

## **PUBLIC REACTIONS TO THE CONFRONTATION WITH AN INDUSTRIAL HAZARD**

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### **ABSTRACT**

In this study differences in feelings of insecurity and ways of coping were assessed between 225 residents of an industrial area near a chemical complex and a control group at a distance of at least 15 kilometers from that complex. The results show that the residents of the industrial area judge the hazards as less threatening and less unacceptable than the control group and report less feelings of insecurity. No differences were found between the residents of the industrial area and the control group with regard to another hazard, namely living nearby an area for the storage of radioactive waste. When the residents of the industrial area are divided into subgroups no differences exist with respect to judgment, feelings of insecurity or ways of coping with both hazards. The results are mainly explained by the interaction-effect between direct behavioral experience with the risk-object and the effect of mass media.

### **INTRODUCTION**

The assessment and acceptance of industrial and technological hazards is based to a considerable extent upon experience. Most individuals do not have direct behavioral experiences and base their assessment on mass media reports. Far fewer people can call upon direct personal experiences, which will be the case for some people living in the neighborhood of hazardous industrial activities. Assuming that a number of negative aspects is associated with industrial and technological activities, it would be expected that the assessment of the hazards would become more negative, the nearer the people concerned live to the risk area. However, research has shown that people living close to an existing nuclear power plant assess this form of energy production to be more acceptable than people living far away. Maderthaner et al. [11] found that people in Vienna living very close to a nuclear reactor, considered the latter to be less hazardous than people living

further away. Also Harris [9, 10] established that the safety of nuclear installations was rated higher by people living in the neighborhood of the plant than by the population as a whole. Chiva [4] also concluded that people living in the vicinity of the hazard rated the associated risks less highly.

In the Netherlands, Midden et al. [13] established that people living closest to a nuclear plant rated the negative consequences to be less serious and less probable than people living further away. However, no significant differences between the two groups were found concerning the advantages of nuclear power, but Ester et al. [5] did find such differences.

Rogers [15] tries to explain the unexpected positive attitude of people living in the vicinity of nuclear power plants. His main assumptions are (a) the residents of a nuclear plant area, on the basis of their own personal experience of living with the potential hazard and the inherent low probability of an accident, assign a lower probability to the risks associated with nuclear power plants; (b) on the basis of the cognitive dissonance theory [6], it can be assumed that the cognitive dissonance that occurs by not emigrating from the risk area, and therefore by accepting the risks of nuclear power, is reduced by estimating the risks less highly; (c) people living near to the risk area have a preference for/or are economically dependent on, nuclear energy, and therefore have a more positive attitude towards it; (d) people living in the neighborhood of the hazard are more altruistic considering the interests of society. Rogers found no empirical support for the cognitive dissonance and the altruistic explanations, but did find weak evidence for the other two.

The question is whether the positive attitude of people living in the neighborhood of nuclear power plants is paralleled by that of people living in the vicinity of large-scale chemical industries. This question has become relevant since the implementation of the Post-Seveso policy guidelines in the Netherlands, which state that the residents of some 70 (mainly chemical) industrial areas must be informed of the risks facing them. A negative attitude and strong feelings of insecurity in these people could hinder or even prevent the transfer of this information.

The reactions of people living close to a petrochemical industrial complex were analyzed in a study by Vlek and Stallen [18]. This study took place among the inhabitants of the Rhine delta area, who were subdivided into categories on the basis of their living distance from the industrial complex, namely 2km, 2 to 5km, 5 to 10km and further than 50km. It was found that the feelings of insecurity were lowest at 2 to 5km, while the greatest insecurity was felt by the people living closest to the plant. It was remarkable, however, that the two groups living closest to the plant rated the risk to be more acceptable than the people living further away. Stallen and Tomas [17] also conducted a study in the Rhine delta area. They differentiated between four distance groups, namely 0 to 0.5km, 0.5 to 1km, 1 to 2km, and 2 to 4km. Furthermore, they made use of two control

groups. Their hypothesis that the closer people live to the industrial complex, the greater their feelings of insecurity, was not supported. In the immediate surroundings of the complex, feelings of insecurity were quite high, then dropped drastically to peak again at about 1km, and then diminished. This implies furthermore that the people in the control groups had lower feelings of insecurity than the people living close to the complex.

