Commuting in a Crisis

A case study of mobility behavior during the COVID-19 pandemic in Malmö, Sweden

Jasmin Reinhard

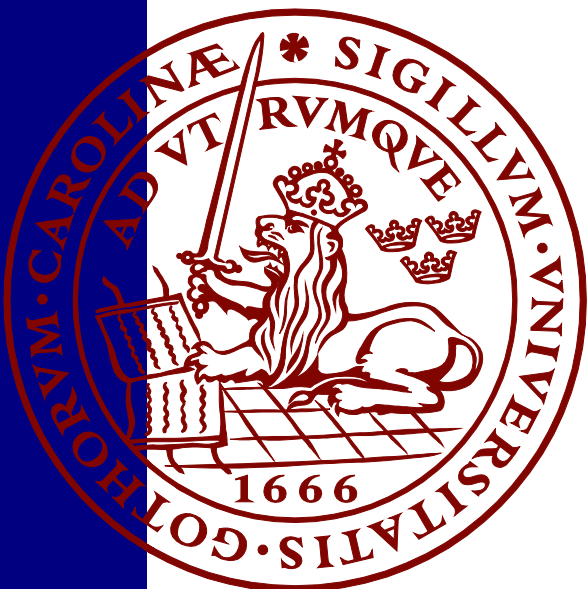**LUCSUS**

Lund University Centre for
Sustainability Studies

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Abstract

The COVID-19 pandemic impacted people's behavior on many levels, one of which is the frequency of commuting and the mode of transportation (MOT) used for it. This case study analyzes mobility behavior during the pandemic of employees commuting to and in Malmö, Sweden, and its predicting factors. A quantitative online survey (n=94) and qualitative semi-structured interviews (n=8) were conducted based on an extended version of the Theory of Planned Behavior (TPB). The results of descriptive statistics, regression analyses, and a thematic analysis suggest that employees commuted less and avoided public transportation. The variable habit strength seems best at predicting MOT choice. The influence of pandemic and environmental awareness on MOT choice cannot be observed clearly. This thesis provides insight into the effects of the pandemic on commuting in Malmö and its implications for the sustainability aims of the municipality. The discussion explains and places the results in the Swedish context.

Keywords: COVID-19 pandemic, commuting, mobility behavior, pro-environmental behavior, habit, theory of planned behavior

Word count: 11,932

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Abbreviations

IV1	Interviewee 1
IV2	Interviewee 2
IV3	Interviewee 3
IV4	Interviewee 4
IV5	Interviewee 5
IV6	Interviewee 6
IV7	Interviewee 7
IV8	Interviewee 8
MOT	Mode of transportation
MOTs	Modes of transportation
OR	Odds ratio
RQ	Research Question
SS	Sustainability Science
TPB	Theory of Planned Behavior

1 Introduction

The COVID-19 pandemic (hereafter "the pandemic") has drastically impacted people's daily behavior worldwide (Toshkov et al., 2021). From March 2020, when the pandemic broke out in Europe, social distancing, avoiding crowds, and working from home became the new normal for most Europeans (Toshkov et al., 2021). Although those restrictions came with disadvantages on a societal, economic, and individual level, many saw possible positive effects on the natural environment (Khan et al., 2021). For instance, a decline in air pollution and greenhouse gas emissions was noted, as people traveled less (Benita, 2021; Khan et al., 2021; Schmidt et al., 2021). Moreover, studies suggest that the pandemic might be considered an "awakening experience" (Zebardast & Radaei, 2022, p. 1) that has led to a better understanding of one's behavior and its environmental effects (Lucarelli et al., 2020; Schmidt et al., 2021). Thus, the question arises if the pandemic can serve as a "window of opportunity" (Schmidt et al., 2021, p. 1) to shift away from unsustainable to pro-environmental behaviors.

Mobility behaviors were greatly affected by the pandemic (Benita, 2021). Although people traveled less overall, they avoided public transportation and instead chose individual transportation, such as the car or bicycle (Schmidt et al., 2021). Of all individual modes of transportation (MOTs), car use is considered unsustainable as it contributes the most to the share of global CO_2 emissions, air pollution and congestion in cities, and ultimately to climate change (Abrahamse et al., 2009; Ünal et al., 2018). Current studies suggest that the pandemic benefits the engagement in pro-environmental behavior on one side but leads to less sustainable MOT choices on the other side (Benita, 2021; Lucarelli et al., 2020; Schmidt et al., 2021; Zebardast & Radaei, 2022).

Changes in mobility behavior can be observed to a large extent in commuting. During the pandemic, employees commuted less and instead worked more from home (Benita, 2021; Schmidt et al., 2021). When they did commute to their workplace, they rather chose individual transportation (Bohman et al., 2021). This gives rise to the question of whether the pandemic led to a less or more sustainable mobility behavior of commuters.

This thesis seeks to explore the connections between the pandemic and commuting, as it is a daily behavior that has the potential to largely impact the environment (Trinh & Linh Le, 2018) while being greatly impacted by COVID-19 measures (Toshkov et al., 2021). Exploring whether the pandemic has led to less or more sustainable commuting practices is relevant as it might imply long-term consequences not only for the environment but for how people continue to commute in the future (Schmidt et al., 2021).

A case study in Malmö in Sweden serves as a foundation to explore this subject, by investigating if and how the pandemic has changed mobility behavior of employees commuting to their workplace in the city center of Malmö. The city makes a relevant case because it promotes sustainable mobility (Malmö stad, 2021). Moreover, conducting a study in Sweden is of special interest because the national COVID-19 measures have been soft compared to other European countries (Brusselaers et al., 2022). Therefore, it is insightful to explore how the pandemic influenced commuting practices of employees in Malmö.

1.1 Research Aim

This research aims to investigate how the pandemic has influenced mobility behavior of employees commuting to the city center of Malmö. This case study explores whether previous findings suggesting that the pandemic strengthened pro-environmental behavior while at the same time driving more frequent use of unsustainable MOTs applies to this case. This study investigates mobility behavior as a whole by including several MOTs. Contrary to reviewed literature, which focused mainly on the early months of the pandemic in Europe, this study considers the past two years. To investigate this phenomenon, two research questions (RQs) are posed:

RQ1: *How has the COVID-19 pandemic influenced mobility behavior of employees commuting to the city center of Malmö?*

RQ2: *Is the influence of the COVID-19 pandemic on mobility behavior for commuting consistent throughout the past two years?*

1.2 Contribution to Sustainability Science

Sustainability Science (SS) investigates human-nature interactions by following an interdisciplinary approach to explore how humans affect their natural environment (Jerneck et al., 2011; Kates et al., 2001). Moreover, SS explores how changes in the environment affect society and vice versa (Clark & Dickson, 2003). This thesis contributes to SS by making advances in these areas. The pandemic can be considered an environmental change that has affected and changed most people's lives. Changes in mobility behavior function as an adaption to this change and can have implications for climate change mitigation efforts related to modes of individual travel. Exploring how the pandemic has led to this behavioral change is relevant for SS, as it gives an insight into 1) how environmental changes trigger behavioral changes and 2) if environmental changes have the potential to provoke less or more sustainable behavior. By exploring pro-environmental and mobility behavior, this thesis uses an

interdisciplinary approach by including elements of environmental and social psychology (Ajzen, 1991; Lucarelli et al., 2020; Yuriev et al., 2020).

2   Background

In the following, the background of this thesis will be presented, consisting of the case of Malmö, Sweden's handling of the pandemic, and research on pro-environmental and mobility behavior in the light of the pandemic.

2.1   The Case: Commuting in Malmö

With around 350,000 inhabitants, Malmö is the fastest growing and third largest city in Sweden (Malmö stad, n.d., a). In its environmental program, Malmö municipality positions itself as a role model for sustainability in Sweden by aiming at mitigating climate change and implementing projects targeting sustainable development (Malmö stad, 2021). In the *Sustainable Urban Mobility Plan*, the municipality defines its goals for a more environmentally, economically, and socially sustainable urban mobility focusing on walking, cycling and public transportation (Malmö stad, 2016). One of the targets of the plan is to make commuting to and within the city more sustainable by tying it to public transportation and cycling (Malmö stad, 2016). In 2013, each day 62,000 employees commuted to Malmö; 62% did so by car while 33% used public transportation (Malmö stad, 2016, pp. 11-13). The municipality aims for reducing the share of car use while increasing public transportation use (Malmö stad, 2016). However, these numbers only refer to commuters not residing in Malmö (Malmö stad, 2016). The latest travel survey for the Scania region reveals numbers on the daily mobility of Malmö's residents (Region Skåne, 2018). Accordingly, the share of MOTs for daily travel consists of 14% by walking, 26% by bicycle, 34% by car, 17% by bus, and 8% by train (Region Skåne, 2018, p. 40). This makes Malmö one of the main cycling and walking cities in Scania (Region Skåne, 2018). The share of bus traffic is among the highest in the region, whereas car traffic is among the lowest (Region Skåne, 2018). These numbers not only relate to commuting in Malmö. However, the municipality states that 110,000 inhabitants commute within the city borders (Malmö stad, n.d., b).

Overall, it can be assumed that most people who work in Malmö also live in the city and that mobility behavior of employees commuting from outside of Malmö slightly differs from those commuting within the city. In this thesis, commuting will relate to all work-related travel from other municipalities to Malmö and within the city. This case study will give an insight into the effects of the pandemic on the goals of the municipality regarding commuting.

2.2   The COVID-19 Pandemic in Sweden

Since the pandemic reached Sweden in early 2020, it has impacted the life of Swedish citizens in multiple ways (Brusselaers et al., 2022). The Swedish strategy to limit the spread of COVID-19 was mainly based on non-binding, voluntary recommendations (Brusselaers et al., 2022). Contrary to other European countries, Sweden did not introduce any sort of lockdown (Bohman et al., 2021). The government has called on its citizens to act responsibly to protect risk groups and limit consequences for society, without enforcing legal restrictions (Brusselaers et al., 2022). From the first wave on, it was advised to keep a distance from others, avoid crowds, and work from home if possible (Bohman et al., 2021; Brusselaers et al., 2022). When the second wave of the pandemic started in the autumn of 2020, it was additionally recommended to avoid public transportation and unnecessary travel (Brusselaers et al., 2022). The Swedish government did not advise wearing facemasks to protect oneself and others from catching the virus, as was common practice in other European countries (Brusselaers et al., 2022). Only at certain times during the second wave, wearing a facemask was suggested in public transportation during busy hours (Krisinformation, 2020).

Since April 2022, the Swedish Public Health Agency no longer considers COVID-19 a generally dangerous disease and most measures have been lifted (Krisinformation, 2022).

2.3   Pro-Environmental Behavior and the COVID-19 Pandemic

Pro-environmental behavior is a much-studied subject in environmental psychology and has been recently researched in the light of the pandemic (Lucarelli et al., 2020; Yuriev et al., 2020; Zebardast & Radaei, 2022). Pro-environmental behavior comprises all possible actions aimed at limiting one's impact on the environment (Lucarelli et al., 2020; Steg & Vlek, 2009). Pro-environmental behaviors that are being studied the most are traveling and commuting, recycling, and energy-saving (Yuriev et al., 2020). The use of sustainable MOTs, such as walking, cycling, and public transportation, is considered a pro-environmental behavior (Yuriev et al., 2020). Research showed that the engagement in pro-environmental behavior is influenced by individual factors, such as knowledge and attitudes, and social factors, such as norms and incentives (Yuriev et al., 2020; Zebardast & Radaei, 2022). For instance, knowledge about the environment and climate change and connecting one's behavior and its environmental effects, along with feeling a moral obligation to act environmentally friendly, favor pro-environmental behavior (Yuriev et al., 2020; Zebardast & Radaei, 2022). This can also be defined as environmental awareness, which affects pro-environmental behavior (Yuriev et al., 2020). In the case of mobility, this means recognizing the environmental consequences of an unstainable MOT would lead to an individual using a sustainable MOT (Trinh & Linh Le, 2018).

Current research on the pandemic's effects on pro-environmental behavior suggests that the pandemic has a supporting effect on these determinants (Lucarelli et al., 2020; Zebardast & Radaei, 2022). Case studies hint that the pandemic led to a higher degree of environmental knowledge and awareness as well as a feeling of responsibility for climate change which in consequence benefited pro-environmental behavior (Lucarelli et al., 2020; Zebardast & Radaei, 2022). Moreover, high concern about the pandemic showed to predict pro-environmental behavior (Zebardast & Radaei, 2022).

