

# Teaching kids about risk in a spatial planning context

How to deal with risk and learn to make decisions under conditions of  
uncertainty in a spatial planning context

Discussion / research

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*“It is by what we do ourselves that we learn”*  
Bertrand Russell, On Education

*“For truly it is to be noted that children’s  
plays are not sports, and should be deemed  
as their most serious actions”*  
Michel de Montagne, Essays

## Abstract

### **Can kids be taught to use the risk-concept with confidence?**

*Using the risk-concept proves difficult for many grown-up lay people. They tend to use the terms “risk”, “problem” and “danger” more or less interchangeably. Probabilities are often ignored. Decisions which rest on misunderstood risk-based information tend to focus on problems with a low probability of occurring. More pressing problems, or problems that are framed in terms of uncertainty, are often ignored.*

*We aim to give kids, the grown-ups of tomorrow, a better understanding of statistical risk- information. Also we help them understand how their minds and bodies process information. Because learning happens in many different ways, we use games to help kids grasp the central concepts. Because most learning needs to be put into practice if it is to lead to real understanding, we let the kids design a workable neighborhood containing risk-sources. They have to explain and defend their choices. Thus they practice both decision-making about risks, and dealing with uncertain information.*

*Evaluation: a qualitative evaluation revealed that the kids understood the risk-concept and retained this knowledge after 9 months. Another evaluation showed kids were less worried about low-probability scenario’s (terrorist attacks) after receiving these lessons.*

*We would like to stress that this article should be seen for what it is: a short introduction to a potentially big topic. Almost every aspect of the cross-disciplinary approach that we attempt calls for a more detailed examination. Also the different steps and combinations that we use merit serious scientific attention. We intend to provide this in subsequent work.*

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## 1. Introduction

In this position paper we present the first, and we feel promising results of a pilot project in Holland that aims to teach children of primary school-age (10-12 years of age) to deal with the risk-concept. We chose as a first possible context in which to learn to work with risk a version of the Dutch spatial planning process of individual and societal risks (in Dutch law termed external safety risks), adapted to be used in an educational setting. Since 2012 we have run several pilots, and have from these evaluated two. The results of these evaluations indicated a positive qualitative effect. We would like to present the results here, as the consequences and benefits of being able to teach kids to learn to use the risk-approach are potentially far reaching.

Decision-making as a social activity is becoming ever more important. And ever more difficult, we might add. However, the relevance of the risk-approach as an aid to decision-making remains largely unrecognized. We aim to change that.

The structure of this paper is as follows: in this **Introduction** we briefly reflect on some of the conditions that gave us the prompters to try to teach “the concept of risk and how to use it” to young children. We also make some background remarks as to the positioning of this fundamentally new element in the field of risk-analysis in the second section (**Risk at the crossroads**). We feel these remarks are needed to make sense of our endeavor. A brief sketch of the lessons (as taught in the first pilot) is presented in the third section (**What did we develop and test?**). The results of the observations (the first pilot was evaluated twice) are described in the fourth section (**Observation and discussion**). Some reflections on the usefulness of our findings, and some promising next steps are also discussed here. We conclude with some contemporary developments (**Further developments and acknowledgements**).

The risk- approach was, at the time our pilot started in 2012, used in the Netherlands to decide on the acceptability of societal and individual risks in Dutch spatial planning <sup>i</sup>. However, this prescribed use of the risk-concept by local government generated confusion. An evaluation (rapport Haskoning, 2010) <sup>ii</sup> specifically noted that the obligation for local authorities to *explicitly accept the risks* was not well understood. This result hinted at a possible suboptimal understanding of the meaning of the word “risk”. There are of course several reasons that can and have been identified as causes for this imperfect understanding of the risk-approach (Geerts & Scheres, 2011).

We assumed that education might heighten the current level of understanding of the risk-concept and its uses. Furthermore it is helpful to have some experience in using it, so that you become familiar with its different aspects. You simply have to learn to work with it.

Western society is gradually becoming ever more risk-aware.<sup>iii</sup> By this we mean that both individuals and organizations are increasingly aware that they are involved in decision-making in which not all available knowledge about the risks is undisputed. Furthermore: not all possible negative consequences of the choices under consideration can be avoided or mitigated. This means, quite simply: things might go wrong. We experienced, and continue to experience, on a first hand basis the trouble many grown-ups have in dealing with the risk-concept used in the environmental safety legislation, and also with the uncertainty that is connected with it.<sup>iv</sup>

It is relevant to make clear first of all that we work on a municipal level with (well-trained) professionals. These are engaged in relatively longstanding, legally defined procedures. Their different responsibilities concern the following:

1. for the safety-region (Veiligheidsregio)- people this is the advice they are required to give on spatial developments about the possible risks and the measures that can be taken to mitigate the risks;
2. for spatial planners the city planning & design-work in those areas where risk-sources are present;
3. and for the city council itself the need to express a judgement about the acceptability of specific external safety risks in this local spatial planning context.

