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**Identifying and explaining differences and similarities in climate adaptation beliefs within Dutch municipalities: using Q methodology**

*A comparative case study of Amsterdam, The Hague and Rotterdam*

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**ABSTRACT** *In search for strategies to improve the implementation of climate adaptation (measures), this study uses Q methodology to identify the climate adaptation belief patterns that exist in three Dutch municipalities - Amsterdam, The Hague and Rotterdam. These cities will most likely have to deal with increasing precipitation as a consequence of climate change. Solutions to adapt to these expected climate risks can be found in measures that serve climate adaptation as well as already existing policy sectors, such as spatial planning and water management. Mainstreaming climate adaptation in existing policy sectors would prove effective and efficient on the short and long term for urban developments. However, mainstreaming is not mandatory in The Netherlands, which makes it dependable on the willingness to act of a municipal organization. We argue that the willingness to act is based on beliefs and organizational structure and that these explain the variation of action towards climate adaptation. The applied methodology revealed differences and similarities in these beliefs between the cities. With regard to the climate adaptation beliefs the outcomes indicate consensus on the problem, cause and solutions, but there is inconsistency in the beliefs on urgency and responsibilities. All municipalities show to some extent a willingness to act in favor of climate adaptation, but the political commitment of each municipality is different which explains the different approaches to adaptation. Notable is all municipalities used different or additional terms for climate adaptation to obtain political commitment.*

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## 1 Introduction

Climate change impacts can form several potential risks for cities. In this article, the focus is on the effects of the expected increase in precipitation and extreme events in the Dutch context. An increase in extreme precipitation events is considered a real problem for Dutch cities as this can lead to water nuisance and flooding (PBL, 2012; Runhaar et al 2011). Adaptation to this climate risk is necessary in order to reduce these negative effects. Adaptive solutions might however not necessarily be found in the traditional standalone investments such as dykes or an expansion of the sewer system, but in the mainstreaming of climate adaptation in existing policy sectors (Hunt and Watkiss 2011; Uittenbroek et al. 2012). Investments in green space, water storage or drainage systems serve climate adaptation and existing policy sectors such as spatial planning and water management as these solutions improve spatial quality and address the issue of water safety (Gill et al., 2007; source?). In this way, mainstreaming climate adaptation in existing policy sectors would prove effective and efficient on the short and long term for urban developments (Kok and De Conink 2007; Smit and Wandel 2006). Yet, in urban practice, mainstreaming climate adaptation has hardly been adopted. In the Netherlands, mainstreaming is not mandatory. Mainstreaming depends then largely on the willingness to act, which thus far many municipal departments – associated with policy sectors that are expected to mainstream climate adaptation such as spatial planning, infrastructure, public health – seem to lack. Hence, how actors from municipal departments that are supposed to mainstream adaptation objectives in their policies perceive the risks, urgency and responsibilities of climate adaptation becomes a crucial condition for mainstreaming.

Research has already shown that climate change (and as a consequence adaptation) is understood differently by various actors in society (e.g. Buys et al 2012; De Boer et al 2010; Weber and Stern, 2011; Runhaar et al 2012). These divergent beliefs on for example the existence and magnitude of the problem, causes and consequences, allocation of responsibilities, the urgency for action and effective solutions complicate the communication on and policies for climate adaptation (Eisenack et al 2007; Lorenzoni et al 2007). The differences in beliefs are often related to one's personal background, worldviews, norms and values, appreciation and their access to knowledge (Rein and Schön, 1996). In the case of a municipality, the political agenda of an aldermen and/or the choices made in the organization on the distribution of responsibilities, power and information can influence the beliefs of an actor or department (Van den Brink, 2009). If, for example, a municipal department is not given the responsibility to act upon climate change, this probably result in climate adaptation beliefs that do not see the urgency for mainstreaming climate adaptation.

The aim of this paper is to identify the beliefs on climate adaptation within three Dutch municipalities – Amsterdam, The Hague and Rotterdam. All three cities have to deal with the calculated increase in precipitation and extreme events as a consequence of climate change (KfC 2010). In three

municipalities, the discussion on adaptation and the allocation of responsibilities has been current, but undefined (as in most other municipalities in Europe). Moreover, there is variation in the responses of the three cities to the problem (KfC 2010). Divergent beliefs between and within cities could play an important role in this variation. In this paper, climate adaptation beliefs are defined as the current position of the municipal department on the topic in new policy processes. We are interested in identifying shared beliefs (later referred to as belief patterns) on climate adaptation, explaining possible differences and similarities in these shared beliefs within and between municipalities and discussing what these belief patterns could possibly implicate for the mainstreaming of climate adaptation. Q methodology is used to map patterns in beliefs on climate adaptation in the municipalities. Since this method is seldom applied in policy research, the secondary aim of this paper is to indicate the value of the method in this type of research. For explaining the differences and similarities in beliefs between and within the municipalities, interviews and focus groups have been done to understand the organizational structures of the three municipalities. The implications of these belief patterns for mainstreaming are also based on these interviews and focus groups.

The article first introduces an analytical framework for identifying all possible beliefs on climate adaptation. Next, it describes Q methodology and how it was applied in the case studies. The results are analyzed and discussed in section 4 and 5. Section 6 presents the conclusions.

## **2 The concourse of climate adaptation: exploring beliefs on climate change adaptation**

The complexity of climate change and therewith climate adaptation leads to various diverging interpretations and beliefs on the policies and actions needed for climate adaptation (Nisbet 2009; De Boer et al. 2010). The collection of all possible beliefs that exist about a topic in conversation, commentary and discourse of everyday life, are part of the ‘concourse’ – a term often used in relation to Q methodology (Brown, 1993; Van Exel and De Graaf, 2005). The beliefs on a topic generally relate to *‘problem definition, causal interpretation, moral evaluation or/and treatment recommendation’* (Entman, 1993, p. 52). With these four elements, Entman (1993) provides an analytical framework as he argues that a combination of such beliefs functions as a frame of reference for an actor. We chose not to use the term ‘frame’ and ‘frame of reference’ but ‘belief’ and ‘belief pattern’. We consider the terms to be interchangeable.

Beliefs are often inspired by personal experiences, norms and values. But in case of municipalities, the organizational structure will probably influence an actor’s position on a topic as well. The organizational structure is built to achieve particular objectives. It allocates roles, power and responsibilities to departments and determines the flow of information, time and financial resources (Van den Brink, 2009). The beliefs of the actors working for an organization can therefore be a mix of personal interpretation and organizational structure.

Entman’s analytical framework provided four elements on which the beliefs of actors can vary with respect to climate adaptation (see figure 2.1). The first element is ‘problem definition’ (problem) which in case of climate adaptation translates into the question whether or not the actor acknowledges the existence of climate change and the associated risks such as sea level rise, higher temperatures and increase in precipitation. The second element relates to the views on ‘causal interpretation’ (cause). This reveals the understanding of the vulnerability to risks and sensitivity to negative and positive impacts in relation to climate change. The third element is the ‘moral evaluation’ (morality) of the topic. In case of climate adaptation, we have identified the moral elements in case of climate adaptation to relate to the allocation of responsibilities and the time frame for action. The final element of ‘treatment recommendation’ (solutions) includes beliefs on the selection of feasible and effective solutions. Below we will elaborate in more detail how the beliefs can vary per element while still being part of the concourse of climate adaptation.