2.4 Mobility Behavior and the COVID-19 Pandemic

Mobility behavior has also been studied frequently in environmental psychology (Trinh & Linh Le, 2018; Yuriev et al., 2020). In this thesis, mobility behavior is considered as traveling for daily activities such as commuting using a certain MOT, e.g., private car, public transportation, bicycle, or walking (Schmidt et al., 2021; Zebardast & Radaei, 2022). Research on mobility behavior shows that the use of a MOT is mainly influenced by incentives, such as costs and convenience, and the habit to use it (Ambak et al., 2016; de Bruijn et al., 2009). As elaborated above, research on mobility behavior as pro-environmental behavior suggests that the feeling of moral obligation towards the environment influences mobility behavior (Trinh & Linh Le, 2018). However, other research contradicts this by stating that feelings of responsibility predict the choice of a sustainable MOT only if the individual is not confronted with too many barriers to performing this behavior (Abrahamse et al., 2009; Heath & Gifford, 2002).

Research on the influence of the pandemic on mobility behavior shows that people have traveled less frequently because of measures (Benita, 2021; Schmidt et al., 2021). A case study suggests that employees in Malmö worked more from home and commuted less during the pandemic and if they had to travel to work, they preferred taking the car or bicycle instead of using public transportation (Bohman et al., 2021). Therefore, the pandemic pushed both less or more sustainable MOTs. Current research also shows that people avoided public transportation depending on the state of the pandemic (Przybylowski et al., 2021). Evidence shows that most public transportation users plan to use it again if they perceive the virus as less threatening (Przybylowski et al., 2021). However, some might continue avoiding it (Przybylowski et al., 2021).

3   Theoretical Entry Point

To investigate the extent to which the pandemic is a determining factor of current mobility behavior for commuting in Malmö, relevant factors that proved to influence pro-environmental and mobility behavior must be considered. To analyze pro-environmental behavior and choice of MOTs, the Theory of Planned Behavior (TPB), developed by Ajzen (1991), serves as a theoretical foundation (Heath & Gifford, 2002; Lucarelli et al., 2020; Yuriev et al., 2020). In current research on environmental and social psychology, it is the most common theory used to investigate both phenomena and has also been employed in the light of the pandemic (Ajzen, 1991; Lucarelli et al., 2020; Schmidt et al., 2021; Yuriev et al., 2020). The TPB serves as the theoretical basis of this thesis and will be elaborated on in the following.

3.1   The Theory of Planned Behavior

The TPB is a theory in socio-psychological science developed by Isec Ajzen as a model for predicting and explaining human behavior in different situations (Ajzen, 1991). The TPB is the extension of the Theory of Reasoned Action that Ajzen and Fishbein originally developed (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The fundamental assumption of both theories is that an individual's behavior is intended and reasoned, i.e., an individual decides to perform a certain behavior consciously after considering several motivational factors and beliefs that lead to its decision (Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). According to the TPB, three variables determine the intention to perform a behavior: attitude toward the behavior, subjective norm, and perceived behavioral control (Ajzen, 1991; Figure 1).
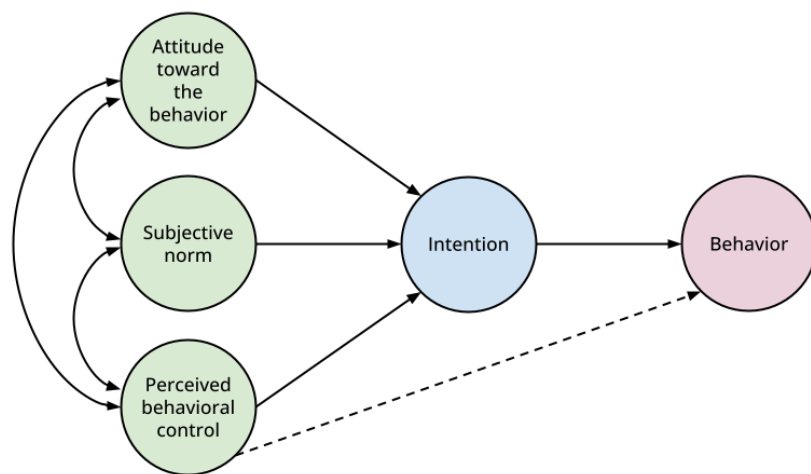
Figure 1. Model of TPB. The arrows represent the influence between the variables. The dotted line shows that perceived behavioral control is the only determinant that directly influences behavior (Figure created by author based on Ajzen, 1991).

3.1.1 Attitude, Subjective Norm, and Perceived Behavioral Control

Ajzen defines the determining variables of behavior as follows. The variable attitude toward the behavior describes an individual's evaluation of behavior and its perception as either favorable or unfavorable (Ajzen, 1991). The determinant subjective norm comprises an individual's perceived pressure from their social surroundings to perform or not perform the behavior (Ajzen, 1991). The third determining variable perceived behavioral control describes how easy or difficult an individual observes the performance of behavior and is influenced by the individual's perception of relevant obstacles (Ajzen, 1991).

The intention to perform a behavior, which is determined by the variables just presented, is a central part of the TPB (Ajzen, 1991). Ajzen defines intention as capturing the motivational factors that lead an individual to the performance of behavior (Ajzen, 1991). As assumed by Ajzen, the performance of a behavior is intended, thus the stronger an individual's intention to perform a behavior, the more likely is the actual performance of the behavior (Ajzen, 1991). Thus, intention directly predicts behavior (Ajzen, 1991).

The determining variables can also influence each other (Ajzen, 1991; Figure 1). Out of the three determining variables, perceived behavioral control is the only one that predicts the behavior in question (Ajzen, 1991; Figure 1). This is because behavior is not only dependent on an individual's motivation and intention to perform a behavior, but on the given conditions that make it possible or impossible for an individual to perform and control the behavior, e.g., road or cycling infrastructure in the case of transportation (Ajzen, 1991; Yuriev et al., 2020). These conditions are factual, but how an individual *perceives* them to perform and control behavior is more relevant (Ajzen, 1991), i.e., it is not relevant if an employee *in fact* has a good train connection to his/her workplace, it is relevant if he/she perceives it as accessible. Thus, perceived behavioral control does not equal actual behavioral control as it depends on an individual's knowledge of the conditions, attitude, and subjective norm (Ajzen, 1991).

The main claim of the TPB is that the more favorable the attitude and subjective norm toward the behavior in question is, and the greater an individual perceives its behavioral control to engage in the behavior, the stronger the intention is to perform the behavior (Ajzen, 1991). The stronger the intention and perceived behavioral control, the more likely is the actual performance of the behavior (Ajzen, 1991). The relative significance of the determining variables depends on the situation and the behavior in question, and they are not necessarily equal (Ajzen, 1991). In some situations, the impact of attitude might be stronger than subjective norm, and in others perceived behavioral control mainly determines intention (Ajzen, 1991).

3.2   Extension of the Theory of Planned Behavior

Additional variables can be added to the TPB, as they may capture determinants not yet covered by the three variables described above (Ajzen, 1991). Ajzen suggests including habit strength and personal norms (Ajzen, 1991; Bamberg et al., 2003).

3.2.1   Habit Strength

The inclusion of habit strength as an additional determinant is useful to predict the intention for later behavior (Ajzen, 1991; Bamberg et al., 2003). It is assumed that repeatedly and routinely performing a behavioral action establishes it as a habitual behavior (Ajzen, 1991; de Bruijn et al., 2009). As each behavioral action is determined by attitude, subjective norm, and perceived behavioral control, also habit is based on these factors (Ajzen, 1991). Thus, habit strength can serve as a predictor of intention.

3.2.2   Personal Norm

In certain contexts, the inclusion of personal norms as additional determinants is useful when the consideration of an individual's personal feelings of moral obligation is relevant (Ajzen, 1991). According to Ajzen, personal norms have the same determining power on intention as attitude, subjective norm, and perceived behavioral control (1991). This variable is based on the Norm-Activation Model developed by Schwartz (1977), which is another common theoretical framework to explain pro-environmental and mobility behavior (Abrahamse et al., 2009; Trinh & Linh Le, 2018). According to Schwartz (1977), personal norms reflect an individual's internalized values and feelings of moral obligation and responsibility to perform or refuse to perform certain behaviors.

4 Methods

In the following, the methods will be presented, consisting of research design, data collection, and analysis.

4.1 Research Design

This thesis uses a mixed-method research approach by combining the collection of quantitative data through a survey and qualitative data through semi-structured interviews to address the RQs (Schoonenboom & Johnson, 2017). First, the quantitative survey based on the TPB (chapter 3), and the background (chapter 2) was conducted. Building from these results (Schoonenboom & Johnson, 2017) and chapter 2, the interviews were conducted with some respondents to the survey.

The survey and its results serve as the centerpiece of this thesis on which the conclusions mainly rely. The interviews serve additional data to give the quantitative results more depth, highlighting reasonings and nuances of mobility behaviors.

To answer the RQs, guiding indicators based on the TPB and the background were formulated (Table 1). Both the survey and the interviews are based on these.

Table 1. Research questions with corresponding guiding indicators (Table created by author).

Research Questions	Guiding Indicators
RQ1: *How has the COVID-19 pandemic influenced mobility behavior of employees commuting to the city center of Malmö?*	A change in MOT for commuting during the pandemic
	A change in frequency of use of MOTs during the pandemic
	A change in frequency of commuting during the pandemic
	Influence of determinants of the TPB (attitude, subjective norm, perceived behavioral control) on choice of MOT
	Influence of additional determinants as suggested in the TPB (habit strength, personal norm) on choice of MOT
	Influence of environmental and pandemic awareness on choice of MOT
RQ2: *Is the influence of the COVID-19 pandemic on mobility behavior for commuting consistent throughout the past two years?*	Change of MOT according to the state of the pandemic
	Change of attitude towards commuting and MOT according to the state of the pandemic
	Change of environmental and pandemic concerns according to state of the pandemic

4.2   Data Collection

In the following, the data collection consisting of a quantitative survey and qualitative semi-structured interviews will be presented.

4.2.1   Quantitative Survey

A common research method based on the TPB is to conduct quantitative questionnaires (Yuriev et al., 2020). The survey aims to investigate the guiding indicators as described above (chapter 4.1.). The survey was targeted toward employees whose workplace is in the city center of Malmö, within two kilometers of the train stations *Malmö central* or *Triangeln*, so it could be assumed that all participants had access to reasonable public transportation as well as road and cycling infrastructure close to their workplace. This was confirmed with a separate question at the beginning of the questionnaire.

In cooperation with Malmö municipality, Region Skåne, and WSP, I sent out the survey to some of their departments. A large part of possible respondents reached were employees in the transport sector. Moreover, I sent the survey to several other departments of Malmö municipality, Region Skåne, and WSP as well as to schools and companies located within the defined area of interest. Moreover, I posted the survey in a Facebook group for housing in Malmö, *"Lägenheter i Malmö – Öppen grupp"*, to reach a diverse group of possible respondents. A list of all recipients can be found in appendix 1. The survey was open from 15th until 28th of March 2022[1] and received 116 replies, of which 94 fit the criteria and were used in the study. The survey was available in Swedish and English, participation was voluntary, and data were collected anonymously.

4.2.2   Survey Elements

The self-composed questionnaire was based on relevant research employing the TPB and on questionnaire guides composed by Ajzen (2002, 2006.). It includes several descriptive questions, e.g., on the chosen main MOT at the time of the survey and before the pandemic, commuting time and distance to the workplace, and availability of certain MOTs. These elements give an insight into the demographics of respondents. The most crucial part of the survey is the questions on opinions and judgments on several variables influencing mobility behavior (Yuriev et al., 2020). Several survey items target one concept and can then be combined into one variable which is applicable for the analysis (Joshi et al., 2015). These questions or statements are formulated on a 5-point Likert scale, on which

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[1] At the time of data collection, most national measures to limit the spread of COVID-19 have been lifted in Sweden.

respondents express their opinion or judgment, e.g., on a scale from *(1) strongly disagree* to *(5) strongly agree* (Ajzen, 1991; Joshi et al., 2015; Zebardast & Radaei, 2022). Answer options can also express how likely or unlikely a respondent evaluates a scenario (Ajzen, 1991). In the case of this survey, the answer rank ranges from the most positive answer to the most negative, e.g. *(1) strongly agree* to *(5) strongly disagree,* as has been applied previously (Ajzen, 2002; Ajzen, 2006)[2]. In the following, the variables retrieved in the survey are presented. A full list of all questions, answer options, and related variables can be found in appendix 2.

