

**Towards a holistic understanding of climate adaptive behaviour against heat:
a Case Study of Katendrecht**

Master thesis - Social Challenges Policies and Interventions

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This thesis has been written as a study assignment under the supervision of an Utrecht University teacher. Ethical permission has been granted for this thesis project by the ethics board of the Faculty of Social and Behavioural Sciences, Utrecht University, and the thesis has been assessed by two university teachers. However, the thesis has not undergone a thorough peer-review process so conclusions and findings should be read as such.

Abstract

With the changing climate, extreme heat will happen more often. To mitigate the effects of this heat, climate adaptation is necessary. This research aims to create a holistic overview of the barriers and facilitators for individual climate adaptive actions to mitigate the effects of heat in an urban context. Research on climate adaptation right now is divided into two strands. One strand focuses on adaptive capacity, or the structural factors enabling adaptation, the other strand focuses on the psychological factors that determine whether someone chooses to adapt. This research uses the COM-B model to combine both strands to create a comprehensive view of adaptation. The research focuses on Katendrecht, a district in Rotterdam. To answer the research question, 14 semi-structured interviews were conducted with residents of Katendrecht.

The results were categorized into six main themes: cool spaces outside the house, the house itself, possible measures, choices for measures, measures taken, and heat stress. Both psychological factors and factors from adaptive capacity research come back in the themes. All components of the COM-B model are represented in the themes. Opportunity was the component that was mentioned most often during the interviews and seen as most important. Especially the financial capital and built quality of the house determined whether people took and could take adaptive action. These results have policy implications. Since opportunity was seen as the most important determinant of adaptive behaviour, policies should focus on enablement, legislation, and environmental restructuring to ensure everyone has an opportunity for coolth.

Towards a holistic understanding of climate adaptive behaviour against heat: a case study of Katendrecht

As a result of the changing climate, climate-related hazards, such as heat waves, will happen more frequently (IPCC, 2022). Heat waves can lead to substantial damages, negative health impacts, and even death (Patz et al., 2005). Due to the urban heat island effect, which causes additional heat stress in urban areas with stony materials, these heat waves will be an especially large problem in cities (Kleerekoper et al., 2012). To mitigate the effect of these hazards, climate change adaptation is necessary (van Valkengoed & Steg, 2019). Climate change adaptation is defined as: “the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities” (IPCC, 2022, p. 43). Examples of climate adaptive behaviour for heat waves include preventative measures such as installing sun shading as well as measures taken during a heat wave such as drinking more water. Many of these climate adaptive measures require a significant investment. Individuals must engage in such climate adaptive behaviour since governance and technological solutions alone will not be enough to protect people from climate related hazards (Takao et al., 2004; van Valkengoed & Steg, 2019). However, this individual climate adaptation will likely exacerbate existing inequalities, since individuals with more access to resources will be better able to adapt (Shepard & Corbin-Mark, 2009; Tan-Soo et al., 2023).

In recognition of this key role that individuals and households play, and the possible inequalities that stem from that, governments are trying to influence behaviour to stimulate climate adaptation and reduce inequalities (van Valkengoed & Steg, 2019). To influence behaviour, it is necessary to understand what determines behaviour first. Only when the underlying causes of behaviour are understood, can effective policies for behaviour change be designed (Kok et al., 2017; Michie & West, 2013; Whitmarsh et al., 2021). There has been research into these underlying causes of climate adaptive behaviour, however, a comprehensive view of these determinants is missing. Additionally, most research focuses on flood risk protection, there is very little research on heat waves (Carman & Zint, 2020; Siders, 2019; van Valkengoed & Steg, 2019), even though they are one of the deadliest climate-related hazards (Akhtar, 2020). The purpose of this study is to provide a comprehensive understanding of climate adaptive behaviour in relation to heat.

Previous research: two strands

Previous research can be divided roughly into two strands. Research on adaptive capacity, which focuses on the structural environmental factors that enable adaptation and research on psychological factors, with a focus on people's choices and motivations. Both strands will be discussed in more detail in the following paragraphs.

Adaptive capacity

One of the factors that determine adaptive behaviour is adaptive capacity. The concept of adaptive capacity is derived from biology and has since been studied by many different disciplines, including geography, economics, and political science. Adaptive capacity research focuses on the structural contextual factors that enable adaptation. However, the field is fragmented and uses a variety of definitions and indicators (Siders, 2019; Smit & Wandel, 2006). The most used definition of adaptive capacity is: "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (IPCC, 2007, p. 21). It is theorized that the capacity of an individual to adapt "is a function of their access to resources" (Adger, 2003, p. 29). These resources, or assets, can be divided into five types of capital (Siders, 2019):

- Natural capital, or the natural resources necessary for adaptation, for example, air and water;
- Physical capital, which are assets derived from resources created by people, such as infrastructure and technology;
- Financial capital, or the ability to pay for adaptation;
- Social capital, which consists of the social bonds and networks that can assist in adaptation;
- Human capital, or the mental and physical resources necessary to adapt, for example, education and health.

These assets together result in the ability of a person to adapt. The inequalities in access to these assets will result in inequalities in adaptive capacity, meaning the existing inequalities in society will likely be exacerbated (Shepard & Corbin-Mark, 2009; Tan-Soo et al., 2023).

However, a gap remains between adaptive behaviour and adaptive capacity. Since adaptive capacity is seen as a latent property of a system, the ability to act in the future, it is not directly connected to adaptive behaviour. Even if people *can* adapt, this does not mean they will *choose* to do so. To be able to understand adaptive behaviour in relation to heat, understanding

people's choices and motivation is essential. Recent research has started to focus more on the psychological factors that determine whether or not someone chooses to adapt, their motivations, instead of the structural environmental factors (Fox-Rogers et al., 2016; Grothmann & Patt, 2005; Mortreux & Barnett, 2017).

Psychological factors

Research on psychological factors focuses on the factors that influence the choice of people to adapt, instead of on the contextual factors that enable adaptive behaviour. Many psychological factors that could influence adaptive behaviour have been identified. The factors highlighted here were found to be influential by literature reviews and meta analyses (Fischer et al., 2022; Kellens et al., 2013; Mortreux & Barnett, 2017; van Valkengoed & Steg, 2019).

Protection motivation theory

The first factors are based on protection motivation theory (PMT), an influential theory that has been used often to explain adaptive behaviour (Babcicky & Seebauer, 2019; Fischer et al., 2022; Kellens et al., 2013). PMT was originally developed in health psychology to understand how people respond to fear appeals in persuasive communication (Rogers, 1975; Rogers & Prentice-Dunn, 1997). It has since been used in many different contexts regarding climate adaptive behaviour, including research on droughts (Truelove et al., 2015), wildfires (Martin et al., 2008), flood risks (Grothmann & Reusswig, 2006; Le Dang et al., 2014; Richert et al., 2017) and heat waves (Budhathoki et al., 2020). The theory states that a behavioural response to a threat, such as a climate-related hazard, stems from two perceptual processes. The first process is threat appraisal. This process consists of:

- Perceived probability, or the perceived likelihood of a threat happening;
- Perceived severity, concerning the perceived severity of damages that would occur if a threat were to happen.