We established that a number of inconsistencies existed between the findings of the study of Vlek and Stallen [18] and that of Stallen and Tomas [17], concerning the people living in the direct vicinity of the complex. It was found that in both studies the distances at which the lowest, but also the highest feelings of insecurity existed, did not agree. Apart from the inconsistency in the results - it should be remembered that both studies concerned the same industrial area - the selection of the control groups is questionable. In the study of Vlek and Stallen [18], the group living at more than 50km from the complex can be considered as a control group. However, specific information concerning this group is lacking, so it is questionable as to whether the demographic variables of this group are comparable to those of the inhabitants of the Rhine delta. In the study of Stallen and Tomas [18], residents of Rotterdam and Apeldoorn were used as control groups. The researchers themselves remarked that these people differed in a number of aspects from the residents of the industrial area. We doubt whether these two studies form a sufficient basis to conclude that people living in the neighborhood of a petrochemical complex have more feelings of insecurity than people living further away. Moreover, this conclusion is inconsistent with the findings of Vlek and Stallen [18], that people living in the direct vicinity of the complex rated the risk to be more acceptable than people living further away.

The main aim of our study was to investigate to what extent the residents of an industrial complex area differed from people living further away, with respect to feelings of insecurity. Furthermore, we also investigated a number of other affective, cognitive and behavioral reactions to hazards. We used a control group which we assumed did not differ on a number of demographic variables from the residents of the industrial area we used in our study. In this way, differences in reactions between the two groups could be established. In order to establish whether the people living in the vicinity of the chemical complex react differently to technological risks in general, we did not restrict the risk-object to a situation very similar to the chemical plant, but we also confronted them with a different type of risk-object, namely the storage of radioactive waste.

## PROCEDURE

The study was aimed to compare the reactions of people living in the neighborhood of the

DSM-complex in the southern part of the Netherlands with those in a control region. As DSM-residents we considered the inhabitants of the towns Beek, Geleen and Stein, which all lie within a radius of 3km from the chemical complex. The control group was made up of inhabitants of the towns Roermond, Echt, Weert and Nederweert, all in the region Limburg, which lie at a distance of at least 15km from the DSM-complex. These towns agreed quite well in size with those in the neighborhood of the plant.

Among the inhabitants of both areas, two aselect samples were drawn up from the Post Office address data bank of private telephone owners, and in May 1985, these people were sent a questionnaire. The response in the DSM area was 44% (n = 225) and in the control region 43% (n = 188). About 70% of the respondents was male, about 30% female.

In the questionnaire the respondent was confronted with the following instructions:

'Imagine the following situation:

You live in the vicinity of a large chemical plant, where among others plastics and artificial fertilizers are made. During the production process, chemicals are used which could form a hazard for the surroundings of the plant.'

This description was applicable to the DSM-complex. After answering a number of related questions, the respondent was confronted with another risk-object, and was instructed as follows:

'Imagine the following situation:

You live in the vicinity of an industrial estate where in the near future an above-ground storage facility will be constructed for light and medium radioactive waste.'

We measured: (a) the acceptability of the environmental hazards [see, 12], (b) dread of the risks [see, e.g., 7], (c) emotional reactions elicited by those risks [see, e.g., 3, 17], (d) the way people cope with risks [see, e.g., 2], (e) somatic complaints [see, 1] and feelings of wellbeing [see, 14] and (f) some demographic variables.

- a) The unacceptability towards the risks was measured on 5-point scales. The subjects indicated their objection and unacceptability towards living in the neighborhood of the hazard, and how risky it would be living there. These three items were found to form a reliable scale (Cronbach's alpha = .84).
- b) The dread of risks was measured on 5-point scales. The subjects indicated how threatening the possibility of an accident would be, whether the consequences of an accident could be controlled, and whether accidents could be prevented by present safety measures. The 3 items formed a sufficiently reliable scale ( $\alpha = .67$ ).
- c) The feelings of insecurity were expressed on 4-point scales indicating whether imagining the risks made the subjects feel tense, nervous, restless, or fearful. ( $\alpha = .92$ .)

