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The effects of information and evacuation plans on civilian response during the National Dutch flooding exercise ‘Waterproof’

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Abstract

This study presents and analyses data about choices citizens made in their evacuation response during three days of the Dutch national flooding exercise ‘Waterproof’. It explores the link of this response with the provided information and communication during the exercise by comparing the risk awareness, information experience and information needs of the individuals to their evacuation behavior in three different flooding scenarios. Overall this study shows that communication and information has an effect on the response of individuals but not necessarily in the way that is expected. Government can influence people’s response but the effect of this communication seems to have limits. Also some aspects in responses are more susceptible for this influence by information than others.

© 2010 Published by Elsevier Ltd Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).*Keywords:* Floods; Netherlands; Flood Preparedness; Risk Awareness; Civilian Response; Evacuation; Communication

1. Introduction

The choice for a certain evacuation strategy in a disaster threatened or stricken area depends on numerous factors such as time, road capacity, available equipment, personnel and the preparedness of actors [1]. Human behavior is argued to be crucial for the success of an evacuation, because the behavior and decisions made by individuals can have a severe negative impact on the outcomes of the wellbeing of a whole group (e.g. by frustrating evacuation routes in order to insure safety of their own family and property) [2]. It is therefore important for government and emergency agencies to be prepared and know how people respond to flood hazards to facilitate the best evacuation

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possible. Knowledge about people's choices and their risk assessment can help authorities in their decisions whether to designate and enforce a mandatory evacuation, how best to communicate that decision for the best result, and the optimal time to do it [3]. Because the high standard of flood protection in the Netherlands, it is one of the best protected delta's in the world [4]. Therefore floods are not a regular event. As a result information about the expected response of Dutch citizens during a flood(threat) is unknown as well as the relation of this response to communication. Information about citizens response is valuable for government in preparing communication strategies and mitigation measures to reduce the consequences of a flood event [3]. This study took the opportunity of a national flood exercise to make a start to gain knowledge about Dutch citizen response during flood threats. It aims to help policy making by I) providing an insight in Dutch citizens response to a flood threat and II) by linking this response to provided information and communication in order to gain knowledge about the interaction between response and communication. The article presents data about choices individuals made in their response during the Dutch national flooding exercise 'Waterproef' and explores the link of this response with provided information and communication. In this way the article not only describes individual behavior but also tries to go more in depth by relating behavior to information and communication. These findings can be useful for the preparations of national and regional authorities to flood events.

The study focuses on the response of citizens during a simulation of a flood event and the relations of this response to the provided information. It tries to through measuring the risk awareness, information experience and information needs of the individuals compared to their evacuation behavior in three different flooding scenarios. In this research a total of 75 individuals were surveyed and observed in three different civilian groups during three days (one group each day) of the Dutch national flood exercise Waterproef in November 2008.

1.1. Background of the Dutch national flooding exercise 'Waterproef'

In the first week of November 2008 the Dutch ministry of the Interior and Kingdom Relations organized together with the ministry of Transport, Public Works and Water Management and the Taskforce Management Flooding, the national crisis management exercise "Waterproef" [5]. During three days of this exercise national and regional governments had to cope with three different flood scenarios. On day one there was a scenario with a flood threat of the urban areas on the coastline within 4 days due to a severe storm combined with high tide (d1); during day two a flood scenario was practiced where a flood threat from the river and possible breach was within 3 days (d2) and on day three a scenario was practiced where a dike unexpectedly breached and which resulted in a flooding from the lakes (d3) [5]. Goal of these exercise days was for authorities to practice decision-making processes for evacuation and response to minimize damage and casualties. During all days there was a panel of civilians involved in the exercise. They were presented with real-time information about the situation. A special exercise environment was created with news bulletins on television (shown to the whole group) and people could individually read newspapers articles and search on the internet where exclusive information about the flood threats was published.