Variables of the TPB

The theory suggests including questions that contribute to the determining variables *Attitude*, *Subjective Norm*, and *Perceived Behavioral Control*, and to the determined variable *Intention* (Ajzen, 1991). In the following, the variables captured in the survey will be presented. The questions associated with the variables were formulated based on the TPB and relevant research (Abrahamse et al., 2009; Ajzen, 1991; Ajzen, 2002; Ajzen, 2006; Bamberg et al., 2003; Schmidt et al., 2021; Yuriev et al., 2020)

The variable *Attitude* is specific to the MOT that an employee is using, i.e., the questionnaire asked specifically how respondents feel about using the car, public transportation, bicycle, or walking for commuting. To include a pandemic-related dimension in the questionnaire, respondents were asked whether commuting with a specific MOT currently felt safer or more convenient than before the pandemic.

The variable *Subjective Norm* is not MOT specific. The questions ask about the approval or disapproval of a respondent's MOT by its social surroundings.

The variable *Perceived Behavioral Control* is MOT specific, as it investigates how easy or difficult it is to commute with a certain MOT. The questions also ask about the state of infrastructure for each MOT.

The variable *Intention* is MOT specific and asks about the respondents' intention to use a certain MOT more often in the future.

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[2] This is of importance for the statistical analysis, as it influences the interpretation of results.

Additional Variables

Most studies applying the TPB extend it with additional variables, to capture more factors influencing the behavior (de Bruijn et al., 2009; Lucarelli et al., 2020; Schmidt et al., 2021; Trinh & Linh Le, 2018; Yuriev et al.; 2020; Zebardast & Radaei, 2022). After reviewing which variables had the most explanatory power in predicting pro-environmental and mobility behavior, I decided to include the following further variables in the questionnaire: *Habit Strength*, *Personal Norm on Environmental Problems*, *Personal Norm on the COVID-19 pandemic, Awareness of the COVID-19 pandemic and Climate Change*, *Knowledge about Climate Change*, *Concern about Climate Change,* and *Concern about the COVID-19 pandemic*. In the following, the additional variables captured in the survey will be presented. The questions associated with the additional variables were formulated based on the TPB and relevant research (Ajzen, 1991; de Bruijn et al., 2009; Lucarelli et al., 2020; Schmidt et al., 2021; Trinh & Linh Le, 2018; Yuriev et al.; 2020; Zebardast & Radaei, 2022).

As elaborated in chapter 3.2.1, *Habit Strength* can be added as a determining variable (Ajzen, 1991; Bamberg et al., 2003). As commuting is in most cases a daily activity, it can be considered habitual (de Bruijn et al., 2009). Thus, this determinant is included in this analysis. The acquisition of it is based on the self-report habit index, as this proved to capture habit strength properly in past research (de Bruijn et al., 2009). This variable is MOT specific, and respondents were asked how habitual it is for them to use a certain MOT in their daily life.

As shown in chapter 3.2.2, personal norms may be included as a variable (Ajzen, 1991). In relevant research, personal norms regarding the environment and the pandemic showed to predict pro-environmental behavior (Trinh & Linh Le, 2018; Schmidt et al., 2021; Zebardast & Radaei, 2022). For the aim of this study, personal norms were split into two: one variable targeting environmental problems and one aiming at the pandemic, as either of them might influence the MOT differently. To investigate pro-environmental behavior, *Personal Norm on Environmental Problems* was included. Respondents were asked a set of questions capturing their sense of duty regarding environmental issues and climate change and the connection to transportation. This variable was used as a high personal norm on environmental problems might lead to using sustainable MOTs (Schmidt et al., 2021; Zebardast & Radaei, 2022). *Personal Norm on the COVID-19 pandemic* was included as people's feelings towards using a MOT might differ due to pandemic-related recommendations (Bohman et al., 2021; Przybylowski et al., 2021). This variable is MOT specific, and respondents were asked about their feeling when using a certain MOT during the pandemic.

Several variables included in the survey are based on current research on pro-environmental behavior and the pandemic's effects on mobility behavior (Lucarelli et al., 2020; Zebardast & Radaei, 2022). *Awareness of the COVID-19 pandemic and Climate Change* is based on current research assuming that

because of the pandemic, people are more aware of their behavior and its connection to climate change and other environmental issues (Lucarelli et al., 2020; Zebardast & Radaei, 2022). Respondents were asked a set of questions targeting this connection as well as the one between climate change and the pandemic. Moreover, because research on pro-environmental behavior assumes that people with a higher degree of environmental and climate change awareness engage in pro-environmental behavior (Lucarelli et al., 2020; Schmidt et al., 2021; Zebardast & Radaei, 2022), *Knowledge about Climate Change* and *Concern about Climate Change* as variables were queried. Research on the pandemic's effects on mobility assumes that a higher concern about the pandemic results in the less frequent use of public transportation (Przybylowski et al., 2021; Zebardast & Radaei, 2022), which is why *Concern about the COVID-19 pandemic* was queried in the questionnaire as well.

Based on the TPB, current research on pro-environmental and mobility behavior, and finally the variables included in this study, I created an extended version of the TPB which serves as the conceptual framework of this paper and will be tested in the analysis (Figure 2).
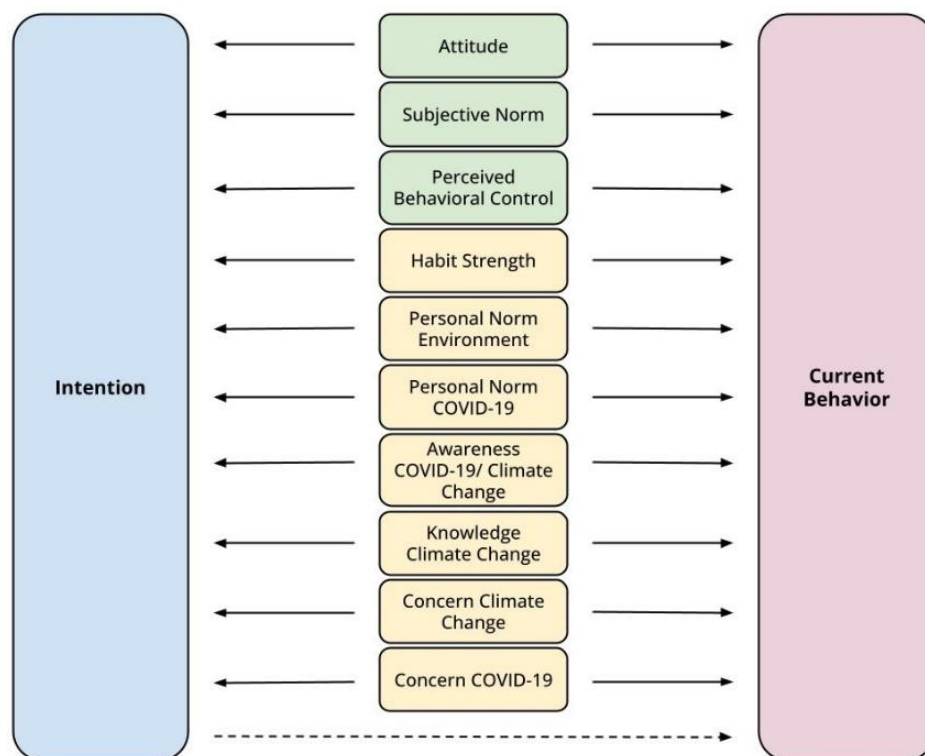
Figure 2. Conceptual framework. The arrows represent the influence of the determining variables in the middle on intention to perform a behavior and current behavior. The dotted line represents the relationship of intention and behavior as suggested by Ajzen (1991) which is, however, not analyzed in this study (Figure created by author).

4.2.3   Semi-Structured Qualitative Interviews

The interviews were based on the survey results and the background and serve as additional data to further explore some phenomena relevant to this study, that have not been covered in the survey. I conducted eight interviews from April 1st to 6th 2022 via *zoom* with survey participants. The interviews were conducted in English and took 15 to 30 minutes. In the questionnaire, I included a question about whether participants are willing to voluntarily participate in a short interview. The interviewees gave consent about the interview being voluntary, recorded, and used anonymously.

The interviews were designed as qualitative semi-structured interviews, as they were based on a specific order of questions and themes but allowed follow-up and/or adapted questions (Roulston & Choi, 2018; Yin, 2016). The full interview guide can be found in appendix 3. The interviews focused on the change in mobility behavior, attitude toward commuting, and concerns about the pandemic and environmental awareness during the past two years. The main goal was to capture the change throughout the pandemic, as this was not covered in the survey. The variable attitude was revisited because most survey respondents answered as neutral. The interviews can be considered phenomenological, as they focus on participants' personal experiences (Seidman, 2013).

4.3   Data Analysis

Next, the analysis consisting of several statistical analyses of the survey and a thematic analysis of the interviews will be presented.

4.3.1   Statistical Analysis of the Survey

I analyzed the survey data using *IBM SPSS Statistics*, version 28. Before analyzing the data of the survey according to the TPB, I calculated descriptive statistics of the demographic data of the sample.

According to the TPB, the influence of the variables on the intention to perform a behavior must be tested to analyze the relationship between the two (Ajzen, 1991). Furthermore, I tested the influence of the variables on the actual behavior as it is of main interest for this study how respondents currently commute and not only how they intend to do so in the future. This is common practice in research with similar aims (Abrahamse et al., 2009; de Bruijn et al., 2009, Trinh & Linh Le, 2018). Moreover, comparing the results of actual behavior and intention will give an insight into the practicability of the theory.

Conducting a regression analysis is a common method to analyze the relationship of corresponding variables to the intention to perform a behavior (Ajzen, 1991; Ambak et al., 2016; Schmidt et al., 2021; Trinh & Linh Le, 2018). In total, I am conducting eight binary logistic regression analyses; one for each MOT and one for each intention to use that MOT. By performing a regression analysis, I am measuring the predictive power of each variable on the intention to choose a certain MOT or the use of the MOT (King, 2008). Performing the regression analysis explores the relationship between behavior or the intention to perform a behavior and the predictive variables (King, 2008). The analysis allows assumptions on the influence of the predictive variables on the dependent variables (King, 2008). It is important to note that the regression analyses carried out in this study are not implying causality among the variables; they rather tell something about the existence or absence of a correlation and its nature (King, 2008). Due to the type of the dependent variables, I am employing a binary logistic regression analysis, which shows to be useful in similar research (Trinh & Linh Le, 2018). Hereby, the MOT and the intention to use a MOT serve as the dependent variables and the potential predictors (i.e., attitude, subjective norm, etc.) serve as independent variables. The MOT, i.e., car, public transportation, bicycle, and walking, functions as a binary variable. I recoded the variable intention, which was measured on the Likert scale, into a binary, nominal variable. Thus, in the regression analysis, it will be differentiated between intention (on the Likert scale indicated as *very likely* and *likely*) and no intention to use a MOT (on the Likert scale indicated as *very unlikely* and *unlikely*). As I am only interested in the intention to use a MOT in the future or the absence of it, neutral answers on the Likert scale are left out of the analysis regarding intention[3].

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[3] Even though this minimizes the sample size and simplifies the analysis by leaving out the nuances of the answer options, I did this to be able to better compare the results of the regression analyses for the MOTs and the intention to use them.

