. The first factor reflects the concept ‘dread’, explaining over 24% of the variance. The items 40, 41 and 42 are direct derivatives of the respective flooding items 6, 4 and 5. Like for flooding, the feelings of dread for water nuisance are also small. However, the mean item scores (see table 2) seem to reveal more dread than for flooding. The presence of item 46 –

reflecting risk reducing measures – is difficult to explain within this factor. Removal of this item from the scale will increase Cronbach's Alpha from 0.71 to 0.76. Like for flood risk, also for water nuisance the participants of the focus group did not express 'dread'. However, whereas they 'did not see a flood happen', they believed that people should take practical precaution measures and take potential financial consequences of water nuisance into account: *"personally I am not seriously worried. I do know that in the future we should take potential damage into account, adjust certain things [practical things in houses like electricity] and that you must accept more (...)"*. We suggest this may account for the difference in the presence of 'dread' between flooding and water nuisance. We experienced some interpretation difficulties with the second factor consisting of the items 39 and 47, since these items seem to reflect two different concepts: we suggest analogous to the flooding items from which they were derived respectively the interpretations '(un)controllable situation' and 'does not affect me'. Their inter-item correlation is 0.48 (Cronbach's alpha = 0.65). Since these items do reveal some interesting correlations with other concepts, we discuss these items further in the next section. The third factor has been interpreted as 'increasing risk of water nuisance'. However, the inter item correlation between the two items in this factor is considered rather weak (0.37). Item 48 – being derived from the items 13 and 15 – reflects this concept best. The mean item score indicates that respondents are just as aware of increasing risks of water nuisance as they are aware of increasing flood risks. Item 45 was derived from flooding item 10, which had been removed from the list during the validation process. However, when considering their mean item scores, respondents somewhat disagreed that they will surely experience flooding in the future, while they slightly agreed that they will surely experience water nuisance in the future, which is consistent with our earlier suggestions. When questioning focus group participants how realistic the story about the water nuisance event was, people reacted like *"...extremities will occur more frequently ... in the former days you assumed: 'that's [heavy rain fall] in the autumn', but [now] it can also happen during the summer"*. Item 50 is considered as a rest item. It loaded on all three factors but on item level, it did not reveal significant correlations. Nevertheless, we discuss its results since item 50 reflects the concept 'being informed by the government', which is an important aspect of our project. From table 2 we see that – similar to their response to information about flooding – respondents expressed rather strongly that they find themselves not well informed by the authorities about the risks of water nuisance.

### **Correlations: bench marking with STAI-DY and relations between concepts**

Table 3 shows the correlations between the risk perception characteristics of flooding, water nuisance and the state and trait scales of the STAI-DY.

We hypothesized that the risk perceptions of flooding and water nuisance might be related to a person's state and trait anxiety characteristics. In general, one may expect that individuals with a high score on the trait anxiety scale will show more frequent a high score on the state anxiety scale, than individuals with lower scores on the trait anxiety scale (*Van der Ploeg, 2000*). We found a strong positive correlation between state and trait anxiety (0.85). The mean values of both state and trait anxiety were rather low (respectively 1.62 and 1.76). Furthermore, we did not find significant relations between trait anxiety and the risk perceptions of flooding and water nuisance. From these findings we infer that the way in which flooding and water nuisance are perceived, are not a personality characteristic. However, we did find a significant correlation (0.33) between state anxiety and the concept '(no) dread' in the water nuisance case. From this finding we hypothesize cautiously that the extent of dread for water nuisance is also determined by the anxiety one experiences at that particular moment.

Between flooding factors, some risk perception characteristics seem related. The inter-item correlations between the items of factors 2 and 4 imply that the characteristics 'unpredictable risk' and 'unknown risk' are (positively) related, which sounds logical from a conceptual point of view. The significant correlation (0.37) between factor 2 and factor 4 is mainly explained by item 36 – about flood risk information – of factor 2 which loaded in the factor analysis also quite on factor 4. However, other inter-item correlations are also quite strong. During the focus group, participants also related lack of knowledge to unpredictability: "*if Texel [most western Ducth Wadden island] is being washed away, what would be the chain reaction following from that? How can we know? (...)*". The characteristic 'risk-benefit trade off' – factor 5 – seems to be related to 'no dread' (correlation 0.38). During the focus group a participant reacted to the question whether she was frightened by the story about the flood: "*... well, yes, if it really happens, yes, but I don't feel that this can happen tomorrow, that it frightens me*". This supports our earlier hypothesis that the risk benefit factor may also be explained by people's reaction that they can hardly imagine a flood to happen. The items of the characteristic '(un)controllable situation' – factor 7 – also correlate significantly to 'no dread' (0.40). Both significant correlations are accounted for by the 'true' dread-items 4 and 5, which correlate significantly with 11 of the 12 items of which the factors 5 and 6 consist.

