ERASMUS UNIVERSITY ROTTERDAM
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A benefit of COVID-19?

How governments could use the COVID crisis to reduce future car trips

Master Thesis Urban, Port and Transport Economics

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Abstract

Using a scenario based survey, this paper tries to discover whether governments could use the COVID crisis to reduce future car trips to work. Additionally, it is studied if active travel could be encouraged with decision making for future selves. Firstly, it is obtained that people intend to travel less to work after the COVID crisis, compared to before the COVID crisis. Additionally, the analysis of the second hypothesis showed insignificant results on the expected increase of active travel days when a decision is made for a future self instead of a present self. However, the performed regression with active travel days per week to work as dependent and decision making for future selves as independent variable returned a significant increase of 0.549 at the 10 % level in active travel days when decided for a future self instead of a present self. Furthermore, it is observed that being shown an infographic that discourages travelling with car seems to lead to less car trips to work. This result is however not robust as the additional performed regression returns no significant effect of being shown the infographic on the amount of car trips to work per week.

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Introduction

The COVID crisis already has an enormous impact on almost all societies worldwide. When it was reported first in China, no one thought it would influence the world in the way it did. Even when entire regions in China were in a strict lockdown, many other parts of the world did not worry about it. However, it quickly spread across the entire world and lead to many fatalities, entire countries in lockdown and even economic recession. The consequences were notable on many different levels. While some countries handled it very well with for example an early lockdown, other countries denied to take measures, leading to even larger problems later on.

However, not all consequences of the COVID crisis were negative. In the early days of the COVID crisis (during the Wuhan lockdown) a large decrease in emissions could be noticed, compared to both a month and a year before (Hauser and Jackson, 2020). Furthermore, it was observed that the dirty canals in tourist hotspot Venice were clear for the first time in a very long time (Guy and Di Donato, 2020). However, this study focuses on different positive effects of the COVID crisis, namely the increase in working at home and the reduction in car trips resulting from the increase in working at home. The reduction in car trips has some positive consequences on his own. Two examples of such consequences are the decrease in accidents (Tameling, 2020) and the decrease in traffic jams (Van der Aa, 2020). Governments are trying to reduce both for a while, but it seems that the COVID crisis has managed reduce traffic jams and accidents more effectively than before. This provides a new challenge for governments. Instead of reducing traffic jams and accidents, it should take action to maintain these reductions. This study focuses on this challenge.

A reason why COVID could make (permanent) changes that were unable to reach before, is the habit factor. Habitual behaviour is already found to play a role in for example food consumption (Khare and Inman, 2006), recycling (Ittiravivongs, 2012) and the focus of this study: travel mode (Aarts, Verplanken and Van Knippenberg (1997). Basically, the theory behind the habit factor is that people tend to follow the same routine because they feel comfortable doing so. Aarts, Verplanken and Van Knippenberg (1998) state that when a kind behaviour is repeated many times it could turn into a habit, even though it can lead to irrational decisions due to “a rather limited process of decision making” (p. 1369). Breaking habitual can therefore be difficult, as people thus choose for the habitual option almost without thinking.

This could provide an ideal moment for governments to design programs that reduce the amount of car trips after the COVID crisis compared to the amount of car trips before the COVID crisis. The general research question is therefore as follows:

How can the government use the COVID crisis to provide beneficial changes in travel mode behaviour?

This study will investigate whether people intend to work more at home after the crisis, whether people will choose more socially acceptable transportation modes when they decide for someone else and whether the government could easily contribute to a decrease in car trips after the COVID crisis, compared to before the COVID crisis. In order to make this study more concrete, the target audience is limited to workers in the Netherlands only.

Furthermore, this paper will first discuss earlier literature on the benefits of, the promoting of and new methods of encouraging active travel, along with literature on working at home. Next, the scenario-based survey is discussed, followed with a detailed description about how the three hypotheses will be tested. The first hypothesis, which tests whether people intend to work more at home, will be tested with four Wilcoxon tests. The second hypothesis includes the expectation that when decided for a future self, people will more often choose an active travel mode compared to deciding for a present self. This hypothesis is tested in two ways; firstly with four Mann-Whitney U tests and secondly with a linear regression. Lastly, the hypothesis that tests whether the government can reduce the amount of car trips with showing an infographic is tested in a similar way as the second hypothesis. Firstly, a Mann-Whitney U test is performed and secondly a linear regression is conducted. Hereafter, the results of these tests will be interpreted in the results section and discussed in the discussion.

Literature

The previous literature that is being reviewed for this study is divided into five parts. First, the benefits of active travel are discussed. Here after, previous methods that encourages active travel and reduces car use are reviewed. Additionally, it is discussed how travel behaviour could be changed. Furthermore, the effects of working at home are discussed as the COVID crisis causes a lot of workers to suddenly work from home. Lastly, the existing literature on commuting and COVID is reviewed.

Benefits of active travel

Active travel modes like walking and cycling are known to have a positive impact on health. For example, Basset et al. (2008) show that countries where people walk and cycle more are also the countries with less obesity. But also many other diseases, including type 2 diabetes mellitus (Hu et al., 1999), hypertension (Hayasi et al., 1999), cardiovascular disease (Murtagh, Murphy and Boone-Heinonen, 2010), osteoporosis (Ebrahim et al., 1997), and depression (Robertson et al., 2012) are linked with a lack of physical activity. Ultimately, an increase in active travel behaviour will lead to less cases of these diseases and therefore less healthcare costs in general.

Governments around the world are using different methods to influence people in such a way that they will choose for active travel modes more often and reduce car trips. For example, walking school buses are used in New Zealand. Here, parents walk with their children in a large group to school. Kingham and Ussher (2007) discussed the benefits this policy has and found that participating children experience social benefits next to an increase in the independent mobility of children. A larger study in the United States (Davison, Werder and Lawson, 2008) confirmed this finding and concluded that children that travel to school actively (walking or cycling), compared to children that travel to school in another way (by car or pubic transport), report a larger contribution in physical activity and also better cardiovascular fitness levels.

Furthermore, the economic benefits of policies that promote walking or cycling are investigated by Davis (2010). This study found that the pay-off of such policies are much more beneficial than thought on beforehand. Furthermore, in a study in Ireland, Deenihan and Caulfield (2008) found that the economic benefits of promoting cycling would be between 2.22 to 1 and 11.77 to 1 compared to the costs. This implicates that both the society and government would benefit if countries could successfully implement policies to encourage walking and cycling.

Reduction of car usage and promotion of active travel

Additionally, Pooley et al. (2013) looked into policies to improve walking and cycling in England. In this paper the authors argue that next to the promotion of walking and cycling, car use should be restricted. Furthermore, they find that the mindset of people need a change. Walking and cycling have to take over the car as the most logical way of transport for short urban trips. This should be accounted for in future policies. The COVID crisis could therefore be seen as an interruption to change the mindset and habitual behaviour, probably causing interventions to work better than at any other moment. This is supported by Chatterjee, Sherwin and Jain (2013), who conducted in-depth interviews across various places in the United Kingdom to investigate what changes cycling behaviour. They found that most changes arise from life events (e.g. child development) that act as trigger points to change behaviour.

Furthermore, Clark, Chatterjee and Melia (2016) used data from the United Kingdom Household Longitudinal Study to investigate changes in travel modes on a larger scale. Next to the fact that life events still have a huge influence, they found that distance plays an important role for choosing active travel modes instead of the car. Furthermore, they found that people who travel with car are less likely to change the way they commute than people who cycle or use public transportation. In another research (Clark et al., 2014), it is added that moving from rural to urban areas have a negative impact on the change of car ownership, while this relation is the other way around for moving from urban to rural areas. In the current situation, the COVID crisis can be seen as a life event and could therefore be used as intervention to positively change commuting modes.

In interventions, an important distinction is the one between monetary interventions and non-monetary interventions. Martin, Suhrcke and Ogilvie (2012) reviewed multiple studies that used monetary incentives to promote active travel behaviour. conclude that these interventions mostly have positive effects. These effects are both found in studies that used positive financial incentives as in studies that used negative financial incentives. Although monetary interventions often work, they have a large downside attached to it; monetary incentives are often expensive, especially the ones with positive incentives. Therefore, this study focuses on the alternative, which are non-monetary interventions, Non-monetary incentives can also be described as nudges. Although the principle of the nudge has been around for some time, the term was introduced by Thaler and Sunstein (2008). A nudge frames the choice in such a way that the freedom of choice is not limited, but people will be more likely to pick the choice that is the most favourable for the implementer of the nudge. In this study, the government is seen as the implementer.

