Possible Change in Risk Perception of Climate Change due to the COVID-19 crisis

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Introduction

As the influence of humans on earth is growing and the impact on the socio-ecological system increases, so does the risk that is faced by humanity. The world is becoming more interrelated and interconnected and this makes it more challenging to respond to the problems in an adequate way (Wood, Garard & Luers, 2020). How policy makers react to these emerging risks is partly determined by the public risk perceptions. Risk perception of the public can support or oppose political, economic and social action to address the risk in question (Leiserowitz, 2006).

For decades, researchers have warned citizens of the negative consequences of climate change. However, their warnings did not lead to a change in behaviour and policy that would keep the global temperature rise below 1.5°C or even 2°C (Oreskes, 2004). This lack of action could be explained by the lack of perceived risk of citizens from the consequences of climate change. There is a spatial and temporal disconnection between the causes and the consequences of the issue. The consequences of climate change occur slowly and do not necessarily take place where the greenhouse gas is emitted, which makes it hard for people to experience the impact of climate change.

In the last period a new crisis has arisen, the COVID-19 crisis. The COVID-19 crisis has had an impact on every citizen in the Netherlands due to the measures that have been taken by the government to control the virus. For COVID-19, there is no disconnection as is experienced with climate change, which explains the direct response in the form of measures for its mitigation (Daszak, MCPhearson, Oni & Wood, 2020).

The measures have changed the daily life that the Dutch society is used to and as perceived risk is partly determined by an experimental and socio-cultural dimension (Helgeson, Van der Linden, & Chabay, 2012), there is a possibility of change in risk perception of climate change. And yet, it is not known how the experience of the COVID-19 crisis affects people's perception of other global risks, such as climate change. Therefore, this study will examine how the COVID-19 crisis has affected risk perception of climate change among Dutch citizens. Risk perception is determined by four dimensions: cognitive, experiential, socio-cultural and socio-demographic (Helgeson et al., 2012), this research studies which of these factors is the most influential in the possible change of perceived risk of climate change due to the COVID-19 crisis. Furthermore, as risk perception of individuals can be partly derived from the knowledge they have about the subject and their behaviour, this research will study if a different attitude towards climate change has an impact on the change in risk perception (Semenza et al., 2008; Sundblad, Biel & Gärling, 2007). In order to answer this question 3 sub-questions were investigated:

- To what extent does the COVID-19 crisis have an effect on the risk perception of climate change among Dutch citizens?
- Which dimensions of risk perception (cognitive, experiential, socio-cultural, socio-demographic) caused the change in perceived risk on climate change?
- How does perceived change in risk perception differ between people with different attitudes towards climate change?

To answer these questions a survey was conducted among Dutch citizens and a quantitative analysis of this data has helped to find answers. The report is divided into several components. Firstly, the theoretical framework that is used to conduct this research will be discussed and

information is given about the relationship between risk perception, climate change, and pandemics. Thereafter, the proposal will continue with the methodology section in which the survey will be explained. At last, the result of the survey, conclusion and the relevance of this research will be reviewed.

Theoretical framework

In human perception there is a difference between the real-world threats and subjective perception of this threat (Pidgeon, Kasperson & Slovic, 2003). This means that a risk is always construed by an individual or a group of individuals (Sjöberg, 2000; Slovic, 1992). Slovic's psychometric theory describes this process and will therefore be used in this research. The psychometric theory argues that risk is a product of the person assessing it (Slovic, 1992) and factors such as imposed proximity and severity of the hazard. The theory is thus suited to describe general patterns of risk assessment of climate change and pandemics.

Risk perception and climate change
Climate change is a risk which is perceived subjectively. However, it is difficult to perceive as a risk since it cannot be experienced directly (Swim et al, 2011; Withmarsch, 2008). Risk perception of climate change is mainly influenced by the following four dimensions: cognitive, experiential, socio-cultural and socio-demographic (Helgeson et al., 2012). These four dimensions, in particular the cognitive dimension, have some common ground with psychometric theory, as they pertain to the entity perceiving the risk. In this research it was expected that the cognitive, experiential and socio-cultural dimensions would change as a consequence to the COVID-19 pandemic. The reason for this is the influence of the pandemic on the knowledge, experience of risks and norms of individuals which lead to change in the dimensions. The socio-demographic dimension is not expected to change but is expected to give more insight into risk perception among different socio-demographic groups.

The cognitive dimension indicates that knowledge about climate change is necessary to estimate its probability and severity (Sundblad et al., 2007). Increased knowledge of the causes, impact and solutions to climate change lead to higher risk perceptions (Van der Linden, 2015). As the reaction to risks also depends on experiential factors and therefore on memories of negative consequences of the risks (Loewenstein et al., 2001), the risk perception of climate change increases with negative affect of climate change (Leiserowitz, 2006; Sundblad et al., 2007; Spence, Poortinga, Butler & Pidgeon, 2011). Especially the prediction of negative consequences for humans influences risk perception (Böhm & Pfister, 2001). Risk perception is also influenced by socio-cultural factors, especially by social norms. This means that the more climate change is seen as a risk by the social surrounding of an individual and the mass media, the higher its risk perception (Van der Linden, 2015). There is uncertainty about the socio-demographic factors that influence the perception, however multiple studies agree that gender has a significant influence on it (Van der Linden, 2015; Loewenstein et al., 2001; Sundblad et al., 2007). Women have been found to be more worried about climate change than men (Van der Linden, 2015; Loewenstein et al., 2001; Sundblad et al., 2007) and to have higher cognitive risk judgements (Sundblad et al., 2007). Individuals with higher risk perceptions of climate change were found to be more likely to change their behaviour in order to mitigate the

consequences of the risk (Semenza et al., 2008). This change in perception is a form of 'altered' behaviour which will be explained in the following section.