Pre-Results: Meeting Requirements for the Regression Analysis

To perform the regression analyses, some requirements must be met (King, 2008), which also show some pre-results of the analysis. All steps for the analysis are explained in the following and outlined in Figure 3.
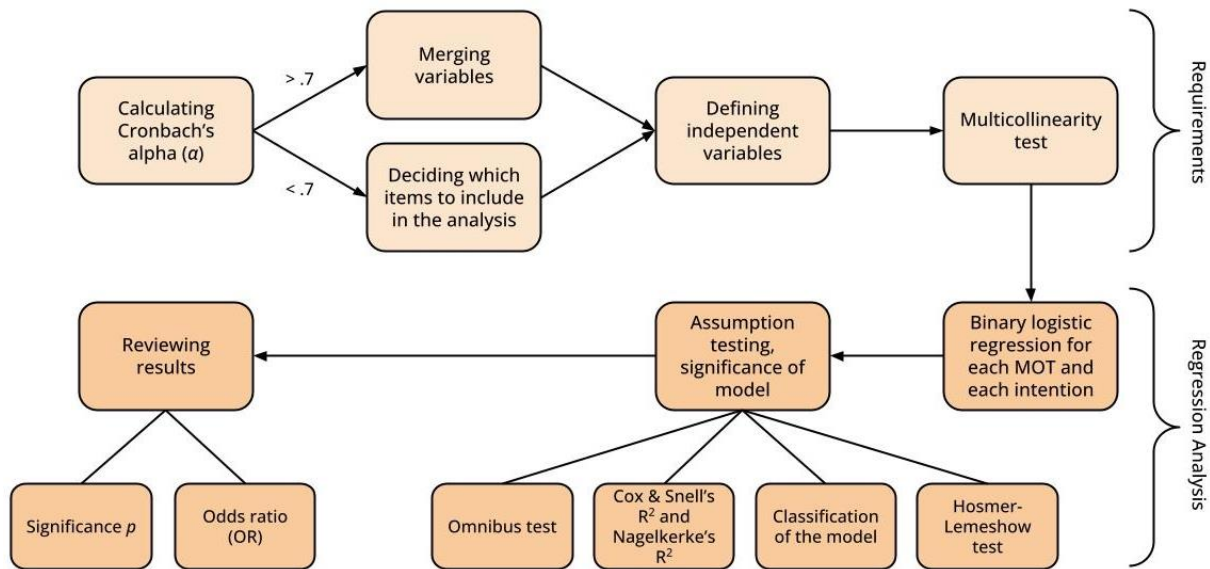
Figure 3. Visualization of statistical analysis. The steps in light orange represent the requirements that must be met before performing the regression analysis. The steps in dark orange represent the steps that are part of the regression analysis (Figure created by author).

In a first step, I calculated Cronbach's alpha (α) to test the reliability of internal consistency of the questionnaire items of each variable (Gliem & Gliem, 2003; Figure 3). A full list of all variables and associated questions and answer options can be found in appendix 2. A value of above .7 proves that the items show an acceptable level of internal consistency, i.e., they measure the same phenomenon and can be merged into one variable (Gliem & Gliem, 2003). This was the case for all items belonging to the variables *Attitude* (MOT specific), *Subjective Norm*, *Perceived Behavioral Control* (MOT specific), *Habit Strength* (MOT specific), and the *Awareness of the COVID-19 pandemic and Climate Change*. Thus, I calculated the mean of the items and merged them to variables on an interval scale that are applicable for the regression analysis (Joshi et al., 2015; King, 2008).

Cronbach's α was below .7 for the items belonging to the variables describing personal norm, environmental, and pandemic awareness (Figure 3). Therefore, I decided to leave certain items out of the analysis and choose single question items that work best at capturing the variables *Personal Norm on Environmental Problems*, *Personal Norm on the COVID-19 pandemic*, *Knowledge about Climate Change*, *Concern about Climate Change,* and *Concern about the COVID-19 pandemic* based on relevant

research (Lucarelli et al., 2020; Schmidt et al., 2021; Zebardast & Radaei, 2022). These variables are on an ordinal scale level. The same is the case for the variable *Perceived Behavioral Control* for walking. It is a common practice to treat Likert scale data as quasi-interval data if the questionnaire suggests that the scale intervals between the answer options are even (Franzen, 2019; Schneider, 2008). This means that respondents can assume that the interval between e.g., *strongly agree* and *agree* is the same as *strongly disagree* and *disagree*. This is the case if the Likert scale offers an uneven number of response options of at least five, which are labeled with numbers and a description at the endpoints of the scale (Franzen, 2019). These requirements are met in the present questionnaire. Thus, I treat these ordinal variables as quasi-interval to include them in the regression analysis[4]. This way, all ten determining variables (Figure 2) meet the requirements of the binary logistic regression analysis and are included as independent variables.

As the last step before performing each regression analysis, I conducted a multicollinearity test for all respective independent variables (King, 2008; Kutner et al., 2004; Figure 3). In a logistic regression analysis, the independent variables should not show a high correlation with each other (Kutner et al., 2004). If the tolerance values of each independent variable are above .1 or if the variance inflation factors are below 10, multicollinearity is not given, and the regression analysis can be performed (Kutner et al., 2004). This is the case for all independent variables.

Binary Logistic Regression Analysis

Finally, I performed the binary logistic regression analysis for each MOT and each intention to use a MOT to determine the effect of each independent variable (Figure 3).

Before looking at the results of the regression analysis, some assumptions must be tested for each regression to assure the significance and fit of the model to the data (King, 2008; Figure 3). This is a requirement to know if the relationship between the dependent and independent variables that the model predicts is meaningful and useful for interpretation (King, 2008; Sheng, 2008). The Omnibus test of model coefficients with $p = < .05$ shows that the model including independent variables is statistically significant and able to explain the dependent variable (Sheng, 2008). Cox & Snell's R^2 and Nagelkerke's R^2 explain the according variance in the dependent variable (King, 2008). The higher the values, the higher the variance the independent variables are explaining (King, 2008). Nagelkerke's R^2 = > .5 shows a large amount of explained variance (King, 2008). The classification value shows the

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[4] However, the assumption of treating ordinal Likert scale data as interval data is controversially discussed in research (Joshi et al., 2015). As I did not want to exclude those variables, I decided to include them in the regression analysis. Therefore, the results arising from these variables will be interpreted carefully and treated as suggestive rather than conclusive.

accuracy of the classification of the model including the independent variables, i.e., it shows how well the independent variables performed in predicting the category of the dependent variable (King, 2008). The last requirement is the Hosmer-Lemeshow test which is a goodness-of-fit test that shows if the model provides a good fit for the data (King, 2008; Rossi, 2009). The significance should be p = > .05, as this means that the data fits the model (King, 2008; Rossi, 2009).

If the assumptions are met, the significance of each independent variable and its odds ratio (OR) can be investigated (Figure 3). A significance value of p = < .05 shows that an independent variable contributed significantly to predicting the dependent variable (King, 2008). The regression coefficient B and the OR show the nature of the relationship between the variables (King, 2008). A positive value of B and OR = > 1 indicates that it is more likely that the event will occur than that it will not occur (King, 2008). In the case of car use, this would mean that it is more likely to commute by car if the independent variable shows a positive B and an OR = > 1. A negative value of B and OR = < 1 indicate that it is more likely that the event will not occur than that it will occur (King, 2008). In the case of car use, this would mean that it is less likely to commute by car if B is negative and OR = < 1.

4.3.2   Thematic Analysis of Interviews

I transcribed and then analyzed the interviews by applying a thematic analysis approach (Bryman, 2016). The interviews were based on the survey results and on current research as elaborated in the background (chapter 2). Thus, I approached them with predetermined ideas that are based on the guiding indicators for each RQ (see chapter 4.1; Table 1). I looked for specific patterns and main themes that participants expressed in the interviews (Bryman, 2016), exploring

1) Why participants changed their MOT and if they changed it according to the state of the pandemic;

2) How participants felt about commuting and if and how their perception of safety regarding commuting changed during the pandemic and;

3) What main concerns they had and if their perception of and the concerns about climate change and environmental issues changed during the pandemic.

5 Results

In the following, both the results from the statistical analysis of the survey and the thematic analysis of the interviews will be presented.

5.1 Survey Results

In this sub-chapter, demographic, and descriptive results, as well as results of the binary logistic regression analyses, will be explored.

5.1.1 Demographic and Descriptive Results

Of the 94 respondents that were included in the analysis, a slight majority of 53.2% identifies as female and 46.8% as male. The average age of respondents was 42; the youngest was 24 and the oldest was 66 years old. In the sample, 93.6% own a bicycle while 65.9% own a car. Only 2.1% of the sample get a job ticket for public transportation from their employer while 10.6% are provided with free parking. A third of respondents (33%) commute 1 to 5 km per day from their residence to their workplace; 17% travel 5 to 10 km and 12.8% more than 35 km. Almost half of the respondents need 10 to 20 (28.7%) or 20 to 30 minutes (20.2%) to commute.

The pandemic made 21.3% of respondents change their MOT for commuting. The majority (78.7%) state that they did not change their MOT because of the pandemic. When comparing the share of MOTs used for commuting before the pandemic and now, only slight changes can be observed for car, bicycle, and walking (Figure 4)[5]. A greater change can be observed in the use of public transportation and working from home. While it was 46.8% of respondents mainly using public transportation before the pandemic to commute, at the time of the data collection it was only 38.3%. Before the pandemic, only 7.4% worked from home; now 19.1% do.

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[5] Respondents were able to select several MOTs in the questionnaire.
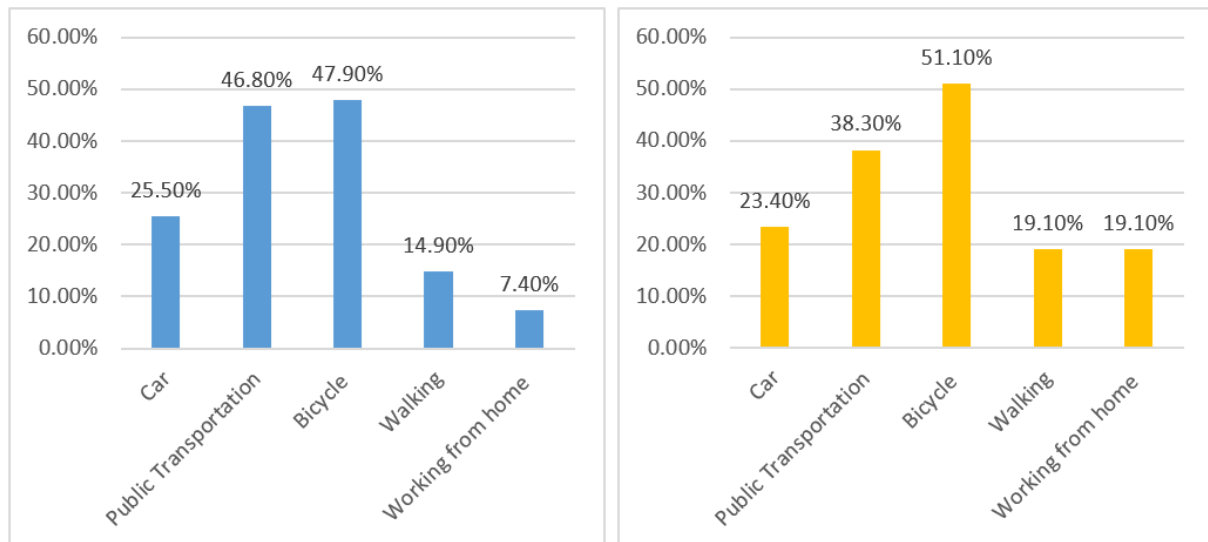
Figure 4. Main mode of transportation before the COVID-19 pandemic (left) and currently (right). (Figure created by author).

This difference also shows clearly when looking at the number of days respondents commuted to their workplace on average per week before the pandemic and in the past three months (Figure 5). Before the pandemic, most respondents (77.7%) on average commuted five days per week and only 1.1% did not commute at all. Contrary to this, in the past three months, more than half of respondents commuted only between two (25.5%) or three days (27.7%). Only 12.8% kept commuting five days per week and the same number of respondents did not commute at all.
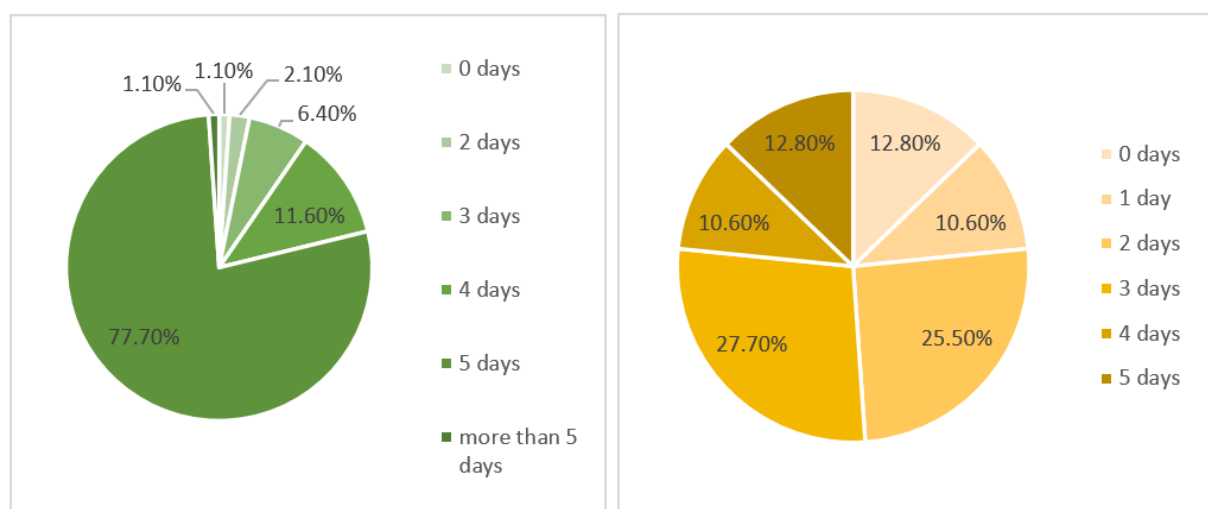
Figure 5. Average number of days commuted to workplace before the COVID-19 pandemic (left) and in the past three months (right). (Figure created by author).

