



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Investigation of Ride-Share Service Decisions with Uncertainty and Perceived Risks: Case Study of Young Adults in Cape Town, South Africa

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Man is affected not by events but by the view he takes of them

- Seneca

Declaration

I, Jennifer Louisa Baufeldt, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I empower the university to reproduce, for the purpose of research, either the whole or any portion of the contents in any manner whatsoever.

Date: 22 June 2024

Dedication

This thesis is dedicated to Cape Town: The Mother City, her people and everything she taught me.

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Summary

In South Africa, and specifically Cape Town, many individuals are dissatisfied with the levels of safety and security of public transport modes. Ride-share services could help avoid or delay car ownership, particularly for young adults, by meeting the individuals' immediate demand for personalised private vehicle transportation in a transport system that is failing to meet the wants of choice users.

However, little is known about how young adults in South Africa, particularly Cape Town, decide on ride-share service trips involving uncertainty and perceived risks. Specifically, how do individuals consider their ride-share service decisions for trips 'at night', 'alone' and 'alone at night'? These three trip decisions are referred to in this work as the *Ride-Share Service Questions*. Explicitly: 'Would you take a ride-share service trip at night/ alone/ alone at night?' If ride-share services remain attractive to individuals for the *Ride-Share Service Questions*, then ride-share services could be an effective way of avoiding or delaying private vehicle ownership.

The theoretical approach was carefully selected to fundamentally incorporate the latest understanding of how individuals make decisions involving uncertainty and perceived risks. While utility theories, such as Expected Utility Theory (EUT) or Random Utility Maximization (RUM), are successful for the more stable and predictable (public) transport mode decisions that do not involve uncertainty or perceived risk, the focus of this work is precisely on including and exploring uncertainty and perceived risks in ride-share service decisions. Therefore, this work requires a different approach.

A nascent approach that focuses on decisions involving uncertainty and perceived risks involves incorporating concepts from Quantum Probability Theory (QPT) to better conceptualise and model these types of decisions (Pothos and Busemeyer, 2022). Such QPT approaches have been adopted in psychology and social sciences to better formalise human decisions that deviate from expected rational outcomes, due to human characteristics, such as framing effects, loss aversion or certainty effects.

Using the QPT concepts of *Belief State* and *incompatibility*, this research aims to better understand the influences of *Gender* (female, male), *Access to a Private Vehicle* (access, no access) and *COVID-19* ('before', 'during', 'after') in ride-share service decisions of young adults that involve personal security uncertainty and perceived risks in Cape Town. These investigations are explored through four

experiments via online surveys using Google Forms distributed to the university community. The experiments are used to explore the four hypotheses, *H1-H4*, which are proposed in this research.

H1: Uncertainty and perceived risks of personal security decrease the willingness to use ride-share services in young South African adults (Chapter 6)

The *Belief States* are defined by *Gender* (*female; male*), *Access to a Private Vehicle* (*access; no access*) and *COVID-19* (*'before COVID-19'; 'during COVID-19'; after COVID-19'*). The differences in willingness to engage in ride-share service trips at night, 'alone' and 'alone at night' are significant for *Gender*, *Access to a Private Vehicle*, and *COVID-19*. These are visualised in *Belief State* models using their amplitudes, as is done for all evidence in this work. In detail, females are much less willing than males to take ride-share service trips 'at night', 'alone' and, with the greatest difference seen in 'alone at night'. Individuals without access to a private vehicle are more willing than individuals with access to a private vehicle to use ride-share services for trips 'at night' or 'alone at night'. However, no significant difference was seen for 'alone'. Lastly, individuals are more willing to engage in ride-share service trips 'at night', 'alone' and 'alone at night' in 'before COVID-19' than in 'during COVID-19'. Furthermore, the future scenario of 'after COVID-19' (the pandemic was still ongoing when this research was conducted) generated the lowest levels of willingness to use ride-share from the respondents for 'at night', 'alone' and 'alone at night'. This indicates that little to no return to pre-COVID-19 levels can be expected.

Next, for *H2*, evidence for incompatibility in the *Ride-Share Service Questions* was explored using pre-questions of related *Transport Factors* (*Sustainable Transport, Reliability, Road Safety, Crime*), as the set of incompatible factors.

H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks (Chapter 7)

Evidence of incompatibility is found for females, where the effect of the pre-questions that evaluate *Transport Factors* encouraged females with access to a private vehicle to engage in ride-share service trips 'at night' so that *Access to a Private Vehicle* was no longer a significant factor. Similarly, a positive effect of the incompatible *Transport Factors* in females' decision of 'alone at night' is also seen in *COVID-19* which is not a significant factor, despite being so in the control data. Males, on the other hand, only generated one case of incompatibility for 'alone'. In the control data, *COVID-19* is a significant factor. However, for the respondents that were first asked the pre-questions of *Transport*

Factors, *COVID-19* is not a significant factor. Considering the very high willingness of males to engage in ride-share service trips ‘alone’, ‘at night’, and ‘alone at night’ (Chapter 6), it is unlikely that males experience high levels of uncertainty or perceived risks in these decisions, and incompatibility is, therefore, less likely to be captured.