The different aspects that need to be addressed are all specified in the BEVI “Besluit Externe Veiligheid Inrichtingen”.<sup>3</sup>

The incomplete understanding these people displayed concerning the nature of the risk-concept had adverse consequences. For starters it led to decisions being taken in which the obligation to reflect on the acceptability of the risk under consideration was sometimes re-constructed to become a yes-no test. It thus became the answer to a question: “does the risk after development fall above or below the reference value?” The Dutch term for this reference value is “oriëntatiewaarde” and it is crucial to note that this oriëntatiewaarde is *not a legally binding norm*. This makes the question as to the exact position of the risk in relation to the oriëntatiewaarde essentially meaningless (Geerts et al, 2016).<sup>v</sup> One of our reviewers pointed out that reconstructing the question so as to include the possibility to compare your decision to a reference point is not in itself wrong. We agree with this, and we will clarify our remarks by giving more information about the BEVI-law in the following footnote.<sup>vi</sup> In other cases the obligation to reflect on the acceptability of a given risk was simply ignored<sup>vii, viii</sup>. We feel that at least some of these unhelpful reconstructions of the question correspond with the demarcation that Knight<sup>ix</sup> introduced between risk and uncertainty. This demarcation makes sense within the narrow domain of actuarial application only, because it marks the difference between computable and non-computable probability distributions. Outside the actuarial domain this demarcation has had unfortunate consequences that linger on to this day. Even among professionals a distressingly high percentage of people think that all risks can be adequately expressed by the “probability times consequences-approach”. This has the logical but unfortunate consequence that people feel that they are justified to worry about any remaining uncertainty.<sup>x</sup> This “uncertainty conceptualized as a problem” (instead of a lamentable but unfortunately unchangeable given) then leads to confusion, frustration and to an increased unwillingness to use risk-based approaches as a way to organize available information and aid decision-making<sup>xi xii</sup>.

It’s our impression that societal decisions are increasingly being framed as risk-handling problems.<sup>xiii</sup> Therefore it seemed sensible to see if the risk-concept proper is teachable to younger people. By learning what risk really is, people can learn to appreciate what the term actually means. A risk does not mean we face imminent danger. And paradoxically: refusing to take any risk at all, might land us into greater trouble in the end. So we have to make a balanced judgement and decide which risks we find acceptable and which ones we consider are too likely to develop into something unwanted.

By educating kids about the nature of the risk-concept, they can learn to see that risk has problematic and beneficial sides alike. They can learn to see that a risk approach can help to guide decision-making in certain specific situations. They might from increased familiarity feel less frightened in using risk-based considerations to organize their thinking and consequent decision-making.

This idea, as far as we know, is new.

There are several possible reasons that explain why teaching about risk is not yet a standard element of the curriculum. The risk field firstly is a relatively young discipline, and the merits and applicability of the developments in this field are not yet widely appreciated outside of the academic community (Aven; 2016)<sup>xiv</sup>. Furthermore, the risk-concept is by nature interdisciplinary, which makes it difficult to pigeonhole it into an existing (category of) subjects taught in schools. Lastly, risks are viewed predominantly as negative entities, as something to be avoided. It is not strange therefore that up to now the usefulness of the risk-concept as an aid in decision-making is undervalued to the point of being invisible. We aim to change that.

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<sup>3</sup> [http://wetten.overheid.nl/BWBR0016767/2007-10-17#Paragraaf8\\_Artikel12-13](http://wetten.overheid.nl/BWBR0016767/2007-10-17#Paragraaf8_Artikel12-13)

## 2. Risk at the crossroads, and beyond...

*The Risk- concept as seen from a scientific perspective is essentially interdisciplinary; also at some point risk-based considerations move beyond the domain of science and into the sphere of ethical considerations, as risks demand a value judgement*

As noted, the risk-approach sits at the cross-roads of many scientific disciplines. To name but a few: Statistics and Psychology; Geography and Communication; Economics and Political science.

Furthermore, and we feel more importantly, the risk-concept joins hands with both the science of decision-making and the ethics of decision-making. This is because a decision involving risks usually concerns distributing drawbacks and benefits unevenly across society. There is an aspect of irreducible subjectivity connected to the acceptability of any risk. It is of course perfectly possible to construct a logically sound judgement about the acceptability of any risk. The subjectivity we refer to concerns the a- prioris, the often unquestioned “givens” that mark the starting point from which we develop our argument. This starting point, that determines for instance the breadth of our analysis, or the parameters to be included, is always a matter of choice.<sup>xv</sup> At the beginning of any decision-making process which involves risks, the question “What do we, after having considered the benefits and drawbacks, accept?” should be addressed. Ideally (representatives of) everybody who can be potentially touched by the consequences of the risk (both beneficial and harmful) is involved in this deliberation. And the deliberation is then followed by an explicit and understandable answer to this question.