Risk perception regarding a pandemic
Becoming ill from a disease such as COVID-19 is also a risk, which means that it is assessed subjectively. The assessment also depends on the cognitive, experiential and socio-cultural factors as explained above. In the case of the current pandemic, increased knowledge of the causes, impacts and solutions to COVID-19 lead to higher risk perceptions. Additionally, memories of negative consequences of the pandemic lead to higher risk perceptions as well as increased risk perceptions of a person's social surrounding and the mass media. During the SARS epidemic in 2003 and the swine flu pandemic in 2009 individuals were found to adopt an 'altered' behaviour when the risk perception increased (Poletti, Ajelli & Merler, 2011; Brug et al. 2004). The 'altered' behaviour is thus an indication of a perceived risk. 'Altered' behaviour is all behaviour that is specifically altered to reduce the perceived risk of falling ill. These findings are in agreement with research pertaining to the 2003 SARS epidemic, where higher risk perceptions of SARS were found to correlate with more worry and more precautionary actions (Brug et al., 2004). However, individuals switch between normal and altered behaviour on the basis of an internal cost-benefit analysis, meaning a consideration of the positive and negative consequences of changing their behaviour to avoid risk, wherein a higher level of perceived risk leads towards 'altered' behaviour (Poletti et al., 2011).

Links between multiple risks
Little research has been done on the connections between risks. Not much is known about the way in which different risks are prioritized and ranked by individuals (Sullivan-Wiley & Short Gianotti, 2017; Doss, McPeak & Barrett, 2008). However, it is known that the characteristics of hazards themselves explain a part of the variation of risk perception in a multi-hazard environment. The factors that shape the risk perception are specific to the particular hazard (Sullivan-Wiley & Short Gianotti, 2017). A way in which risks are connected to each other is through the personal experience with the corresponding category of hazard experience (Lindell & Hwang, 2008) as explained with the experiential dimension of risk perception earlier.

The risks discussed in this research have large negative consequences for humans which leads to higher risk perceptions (Böhm & Pfister, 2001). However, as described before, information about the connection between the risks is limited. Therefore, it is needed that more research is done on this topic. Furthermore, change in behaviour can be used as a measure to study change in risk perception. A link between the 'altered' behaviour (e.g. social distancing, increased hygiene measures) caused by the pandemic and 'altered' behaviour to mitigate the risks of climate change, (e.g. vegan diet, refraining from plane travel) is possible to occur.

Methodology

To answer the research question 'How has the COVID-19 crisis affected risk perception of climate change among Dutch citizens?' a survey was used to collect the risk perception of different people. A survey was a sufficient tool to collect the data, because risk perception is a subjective topic and by using a survey, the different opinions and feelings of many people were collected.

The survey questions relate to the theoretical framework because they anticipate the different dimensions and provide data to answer the other sub-questions as well. The theoretical framework was used to formulate the questions in a way that sufficient data was provided afterwards and there has been tried to not guide the respondents in any way. This has presumably been accomplished by making the survey question as specific as possible. While writing the survey questions the theoretical framework was used. The survey questions can be found in appendix C.

Measuring a change in risk perception in one survey is a challenge. Ideally, longitudinal research is preferred to measure the change in risk perception. Unfortunately, it was not possible to perform such research due to limited time and resources. This is why the data cannot show if and how risk perception has changed, it can only show the perceived change in risk perception, so the change people think they went through regarding risk-perception.

This research is a quantitative research. The sample size is well over 200 respondents and this is used to receive an idea of the total population of the Netherlands. The survey data was used to measure and analyse the perceived change in risk perception of Dutch citizens. Ideally the respondents would be a sample of the overall population of the Netherlands, with different ages, backgrounds, interests, lifestyles and knowledge of the topic. However, the sample contains friends, family and acquaintances of the research team and as all five members of the research team are 'Global Sustainability Science' (GSS) students, many respondents will probably be GSS students as well. This could result in a bias of the sample and decrease the generalizability because GSS students have more knowledge about climate change than the average Dutch citizen. However, to distinguish the GSS students and non-GSS students, or other respondents with a great interest in this topic, a question regarding the level of having climate change as a leading topic in people's work/hobby/study/political party/social movement was added. The survey was shared on social media, WhatsApp, email and LinkedIn.

The survey contains questions to determine the perceived risk perception of the respondents before and after the COVID-19 outbreak in the Netherlands, to find the change in perceived risk perception. Questions regarding different dimensions have been included to find the reason behind the change in risk perception. These independent and dependent variables were analysed to study significant correlations between these variables. The socio-demographic information can be seen in *table 1*.

Number of respondents	Gender	Age	Level of education
212	Male: 74 (35.1%) Female: 137 (64.9%)	18-24: 132 (62.6%) 25-34: 14 (6.6%) 35-44: 14 (6.6%) 45-54: 23 (10.9%) 55-64: 10 (4.7%) 65+: 18 (8.5%)	Mavo: 10 (4.7%) Havo: 1 (0.5%) VWO: 16 (7.6%) MBO: 20 (9.5%) HBO-Bachelor: 33 (15.6%) WO-Bachelor: 78 (37.0%) HBO-Master: 11 (5.2%) WO-Master: 42 (19.9%)

Table 1: Socio-demographic information of respondents.

The data analysis that was used for this research is as follows. First the survey was set up by using Qualtrics which is a platform to create surveys and is prescribed to us by the Utrecht University. The survey was shared on social media platforms and other people were asked to do this as well, so the number of respondents was maximized. Afterwards, reminders were sent. Within ten days since publication, the data analysis started by collecting the survey data and inserting it in SPSS. In this statistical computer program the collected data was analysed to answer the research sub-questions. For analysing the data, a p-value is chosen of 0.05.

Perceived change in risk perception
Q15 and Q16 of the survey contributed to answer the question if perceived change in risk perception of climate change has occurred due to the COVID-19 crisis. To be able to analyse Q15 and Q16 there was the need to combine the sub-question of these two questions to a new variable. This has been done by giving each possible answer a number, e.g.: 0= I don't know 1= very small 2= small, etc. Both Q15 and Q16 had 6 sub-questions. The number corresponding to each sub-question was summed up and divided by 6, this way the variables of the average perceived risk perception before and after the COVID-19 crisis was derived. A paired sample T-test between these variables was performed. This test can determine if there is a significant difference between the mean of two measurements at different times, in this case before the COVID-19 crisis and after. A paired sample T-test was used to measure the significant difference between two normally distributed scale variables. The program SPSS can define whether the difference between these variables is significant or not, by determining the p-value.