When asked about the intention to change the current MOT depending on the state of the pandemic (Figure 6), most respondents stated that it is very unlikely (62.8%) that they will change their MOT if the pandemic worsens. A third (33%) of all respondents state that it is very unlikely for them to change their MOT back to what it was before the pandemic if the pandemic calms down. In the same scenario, a quarter (25.5%) of respondents express that it is very likely for them to change their MOT back to what it was before the pandemic.
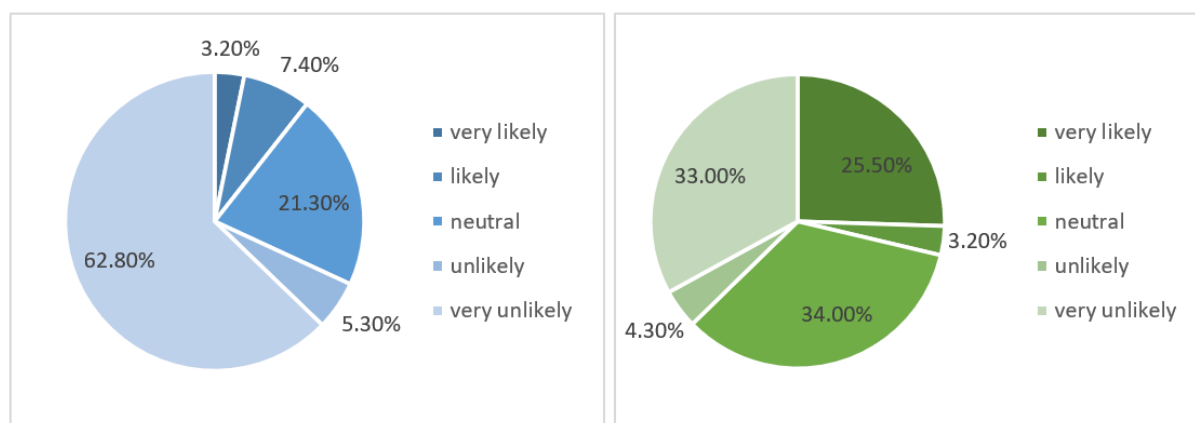
Figure 6. Intention to change the mode of transportation 1) if the state of the pandemic worsens (left); and 2) back to what it was before the pandemic if the pandemic calms down (right). (Figure created by author).

5.1.2 Results of Regression Analyses

The following sections present the result of all eight regression analyses relating to the four MOTs included in the analysis and the intention to use those more often in the future. As described in chapter 4.3.1, some requirements had to be met to perform the regression analysis (Figure 3). The results of the calculation of Cronbach's α and the multicollinearity test enabled all eight regression analyses (see chapter 4.3.1). Before investigating the implications of the results of the regression analyses, some assumptions must be tested (see chapter 4.3.1): 1) the Omnibus test, 2) Cox & Snell R^2 and Nagelkerke R^2, 3) the classification value and 4) the Hosmer-Lemeshow test. The results of those are presented in Table 2 and show that the regression model for each analysis is statistically significant (1), explains sufficient variance of dependent variables (2), correctly classifies a meaningful number of cases (3), and provide a good fit for the data (4).

Two analyses (bicycle as a MOT and intention to use the bicycle) show that the Hosmer-Lemeshow test suggests that the model does not fit the data (Table 2). However, Rossi (2009) suggests only considering this goodness-of-fit test if the number of variables included in the analysis is lower than

the sample size divided by ten. This is not the case for this study, thus the Hosmer-Lemeshow test will not be considered in those analyses[6].

Table 2. Results of assumption testing as part of regression analyses (Table created by author).

	1) Omnibus test	2) Cox & Snell R^2 and Nagelkerke R^2	3) Classification value	4) Hosmer-Lemeshow test
Car as a main MOT	χ^2(10, *N* = 94) = 71.191, *p* = <.001	Cox & Snell R^2 = .531 Nagelkerke R^2 = .801	92.6%	*p* = .990
Intention to use the car	χ^2(10, *N* = 79) = 26.931, *p* = .003	Cox & Snell R^2 = .289 Nagelkerke R^2 = .695	94.9%	*p* = .849
Public transportation as a main MOT	χ^2(10, *N* = 94) = 43.196, *p* = <.001	Cox & Snell R^2 = .368 Nagelkerke R^2 = .501	72.3%	*p* = .382
Intention to use public transportation	χ^2(10, *N* = 68) = 27.138, *p* = .002	Cox & Snell R^2 = .329 Nagelkerke R^2 = .474	83.8%	*p* = .664
Bicycle as a main MOT	χ^2(10, *N* = 94) = 102.670, *p* = <.001	Cox & Snell R^2 = .665 Nagelkerke R^2 = .886	94.7%	*p* = .003
Intention to use the bicycle	χ^2(10, *N* = 76) = 68.882, *p* = <.001	Cox & Snell R^2 = .596 Nagelkerke R^2 = .795	89.5%	*p* = <.001
Walking as a main MOT	χ^2(10, *N* = 94) = 48.834, *p* = <.001	Cox & Snell R^2 = .405 Nagelkerke R^2 = .650	89.4%	*p* = .387
Intention to walk	χ^2(10, *N* = 75) = 63.425, *p* = <.001	Cox & Snell R^2 = .571 Nagelkerke R^2 = .902	94.7%	*p* = .99

As the assumptions are met for all analyses, the implications of results for each regression analysis for the current use of a MOT for commuting and the intention to use a MOT in the future can be investigated. All model coefficients and OR can be found in the respective tables for each regression analysis (Tables 3, 4, 5, 6, 7 & 8).

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[6] According to this, I could have decided not to consider this goodness-of-fit test in all the other regression analyses as well. However, as it is a common practice to consider the Hosmer-Lemeshow test (King, 2008), I decided to keep it for the other regression analyses. The significance of the test was too low only in the case of bicycle use and I wanted to avoid discarding the results of those analyses.

Car as a Main Mode of Transportation

The results of the survey show that of the 94 cases included in this regression, 22 respondents use the car as the main MOT for commuting, and 72 do not. Of the ten independent variables included in the regression, two contributed significantly to predicting car use: subjective norm (p = .035) and habit strength (p = .003) while the other variables showed no significant effect (Table 3). Results for subjective norm suggest that the less appropriate the social surroundings of respondents rate the MOT, the more likely it is that they use the car to commute[7]. Results for habit strength suggest that the stronger the habit of respondents is to use the car, the more likely it is that they use it to commute.

Table 3. Results of regression analysis for car as a main mode of transportation (Table created by author).

	B	SE	Wald	df	p	Odds Ratio	95% CI for Odds Ratio	
							Lower Bound	Upper Bound
Attitude (Car)	,129	,601	,046	1	,830	1,137	,350	3,691
Subjective Norm	2,228	1,059	4,430	1	**,035**	9,285	1,166	73,962
Perceived Behavioral Control (Car)	-1,676	,862	3,782	1	,052	,187	,035	1,013
Habit Strength (Car)	-2,730	,915	8,904	1	**,003**	,065	,011	,392
Awareness COVID-19/Climate Change	1,237	,938	1,737	1	,187	3,444	,548	21,667
Knowledge Climate Change	,849	1,181	,517	1	,472	2,336	,231	23,627
Concern Climate Change	-,765	,655	1,364	1	,243	,465	,129	1,681
Concern COVID-19	-,281	,526	,287	1	,592	,755	,269	2,115
Personal Norm Environment	,687	,684	1,008	1	,315	1,988	,520	7,602
Personal Norm COVID-19 (Car)	,625	,474	1,740	1	,187	1,869	,738	4,731
Constant	-,565	3,969	,020	1	,887	,569		

Intention to Use the Car

The results of the survey show that of the 79 cases included in this regression, 6 respondents intend to use the car more often in the future and 73 do not intend to do so. Of the ten independent variables included in the regression, none showed a significant effect to predicting the intention to use the car.

Public Transportation as a Main Mode of Transportation

The results of the survey show that of the 94 cases included in this regression, 36 respondents use public transportation as the main MOT for commuting, and 58 do not. Of the ten independent variables included in the regression, habit strength (p = <.001) contributed significantly to predicting public transportation use while the other variables showed no significant effect (Table 4). The results suggest

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[7] This is due to the direction of the Likert scale and must be considered for all independent variables (see chapter 4.2.2). A low value on the Likert scale is an indicator of a high subjective norm. This is transferable to all variables; a low value on the Likert scale accounts for a high expression of the variable and vice versa.

that the stronger the habit of respondents is to using public transportation, the more likely it is that they use it to commute.

Table 4. Results of regression analysis for public transportation as a main mode of transportation (Table created by author).

	B	SE	Wald	df	p	Odds Ratio	95% CI for Odds Ratio	
							Lower Bound	Upper Bound
Attitude (Public Transportation)	,322	,422	,582	1	,446	1,380	,604	3,153
Subjective Norm	,359	,346	1,077	1	,299	1,433	,727	2,824
Perceived Behavioral Control (Public Transportation)	-,356	,282	1,596	1	,207	,700	,403	1,217
Habit Strength (Public Transportation)	-1,224	,287	18,249	1	**<,001**	,294	,168	,516
Awareness COVID-19/ Climate Change	,140	,323	,189	1	,664	1,151	,611	2,167
Knowledge Climate Change	,616	,596	1,070	1	,301	1,852	,576	5,952
Concern Climate Change	,186	,351	,281	1	,596	1,205	,605	2,400
Concern COVID-19	-,241	,317	,578	1	,447	,786	,422	1,464
Personal Norm Environment	,100	,238	,177	1	,674	1,105	,694	1,760
Personal Norm COVID-19 (Public Transportation)	-,066	,269	,060	1	,806	,936	,553	1,586
Constant	1,054	2,136	,244	1	,622	2,869		

Intention to Use Public Transportation

The results of the survey show that of the 68 cases included in this regression, 19 respondents intend to use public transportation more often in the future and 49 do not intend to do so. Of the ten independent variables included in the regression, habit strength (*p* = .007) contributed significantly to predicting the intention for public transportation use while the other variables showed no significant effect (Table 5). The results suggest that the stronger the habit of respondents is to using public transportation, the more likely it is that they intend to use it in the future.

Table 5. Results of regression analysis for intention to use public transportation (Table created by author).

	B	SE	Wald	df	p	Odds Ratio	95% CI for Odds Ratio	
							Lower Bound	Upper Bound
Attitude (Public Transportation)	-,079	,482	,027	1	,870	,924	,359	2,380
Subjective Norm	,855	,449	3,632	1	,057	2,352	,976	5,668
Perceived Behavioral Control (Public Transportation)	-,305	,390	,612	1	,434	,737	,343	1,583
Habit Strength (Public Transportation)	-,896	,331	7,336	1	**,007**	,408	,214	,781
Awareness COVID-19/ Climate Change	-,522	,440	1,407	1	,235	,593	,250	1,406
Knowledge Climate Change	-1,182	,940	1,583	1	,208	,307	,049	1,934
Concern Climate Change	,329	,502	,430	1	,512	1,390	,519	3,721
Concern COVID-19	-,630	,436	2,088	1	,148	,533	,227	1,252
Personal Norm Environment	,287	,332	,746	1	,388	1,332	,695	2,555
Personal Norm COVID-19 (Public Transportation)	-,043	,376	,013	1	,909	,958	,458	2,003
Constant	5,198	2,868	3,285	1	,070	180,872		

Bicycle as a Main Mode of Transportation

The results of the survey show that of the 94 cases included in this regression, 48 respondents use the bicycle as the main MOT for commuting, and 46 do not. Of the ten independent variables included in the regression, three contributed significantly to predicting bicycle use: subjective norm (*p* = .029), perceived behavioral control (*p* = .005), and habit strength (*p* = .029) while the other variables showed no significant effect (Table 6). Results for subjective norm suggest that the more appropriate the social surroundings of respondents rate the MOT, the more likely it is that they use the bicycle to commute. Results for perceived behavioral control suggest that the easier it is for respondents to commute by bicycle, the more likely it is that they use it to commute. Results for habit strength suggest that the stronger the habit of respondents is to use the bicycle, the more likely it is that they use it to commute.