Figure 2.1: Analytical Framework

<b>Elements</b>	<b>Beliefs on</b>
<b>Problem</b>	<ul style="list-style-type: none"> <li>• acknowledgement of climate change</li> </ul>
<b>Cause</b>	<ul style="list-style-type: none"> <li>• causes and consequences of climate change</li> </ul>
<b>Morality</b>	<ul style="list-style-type: none"> <li>• the allocation of responsibilities</li> <li>• the time frame for action</li> </ul>
<b>Solutions</b>	<ul style="list-style-type: none"> <li>• the selection of feasible and effective solutions</li> </ul>

Source: Entman (1993) and operationalisation

### *2.1 Acknowledgement of climate change*

Even though there is a growing consensus in the scientific community on a changing climate as a result of natural and human activities (IPCC, 2007), there are many gradations of acknowledgement of the topic in society. Climate alarmists see climate change as a real and urgent problem. They acknowledge that there is uncertainty, but find the existing scientific findings substantive. They accept that complete certainty for future predictions related to climate change is difficult to establish (Buys et al., 2012). Others cannot fully comprehend the seriousness of climate change, possibly as a result of the existing uncertainty. Therefore, they might or might not perceive the changes in climate and the possible consequences related. Leiserowitz (2005) identified five skeptical understandings of climate change; (1) global warming is a natural process and not anthropogenic, (2) it is considered a hype, (3) doubting the scientific proof, (4) total denials of its existing, and (5) it is thought to be a conspiracy theory or hoax.

### *2.2 The causes and consequences of climate change*

Beliefs on the causes and consequences of climate change also diverge. The uncertainty related to the rate and magnitude of the impacts as well as the persistence and irreversibility of the climate changes makes it largely unclear how climate change will affect society (Biesbroek et al. 2009, Dessai et al. 2009; Hulme 2009). Climate change has various known risks such higher temperatures and an increase in extreme weather events that might affect areas differently. This depends on the vulnerability of the area. Vulnerability is assessed by the character, rate and magnitude of climate associated risks and the characteristics of a local system (IPCC 2007). In case of urban areas, the urban design might intensify the expected risks of higher temperatures and more extreme precipitation events. Several researchers have argued that hardened surface complicate the run off of excessive storm water and absorb heat rather than reflect it (Gill et al 2007; Bulkeley et al 2005). However, not all climate associated risks are necessarily acknowledged in all societies equally. Runhaar et al. (2012) show for example for the Netherlands that while an intensified risk of extreme precipitation events (as a consequence of climate change) is addressed, heat stress (in itself as well as the expected increase as a result of climate change) is overall not considered a risk. In Southern European countries, an expected increase in temperatures and drought are perceived as climate risks while there is less attention for excessive precipitation. Vulnerability relates to the sensitivity of a local system. Sensitivity is defined as the degree that a system can be affected, either adversely or beneficially, by climate change. In case of water nuisance and flooding, the system is often negatively affected in terms of material damages, societal disruption and health injuries. Because uncertainty regarding the magnitude of the risks, it is evenly difficult to forecast the impacts on the local system. In practice, there is however discussion on the minimal damage acceptable. Alternatively, for some countries, the change in climate can result in more tourism, which is considered beneficial for the economy (Amelung et al 2005; PBL 2012). Hence, climate change can also be used as a business opportunity to develop new markets and products (see e.g. Mills and Lecomte 2006; Botzen et al 2010).

### *2.3 The allocation of responsibilities*

There are different views on how the distribution of responsibilities should be arranged institutionally (Mees et al., 2012). It is discussed whether to address climate adaptation as a standalone issue or to mainstream the issue in into existing policy domains (Kok and De Coninck 2007; Bouwer and Aerts 2006; Smit and Wandel 2006; Uittenbroek et al 2012). In theory, several researchers have argued the need for a new policy sector dedicated to climate change. Herewith placing the responsibility with the actors in that sector. In practice, there is a need for strategies that not only serve climate adaptation but also other policy sectors such as urban planning or water management (Tompkins et al, 2010). By integrating climate adaptation into existing policy sectors, responsibilities for implementation are divided as well as it might lead to more effective and efficient solutions. Besides the distribution of responsibilities among public policy sectors, the allocation among public and private actors is evenly a point of discussion. Some researchers argue that actors (public and private) need to cooperate to face

the challenges associated with climate change and share responsibilities for implementing adaptation measures (Mees et al 2012; Reid and Toffel 2009). Beliefs diverge on what these responsibilities entail. Tompkins and Adger (2005) argue that the responsibility of the public sector ranges from preparing the physical structures to raising awareness and risk communication to the public, while private actors should take responsibility for organizing R&D and private insurance markets, and providing solutions (Tompkins and Adger 2005).

#### *2.4 The time frame for taking action*

Beliefs differ on when to respond to climate risks. Moser and Dilling (2004) argue that the uncertainty on climate change, the fact that it has been mainly hidden from developed countries and the overshadowing of other societal problems, provide an excuse for doubt and inaction. Moreover, there is a time delay between the actual cause of climate change and the possible experience of consequences in society. Certainly in the political arena, politicians have to consider which issue is more pressing. This might be influenced by what topic provides more credits for reelection (Biesbroek et al. 2009). This leads to a belief in which climate change is viewed as a far off problem that can be placed on the mid-term or long-term agenda. Furthermore, people are not willing to invest in potentially costly actions and since there is still ambiguity regarding the causes and consequences, which makes a wait-and-see approach a valid alternative (Sterman 2011; Buys et al 2012). A wait-and-see approach can lead to reactive solutions as actors postpone action until harm is done. Several researchers argue that climate change despite its time delay still requires short-term efforts and investments (e.g. Adger et al 2007). The urgency for investing on the short-term is supported by the idea that the current costs of required solutions are lower than future costs of possible damages (Runhaar et al 2012).

#### *2.5 The selection and implementation of feasible and effective solutions*

The complexity of climate change expressed in the various risks and the uncertainty regarding the rate and magnitude of impacts, makes it difficult to select solutions. The variation in beliefs on what the outcome could be forms a barrier for the selection of solutions since the effectiveness of a solution is overall measured with respect to the projected outcome. Some believe that the solutions need to result in a climate proof system. This means that the vulnerability to climate risks is ideally reduced to zero (Schipper 2007). Others believe that a fully climate proof system is an unrealistic goal (e.g. Kabat et al 2005). They propose solutions that are more flexible, resilient (see Dessai and Hulme 2004) or non-regrettable (see Hallegatte 2009). The feasibility of the solutions also varies on spatial scale; for example green roofs is feasible on building scale, but water storage might be more effective on neighborhood scale (cf. Runhaar et al 2012). In addition, municipalities can choose to promote the implementation of certain adaptation measures in different ways: implement these themselves, oblige

property owners to install e.g. green roofs, create awareness by communicating climate change projections et cetera. These different ways of governing are narrowly related to how a municipality has allocated responsibilities for climate change adaptation (Mees and Driessen 2011).