To perform descriptive analysis on this question and to make a variable that could be used to answer sub question 2 and 3, a new variable was created. The 'average perceived risk perception before' was subtracted from the 'average perceived risk perception after'. In this way the new variable 'perceived change in risk perception' was made. The scale of this variable went from -2 to 2, with -2 being a high decrease in perceived risk perception and with 2 as a high increase. Due to the fact that the total number was divided by six, there were also point values. Therefore, there was the need to transform the data into a new variable. All the numbers between -2 and -1 became 1, all the numbers between -1 and 0 became 2, zero became 3, all the numbers between 0 and 1 became 4, and all the numbers between 1 and 2 became 5. The new variable 'PCRP_inceaseordeceraease' was made this way, with the following scale: 1=

high decrease, 2=moderate decrease, 3= no change, 4= moderate increase and 5= high increase. Although the variable is named 'PCRP_categories' in SPSS, the term 'perceived change in risk perception' will be used during this report. By analysing this variable descriptively, it was possible to find answers to the question how perceived change had occurred due to COVID-19 among Dutch citizens. This variable was also used to find answers to sub-question 2 and 3.

Respondents who have chosen the '0= I do not know' option did not provide data about their perceived change in risk. Therefore, this data was indicated as not sufficient and this answer possibility was given a value of 0 during the data analysis.

One indicator of change in risk perception is change in behaviour, therefore Q18 asked if any possible change in behaviour was due to COVID-19. In this way it was possible to see if there was any change in behaviour and if COVID-19 was the cause of this change according to the respondents.

Dimensions of risk percpetion
To answer this sub-question, 15 variables are used. An overview of all the tested variables can be found in Appendix A. For each dimension several variables were made to capture the possible influence of the dimension. To collect data about the variables several questions were made. For the variables of the cognitive dimension Q3 and Q9 captured the perceived knowledge of the respondents of climate change and COVID-19. Q5, Q6, Q10, Q12 and Q13 were used to collect data for the experiential dimension. For the socio-cultural dimension Q4, Q7, Q11 and Q14 were created. To collect information about the socio-demographic dimension, Q19, Q20 and Q21 are used. As the sub-question concerns the dimensions that cause a change in risk perception, the Spearman's rho test was conducted between the variables of the respective dimensions (independent variable) and the variable 'Change in perceived risk perception of climate change' (dependent variable). Each test was composed of two ordinal variables, which is why the Spearman's rho test had to be performed. This test shows whether there is a significant correlation between two variables. The change in perceived risk perception was quantified by a scale as explained earlier.

Attitude towards climate change
Four variables have been studied to find an answer to the question how perceived change in risk perception of climate change differs because of different attitudes towards climate change. The three variables are as follows: level of people including sustainability in their study/job/hobby/social movement (Q1), level of care about the environment (Q2), behaviour to reduce environmental impact (Q17) and perceived change in risk perception. These are all dependent variables.

To analyse these variables the Spearman's rho test in SPSS was used. The justification for using this test is explained in the methodology section of sub-question 2.

Results

In this section the results of the analysis are presented. A p-value of 0.05 was chosen because this value reduces the chance to make a Type I or Type II error. The reason for this is because when a p-value is smaller than 0.05 the null-hypothesis can be rejected and the probability that the null-hypothesis is falsely rejected is smaller than 5%.

Sub-question 1: Perceived change in risk perception of climate change
To answer this sub-question a descriptive analysis and a paired sample T-test is performed. The results of these analyses will be discussed here.

The paired samples T-test gave a p-value of 0.00. This means the null-hypothesis can be rejected and a significant difference exists between the perceived risk perception before the COVID-19 crisis and after.

The distribution of the respondents over the different categories of the variable 'perceived change in risk perception' can be seen in *figure 1*. 'High decrease' is not shown in the table, as this category was not applicable to any of the respondents. The mean of this variable is 3.36. Because value 3 corresponds with 'no change' and the mean is above this number, an overall moderate increase in perceived change has occurred.
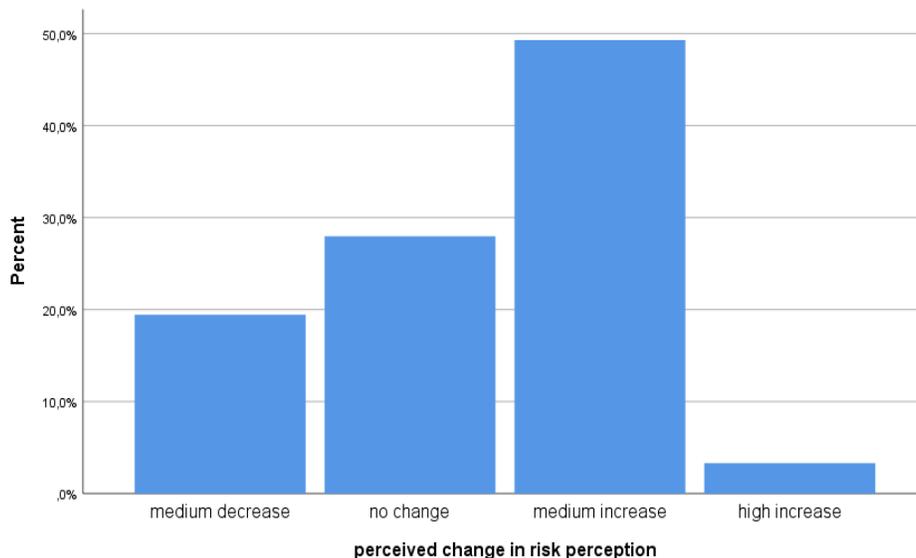

Figure 1: The percentages of perceived change in risk perception among the respondents.