Table 6. Results of regression analysis for bicycle as a main mode of transportation (Table created by author).

| | B | SE | Wald | df | *p* | Odds Ratio | 95% CI for Odds Ratio | |
							Lower Bound	Upper Bound
Attitude (Bicycle)	-1,892	1,071	3,121	1	,077	,151	,018	1,230
Subjective Norm	-2,158	,987	4,776	1	**,029**	,116	,017	,800
Perceived Behavioral Control (Bicycle)	-2,357	,843	7,818	1	**,005**	,095	,018	,494
Habit Strength (Bicycle)	-1,569	,718	4,767	1	**,029**	,208	,051	,852
Awareness COVID-19/ Climate Change	-1,009	,732	1,900	1	,168	,365	,087	1,531
Knowledge Climate Change	-,157	1,195	,017	1	,896	,855	,082	8,887
Concern Climate Change	,618	,677	,831	1	,362	1,854	,492	6,995
Concern COVID-19	-,440	,726	,367	1	,545	,644	,155	2,671
Personal Norm Environment	,356	,429	,688	1	,407	1,428	,616	3,310
Personal Norm COVID-19 (Bicycle/Walking)	,956	,742	1,661	1	,197	2,601	,608	11,128
Constant	18,745	6,886	7,411	1	,006	138347215,995		

Intention to Use the Bicycle

The results of the survey show that of the 76 cases included in this regression, 37 respondents intend to use the bicycle more often in the future and 39 do not intend to do so. Of the ten independent variables included in the regression, three contributed significantly to predicting bicycle use: perceived behavioral control (*p* = .005), awareness of the pandemic and climate change (*p* = .004), and concern about climate change (*p* = .021)[8] while the other variables showed no significant effect (Table 7). Results for perceived behavioral control suggest that the easier it is for respondents to commute by bicycle, the more likely it is that they intend to use it in the future. Results for awareness of the pandemic and climate change suggest that the more aware respondents are about this, the more likely

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[8] The results of awareness of the pandemic and climate change as well as concern about climate change need to be interpreted carefully as both variables are on an ordinal and thus quasi-interval level (see chapter 4.3.1). Thus, these results are rather suggestive than conclusive.

it is that they intend to use the bicycle in the future. Results for concern about climate change suggest that the less concerned respondents are about climate change, the more likely it is that they intend to use the bicycle in the future.

Table 7. Results of regression analysis for intention to use the bicycle (Table created by author).

| | B | SE | Wald | df | p | Odds Ratio | 95% CI for Odds Ratio | |
							Lower Bound	Upper Bound
Attitude (Bicycle)	-,310	,665	,218	1	,641	,733	,199	2,700
Subjective Norm	,239	,668	,128	1	,720	1,270	,343	4,707
Perceived Behavioral Control (Bicycle)	-1,894	,674	7,884	1	**,005**	,151	,040	,564
Habit Strength (Bicycle)	-,235	,617	,145	1	,703	,790	,236	2,648
Awareness COVID-19/ Climate Change	-2,045	,718	8,119	1	**,004**	,129	,032	,528
Knowledge Climate Change	-,716	1,019	,494	1	,482	,489	,066	3,600
Concern Climate Change	1,413	,610	5,368	1	**,021**	4,108	1,243	13,576
Concern COVID-19	-,446	,492	,821	1	,365	,640	,244	1,680
Personal Norm Environment	,372	,360	1,071	1	,301	1,451	,717	2,938
Personal Norm COVID-19 (Bicycle/Walking)	-,281	,577	,237	1	,626	,755	,244	2,340
Constant	11,647	3,764	9,576	1	,002	114298,948		

Walking as a Main Mode of Transportation

The results of the survey show that of the 94 cases included in this regression, 18 respondents walk as the main MOT for commuting, and 76 do not. Of the ten independent variables included in the regression, two contributed significantly to predicting walking: attitude (p = .018) and habit strength (p = .001) while the other variables showed no significant effect (Table 8). Results for attitude suggest that the more convenient respondents find it to walk, the more likely it is that they commute that way. Results for habit strength suggest that the stronger the habit of respondents is to walk, the more likely it is that they choose to commute walking.

Table 8. Results of regression analysis for walking as a main mode of transportation (Table created by author).

	B	SE	Wald	df	p	Odds Ratio	Lower Bound	Upper Bound
Attitude (Walking)	-1,763	,748	5,549	1	**,018**	,171	,040	,744
Subjective Norm	,977	,503	3,774	1	,052	2,656	,991	7,114
Perceived Behavirol Control (Walking)	-,150	,254	,351	1	,553	,860	,523	1,415
Habit Strength (Walking)	-2,388	,730	10,710	1	**,001**	,092	,022	,384
Awareness COVID-19/ Climate Change	,231	,543	,182	1	,670	1,260	,435	3,651
Knowledge Climate Change	1,075	1,078	,994	1	,319	2,930	,354	24,247
Concern Climate Change	-,490	,692	,500	1	,479	,613	,158	2,381
Concern COVID-19	,303	,455	,444	1	,505	1,354	,555	3,307
Personal Norm Environment	-,036	,303	,014	1	,905	,965	,533	1,747
Personal Norm COVID-19 (Bicycle/Walking)	,800	,520	2,372	1	,123	2,226	,804	6,163
Constant	3,073	2,540	1,464	1	,226	21,605		

Intention to Walk

The results of the survey show that of the 75 cases included in this regression, 15 respondents intend to walk more often in the future and 60 do not intend to do so. Of the ten independent variables included in the regression, none showed a significant effect to predicting the intention to walk.

5.2   Interview Results

In the following, the results of the thematic analysis of the interviews will be presented according to the structure of the interview guide.

5.2.1   Demographics of Interviewees

The age of interviewees ranged from 26 to 55; five of them identify as male and three as female. Most interviewees currently use public transportation as their main MOT to commute to their workplace; three of them take the bus and two go by train. Three participants occasionally drive by car and two interviewees commute by bicycle. Half of the interviewees partly worked from home at the time of the interview.

5.2.2   Mobility Changes in Commuting

This section is about if and how mobility behavior for commuting of interviewees changed during the pandemic and the reasoning behind it.

Most of the interviewees stuck to the MOT they used before the pandemic for commuting (IV1,IV2,IV5,IV6,IV7,IV8) while some changed it occasionally (IV3,IV4,IV6,IV7). Almost all interviewees avoided commuting to their workplace especially in the first year of the pandemic by working from home more frequently (IV1,IV2,IV3,IV4,IV5,IV6,IV8).

The interviewees who did not change their MOT named several reasons for this decision. IV1 stated that they did not have another option than taking the bus to their workplace. IV2 and IV7 expressed that their main MOT (walking or cycling) fit the Swedish recommendations of avoiding public transportation and crowded places. Three interviewees indicated that they did not feel a need to stop using public transportation and did not have another option than their current mode (IV5,IV6,IV8). IV8 stated that they were able to take the bus at times when it was not too crowded.

The interviewees who changed their MOT were those who usually use public transportation. The main reasons for not using public transportation during the pandemic expressed were that the trains and busses felt too crowded (IV3,IV4,IV6,IV7), not wanting to risk getting infected or infecting others and following the state's social distancing recommendations (IV2,IV3,IV4,IV7). IV7 expressed it as: "I wanted to contribute too so that those who had to take the bus could take the bus in a safer way," (p. 1). On occasions in which interviewees would have chosen public transportation to commute before the pandemic, they then chose to either commuting by car (IV3,IV4,IV7) or bicycle (IV4, IV6). Most of them preferred bicycling in case of good weather (IV1,IV4). When that was not the case, they chose or would have chosen the car (IV1,IV4).

Several interviewees argue that driving the car in Malmö is not worthwhile as parking is too expensive (IV1,IV4,IV5,IV7,IV8). This is the reason why even those who occasionally switched to driving the car are not using it to commute regularly (IV3,IV4,IV7).

5.2.3   Changes in Attitude toward Commuting

The following chapter deals with the feelings of interviewees toward commuting and their chosen MOT and how their perception of safety towards commuting changed during the past two years.

Most of the interviewees who mainly use public transportation to commute felt uncomfortable and unsafe because of crowded trains and busses and not being able to avoid others (IV1,IV3,IV4,IV6,IV7). IV1 expressed it as "[…] I found myself feeling a little bit like anxious and […] I really disliked when people were like sitting next to me and close to me. […] it felt really uncomfortable taking the bus," (p.2). The feeling of being unsafe when using public transportation was mainly related to health concerns, as interviewees were afraid to catch COVID-19 themselves or infect others (IV1,IV3,IV4,IV6,IV7). Moreover, IV2 indicated a feeling of responsibility as they did not want to put other people at risk by commuting by public transportation. IV3 expressed a feeling of frustration when they had to commute to their workplace instead of working from home because it was observed as an unnecessary risk.

Some interviewees who used public transportation did not feel unsafe or uncomfortable because they did not perceive it as too crowded (IV5,IV8). Several interviewees noted that the *Skånetrafiken* app, which is the local public transportation app in Scania, started giving an estimate on how crowded a train might be, which gave them a feeling of comfort (IV1,IV7,IV8). IV5 also states that they were wearing a mask that made them feel safe. Two other interviewees also expressed that they have worn a mask when using public transportation (IV1,IV6), although it has not been obligatory to do so in

Sweden (see chapter 2.2). IV1 states: "I felt like I was one of the few ones wearing a mask," (p. 2), which made them feel uncomfortable taking the bus.

The interviewees who commuted by or switched to the car or bicycle during the pandemic felt safe doing that, as it allowed them to avoid crowds and follow the recommendations (IV2,IV3,IV4,IV7).

Some changes in the perception of safety while commuting during the past two years of the pandemic can be observed. Especially at the beginning of the pandemic, interviewees were afraid of getting infected or infecting others with COVID-19 while commuting (IV1,IV2,IV3,IV4,IV6,IV7). Some interviewees expressed that they felt unsafe especially in the beginning stages of the pandemic because of the uncertainty around it, as it was a new disease (IV4,IV6,IV8). Several aspects led to interviewees feeling safer and more comfortable after a while with using public transportation: a large proportion of society getting vaccinated, the interviewees getting vaccinated or recovering from COVID-19 themselves, and the emergence of the new variant *omicron* (IV1,IV2,IV3,IV4,IV6). Moreover, as soon as the interviewees felt like they could evaluate better the danger of the disease, they felt more comfortable using public transportation again (IV4,IV6,IV8).

At the time the interviews took place, most interviewees did not feel concerned about catching COVID-19 while commuting anymore (IV1,IV2,IV5,IV6,IV8). "[…] I don't even think about it [COVID-19] anymore to be honest," (IV6, p.3). However, some of the interviewees who stopped using public transportation, express that it feels unusual for them to be close to others again (IV7,IV8).

> "And now I feel still a little bit uncomfortable taking the bus because it's still COVID out there […]. So, but I take the bus now if I have to, but […] it's not as natural as it was before the pandemic for me to take the bus. Now it's more like in firsthand for me to bike," (IV7, p.3).

5.2.4   Main and Environmental Concerns

This section focuses on the main concerns interviewees had during the pandemic and how their concerns about climate change and other environmental issues as well as their perception of it changed.

Most interviewees expressed that the main concerns they had during the pandemic were related to the pandemic and the disease itself, i.e., catching COVID-19 or infecting others, and concerns about their families (IV1,IV3,IV4,IV6,IV7). They were also concerned about societal and economic consequences the pandemic might have (IV1,IV2,IV3,IV5,IV6,IV7). These concerns were stronger in the beginning stages of the pandemic than in the past few months (IV1,IV2,IV3,IV4,IV6,IV7).