These civilians groups were asked to react on the information by asking questions or express their concerns and opinions by reacting on on-line forums as well by calling to emergency agents. The timeline of the main presented information during the exercise days were as follows:

Day one: Flood threat from the sea within four days

- 9:00 am – News bulletin; There is a severe chance of a big storm, combined with the high tide this can result in a flooding in 4 days.
9:15 am Survey 1.1
- 10:00 am – Newspaper; there are messages from mayors to evacuate voluntarily, directions of national government are expected later.
11:00 am Survey 1.2
- 13:00 pm – News bulletin; national government will evacuate the elder and sick people, directions for other individuals is to be expected later.
14:30 pm Survey 1.3
- 16:00 pm – Press release; Shows cards with general indication of safer areas within the city. Directions for individuals other than the old and sick will be given in the morning of the next day.

Day two: Flood threat from the river within three days

- 9:00 am – News Bulletin: There is a high discharge expected in two days that can cause a flooding.
9:15 am Survey 2.1
- 10:30 am - News Bulletin: Evacuation directions for voluntarily evacuation are given and routes are showed
12:30 pm Survey 2.2
- 13:00 pm – News bulletin: Shows people are evacuating
14:45 Survey 2.3

Day three: Unexpected dike breach and flood from the Lake IJsselmeer

- 9:00 am – News bulletin: dike is broken. Experts give advice what to do with respect to the flood.
9:15 Survey 3.1
- 10:00 am – News Bulletins: Expected water depths are given. Experts give advice to look for shelter within the area. Local authorities give mandatory evacuation order out of the area.
10:30 survey 3. 2
- 12:00 – News bulletin: National government advices people to work together, and affirm that rescue teams are working to help people evacuate. They repeat the evacuation order. Experts explain that the evacuation will take days.
14:00 Survey 3.3

Besides these general information moments there were newspaper articles on the Internet, discussion forums and access to websites of crisis organizations. Also organizations could be called for information.

2. Study methodology

The data of this article exists out of two components: surveys¹ and personal observations. Both were conducted during all three days of the flooding exercise. Several times during an exercise day the group of civilians were shown together a news bulletin and afterwards asked the same standard series of questions that relate to the three topics under research in this study: 1) risk awareness, 2) information experience and 3) evacuation response. Both Lindell and Perry [6] as Slovic [7] discovered that the risk perception people influence their response to a threat. Only if people perceive a threat as realistic and they feel that they have some sort of control to manage this risk they are likely to take precautionary actions. So this study assumes that the higher the risk awareness is and the better people can interpret the communicated information about the flood threat and precautionary actions, it will result in a higher risk perception and an increase of precautionary actions in people's response. The questions of the survey were of the constrained response type and categorized in the three above-mentioned topics. Times of the survey are shown above between the timeline of the information presented. It is noted that due to exercise set-up not all questions returned in every survey so in the analysis only survey questions are used that returned in all surveys. This set up allows detecting the development and changes in decision-making behaviour during the day. Personal observations and face-to-face questioning of certain behavior of civilians are used to complement the survey results. They provide more detailed and more insight in responses and give additional information about the motivation of behavior. The results from these observations give a first impression and a direction rather than an exact explanation for the motivation of behavior.

The civilian groups during the different days represent people from all ages and professions. The number of people on the panel differed each day but numbers were between 24-29 persons.

¹ The data was provided by the Dutch ministry of the Interior and Kingdom Relations