The second process is coping appraisal, which consists of:

- Response efficacy, which is about the belief that protective actions will be effective to protect from harm;
- Self-efficacy, or the perceived ability to carry out a certain response;
- Response cost, relating to the assumed cost of a response, this consists not only of the financial cost but also of physical and mental effort and time.

These two processes can lead to either a protective response or a non-protective response. A visual overview of the theory can be seen in figure 1.

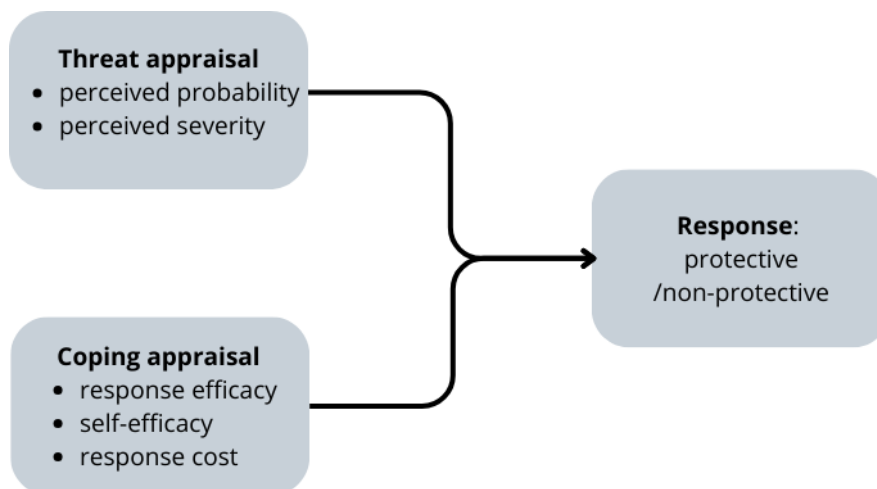


Figure 1: Schematic overview PMT

A variety of similar models, with a differentiation between threat and coping appraisal have been used to explain climate adaptive behaviour (Fischer et al., 2022; Kellens et al., 2013). Literature reviews and meta-analyses show that the different PMT variables are often found to be influential, although the conceptualization differs slightly (Bubeck et al., 2012; Fischer et al., 2022; Kellens et al., 2013; Mortreux & Barnett, 2017; van Valkengoed & Steg, 2019).

Affect, descriptive norms, and responsibility

Research consistently shows three other psychological factors that affect adaptive behaviour: affect, descriptive norms, and responsibility. These are not based on one coherent theory, but are consistently found to be important (Fischer et al., 2022; Kellens et al., 2013; Mortreux & Barnett, 2017; van Valkengoed & Steg, 2019).

One of these factors that is found to influence adaptive behaviour is affect (Kellens et al., 2013; van Valkengoed & Steg, 2019). Affect is the automatic emotional response or feeling that an experience evokes. If a potentially risky experience evokes positive feelings, this will soothe concerns, consequently, people will be less likely to protect themselves. Affect is especially relevant in the context of adaptation behaviour in relation to heat waves, since many people experience positive affect with regard to heat (Erens et al., 2021; Lefevre et al., 2015).

Descriptive norms have also been found to affect climate adaptive behaviour (Fischer et al., 2022; van Valkengoed & Steg, 2019). Descriptive norms refer to the perception of the behaviour of others in a social network, in this case, whether others are engaging in adaptive behaviour or not. This can, for example, be seen in the context of a green front garden. When the

whole street has a green front garden, you will be more likely to also green your garden (Frost & Murtagh, 2023).

The last influential factor discussed here is a sense of responsibility (Mortreux & Barnett, 2017; van Valkengoed & Steg, 2019). If people feel responsible for adapting to climate change and taking measures themselves, they are more likely to adapt than if they think the government, an NGO, or God has responsibility for protecting them against the harmful effects of for example heat waves (Mishra et al., 2009).

Research on psychological factors has informed many policies that try to change behaviour (van Valkengoed & Steg, 2019). These policies often focus on increasing knowledge and awareness of risks to target risk perception, responsibility, and affect, and on possible actions to undertake to target self-efficacy and outcome efficacy. However, research shows that these policies often do not reach the intended outcomes (Cornes & Cook, 2018; Michie & West, 2013; Strengers & Maller, 2011; Whitmarsh et al., 2021), since they are “too reductive, individualistic, [and] linear” (Whitmarsh et al., 2021, p. 76). As Cornes and Cook (2018) suggest, there is “a need to shift beyond the traditional framing by government of public inaction caused by a lack of awareness and knowledge of hazards and strategies to address vulnerability” (p. 170). Policies and interventions should take the complexity of behaviour into account and should start from a holistic understanding of behaviour (Kok et al., 2017; Michie & West, 2013; Whitmarsh et al., 2021). To form this holistic understanding, research on the psychological factors and the structural environmental factors should be integrated.

An integrated approach

To fully understand climate adaptive behaviour, a holistic approach that takes factors from both psychological and adaptive capacity research into account is necessary. Whitmarsh and colleagues (2021) identified a need for “interdisciplinary interventions that address the multiple drivers, barriers, and contexts of behaviour” (p. 76). By integrating insights from adaptive capacity research, with a disciplinary background of biology, geography, and economy, with research on psychological factors, this need can be met, which would assist in the development of effective policies to encourage climate adaptive behaviour and minimize possible inequalities.

COM-B model

The COM-B model can be used to integrate the different research strands of adaptive capacity, focused on environmental factors, and psychology, focusing on motivational factors. It

was developed from a behavioural change perspective to provide a comprehensive overview of all factors that are known to influence behaviour (Michie et al., 2011). The COM-B model is part of the Behaviour Change Wheel (BCW), which links the factors influencing behaviour with possible policy directions for behavioural change. The model has been applied to many different types of behaviour, including pro-environmental behaviour (for example Addo et al., 2018; Graça et al., 2023; Ford et al., 2023; Frost & Murtagh, 2023; Smaliukiene et al., 2020), but not yet to the field of climate adaptive behaviour.

The model has three components, that together shape behaviour: capability, opportunity, and motivation. The capability component covers the capacity to engage in certain behaviours. This can be divided into psychological and physical capability. Opportunity concerns the factors in the environment that enable or prompt certain behaviours. It can be divided into social and physical opportunity. Lastly, motivation can be divided into automatic (involving emotions and impulses) and reflexive motivation (involving evaluations and plans).

A new integrated model

When reflecting on previous research in light of the COM-B model, it can be seen that not all components are taken into account. Adaptive capacity research focuses on opportunity and capability but leaves out motivation, while research on psychological factors overfocuses on motivation. By focusing on motivation alone, “we run the risk of blaming those who lag behind in this transition for lacking the motivation to counter climate change” (Bal & Stok, 2022, p. 184). Studies have shown that even though groups with lower socio-economic status tend to be late adopters of new, sustainable behaviours, “lower socio-economic status groups are *not* less motivated, nor do they have fewer intentions to behave sustainably” (Bal & Stok, 2022, p. 184). However, only looking at opportunity and capability is also not sufficient, since motivation is an important part of human behaviour, which can also be seen by the gap between adaptive capacity and adaptive behaviour (Fox-Rogers et al., 2016; Grothmann & Patt, 2005; Mortreux & Barnett, 2017). The two strands of research can be combined to create a new holistic model of adaptive behaviour. A visual representation of this integration, with the COM-B model as a foundation, can be seen below, in figure 2. The psychological factors are underlined and the factors from adaptive capacity are in italics.