*Why is it important to mention this in the context of risk-lessons?*

Because it would in our view be wrong, although this has often been tried, to dissolve this subjectivity into fixed rules of law, or yet more detailed and state-of-the-art calculations<sup>xvi</sup>. This subjectivity is unavoidable for 3 reasons:

- 1) The fundamentally uncertain nature of the available data which underpin the decision;
- 2) The infinitely varied connections and interdependencies that exist between any specific risk and the social context in which it is proposed.

These two aspects of the risk-concept preclude the straightforward application of a set of rules, however refined, to reach an acceptable judgement. Furthermore, because we deal with societal risks, we will have to arrive at a shared decision in a situation where goals and values are likely to be contested.

- 3) This means that conflict, in one form or another, is part of this irreducible political nature.

From these three unalienable aspects of the process of political decision-making we conclude that to be ultimately successful in our efforts to position the risk-concept, we need to an extent to leave the scientific search for still more objective knowledge, and engage in another search, to wit: for the way in which the scientific knowledge we found can be so positioned that it can help ease the burden of political decision-making *without altering its essentially subjective and conflictual nature.* <sup>xvii</sup>

*The essence of the risk-approach is that it is a tool (nothing more) to facilitate decision-making*

Especially from a governmental/governance perspective the risk-approach therefore is highly interesting because it is a way to facilitate complex and difficult decision-making by giving a better understanding of the way to organize the available information into preferable and less-preferable choices. Especially, the potentialities that the risk-approach offers to improve the societal debate about uncertain knowledge is very promising and exciting to explore.

We move into an era of ever more uncertain knowledge on almost every conceivable field: “ what developments will we accept in the field of human genomics?”, “how to tackle climate change?” and “what macro-economic policies to pursue?”, to name but three of the fields in which decisions we make are likely to have far-reaching but partly unknown consequences. Also we

will have as a society to come round to the fact that it will be almost impossible to arrive at certain knowledge in these domains.<sup>xviii</sup> This means that being able to deal with *unresolved uncertainty* becomes important also. At the same time the urgency that people experience to act on this uncertain information grows. And thirdly, the arena in which decisions are taken changes fast. We move from predominantly hierarchal societies with relatively predictable and defined lines of power and influence into ever more network-oriented/ multi-actor/complex interdependencies-arenas.<sup>xix</sup> This means that the uncertainty we have to deal with does not only concern the content and ambiguity of (the scientific findings under) the topic under discussion, but also envelops the decision-making process itself. The uncertainty in the decision-making process centers around the way in which a critical minimum level of legitimacy for any taken decision can be reached. The challenge lies in opening up the possibility to re-politise elements of the risk-producing-process that are now considered unproblematic (Beck 1992).

It is therefore of paramount importance to gain as good an understanding as possible of the instruments that can help people remain on top of the decision-making process under these daunting new societal realities. Personally we would feel very happy if we could help people understand, if only a little bit, that this troubling ill-named thing, Risk, is actually a friend, and is not to be feared.

### ***How did we structure our research?***

Every scientific discipline has its conventional wisdoms (Galbraith 1998), its accepted dogmas and paradigms, which are as useful in structuring ideas and identifying promising research topics, as they can be blinding to less obvious other topics (Fleck 1935). Because of the essentially blank field before us, we preferred to be as empirical as possible. Guided by a few well developed ideas from different disciplines to direct our experiments, our aim was to see if the approach we developed would yield results. Small pilots, that could easily be adapted, would give us over time valuable data with which to refine our initial ideas. We aim to work as broadly as possible and incorporate new information into our design as we progress. Thereby we hope in time to arrive at a somewhat generalizable idea of the sort of didactic approaches that would be suitable under different sets of cultural contexts, and to guide and help people in their dialogues about different kinds of risks.

### ***Main elements of the theoretical basis on which we developed the lessons.***

Following is a set of very brief introductions to the thoughts we based our experiments on, and the hypotheses to be tested

#### *age for first exposure matters*

- this element originates in Bertrand Russell “On education” (Russell 1920). He states that fear and anxiety are partly inborn, but partly cultural and thus learned. He so engendered our question/ research hypothesis “does the age at which one is exposed for the first time to explicit information about risks matter for the emotional/ cognitive reaction one has to it?” . Zajonc (Zajonc 1980), who did research on first impressions and the difficulty people have in changing their mind, gave us some useful insights.

#### *do people really understand the risk concept, our could they use the word whilst in fact meaning something else ?*

- this element originates in Ludwig Wittgenstein (Wittgenstein 1922), and addresses the question: how well does a word capture the thing it points to? And is this communicable in the intended fashion (i.e.: does the recipient of my message understand it in the same way I do)? We also found inspiration in Daniel Kahneman (Kahneman 2008), especially in his thoughts on how we reconstruct difficult questions: If a question is actually too difficult to answer (f.i. a knowledge-based answer to the question: “are Volvos good cars?”) I will replace this question with a simpler one (“do I like Volvos?”) without noticing it.<sup>4</sup> The hypothesis we formulated reads: “how well does a word capture the abstract concept it is referring to? How do implicit supporting associations guide or influence one’s

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<sup>4</sup> NB: We kindly invite you, dear reader, to help us: this needs more thinking, because there seems to be a subtle difference here that we cannot now catch.

understanding of a concept; and how do these same implicit associations hinder a real communication by use of the explicit word?”