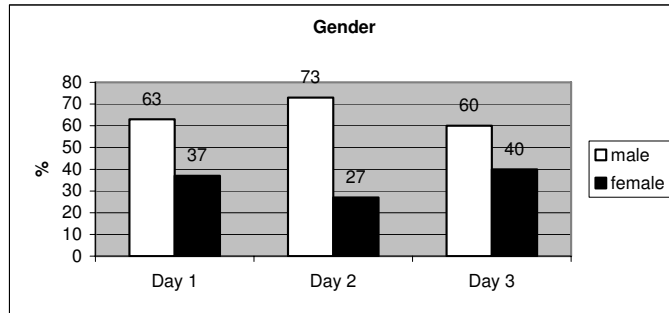


Fig. 1. Gender of participants during the different exercise days

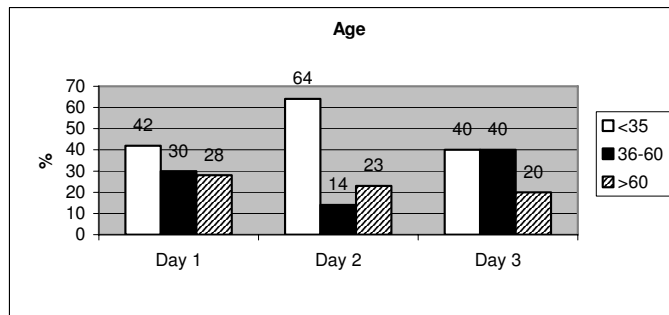


Fig. 2. Age of participants during the different exercise days

During all days males were more represented than female (Fig. 1.). The age of the participants are relatively well distributed during the first and the last day. However, on the second day there was an over representation of young people (Fig. 2.) This was a result of the high number of students during that day. On all the exercise days about 75% to 80% of the participants did not have any kind of flood experience.

3. Results

3.1. Risk awareness

The first surveys in the beginning of all days show that of the participants on the first day only 21% were very aware, on the second day 18% and on the third day only 10% of the flood risk in their environment (Fig 3). Interestingly this awareness decreased on the first day with 9%, while on the other days it increased with respectively 20% and 23%. The difference between day one where the flood awareness decreased and the other two days where it increased can partially be explained by the fact that on the first days it also uncertain if there would be a storm that would cause a flood. Also on the second and third day more details were given about specific threatened areas by giving postal codes.

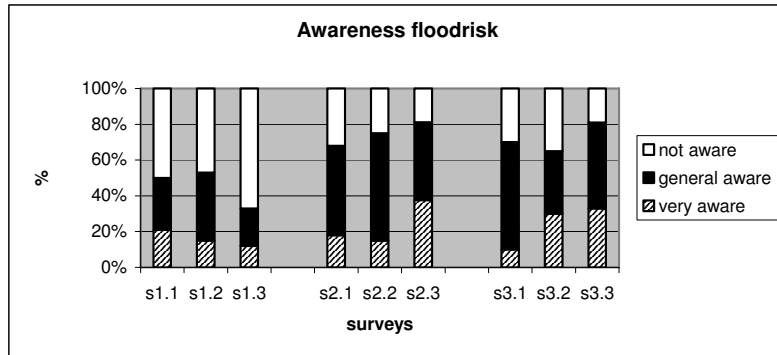


Fig. 3. Results to question: Till what extent are you now aware of the flood risk in your living environment.

Although in the last two days the awareness increased the number of people that were general aware or not aware can still be considered high at the end of the days with 88% (d1), 62% (d2) and 67% (d3). This can be explained by the fact that people were informed about the general flood risk. They were not informed about more detailed characteristics of the possible flood. During the observations the most important question people had was about the height of the water. The lack of this information provided big insecurities about a safe place to stay and seemed to prevent people of making a decision where to go.

This is also reflected in Table 1 where it shows that on day one the information need of the participants was 19% about the arrival of the storm would arrive. This decreased in s1.2 to 8% so there are more reasons for the decrease in flood risk awareness. The most indicated information need was about the safety of the living environment (24%, 55% and 20%) followed by the need for information about the evacuation necessity and evacuation time was indicated as desired (Table 1). On day three the need for information about help expected from government was much bigger then the other days. It seems that after the dike breach people have less obvious possibilities to act and therefore have a bigger need to know from directions from government. Attention must be paid that during all three days the amount of information needs about different topics are rather large (17%, 13% and 19% at the end of all days). It is important to pay attention to what these needs are. Interesting is the fact that on day three the information need on different topics is decreasing, while it increases on the first day.

The majority of the people named the local municipality, news and Internet as their main sources of information. However on day three with the actual flooding scenario, people appointed the national disaster broadcast network as main source of information followed by the Internet. It is interesting to see that people expect that Internet continuous to function after the dike breaches.