A nudge can exist in many different forms. In 2014, Sunstein listed ten of the most important kind of nudges. One of these listed nudges is the disclosure of information. About this kind of nudge, Sunstein stated that it is often used in combination with available data to guide choice makers towards the preferred choice. In this study, nudging will be used in this form.

Changing travel behaviour

There are some other ways in which active travel could be encouraged, which are discussed here. One way of encouraging active travel could be to reduce the use of other transportation modes, like car usage. To understand how car usage could be reduced, the underlying factors that play a role in choosing the car as travel mode should be identified. A factor that influences the choice of travel mode is habit. Many studies did research the precise effects of habitual travel, specifically on the effect it has on processing information that should be considered when choosing a travel mode for a certain trip. Aarts, Verplanken and Knippenberg (1997) showed that people with a strong habit attitude used and processed less information about their choice than people with a weak habit attitude. Building on this fact, Eriksson, Garvill and Nordlund (2008) investigated how personal car use could be reduced. They tried to accomplish this by interrupting the habitual car use. The intervention included a research assistant going to the homes of the ones enlisted in the experiment group to discuss the possibilities to reduce car use. Doing so, they found that such an interruption decreases car use. Noted by this study should be that only the short term effects are investigated. However, it shows that an interruption of habitual behaviour could change this behaviour.

As active travel is proven to have health benefits, it is important to develop and discover new ways of encouraging active travel. Here, decision making for future selves can play a role. Pronin, Olivola and Kennedy (2008) examined the effects that choosing for your future self or others has, compared to choosing for your present self. They designed four experiments to show that decision making differed between these three groups. In the first experiment for example participants had to choose how much of a disgusting liquid would be drunk. Doing so, they found that the group that choose for their present selves chose less than half of the liquid than the other two groups. Furthermore, in another experiment, they found evidence that the group that chose for their present selves chose less time to tutor their peer students than the other two groups did. From these results it could be concluded that people often chose to be easy off when they decide for their present self. Relating to this study, it could mean that people choose a more comfortable and convenient way of travel, like the car, more often when they decide for their present self. Therefore, it could be more efficient do let people decide

for their future selves, as it is suggested that they will spare themselves less this way. In order to let them stick to the decisions they made for their future selves, the commitment part of the MINDSPACE framework could be implemented (Dolan et al., 2012). The MINDSPACE framework is designed as an overview of the nine most impactful behavioural influences. This is however outside the scope of this study.

Working at home

Another way that reduces the amount of car trips is to increase the proportion of work that is done at home instead of at the office or other workplace. The reasoning is simple, a worker that works at home does not have to travel to work that day. Increasing working from home will thus immediately reduce the amount of car trips. Eriksson, Friman and Gärling (2008) investigated what workers themselves would do to reduce the use of cars in a survey among 602 car users in Sweden. They found that the most frequent solution to reduce car use stated by these workers was in fact to work at home more often. Additionally, Bloom et al. (2015) researched the effects of working from home on the work satisfaction and productivity among employees. Conducting an experiment in China among call-centre employees, they randomly assigned a part of the employees to work from home for nine months. The results implicated that the group that worked from home showed a higher productivity and noted higher work satisfaction at the end of the experiment. Furthermore, these workers reported to be less exhausted than the workers at the office.

Concluding from these studies, working from home is probably the most obvious solution to reduce car trips. Moreover, it is also beneficial for both the employers and the employees. In the Netherlands, people work more at home than any other European country (Working from home in the EU, 2018). However, statistics from the CBS (Dutch Office for Statistics) show that 60% of all workers in the Netherlands still never works from home (table 1). Although more people work at home at least incidental in 2019 (39.09%) compared to 2013 (34.45%), this number could be increased a lot more. Especially because it is shown that working at home could have positive effects on all parties involved. Here, the COVID crisis could play an important role, because it causes a lot of workers to work at home. This could be the interruption in habitual behaviour that is needed to make sure that people will work at home more often, also when the COVID crisis is over.

Noted should be that not all jobs could be performed from home. Groenewegen and Hardeman (2020) investigated how many jobs in the Netherlands could be performed from home entirely. Doing so,

they found that this percentage was around 43%. However, they did not mention or note how many jobs could be done from home partly. The breakdown per sector is shown in figure 1.

Table 1

Amount of homeworkers in the Netherlands over the period 2013-2019 in percentage of the total amount of workers in the Netherlands.

	2013	2014	2015	2016	2017	2018	2019
Total workers (x1000)	8266	8214	8294	8403	8579	8774	8953
Homeworkers	34,45%	35,17%	35,91%	35,98%	36,69%	37,09%	39,09%
Homeworker that works usually from home	12,82%	13,33%	13,77%	13,63%	14,05%	14,14%	14,30%
Homeworker that works from home incidentally	21,62%	21,84%	22,14%	22,34%	22,65%	22,93%	24,80%
Homeworker, incidentally on regular days	3,36%	3,43%	3,67%	3,77%	4,06%	4,47%	5,24%
Homeworker, incidentally no regular day	18,27%	18,41%	18,48%	18,56%	18,60%	18,88%	19,55%
No homeworker	65,52%	64,83%	64,09%	64,04%	63,31%	62,92%	60,91%

Source: CBS.nl

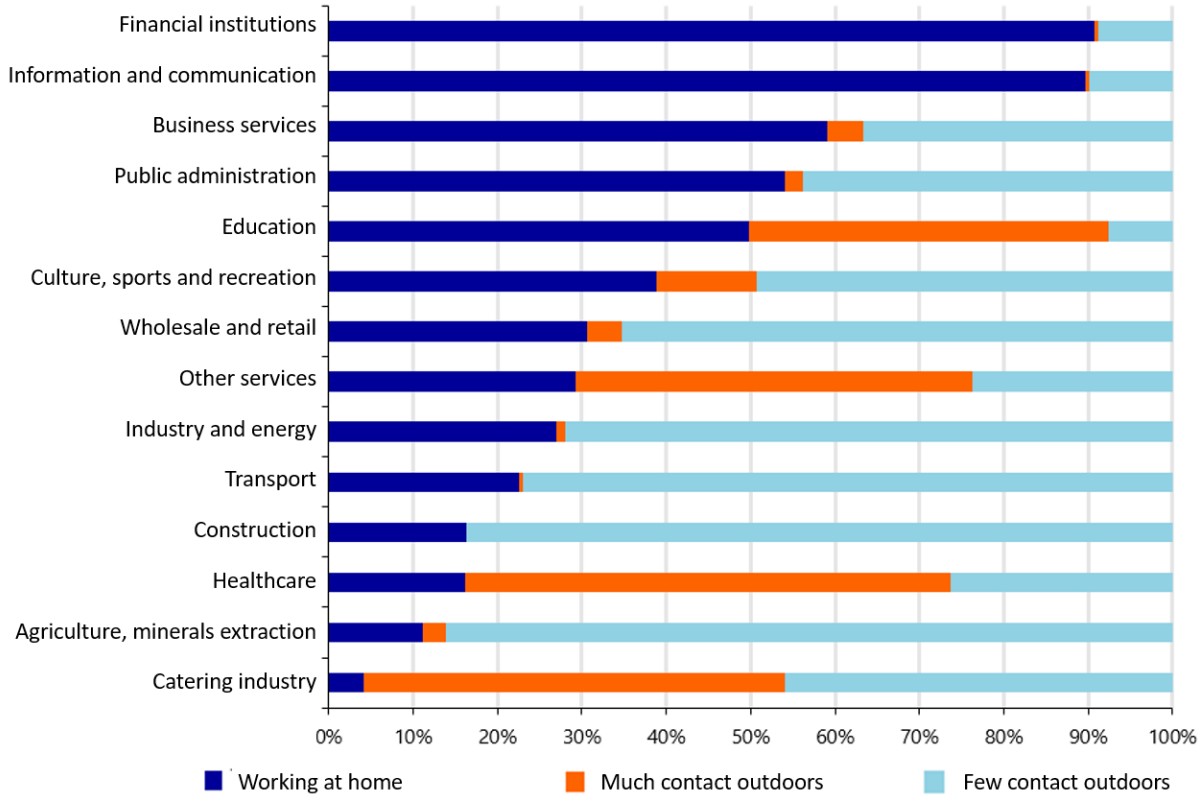

Figure 1. Percentage that could work at home, without much contact outdoors or with much contact outdoors per sector in the Netherlands. From Groenewegen and Hardeman (2020)