*how do emotions affect your decision making?*

- This element originates in Kahneman’s and Tversky’s work on the affect heuristic (Kahneman 1982) and addresses the question/research hypothesis “Does it help to include in the teaching about risk the scientific understanding that your brain distorts available information?” People’s thinking is not a straightforward and level process in which all the available information is coolly evaluated. Rather it is a skewed affair in which, following predictable patterns, certain bits of information actually get significantly more attention and therefore have a larger effect on the eventually reached decision. This leads to decisions that are actually distorted as they do not really rest evenly on all the available information. Decisions for instance are influenced predominantly by scenarios that are easily retrieved (availability heuristic) or by scenarios that have a prominent emotion attached to them (saliency heuristic.). If you inform people about this distorting tendency, will this make them more receptive to the risk message proper? Do they for instance correct their own initial responses?

*Is learning just cognitive, or physical as well?*

- This element originates in Antonio Damasio’s work (Damasio 1994) on the differentiated but connected roles of brain and body in decision-making. We choose to provide a short explanation here because this element as far as we know is new within the field of risk communication and education: The brain evolved as an differentiated but integrated part of the body to help preserve the physical integrity of the entire organism. This means that neurological signs that this physical integrity is under threat will be of influence in decision-making on the best course of action/ appropriate behavior (very roughly categorized as Fight, Flight or Freeze- behavior). This finding takes our own psychology-based risk- research on the dominance of emotions one step further, because it answers the question that follows after the inquiry into the role of affects. We begin with asking the question: “why are negative scenarios, or scenarios that carry a prominent emotion that make us fearful, dominant over statistical information?” After that we should take this line of questioning further: “why are we fearful?” Answer: Because the body is concerned (mistakenly) that there is an *imminent* threat to physical integrity. So we need to do more than just feed reassuring information of a statistical nature (“the danger is indeed there as one of the many possible future scenarios, but it is very unlikely to materialize”) to the brain only. We should aim to make the body understand and learn the relevance of this statistical information also. That means learning in a physical way to differentiate between an imminent and a possible danger, or more simple still: learn to have a feeling, a confidence about a possible danger as urgent (because it is likely to happen), or not so urgent (because it is unlikely to happen). This physical learning is not new as such: everybody getting acquainted with a new form of sports learns to gradually re-interpret bodily signals and fine-tune their conscious response to these. But in risk-education this is a new element.

*What is the importance of learning by doing?; how important is repeated exposure and practical learning when learning to deal with a new concept?*

- This element originates in John Dewey’s work on learning. (Dewey 1916). The question/ research hypotheses we are seeking to answer are : does repeated exposure, building up confidence help to learn to deal with the risk- concept?

*Can we learn to deal with conflicting views when dealing with risks?*

- This question originates in work by among others Chantal Mouffe (Mouffe 1993) who emphasize the essentially conflictual nature of politics. In politics if a decision needs to be taken on a specific course of action, there is almost never only one correct answer among others that are false. Politics is not, nor will it ever be, a process that can be understood as an analog to natural science processes. The risk- concept helps to structure

information and order possible alternatives and their respective drawbacks in a situation in which a contested decision seems likely. As such it is an instrument that essentially assists in those situations where there are conflicting views but a decision needs to be taken, or in decisions where any alternative under consideration (including doing nothing) has unwanted consequences. This points to the fundamental, but within the political sphere of risk-decision-making not widely recognized reality of *conflict* as a normal aspect of decision-making. And hence to the need to learn to handle conflicts in decision-making.

#### *Other work done in this area*

As far as we could oversee, we are pioneers in teaching kids about risks. When we prepared our study on how to teach kids about risks and, related to this, how to deal with uncertainty back in 2010<sup>xx</sup>, we were not aware of a project in Israel conducted in the second half of the seventies. There, A teaching method was then developed to help children to think under uncertainty.<sup>xxi</sup> In these trial lessons 14-year-old children were educated to improve their skills of probabilistic thinking; the concept “uncertainty” was introduced to them; they were given information about the way our thinking processes lead them astray, and they were given tools to improve their skills when dealing with uncertainty.

#### *New elements in our approach*

The risk-concept that we used as a central feature is not introduced in these lessons developed in Israel. Also, since we hypothesized that (the absence of) prior learning is influential in dealing with the risk concept, we have chosen as our target population a different, younger, age group (See the next section: “what did we develop?”). Furthermore we have introduced a practical element in that we offered the children two practical cases in which to exercise their newly learned knowledge, and exercise also the social aspects of reaching a decision in a context of possible conflict. And lastly, and most importantly we incorporate the possibility of learning about this abstract concept with your body as well.