### **3 Methodology**

#### *3.1 Introduction to Q methodology*

To gain insight into the beliefs on climate adaptation within municipal organizations we have developed a research protocol, including Q methodology. This methodology provides a way to systematically identify individual beliefs and to reveal patterns in these beliefs by applying a factor analysis (McKeown and Thomas 1988; Stephenson 1953). This reconstructive methodology measures quantified individual responses to statements that accordingly are evaluated and compared in a qualitative way (Wolsink 2010). The method is useful for uncovering belief patterns related to open discourses – this means that the topic at hand is open to various interpretations, difficult to comprehend and ambiguous (Wolsink 2010; Dryzek and Berjikian 1993). This is why environmental policy issues such as waste management (Wolsink 2004), wind energy (Ellis et al 2007; Wolsink 2010) and flood management (Raadgever et al 2008) have been subject to Q methodology. While climate change is a suitable topic for a Q study, only limited research has combined the topic with the method. Lorenzoni et al. (2007) used Q methodology for identifying barriers to individual engagement among citizens in relation to climate change. Similar to the research of O'Neill and Nicholson-Cole (2009), they used climate change imagery to measure human subjectivity. Niemeyer et al. (2005) applied the method to map the responses of the UK public to several climate scenarios. In case of climate change and Q methodology, the focus has been on the beliefs of the public while it is also relevant to understand the beliefs of actors that are appointed with task of implementing climate adaptation measures such as municipalities.

An advantage of Q methodology is that the input for the analysis is produced by the respondents and not the analyzing researcher (Wolsink 2010). Q methodology can be applied on a small, selected sample of individuals and does not allow generalization to a larger population than the group of selected respondents (Raadgever et al 2008; Steelman and Maguire 1999). Therefore, to increase the validity, this research employs a multiple case study design (cf. Yin 2008).

#### *3.2 Applying Q methodology*

Q method encompasses five steps: 1) collecting statements that together represent all possible beliefs in the concourse, 2) selecting the most relevant and representative statements (Q-set), 3) selecting the respondents (P-set), 4) sorting of statements by respondents (Q-sort) and 5) the factor analysis (cf. Brown 1993; Van Exel and De Graaf 2005; Webler et al 2009). For the first step, a number of 180

statements on the elements discussed in section 2 were collected from policy documents, scientific articles and newspaper articles. From this collection, 48 statements were selected on the criterion that the Q set included a wide range of diverging beliefs on climate adaptation, but in line with the elements introduced in paragraph 2. Preliminary Q sets, which were in Dutch, were tested on ten colleagues of the authors in order to verify consistency and completeness (cf. Raadgever et al 2008).

The selection of the respondents, the P-set, was done in a structured manner in order to gain a representative image of each department. The network of the ‘Knowledge for Climate’ program was used to find a first respondent within each municipality. Accordingly, they were asked to select fellow respondents that worked within one of the eight departments in their municipality. Other selection criteria for the respondents were that they were a municipal official (not an administrator or politician), worked for at least a year at the department (so that the respondent had an understanding of the beliefs present in the department) and participated in current policy debates and processes. This resulted in a P-set of 27 interviewees (table 3.1) who were interviewed between June and August 2012 (also see appendix A).

During the interviews, we learned that most of the selected respondents worked on projects that to some extent included climate adaptation. As this might translate into a biased belief (i.e. these respondents know more about climate change than their colleagues and might not be representative for their department), we asked each respondent whether or not they considered their knowledge of climate adaptation more developed compared to that of their colleagues in the same department. Ten of the 27 respondents said that they expected this to be so. Therefore, before the Q sorting, the respondents were explicitly asked to sort the statements according to how much they agreed with them while keeping in mind that they represented their department.

During the sort, the respondent assigned each statement to one of the 48 boxes which ranged from most agree (score 5) to most disagree (score -5) (see table 3.3). Due to the fixed distribution of the Q sort, respondents were allowed to only place two statements on the extremes and more statements on the middle scores. In this way the statements are compared relatively to each other. This reduces the risk of biased sorting and increases the repeatability of the exercise (Raadgever et al 2008). After sorting the statements, the respondents were asked whether they missed statements and explain the placement of certain statements.

Table 3.1: Number of respondents representing departments in the municipalities

Departments	Municipality		
	<i>Amsterdam</i>	<i>The Hague</i>	<i>Rotterdam</i>
Spatial Planning	1	1	2
Urban Design	1		1
Water	2	1	1

Environment	1	1	1
Infrastructure	2	1	1
Urban Development	1	1	1
Climate / Sustainability	1	1	1
Public Health	2	1	1
<b>Total (N=27)</b>	11	7	9

Table 3.2: Fixed distribution for the statements and the scores

Score	-5	-4	-3	-2	-1	0	1	2	3	4	5
No. of statements	2	3	4	5	6	8	6	5	4	3	2

The fifth step entailed the principle component analysis and rotation for which the software program PQmethod was used (Schmolck 2002). The input for the analysis were the results of the 27 q sorts done by the respondents. The program first performed a principal component analysis which correlates the common valuations of the statements in the context of all statements (Wolsink 2010). Accordingly, varimax rotation was applied to maximize the sum of variances of the factor loadings. The first three factors explained 66% of the total variance and the first factor had an explained variance of 36% - indicating that most respondents defined this belief pattern. These factors should be considered as ‘ideal types’ as these represent the common parts of the individual q sorts (Wolsink 2010).

However, during the q sorts, we got the impression that in spite of the relevance given to climate adaptation in all three municipalities, not all respondents expressed the relevance in the same manner (cf. Brown 1993). Therefore, by means of manual rotation we probed whether this notion was correct. By manually rotating factors 1 and 3, we reduced the factor loading on factor 1, but highlighted that most respondents related to The Hague share a slightly different belief pattern than most other respondents related to factor 1. This is elaborated on more in paragraph 5.

The data presented in this paper is the data obtained after the manual rotation. It needs to be pointed out that the manual rotation did not change the coherence of the individual q sorts nor the relationships between the q sorts (Wolsink 2010). It did alter the explained variance of the individual factors and the correlation between the factors – see table 3.3 for differences in outcome in case of varimax and manual rotation. As a result of the manual rotation, the correlation between factor 1 and 3 is even more significantly positive (0.78). This means that these belief patterns agree on most of the statements. This is also visible in table 3.4 where several respondents have significant factor loadings on two belief patterns and herewith defining more than one belief pattern. A respondent defines a belief pattern when the factor loading is above 0.5 (plus or minus)(Brown, 1993). In case of the manual rotation, factor 3 could be considered as an embranchment of factor 1.