The change in behaviour can be seen in *figure 2*. When asked about changes in behaviour pertaining to sustainability (applying sustainable habits to daily life) 43.1% did not experience any change. 32.7% of participants indicated that any changes they applied to their behaviour, whether these changes were in favour of sustainability or not, were not a product of the circumstances imposed on the participants by the COVID-19 pandemic. Only 23.7% of the respondents said their change in behaviour was due to COVID-19 or partly due to COVID-19.
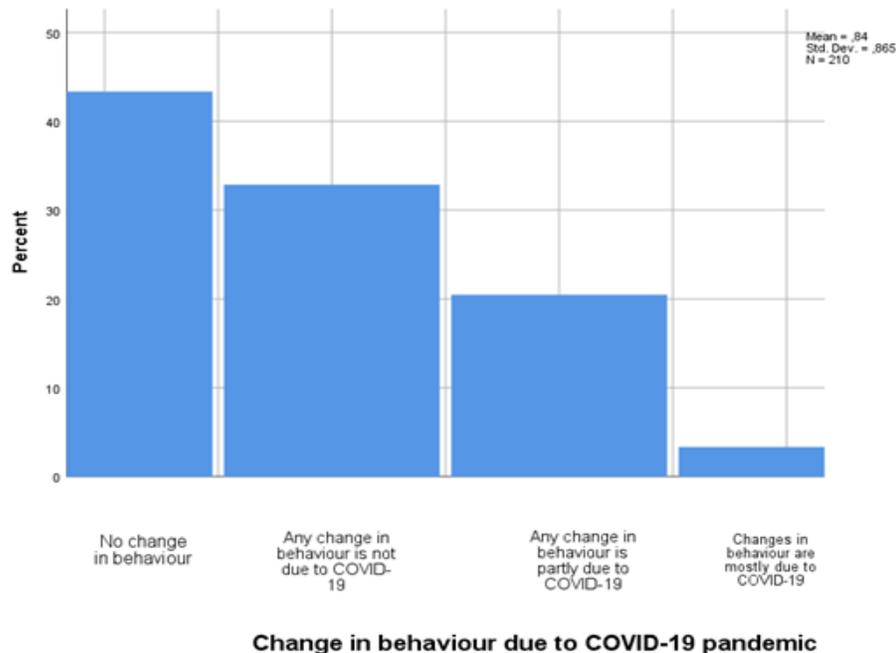
Figure 2: Change in behaviour due to the COVID-19 pandemic.

Sub-question 2: Dimensions of risk perception
The null-hypothesis was that there is no significant correlation respectively between the dimension and the perceived change in risk perception. Hence, the alternative hypothesis was the existence of a significant correlation between the two variables.

Cognitive dimension
This study has found no significant link between the cognitive dimension and risk perception on climate change, since the p-value of the Spearman's rho test for all two variables exceeds 0.05.

Experiential dimension
To examine the experiential dimension, five independent variables have been tested on a correlation using the Spearman's rho test. All five variables have shown a p-value which exceeds 0.05. This means that there is no significant correlation of the tested variables about experience with the dependent variable 'Change in perceived risk perception'. Therefore, the null-hypotheses are accepted.

Socio-cultural dimension
For the socio-cultural dimension, no significant correlation could be found between the variables measuring the socio-cultural dimension and the change of risk perception of climate change since the p-values of the Spearman's rho test all exceed 0.05. This means that the null-hypotheses are accepted.

Socio-demographic dimension
The Chi-square test on the differences between genders and their change of risk perception delivered a statistically significant result. In other words, the two genders experience the change in risk perception of climate change differently. As can be seen in *figure 3*, the female respondents experienced a significantly higher increase in perceived risk. 74.8% of women experienced an increase in perceived risk as opposed to 25.2% of men. The tests on correlation between the level of education and age with the perceived change of risk do not show statistically significant results as the p-values exceed 0.05. Thus, the null-hypotheses are accepted.
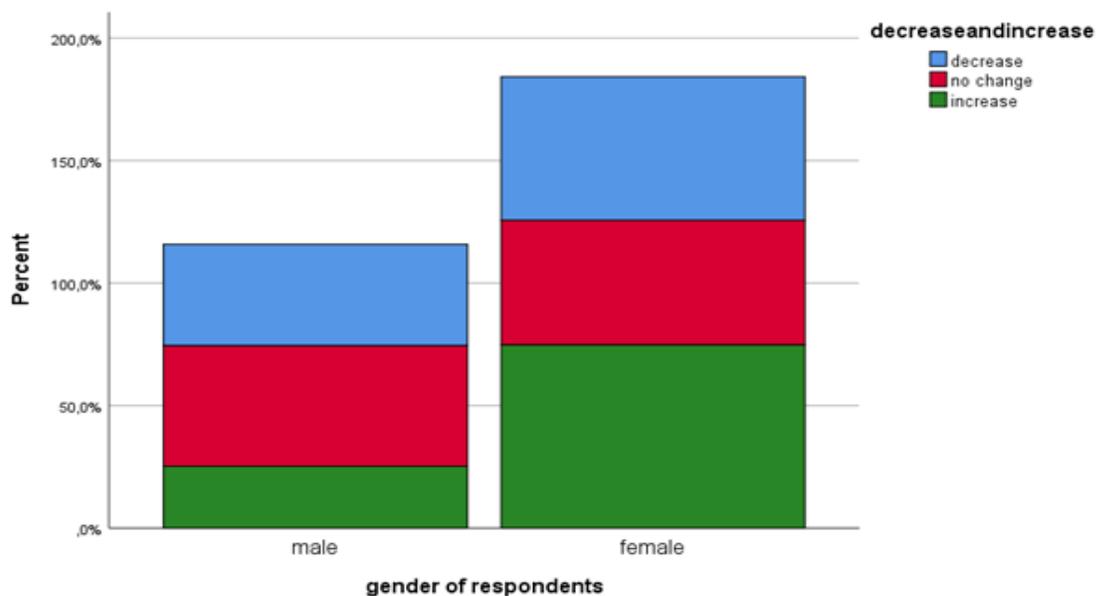
Figure 3: The gender of respondents and their change in perceived risk perception of climate change.

Sub-question 3: Attitude towards climate change
The Spearman's rho test was used to find answers to sub-question 3. For all variables that were tested to find the answers to sub-question 3, p-values exceeded 0.05. The null-hypothesis for this sub-question was: there is no significant relation between attitude towards climate change and perceived change in risk perception of climate change. The null-hypotheses have to be accepted and no correlation exists for the variables.

The descriptive analysis of this question shows that in 73% of the respondents studies/work/social movement climate change is an included subject. Only 2,8% of the respondents think combating climate change is unimportant and 4,7% percent never make a sustainable choice or only yearly.