Most interviewees expressed that their concerns and perceptions about the environment and climate change did not change during the pandemic (IV1,IV2,IV4,IV5,IV6,IV7). Most of them state that they are constantly concerned about both (IV1,IV2,IV5,IV6,IV7,IV8). However, some interviewees assume a shift of focus in society because of the pandemic, which pushed environmental concerns into the background (IV1,IV4,IV5,IV7).

Two interviewees indicate a feeling of hope at the beginning of the pandemic, that it might lead to a reduction of people traveling and that the restrictions show how fast society is capable to implement changes (IV5,IV8). IV8 expressed this as: "[…] it's actually possible to change things and I think we should try to learn more from it," (p.3). However, this feeling of hope was stronger at the beginning of the pandemic, as now they perceive how certain behaviors and structures go back to pre-pandemic state (IV5,IV8).

> "It was mostly in the beginning where I thought […] this would be a moment of opportunity where we could make some kind of changes because […] what the societies did in the start of the pandemic was really drastic and that somehow showed that it is possible actually to make some changes. But I don't think that these changes have been implemented on for example transport and environmental goals and so on," (IV5, p. 3).

IV7 also expressed that they do not believe that things will turn out for the better for the environment because of the pandemic.

6   Discussion

"I mean, they told people not to commute, but […] it felt like a week of the pandemic, and then everybody was commuting again. So, the Swedes' kind of relationship to the pandemic was kind of like loose and overall didn't care that much," (IV6, p. 5).

This statement suggests that the pandemic did not have any major impact on people's lives in Sweden, therefore, not provoking any great changes in commuting. Does IV6 have a point with this assessment of the pandemic's effects on commuting in Sweden, and more particularly in Malmö? This amongst other results of the study will be discussed in the following chapters.

6.1   Implications for Research Question 1

RQ1: How has the COVID-19 pandemic influenced mobility behavior of employees commuting to the city center of Malmö?

The descriptive results of the survey show that most of the respondents only have a short distance to travel to their workplace, suggesting that they live in Malmö, and mainly use sustainable MOTs to commute. This matches with the aims of the municipality for sustainable mobility in the city (chapter 2.1). Those results also show, in line with current research on the subject (chapter 2.4), that the employees included here overall commuted less frequently and a few avoided public transportation during the pandemic. This was also covered in the interviews, as some participants stated that they avoided public transportation to follow the recommendations, for safety reasons and/or to protect others and themselves. However, this study did not confirm the assumption of similar research that the pandemic pushed less or more sustainable MOTS (chapters 2.3 & 2.4) when comparing the use of MOTs before the pandemic and at the time of data collection. Although the use of public transportation decreased, the use of car, bicycle, and walking stayed unchanged.

Regarding this, interviewees mentioned that driving a car is too expensive in Malmö, which might serve as an explanation for why car use did not increase significantly in this study. Moreover, interviewees stated that weather condition influences their decision whether to take the bicycle or not. Both examples suggest that mobility behavior is to a large extent influenced by considering costs and benefits, in line with previous findings (Ambak et al., 2016).

The results of the regression analyses suggest that if employees have a strong habit to use a certain MOT, they most likely also currently use it to commute. This was the case for all MOTs analyzed. Research suggests that if a behavioral action becomes habitual, the behavior in question might no longer be reasoned and determined by attitude, subjective norm, and perceived behavioral control, as

Ajzen (1991) suggested, but rather that the behavior is repeated automatically, without the individual reflecting about it (de Bruijn et al., 2009). This provokes the question if commuting must be seen as rather a habit than a behavior that is actively reflected. Current studies suggest that crises such as the pandemic might provoke a breaking of habits (Schmidt et al., 2021). As habit strength was the only independent variable that showed influence for every MOT, the question arises whether the pandemic influenced it. As this study only conducted the current habit strength, this connection was not further investigated.

The results further suggest that subjective norm has both an influence on current car and bicycle use. For bicycle use, it suggests that the social surroundings of bicycle users find this MOT appropriate. For car use, it is the opposite because a low subjective norm was connected to it. This is of particular interest, as this suggests that car users rate their MOT as socially undesirable (Vesely & Klöckner, 2020). This indicates that other factors such as habit strength must have a higher relevance for choosing the car, as car users choose this MOT although their social surroundings do not support it, which is contrary to the TPB (Ajzen, 1991).

Pandemic and environmental-specific variables only suggested the prediction of intention in the case of bicycle use. Results hint that the more the pandemic made respondents aware of climate change and other environmental issues, the more likely they intend to use the bicycle more often in the future, which is in line with relevant research (chapter 2.3). Contrary to this, the variable concern about climate change suggests that the lower the concern is, the higher the likelihood of this intention might be. This result is contrary to what relevant research found (chapter 2.3). One could speculate about the reasons for this, but further research would be required to be certain. Thus, these results serve as a suggestion.

Moreover, the results of the regression analyses of the current behavior and the intention for each MOT slightly differed. A reason for this might be the difference in sample size. It especially showed in the case of car use, as considerably fewer participants intended to use a car than the number of commuters who currently do so. An explanation might be that participants perceive it as socially undesirable to choose the car (Vesely & Klöckner, 2020) and that is why they did not indicate to intend to use it more often in the future.

Another reason for the difference in the results of the regression analyses might be that the intention to perform a behavior does not necessarily equal actual behavior, as suggested by relevant research (Yuriev et al., 2020). This contradicts the assumption of the TPB that intention makes the actual behavior more likely to occur (Ajzen, 1991). In this study, the influence of intention on behavior was not analyzed, as the current behavior and the intention in the future cannot be put in relation.

Overall, the results of the regression analyses show that not all included independent variables predict the current use of a MOT or the intention to use it more often in the future. The survey as well as the interviews show that the pandemic did not have a meaningful impact on the choice of MOT, nor did environmental considerations. The pandemic only reduced the frequency of commuting and to a small extent reduced the use of public transportation. Habit strength was the only variable that appeared to predict the current use of all MOTs. Moreover, the different MOTs were influenced differently. However, there is no considerable difference between sustainable and unstainable MOTS. Thus, the TPB and results of current research and the conceptual framework designed for this study (chapter 4.2.2) could only be partially confirmed or refuted.

6.2 Implications for Research Question 2

RQ2: Is the influence of the COVID-19 pandemic on mobility behavior for commuting consistent throughout the past two years?

The interviews suggest that the participants perceived the safety of using public transportation under the perceived state of the pandemic. Whenever the virus was perceived as less threatening, commuters felt better about using public transportation, which is in line with relevant research (chapter 2.4). However, the results of the survey and the interviews also show that some are still careful about going back to business-as-usual regarding the use of public transportation. When asking about the intention to change one's MOT depending on the state of the pandemic, most respondents indicate that they do not plan the change it in case it worsens. In contrast, the results are not clear when it comes to changing it back to how it was before the pandemic. For this reason, the significance of the impact of the pandemic on long-term mobility is not clear.

In the interviews, most participants did not show any kind of change in their environmental concerns or perception of climate change and environmental issues as most of them stated that they continuously are concerned and perceive it as relevant. Thus, it seems that the pandemic did not have any major effects on this, contradicting similar research (chapters 2.3 and 2.4). However, this is less surprising considering that the pandemic overall did not show major impacts on participants in this case study.

Overall, as the influence of the pandemic on mobility behavior did not show to be as strong as proposed in relevant research, also the consistency over the past two years and beyond can only be evaluated to some extent in this study. This leaves room for further research.

6.3   Embedding Implications and Future Research

The results of this study give implications for Malmö municipality and further research as they show how commuters were affected by the pandemic. As the influence of the pandemic on mobility behavior did not show to significantly go beyond impacting the frequency of commuting, other than the seemingly temporary avoidance of public transportation, this study suggests that in the case of Malmö the pandemic has neither led to a push of sustainable nor unsustainable MOTs. Thus, this study suggests that the aims of the municipality to make commuting more sustainable might neither be hindered nor supported by the pandemic.

A reason for the rather weak effect of the pandemic might be the specific case of the Swedish approach to handling it. As COVID-19 measures were soft and people overall showed trust in them, it can be assumed that concerns were slim (Brusselaers et al., 2022). Although employees were asked to work from home and avoid public transportation (Brusselaers et al., 2022), as some of the participants of this study did, the influence of the pandemic cannot be observed on a deeper level. In this case study, the pandemic did not have any *awaking* effect, as suggested by other research (Zebardast & Radaei, 2022). This might simply be the case because the pandemic was not perceived to be as threatening in Sweden as it was the case in other countries (Brusselaers et al., 2022). Therefore, this may be a reason why it might not have triggered major rethinking or changes in attitudes towards environmental issues. Thus, a similar case study in other countries with both similar COVID-19 measures or stricter regulations such as lockdowns is of interest for comparison.

In this case study, commuting was not identified as a pro-environmental behavior, as it has not been significantly predicted by associated variables. However, this study showed that commuting might rather be considered a habit. The results of this study did not show whether this habit was influenced by the pandemic, which leaves room for further research.

This case study contributes to similar research by implying that the effects of the pandemic on mobility behavior and commuting depend on national COVID-19 measures. A similar case study in a different country or different city might lead to different results.

6.4   Research Limitations

By composing a questionnaire and interview guide by myself based on relevant research I was able to customize this study to the case. However, this comes along with certain limitations. As the scope of this thesis did not allow to test if the survey questions capture the associated variables, this might be the reason why not all variables show an influence on mobility behavior as suggested by relevant research. Moreover, the survey results had several questions in which people answered neutrally, e.g., intention and attitude. This might be due to misunderstandings of the questions and should be adjusted in further studies.

The nature of self-reported measures used in this study leads to certain self-report biases such as meeting social desirability (Vesely & Klöckner, 2020). Moreover, in the interviews as well as in the survey, I am biased by my subjective viewpoint as a researcher (Seidman, 2013). What participants of both the survey and the interviews mean with their answers might differ from how I understand them (Seidman, 2013). Moreover, when answering survey questions on the Likert scale, participants might have a different understanding of the answer options (Joshi et al., 2015).

Regarding the statistical analyses carried out in this study, several statistically limiting aspects have been identified. Some of them have been already mentioned in the analysis such as treating Likert scale data as quasi-interval data and the significance of the Hosmer-Lemeshow test (chapter 4.3.1). Other statistical analyses could have been conducted, such as examining the relationship between intention and actual behavior, but due to the scope of this thesis, the regression analyses conducted represented the most meaningful analyses.

This case study gave some suggestive implications on which future research can build on. Further research on this topic is needed, because the sample size in this study was small and most likely biased to some degree, as a large part of the potential respondents work in the transport sector and most respondents used sustainable MOTs. Moreover, due to its scope, this study could not consider all factors that could impact commuting. In addition, the results presented in this study must be considered regarding the timing of the data collection. For example, the results might have differed at a different time during the pandemic. Therefore, further studies on this topic are of importance.

7 Conclusion

This case study aimed at exploring whether the pandemic has impacted mobility behavior of employees commuting to and in Malmö. It did so by investigating which factors mainly influenced commuting to understand to what extent the pandemic influenced the choice of MOT. By examining this case from different angles using a mixed-methods approach, this study was able to obtain a diverse picture of the influence of the pandemic in the case of Malmö.

The results imply that mobility behavior was not influenced deeply by the pandemic as it mostly triggered a change in the frequency of commuting and avoiding public transportation. Neither environmental nor pandemic-related factors proved to significantly influence commuters' MOT choices. One takeaway from this study is that commuting might be considered a habit rather than a reasoned pro-environmental behavior and therefore not greatly influenced by the pandemic. However, further research is needed to investigate this assumption in more detail. Moreover, contrary to the assumptions of recent research, this case study did not reveal a strengthening effect of the pandemic on neither sustainable nor unstainable mobility. Therefore, in this case study, the pandemic did not show to serve as a "window of opportunity" for sustainable change as proposed by Schmidt et al. (2021, p. 1). Environmental considerations did not show to change throughout the pandemic, which seems fitting as the pandemic showed overall limited influence in this study.

This case study assumes that a reason for the rather weak effect of the pandemic is that Sweden's COVID-19 measures have been relatively soft and that citizens showed less concern about the pandemic and strong trust in its government (chapter 2.2). The statement of IV6 presented at the beginning of the discussion can thus be partly confirmed (chapter 6), as this study did not find any major changes of commuting due to the pandemic on a deeper level. Thus, this study concludes that changes in mobility behavior during the pandemic are strongly connected to national and regional COVID-19 measures. Similar research in different cities and countries might further investigate this assumption. The pandemic has affected people's daily behavior worldwide, although the extent may vary from case to case.