Table 3.3: Varimax rotation versus manual rotation

		Varimax rotation	Manual rotation
<i>Explained variance / defining respondents</i>	Factor 1	36% / 19 respondents	26% / 12 respondents
	Factor 2	16% / 5 respondents	14% / 6 respondents
	Factor 3	14% / 3 respondents	26% / 9 respondents
<i>Correlation Coefficients</i>	Factor 1-2	0.64	0.61
	Factor 1-3	0.62	0.78
	Factor 2-3	0.47	0.61

Table 3.4: Scores of respondents with factors per municipality

<b>ROTTERDAM</b>	Factor 1	Factor 2	Factor 3
Urban Design	<b>0.59</b>	0.19	0.48
Spatial planning (1)	<b>0.60</b>	0.08	<b>0.59</b>
Climate / Sustainability	<b>0.59</b>	0.06	<b>0.53</b>
Environment	<b>0.67</b>	0.46	0.36
Project management	<b>0.70</b>	0.12	0.24
Infrastructure	-0.05	<b>0.64</b>	<b>0.53</b>
Public Health	0.33	0.32	<b>0.57</b>
Water	<b>0.52</b>	0.37	<b>0.58</b>
Spatial planning (2)	0.30	0.16	<b>0.71</b>

<b>AMSTERDAM</b>	Factor 1	Factor 2	Factor 3
Infrastructure (1)	<b>0.72</b>	0.18	0.31
Public Health (1)	<b>0.66</b>	0.29	0.49
Public Health (2)	<b>0.60</b>	0.09	<b>0.58</b>
Environment	<b>0.58</b>	0.26	0.48
Water (1)	<b>0.61</b>	0.24	<b>0.52</b>
Spatial Planning	<b>0.78</b>	0.13	0.32
Urban Design	-0.06	<b>0.64</b>	0.44
Project management	0.16	<b>0.51</b>	0.44
Climate / Sustainability	0.44	<b>0.72</b>	0.11
Infrastructure (2)	<b>0.51</b>	<b>0.52</b>	0.33
Water (2)	0.04	-0.05	<b>0.83</b>

<b>DEN HAAG</b>	Factor 1	Factor 2	Factor 3
Project management	<b>0.72</b>	0.27	0.34
Environment	0.30	<b>0.83</b>	0.18
Spatial Planning	0.48	0.31	<b>0.60</b>
Public Health	0.45	0.31	<b>0.60</b>
Climate/Sustainability	<b>0.57</b>	0.22	<b>0.62</b>
Water	-0.07	0.29	<b>0.62</b>
Infrastructure	0.34	0.31	<b>0.51</b>

In the following section the three belief patterns are presented, which in this article are referred to as; 1) ‘Start today’, 2) ‘Not a main task’ and 3) ‘Communicating awareness’. The argumentation within each belief pattern has been reconstructed based on core and secondary beliefs (Webler et al 2009). Core beliefs are defined by an average q sort value score of (-)4 or (-)5 and secondary beliefs have a score of (-)3. These q sort value scores are presented behind the statements in table 4.1. In table 4.1 the statements are arranged from consensus to disagreement. The similarities and differences between the three belief patterns are presented in paragraph 4.4.

#### 4 Results: three belief patterns on climate adaptation

##### 4.1 Factor 1: Start today

The belief pattern, which we have named ‘start today’, is characterized by a clear sense of urgency and is defined by respondents from all types of departments (see table 4.2). The core belief in this belief pattern is that climate adaptation is a current issue and not a hype [26] that requires a new way of thinking [18]. The belief patterns highlights the importance of making the city climate proof [36] and rejects beliefs that tend to nuance or minimize the urgency for climate adaptation [8, 11, 27, 33]. The urgency for action is additionally expressed by the support for the belief that uncertainty about risks and impacts should not be considered an excuse for inaction [36]. According to a respondent: “Knowledge needs to be developed further. There is still much to discover and things that need to become more concrete, but the lack of knowledge does not discharge you of acting on the knowledge that we do know” (Interview E/A<sup>4</sup>). The reason that action should take place now is also explained by the (secondary) belief that by investing in adaptation measures today higher costs on the long term can be avoided [21]. In case of the distribution of responsibilities, the belief pattern includes only secondary beliefs in which everybody developing the city is considered responsible for climate adaptation [3] and that the issue should be part of the knowledge agenda of the municipality [1]: herewith acknowledging at least a role for the municipality.

Table 4.1: Statements with factor arrays arranged from consensus to disagreement

Statements (random numbers)		Q-sort value scores per factor		
		1	2	3
38	Combining housing, water and green infrastructure creates more value.	2	3	3
45	When planning new infrastructure, the vulnerability of the location to extreme weather circumstances should be taken into account.	4	4	5

<sup>4</sup> The first letter indicates the department (C for Climate/Sustainability, E for Environment, I for Infrastructure, PM for Project Management, PH for Public Health, SP for Spatial Planning, UD for Urban Design, W for Water) and the second letter indicates the municipality (A for Amsterdam, R for Rotterdam, H for The Hague).

40	By adding green and water in public space foremost in areas that has much hardened surface, increases the spatial quality of the area.	4	4	4
44	The only policy that needs to be adjusted within the municipality is that of water management.	-4	-4	-5
24	When intensifying the city, this means that space should be reserved for extra water storage that will be needed due to the increase of hardened surface.	3	3	4
41	The consequences of extreme rainfall form a bigger threat to the city than the consequences of heat.	3	2	1
1	Climate change belongs on the knowledge agenda of the municipality.	3	2	2
16	Citizens need to get aware of the idea that water nuisance can increase due to climate change.	1	1	2
5	What happens in the future, should be dealt with in the future.	-5	-4	-5
30	Anticipating on climate change creates market opportunities.	1	0	1
9	This city has to anticipate on climate change.	5	3	5
31	Mostly private actor profit from adaptation measures so they should invest in them.	-2	0	-1
34	A few flooded basements does not directly mean that het climate is changing.	0	1	0
36	As long as there is uncertainty about the risks and effects of climate change, there is no reason for taking action.	-4	-3	-3
33	Climate change is not taken such a fast pace - we have time.	-3	-1	-2
21	By investing in climate adaptation measures today circumvents higher costs (e.g. related to future water damage to buildings) on the long term.	3	1	2
2	Water on the street is acceptable as long as it does not evolve in dangerous situations.	0	-1	0
14	Possible health issues caused by climate change need to be communicated by the Public Health department to the citizens.	1	0	3
20	Anticipating on climate change is in the interest of my department.	1	2	0
32	The climate is changing and when it becomes a threat my department will deal with it.	-2	-1	-3
25	Climate adaptation is an important issue on the political agenda.	-1	-3	-1
39	Everybody is understanding the relevance of climate adaptation, but other interests often get priority.	1	-1	1
7	The municipality is aware of climate change, but the municipality does not have enough knowledge to act adequately.	0	-2	-1
27	The safety of citizens is only at stake if the water comes above our knees.	-4	-2	-4
26	Climate adaptation is an hype; it will blow over.	-4	-3	-2
11	Damages and human sufferings due to climate change (such as floods) are exaggerated; it is not that bad.	-3	-1	-1
13	The municipality should give basic information to citizens on the expected risks and dangers related to climate change for the city.	1	1	3
22	Today's urban design is inadequate and innovative measures are necessary; for example green roofs or water squares.	2	0	2