- d) We distinguished between three ways of coping with risks: information seeking, avoidance behavior and behavioral intentions. Information seeking was measured on 5-point scales by asking the subjects whether they would consult 11 possible sources of information such as the mass media, the authorities, or interest groups ( $\alpha = .83$ ). Avoidance was measured on 5-point scales. The subjects indicated whether they would not worry about the risk, neglect the risk, resign themselves to the situation, and try to concentrate on something else ( $\alpha = .77$ ). Behavioral intentions were also determined on 5-point scales. Respondents indicated whether they would take part in a protest activity, join a pressure group, call in the press or talk to the local council. The four items formed a reliable scale ( $\alpha = .80$ ).
- e) Somatic complaints and feelings of wellbeing. Further we investigated physical complaints and the general feelings of wellbeing. Six questions (5-point scales) were included to study the somatic complaints, based on the Dutch version of the Symptom Checklist [1]. The items formed a reliable scale ( $\alpha = .79$ ). Feelings of wellbeing has so far received but little attention in relation to industrial hazards. Hence, four questions from the Self-assessment questionnaire [14], which formed a reliable scale ( $\alpha = .81$ ), were also included in the study.
- f) The questionnaire contained questions relating to the demographic variables age, sex, education and political preference. Further, the respondents were asked whether they were employed by a chemical concern, and which regional/national newspapers they read. The living distance of the residents of the industrial area was calculated by determining the location of the address from the postcode and hence the distance from the complex.

## RESULTS

As a control on the manipulation, the respondents were asked whether a location existed, within a few kilometers of their homes, which agreed with the description in the questionnaire of the chemical plant and the storage facility for radioactive waste. Concerning the chemical plant, 82% of the respondents in the vicinity of the DSM-complex indicated that this was the case, and 12% of the respondents in the control region. Concerning the storage of radioactive waste, the numbers were respectively 5% and 3%. On the basis of these figures we can assume that the respondents found that our description of the chemical plant applied to the DSM-complex, and that the storage facility for radioactive waste was not seen as a local situation. Likewise, we analyzed whether the residents of the industrial area and the people in the control group differed in terms of the demographic variables age, sex, education and political preference, and it appeared that

no significant differences existed between the two groups. We also established that the two groups did not differ in the subscription rate to regional and national daily newspapers. We did find that among the people living in the vicinity of the DSM-complex, significantly more people were employed by the chemical industry than in the control group ( $\chi^2 = 41.99$ ,  $df = 1$ ,  $p < .001$ ). An analysis of variance (ANOVA) showed that the people employed by the chemical industry considered the risks of living in the vicinity of a complex to be less threatening ( $F_{(1,181)} = 10.5$ ,  $p < .001$ ), and they furthermore showed less feelings of insecurity ( $F_{(1,176)} = 7.3$ ,  $p < .01$ ) than the people not employed in the chemical industry. This meant that we had to take this into account by including the variable as a covariate in the subsequent analyses.

In table 1 are presented the average scores of the residents of the industrial area and the control group for the two risk-objects, with the uncorrected data in the left column and in the right column the data corrected for employment in the chemical industry and the incorrect answers to the question whether the hazard we described occurred in the vicinity of the respondents' place of residence.

TABLE 1  
Average corrected and uncorrected scores on reactions to the environmental hazards 'chemical plant' and 'radioactive waste' as well as scores on somatic complaints and feelings of wellbeing, of DSM residents ( $n = 225$ ) and a control group ( $n = 188$ ).

hazards	'chemical plant'				'Radioactive waste'			
	uncorrected		corrected		uncorrected		corrected	
	DSM	CON	DSM	CON	DSM	CON	DSM	CON
Dread	3.4	3.8**	3.4	3.8**	3.9	4.0	3.9	4.0
Unacceptability	3.1	4.1***	2.9	4.1***	4.1	4.2	4.1	4.3
Feelings of insecurity	1.4	1.8***	1.4	1.8***	1.9	2.1	1.9	2.1
Avoidance behavior <sup>1</sup>	3.6	3.9**	3.6	3.9**	4.0	4.1	4.0	4.1
Information seeking	2.8	3.0**	2.7	3.0	3.1	3.2	3.1	3.2
Behavioral intentions	2.4	2.9***	2.3	2.9***	2.8	3.1*	2.8	3.1
Somatic complaints	2.1	2.0	2.1	2.0				
Feelings of wellbeing	2.8	2.8	2.8	2.8				