Discussion

In this research the impact of one risk (COVID-19 crisis) on risk perception of another risk (climate change) was studied. The most important findings are an increase in the average perceived risk perception and that the change is independent of the dimensions and attitude. Only a significant difference in perceived change in risk perception between male and female has been found in this research. The influence of one risk on the risk perception of another has not been studied comprehensively before, which means that no direct comparisons with previous literature can be made. However, Slovic's psychometric theory (1992) was combined with the four dimensions of risk perception by Helgeson et al. (2012). Further on in this discussion the interpretation and limitation will be reviewed in detail per sub-question.

Perceived change in risk perception
The sub-question that needed to be answered was: to what extent does COVID-19 have an effect on the perceived change in risk perception among Dutch citizens? From the results of the survey it can be concluded that a significant change in perceived risk of climate change has occurred due to the COVID-19 crisis among Dutch citizens. The average risk perception of Dutch citizens has increased in the period of the COVID-19 crisis. This was the expected outcome regarding the theoretical framework, as negative consequences for humans lead to a higher risk perception (Böhm & Pfister, 2001). In this research it was found that negative consequences of one risk, in this case risk of a pandemic, can increase another major risk, in this case climate change. Thus, this research even expands the existing literature as one risk can increase the risk perception of another risk. It shows that risks are interlinked. So far the theories about risk perception have focused on understanding how one particular risk perception is perceived, but from the results of this research the focus should shift to a broader approach. To understand how a person perceives risk, it should be taken into account how the person views other risks and risks which the person might experience at that moment.

One of the theories proposed in the literature review is that behaviour is an important indicator of change in risk perception. The results, however, indicate that the majority of participants found that changes in their behaviour regarding sustainability did not occur during the COVID-19 pandemic and that any changes that did occur were not a result of the pandemic itself. What is interesting to notice is that people had to change their behaviour due to the measures of the Dutch government to reduce the spreading of the virus, but the respondents do not think this has led to a more sustainable behaviour. The question in the survey asked if people made more conscious sustainable choices, but unconscious decisions were disregarded. For example, the measurements of the government prohibited travel to work/study if it was not necessary, which automatically has led to a reduction in greenhouse gas emission. This leads to the conclusion that people actually did partly change to a more sustainable way of living due to COVID-19 crisis, but it was not based on a conscious choice as the change would not have occurred if COVID-19 had not introduced itself in the country. This can explain why 43.1% of the respondents answered that their behaviour in sustainable choices did not change and 32.7% said the change in behaviour was not caused by the COVID-19 crisis. In addition, it raises the question if people will continue to show this behaviour when the measurements are lifted as people do not experience it as a conscious choice.

Dimensions of risk perception

One of the sub-questions this study poses is whether the different dimensions (cognitive, experiential, socio-cultural and socio-demographic) of risk perception have an influence on the Dutch public's risk perception towards climate change and if so, how large that influence is. As explained in the previous described parts of this research, this study shows no significant correlation between the cognitive dimension and the change in perceived risk perception. This aspect of risk perception is thus contradictory to the research described in the theoretical framework.

These findings suggest that people's knowledge on the subject of COVID-19 and climate change do not affect their risk perception. An explanation for this could be the fact that risk perception regarding climate change and that of COVID-19 is not as much the result of prior knowledge on those subjects, as it is a result of the media's framing of the subjects.

The results addressing the experiential dimension have given no significant correlation between the studied variables and the change in perceived risk perception. Possibly, these findings indicate that the experiences of an individual do not affect sudden changes in risk perception. Otherwise, it is also possible that the sample did not include enough people who underwent experiences that warrant significant results on this variable.

The results pertaining to the socio-cultural dimension suggest that no correlation between the government's effort to reduce the impacts of the risk and the concern of family and friends do not influence the change in risk perception. This suggests that risk perception regarding climate change is independent of the government's effort to combat climate change. This would likely be the case because citizens are often inclined to disagree with the government regardless of their personal risk perception on a subject.

The results pertaining to the socio-demographic dimension showed that women are more likely to have shown an increase in risk perception than men. These findings coincide with research discussed in the literature review of this study, which also claims that women are more receptive to risk than men.

Lastly, the argument could also be made that, although the aforementioned dimensions affect an individual's static risk perception, they do not directly explain a sudden change in risk perception. For this hypothesis to be confirmed, further research would have to be done concerning the limits of the influence of these dimensions. Furthermore, little to no research has been done thus far on the influence of the dimensions in a setting of multiple risk perception which may influence each other (as is the case in this study), which is why much is still uncertain about the role of these dimensions.

Attitude towards climate change

The question that needed to be answered was: how does perceived change in risk perception differ between people with different attitudes towards climate change? For the variables that were tested in this research, no correlation was found between the attitude towards climate change and perceived change in risk perception. In the psychometric theory, the attitude of a person towards climate change influences the risk perception towards climate change as risk perception is subjective. This research suggests that someone's attitude towards climate change does not influence the perceived change in risk perception. The increase in perceived

change in risk perception that is measured at sub-question 1 is distributed across the different attitudes of the respondents, as no correlation is found.

The theory describes that people with a positive attitude towards the environment have a higher risk perception. Many attitudes of the respondents were positive towards the environment. Therefore, it is possible that a high percentage of the respondents already had a high risk perception of climate change which was not increased due to the experience of another risk (COVID-19).

Risk perception is subjective, but the perceived change in risk perception seems to have this characteristic less, because the results show it does not matter how you view climate change. To explain the difference in perceived change among respondents in risk perception there has to be looked into another direction than attitude towards climate change.

Limitations
Firstly, it is beyond the scope of this study, to research the causal relationship of risk perception between the two different risks (COVID-19 crisis and climate change). Merely the cross-risk links have been investigated.

Secondly, the generalizability of the results to the entire Dutch population is limited by the socio-demographic properties of the sample. The sample does not represent the Dutch population as they don't share the same socio-demographic proportions which can be seen in *table 2*. This means that the risk perception of certain demographic groups is under- or overrepresented in the sample and might have influenced the results largely resulting in a limitation of external validity.

Socio-demographic group	Sample	Dutch population (Maslowski, 2018; CBS, 2019)
Gender: females males	64.9% 35.1%	~50% ~50%
Age-group: 18-24	62.3%	6.75%

Educational level:
    MBO+Havo+VWO
    HBO
    MAVO
    WO - bachelor+master
	
	14.7%
	20.8%
	4.7%
	56.9%
		
		42%
		23%
		22%
		15%

Table 2: Comparison between socio-demographic properties in the sample and the Dutch population.