48	Climate change only knows adverse effects.	-2	-2	-4
29	Further intensification of the city is necessary to achieve growth.	0	3	0
17	Climate adaptation is necessary to avoid irreversible damages.	2	0	1
47	Innovative adaptation measures, such as green roofs and permeable surfaces, lead to higher maintenance costs.	-1	2	-1
3	Climate adaptation is a responsibility of everyone that works on the development of the city.	3	0	4
46	The municipality should provide subsidies to stimulate the implementation of adaptation measures.	0	-2	1
37	Climate adaptation should be a goal in itself.	-1	-4	-3
8	Climate adaptation is necessary, but there is no hurry.	-3	0	0
23	Climate adaptation should be included as goal in every policy process.	2	-1	-1
6	Individuals should provide for their own water storage.	-3	-2	0
12	It is better to mainstream climate to relevant sectors than create a separate department.	2	5	3
43	The municipality needs to follow the example of Toronto and Stuttgart, where buildings with a large roof are obliged to have a green roof.	0	-3	-2
10	It is clear that climate change results in certain risks, but it is unclear to what rate and what the precise consequences are.	-1	2	2
19	My department should be main responsible for climate proofing public space.	-2	-5	-2
18	Climate adaptation requires a difference in thinking and acting.	5	0	1
28	My department has a budget for climate adaptation measures.	-1	-5	-2
42	Reducing CO2 emissions is more important than adjusting the urban design because of climate risks.	-2	1	-3
4	My department has more important tasks than anticipating on climate change.	0	4	0
15	A climate proof city circumvents nuisance that is created by extreme weather circumstances such as heavy precipitation.	4	5	0
35	Climate adaptation is not important within my department.	-1	1	-4

Table 4.2 Number of respondents that define each factor per department and municipality

	Department								Municipality			Total
	Spatial planning	Urban Design	Water	Environment	Infrastructure	Project management	Climate/Sustainable	Public Health	Amsterdam	The Hague	Rotterdam	
Factor 1	2	1	1	2	1	2	1	2	6	1	5	12
Factor 2		1		1	2	1	1		4	1	1	6
Factor 3	2		3		1		1	2	1	5	3	9
<b>Total</b>	4	2	3	3	4	3	3	4	11	7	9	27

#### 4.2 Factor 2: Not a main task

The second belief pattern, which we have named ‘not a main task’, takes a stronger position on the responsibilities of a department towards climate adaptation. Notable is that none of the respondents of Water, Spatial Planning or Public Health share this belief pattern and that the belief pattern is overall defined by respondents related to the municipality of Amsterdam. The core beliefs of this belief pattern are that the departments (which define this belief pattern) are not main responsible for climate adaptation [4, 19] and neither have the budget to invest in climate adaptation measures [28]. Since climate adaptation is not listed high on the political agenda (a secondary belief)[25]. However not arguing that climate adaptation is not an issue, but rather following the belief that it should not be considered as a standalone issue [37]. It should be mainstreamed into relevant sectors [12]. As one of the respondents argued: “Adaptation needs to be given foundations. In Amsterdam, mitigation is linked to a strategy that includes the wallet of the citizen: saving their money and saving energy. That convinces” (Interview C/A). There are two minor beliefs<sup>5</sup> on which the other two belief patterns show negative q sort value scores, but scored positive in this belief pattern. The first minor belief is mitigation is thought to be more important than climate adaptation [42] and second, adaptation measures are believed to have higher maintenance costs [47].

#### 4.3 Factor 3: Communicating awareness

The third belief pattern, which we named ‘communicating awareness’, shares several beliefs with the first belief pattern, but distinguishes itself from ‘Start today’ mainly on the beliefs on communication with citizens. The belief pattern is defined by departments from all municipalities, but is most consistently present in the departments of The Hague. In this belief pattern, climate adaptation is a

<sup>5</sup> Minor beliefs have an average q sort value of (-)1 or (-)2.

responsibility of everybody who develops the city [3]. The municipality has the role of communicating information on climate adaptation to the citizens [13,14]. In this way, the responsibility for climate adaptation is shared with the citizens: “it is important to provide basic information so that citizens have a starting point and can decide to do something” (Interview W/R). On the other hand, this is the only belief pattern with the core belief that climate adaptation is considered important within the department [35]. A respondent replied “there are of course more acute issues on the short-term. (...) Thinking about climate adaptation today will make it easier on the long term though (...) and most people do not realize the health risks that can occur as a result of climate change” (Interview PH/A). The secondary beliefs show however that climate adaptation needs to be integrated in relevant policy sectors [12] and it should not be a goal on itself [37]. As one of the respondents stated: “if you give the responsibility [for adaptation] to one department, the other departments may automatically think it is taken care of” (interview W/H). Notable is that almost all Public Health and Water departments define this belief pattern. To some extent this could be explained by the beliefs related to communication, the strong aversion against water management being the only department mainstreaming climate adaptation [44] and the more nuanced belief for taking action.

#### *4.4 Similarities and differences between the three belief patterns*

All belief patterns represent support for climate adaptation, but from different perspectives. All belief patterns agree that each city should anticipate climate change as it is a concern of this generation and not solely the next [5, 9]<sup>6</sup>. Additionally, the consensus on statements [24], [40] and [45] indicates that the more specific relation between the possible impacts of climate change, location and solutions in urban design is understood in all three belief patterns. There is common ground on the elements of problem, cause and solutions.

The differences between the three belief patterns can be found in beliefs that relate to the moral elements. The belief patterns disagree in the time frame of action. The first belief pattern reveals a more urgent position towards climate adaptation by strongly rejecting beliefs that minimize or nuance climate change [8, 11, 21, 26, 27, 33, 36]. The other two belief patterns have taken a more neutral stance on the time frame for action and identify more precisely the relevance of the issue within a department (see belief pattern 2)[4, 28, 35] or the role of the municipality [13, 14] (see belief pattern 3).

Remarkable is that belief patterns take a strong position on the responsibilities of private actors [6, 31] or on the use of governance tools such as financial incentives [46] or legal obligations [43]. To some

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<sup>6</sup> The number between the brackets corresponds with a statement.

of extent, this could be a result of the formulation of the statements or the amount of statements in which the respondents had to make a selection. But when asked after the q sort, it became clear that climate adaptation is not purely considered a task of private actors. Dutch municipalities are responsible for the maintenance of public space and should be governing the development (Interview C/H, Interview UD/R). As pointed out by several respondents, in some cases, a centralized approach is considered to be more effective, for example in case of water storage (Interview Spatial Planning Rotterdam / Interview Infrastructure Rotterdam / Interview Environment The Hague). However, several respondents did not consider financial incentives and legal obligations as the best options to do so. Legal obligations were thought by most respondents to “work aversive” or as “a barrier” (Interview E/R, Interview SP/A). Others pointed out that legal obligations were not preferred by the department or in the municipality (Interview SP/A, Interview E/R). In case of financial incentives, respondents argued that “the municipality is not a pay box” (Interview I/R) and that “with subsidies people do not learn anything” (Interview W/H, Interview PM/R), although some respondents also acknowledged that “subsidies can help in getting things started” (Interview I/R, Interview UD/H).

## **5 Comparison between the three municipalities**

Although the three belief patterns are present in each municipality, different belief patterns dominate (see table 4.2). In Amsterdam, the ‘Start today’ and ‘Not a main task’ belief patterns are most prominent, while The Hague relates more to the belief pattern of ‘Communicating awareness’ and in Rotterdam, the first and third belief pattern dominate. It must be pointed out that in the case of Amsterdam, several respondents who relate to factor 1, also show significant factor loadings on factor 3. Nonetheless, this analysis shows that there are different beliefs on climate adaptation within and between municipalities.