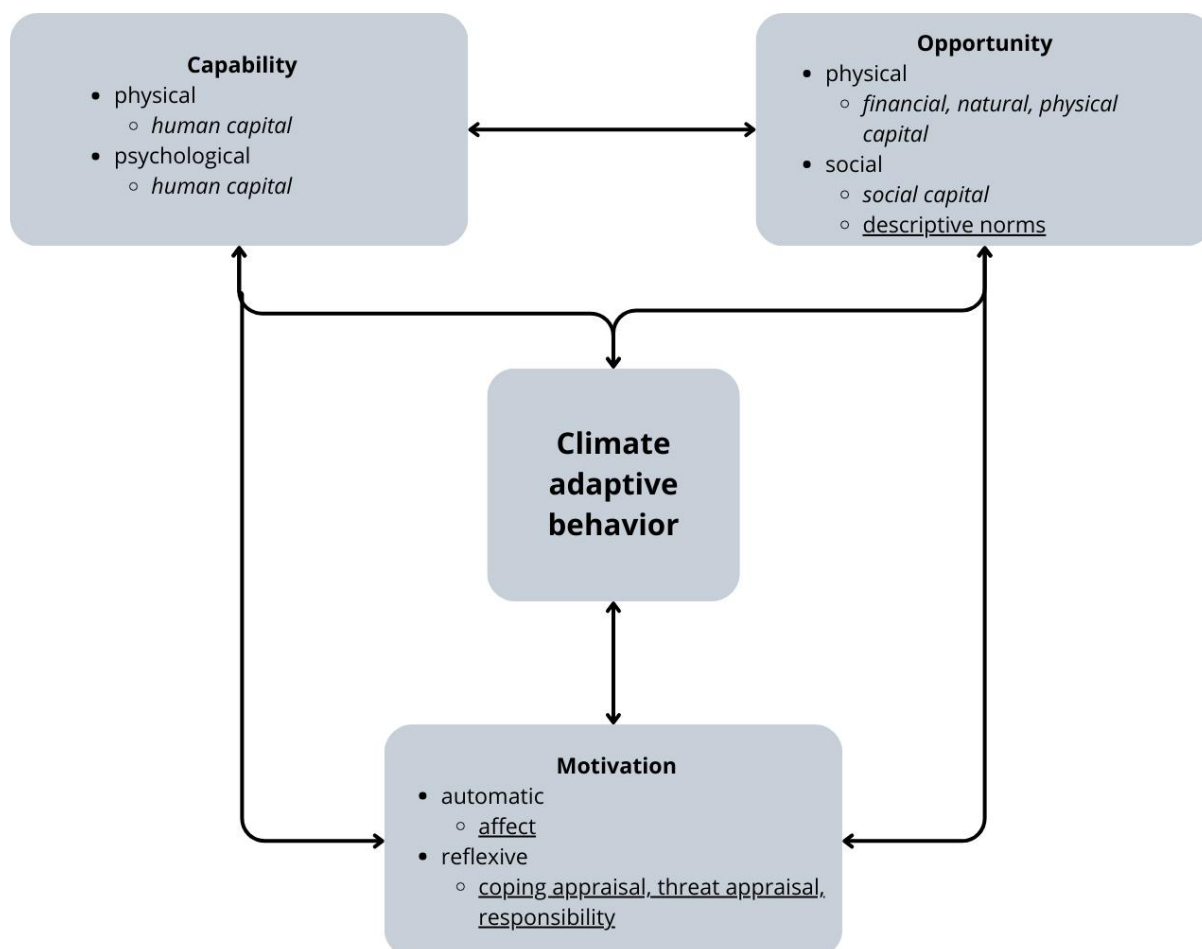


Figure 2: Schematic overview of an integrated model of climate adaptive behaviour

This research

This research will be conducted based on a case study of Katendrecht, a district in Rotterdam. Since the municipality of Rotterdam recognizes the threat of heat in the city, especially considering the urban heat island effect, they are developing climate adaptation strategies for some of their districts. One of these districts is Katendrecht.

The purpose of this research is to create a holistic view of facilitators and barriers for climate change adaptation in relation to heat for residents of Katendrecht. The research question it aims to answer is: *How do capabilities, opportunities, and motivation facilitate or hinder climate adaptive behaviour to mitigate the effects of heat for residents of Katendrecht?*

The expectation is that a variety of different factors affect the experiences of residents. Both factors from the climate adaptation field and psychological factors could play a role. It is also expected that factors falling in all components of the COM-B model will be of influence. Additionally, factors that are not covered in either adaptive capacity or psychological research could have an influence, such as rules and regulations from the municipality or housing corporations.

Methods

Study Design

To answer the research question in-depth semi-structured interviews were conducted. This research method was chosen to gain insight into the perspectives and experiences of residents of Katendrecht. Since there has not been any previous research on this topic that uses the COM-B model, or another holistic approach, the goal was to explore the diverse factors that influence the experiences of residents. Semi-structured interviews allow for an openness and flexibility that suit this exploration of experiences. In total, 14 interviews were done with different residents of Katendrecht. These residents were selected based on their socio-economic status, house ownership, the type of building they live in, and their social network. The interviews lasted roughly 30 minutes. Prior to starting the data collection, one interview was done as a test with a personal acquaintance who is a resident of Rotterdam and has lived in Katendrecht before. This interview was used to gather feedback on the questions and the interview style. After this interview, the wording of some questions was adjusted.

Study Sample

The target population of this research was residents of Katendrecht. Katendrecht has roughly 6.000 inhabitants. There is a mix of people living in Katendrecht, consisting of the old Kapenezen, often with a low socio-economic status, mainly living in older, badly isolated buildings and young professionals and young families with a high socio-economic status, often living in newer well-isolated family homes or apartment towers (Gemeente Rotterdam, 2022). To ensure the sample was as representative as possible, different zones in Katendrecht were identified based on the built year of the houses, house ownership, and information on the characteristics of inhabitants (Dienst Stedebouw & Volkshuisvesting & Ontwikkelingsbedrijf Rotterdam, 2005; Gemeente Rotterdam, 2022), a map of the different zones can be found in figure 3. At least two people from every zone were interviewed.



Figure 3: Map of Katendrecht divided into zones, source base map: Google Maps (2024)

Participants were recruited through the “Huis of de Wijk” or the house of the neighbourhood. This is an open house where residents can go to socialize. Here it was asked if they would be open for a one-on-one interview. Additionally, participants were recruited through the district council of Katendrecht and personal contacts. Information on the characteristics of participants can be found in table 1.