Commuting and COVID

It is already discussed that the COVID crisis could be an intervention to break habitual behaviour. In this section it is reviewed which effect COVID could have on travel. Although it is a very recent topic, already some research is conducted on the effects that COVID has on commuting. Rubin et al. (2020) designed a survey to on one hand discover the main perceived advantages and disadvantages among commuters and on the other hand how people think about working at home after the COVID crisis. They found that the main disadvantages were a lack of social contact (especially when the worker did not have young kids) and a mixed-up work-life balance. The most stated advantages were the ability to combine activities when working from home and the fact that commuting is no longer needed. Moreover, especially people who travelled with car or public transport do not miss commuting. This is in contradiction with people who used to walk or cycle to work, who mostly miss their commuting. Another factor that plays a role here is the travel time. When the trip was longer, less people stated that they do not miss commuting. This can however be correlated with the earlier stated finding that people who take the car or public transportation miss commuting less, as these trips are likely to be

longer compared to walking and cycling. Furthermore, they found that 37% think they will work at home more, while 38% chooses to go back to the office.

Hypotheses

Based on the reviewed literature, three hypotheses are formed and listed below. Here, they will be discussed. The first hypothesis will have a more general form and is based on the work of Rubin et al. (2020). In their research was stated that a part of their subjects think that the amount of work done at home will increase after the COVID crisis. In order to test whether the same effect holds in this paper, it is tested whether people intend to work at home more often after the COVID crisis. This implies that it is tested whether the amount of trips towards work will decrease after the COVID crisis, compared to before the COVID crisis. The expectation for the first hypothesis is that there will be less commuting to work after the COVID crisis. Concluding, the first hypothesis will be as follows:

People intend to travel less to work after the COVID crisis, compared to before the COVID crisis.

Additionally, the second hypothesis will be discussed. Because it was shown that active travel has an positive impact on health (Ebrahim et al., 1997; Hu et al. 1999; Hayasi et al., 1999; Basset et al., 2008; Davison, Werder and Lawson, 2008; Murtagh, Murphy and Boone-Heinonen, 2010; Robertson et al., 2012) and additionally, Deenihan and Caulfield (2008) found that promoting cycling could return over ten times the cost in economic benefits, it is tested how active travel could be encouraged. Furthermore, it is found by Pronin, Olivola and Kennedy (2008) that people who decide for their present self choose more convenient and comfortable options than people who decide for their future selves. Therefore, the second hypothesis will test whether active travel is chosen more often when people decide for their future self, which is also the expectation for this hypothesis. If this effect occurs, people could be held onto their decisions by using the commitment part of the MINDSPACE framework (Dolan et al., 2012). The second hypothesis will be stated as follows:

Active travel behaviour is chosen more often than non-active travel behaviour when decided for the future self, compared to the present self.

Furthermore, it is debated what the third hypothesis holds. Eriksson, Garvill and Nordlund (2008) showed that car use could be restricted if the habit of choosing the car is interrupted. Therefore, it is thought that the COVID crisis could provide such an interruption. Next to the interruption to break the

habit factor, this hypothesis will use nudging in the form of disclosing information as Sunstein (2014) listed such as nudge as one of the most important nudges. Furthermore, nudging in the form of disclosing information can be done cost-effectively and is therefore a good alternative for the government. In this case, the government could highlight the time and money that is lost due to traffic delays in order to reduce the amount of car trips. The third hypothesis is therefore as follows:

When the government provides information about the amount of time and money lost due to traffic delays, the car is chosen less as transportation mode after the COVID crisis compared to before the COVID crisis.

Data and Methodology

Survey

In this part, the survey is discussed. For this study, a within subject scenario-based survey is conducted. Scenario-based surveys are often used when it is difficult to perform the experiment in real life. This could for example be due to that the researched situation does not occur very often, lays in the future or to obtain more data, as it is more easy than a real life experiment. Examples here are how people react to phishing mails (Flores et al., 2014), difference between old and young people in the possible interaction with future robots (Biswas et al., 2020) or differences in research ethics (Taljaard et al., 2014).

The platform used to create and this survey is Qualtrics. In the first question the subjects are asked how much of their work related activities can be performed from home. If they answer this question with less than ten per cent they will be dropped out of the survey. If they answer with 10 per cent or more, the respondents proceed to the survey. Firstly, they will be asked about their travel behaviour before the COVID crisis. In this section, it is asked how many times per week the subjects worked, travel to work and how many times they travelled to work with car, public transport and by bike or walking.

Then, the subjects are randomized into three groups. In the scenario that is described for these groups it is assumed that the government dropped the regulations regarding the COVID crisis. All three scenarios will include the same questions, the only difference is the scenario the subjects are in. The questions include asking about how many times the subject will travel to work per week in the particular scenario and how many times they will travel per week by car, public transport and by bike or walking. In the first scenario, the decision about travel behaviour is made for the present self without any intervention of the government. However, in the scenario of the second group the decision about travel behaviour after the COVID crisis is made for the subject's future self. To control for weather effects, as people are more likely to walk or bike in the summer than in the winter for example, it is stated that the measures regarding COVID are dropped exactly one year from now.

In the third scenario, the decision is again made for the subject's present self. Different to the first scenario, the government intervenes with providing information in the form of an infographic (Appendix A, figure 2) about how much traffic delay costed the society in terms of time and money.

With this infographic, people are encouraged to take the car to work less after the COVID crisis, compared to before the COVID crisis. This method follows from the literature review, as it is a nudge in the form of providing information. As Sunstein (2014) already obtained, such is nudge is often used in combination with available data to guide choice makers towards the preferred choice.

After the subject is randomly shown one of these scenarios, the third and last part of the survey starts. This part asks some basic demographics like age, gender and work status, but also whether work and home are located in rural or urban areas. Lastly, it has to be noted that the survey is conducted in Dutch, because this study focuses on the Netherlands only. The precise questionnaire can be found in Appendix B.

After creating the survey, the survey was posted on LinkedIn as it was thought that this platform could reach the most working people. In the message, people were encouraged to distribute the survey even further. In the end, the survey was taken by a total of 266 respondents. However, 28 people did not fill in the entire survey, 37 people indicated that they could perform less than ten per cent of their work at home, two people indicated that they were retired and one person noted that he or she was still looking for a job. These subjects are removed from the dataset, leaving the total of completed records on 198. From those 198 subjects, 69 were shown the first scenario where they decided for their present self, 65 were shown the second scenario where they made the choices for their future self and 64 subjects were divided into the third scenario with the infographic.

The average age of the respondents is 43.5 years. Furthermore, 62% of the subjects identified themselves as female, while 63 per cent was working full time when they filled in the survey and 30 per cent was working part time. The other 7 per cent identified themselves as students. Additionally, it is noted that 82 per cent is well educated (HBO degree at least) and that the most common work sector is the financial institutions, with 20 per cent. These statistics can be found in further detail in Appendix 1, table 7. It can be concluded from these statistics that the dataset is not similarly distributed as the Dutch society, especially regarding education. This should be kept in mind when interpreting the results.

Methodology

In this section it is discussed how the assumptions for parametric testing are tested and how the hypotheses are tested. To design the dataset in a way that it is suitable for testing and for the tests themselves, the statistical program STATA will be used.

Testing of parametric assumptions

Firstly, it is it is discussed how the assumptions for parametric will be tested. This is done for the first three hypothesis. There are four assumptions that should hold (Granic, 2019); independent observations, normal distribution among the observations, same variance when more than one group is analysed and lastly, the variables should be at least measured in an interval scale. The survey already makes sure that there will be independent observations as it is assumed that the respondents did not influence each other. Furthermore, because of the design of the survey, all variables tested will have be classified as ratio data. The two remaining assumptions however need testing to discover whether they hold or not. When one of these assumptions does not hold, testing of the other assumption is useless as all assumptions have to hold to perform parametric tests.