A contradiction in belief patterns can be seen in Amsterdam. One belief pattern outlines a call for action for climate adaptation since it requires a new way of thinking, while the other indicates that climate adaptation does have not a priority in the department (that defines this belief pattern). That four departments of the municipality define the belief pattern of ‘not a main task’ can be explained based on the political agenda of the current alderman who holds the portfolios of Spatial Planning and Development and Climate and Energy. The alderman has chosen to make a statement on climate mitigation (reducing CO2 emissions and energy costs) and to disregard climate adaptation. Hence, officially, the organizational structure does not address climate adaptation. According to one of the respondents: “It is not that I think it is not our task, it is just that I can only spend 2% of my time on it” (Focus Group Amsterdam). The departments related to first belief pattern – Water, Spatial Planning, Public Health and Environment – do address climate adaptation by investing in for example heat maps and research programs despite the focus of the alderman on mitigation (see e.g. interviews

SP/A and W/A). As a respondent said “aldermen can be curious, but you have to present them the information first. The departments should develop this knowledge” (Interview W/A).

The dominating belief patterns in Rotterdam mostly differ on the second beliefs instead of the core beliefs. Some departments – overall related to spatial development - put more focus on getting investments in adaptation measures and urban design started, while other departments such as Water and Public Health consider the communication with citizens as more relevant. The observation that the Infrastructure department thinks differently could be explained by uncertainty on the causal relations between climate and infrastructure: “It is difficult to prove if the traffic jam was caused by the extreme rainfall or by something else” (interview I/R). During the interviews, the departments pointed out that the alderman was convinced to provide a budget for adaptation “a couple of years ago. (...) At that time, we presented climate adaptation and smart water management as an opportunity” (interview C/R). As a result of this way of framing, several departments had resources to explore adaptation measures and develop an adaptation strategy for the municipality. However, during the focus group, it was questioned “if a new budget would be given today or in the future. The focus is currently on other social and economic issues” (Focus group Rotterdam).

The departments of The Hague appeared the most consistent in the beliefs on climate adaptation: five out of the seven respondents define the ‘Communicating awareness’ belief pattern. From the interviews it became clear that within the municipality, climate adaptation was a task of the overarching department ‘Urban Development’ which included the departments of Spatial Planning, Climate/Sustainability, Infrastructure and Project Management – all related to third belief pattern. The Environment and Water<sup>7</sup> departments are part of the overarching department ‘City Maintenance’ which is responsible for mitigation. This explained the position of Environment with the second belief pattern. The respondent representing the Water department stated that water and climate are implicitly related and disapproved of the allocation of adaptation tasks with solely the departments of ‘Urban Development’. The belief of project management was difficult to clarify as the respondent significantly defines the ‘start today’ belief pattern, but also said that “not many of his colleagues would necessarily pick up adaptation or sustainability if it was not included in the project assignment” (interview PM/H). As said before, the third belief pattern illustrates a more nuanced belief on climate adaptation. During the focus group, the departments endorsed the nuances and that if they did address it that they preferred to use other terms than climate adaptation so that the aldermen and citizens would understand better (Focus group The Hague). According to a respondent: “we already did much in the city [which links to adaptation]. (...) It is just that the last couple of years this is referred to as

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<sup>7</sup> Public Health belongs to neither of these departments, but belongs to the department of Education, Culture and Health.

climate adaptation. (...) The term is not really understood by the aldermen. However when you talk about water nuisance or sea level rise you have their attention immediately” (interview C/H).

Based on the belief patterns presented in this paper, none of the departments are opposing action in favor of climate adaptation, meaning that in all belief patterns there is to some extent a willingness to act. Mainstreaming climate adaptation is also considered a possible approach for realizing adaptation in all three belief patterns [12]. However, what the belief patterns and additional interviews and focus groups explain is that currently, some departments are not given the role to address and/or the resources for climate adaptation. In some departments such as e.g. the infrastructure departments this is not considered a problem as there is no clear relation with adaptation (but e.g. more with mitigation). But for other departments this is problematic (e.g. spatial planning or water). In order to get climate adaptation mainstreamed there is not only need for willingness to act, but also political commitment that allows the organizational structure to address climate adaptation. From the focus groups it can be understood that political commitment requires reciprocity between the aldermen and the departments of a municipality. On the one hand, the organizational structure is subsequent to the political agenda of the alderman. But it is also considered the departments task to steer this political agenda and acquire the political commitment of the alderman for the topic. In other words, by presenting the ‘right’ narrative to an alderman, political commitment for the topic can be obtained by the departments. It turns out that in these three municipalities the ‘right’ narrative does not necessarily include the term climate adaptation as all three municipalities apply different or additional terms to make climate adaptation relevant and understandable.

## **6 Concluding remarks**

The aim of this article was to identify different beliefs on climate adaptation within three Dutch municipalities – The Hague, Amsterdam and Rotterdam - and to learn to what extent these beliefs can be explained. Climate adaptation should ideally be mainstreamed in existing policy sectors. However, since in The Netherlands, this only happens if there is willingness to act, it is relevant to learn the beliefs on climate adaptation of different departments – associated to the policy sectors that should mainstream climate adaptation - within a municipality as well as it could explain the variation in actions towards climate adaptation. Q methodology has been an applicable method in disclosing the nuances in the beliefs but has been limited in the amount of beliefs that can be put in. Also the thin line between the actual belief of the department and the personal beliefs of the respondents was sometimes questionable. The strength of the method is however the combination of quantitative and qualitative analysis. The qualitative elements (interviews and focus groups) assisted in clarifying any possible misconceptions that existed.

Q methodology has provided findings that have shown that within the three municipalities, there is less discussion on the acknowledgement of climate change, causes and consequences and feasible solutions than there is on the moral issues. The three beliefs retrieved from the factor analysis – 1) ‘Start today’, 2) ‘Not a main task’ and 3) ‘Communicating awareness’ – indicate differences in the time frame of action towards climate adaptation and the allocation of responsibilities for implementation. Both issues have been broadly discussed in other literature (e.g. Mees et al 2012). Moreover, it is interesting to learn that while some departments clearly stated that climate adaptation is not considered as one of their tasks, other department acknowledged the relevance of the issue but missed the political commitment of their aldermen and subsequent the organizational structure allocating responsibilities and resources to act upon climate adaptation. In order to for the departments to convince their aldermen and citizens to support climate adaptation projects they applied different or additional terms. The ‘right’ narrative for adapting to climate change seems not necessarily to include the terminology that is linked to climate adaptation. For climate adaptation to be mainstreamed in existing policy sectors, it requires terminology that relates to that policy sector. In this way, there is a much likelier possibility that climate adaptation measures are embedded in future policy. It will be interesting to learn if the beliefs and narratives for political commitment are very different with municipalities that are obliged to create a local adaptation strategy. In this case, mainstreaming of climate adaptation is no longer an issue of willingness to act. However, the issue of the allocation of responsibilities might not be solved by this. Hence, also further research on the materialization of the allocation of responsibilities within the municipality (and between public and private actors) is necessary.