#### ***What did we develop?***

“Why teach kids about risks? It is important to understand first of all what the risk approach is. A risk-approach does not stimulate dangerous behavior.” This is how we introduce our lessons to lay people. Because most people think that they have a very good idea about what a risk is: “it means there is danger”. Although risk- communication has been developing at a steady pace for at least a few decennia<sup>xxii</sup>, the use of the risk concept in lay-contexts is predominantly problematic. Somewhat surprisingly perhaps we did not have too much trouble convincing several schools about the usefulness lessons about risk could have.

Because the pilot started from scratch, we have developed the material in several stages, which we will now discuss. Luckily we have been able to do some form of evaluation in every stage, so we can report positive qualitative effects in both different approaches developed so far. This strengthens our hypothesis/ idea, that the risk-concept is teachable, and even hints that the precise form in which the concept is introduced might not really be all that important, as long as both cognitive and physical means of communication are present. Repeated exposure however seems crucial. We have of necessity had to collapse in our second pilot the 3 times 1 hour exposure to 1 afternoon, and it seems this somewhat lessens the effectiveness of the lessons.

#### ***Pilot I***

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The first series of lessons were given over a period of 3 weeks, in 3 primary schools in Leiden in 2012, Wassenaar and Hoofddorp, to children aged approximately 11 years old. Each of the lessons lasted for an hour. In the lessons in our first pilot we combined a variety of games and didactic forms to introduce to the kids the different elements of the risk- approach.

#### ***Lesson 1***

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*Introductory discussion about the word “risk”*

In the introductory lesson we explained firstly that we had come to talk with them about risks. And we asked about the different ideas about the meaning of this word they thought of when they heard this word.

*.. what kind of risks can you think of?*

We then proceeded to let them take on the role of a safety professional (firefighter; policeman etc) and inspect an imaginary street for possible risks. After letting them make an inventory we proceeded to discuss the relevance the kids attached to these risks. Which risks would they take, and which not? Is it possible to give some kind of ranking to these different risks? The elements that the children identify are jotted down on a large sheet of paper and retained for the third lesson in which the children will make a spatial planning exercise in which they will include risk-sources.

*Introduction of the concept of chance*

We then introduce a new item: the possibility to think about risks in terms of chances: how likely do you think a risk is? Would it be possible to measure this in any way?

We are going to play some games to get a basic understanding of probability: firstly by using dice that have different numbers of sides (4,6, 8, 10, 12 respectively) we let the children work out that there is a connection between the number of sides a die has, and the likelihood that any specific side is going to be cast.

We then tell them that this game teaches them something about a type of chance that has only a limited number of possible outcomes. Are there other types of chances? We now play a game with a basketball: is it possible to make a prediction about how many times a child will throw the ball through the hoop? Why? Why not? Is there maybe information that is missing so that you cannot really answer this question? Depending on whether the class has already covered percentages we proceed to discuss the possibility to still make some kind of estimate about the likelihood of the different scores.<sup>xxiii</sup> Then a number of children takes two shots and the scores are tallied on the board.

Discussion: is there a difference between the die and the basketball-throw? (To ascertain whether the children have understood the importance of needing additional information?)

## Lesson 2 \_\_\_\_\_

After a short recaption of the things we talked about last lesson, we introduce today's topic:

*Risk and Chance: we saw that there are certain events for which it is not really possible to make predictions about the possible outcomes. You need more information than you have. Also, the situation might change over time as you get more information*

Still in these situations it is possible to work out some kind of estimate. We practice this with different amounts of pingpongballs (resp 10; 100; 1000 balls) to help kids get an understanding for the difference of likely, not so likely and very unlikely. Especially important is that we take this information out of the purely cognitive realm (as when we would have offered this information on paper only) and make it real: through repeated digging into the boxes of balls the possibility of physical aid in understanding this abstract concept (namely the likelihood of a future event) of the children is also engaged.

The question we are going to talk about: "when is the chance of something bad happening small enough? We practice with different scenarios and the children discover that it makes a difference whether the goal is to win a small prize (so positive) or to avoid a negative outcome.

When we discuss this in class we point to the fact that we saw last week that risks are real- even though we have negative feelings about some of the possible outcomes we cannot take them all away. Or could we? What would happen if we never took risks? Are the risks that society engages in smaller than the one with 10 pingpongballs?; 100 pingpongballs etc? Can you imagine a risk that is 1 in a million? How many boxes of pingpongballs would fit in your classroom... can you get a feeling for the really small chances we talk about in policies governing hazardous substances?

### *Risks that are small but also scary*

Usually, when you think about something, you don't just use information. You also have a certain feeling for the idea: it makes you happy and hopeful. And sometimes it can make you feel scared. We are now going to learn something about these emotions. We do this by using a trust fall.

Afterwards in the group we discuss what the children noticed. Have they noticed how a feeling can influence a course of action? Were they scared? Did it help to practice? Did it help to have information that maybe reduces the fear (fi that they would be caught by fellow kids/ the teacher who is stronger?). We also widen this discussion: are there kids that now do things (fi in a sport that they play for some time) that they did not dare to do before? How did they improve their daring?