To test whether all observations come from the same population, a Shapiro-Walk test will be used. If this test returns a p-value lower than 0.05 the null hypothesis that the tested variable is normally distributed is rejected at the 5% level. The assumption that the observations come from the same population will then be violated and it will not be possible to use a parametric test. However, if the assumption holds, the last assumption will be tested. This assumption states that all groups examined should have the same variance and will be tested with a Levene's test. When the Levene's test returns a value lower than 0.05, the null hypothesis that the tested groups have the same variance will be rejected at the 5 % level. This will violate the assumption for parametric testing and therefore a non-parametric will be used in such a case. However, if all assumptions hold a parametric test will be used.

Working at home after the COVID crisis

The first hypothesis includes the expectation that, compared to the before the COVID crisis, people intend to travel less to work after the COVID crisis. In other words, this includes that it is expected that people will work at home more often after the COVID crisis. The test that is going to be used to test this hypothesis depends on the obtained data. If the assumptions for parametric tests are met, a dependent t-test is used. When the assumptions are not met, one of the non-parametric equivalents of the t-test is used, which are the Mann-Whitney U test and the Wilcoxon test. Because the data for this hypothesis is obtained using a between-subject design, the Wilcoxon test is preferred above the Mann-Whitney U test. The exact null hypothesis for this hypothesis will be stated when it is observed whether the data meets the assumptions for parametric testing.

Active travel and decision making for future selves

Furthermore, it is discussed how the second hypothesis is going to be tested. This hypothesis includes decision making for future selves. It tests whether people intend to choose more active travel trips to work after the COVID crisis when they decide for their future self instead of for their present selves. This time, an independent t-test is used when the conditions for parametric testing hold. If not, a Mann-Whitney U test will be performed as the data for this hypothesis is obtained using a between-subjects design. The exact null hypothesis for this hypothesis will be stated when it is observed whether the data meets the assumptions for parametric testing.

In addition to this, a linear regression will be performed that examines the effect that the independent variable deciding for a future self (one year from the moment the survey is taken) has on the amount of days travelled to work cycling or walking per week, which will be the dependent variable. It is expected that deciding for a future self will increase the amount of days actively travelled to work per week more than the deciding for a present self. In addition, several control variables as distance, education and whether the work/home is located in a rural or urban area will be included in the regression. Moreover, decision making for future selves should be compared to decision making for present selves, being a student and working full time compared to working part time, all education variables to HBO bachelor, all work sector variables to public administration, work location to a rural work environment and, finally, home location to rural home surroundings.

Additionally, it will be tested whether heteroskedasticity is an issue. This will be done with the original Breusch-Pagan/Cook-Weisberg test, which checks whether the standard errors are normally distributed. When they are normally distributed, a normal linear regression is used. However, when the errors are not normally distributed a linear regression with robust standard errors will be used.

Influence of the government on increasing working at home

Lastly, the way of testing the third hypothesis will be discussed. This hypothesis will test whether the government can decrease the amount of car trips after the COVID crisis, compared to before the COVID crisis, by supplying information about the reduction in car trips and the positive consequences from this development in order to encourage people to make less car trips to work. For this hypothesis, the group that was randomized into scenario one is compared with the group that was randomized into scenario three. The method of testing is equal to the second hypothesis. An independent t-test is

used when the conditions for parametric testing hold. If not, a Mann-Whitney U test will be performed as the data for this hypothesis is obtained using a between-subjects design.

In addition to this, a linear regression will be performed that examines the effect of the infographic (independent variable) on the amount of days travelled to work per week, which will be the dependent variable. In this regression, the main focus will thus be the group that was shown the infographic. It is thought that this intervention will decrease the amount of days travelled to work per week more than the other two scenarios. Furthermore, several control variables as distance, education and whether the work/home is located in a rural or urban area will be included in the regression. In more detail, the infographic scenario should be interpreted compared to the scenarios where the infographic was not shown (decision making for present self and decision making for future self scenarios), being a student and working full time compared to working part time, all education variables to HBO bachelor, all work sector variables to public administration, work location to a rural work environment and, finally, home location to rural home surroundings.

Additionally, similar to the earlier discussed regression, it will be tested whether heteroskedasticity is an issue. Again, this will be done with the original Breusch-Pagan/Cook-Weisberg test, which checks whether the standard errors are normally distributed. When they are normally distributed, a normal linear regression is used. However, when the errors are not normally distributed a linear regression with robust standard errors will be used.

Results

In this section the results from the statistical tests will be discussed and interpreted. Firstly, it will be examined whether people intend to work more at home after the COVID crisis. Additionally, decision making for future selves compared to present selves is reviewed. Next, it is discussed whether governments can influence the decision of working at home instead of at work with a simple infographic. Hereafter, the results of the regression on the amount of days travelled to work will be performed and interpreted.

Working at home after the COVID crisis

In order to measure whether the COVID crisis has an effect on the amount of days people will be working at home it will be tested whether people intend to work more at home after the crisis, compared to before the crisis. But before a test can be performed, it has to be checked whether the assumptions for parametric testing hold or not. Firstly, it is tested with a Shapiro-Wilk test whether the variable that indicates how many times people went to work before COVID and the variable that indicates how many times people intend to go to work after COVID are normally distributed or not. The test returns a p-value lower than 0.05 for both variables, which means that the null hypothesis that both variables are distributed normally could be rejected. It is unnecessary to test the other assumptions, as a parametric test could not be used here. Therefore, as discussed in the methodology section, the non-parametric test is used. Because of the between-subject design for this hypothesis, a Wilcoxon test will be performed.

The Wilcoxon test tests whether two samples are derived from the same population. For this hypothesis, the two samples are the variables going to work before the COVID crisis and going to work after the COVID crisis. The tested null hypothesis is that both samples come from the same population. The Wilcoxon test (n=198) returns a p-value of 0.000, meaning that the null hypothesis that the samples come from the same population could be rejected at the 1% level. In other words, the result of the Wilcoxon test indicates that the two samples are significant different from each other. In addition, the mean is observed from both variables. Here, it can be seen that the average amount of days people intend to travel to work after the COVID crisis (2.783) decreases with more than 1, compared to before the COVID crisis (3.823), see table 2. Because of the significant result of the Wilcoxon test, it can be said that people significantly intend to travel less to work after the crisis, compared to before the crisis.

Table 2

Results of four Wilcoxon tests on the variables "Days per week travelled to work before COVID" and "Days per week intended to travel to work after COVID". The averages of these variables are given to provide clarity about how the variables differ. The test is performed on the entire sample and once per scenario group.

	Entire sample	Present self	Future self	Infographic
P-value Wilcoxon test	0.000	0.000	0.000	0.000
Average days travelled to work before COVID per week	3.823	3.855	3.831	3.781
Average days intended to travel to work after COVID per week	2.783	2.739	2.846	2.766
Observations	198	69	65	64

In addition to above mentioned result, it has to be noted that for this test, all three scenarios are taken into account together. Therefore, to look into this result in more detail, the same test is performed another three times. Once for every scenario apart. Firstly, the test is performed on the group that decided for their present self without the infographic. The Wilcoxon test over the 69 observations in this group again returns a p-value of 0.000, meaning that the null hypotheses that the samples come from the same population could be rejected at the 1% level. When the averages of both variables are observed, it can be seen that the average amount of days travelled to work before the crisis (3.855) is more than one higher than the intended travelled days after the crisis (2.739), see table 2. Therefore, it can also in this scenario be concluded that it is an significant result that people intend to travel less to work after the COVID crisis, compared to before the crisis.

Secondly, the test is performed on the group that decided for their future self. The Wilcoxon test (n=65) performed on this group returns a p-value of 0.000, meaning that the null hypotheses that the samples come from the same population could be rejected at the 1% level. When the averages of both variables are observed, it can again be seen that the average amount of days travelled to work before the crisis (3.831) is higher than the intended travelled days after the crisis (2.846), see table 2. Therefore, it can be concluded that also for the group that decided for their future self it significantly holds that people tend to travel less to work after the COVID crisis, compared to before the COVID crisis.