Table. 1. Results to question: Over which subjects do you need additional information? (one answer possible)

Information needs	Day 1		Day 2		Day 3	
	s1.1	s1.2	s2.1	s2.2	s3.1	s3.2
1.If the storm arrives	19%	8%	-	6%	-	-
2.If I am in danger in my living environment	24%	29%	55%	50%	20%	19%
3.If I should evacuate	19%	17%	14%	-	10%	10%
4.If government will help me or not	4%	-	5%	-	20%	38%
5.If I am insured against the damage	9%	-	5%	6%	-	-
6.If government will take measures for not self reliable persons	6%	4%	-	6%	5%	5%
7. If government will take measures for cattle	-	-	5%	-	-	-
8.If there are dry areas in the Netherlands	8%	4%	-	6%	5%	-
9.If there is time to evacuate	8%	25%	9%	13%	15%	10%
10. Different	3%	17%	9%	13%	25%	19%

3.2. Information experience

In general the information of the experts is a bit more trusted than government but overall the credibility of the given information is low. One respondent even said: “When the government and the experts started to contradict each other I knew things were going wrong. This was a sign that I had to leave.” Fig. 4. shows that in all days the credibility decreases with respectively, 34% on day one, 13% on day two, and with 6% on day three. And is with 88% of the people indicating a low credibility of the evacuation information extremely high on day one, and also with 44% on day two and 66% on day 3. The decrease of credibility on the first day seems to be related to the fact that the given information is not accurate and detailed enough and does not address the individuals that are not sick or old. People need this personal directed information.

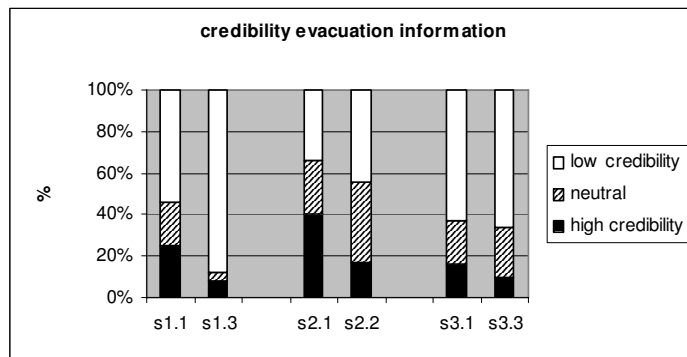


Fig. 4. Results to question: Till what level do you have confidence in the information supplied by government?

On the first day no directions were given to the individuals about evacuation, also not why they should not evacuate. The people indicated that they did not understand this situation. One woman said: *‘If they would only say they are in the process of deciding what is best and that they cannot say anything to us at the moment, then we know what we can expect’*. This was later confirmed when news was received positively by the individuals about the fact that there would be a decision in the next morning about to evacuate or not.

3.3. Evacuation Response

In first survey of each exercise day people were asked which measures they had considered. Evacuation was considered mostly in all three cases with 38%, 32% and 55% respectively followed by buying water and food and secure household belongings. (Table 2). Interestingly almost nobody indicated to secure of his or her personal medicines as a measure.

Table 2. Results to question: Which measures did you considered most?(one answer possible)

	Day one	Day two	Day three
Evacuation	38%	32%	55%
Secure household belongings	-	23%	10%
Buy water and food	25%	23%	15%
Helping neighbours and family	17%	9%	5%
Withdraw cash and copy personal documents	4%	5%	5%
Secure medicine stock	-	-	5%
Safety for pets	13%	-	-
Different	4%	9%	5%

People that would evacuate on their own initiative and not wait for government orders increases the first day from 38% to 75%, and decreases during the second day with 12 % to 43% and with 5% to 65 % on the third day. Figure 5 illustrates the data if the evacuation is on people’s own initiative, or if they wait for orders. The largest difference is that in the coastal scenario’s people seem to evacuate more quickly on their own initiative then in the case of the river flood threat. In both days most people evacuate with their whole family. On day one this is 95% and on day two 83%.