## **Appendix 1: INTERVIEWS**

### **ROTTERDAM**

Climate/Sustainability: Program manager Rotterdam Climate Proof at Municipality Rotterdam, June 28<sup>th</sup> 2012

Environment: Program manager at Bureau of Sustainability, Municipality Rotterdam, June 28<sup>th</sup> 2012

Infrastructure: Policy advisor Infrastructure at Department of Urban Development (Stadsontwikkeling), Municipality Rotterdam, June 28<sup>th</sup> 2012

Project Management: Project manager at Department of Urban Development (Stadsontwikkeling), Municipality Rotterdam, June 28<sup>th</sup> 2012

Public Health: Senior Advisor Public Space and Health at Department of Public Health (GGD), Municipality Rotterdam, June 19<sup>th</sup> 2012

Spatial Planning (1): Project manager at Department of Urban Development (Stadsontwikkeling), Municipality Rotterdam, June 19<sup>th</sup> 2012

Spatial Planning (2): Urban planner at Department of Urban Development (Stadsontwikkeling), Municipality Rotterdam, June 29<sup>th</sup> 2012

Urban Design: Advisor of Maintenance Public Space, Municipality Rotterdam, June 19<sup>th</sup> 2012

Water: Policy advisor Water at Department of Urban Development (Stadsontwikkeling), Municipality Rotterdam, June 29<sup>th</sup> 2012

## **AMSTERDAM**

Climate/Sustainability: Board advisor Climate at Department of Administration (Bestuursdienst), Municipality Amsterdam, July 2<sup>nd</sup> 2012

Environment: Senior advisor Environment at Department of Environment and Development (DMB), Municipality Amsterdam, June 26<sup>th</sup> 2012

Infrastructure : Senior advisor at Department of Infrastructure (DIVV), Municipality Amsterdam, July 2<sup>nd</sup> 2012

Infrastructure: Board advisor Infrastructure at Department of Administration (Bestuursdienst), Municipality Amsterdam, July 2<sup>nd</sup> 2012

Project Management: Project manager at Stadsdeel Nieuw West, Municipality Amsterdam, July 6<sup>th</sup> 2012

Public Health: Senior advisor Disasters and Emergencies at Department of Public Health (GGD), Municipality Amsterdam, June 26<sup>th</sup> 2012

Public Health: Researcher Animal Pests at Department of Public Health (GGD), Municipality Amsterdam, June 26<sup>th</sup> 2012

Spatial Planning: Urban planner at Department of Spatial Planning (DRO), Municipality Amsterdam, July 2<sup>nd</sup> 2012

Urban Design: Urban Designer at Department of Spatial Planning, Municipality Amsterdam, July 19<sup>th</sup> 2012

Water: Strategic Advisor at Waternet, Municipality Amsterdam, July 2<sup>nd</sup> 2012

Water: Senior policy advisor Wastewater at Waternet, Municipality Amsterdam, July 5<sup>th</sup> 2012

## **THE HAGUE**

Climate/ Sustainability: Urban Planner / Policy Advisor Coast and Water at Department of Urban Development (DSO), Municipality The Hague, June 21<sup>st</sup> 2012

Environment: Policy advisor Environment and Permits / Climate Change at Department of Urban management (DSB) Municipality The Hague, June 21<sup>st</sup> 2012

Infrastructure: Policy advisor Infrastructure at Department of Urban Development (DSO), Municipality The Hague, July 24<sup>th</sup> 2012

Project Management: Project manager at Department of Urban Development (DSO), Municipality The Hague, July 24<sup>th</sup> 2012

Public Health: Manager Public Space at Department of Public Health (GGD), Municipality of The Hague, July 3<sup>rd</sup> 2012

Urban Design: Urban designer at Department of Urban Development (DSO), Municipality The Hague, July 3<sup>rd</sup> 2012

Water: Policy advisor Water at Department of Urban management (DSB), Municipality The Hague, July 3<sup>rd</sup> 2012

## **FOCUS GROUPS**

Focus Group Rotterdam, October 1<sup>st</sup> 2012

Focus Group Amsterdam, August 27<sup>th</sup> 2012

Focus Group The Hague, September 20<sup>th</sup> 2012

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## **References (incomplete / needs update)**

Adger WN, Agrawala S, Mirza MMQ, Conde C, O'Brien K, Pulhin J, Pulwarty R, Smit B, Takahashi K (2007) Assessment of adaptation practices, options, constraints and capacity. In: M L Parry, OF Canziani, JP Palutikof, CE Hanson PJ van der Linden (Ed) Climate Change 2007 Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, pp 719-743

Amelung B, Nicholls S, Viner D (2007) Implications of Global Climate change for Tourism Flows and Seasonality. *Journal of Travel Research* 45:285

Biesbroek GR, Swart RJ, Knaap WGM van der, (2009) The mitigation–adaptation dichotomy and the role of spatial planning. *Habitat Int* 33(3):230-237.

Botzen WJW, van den Bergh JCJM, Bouwer LM (2009) Climate change and increased risk for the insurance sector: a global perspective and an assessment for The Netherlands. *Nat Hazards*. <http://www.springerlink.com/content/u237166571587112/fulltext.pdf>

Bouwer L, Aerts J (2006) Financing climate change adaptation. *Disasters* 30(1):49–63

Brown SR (1993) A primer on Q methodology. *Operant Subjectivity* 16(3/4):91-138

Buys L, Miller E, Megen K van 2012 Conceptualising climate change in rural Australia: community perceptions, attitudes and (in)actions. *Reg Environ Change*, 12, 237-248.

CROW (2010) Aanpassen openbare ruimte aan klimaatverandering. Gemeenten aan de slag met klimaatadaptatie. CROW, Ede

De Boer J, Wardekker A, Sluijs P van der (2010) Frame-based guide to situated decision-making on climate change. *Global Environmental Change*, 20, 3, 502-510.

Dessai S, Hulme M (2004) Does climate adaptation policy need probabilities? *Climate Policy* 4:107–128

Dessai S, Hulme M, Lempert RJ, Pielke R Jr (2009) Climate prediction: a limit to adaptation? In: Adger WN, Lorenzoni I, O'Brien K (eds) *Adapting to climate change: thresholds, values, governance*. Cambridge University Press, Cambridge (in press)

Dryzek, J, Berejikian, A (1993) Reconstitutive democratic theory. *American political science review*, 87, 48–60.

Eisenack K, Tekken V, Kropp JP (2007) Stakeholders perception on climate change in the Baltics. *Coastline Reports*: 245-255.

Entman RM (1993) Framing: Toward clarification of a fractured paradigm. *Journal of*

communication, 43,4, 51-58.

García-Herrera R, Diaz J, Trigo RM, Lutterbacher J, Fischer EM (2010) A review of the European summer heat wave of 2003. *Critical Rev Environ Sci Technol* 40(4):267-306

Hallegate S (2009) Strategies to adapt to an uncertain climate change. *Glob Environ Change* 19:240–247

Hulme, M. (2009a) Chapter 3 in, *Why we disagree about climate change: understanding controversy, inaction and opportunity* Cambridge University Press, Cambridge, 392pp.

Hulme, M. (2009b) Mediating the messages about climate change: reporting the IPCC Fourth Assessment in the UK print media pp.117--128 in, *Climate change and the media* (eds.) Boyce, T. and Lewis, J., Peter Lang, New York, 261pp. Tol

Huynen MMTE, Martens P, Schram D, Weijenberg MP, Kunst AE (2001) The impact of heat waves and cold spells on mortality rates in the Dutch population. *Environ Health Perspect* 109(5): 463-470.