Finally, the test is performed on the group that decided for their present self and were shown the infographic. The Wilcoxon test over the 64 observations in this group again returns a p-value of 0.000, meaning that the null hypotheses that the samples come from the same population could be rejected at the 1% level. When the averages of both variables are observed, it can be seen that the average amount of days travelled to work before the crisis (3.781) is more than one higher than the intended travelled days after the crisis (2.766), see table 2. Therefore, it can be concluded that in all three scenarios the same effect holds, because also in the group that were shown the infographic it is observed that, compared to before the COVID crisis, people significantly tend to travel less to work after the COVID crisis. Active travel and decision making for future selves

For the second hypotheses, that investigates whether people tend to choose more active travel days when the decision is made for their future self instead of for their present self, it is again tested whether the assumptions for parametric testing hold. If they hold, an independent t-test is used. Otherwise, a Mann-Whitney U test will be performed. To test for normal distribution in the used variables a Shapiro-Walk test is used. The two variables in this case are active travel days to work per week for the group that decided for their present self on the one hand and for their future self on the other hand. The Shapiro-Walk test for both variables returns a p-value below 0.05, which means that the null hypotheses that the variables are normally distributed could be rejected. This violates the assumptions for parametric testing, therefore a Mann-Whitney U test is used as non-parametric variant of the independent t-test.

The Mann-Whitney U test is thus performed on the variable active travel and compares the group that decided for their present selves (n=69) and their future selves (n=65). The test tests the null hypothesis that both groups come from the same population. The Mann-Whitney U is performed and returns a p-value of 0.815 (table 3). With the p-value being above 0.1, the null hypothesis cannot be rejected at the 10% level. Therefore, there is no proof found that people choose to travel by bike or walk more when decided for their present selves, compared to their future selves.

Table 3

Results of four performed Mann-Whitney U tests. The test is performed on the variable "Active travel days to work per week" between two groups. The first group decided for their present selves and the second group decided for their future self (one year from now).

	Entire	Maximum distance between work and home		
	sample	20 km	10 km	7.5 km

P-value Mann-Whitney U test	0.815	0.484	0.279	0.189
Amount of observations deciding for present selves group	69	48	34	27
Amount of observations deciding for future selves group	65	43	27	20

A reason why there is no evidence found that active travel is influenced by deciding for a present or future self could be the distance between work and home. Therefore, the test is performed three more times. In these tests a restriction is set in the distance between work and home. In the first test people who live more than twenty kilometres away are not considered in the test. Additionally, in the second test the restriction is sharpened even more, which means that the only people considered are the ones who live maximum ten kilometres away from their work. Lastly, the test is performed again, but now only with people who live at a maximum of 7.5 kilometres distance from their work.

Firstly, the test is performed for people who live at a maximum distance of 20 kilometres. In this subsample the group that decided for their present self has 48 observations and the group that decided for their future self has 43 observations. The null hypothesis stays the same, it tests whether these groups come from the same population. The performed Mann-Whitney U test returns a p-value of 0.484, which is higher than 0.1 (table 3). Therefore, the null hypothesis could not be rejected at the 10% level. The result for this subsample is therefore the same as for the entire sample, there is no evidence found that deciding for a future self influences the amount of days that is actively travelled to work per week, compared to deciding for present selves.

Secondly, the test is performed for people who live at a maximum distance of ten kilometres. In this subsample the group that decided for their present self has 34 observations and the group that decided for their future self has 27 observations. The null hypothesis stays the same once more and tests whether these groups come from the same population. The Mann-Whitney U test is then performed and returns a p-value of 0.279 (table 3). The p-value is higher than 0.1 and therefore the null hypothesis could not be rejected at the 10% level. The result for this subsample is therefore the same as for the entire sample and the twenty kilometres or less sample, there is no evidence found that deciding for a future self influences the amount of days that is actively travelled to work per week, compared to deciding for present selves.

Lastly, the Mann- Whitney U test is performed for people who live at a maximum distance of 7.5 kilometres. In this subsample the group that decided for their present self has 27 observations and the group that decided for their future self has twenty observations. Noted here should be that the amount of observations is a bit low in order to perform a powerful test. The null hypothesis remains that the tested groups come from the same population. The performed Mann-Whitney U test returns a p-value of 0.189, which is higher than 0.1 (table 3). Therefore, the null hypothesis could not be rejected at the 10% level. The result for this subsample is therefore the same as for the entire sample and the samples with people who live maximum ten and twenty kilometres away, there is no evidence found that deciding for a future self influences the amount of days that is actively travelled to work per week, compared to deciding for present selves.

Although the results presented in table 3 are not significant, it can be noticed that the p-values decrease when the maximum distance between work and home decreases as well. Unfortunately, the test could not be performed with a further decrease in maximum distance between work and home. Then, there would be too little observations left when the maximum distance is reduced to for example five kilometres, which will lead to unpowerful and inaccurate tests. The same holds for excluding people that already actively travelled to work and solely focusing on people who normally take public transport. Testing with these subsamples cannot be done with a reduction in amount of kilometres, which seems to be an important factor in the decision for active travel.

In order to obtain these results in another way, a linear regression is performed. The regression performed examines the effect of decision making for future selves (independent variable) on the amount of days travelled to work cycling or walking per week (dependent variable). In order to decide if a robust regression is needed or not, it is firstly observed whether the standard errors are normally distributed. Here, an original Breusch-Pagan/Cook-Weisberg test is used. The null hypothesis of this test is that there is constant variance among the dependent variable. The test returns a p-value of 0.017, which means that the null hypothesis can be rejected at the 5% level. Therefore, it is assumed that heteroskedasticity is an issue. To control for heteroskedasticity, the regression will be performed with robust standard errors.

Hereafter, the regression is performed. Next to the independent variable, several control variables are added to give a more precise understanding of the situation. The results of the regression are presented in and discussed after table 4.

Table 4

The results of the linear regression with the amount of days people intend to travel to work cycling or walking per week after the COVID crisis as dependent variable and deciding for a future self (one year from the moment the survey was taken) as independent variable. The coefficient is presented, along with the standard errors between brackets.

Variable	β (SE)
Deciding for future self	0.549* (0.288)
Female	-0.387 (0.341)
Working full time	0.138 (0.364)
Student	0.694 (0.816)
VMBO	-1.141* (0.619)
HAVO	-0.547 (0.525)
VWO	3.389*** (0.623)
MBO	-0.321 (0.468)
HBO master	-0.229 (0.430)
University bachelor	0.379 (0.641)
University master	-0.159 (0.384)
Financial institutions	-0.531 (0.434)
Information and communication	-1.009 (0.672)
Business services	0.341 (0.588)
Other services	0.078 (0.564)
Education	0.591 (0.643)
Culture, sports and recreation	-0.674 (0.722)
Whole sale and retail	0.326 (0.920)
Industry and energy	0.895* (0.484)
Transport	0.712 (0.594)
Construction	-0.163 (0.702)
Healthcare	0.328 (0.556)
Work sector does not apply	-3.399*** (1.037)
Distance between work and home (in km)	-0.025*** (0.007)
Work in village environment	1.353*** (0.509)
Work in city environment	0.948** (0.417)
Home in village environment	0.532 (0.500)
Home in city environment	-0.210 (0.612)

Constant	1.080 (0.722)

*Note: * p < 0.1, ** p < 0.05, *** p < 0.01*

The results of the regression seem to suggest that deciding for a future self, compared to deciding for a present self, increases the amount of actively travelled days to work per week with 0.549. This effect is significant at the 10% level.

In addition, the control variables that are significant at the 5% level are discussed. Only exception here is the variable work sector does not apply, due to a lack of information about the work sector. Therefore, this variable cannot be interpreted correctly. Firstly, the variable VWO is discussed. Having a VWO as highest perceived degree should be compared to having a HBO bachelor at most. When this is done, having VWO at most increases the amount of active travel days per week with 3.389. This is even significant at the 1% level. A possible explanation is that people who finished VWO at most are less likely to own a car yet because they are still studying for example. However, it is most likely that this is a random finding as there are only three people in the subsample for this regression who filled in VWO as their highest perceived degree.

Furthermore, it is observed that the distance between work and home has a significant effect on the active travel days to work week at the 1% level. If the distance between work and home increases with one kilometre, the amount of days actively travelled to work per week decreases with 0.025. This result is as expected before.. A decrease of 0.025 actively travelled days to work per week per extra kilometre distance between work and home implies that the a distance of forty kilometre between work and home decreases the actively travelled days with one. With a constant of 1.080 (should be noted that the constant is not significant at the 10% level), this means that people who live approximately 40 kilometre away from their work never travel to work actively, ceteris paribus.