Table 1

Characteristics of participants

Variable	N
Age groups	
Below 30	2
30-50	3
50-70	6
Over 70	3
Time living in house	
1-5 years	5
5-15 years	4
Over 15 years	5
House ownership	
Social rent	4
Private rent	3
Bought	7
Built year house	
Before 1980	3
1980-2000	4

2000-2020	5
After 2020	2
Type of house	
Apartment	7
House	7

Data and Measurements

In the interviews, a topic list was used with a structure of questions, which can be found in Appendix A. The interview started with general questions on participants' perceptions of heat. It then went into their behaviour to prevent heat in their homes, asking whether they had taken any measures and what motivated their decisions. Afterwards, their behaviour during a heat wave was questioned, again asking if they took any measures and their motivations for their behaviour. With both of these topics, participants were first asked freely if they had taken any measures. Afterwards, a list of possible measures was shown to participants to remind them of possible measures, which can be found in Appendix B. It was ensured that all variables from the integrated model presented in figure 2 were mentioned during the interview. These variables often came up naturally when asking about the previous behaviour of participants, if not, a question hinting specifically at a certain variable was asked. The prompts used to question the different types of assets were based on literature from adaptive capacity, for example, the interviews done by Lindblad (2012). The questions about the psychological factors were based on psychological research, for example, the questions posed by Steven and Stephen (2020) and Brink and Wamsler (2019). Afterwards, participants were asked what could help them to take more measures. Finally, it was asked if there was anything that was not discussed that participants thought might be relevant.

Data Analysis

For the analysis of the data, the thematic analysis procedure was followed (Braun & Clarke, 2006; Braun & Clarke, 2019). The interviews were first transcribed using Microsoft Word, these transcriptions were checked and read to familiarize with the data. Afterwards, one interview was fully coded, using an inductive approach. These codes were then used as a foundation for coding the other interviews. When a new code was generated in an interview, all other interviews were checked for containing this new code. The codes were associated with a specific component of the COM-B model. After all interviews were coded, themes were generated from the codes. This was done by printing out the codes and categorizing them into

groups. These groups were then reviewed based on internal homogeneity and external heterogeneity. For example, a theme 'choices for measures' was created, this theme contained codes regarding the advantages and disadvantages of certain measures and the experienced heat stress. However, after review, it was decided that the internal homogeneity of the theme was too low, there were too many different codes in one theme, so heat stress was taken out of this theme and made to form a theme of itself. After the review, a thematic map was made and themes were named. The generating, reviewing, and defining of themes was an iterative process. Finally, a final thematic map was made. After the interviews, data was anonymized. After data collection, all data was deleted from personal devices and stored on secure servers of Utrecht University.

Reflections and considerations

As a researcher, my personal opinions could have influenced the research process. I believe climate change is a serious issue and climate change adaptation is necessary. Simply by holding that opinion, I might have influenced participants to answer in socially desirable ways, by for example overstating their motivation for climate adaptation. To mitigate this, I tried to reassure participants that there were no right or wrong answers in the interviews and that I was simply interested in their experience. According to research by Bergen and Labonté (2019) providing assurances can help in decreasing social desirability bias, but some effect likely remains.

Additionally, the use of the COM-B model and my belief that factors influencing behaviour will be spread across different components could have influenced the data analysis. I may have been biased to over- or underemphasize some elements to fit the spread of the COM-B model better. Also, the use of the COM-B model means my interpretation of the data was done through a certain lens, this lens means I could have missed things that were important but did not fit within the COM-B model. To reduce this effect, I discussed the data analysis with my supervisors to get a second opinion. However, in coding the data and generating the themes, some biases could still have slipped in. In future research, it might be good to conduct similar research that is less guided by theory and fully guided by the experiences of the participants.

Lastly, I do not have extensive experience in conducting semi-structured interviews. This means I could have missed opportunities to ask additional questions, I may have misinterpreted something participants said, or I was too rigid in following the topic list. A literature review by West and Blom (2016) shows that interviewers with less experience obtain lower-quality answers. In an attempt to mitigate this, a test interview was done prior to data

collection, where feedback was also asked on the interview style. However, this test interview does not substitute extensive experience in interviewing.

Results

Six main themes were generated with the thematic analysis (an outline of the code tree can be found in Appendix C). The first theme is “cool spaces outside the house”. The “house” itself is also a theme, it regards the characteristics of the home that influence how much it heats up, and the ownership status of the home. The home influences the third theme: “possible measures”, concerning the measures that are possible both legally and physically. The possible measures together with the fourth theme, “choices for measures”, lead to the “measures taken”. Both the house, the cool spaces outside the home, and the measures taken together lead to the experienced “heat stress”. Below, all themes will be discussed one by one, a visual overview can also be seen in figure 4.