IPCC (2007) *Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge.

KNMI (2009) *Climate change in the Netherlands: supplements to the KNMI06 scenarios.* Royal Netherlands Meteorological Institute (KNMI), De Bilt.

Kok MTJ, De Coninck, HC (2007) Widening the scope of policies to address climate change: directions for mainstreaming. *Environ Sci Policy* 10:587–599.

Leiserowitz A (2005) American risk perceptions: Is climate change dangerous? *Risk Anal.* 25,1433–1442.

Lorenzoni I, Nicholson-Cole S, Whitmarsh L (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17, 445-459.

McKeown B, Thomas D (1988) *Q methodology.* Thousand Oaks, Ca, Sage.

Mees HLP, Driessen P (2011) Adaptation to climate change in urban areas: Climate-greening London, Rotterdam, and Toronto. *Clim Law* 2:251-280

Mills E, Lecomte E (2006) From risk to opportunity: how insurers can proactively and profitably manage climate change. *Ceres Report*. Aug 2006

Municipality of Amsterdam (2011a) Structural Vision Amsterdam 2040. January 2011. Available from: <http://www.amsterdam.nl/wonen-leefomgeving/structuurvisie/english/>

Municipality of Amsterdam (2011b) Amsterdam Waterproof (Amsterdam Waterbestendig). September 2010. Available from: <http://www.amsterdam.nl/@495182/pagina/>

Municipality of The Hague (2011) Klimaatplan Den Haag. Juni 2011. Available from: <http://www.denhaag.nl/home/bedrijven-en-instellingen/natuur-en-milieu/to/Het-klimaatplan-van-Den-Haag.htm>

Moser SC, Dilling L (2004) Making climate hot. Communicating the urgency and challenge of global climate change. *Environ* 46(10):32-46

Niemeyer S, Petts J, Hobson K 2005 Rapid climate change and society: assessing responses and thresholds. *Risk analysis*, 25, 6, 1443-1456

Nisbet MC (2009) Communicating climate change: why frames matter for public engagement. *Environment* 51(2): 514–518.

O'Neill S, Nicholson-Cole S 2009 “Fear won’t do it”: Promoting Positive Engagement with climate change through visual and iconic representations. *Science Communication*, 30, 355-379

Oudenhoven van, A.P.E. (2008) The oak processionary caterpillar marching on; Research into the climate and environmental variables determining the spatial distribution and population dynamics of *Thaumetopoea processionea*. Wageningen University. Wageningen.

PBL (2009) Wegen naar een klimaatbestendig Nederland. Netherlands Environmental Assessment Agency, Bilthoven.

Raadgever, G.T., Mostert, E., and Van de Giesen, N.V., 2008. Identification of stakeholders

perspectives on future flood management in the Rhine basin using Q methodology.

Hydrology and earth system sciences, 12, 1097–1109.

Reid EM, Toffel MW 2009 Responding to public and private politics: corporate disclosure of climate change strategies. Strategic Management Journal, 30, 1157-1178.

Rein M, Schön DA. Frame-critical policy analysis and frame-reflective policy practice. Knowl Policy 1996;9(1):85-104.

Rotterdam Climate Initiative (RCI) (2010) Rotterdam Climate Proof Adaptatieprogramma 2010. Available from: [http://www.rotterdamclimateinitiative.nl/documents/RCP/RCP\\_NL\\_def.pdf](http://www.rotterdamclimateinitiative.nl/documents/RCP/RCP_NL_def.pdf)

Runhaar H, Mees H, Wardekker A, Sluijs J van der, Driessen PPJ (2012) Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers. Reg Environ Change DOI 10.1007/s10113-012-0292-7

Schipper L (2007) Climate Change Adaptation and Development: Exploring the Linkages. Tyndall Centre for Climate Change Research. Working paper 107.

Schmolck, P (2002) pQMethod 2.31. [online] Available from: <http://www.lrz.de/~schmolck/qmethod/>  
Last accessed: 14 august 2012.

Smit B, Wandel J (2006) Adaptation, adaptive capacity, and vulnerability. Glob Environ Change 16:282–292

Steelman TA, Maguire LA (1999) Understanding participant perspectives: Q-methodology in national forest management. J. Policy Anal. Manag. 18: 361-388

Sterman JD (2011) Communicating climate change risks in a skeptical world. Clim change 108:811-826

Tompkins EL, Adger WN. 2005. Defining response capacity to enhance climate change policy. Environ. Sci. Policy 8:562–71

Tompkins EL, Adger WN, Boyd E, Nicholson-Cole S, Weatherhead K, Arnell N (2010) Observed adaptation to climate change: UK evidence of transition to a well-adapted society. Glob Environ Change 20(4):627-635

Van Exel, N.J.A., de Graaf, G., 2005. Q methodology: a sneak preview. Available from [www.qmethodology.net](http://www.qmethodology.net), pp. 1–30.

Weber E, Stern P 2011 Public understanding of climate change in the United States. *American Psychological Association*, 66, 4, 315-328.

Wolsink, M. (2004) Policy beliefs in spatial decisions: Contrasting core beliefs concerning space making for waste infrastructure. *Urban Studies* 41: 2669-2690.

Wolsink, M. & Breukers, S. (2010) Contrasting the core beliefs regarding the effective implementation of wind power. An international study of stakeholder perspectives. *Journal of Environmental Planning and Management* 53 (5): 535-558.

## **WEBSITES**

Municipality of Amsterdam (2012) Programmabureau klimaat en energie. City of Amsterdam. Last accessed: 13 august 2012. Available from: <http://www.amsterdam.nl/wonen-leefomgeving/klimaat-energie/programmabureau/>

Rotterdam Climate Initiative (RCI) (2007) Mission and ambition. City of Rotterdam, 7 september 2007. Last accessed: 8 august 2012. Available from: [http://www.rotterdamclimateinitiative.nl/en/about\\_rotterdam\\_climate\\_initiative/rotterdam\\_climate\\_initiative/mission\\_ambition](http://www.rotterdamclimateinitiative.nl/en/about_rotterdam_climate_initiative/rotterdam_climate_initiative/mission_ambition)

Rotterdam Climate Initiative (RCI) (2011a) Underground water storage facility with a capacity of 10 million litres. City of Rotterdam, 30 august 2011. Last accessed: 8 august 2012. Available from: [http://www.rotterdamclimateinitiative.nl/en/100\\_climate\\_proof/news/news/underground\\_water\\_storage\\_facility\\_with\\_a\\_capacity\\_of\\_10\\_million\\_litres\\_news\\_id=743](http://www.rotterdamclimateinitiative.nl/en/100_climate_proof/news/news/underground_water_storage_facility_with_a_capacity_of_10_million_litres_news_id=743)

Rotterdam Climate Initiative (RCI) (2011b) Design of Bethemplein water square revealed. City of Rotterdam, 26 januari 2012. Last accessed: 8 august 2012. Available from: [http://www.rotterdamclimateinitiative.nl/en/100\\_climate\\_proof/news/news/design\\_of\\_bethemplein\\_water\\_square\\_revealed\\_news\\_id=856](http://www.rotterdamclimateinitiative.nl/en/100_climate_proof/news/news/design_of_bethemplein_water_square_revealed_news_id=856)