Lastly, the variables work in city environment and work in village environment are discussed. Working in a city environment and working in a village environment respectively increases the amount of actively travelled days to work per week with 1.353 and 0.948, compared to working in a rural environment. The effects are respectively significant at the 1% and the 5% level. A possible explanation for these effects is that people who live in a city or village are more likely to live in the same city or village as their work is located. This is because there is simply more work in a city or village than there is in a rural environment. Furthermore, it could also be the explanation why the effect of working in a city environment is larger than the effect of working in a city.

Influence of the government on increasing working at home

The third hypothesis of this study states that when the government provides information about the reduction in traffic jams, and thus travel time, the car is chosen less as transportation mode after the COVID crisis, compared to before the COVID crisis. Similar to the first two hypotheses, it is firstly tested whether the variable that is used for this test meet the assumptions for parametric testing.

In more detail, it is tested whether the variable travel days to work by car per week is normally distributed. This is done for the group that decided for themselves without being confronted with the infographic and the group that decided for themselves with being confronted with the infographic. To test for normal distribution for the travel days to work per week by car variable among these two groups, two Shapiro-Walk tests are performed. The test returns a p-value lower than 0.05 twice, which means that the null hypothesis that the variable travel days to work by car per week is normally distributed among these groups could be rejected. This violates the assumptions of parametric testing and therefore a non-parametric test is used. The non-parametric test that will be performed is the Mann-Whitney U test, similar to the second hypothesis. Hereafter, a regression is performed to obtain the effect the infographic has on the amount of times people intend to travel to work per week after the COVID crisis.

Additionally, the Mann-Whitney U test is thus performed on the variable travel days to work by car per week for two groups that both decided for their present selves. One group was shown an infographic with information about the annual costs and delay of traffic jams and one group decided without being shown this infographic. The Mann-Whitney U test tests the null hypothesis that both groups come from the same population. The performed Mann-Whitney U test returns a p-value of 0.080 (table 5), which means that the null hypothesis can be rejected at the 10% level. In more detail, the average amount of travel days to work by car per week for the group that was not shown the infographic is 1.681 and 1.219 for the group that was shown the infographic. The difference in averages is thus significantly proven by the Mann-Whitney U test at the 10% level. It could therefore be said that being shown the infographic has a significant effect on the amount of days travelled to work by car per week.

Table 5

Results of the performed Mann-Whitney U test. The test is performed on the variable "travel days to work by car per week" between two groups. The first group decided for their present selves without being shown the infographic. The second group decided for their present selves as well, but were not shown the infographic.

	Results
P-value Mann-Whitney U test	0.080
Amount of observations deciding for present selves without being shown the infographic	69
Amount of observations deciding for present selves while shown the infographic	64

Furthermore, this finding seems to suggest that that the government could influence the decision of travelling with car in a quite simple way. With just showing people an infographic, it is significantly proven at the ten per cent level that less car trips to work will be made per week. This could be a cost-effective way of reducing the traffic jams after the COVID crisis. It could probably even be possible to influence the decision on going to work by car even further with more active approaches. However, these effects should be studied in further research as it is outside the scope of this paper.

In addition, the results of the linear regression will be discussed. The regression performed examines the effect of the infographic on the amount of days travelled to work per week (dependent variable). In order to decide if a robust regression is needed or not, it is firstly observed whether the standard errors are normally distributed. This is done with an original Breusch-Pagan/Cook-Weisberg test. Here, the null hypothesis is that there is constant variance among the dependent variable. The Breusch-Pagan/Cook-Weisberg test returns a p-value of 0.482, which means that the null hypothesis cannot be rejected. Therefore, it is assumed that the standard errors are normally distributed. With normal distributed standard errors there is no need to perform a regression with robust standard errors.

Additionally, the regression is performed. As discussed before, the main focus is on the group that was shown the infographic as this intervention is expected to decrease the amount of days travelled to work per week. Moreover, several control variables are added and interpreted in order to give a more precise image of the situation. The results of the regression are presented in table 6 and are discussed after the presentation of table 6.

Table 6

The results of the linear regression with the amount of days people intend to travel to work per week after the COVID crisis as dependent variable and being shown the infographic as independent variable. The coefficient is presented, along with the standard errors between brackets.

Variable	β (SE)
Infographic	-0.126 (0.216)
Female	-0.287 (0.240)
Working full time	0.635** (0.245)
Student	0.430 (0.502)
VMBO	0.145 (1.363)
HAVO	-0.338 (0.602)
VWO	1.250** (0.607)
MBO	0.160 (0.369)
HBO master	-0.343 (0.296)
University bachelor	0.310 (0.448)
University master	-0.242 (0.267)
Financial institutions	-0.195 (0.343)
Information and communication	0.055 (0.396)
Business services	0.582 (0.402)
Other services	0.404 (0.411)
Education	0.958** (0.431)
Culture, sports and recreation	-0.746 (0.658)
Whole sale and retail	1.251** (0.575)
Industry and energy	0.789 (0.750)
Transport	2.381*** (0.710)
Construction	1.547** (0.654)
Healthcare	0.618 (0.431)
Agriculture	-1.038 (1.371)
Work sector does not apply	1.077 (0.882)
Distance between work and home (in km)	-0.014*** (0.005)
Work in village environment	0.216 (0.554)
Work in city environment	0.228 (0.506)
Home in village environment	0.058 (0.372)
Home in city environment	-0.027 (0.398)

Constant	2.300*** (0.662)

*Note: * p < 0.1, ** p < 0.05, *** p < 0.01*

As can be seen in table 6 there is no significant evidence found that being shown the infographic has an effect on the amount of days travelled to work per week, compared to the group that was not shown the infographic (decision making for present self and decision making for future self). The coefficients from the groups that were not shown the infographic are above zero as expected, which could mean that these groups have a lower willingness to go to work. However, the p-values are above 0.1. The effect is therefore not significant at the 10% level.

Additionally, the control variables that returned significant coefficients will be discussed. Firstly, working full time is therefore examined. Compared to working part time, working full time leads to an increase of 0.635 days travelled to work per week. This effect is significant at the 5% level. The explanation is probably rather simple, people who work full time work more often than people who work part time and will therefore also travel to work more often.

Secondly, the variable VWO is discussed. Having the highest level of the Dutch high school system as highest perceived education finished with a degree increases the days travelled to work per week with 1.250, compared to having a HBO bachelor as highest degree. The effect is significant at the 5% level. A reason for this effect could be that people who received their HBO bachelor degree are more likely to be employed in jobs that can be done at home, like office jobs, than people who finished their VWO at most. However, if this is the reason for the effect, it should be logical that this effect also occurs at the variables VMBO and HAVO. The effect is not observed among these variables, which suggests that the earlier stated reason is probably not true.

In addition, the significant effects of several work sectors variables are examined. There are four sectors with a significant effect on the intended days travelled to work per week after the COVID crisis. The first one is the sector education. Being employed in the sector education, compared to being employed in the public administration sector, increases the amount of days travelled to work per week with 0.958. This effect is significant at the 5% level. A similar effect is observed for the whole sale and retail sector, the transport sector and the construction sector. These sectors increase the amount of days travelled to work per week respectively with 1.251, 2.381 and 1.547. All three coefficients are significant at the 5% level, the effect of the transport sector even at the 1% level. The reason why these sectors increase the amount of days travelled to work per week is clear. For all four discussed

sectors travelling to work is often required in order to perform work, which thus increases the amount of days travelled to work per week.

Lastly, the effect of the distance between work and home in kilometres on the amount of days travelled to work per week is discussed. The effect is significant at the 1% level and implies that for every extra kilometre a person lives away from their work, the amount of days travelled to work per week decreases with 0.014. As Clark, Chatterjee and Melia (2016) already found that distance was an important factor for people who chose to travel with car. Therefore, it was expected that working from home would increase when the distance between work and home increases as well. This effect is found to be significant and the interpretation is clear again. People who work further away from their work have an increased amount of travel time and because of that, they choose to work at home more often.