1) A low score here means more avoidance behavior.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$

It emerged from a multivariate analysis of variance (MANOVA) of the uncorrected data that the residents of the DSM area assessed the risk-object 'chemical plant' significantly more positively than the respondents in the control group ( $F_{(1,378)} = 31.24$ ,  $p < .001$ ). A univariate

analysis of variance showed that the residents of the industrial area considered the risk-object to be less threatening ( $F_{(1,404)} = 9.76, p < .01$ ) and less unacceptable ( $F_{(1,404)} = 65.86, p < .001$ ). It further appeared that the people living in the vicinity of the hazard had less feelings of insecurity with respect to the risk-object 'chemical plant' than the respondents in the control group ( $F_{(1,378)} = 32.81, p < .001$ ). A multivariate analysis of variance showed furthermore that the residents of the industrial area coped less actively with the risk than the control group ( $F_{(1,378)} = 21.32, p < .001$ ). In an univariate analysis of variance we found that the people living in the vicinity of the hazard showed more avoidance reactions ( $F_{(1,371)} = 7.50, p < .01$ ), indicated that they would seek less information ( $F_{(1,371)} = 7.44, p < .01$ ), and showed less behavioral intentions ( $F_{(1,371)} = 33.10, p < .001$ ) than the control group. No significant differences were found between the two groups with respect to somatic complaints and feelings of wellbeing. As can be seen in table 1, a subsequent analysis of the corrected scores did not alter the general picture. With the exception of information seeking, all other significant differences between the two groups remained significant after correction of the data. We also performed a number of analyses of variance concerning reactions to living in the vicinity of a storage facility for radioactive waste (see table 1). With respect to this risk-object, for the uncorrected data only one significant difference was found (behavioral intentions), but after correction even this difference disappeared.

In order to investigate whether differences existed in the reactions among the residents of the DSM area, dependent on the absolute living distance from the industrial complex, these respondents were subdivided into four categories based on living distance, namely within 0.5km, from 0.5 to 1km, from 1 to 1.5km, and from 1.5 to 3km. Between these four distance groups no significant differences were found in age, sex, education and political preference, and also regarding employment in the chemical industry. Table 2 presents the average scores with respect to living in the vicinity of the chemical plant, for the four distance groups.

TABLE 2  
Average scores for reactions to the environmental hazard 'chemical plant' of DSM residents, subdivided in four categories based on living distance to the chemical plant, as well as scores on somatic complaints and feelings of wellbeing.

distance in kilometers	0-0.5	0.5-1	1-1.5	1.5-3
Dread	3.5	3.4	3.5	3.6
Unacceptability	3.2	2.9	3.1	3.4
Feelings of insecurity	1.6	1.4	1.3	1.5
Avoidance behavior	3.7	3.6	3.6	3.6
Information seeking	2.6	2.8	2.8	2.8
Behavioral intentions	2.5	2.4	2.4	2.5
Somatic complaints	2.1	2.2	1.9	2.1
Feelings of wellbeing	3.1	2.8	2.5	2.9**

An analysis of variance revealed no significant differences between the groups for the assessment of the risk, the feelings of insecurity and active coping with the hazard. Also the level of somatic complaints did not differ significantly, but we did find a significant difference between the groups concerning the feelings of wellbeing. From table 2 it can be seen that the group living closest to the DSM-complex showed the greatest level of wellbeing, but this difference was only significant compared to the group living at a distance of 1 to 1.5km from the complex ( $F_{(1,84)} = 8.29, p < .01$ ).