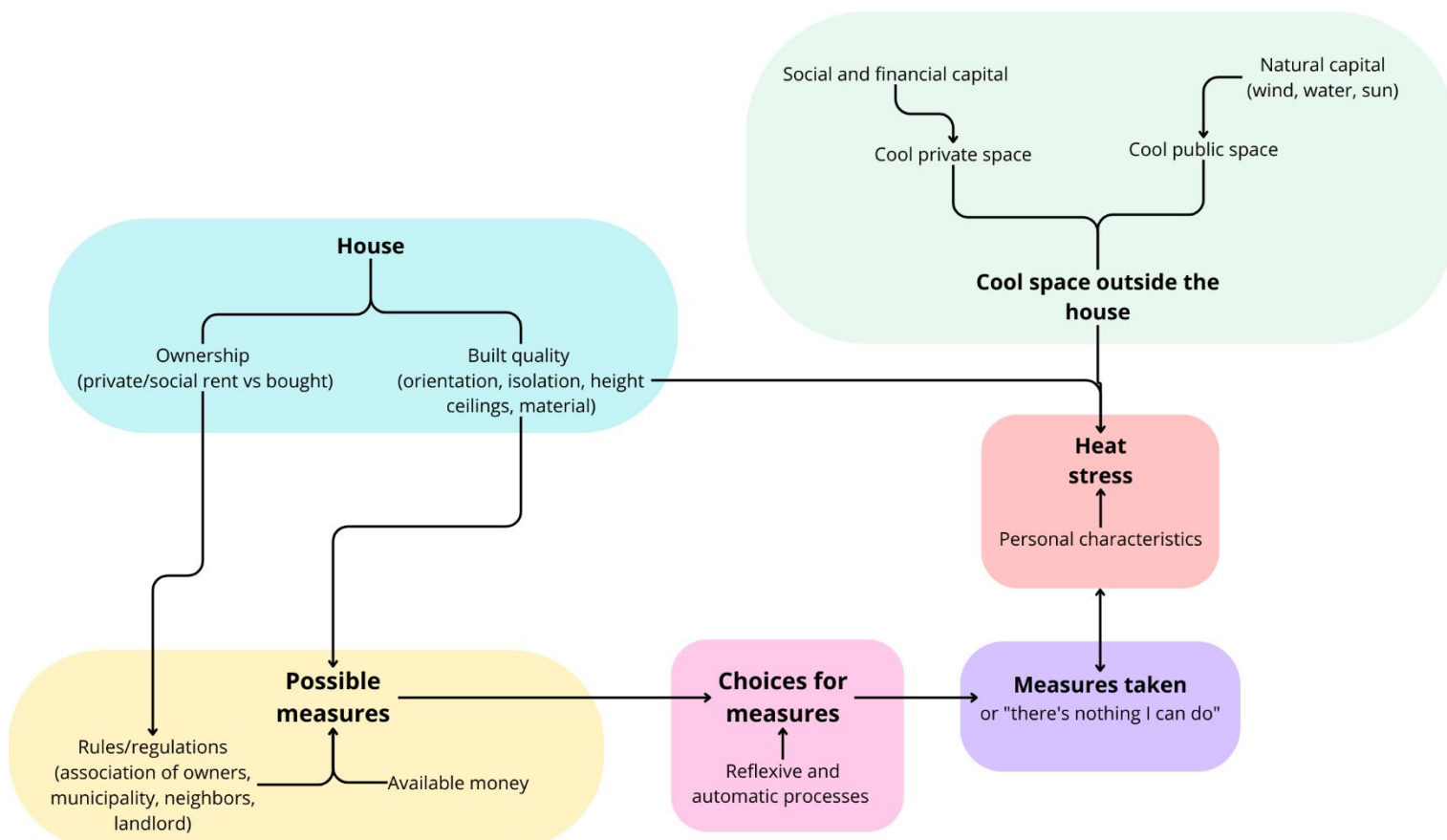


Figure 4: Schematic overview of the thematic map

Cool space outside the home

For some participants, their access to cool spaces outside of the home was an important factor in keeping their heat stress low. As “Diya” (age 50-70, social rent) said: “Look, I

am never home, I am always working and there it is cool, or I am my friend's house, that is also cool".¹ This cool space can be divided into two types: public and private space, both can be seen as a type of physical capital.

The 'coolth' of the public space of Katendrecht is strongly influenced by natural capital, especially wind and water. Many participants said they appreciated the wind and water for their coolth, "Jack" (age 50-70, house owner) for example said: *"We live so close to the water, that really makes it nice and cool, and then together with the wind, yes that really helps, those are really the advantages of living here"*. Although some participants did say there was too little shade on the street, making it a struggle for them to keep out of the sun, "Fatima" (age 70+, social rent) even said: *"out on the streets, especially at the front of the Kaap, it gets so hot you can cook an egg on the street"*. The cool private space that people have access to, such as co-working spaces, the house of the neighbourhood (which is a public-private cooperation), or houses of friends, is often influenced by their social and financial capital.

Access to cool spaces especially helped participants whose house got quite hot, "Sophie" (age 50-70, social rent) noted: *"I am lucky I can come here [the house of the neighbourhood], I always go here in the summer, cause it's always cool here, I need to get out of the house, it gets boiling hot in there"*. The access to cool spaces outside of the home is a facilitator for individual climate adaptation towards heat. The lack of shade in the public space experienced by some participants is a barrier to adaptation.

House

The biggest influence that participants noted in relation to their heat stress was their experienced temperature in the house. Some participants, like for example "Marie" (age 50-70, house owner) said: *"No, no, the heat doesn't bother me, no, you know, it always stays cool in my house, so then it's really not a problem"*, while others felt the opposite, with "Mo" (age 50-70, house owner) for example saying: *"yeah I am really bothered by the heat, yes it just becomes so hot in my house, it really becomes way too hot"*.

The built quality of the house is a key factor in determining how hot it gets, with factors like isolation, the height of the ceilings, the built material, and mainly the orientation of the windows having a big influence. Most people did not consider this when choosing their house to live in, either ending up lucky or unlucky. With the current housing market, participants also did not have the opportunity to consider this when choosing a new house. "Hanna" (age 30-50,

¹ All interview quotes are translated from Dutch

private rent), with windows on the north-east, for example, said: *“No, I did not pay any attention to heat, actually, I thought, oh that’s sad that I only have the morning sun, but I didn’t have other options right. But yeah, now I’m really happy with it”*. This physical capital of the built quality is not something that individuals directly have control over, but it does have a significant influence on their heat stress.

Another important aspect of the house is the ownership. When people rented their house, they felt like it was the responsibility of the house owner to take measures against heat, “Julia” (age 70+, private rent) for example said: *“I am not going to do these investments, the house owner should”*. Especially in social rent, people felt like they couldn’t do anything themselves and the responsibility was really with the corporation, as “Sophie” (age 50-70, social rent) said: *“Isn’t it obvious, the corporation is responsible, I can’t do any of these things myself”*. The ownership of the house was experienced as a barrier for taking adaptive action by participants, if they did not own the house they did not want to invest in it and they also needed approval from the owner to take any action.

Possible measures

The possible measures that participants could take were influenced by their house. The built quality influences the physical possibilities. One participant, for example, said that she would like to get sun shading, but it was not possible because the walls were too porous. The built quality of the house was often experienced as a barrier to taking adaptive actions.

Additionally, various rules and regulations determine the possible measures for participants, for example, a rule from the municipality, states that the facades of buildings should fit with the style of Katendrecht, meaning they should consist of steel, glass, and concrete. Other examples of such rules are the rules of an association of owners, or agreements made between neighbours. These rules are often experienced as barriers, as “Lucas” (age 30-50, house owner) for example said on installing sun shading: *“No I couldn’t do that on my own, I would need permission from the association of owners, and I already know they won’t give it, because it’s been tried before.”*

Another influence on these possible measures is the money available to people, their financial capital. Measures such as sun shading or installing a green roof are big investments, which means they are not an option for every household because of the cost. The available money was a barrier for quite some participants, like “Anne” (age 70+, social rent) for example

saying about installing sun shading: *“No I would like it, but I mean, yeah, who is going to pay for that, yeah, no, I can’t pay for it”*.

Choices for measures

The possible measures then serve as options for people to make choices, which is where motivation comes in. These choices are based on both the reflexive process of actively weighing the pros and cons as well as the automatic feelings that come up. Both automatic and reflexive motivation were seen as both barriers and motivators, motivating some participants for action, while demotivating others. Some participants for example chose air-conditioning because it was effective, quick, and easy, others said they didn’t like the feeling, found it too cold, or perceived the air as unhealthy, for others the energy use, both in terms of cost and environmental damage, was an important factor affecting their decision.

Another important factor in this decision-making process was the complexity of a certain measure and knowledge participants had, which relates to the psychological capability. “Christine” (age 30-50, house owner) for example said: *“A green roof I find very interesting, but there are so many technical things involved, a lot of technical information needs to be researched, but I don’t know, I don’t know anything about that, you really need to have knowledge on these technical things”*. Some participants also mentioned a lack of objective information, like “Tess” (age 50-70, house owner) for example saying: *“Yeah I need information that is not trying to sell me anything, right now nothing is objective”*. Participant also mentioned not having thought about a certain measure before, and not knowing the effectiveness. As Rick (age 30-, private rent) said: *“It would really help me if there was some information on how much something does, how much does it help, then I could make a decision also considering all the possibilities”*. The psychological capability of knowledge was seen as a barrier to adaptive action here.