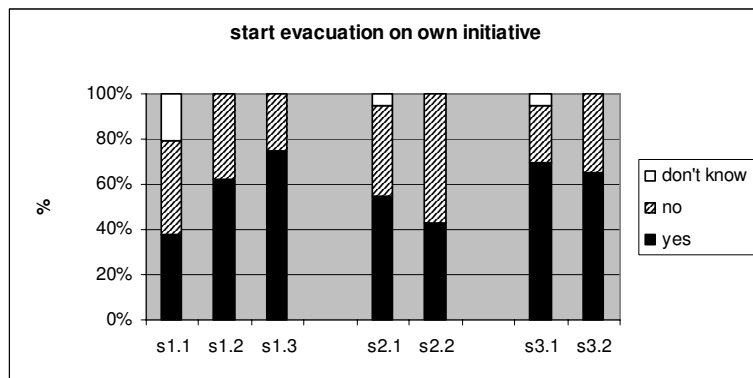


Fig. 5. Results to question: Do you consider evacuating preliminary to the storm on your own initiative?

Figure 6 shows that the attitude of people towards evacuation directions does not change much during the days for people who follow directions of government. This is overall between 36% and 55% (fig.6). It is noticed that on day two people who follow directions is slightly lower. Interesting is also that on day one and day three people that will follow their own judgement increase to respectively 21% and 35% at the last survey.

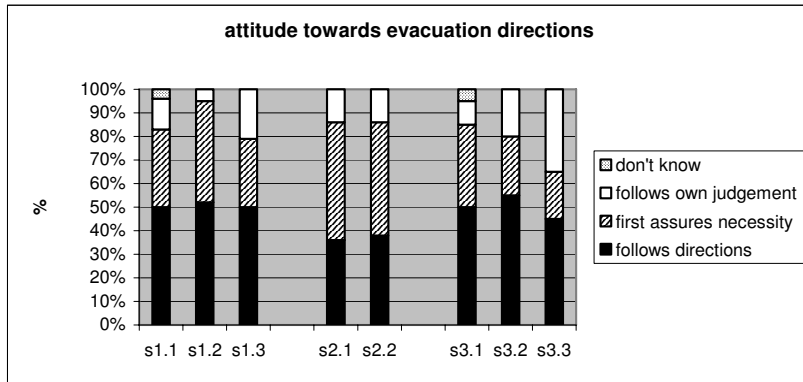


Fig. 6. Results to question: Imagine that government announces that all people in your neighborhood should evacuate, what would be your attitude?

Figure 7 shows the moment of evacuation of the respondents. During day one people that would leave the same day increased from 21% to 63%. 25 % would leave 2 or 3 days before, 8% indicated they would leave on the day before the flood and 4 % would not leave. On day two people that would leave three days before the flood was 38% and that would leave on the second is 24 %. 19% indicated to leave on the day of the flood and 10% would stay. 10% indicated they would do something different.

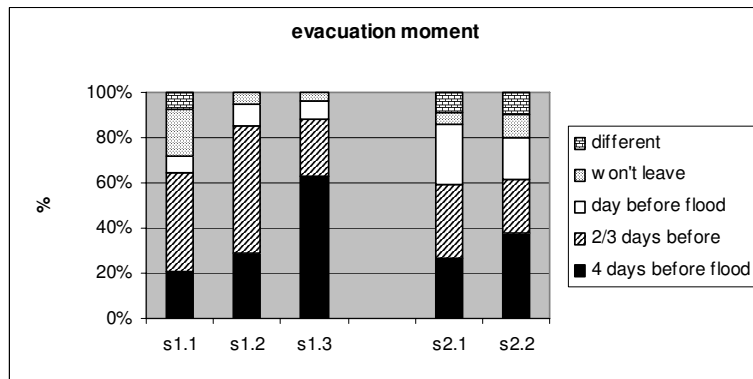


Fig.7. Results to question: On what moment would you decide to evacuate if the government would advise evacuation?