**Table 3:** Correlations between the risk perception characteristics of flooding, water nuisance and the STAI-DY. N = 49. The characters ‘0.’ preceding the numbers are left out in order to save space.

Factor	Flooding								Water nuisance				STAI-DY	
	F1	F2	F3	F4	F5	F6	F7	F8: Item 18	F1	F2	F3	Rest: Item 50	State anxiety	Trait anxiety
F1		208	144	-020	178	125	190	-045	364*	307*	506**	-248	087	053
F2			216	367**	267	103	107	-145	318*	-033	320 *	-536**	054	095
F3				-029	379**	230	395**	-138	049	202	095	-033	113	137
F4					-049	031	-078	006	132	-026	146	-426**	247	049
F5						170	344*	-038	313*	294*	244	-184	134	124
F6							269	-187	105	360*	193	-026	136	059
F7								-179	119	363*	159	-003	151	172
F8									-174	-174	-069	-129	107	152
F1										246	261	-159	332*	203
F2											235	141	-107	-154
F3												-167	218	182
Item 50													157	153
State Trait														0.850**

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

Furthermore, of all 25 significant inter-item correlations between items of different characteristics/factors, 14 times one of the dread items 4 or 5 was involved.

Surprisingly, we see no significant correlations between the water nuisance dread-factor and other water nuisance factors. We suggest that this may be explained by the fact that we only used a small number of items to assess the risk perception of water nuisance. The risk perception characteristics ‘(un)known risk’ and ‘(un)predictable risk’ that were related to the dread concept in the flooding case, are not reflected in these water nuisance items. However, when considering correlations on item level, we did find interesting similarities with the risk perception of flooding. As mentioned in the previous section, water nuisance factor 2 – consisting of the items 39 and 47 – proved hard to be interpret: in item 39 we recognize flooding item 3 which reflects the concept ‘(un)controllable situation’, while in item 47 we recognize flooding item 8 reflecting the concept ‘does not affect me’. However, when considering inter-item correlations, we find in the water nuisance case the concepts ‘(un)controllable situation’ and ‘does not affect me’ within one factor being significantly related to the concept ‘no dread’, while in the flooding case we find the concepts ‘does not affect me’ and ‘no dread’ within one factor being significantly related to the concept ‘(un)controllable situation’. Thus, both in the cases of flooding and water nuisance the concepts ‘(no) dread’, ‘(un)controllable situation’ and ‘does not affect me’ seem to be related. Between the flood risk and water nuisance factors 11 correlations are significant, ranging from 0.29 to 0.54. Some correlations we find remarkable. The water nuisance ‘dread’-factor (factor 1) correlates with three flooding factors. Remarkable about the correlation with ‘(global) increase in flood risk’ (flood risk factor 1) is, that the counterpart items 17 and 46 which both concern risk reducing measures, play a key role. Item 17 correlates significantly with all dread items of the water nuisance factor while item 46 correlates significantly with two ‘increase’-items of the flood risk factor. We wonder whether the concept of measures is some sort of a ‘binding’ concept. Furthermore, although we did not find a significant inter-factor correlation between the flooding and water nuisance ‘(no) dread’ factors, on item level some dread items did show significant correlations. The correlations between rest-item 50 concerning ‘being informed by the government about water nuisance’ and the flooding factors ‘(un)predictability and no dread’ and ‘(un)known risk’ are significant. Like before, we here find another indication that the concepts of ‘(un)predictable risk’ and ‘(un)known risk’ are related.

## **CONCLUSIONS**

We argue that our findings reveal interesting results about the perception of flood risk and water nuisance. The questionnaire enabled us to measure several risk perception characteristics in a reliable manner. Our findings were supported by the focus group. However, there are still some characteristics which have not been measured at all or with insufficient reliability.

We investigated 16 characteristics of the risk perception of flooding and 6 of the risk perception of water nuisance. The results of our questionnaire indicate that we identified respectively 8 and 3 characteristics. Most of the variance in risk perception is explained by the characteristic 'increase of risk', particularly in the flooding case. Both in the cases of flooding and water nuisance we measured 'no dread', with satisfying reliabilities. 'Dread' seems to be more present for water nuisance. We hypothesize – also based on the focus group results – that this difference may be explained by the fact that people can not imagine a flood really to happen, while they do believe that they will experience water nuisance in the future. Although the items reflecting the concept 'trust' in our questionnaire were removed in the validation process, the participants of the focus group expressed not to feel confident with regard to how flood risk and water nuisance are managed and with regard to how they are informed. This latter finding is also clearly supported by results of the questionnaire. Like in the perception of external safety risks, 'dread' seems to bind different risk perception characteristics. From the results of the State-Trait Anxiety Inventory, we hypothesize cautiously that the extent of dread for water nuisance is also determined by the anxiety one experiences at that particular moment. In both the cases of flooding and water nuisance the concepts '(no) dread', '(un)controllable situation' and 'does not affect me' seem to be related. The characteristic 'risk-benefit trade off' seems also to be related to 'no dread'. However, respondents may as well have expressed here that the benefits of their residential situation exceed the risks of flooding by large, because they can hardly imagine a flood to happen.