Measures taken

The possible measures and choices for measures together lead to the measures taken. There was a wide variety of measures that participants took, ranging from larger measures, such as installing a green roof or exterior sun shading, to smaller measures such as getting a ventilator or interior sun shading. Some participants had virtually not taken any measures, since they did not experience heat stress in their house.

In general, participants felt like the larger measures that were taken were quite effective. Participants felt like the smaller measures were not as effective, as “Fatima” (age 70+, social

rent) for example said: *“No it only helps a little bit, but no not really, no it doesn’t do everything”*. Participants who took these smaller measures were often constrained by the possibilities. For some participants, these constrained possibilities are combined with high heat stress. These people often felt quite hopeless, they experienced significant heat stress and felt like they couldn’t do anything to change that. As “Anne” (age 70+, social rent) said: *“I really don’t like the heat, I am also concerned about my health, but I mean, I can’t do anything about it, what can you do, no we really can’t do anything”*.

Heat stress

The measures taken, together with the built quality of the house and the access to cool spaces outside the home resulted in the heat stress participants experienced. Personal characteristics also influenced this heat stress, with “Ali” (age 30-, house owner) for example saying: *“I really love the heat, yeah I am one of those annoying people that actually really like global warming”*. Others strongly disliked the heat and said they were very sensitive to it. Experiencing heat stress was one of the main motivators for participants to take measures against heat.

Theme interactions leading to inequalities

All themes interact with each other, during the interviews it became apparent that these interactions often caused inequalities in heat stress that mirrored already existing inequalities in society. Participants with less money often experienced more heat stress. Their financial capital limited the possible measures they could take, which meant they could not take any large measures against heat to ensure a cool house. Additionally, their houses were often poorly isolated and the built quality sometimes limited the possible measures. Newly built, or renovated, houses often have measures such as a ventilation system, floor cooling, or a green roof included, in older, more affordable houses this is not the case. The ownership status of the participant also played a role, in social rent, participants thought that the corporation should be responsible for any measures on the exterior of the house, such as installing sun shading or a green roof, since participants themselves felt like they could not do this. However, participants said that their corporations often didn’t do anything, with “Diya” (age 50-70, social rent) for example saying: *“No, no, you have to do everything yourself, they really won’t do anything, definitely not”*. These constrained possibilities together with the higher heat stress led to feelings of helplessness for participants. Moreover, some cool spaces outside of the home, such as co-working spaces or restaurants cost money, which means participants with less money were also limited in their access to these spaces. Together this means that participants

with less financial capital experienced more heat stress, and a cool house is becoming a luxury product.

Findings

In conclusion, whether or not participants took measures against heat was influenced by both psychological factors and adaptive capacity. Mainly opportunity, especially physical capital, played a big role in influencing climate adaptive behaviour. The house, a form of physical capital, strongly influenced the amount of heat stress experienced and the possibility for certain measures. The physical capital of access to cool spaces was another opportunity that facilitates climate adaptive action. Both the financial capital available and the rules and regulations from the municipality, association of owners, or the national government, were often experienced as barriers to adaptive action. Motivational factors also played a role. This motivation was firstly strongly influenced by the amount of heat stress participants experienced. Participants also made active choices in taking or not taking measures, meaning reflexive motivational processes also had an influence. These were experienced as both a barrier and a facilitator, with preconceived notions and opinions participants had playing a big role. In short, all components of the COM-B model had an influence on climate adaptive behaviour.

Discussion

The research question of this research was: *How do capabilities, opportunities, and motivation facilitate or hinder climate adaptive behaviour to mitigate the effects of heat for residents of Katendrecht?* It can be seen that opportunity played a big role in climate adaptive behaviour. Mainly the physical capital of the house and the financial capital of participants were important factors. The house was seen as both a facilitator, for example, when a new house already had a green roof and floor cooling installed, as well as a barrier, for example, when the built quality of the house limited the possible measures or when the ownership status of the participant constrained what they were able to do. Participants experienced financial capital as a barrier. The high cost of measures was a reason for many participants not to take certain measures. Capability, specifically a lack of skills and knowledge on how to install certain measures, was experienced as a barrier to adaptation. Motivation was experienced as both a hindrance and a facilitator. Motivations differed from person to person. Some participants opted for air-conditioning because they thought it would be a quick and easy solution, while others did not want air-conditioning because they did not like the air or thought it was too noisy.

A big effect on motivation was the experienced heat stress. When participants experienced heat stress, they were in principle more motivated to take measures. However, if the possible measures were heavily constrained by the opportunities, this resulted in a feeling of helplessness, which was seen as a barrier to adaptation. Another interaction between the components of the COM-B model was between opportunity and motivation. If participants felt like their opportunity was a barrier, their motivation would often also be low. All components of the COM-B model have an influence on climate adaptive behaviour, which is in line with the expectations for this research.

When reflecting on the results of this study in light of previous research, it becomes evident that all factors from previous research play a role, and interact with each other, which is in line with the expectations of the research. This research confirms the factors that previous research identified. The research adds specificity for the case of climate adaptation towards heat to the more general factors identified by previous research. Additionally, it combines the different factors from previous research to create a holistic overview. A visual overview of how the factors from previous research relate to this research can be found in figure 5. The themes from this research are in the coloured block, the factors from previous research in grey, where the underlined factors stem from psychological research, and the factors in italics from adaptive capacity research.