The teacher guides the discussion about fear and risk: How are they connected? How can we use the knowledge of the likelihood of a risk to lessen our worry? We conclude that it is possible to quantify (give a score) to risks, but this does not give us all the relevant information to decide on it. We need to have more information, and very importantly, we want to get a feeling for how acceptable it is

### Lesson 3 risks in society \_\_\_\_\_

Again recapturing the lessons already learned, we briefly talk about how people generally discuss risks; how we can use chance to express a measure of the likelihood of positive and negative outcomes occurring, and how the feelings we have about these risks are important in helping us to decide.

Now we are going to grow up real fast, and go to work in designing around safety: first we're going to design a playground, and then a city or a city neighborhood.

The first game we play involves designing a playground for toddlers. Kids design a playground and afterwards discuss their design choices. Most important point to be discussed: has the wish for safety been balanced with other design features, or have you made something that is so safe it has become boring?

The second game centers on the same principle but on a different scale: they will design a city block now. They will incorporate all kinds of features in their design like houses, schools, streets etc and also risk sources. The idea is to design a workable city. The kids have some budget to invest in safety measures. This budget is too small of course, forcing them to make trade-offs.

Group discussion centers on their design choices: which risks have they mitigated? Why? What were the reasons to include risks in the first place (have they understood that risk sources have positive effects also? On welfare, employment etc). We emphasize that there are in principle no "wrong" answers: you might do away with the playground entirely because you feel it is unsafe, only have you thought about what might happen then? We try to sensitize kids to the fact that risks are trade-offs.

Concluding discussion with the entire class: we have seen that risks are connected with many aspects in society. Sometimes this risk is very small, sometimes it is bigger. How we feel about this risk is dependent on many factors: the benefits we see, the chance of things going wrong, the feeling we have when we think about things going wrong and also how much experience we have in dealing with this particular risk. The Dutch government also thinks about risks. In general it tries to lower the risk as much as possible, but the risk is generally not taken away completely. As long as we are careful how we deal with these, having certain small risks around us is not a problem.

## **4. Evaluation and discussion**

The second pilot as we mentioned has been constructed a bit differently.

We have been able to evaluate the first pilot twice: directly after conclusion of the lessons<sup>xxiv</sup>, and again (testing whether children had retained any of the information, after nine months) in 2013<sup>xxv</sup>. Both evaluations showed a positive effect, and gave valuable information about the

possible further development of the lessons. We learned for instance that the effectiveness might be even further enhanced if the kids would be given some kind of prior introduction to help them get an understanding of the things we were going to discuss. This might also be useful in classes with a lower social-economic status (we found a difference in level of understanding attained in our classes here. The teachers suggested the lower status class took more time to become engaged to the material).

Overall, after the conclusion of the lessons, the kids had well understood the central features and understood what was asked of them in the different games. They used the risk- concept in their discussions and were able to elaborate their knowledge into examples they thought of themselves. Their teachers confirmed this. Especially they noted that the kids kept talking about risks and risk- associated topics outside class as well.

We conducted the second evaluation because we wanted to see if we could measure any kind of long term effect. We did. We found that the kids had retained the risk concept and remembered several elements of the lessons. Most importantly they had retained the important idea that risks (in some form or other) are a part of life.

As you will see this improved understanding about the essence of the risk-concept is an important basis on which to ground the decision-making about how to think about risk (the way in which it is categorized, either as a problem or as a given, is exceedingly important), and about which risks to take. These results represent a large step in accepting risk as a normal feature of political decision-making instead of recasting risk-as-concept as a problem to be solved.

## 5. Further developments

Since 2016 one of the authors has been giving an adapted and shortened version of these lessons to graduated spatial planners and environmental specialists (in the Ministry of the Environment and Infrastructure summer school). Although it has not been possible to evaluate these lessons, feedback indicates that speaking about risks in a spatial planning contest using games can also be of assistance in taking away the frightening nature of the risk-concept in older people. It would be really exiting to research this further, because this widens the applicability of our approach enormously. Especially in situations where “traditional” forms of risk-communication do not yield the hoped for result ( Löfstedt,2005), teaching about risks in the manner we developed might prove of assistance.

Our goal is to keep giving these lessons and see if in 2017 we can solidify their theoretical basis to gain a better understanding of the process of learning about risk. Also via more evaluation we want to get a better understanding of the precise effect of the different didactic forms that we use. There is a huge amount of possible subjects that could be researched. Especially the confidence that is shown by the teacher whilst teaching the lessons could be important (reflecting the fact that we should actually learn to see risk as falling under the normal set of possibilities (albeit as one of the exceedingly rare scenarios to develop out of the current contingent situation (Perrow 1985), and building on earlier research (Zajonc 1980) that hints that helping people develop a good feeling about this concept might be exceedingly important as this feeling both precedes and colors their subsequent conscious reflecting on it).