Discussion

The COVID crisis is one of the most challenging problems in the last few decades. It turns the society upside down and forces governments and companies to adapt very quickly. However, it also provides opportunities. Firstly, the hypothesis that states that people intend to travel less to work after the COVID crisis, compared to before the COVID crisis is accepted at the 1% level. Hereafter, the second hypothesis that states that active travel behaviour is chosen more often than non-active travel behaviour when decided for the future self, compared to the present self is accepted at the 10% level. Lastly, the hypothesis that states when the government provides information about the amount of time and money lost due to traffic delays, the car is chosen less as transportation mode after the COVID crisis compared to before the COVID crisis is accepted at the 10% level.

Additionally, all three hypotheses are reviewed in more detail. First, the hypothesis that compares the amount of days travelled to work before and after the COVID crisis is discussed. As noted before, this paper significantly seems to prove that people intend to travel less to work after the COVID crisis. Logically thinking, this also means that people will thus work at home more.

For the first hypothesis, four Wilcoxon tests were performed. One for the entire sample and one for each scenario. All four tests, in combination with consulting the average amount of days travelled to work, showed that people intend to travel less to work after the COVID crisis. The result is in line with literature and can be compared with Eriksson, Garvill and Nordlund (2008). They intervened habitual behaviour to change travel behaviour. However, they had to design their own intervention. In this case the COVID crisis could be seen as a natural intervention to change travel behaviour. Furthermore, Bloom et al. (2015) already found the benefits of working at home, compared to working at work. It could be that because of the COVID crisis more people discovered the benefits of working at home and decided to profit from it more, also when the crisis is over. This is however outside the scope of this paper and could be researched further in future studies.

Additionally, the reason that the amount of days that is intended to travel to work does only reduce with one day and not any further is in line with literature as well. Rubin et al. (2020) found that a main disadvantage of working at home more was a lack of social contact. It could be that people want to maintain these contacts and therefore do not choose to work at home entirely. Noted by this interpretation should be that not all work can be done at home, which could not be controlled for in this paper. It is therefore unlikely that the amount of days people intend to work at home decreases

to zero. Another disadvantage of working at home could be that when people travel to work less often, it could also mean that active travel will be reduced. This can be problematic as it could cause less exercise for active travellers, which could have health consequences. Furthermore, an often stated benefit of an increase in working at home is a reduction in emissions, as people will travel less with car. However, working from home could actually be worse in terms of emissions than working at (and thus commuting to) the office (Turits, 2020).

Concluding, employers should provide people opportunities to work at home as people intend to work more often. This could mean investments in home offices and investments in technology to ensure that the performance at home is not influenced such factors. In addition, the employers should control that the employees do not sacrifice the amount of social contact between each other too much with for example obligated days, meetings or events at the office.

Secondly, it was tested whether decision making for future selves could influence the amount of active travel days to work per week. To test the second hypothesis, four Mann-Whitney U tests were performed. One on the entire sample and then three with a smaller maximum distance between home and work each time. Although none of the tests showed significant results, the p-value decreased with every reduction in distance. Due to a lack of observations with a small distance between work and home the distance could not be decreased further than 7.5 kilometres. Therefore, future research should look into the effect of decision making for future selves for people who live close to their work as the observed results of these tests are promising.

Additionally, a regression was performed to give a more detailed image of the effect of decision making for future selves on the actively travelled days to work per week. Here, it is observed that the amount of actively travelled days to work per week significantly increases when the decision is made for a future self at the 10% level. The obtained result is as expected on beforehand and is in line with the earlier reviewed literature. The result is similar to the research of Pronin, Olivola and Kennedy (2009), who already found that deciding for a future self leads to choosing less comfortable and convenient options. As travelling by bike or walking can be seen as less comfortable than travelling with car, deciding for a future self seems to have the same effect in this study. This result seems to suggest that active travel to work can be increased with decision making for future selves. To make sure that people will follow the decisions that they made for their future selves, the commitment part of the MINDSPACE framework (Dolan et al., 2012) could be used. Future research could look into this relationship and effectiveness.

Lastly, it was tested whether the government could reduce the amount of car trips to work per week. With an infographic that highlights the amount of time and money that is lost yearly due to traffic jams the subject were nudged to decrease the amount of weekly car trips to work. Similar to the second hypothesis, a Mann-Whitney U test was performed. The result showed a significant difference at the 10% level between the people who were shown the infographic and the group that were not shown the infographic. When looked at the mean of these groups it could be concluded that the subjects that saw the infographic choose less car trips to work per week than the group that did not see the infographic. When said that travelling with car could be seen as a habit, the COVID crisis could act as interruption that breaks this habit. The government could reduce the amount of car trips per week after COVID even further relatively easy with this infographic and thus decrease the amount of traffic jams. Future research could look into more active approaches in order to reduce the traffic jams even further.

In addition, a linear regression was performed to examine which effects the infographic scenario has on the amount of days travelled to work per week. However, no significant results were obtained among these scenarios. On the other hand, some control variables returned significant coefficients. Shortly said, it could be concluded that sectors that required people to go to work increased the amount of days that was travelled to work. Furthermore, the distance between work and home effects the amount of travelled days to work as well. Logically, the larger the distance between home and work, the larger the amount of days worked at home.

Lastly, the limitations of this study are discussed. Firstly, because a scenario-based survey is used, it could be that the obtained answers differ from the actions people would actually take when they find themselves in such situation. This effect is probably larger for the group that decided for their future self, as people often do not know how they will decide in a year from now. Additionally, this survey only captures one moment of decision making. To capture the real effect of decision making for future selves or the real effect of the infographic, a longitudinal study could be performed in the future. This coincides with the fact that the external validity of this study is not proven yet. Furthermore, some tests would have been more powerful and accurate with a larger sample. For example, the Mann-Whitney U tests of the less or equal than 10 and 7.5 kilometre subsamples that tested the second hypothesis had about respectively groups of 34 and 27 subjects and groups of 27 and 20 subjects. In addition, a test with a subsample with a maximum distance between work and home of 5 kilometre could not be performed due to this reason.

Concluding, this study proves that people intend to work more at home after the COVID crisis. However, for some sectors it is more difficult to work at home and that the distance between work and home plays an important role in the amount of days travelled to work per week. Furthermore, this paper shows promising results that decision making for future selves could influence the amount of active travel days. Lastly, it is shown that the government could reduce the amount of car trips to work with a simple intervention.

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Appendix A: Tables and Figures

Table 7

Descriptive statistics of all control variables. All variables are dummies, except age (in years) and distance between work and home (in kilometres).

	Mean	Standard Deviation	Observations
Age (years)	43.475	12.974	198
Distance between work and home (km)	20.317	22.601	198
Female	0.616	0.488	198
Student	0.707	0.257	198
Working Full Time	0.626	0.485	198
Working Part Time	0.303	0.461	198
VMBO	0.005	0.071	198
HAVO	0.030	0.172	198
VWO	0.030	0.172	198
MBO	0.116	0.321	198
HBO (Bachelor)	0.293	0.456	198
HBO (Master)	0.167	0.374	198
University (Bachelor)	0.086	0.281	198
University (Master)	0.273	0.446	198
Construction	0.303	0.172	198
Culture, Sports and Recreation	0.303	0.172	198
Financial Institutions	0.197	0.399	198
Whole sale and Retail	0.040	0.197	198
Industry and Energy	0.020	0.141	198
Information and Communication	0.121	0.327	198
Agriculture, minerals extraction	0.005	0.071	198
Education	0.086	0.281	198
Public Administration	0.146	0.354	198
Transport	0.303	0.172	198
Healthcare	0.076	0.265	198
Business Services	0.111	0.315	198
Other Services	0.091	0.288	198

Does Not Apply	0.015	0.122	198
Work Rural	0.061	0.239	198
Work Village	0.152	0.359	198
Work City	0.788	0.410	198
Home Rural	0.106	0.309	198
Home Village	0.460	0.500	198
Home City	0.434	0.497	198

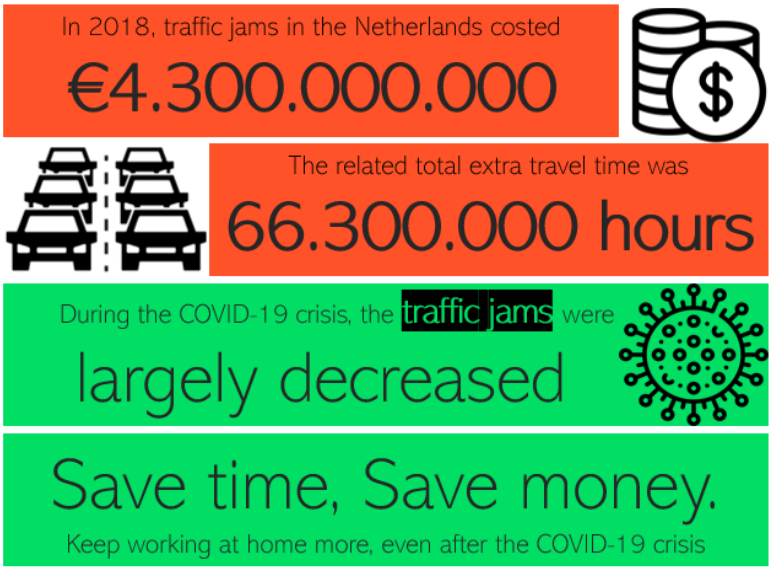

Figure 2. The infographic as used in the survey, translated to English. For the original infographic, see Appendix B. Sources: Mobiliteitsbeeld 2019, Dutch Government. Third Rapport National Road Network 2018, Ministry of Infrastructure and Water Management.