As explained in the methodology section, it was not possible to answer the question if the COVID-19 crisis has affected risk perception of climate change among Dutch citizens, but it was only possible to look at the perceived change. This means that not the actual change is measured, but the change people think they have experienced. To research this change, data was needed about the perceived risk perception before the COVID-19 crisis and after.

As risk perception is subjective and differs for each person, so can the reason for change in this risk perception. In this research it is attempted to research the change in risk

perception of climate change due to the COVID-19 crisis. Nevertheless, it was hard to know what the actual cause (independent variable) of the change is and this is difficult to research in a self-completion survey as a research perspective is used. Furthermore, more variables on the dimensions and attitude would need to be tested in order to get a complete picture of the causes of perceived change in risk perception.

Another reason for not finding a correlation between attitude and perceived change in risk perception could be that among our respondents there was little difference in attitude. There were almost no respondents who think combating climate change is unimportant and only a small proportion of the respondents made a sustainable choice once a year or never. It can thus be questioned whether the variance within the attitudes of our respondents was large enough to measure a correlation.

Conclusion

After conducting this previous described research, the research question could be answered; how has the COVID-19 crisis affected risk perception of climate change among Dutch citizens? Several dimensions and causes which can lead to a change in the perceived risk perception of people have been investigated. To answer the research question, a survey was used to collect data and this data was analysed, which offered useful results.

A significant change in the perceived risk perception of climate change since the COVID-19 crisis was found. This result confirms the theoretical framework which estimates that negative consequences of a risk can increase the risk perception. This research concludes that negative consequences of a risk, such as the COVID-19 crisis, can also increase the risk perception of another risk, climate change. This change in risk perception is not reflected in a conscious change in behaviour. The significant change in perceived risk perception was used to analyse whether cognitive, experiential, socio-cultural and socio-demographic dimensions have influenced this change. No significant correlation has been found between the variable 'change in perceived risk perception' and the cognitive, experiential and socio-cultural dimensions.

However, there is a correlation between a socio-demographic variable 'gender' and the change in perceived risk perception. The result shows that females are more likely to have an increased perceived risk perception than males. These results are supporting the theoretical framework. The age and level of education variables in this dimension did not give a significant correlation. The cognitive, experiential and socio-cultural did not give a significant correlation, which contradicts the theory. The examined attitude towards the environment did not show a significant correlation as well, which also contradicts the information in the previous mentioned theoretical framework.

This research can be used to be implicated in policy making because it shows that a risk as the COVID-19 crisis influences the perceived risk perception of Dutch citizens toward climate change. This provides opportunities for policy change because the majority of citizens supports policy makers to take more sustainable action. Future research can pursue this study and research on the effects of this change in about a year from now, e.g. on policymakers. Something that also could be studied in future research, is the attitude towards the environment. This has great influence in this research, yet this is not specifically studied right now because this research was done in a more general sense.

What is important to remember about the result of this research is that the way people estimate a risk can change because of a crisis. Perceived risk is not a constant value, it develops over time. This research was not able to capture which factor or factors were influenced by COVID-19, but factors did change.

Relevance

A change in risk perception can be relevant because this can open a window of opportunity to take action. A high-risk perception leads to motivation to search for a solution to combat climate change (Roser-Renouf, Maibach, Leiserowitz, Zhao, 2014). In addition, the support of citizens for implementing sustainable rules increases with an increase in risk perception (Leiserowitz, 2006). These two factors can result in political action, because the willingness of the public has increased and decreases the threshold for politicians to introduce new rules. The risk perception is increased now pertaining to before the COVID-19 crisis and this can result in more effective action to combat climate change.

Furthermore, information is acquired about the factors that do not influence the change in perceived risk perception across two risks. This is an interesting acknowledgement for the research world as this means change is independent of the knowledge, socio-cultural influence, experiences and attitude of a person. This makes it hard for governments, researchers etc. to influence the perceived change in risk perception.

To conduct this research and acquire answers to the research question an interdisciplinary approach is necessary. As mentioned in the theoretical framework, risk perception is dependent on different dimensions. These different dimensions are based on different disciplines and to understand risk perception it is important that all disciplines are involved and considered. For example, knowledge about causes and consequences of climate change determines risk perception. Researchers provide information about this, but if it does not reach citizens the risk perception can also not be based on this information. Therefore, natural scientists need to work together with politicians and social scientists.

This research is done by students following the course 'Regional Integration Project'. In this course, other groups have focused on the relation between COVID-19 and sustainability as well. The findings of these researches can complement this research as they have focused on different dimensions of risk perception. For example, one research has studied the leading discourse on the link between COVID-19 and sustainability in the media. The leading discourse influences the socio-cultural dimension.

The COVID-19 crisis is a great opportunity for the government and societal organizations to address climate change and sustainability issues. Whether governments and organizations take this opportunity to change the way people view climate change, COVID-19 also sets a great example of how people can come together and how people are able to put their minds and work together and serve a greater cause, such as climate change. Just as COVID-19 is about protecting one part of the population, combating climate change is about protecting the whole current and future population.

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Appendix A: overview variables

Sub-question 1

Variable	Analysis test	Dependent/independent	Question
Perceived risk perception of climate change before COVID-19. Perceived risk perception of climate change after COVID-19.	Paired sample T-test	Dependent variables	Q15 & Q16
Perceived change in risk perception	Descriptive analysis	Dependent variable	composed
Change in behaviour due to COVID-19	Descriptive analysis	Dependent variable	Q18

Sub-question 2

<u>Cognitive dimension</u>

Variable	Analysis test	Dependent/independent	Question
Knowledge of climate change	Spearman's rho test	Independent variable	Q3
Knowledge of COVID-19	Spearman's rho test	Independent variable	Q9

<u>Experimental dimension</u>

Variable	Analysis test	Dependent/independent	Question
Change in workload due to COVID-19	Spearman's rho test	Independent variable	Q12
Expected change in workload due to climate change	Spearman's rho test	Independent variable	Q5