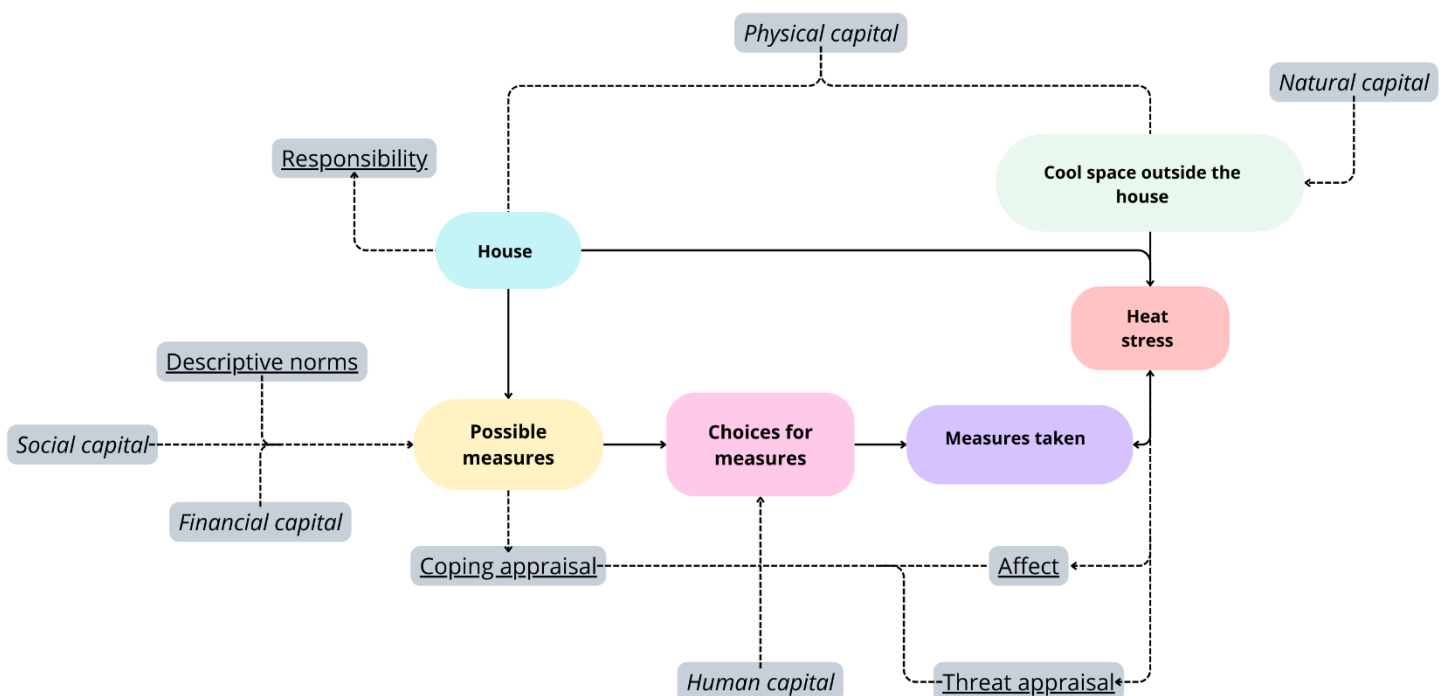


Figure 5: Schematic overview of the combination of this research and previous research

The house and the cool space outside the home are both examples of physical capital, especially the house was seen as an important determinant of whether or not participants took

measures against heat, making physical capital an important factor in this research. Natural capital influences the access to cool public space: wind and water were seen as a facilitator for climate adaptation. The ownership status of participants influences the sense of responsibility people feel for taking measures, feeling like the house owner is responsible. Descriptive norms and social capital come back in the (informal) agreements with neighbours that people make, which together with their financial capital influences which measures are possible. Especially financial capital was seen as an important barrier to action. The coping appraisal is influenced by the possible measures participants could take and influences the choices for measures. This coping appraisal is also where some participants expressed helplessness, saying there was nothing they could do about the heat, which was a barrier to adaptation. The choices for measures are also influenced by human capital, especially the skills and knowledge necessary for certain measures. Affect and threat appraisal also have an effect on the choices for measures, both of these variables are influenced by the experienced heat stress. It is interesting to note that these elements from different research strands also interact with each other. The financial capital, for example, influences the possible measures, which influence the coping appraisal. By using a holistic model, it becomes clear that all factors are connected.

Strengths and limitations

The strengths of this study are the interdisciplinary nature and the use of a holistic framework. By the use of this holistic framework, the study has a broad view, not focusing on one specific factor, but showing different types of factors that influence behaviour and their interactions. Another strength is the use of the COM-B model and its connection to the BCW, which means specific policy recommendations can be given based on the theory.

A limitation of the study is the sample size, since only 14 people were interviewed, the external validity of the study can be questioned. Especially since there was some homogeneity in the sample, with a lot of older participants with lower socio-economic status, and younger participants with higher socio-economic status, although this can also be said to be typical of Katendrecht. Participant recruitment could also influence the external validity. Many participants were recruited through the House of the Neighbourhood, even though it is not necessarily typical to visit this house. Additionally, there were some participants recruited through personal contacts, this may also have affected the representativeness of the sample. To ensure the results of this research are representative, a follow-up quantitative study, with a much larger sample size, could be done, using the themes found in this study as a basis.

Future research could focus on different geographical locations, for example, in the countryside or using a whole city as location, instead of one district, to be able to see if the themes found in this research apply to different locations. Another direction for future research is to examine how to encourage climate adaptation, analysing the effectiveness of different behavioural change techniques in the context of climate adaptation towards heat.

Policy recommendations

The results of this study point to possible (and necessary) policy directions. The BCW informed the recommended policy directions based on the identified factors that influence climate adaptive behaviour. Right now, policies in the Netherlands aimed at thermal comfort in houses often focus on keeping houses warm in winter. Considering heat in newly built homes is a relatively recent development, only being taken into the Bouwbesluit in 2021 (Rijksoverheid, 2020). When heat is considered for newly built houses, active cooling is encouraged. However, active cooling costs energy and often heats up the street. So it is recommended that policies also, or mainly, encourage passive cooling. This is also more accessible for people with less money since the energy bill won't rise.

Policies should aim to ensure that everyone has access to coolth and a cool house does not become a luxury product. Ensuring this requires unified political decision-making, it needs to be decided who is responsible for what. To make these decisions and implement the recommended policies, a direction needs to be decided on with broad political support, meaning parties need to come together.

To ensure access to coolth for everyone, policies should focus on enabling people to take adaptive action, since opportunity plays such a big role in adaptive behaviour (Michie et al., 2011). This enablement can come through service provision. With for example a heat box similar to the energy box that was already distributed in the Netherlands (Rotterdams Milieu Centrum, 2022). Such a box could contain sun-repelling foil, a ventilator, and clear instructions on accessing subsidies. Additionally, legislation and regulations should be used for newer buildings to ensure that they are built with heat in mind. This can be done by changing the orientation of the windows, or making it mandatory to offer sun shading when windows are oriented to the south. Usually, people living in these newer buildings have the money to invest in measures, so for them, it is an option to invest themselves. Here, the priority is to encourage passive cooling over air-conditioning. The associations of owners could be restricted in their ability to prohibit certain measures like sun shading. Legislation and regulations should also be used to ensure corporations take action and install measures in already existing social rent

houses. Finally, to target the opportunities people have, environmental restructuring can be used to make sure the public space is cool. By planting more trees, and designing some cool indoor public spaces, such as a House of the Neighbourhood or a library, access to cool spaces outside of the home can be increased. The motivation and capability can be targeted by providing information on possible measures (Michie et al., 2011). This information should consist of both technical information, with details on how to install for example a green roof, as well as more basic information on which measures exist and their effectiveness.

Although the aforementioned policy directions are all recommendations for adaptation policies, it is important to note that adaptation should not replace mitigation. The effects of climate change should be addressed, but so should the causes, since there is only so much we are able to adapt to (Stoddard et al., 2021). Participants also noted that this is not done effectively, saying that policymakers are now trying to solve the problems that they caused. So, the causes of climate change should be addressed, not only the effects.

Together these policy recommendations should make sure that everyone has the opportunity for coolth. To address both the causes and effects of climate change, unified political action is needed. We need to work together to ensure a cool house is for everyone.