Appendix B: Survey

Here, the survey used for this study is presented. Important to notice is that the subjects were only shown one randomized scenario. Furthermore, the language of the survey was Dutch. For clarity, the translation of each question is given between brackets.

Introduction

Deze enquête dient als mijn onderzoek voor de masterscriptie die de studie Urban, Port and Transport aan de Erasmus Universiteit afsluit. Vul de vragen alstublieft zo eerlijk mogelijk in en sluit de enquête niet tussentijds af. Uiteraard worden is deze enquête volledig anoniem. Alvast bedankt voor uw medewerking!

(This survey serves as research for the masterthesis of the study Urban, Port and Transport at the Erasmus University. Please answer truthfully and do not close the survey in the middle. Of course, this survey will be completely anonymous. Thank you in advance for your participation!)

Selection question

In percentages, hoeveel van uw huidige baan zou u ongeveer eventueel thuis uit kunnen voeren?
(In percentages, how much of your current job could be performed from home?)

	0 10 20 30 40 50 60 70 80 90 100
Percentage werkzaamheden die uitgevoerd kunnen worden vanuit huis (Percentage of work that could be performed from home)	

General questions

Voor de COVID-19 crisis, hoeveel dagen per week werkte u in het algemeen?
(Before the COVID-19 crisis, how many days per week did u work?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Voor de COVID-19 crisis, hoeveel dagen per week reisde u richting uw werk?

(Before the COVID-19 crisis, how many days per week did you travel to work?

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Voor de COVID-19 crisis, hoeveel dagen per week reisde u richting uw werk met de auto?

(Before the COVID-19 crisis, how many days per week did you travel to work with the car?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Voor de COVID-19 crisis, hoeveel dagen per week reisde u richting uw werk lopend of fietsend?

(Before the COVID-19 crisis, how many days per week did you travel to work cycling or walking?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Voor de COVID-19 crisis, hoeveel dagen per week reisde u richting uw werk met het openbaar vervoer?

(Before the COVID-19 crisis, how many days per week did you travel to work with public transportation?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Scenario 1

Stelt u zich voor de volgende vragen voor dat alle genomen maatregelen omtrent de COVID-19 crisis per direct vervallen.

(Imagine for the following questions that all additional measures regarding the COVID-19 crisis are dropped immediately)

Hoeveel dagen per week gaat u naar uw werk reizen in deze situatie?

(How many days per week will u travel to work in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met de auto naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with the car in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u lopend of fietsend naar uw werk reizen in deze situatie?

(How many days are you going to travel to work walking or cycling in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met het openbaar vervoer naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with public transportation in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Scenario 2

Stelt u zich voor de volgende vragen voor dat alle genomen maatregelen omtrent de COVID-19 crisis over precies 1 jaar vervallen.

(Imagine for the following questions that all additional measures regarding the COVID-19 crisis are dropped in exactly one year.

Hoeveel dagen per week gaat u naar uw werk reizen in deze situatie?

(How many days per week will u travel to work in this situation?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met de auto naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with the car in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u lopend of fietsend naar uw werk reizen in deze situatie?

(How many days are you going to travel to work walking or cycling in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met het openbaar vervoer naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with public transportation in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Scenario 3

Stelt u zich voor de volgende vragen voor dat alle genomen maatregelen omtrent de COVID-19 crisis per direct vervallen. Neemt u daarnaast even de tijd om onderstaande infographic te lezen (Bron: Mobiliteitsbeeld 2019, Rijksoverheid; 3e Rapportage Rijkswegennet 2018, Ministerie van Infrastructuur en Waterstaat).

(Imagine for the following questions that all additional measures regarding the COVID-19 crisis are dropped immediately. Take your time to read the infographic below (Sources: Mobiliteitsbeeld 2019, Dutch Government. Third Rapport National Road Network 2018, Ministry of Infrastructure and Water Management).)

Hoeveel dagen per week gaat u naar uw werk reizen in deze situatie?

(How many days per week will u travel to work in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met de auto naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with the car in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u lopend of fietsend naar uw werk reizen in deze situatie?

(How many days are you going to travel to work walking or cycling in this situation?)

0 1 2 3 4 5 6 7

Aantal dagen (Amount of days)	

Hoeveel dagen per week gaat u met het openbaar vervoer naar uw werk reizen in deze situatie?

(How many days per week are you going to travel to work with public transportation in this situation?)

	0 1 2 3 4 5 6 7
Aantal dagen (Amount of days)	

Demographics

Wat is uw leeftijd?

(What is your age)

	0 10 20 30 40 50 60 70 80 90 100
Leeftijd (Age)	

Wat is uw geslacht?

(What is your gender)

- ○ Man (Male)
- ○ Vrouw (Female)
- ○ Anders, namelijk: (Other:) _____

Wat is uw huidige werkstatus?

(What is your current workstatus)

- ○ Werkend, fulltime (working, fulltime)
- ○ Werkend, parttime (working, parttime)
- ○ Student (student)
- ○ Gepensioneerd (retired)
- ○ Werkzoekend (looking for work)

Wat is uw hoogst genoten opleiding (afgesloten met diploma)?
(What is your highest perceived education (finished with degree))

- ○ VMBO (lowest level high school)
- ○ HAVO (middle level high school)
- ○ VWO (highest level)
- ○ MBO (secondary vocational education)
- ○ HBO (bachelor) (higher vocational education (bachelor))
- ○ HBO (master) (higher vocational education (master))
- ○ WO (bachelor) (university (bachelor))
- ○ WO (master) (university (master))

In welke sector werkt u momenteel?
(Which sector do you work in at the moment?)

- ○ Financiële Instelling (Financial Institution)
- ○ Informatie en Communicatie (Information and Communication)
- ○ Zakelijke Diensten (Business Services)
- ○ Openbaar Bestuur (Public Administration)
- ○ Onderwijs (Education)
- ○ Cultuur, Sport en Recreatie (Culture, Sports and Recreation)
- ○ Groot- en Detailhandel (Whole sale and Retail)
- ○ Indsutrie en Energie (Inustry and Energy)
- ○ Vervoer (Transport)

- ○ Bouw (Construction)
- ○ Zorg (Healthcare)
- ○ Landbouw, winning van delfstoffen (Agriculture, extracting minerals)
- ○ Horeca (Catering)
- ○ Overige diensten (Other Services)
- ○ Niet van toepassing (Does not apply)

Hoelang is de afstand tussen uw huis en uw werk ongeveer in kilometers?
(What is the distance between your home and work in kilometres?)

_____

Hoe zou u de omgeving van uw werk het beste omschrijven?
(How would u describe the area of your work)

- ○ Landelijke omgeving (rural)
- ○ Dorpse omgeving (village)
- ○ Stedelijke omgeving (city)

Hoe zou u de omgeving van uw huis het beste omschrijven?
(How would u describe the area of your home?)

- ○ Landelijke omgeving (rural)
- ○ Dorpse omgeving (village)
- ○ Stedelijke omgeving (city)

End note

Bedankt voor het invullen van de enquête. Mocht u naar aanleiding van deze enquête vragen of opmerkingen hebben, kunt u mailen naar marijnvdvaate@student.eur.nl.
(Thank you for participating in this survey. If you have any questions or remarks regarding this survey, you can send a mail to marijnvdvaate@student.eur.nl)