We are exceedingly grateful therefore to the Provinces of Noord- and of Zuid- Holland respectively which have been liberally and loyally supporting this project ever since 2012. In 2017 we have also been able to secure the support of the Omgevingsdienst West- Holland, which is subsidizing lessons that focus on water-safety which is quickly gaining importance in the Netherlands. It is furthermore exiting to notice ever more parties beginning to take an interest, as we are now, among other parties, conducting talks with Waterboards, the municipality of Leiden, and the Province of Limburg.

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## Endnotes

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- i The risk- approach was introduced in the Netherlands to accommodate the uncertainty inherent in those instances of political decision-making in which the available knowledge did not permit an unambiguous verdict on the acceptability of any decision. Furthermore: the stated policy-goal up to that point of guaranteeing everybody the same level of protection against environmental risks proved unfeasible. (Emerging) risks of all kinds of differing and uncertain natures had to be balanced against the status-quo in which some people were already much more exposed than others. Furthermore, the prohibitive costs of giving everybody the same level of protection posed a real problem and needed to be addressed. But this question (how much money are we willing to spend to solve a problem?) is of course ultimately a political one and cannot be answered by science alone. The risk approach therefore was introduced in 2005 in the BEVI-law. For a historical sketch on the development of the risk approach in the Netherlands (Ale, 2012). The BEVI law aimed at regulating external safety risks in spatial planning developments. The legal requirements in this law state two complementary aspects. First: the obligation to use as much quantitative information as can be viably obtained (expressed in the (F,n)- formula), with the aim of using the chance/ probability aspect to somewhat objectively underpin the decision on whether certain risks were pressing or not so urgent. The second obligation is just as important: to qualify this objective information by giving political (ultimately subjective) reasons for the need to take this risk in the first place. Thus an attempt was made to combine objective (quantitative) aspects and subjective considerations. (see: *Nuchter omgaan met Risico's; bijlage bij het Indicatief Meerjarenprogramma Milieubeheer (1986-1990)*; <http://www.rivm.nl/bibliotheek/rapporten/251701047.pdf>)
- ii Evaluatierapport Verantwoordingsplicht Groeprisico; (2010) in opdracht van het Ministerie van VROM,
- iii This is an observation in the sense of Galbraith's concept of The conventional wisdom (Galbraith,1999). To quote Galbraith: It will be convenient to have a name for the ideas which are esteemed at any time for their acceptability, and it should be a term that emphasizes this predictability. "He narrowed the concept to those commonplace beliefs that are also acceptable and comfortable to society, thus enhancing their ability to resist facts that might diminish them. He pointed at the high degree of resistance in academic economics to new ideas and used the term conventional wisdom to characterize this resistance to facts. To quote Galbraith again "Just as truth ultimately serves to create a consensus, so in the short run does acceptability. Ideas come to be organized around what the community as a whole or particular audiences find acceptable."
- iv Uncertainty is a term that is used in many different meanings, both within and outside the scientific community (see van Asselt, M.B.A. (2000): *Perspective on uncertainty and risk: the PRIMA approach to decision support*. Dordrecht: Kluwer Academic Publishers). Recently efforts have been directed to prune at least the academic proliferation of meanings (see: the SRA-glossary: <http://sra.org/sites/default/files/pdf/SRA-glossary-approved22june2015-x.pdf>) It is however not very likely that this attempt at a more disciplined usage of words will soon have much effect on the confusion that still reigns supreme in society at large.
- v A brief historical background of the chosen values for the 'oriëntatiewaarde' (translated into English: reference value ) can be read in Geerts, R. et al (2016).
- vi This law does in fact contain the possibility to agree on a reference point, by adopting a local policy with key-reference aspects and points for judging the risk-level of any subsequent development. If you create a local policy, you will ideally have a political discussion about this in the city council. Thus at least the possibility for a debate on the acceptability of risks is created. The problem is that most municipalities do not develop this policy (Geerts 2011).
- vii This misinterpretation of the intended use of the reference value stems from the fact that the historical reasons for the use of the reference value have been forgotten; see footnote 1: the Dutch had a distance/ effect-approach which however resulted in prohibitive costs, so we traded it for an imperfectly understood risk- approach. It is really interesting to reflect on the observation that thus one troubling political situation ("we cannot afford to solve the problem") was traded for another one that is actually more pressing ("we will not be equal in the amount of risk we receive"). Because in trading these you change a financial problem into a moral problem while in fact the moral problem could be solved by introducing the possibility of financial re-compensation. Again, a side track but what an fruitful one to explore.