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## REFERENCES

- Maas, H.L.J. van der, R. Kolstein and J. van der Pligt (2003). 'Sudden Transitions in Attitudes'. *Sociological Methods & Research*. **32**(2), 125-152.
- Gutteling, J.M. and O. Wiegman (1996). *Exploring Risk Communication*. Dordrecht: Kluwer Academic Publishers.
- Gurabardhi, Z, J.M. Gutteling and M. Kuttschreuter (2004). 'The development of risk communication: An empirical analysis of the literature in the field'. *Science Communication*. **25** (4), 323-349.
- Renn, O. (1992). 'Concepts of risk: a classification'. In: Krinsky & Golding (Eds.): *Social theories of risk*. Westport: Praeger Publishers, 53-79.
- Sjöberg, L. (2000). 'Factors in Risk Perception'. *Risk Analysis*. **20**(1), 1-11.
- Slovic, P. (2000). *The Perception of Risk*. London: Earthscan Publications Ltd.
- Slovic, P. (2000a). 'The Perception of Risk'. In: R.E. Löfstedt (Ed.): *The Perception of Risk*. London: Earthscan Publications Ltd., 220 – 231.
- Slovic, P. (2000b). 'Trust, Emotion, Sex, Politics and Science: Surveying the Risk-assessment Battlefield'. In: R.E. Löfstedt (Ed.): *The Perception of Risk*. London: Earthscan Publications Ltd., 390 – 412.
- Van der Ploeg, H.M. (2000). Handleiding bij de Zelfbeoordelingsvragenlijst. Een Nederlandstalige bewerking van de State-Trait Anxiety Inventory STAI-DY. Second press. Lisse: Swets & Zeitlinger B.V.



## APPENDIX

### Selected flooding items

- Item 1: In case of a flood, I can bring myself into safety.
- Item 3: Against floods I stand powerless: I can not protect myself against them.
- Item 4: I experience living below sea level as a threat to my safety.
- Item 5: The flood risk I am exposed to, discomforts me.
- Item 6: When I think of floods, I get anxious feelings.
- Item 7: Throughout the world, people living in coastal areas will be exposed to increasing risks of flooding.
- Item 8: A flood has merely consequences for my future.
- Item 12: The risk of a flood does absolutely not weigh against the advantages of my current residential situation.
- Item 13: Future generations will be exposed to increasing risks of flooding.
- Item 15: In the future, the Netherlands will be exposed to increasing risks of flooding.
- Item 17: Measures aiming to reduce the risks of flooding in a durable manner, are financially hard to achieve. I
- Item 18: Measures aiming at reducing flood risks, are supported with sufficient public commitment.
- Item 20: In case it becomes necessary from a flood risk perspective, nothing will hold me back to settle somewhere else.
- Item 22: The moment that a flood occurs, is well known in advance
- Item 24: To people like me, the flood risks in this region are well known.
- Item 25: I can estimate the chance on flooding well.
- Item 27: Due to climate change, flood risks will increase substantially.
- Item 29: To experts the risks of floods are very well known.
- Item 30: Experts know exactly when the dikes fail.
- Item 31: A flood will only strike a small number of people in my region.
- Item 32: Failure of a dike will quickly lead to the inundation of a large area.
- Item 33: In the media flood risks are often exaggerated.
- Item 36: The authorities inform me well about the flood risks in my region.

### Selected water nuisance items

- Item 39: Against water nuisance I stand powerless: I can not protect my properties against it.
- Item 40: Of the thought of water nuisance, I get anxious feelings.
- Item 41: I experience water nuisance as a threat to my safety.
- Item 42: The risks of water nuisance discomfort me.
- Item 45: In the future I will surely experience water nuisance.
- Item 46: Measures to fight water nuisance in a durable way, are easy to realize.
- Item 47: Water nuisance is nothing more than an annoying event: it will merely affect my daily life.
- Item 48: Water nuisance will occur more frequent in the future.
- Item 50: The authorities inform me well about the risks of water nuisance in my region.