## DISCUSSION

Our study concerned the reactions of people towards living in the proximity of a large chemical complex (DSM-Limburg). The DSM residents reacted more positively than the control group. The residents of the industrial area perceived the hazard to be less threatening and less unacceptable and indicated having less feelings of insecurity and coped less actively with the risk. People living in the vicinity of the DSM-complex did not show more somatic complaints than the control group, and had a comparable level of feelings of wellbeing. We established that the DSM residents in general did not react more positively to technological risks, because for the storage of radioactive waste we found no differences with the control group. When the DSM residents were subdivided into four groups, depending on the absolute living distance from the DSM-complex, it appeared that these groups did not differ regarding the assessment of living in the vicinity of a large chemical complex, the extent to which this hazard caused feelings of insecurity, and the way of coping with the risk. Hence, in this study we found no support for the relation reported

elsewhere [17, 18] between living distance from the industrial complex and feelings of insecurity. Some relation did exist between living distance and the feelings of wellbeing; people living closest to the plant scoring highest. However, no systematic reduction in feelings of wellbeing was found as a function of living distance from the DSM-complex.

Rogers [15] offers four possible explanations for the positive attitude of people living in the direct neighborhood of nuclear plants, which also could apply to the residents of a chemical complex. A certain economic dependence of these residents upon the industrial complex could explain this result. We indeed found that more people were employed by the chemical industry among the DSM residents than in the control region. Furthermore, we established that this particular group of employees found the hazard to be less threatening and had less feelings of insecurity. After correction for this economic dependence, however, the differences between the DSM residents and the control region remained significant, which means that the economic dependence is not the main factor to explain the effect.

People living in the neighborhood of a large industrial complex might be more altruistic i.e. more concerned about the interests of society than the rest of the population. This explanation could be valid if they also reacted more positively towards other technological hazards, but as we demonstrated with respect to the storage of radioactive waste, this was definitely not the case.

The explanation that acceptance of the risk reduces cognitive dissonance, which results in a more positive assessment cannot be eliminated on the basis of our study.

The fourth possible explanation for the effect we demonstrated could be that the DSM residents on the basis of their direct experiences with the potential hazards assign a low probability to an accident. However, the situation for the DSM residents is quite different from people living in the surroundings of nuclear power plants who in general do not observe any pollution or industrial accidents. In the period preceding our study, however, a large number of incidents did occur at the DSM-complex such as the emission of polyethen dust, air and noise pollution and flares, as was reported in a local governmental study [19]. The DSM residents therefore clearly did have direct negative experiences with the complex, so this explanation is not tenable.

We established that the mass media and in particular the daily newspapers play a very important role in people's assessment of technological and environmental hazards [3]. We established that newspapers differed enormously in the coverage of environmental hazards but the disquieting content did not differ. Another remarkable result of that study was that the readers of newspapers which paid a lot of attention to these hazards had significantly more feelings of insecurity and reacted more negatively than the readers of newspapers which published relatively little on this subject. In our opinion it was the quantity of newspaper coverage of technological and environmental hazards which was the

the main factor explaining the differences in the reactions of the readers. However, DSM residents and the inhabitants of the control region did not differ in the subscription rate to daily newspapers. The conclusion is that the difference in reactions between the people living in the vicinity of the DSM-complex and the residents of the control region cannot be explained by the influence of daily newspapers as a separate factor.

We stated that the DSM residents had many direct behavioral experiences with the hazard, while we can assume that the inhabitants of the control region did not have these experiences. In an earlier experiment [8, 16] we showed that people having direct behavioral experiences with a particular topic were less influenced by information on that topic than people who had no such experiences. People with direct experience in particular had problems with information that was incompatible and contrary to their own experiences. Moreover, it appeared that this group was also less influenced by written information. This implies that direct behavioral experiences apparently can hinder the transfer of information, which is in particular the case for written information, but we assume also for printed information in general, including newspapers. The relatively positive attitude of the DSM residents, who have many direct experiences with the risk-object, can in our view be explained by the interaction effect between behavioral experiences and the influence of the mass media. This group is less influenced by the reports in the newspapers and react less negatively to this risk-object than people living in the control area, who have no direct behavioral experiences with the risk-object and who are to a great extent dependent for their information on the media.

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