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- viii The oriëntatiewaarde (abr. OW; reference value) is defined by a mathematical relation between the cumulative probability, denoted by  $F$ , and the number of deaths, denoted by  $n$ .  $OW = 10^{-3}/n^2$ . The value that was fixed upon as a result of a political cost-benefit trade off resulted in a situation in which roughly over 90% of the local societal risks fell below the OW. The political relevance of this fact is that in cases where the societal risk clearly rises above the OW, due to a decision to permit a spatial development project, local authority should be aware of the relative high societal risk and therefore good political arguments are needed to justify the decision.
- ix Frank Knight, "Risk, uncertainty and profit, Ithaca New York 1921, chapter 7
- x Because as you will realize: probability times consequences, especially if you ignore epistemic uncertainty, leaves you with a potentially finite number of scenario's which in effect removes the uncertainty.
- xi There are additional problems in dealing with risk that are more closely associated with the specific way the Dutch external safety law has distributed responsibilities. This is also really interesting to consider as it offers much scope for relatively simple improvements, but rather falls outside the scope of this article.
- xii We have noticed again and again that (in the Netherlands) most people professionally involved in the decision making process formally define risk as 'probability (P) times consequence (Q)' or '(utility times p) – (utility times (p-1))'. But they aren't aware of the distinction between expected value, or the probabilistic averaging of consequences, and the linguistic interpretation (Geerts, R., 2013). The linguistic interpretation is that risk is some kind of expression that specifies how probability is related to its consequences. Averaging consequences by probability however is only useful when the decision maker has to deal with a vast population of activities (or actors), where averaging makes sense and is useful for calculating costs and profits in the manner of assurance companies.
- xiii In a few years' time almost the whole of the Dutch spatial planning and environmental law-system will be overhauled and replaced by an integrated version in which norm-based considerations will be replaced by an acceptability-within -a -given- bandwidth)- judgement; so in effect creating a risk- approach for the entire field. If the level of awareness of what it is exactly they are creating will not rise, the societal discussions concerning the acceptable level of risk or uncertainty in all these different and interrelated domains will prove to be confusing, lengthy and unsatisfactory.
- xiv Terje Aven "What Defines Us as Professionals in the Field of Risk Analysis?", Risk Analysis 2016
- xv We could only adequately express this after reflecting on " On the allegations that small risks are treated out of proportion to their importance" Aven; 2015. So not a reference as such but an acknowledgement for help in directing our thinking.
- xvi One of our reviewers pointed out that these *do* have their uses. Again, we agree, but the point we want to make is that rules and calculations should be seen as useful instruments to support decision-making, and not as an acceptable replacement thereof. Dealing with risk concerns the troubling given that most often the costs and benefits are distributed unevenly. This troubling nature is reflected in the difficult political discussions which ideally centre on the compensation which would make this distribution bearable.
- xvii There is something potentially fascinating in this, because it means that in promoting an increased understanding of the uncertainty involved we actually make the decision-process more accessible. Lay people who usually lag far behind when it comes to understanding the intricacies of scientific findings are not at a disadvantage at all when they can accept that most of this in-crowd-knowledge is in itself also uncertain to a degree. And thus decision involves a best estimate resting in ultimo also on what we feel would be the best thing to do. Although having a good understanding of scientific knowledge as opposed to pseudo-science should probably accompany this.
- xviii As opposed to *fi* chemistry: it is important that the scientific community in its communication sharply distinguishes between, on one side processes and problems that scientific methods can capture completely and thus in a way "solve"- as the research on aforementioned chemical reactions (although even these continue to surprise us), and on the other side science directed at researching situations in which the complexity of the interconnected factors is such that the problem will never be completely charted, although this should not be taken to mean that all efforts to gain additional understanding are therefore meaningless (Pigliucci 2010).
- xix Norbert Elias (2012). In 'what is sociology?' Elias introduces the concept of interdependencies and figurations. In understanding the behavior of people we have to look at the interdependency of relations of organizations and institutions. Power is not absolute but relative. The more powerful have to take into account the capabilities of the less powerful in order to achieve their goal. Figurations can be seen as functional relations and networks in society between institutions, organizations. Concepts as fragility, sustainability, the

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connected society all rest on the idea of interdependency and social figurations. (For a practical illustration of these concepts see for example: <https://www.weforum.org/reports/the-global-risks-report-2017> )

<sup>xx</sup> We are grateful to Prof Ragnar E. Löfstedt, KCL, who pointed this out to us

<sup>xxi</sup> . Beyth-Marom R. and Dekel, S (2010): An elementary approach to thinking under uncertainty, NewYork, Routledge

<sup>xxii</sup> . <http://www.soc.iastate.edu/sapp/Fischhoff.pdf>

<sup>xxiii</sup> This differs mainly in the way the question is worded: if they have covered percentages we ask them to give a percentage in their estimate; if not we ask them “how often do you think you’ll hit the hoop?”

<sup>xxiv</sup> [file:///F:/klein%20beginnen/Rap\\_tweede%20evaluatie%20pilot%20lespakket%20risico%2527s\\_7novt2013%20\(1\).pdf](file:///F:/klein%20beginnen/Rap_tweede%20evaluatie%20pilot%20lespakket%20risico%2527s_7novt2013%20(1).pdf)

<sup>xxv</sup> Evaluation conducted by Mense A. of the risk- lessons conducted by Technolab, Leiden internal evaluation, as yet unpublished