Expected change in social life due to climate change	Spearman's rho test	Independent variable	Q6
Change in social life due to COVID-19	Spearman's rho test	Independent variable	Q13
Level of experience with COVID-19	Spearman's rho test	Independent variable	Q10

Socio-cultural dimension

Variable	Analysis test	Dependent/independent	Question
Effort of government to reduce impacts of climate change	Spearman's rho test	Independent variable	Q4
Effort of government to reduce impacts of COVID-19	Spearman's rho test	Independent variable	Q11
Level of concern of friends and family of climate change	Spearman's rho test	Independent variable	Q7
Level of concern of friends and family of COVID-19	Spearman's rho test	Independent variable	Q14

Socio-demographic dimension

Variable	Analysis test	Dependent/independent	Question
Gender	Chi-square test	Independent variable	Q19
Level of education	Spearman's rho test	Independent variable	Q20
Age	Spearman's rho test	Independent variable	Q21

Sub-question 3

Variable	Analysis test	Dependent/independent	Question
Level of people including sustainability in their study/job/hobby/social movement\	Spearman's rho test	Independent variable	Q1
Level of care about the environment	Spearman's rho test	Independent variable	Q2
Behaviour to reduce environmental impact	Spearman's rho test	Independent variable	Q17

Appendix B: overview of analytical test

Sub-question 1

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
Perceived risk perception before COVID-19 x Perceived risk perception after COVID-19	Paired sample T-test	0.000	rejected
Perceived change in risk perception	Descriptive analysis	-	-

Sub-question 2

Cognitive dimension

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
Knowledge on climate change	Spearman's rho test	0.101	accepted
Knowledge on COVID-19	Spearman's rho test	0.238	accepted

Experimental dimension

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
Change in workload due to COVID-19	Spearman's rho test	0.980	accepted
Expected change in workload due to climate change	Spearman's rho test	0.927	accepted
Expected change in social life due to climate change	Spearman's rho test	0.521	accepted
Change in social life due to COVID-19	Spearman's rho test	0.442	accepted

Level of experience with COVID-19	Spearman's rho test	0.166	accepted

Socio-cultural dimension

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
Effort of government to reduce impacts of climate change	Spearman's rho test	0.980	accepted
Effort of government to reduce impacts of COVID-19	Spearman's rho test	0.260	accepted
Level of concern of friends and family of climate change	Spearman's rho test	0.549	accepted
Level of concern of friends and family of COVID-19	Spearman's rho test	0.277	accepted

Socio-demographic dimension

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
Gender	Chi-square test	0.005	rejected
Level of education	Spearman's rho test	0.679	accepted
Age	Spearman's rho test	0.843	accepted

Sub-question 3

Variable	Analysis test	P-value	Null-hypothesis (rejected/accepted)
level of people including sustainability in their study/job/hobby/social movement	Spearman's rho test	0.773	Accepted
level of care about the environment	Spearman's rho test	0.095	Accepted
behaviour to reduce environmental impact	Spearman's rho test	0.670	Accepted

Appendix C: survey

Vraag 1: Is klimaatverandering een leidend onderwerp in uw werk/studie/hobby/sociale beweging/politieke partij?
- Ja
- Deels
- Nee

Vraag 2. Hoe belangrijk is milieubescherming voor u persoonlijk? (op schaal van 1-5)
1 = extreem onbelangrijk, 2 = onbelangrijk, 3 = niet onbelangrijk / niet belangrijk, 4 = belangrijk, 5 = extreem belangrijk

<div style="text-align:center">1   2   3   4   5</div>

Vraag 3: Hoe schat u uw kennis in over de oorzaken en gevolgen betreffend klimaatverandering, vergeleken met de gemiddelde Nederlander?
Oorzaken; zoals de CO_2-uitstoot van de mens.
Gevolgen; zoals stijgende zeespiegel, biodiversiteitsverlies, oceaanverzuring etc.
1 = ver onder het gemiddelde, 2 = onder het gemiddelde, 3 = gemiddeld, 4 = boven het gemiddelde, 5 = ver boven het gemiddelde

<div style="text-align:center">1   2   3   4   5</div>

Vraag 4. Hoe beoordeelt u de inspanning (het opstellen van regels en de handhaving daarvan) van de Nederlandse regering om de impact van klimaatverandering te verkleinen?
- Te veel inspanning
- Te weinig inspanning
- De juiste hoeveelheid inspanning
- Dat weet ik niet

Vraag 5: In hoeverre denkt u dat uw (toekomstige) werkdruk zal veranderen door effecten van klimaatverandering?
- Ik zal mijn baan hierdoor verliezen.
- Ik zal mijn baan niet hierdoor verliezen.
- Ik zal een lagere werkdruk krijgen.
- Ik zal een hogere werkdruk krijgen.
- Ik zal dezelfde werkdruk behouden.
- Ik zal geen/moeilijker een baan kunnen vinden.
- Ik zal wel/makkelijker een baan kunnen vinden.
- Weet ik niet

Vraag 6: In hoeverre denkt u dat uw sociale leven zal veranderen veranderd door de gevolgen van de toekomstige klimaat maatregelingen van de Nederlandse regering?

- Mijn sociale leven zal niet veranderen door de klimaat maatregelingen.
- Mijn sociale leven zal gedeeltelijk veranderen door de klimaat maatregelingen.
- Mijn sociale leven zal veel veranderen door de klimaat maatregelingen.