4. Discussion

It is very difficult to get dependable results from surveys other than matter of facts. Issues that are not open for interpretation, such as which additional information is required or the means of evacuation are relatively straightforward, and the respondents answers to these questions can be taken to be relatively reliable. Issues that

require interpretation, however, such as motivation for behavior, are much more difficult to research. Therefore the survey results have to be interpreted with some caution. Also with the selection of the civilian panels no special attention was paid to representivity. This is due to the fact that the civilian panels were primarily involved in the exercise to respond to the crisis communication and to provide feedback on the presented information for governmental organizations. Monitoring the behavior and evacuation response of the civilian groups was not an official objective of the exercise. And therefore this study used a simulation of a situation that had a training goal for a research purpose. This is something done not to often as (name) presented [8]. Therefore the outcomes of this research have to be seen in perspective. There were no controlled conditions that allowed to test hypothesis or strategies. Still, as argued by (name) the data and circumstances allow the exploration of the relationship between certain variables for a particular phenomenon [9]. In this case the relation between crisis information and citizens response. This helps to develop hypotheses that can help government in their preparation of crisis communication. The surveys and the observations conducted on the responses of individuals were therefore done additional to the primary exercise objective of the panels. This research is therefore taking advantage of the situation provided in November. As a consequence the sample is not representative and the results should be used with caution and rather as an indication and not as a given. Another problem in the exercise was that the civilians were coming from all over the Netherlands and did not know the area under threat or which was flooded in the different scenarios. They were asked to take their own family situation as reference and act from there. This set-up is also likely to influence the outcomes. However, comparing this study with findings of several other scientific studies, the outcomes are similar. For example it reflects the findings of Helsloot and Scholtens [10] with respect that evacuation is dependable on family situation; and the study of Terpstra en Gutteling [11] that the flood risk awareness of individuals is in general low. It also reflects the experience of New Orleans before Hurricane Katrina found by (name) that people mainly evacuate with their personal vehicle[3]. Therefore, despite the issue of representivity due to the exercise context, the data of this research is valid enough to conclude with some observations of the interaction between the provided information and the behavior of individuals. This hopefully can improve the knowledge that will help in preparing for floods.

5. Conclusions

In the civilian response to a flood (threat) many factors play a role. Besides social, economic and political processes; communication of information is one of them. On the basis of the data provided in the Dutch National flood exercise Waterproof some observations can be documented.

The first observation that can be made is that people tend to evacuate in an earlier stage and on their own initiative if they have no detailed information. While if they were provided with detailed information more people waited for government instructions for evacuation. The second observation is about the attitude towards evacuation directions. This stays during all days rather constant and therefore does not seem to be influenced by the risk awareness of individuals or information credibility. This seems to indicate that in the evacuation response of people, the moment of leaving is more susceptible by communication and information than the evacuation directions people follow.

As mentioned before the awareness of individuals of the flood risk in their environment is low and also the credibility of evacuation information was indicated as low. During all the exercise days the credibility even decreased further, despite the information provided. On day one the risk awareness decreased while on the other two days it only increased slightly. Reasons for this might be the lack of detailed information and the failing of addressing people directly. Especially this low awareness and low credibility seemed to have a positive effect on starting the evacuation on people's own initiatives. Also the moment to start the evacuation seems to be earlier due to this.

There is a distinction between day two with the river scenario and day one and two with coast scenarios. This indicates that the evacuation response of people not only depends on the information provided but also on the cause of the flooding. Overall this study shows that communication and information has an effect on the response of individuals but not necessarily in the way that is expected. Government can influence people's response in a way but the effect of this communication seems to have limits. Also some responses are more susceptible to be influence by information than others.

Interesting aspects for further research are therefore 1) to investigate more in- depth which responses during evacuation are subjective and likely to be influenced by information and which are more static; 2) the relation of crisis communication and information on credibility and risk awareness; and 3) the evacuation response of individuals to improved risk awareness and credibility of information.

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