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9 Appendices

9.1 Appendix 1

Recipient list of the survey

No	Company/ Organization/ Institution
1	Malmö municipality, Municipal Office
2	Malmö municipality, Employment and Social Affairs
3	Malmö municipality, Property and Street Office
4	Malmö municipality, Leisure Administration
5	Malmö municipality, Functional Support Administration
6	Malmö municipality, Pre-school Administration
7	Malmö municipality, Primary School Administration
8	Malmö municipality, Upper Secondary and Adult Education Administration
9	Malmö municipality, Health, Care and Welfare administration
10	Malmö municipality, Department of Culture
11	Malmö municipality, Environmental Department
12	Malmö municipality, Transport Department
13	Malmö municipality, Service Administration
14	Malmö municipality, City Planning Office
15	Malmö municipality, City Audit
16	Malmö municipality, Corporate Activities of the City of Malmö
17	Malmö municipality, Communication Office
18	Region Skåne
19	Region Skåne, Transport Department
20	WSP Sverige Malmö
21	WSP Sverige Malmö, Transport Department
22	Monbijouskolan
23	Österportskolan
24	Rådmansvångens skolan
25	Möllevångsskolan
26	Mellersta Förstadsskolan
27	Malmö University
28	ODD Company
29	Koala Marketing Company
30	PWC Malmö
31	Oatly Malmö
32	Vårdhuset Malmö
33	Deloitte Malmö
34	World Maritime University
35	Hilding Anders
36	Facebook Group „Lägenheter i Malmö – Öppen grupp"

9.2   Appendix 2

Survey questions, answer options and related variables

The order of questions has been re-organized in this table and does not resemble the order of the survey. Questions marked with * have not been considered in the analysis.

Variable	Related Question	Answer options
Demographic Data		
	Which gender do you identify with?	male; female; other; prefer not to say
	How old are you?	open
	Is your workplace located within 2 km of the trainstations Malmö Central or Triangeln?	yes; no; I don't know
	What is the distance from where you live to your workplace?	1-5 km; 5-10 km; 10-15 km; 15-20 km; 20-25 km; 25-30 km; 30-35 km; more than 35 km
	What is/are the main mode(s) of transportation you are currently using to commute to your workplace? You can select multiple answer options.	car; public transportation (train, bus, etc.); bicycle; I walk; I work from home; other…
	How long does it take you on avarage to commute to your workplace?	less than 10 minutes; 10-20 minutes; 20-30 minutes; 30-40 minutes; 40-50 minutes; 50-60 minutes; more than an hour
	Do you own a car?	yes; no; other…
	Do you own a bicycle?	yes; no; other…
	Does your employer provide you with a jobticket for public transportation?	yes; no; I don't know
	Does your employer provide you with a free parking lot?	yes; no; I don't know
	Before the beginning of the COVID-19 pandemic, which mode(s) of transportation did you mainly choose to travel to your workplace? You can select multiple answer options.	car; public transportation (train, bus, etc.); bicycle; I walked; I worked from home; other…
	Have you changed the mode of transportation to travel to your workplace during the COVID-19 pandemic?	yes; no; I don't know

	In the past three months, which mode(s) of transportation did you mainly choose to travel to your workplace? You can select multiple answer options.	car; public transportation (train, bus, etc.); bicycle; I walked; I worked from home; other…
	Before the beginning of the COVID-19 pandemic, how many days per week did you on avarage commute to your workplace?	0 days; 1 day; 2 days; 3 days; 4 days; 5 days; more than 5 days
	How many days per week did you on avarage commute to your workplace in the past three months?	0 days; 1 day; 2 days; 3 days; 4 days; 5 days; more than 5 days
Attitude		
Car	Compared to before the COVID-19 pandemic, commuting to work by **car** is currently more:	convenient (1) to inconvenient (5)
Car	Compared to before the COVID-19 pandemic, commuting to work by **car** is currently more:	safe (1) to unsafe (5)
Public Transportation	Compared to before the COVID-19 pandemic, commuting to work with **public transportation** (train, bus, etc.) is currently more:	convenient (1) to inconvenient (5)
Public Transportation	Compared to before the COVID-19 pandemic, commuting to work with **public transportation** (train, bus, etc.) is currently more:	safe (1) to unsafe (5)
Bicycle	Compared to before the COVID-19 pandemic, commuting to work by **bicycle** is currently more:	convenient (1) to inconvenient (5)
Bicycle	Compared to before the COVID-19 pandemic, commuting to work by **bicycle** is currently more:	safe (1) to unsafe (5)
Walking	Compared to before the COVID-19 pandemic, commuting to work **walking** is currently more:	convenient (1) to inconvenient (5)
Walking	Compared to before the COVID-19 pandemic, commuting to work **walking** is currently more:	safe (1) to unsafe (5)

Subjective Norm		
	Most of my family members and friends consider my chosen mode of transportation to be appropriate.	strongly agree (1) to strongly disagree (5)
	Most of my colleagues at work consider my chosen mode of transportation to be appropriate.	strongly agree (1) to strongly disagree (5)
Perceived Behavioral Control		
Car	For me, commuting to work by **car** is	very easy (1) to very difficult (5)
Public Transportation	For me, commuting to work with **public transportation** (train, bus, etc.) is	very easy (1) to very difficult (5)
Bicycle	For me, commuting to work by **bicycle** is	very easy (1) to very difficult (5)
Walking	For me, commuting to work **walking** is	very easy (1) to very difficult (5)
Public Transportation	The public transportation connection from where I live to my workplace is good.	strongly agree (1) to strongly disagree (5)
Bicycle	The cycling infrastructure from where I live to my workplace is good.	strongly agree (1) to strongly disagree (5)
Car	With the car I can easily reach my workplace without much traffic.	strongly agree (1) to strongly disagree (5)
Habit strength		
Car	Driving a **car** as a mode of transportation is something that belongs to my routine.	strongly agree (1) to strongly disagree (5)
Car	Driving a **car** as a mode of transportation is something I do without thinking.	strongly agree (1) to strongly disagree (5)
Public Transportation	Using **public transportation** (train, bus, etc.) as a mode of transportation is something that belongs to my routine.	strongly agree (1) to strongly disagree (5)

Public Transportation	Using **public transportation** (train, bus, etc.) as a mode of transportation is something I do without thinking.	strongly agree (1) to strongly disagree (5)
Bicycle	Using a **bicycle** as a mode of transportation is something that belongs to my routine.	strongly agree (1) to strongly disagree (5)
Bicycle	Using a **bicycle** as a mode of transportation is something I do without thinking.	strongly agree (1) to strongly disagree (5)
Walking	**Walking** as a mode of transportation is something that belongs to my routine.	strongly agree (1) to strongly disagree (5)
Walking	**Walking** as a mode of transportation is something I do without thinking.	strongly agree (1) to strongly disagree (5)
Intention		
	As soon as the COVID-19 pandemic has calmed down, I intend to change my mode of transportation to commute to work back to what it was before the pandemic.	very likely (1) to very unlikely (5)
	If the COVID-19 pandemic worsens again, I intend to change my mode of transportation to commute to work.	very likely (1) to very unlikely (5)
Car	In the future, I intend to use the **car** more often to commute to work.	very likely (1) to very unlikely (5)
Public Transportation	In the future, I intend to use **public transportation** (train, bus, etc.) more often to commute to work.	very likely (1) to very unlikely (5)
Bicycle	In the future, I intend to use the **bicycle** more often to commute to work.	very likely (1) to very unlikely (5)
Walking	In the future, I intend to **walk** more often to commute to work.	very likely (1) to very unlikely (5)
Personal norm Environment		
*	Driving a car contributes to environmental problems.	strongly agree (1) to strongly disagree (5)

	I feel personally responsible for environmental problems resulting from my choice of mode of transportation.	strongly agree (1) to strongly disagree (5)
Personal norm COVID-19		
Car	During the COVID-19 pandemic, I felt (or would have felt) good about commuting to work by **car**.	strongly agree (1) to strongly disagree (5)
*	During the COVID-19 pandemic, I felt (or would have felt) guilty about commuting to work by **car**.	strongly agree (1) to strongly disagree (5)
Public Transportation	During the COVID-19 pandemic, I felt (or would have felt) good about commuting to work with **public transportation (train, bus, etc.)**.	strongly agree (1) to strongly disagree (5)
Bicycle/Walking	During the COVID-19 pandemic, I felt (or would have felt) good about commuting to work by **bicycle/walking**.	strongly agree (1) to strongly disagree (5)
*	During the COVID-19 pandemic, I felt (or would have felt) a moral obligation to reduce my car use for commuting.	strongly agree (1) to strongly disagree (5)
*	During the COVID-19 pandemic, I felt (or would have felt) a moral obligation to reduce using public transportation for commuting.	strongly agree (1) to strongly disagree (5)
*	During the COVID-19 pandemic, I felt a moral obligation to choose the bicycle or walking for commuting.	strongly agree (1) to strongly disagree (5)
Awareness COVID-19/ Climate Change		
	During the COVID-19 pandemic, I informed myself more about other natural crises such as climate change.	strongly agree (1) to strongly disagree (5)
	Because of the COVID-19 pandemic, I understood better the connections between my behavior and environmental problems.	strongly agree (1) to strongly disagree (5)

	If climate change is not tackled, more pandemics like COVID-19 could arise in the future.	strongly agree (1) to strongly disagree (5)
Knowledge Climate Change		
	The causes of climate change are man-made.	strongly agree (1) to strongly disagree (5)
*	My daily behavior and habits potentially have an impact on the environment.	strongly agree (1) to strongly disagree (5)
Concern Climate Change		
	I am very concerned about climate change.	strongly agree (1) to strongly disagree (5)
Concern COVID-19		
	I am very concerned about the COVID-19 pandemic.	strongly agree (1) to strongly disagree (5)
Closing questions		
	Would you be interested in participating in an interview as part of this study? Note that the interview will be conducted in English. If yes, please leave your e-mail address. Thank you!	open
	I hereby confirm that I understand that my responses to this survey will be used for a research paper conducted as part of a master's thesis at the Centre for Sustainability Science at Lund University. The data I have provided will be kept confidential and securely stored, and anonymity is guaranteed. The submitted data will be used for academic purposes only. I agree that the final result of the study will be published as a thesis on a public website managed by Lund University Library.	I understand

9.3 Appendix 3

Interview Guide

No	Question
Part 1	
1	Was there a change in your mode of transportation for commuting in the past two years? Or have you changed your mode of transportation several times? Or did you go back and worth, depending on the state of the pandemic?
2	Why did you change your mode of transportation? / Why did you not change your mode of transportation?
3	*If it applies:* If you have had the opportunity to choose another mode of transportation during the pandemic, would you have changed your mode of transportation? And what would you have chosen?
Part 2	
4	Can you tell me something about your feelings associated with commuting during the pandemic?
5	*If it was not covered yet with the previous question:* What feelings or ideas come up in your mind when you think about the mode(s) of transportation you used to commute to work during the pandemic?
5a	Do you think these feelings or ideas were the same or different in the different stages of the pandemic? Think about the beginning, last year and now.
6	*If it was not covered yet with the previous question:* Did you feel safe with the mode of transportation you chose during the pandemic?
6a	*If it applies:* Was safety a reason you changed your mode of transportation?
6b	Do you think you felt different about safety in commuting in the different stages of the pandemic? Think about the beginning, last year, and now.
Part 3	
7	Can you tell me about the main concerns you have had during the pandemic? This can be related to the pandemic but also other global issues.
7a	How have these concerns changed during the pandemic? Think about the beginning, last year, and now. For example, if you had concerns about COVID, was there a time in the pandemic they have been stronger and a time they have been weaker?
8	If you think about your concerns about climate change and other environmental issues, how have they changed during the pandemic?
8a	If yes, in what way? Think about the beginning of the pandemic, last year, and now.
9	Do you think the pandemic influenced how you perceive climate change and other environmental issues? Why?

9a	*If it applies:* Was there a difference between the beginning of the pandemic, last year, and now?
Part 4	
10	Is there something else you want to tell me, regarding commuting during the pandemic?
11	Do you have any questions?