Vraag 7: Hoe vaak worden de risico's van klimaatverandering in het algemeen besproken in uw sociale kringen?
- Dagelijks
- Wekelijks
- Maandelijks
- Niet
- Weet ik niet

Vraag 8: Hoe vaak maakte u in 2019 bewust een duurzame keuze (minder/geen vlees, reizen met het ov in plaats van auto) in uw dagelijks leven?
- Dagelijks
- Wekelijks
- Maandelijks
- Enkele keren per jaar
- Nooit
- Niet van toepassing (denk bijvoorbeeld aan zonnepanelen op een huurhuis of een elektrische auto zonder rijbewijs)

Vraag 9: In vergelijking met de gemiddelde Nederlander, hoe schat u uw kennis in over de oorzaken en gevolgen van het COVID-19 crisis?
Oorzaken; zoals besmet raken.
Gevolgen; zoals ziek worden, op de intensive care terecht komen en/of overlijden.
(Op schaal van 1-5)
1 = ver onder het gemiddelde, 2 = onder het gemiddelde, 3 = gemiddeld, 4 = boven het gemiddelde, 5 = ver boven het gemiddelde

<div align="center">

1   2   3   4   5

</div>

Vraag 10: Op welke manier bent u sinds de uitbraak van het virus in contact gekomen met COVID-19? (meerdere antwoorden mogelijk)

- Ik ben zelf besmet geraakt met COVID-19.
- Één of meerdere van mijn huisgenoten zijn besmet geraakt met COVID-19.
- Één of meerdere van mijn familieleden zijn besmet geraakt met COVID-19.
- Één of meerdere van mijn vrienden/kennissen zijn besmet geraakt met COVID-19.
- Één of meerdere van mijn huisgenoten zijn overleden door toedoen van COVID-19.
- Één of meerdere van mijn familieleden zijn overleden door toedoen van COVID-19.
- Één of meerdere van mijn vrienden/kennissen zijn overleden door toedoen van COVID-19.
- Ik ken niemand die besmet is geraakt of overleden is door toedoen COVID-19.

Vraag 11. Hoe beoordeelt u de inspanning (het opstellen van regels en de handhaving daarvan) van de Nederlandse regering om de impact van COVID-19 te verkleinen?
- Te veel inspanning
- Te weinig inspanning
- De juiste hoeveelheid inspanning
- Dat weet ik niet

Vraag 12: In hoeverre is uw werkdruk veranderd sinds de uitbraak van COVID-19 in Nederland?
- Ik ben mijn baan verloren.

- Ik ben mijn baan niet verloren, maar er was/is geen werk voor mij tijdens de COVID-19 crisis (horeca, kapperszaken etc., ook als u vanaf 11 mei of 1 juni (waarschijnlijk) weer mag gaan werken).
- Ik heb een <u>lagere</u> werkdruk dan voor de COVID-19 crisis.
- Ik heb een <u>hogere</u> werkdruk dan voor de COVID-19 crisis.
- Ik heb dezelfde werkdruk als voor de COVID-19 crisis.
- Ik heb geen baan.

Vraag 13: In hoeverre is uw sociale leven veranderd door de gevolgen van de COVID-19 maatregelen van de Nederlandse regering?

- Ik heb mijn gedrag <u>niet</u> veranderd sinds de uitbraak van COVID-19.
- Ik heb de maatregelen van de overheid gedeeltelijk opgevolgd (ik zie bijvoorbeeld nog steeds vrienden (niet op 1,5 meter)).
- Ik heb de regels van de overheid precies opgevolgd.
- Ik heb mijn gedrag meer veranderd dan dat de overheid noodzakelijk acht.
- Dit wil ik liever niet zeggen

Vraag 14: Hoe vaak worden de risico's van COVID-19 in het algemeen besproken in uw sociale kringen?
- Dagelijks
- Wekelijks
- Maandelijks
- Niet
- Weet ik niet

Vraag 15: Hoe bezorgd was u over klimaatverandering <u>voor</u> de eerste COVID-19 besmetting in Wuhan?
1 = Zeer klein, helemaal niet, 2 = klein, 3 = neutraal, , 4 = groot, 5 = extreem groot, x = weet ik niet

Hoe bezorgd was u dat de negatieve effecten van klimaatverandering impact zullen hebben op uw leven?	1	2	3	4	5
Hoe bezorgd was u dat een familielid of vriend te maken krijgt met de negatieve effecten van klimaatverandering?	1	2	3	4	5
Hoe bezorgd was u over het ontstaan van een economische crisis?	1	2	3	4	5
Hoe bezorgd was u over dat klimaatverandering uw sociale leven zal beïnvloeden?	1	2	3	4	5
Hoe bezorgd was u dat klimaatverandering uw mentale gezondheid zal beïnvloeden?	1	2	3	4	5
Hoe bezorgd was u over klimaatverandering in het algemeen?	1	2	3	4	5

Ik ga wel even in SPSS kijken of get overeenkomt xxxxx

Vraag 16: Hoe bezorgd bent u <u>nu</u> over klimaatverandering?
1 = zeer klein, helemaal niet, 2 = klein, 3 = neutraal, 4 = groot, 5 = extreem groot, x = weet ik niet

Hoe bezorgd bent u dat de negatieve effecten van klimaatverandering impact zullen hebben op uw leven?	1	2	3	4	5

Hoe bezorgd bent u dat een familielid of vriend te maken krijgt met de negatieve effecten van klimaatverandering?	1	2	3	4	5
Hoe bezorgd bent u over het ontstaan van een economische crisis?	1	2	3	4	5
Hoe bezorgd bent u over dat klimaatverandering uw sociale leven zal beïnvloeden?	1	2	3	4	5
Hoe bezorgd bent u dat klimaatverandering uw mentale gezondheid zal beïnvloeden?	1	2	3	4	5
Hoe bezorgd was u over klimaatverandering in het algemeen?	1	2	3	4	5

Vraag 17: Hoe vaak bent u sinds de COVID-19 crisis in Nederland bereid bewust een duurzame keuze (minder/geen vlees, reizen met het ov in plaats van auto) te maken in uw dagelijks leven?
- Dagelijks
- Wekelijks
- Maandelijks
- Jaarlijks
- Nooit

Vraag 18: Is COVID-19 de reden dat u vaker/minder-/even vaak een bewuste duurzame keuze (minder/geen vlees, reizen met het ov in plaats van auto) maakt in uw dagelijks leven?
- De aanpassing aan mijn levensstijl kwam wel door COVID-19.
- De aanpassing aan mijn levensstijl kwam niet door COVID-19.
- De aanpassing aan mijn levensstijl kwam gedeeltelijk door COVID-19.
- Ik heb mijn levensstijl niet aangepast.

Persoonlijke vragen

Vraag 19: Wat is uw leeftijd?
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

Vraag 20: Wat is uw geslacht?
- Man
- Vrouw
- Anders: ___
- Wil ik liever niet zeggen

Vraag 21: Wat is uw laatst afgesloten opleiding?
- Mavo
- Havo
- Vwo
- MBO

- HBO-Bachelor
- WO-Bachelor
- HBO-Master
- WO-Master