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Appendix A: Topic list interviews

Welcome, thank you for being here. I'll start with explaining again why I invited you. For my master thesis, I am doing research on climate adaptation against heat of residents of Katendrecht. My goal is to find out the barriers and motivators for taking measures against heat, and how residents can be helped to take measures. I would like to interview you for this research. This interview will last roughly 30 minutes. You can stop at any point during this interview, without negative consequences. Your data will be anonymized. You have already read and signed the informed consent form, do you have any questions about that or any part of the procedure?

I want to remind you that there are no right or wrong answers, I am simply interested in your experiences. Then I will now start the audio recording, and we can start.

General

- Can you show me where in Katendrecht you live on this map?
 - o How long have you lived there?
 - o Do you own the house or do you rent it?
- Are you worried about heat, or do you look forward to warmer weather?
- Do you have experiences last summers where you were feeling uncomfortably hot?
 - o What do you notice?
- What do you think the consequences of heat can be?
- How do you estimate the chance that you will be bothered by heat?
 - o Do you think that it could be dangerous for you?

Before heat: preventative

- Have you done anything to make sure that the house heats up less?
 - o What did you do? Why did you take this measure?
 - o Were you aware that you could do something, do you have an idea of possible measures?
- Would you want to do anything to ensure that the house heats up less?
 - o Why/ why not?
 - o What would you like to do?
 - o Why have you not done so yet?
 - Would you have money for it?
 - Do you have access to the right infrastructure or technology that could help you?
 - Do you have access to the natural resources necessary?
 - Do you have access to social connections that could help you?
 - Do you have the physical and mental capacity?
 - Are there certain rules or procedures that make it hard for you to do?
 - What are the disadvantages?
 - What do you think the cost would be?
 - Do you have enough space for it?
- Based on the overview of possible measures:
 - o Is there anything from this list you would like to do? (dependent on answers previous questions)

- What do you think would work from this list?
- What do you think would be easy for you to do?
 - Why
- What do you think would be hard for you to do?
 - Why?
- What would you be most likely to do?
 - Why?
- What could help you to do more of these measures?
- What are people around you doing, do you think they took preventative measures?
- Who do you think is responsible to prevent heat?
 - Why, do they take their responsibility?

During: while it is hot

- What do you notice?
- Do you take any measures to make sure you are less bothered by heat?
 - Why do you do these things
 - What could you do?
- Are there things you would like to do, but don't (always) do?
 - What?
 - Why cant you always do them?
 - Would you have money for it?
 - Do you have access to the infrastructure or technology you would need?
 - Do you have access to the natural resources necessary?
 - Do you have access to social connections that could help you?
 - Do you have the physical and mental capacity?
 - Are there certain rules or regulations that make it harder for you?
 - Do you have the space for it?
 - What could help you to do these things more?
- What are people around you doing, do they behave differently when it is hot?
- Who do you think is responsible for protecting you when it is hot?
 - Why? Do they take their responsibility?

Ending

- Are there things that you think might be relevant that we have not yet discussed?

Thank you for your time, I am going to analyze the responses, would you like to be kept informed about the results?

Appendix B: Possible measures against heat

Preventative (to prevent heat in the house):

- Making a green front garden
- Ensuring more shade in the garden or on the balcony
- Installing sunshading (sunscreens, sun canopies, sun repelling foil, etc.)
- Getting air conditioning or a ventilator
- Installing floor cooling
- Painting the house with light, reflecting paints
- ...

During heat (to reduce the effects of heat):

- Drink more water
- Work out less in warm spaces
- Go to cool spaces
- Close the windows during the day
- Open the windows at the night
- Stay out of the sun between 11:00-15:00
- Stay in the shade
- Use sunscreen
- Use a ventilator or air conditioning
- Close curtains during the day
- Use sunshading during the day
- ...

Appendix C: code tree

Opportunity

- Physical
 - (Cool?) public space
 - Natural capital
 - Wind
 - Water
 - Air quality
 - Shade outside/ No shade outside
 - Avoiding the sun on the street
 - Green outside
 - More green necessary
 - Municipality responsible
 - No trust in municipality
 - Preventative measures against climate change
 - Water safety
 - Policies
 - Buildings closer to each other
 - Free drinking water available
 - Cool private space (outside of house)
 - Co-working spaces
 - Friend's house
 - House of the Neighbourhood
 - Not home often
 - House
 - Built quality
 - Physical possibilities
 - Green roof
 - Floor cooling
 - Material house
 - Climate adaptation regarded in building
 - Floor cooling
 - Builders responsible
 - Orientation windows
 - Isolation
 - Energy label
 - Newly built/old building
 - High ceiling
 - Size
 - Household composition
 - Use of house
 - Flat roof
 - Garden
 - No space for greenery
 - Green garden
 - Cool garden

- Ownership
 - Corporation owns building
 - Corporation responsible
 - Corporation does not do enough
 - No trust in corporation
 - Bought house
 - Owner responsible
 - VVE
 - Private rent
 - Owner/renter responsible
 - Resident responsible
 - Possible measures
 - Rules/regulations
 - Rules VVE
 - Agreements neighbours
 - Do everything with neighbours
 - Style of Katendrecht
 - Architecture protected
 - Available money
 - Costs
 - Energy costs
 - Subsidy
 - Policies
- Social
 - Descriptive norms
 - Others do more
 - Others do the same
 - Access to information
 - Information from neighbours
 - Information from a friend
 - Information from TV
 - Technical information
 - Social network responsible for looking out

Capability

- Physical
 - Mobility
 - Health
 - Health of elderly
- Psychological
 - Knowledge
 - Technical information

Motivation

- Automatic
 - Measures feel good physically
 - Affect:
 - nice in sun
 - Dirty air of airconditioning
 - Liking/ not liking greenery
 - Feeling of airconditioning
 - Forgetting actions
 - Only bothered when it is hot
- Reflexive
 - Coping appraisal
 - Response-efficacy
 - Effective/not effective
 - There's nothing you can do
 - Easy
 - Quick
 - No other options
 - Self-efficacy
 - There's nothing you can do
 - Complicated
 - Cost
 - Dark
 - View
 - Environment
 - Ugly
 - Effort
 - Sound
 - Fresh air/air airconditioning
 - Threat appraisal
 - Personal characteristics
 - Feel hot fast
 - Can always sleep well
 - Feel stuffy fast
 - Menopausal
 - Don't need it
 - Only hot very shortly
 - It gets hotter
 - Don't worry too much
 - Not a priority
 - Have to think about measures
 - 'gezelligheid'
 - Visits
 - Bad vibe when it is too hot
 - Depends on activity

Measures taken

- Preventive

- Airconditioning
- Ventilation
- Sunshading
 - Inside
 - Outside
- Shade on balcony/garden
 - Greenery
 - Parasol
- Floor cooling
- Heat pump
- During
 - Using aircon/ventilation/floor cooling/sun shading
 - Drinking water
 - Not working out in hot spaces
 - Going to cool spaces
 - Staying out of the direct sun
 - Going outside
 - Staying inside
 - Adjusting rhythm
 - Getting used to the heat
 - Don't worry too much
 - Taking it easy
 - Opening/closing windows

Rest

- Reflection of the sun
- Others do not have options
- Gap between rich and poor gets bigger
- Houses are getting more expensive