Next, for *H3*, the potential of capturing measurable effects of positive emotional framing is explored by incorporating the pre-questions *Good Mood Questions*.

H3: Positive emotional framing in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty and perceived risks (Chapter 7).

The *Good Mood Questions* were formulated to be unrelated and, therefore, compatible with the *Ride-Share Service Questions*. The *Good Mood Questions* did present the respondents with questions about enjoyable or positive things or activities, thus potentially affecting the respondents’ emotional mood. The findings of the effects of the *Good Mood Questions* on the *Ride-Share Service Questions* are limited, yet still insightful.

For females, the effect of the *Good Mood Questions* is impactful for the ride-share service decision of ‘alone at night’, where the influence of *COVID-19* scenarios was no longer a significant factor compared to the control data. This indicates that the positive framing and incompatibility effects in the experiments affected the same factor (namely *COVID-19*) for the decision ‘alone at night’, particularly for females. This decision of ‘alone at night’ presents the *Ride-Share Service Question*, where females indicated the least willingness to engage in it and, therefore, the most uncertainty and perceived risk. Similarly, for males, the decision ‘alone’ showed evidence that the *Good Mood Questions* had a positive effect on *COVID-19* scenarios, as it was not a significant factor in the experiment, yet in the control data (no pre-question of *Good Mood Questions*) it was significant.

Lastly, in *H4*, the potential effects of the *Ride-Share Service Questions* on the responses of the *Transport Factors* were explored.

H4: Ride-share service decisions involving uncertainty and perceived risks increase the perceived importance of incompatible factors (Chapter 8).

The focus of *H4* is to see what effects the *Ride-Share Service Questions* could have on questions that are incompatible, namely the *Transport Factors*. This is presented in Chapter 8. No effects from the *Ride-Share Service Questions* are seen for the responses to *Crime*. However, effects at the 5% and 10%

significance levels are seen in the remaining *Transport Factors of Sustainable Transport, Reliability ('being on time')* and *Road Safety*. However, the impact of these factors is limited to specific *Belief States*. For example, for *Sustainable Transport*, impacts are seen for individuals without access to a private vehicle and in 'before COVID-19' period, where individuals reported higher levels of perceived importance compared to the control data.

Overall, the implications of these findings for ride-share service providers are that there is a need for more measures to improve personal security for females when taking trips 'at night' or 'alone at night'. Furthermore, this research shows that, for questions that involve uncertainty and perceived risks, the *Belief State* of the individual at the time of decision can have a measurable effect on the decision and, therefore, this new knowledge should be taken into consideration for research focusing on decisions that involve high levels of uncertainty and perceived risks.

While this research is limited by the scarcity of data from ride-share service companies, future research can expand on these findings by including more diverse population groups, especially lower-income groups, for more representative knowledge of the larger Cape Town population.

Keywords

Ride-share services

Decision-making

Uncertainty

Perceived risks

Cape Town, South Africa

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Introduction

For several decades, decision scientists have argued that beliefs and preferences are constructed, rather than being read out from their memory. Furthermore, individuals use a collection of methods for forming their preferences or developing their beliefs (Payne et al., 1992). This is particularly relevant for decisions involving uncertainty and perceived risks (Pothos and Busemeyer, 2022). Individuals making decisions about their travel behaviours may also experience uncertainties or perceived risks, in some circumstances, or when taking specific trips, either because of their perception of the transport mode or the trip's context. Perceptions of transportation modes or the context around the trip may lead to uncertainty or a perception of risk. These uncertainties, or perceived risks, contribute to the motivation of individuals to switch from public transport modes to purchasing private vehicles.

However, with the establishment of ride-share services, it may be possible to avoid or delay car ownership by meeting the individuals' immediate want of more personalised private vehicle transportation. Thus, ride-share services may contribute to a multi-modal transport culture in South Africa (Vanderschuren and Baufeldt, 2018). Using ride-share services can be particularly attractive for individuals who cannot easily afford to purchase or maintain a private vehicle.

Ride-share services have several advantages over public transport modes or traditional (metered) taxis. These advantages include ease of accessibility, security features (for example, tracking of trips), and on-demand service aspects, such as door-to-door trips. However, it is unclear whether all individuals perceive ride-share services as an alternative or supplement to transport modes, associated with personal safety and security challenges, such as public transport modes or active modes, for example, walking or cycling.

This is especially true considering that ride-share service trips may also involve some uncertainty or perceived risk directly associated with the ride-share service trips, such as the user's personal safety or security concerns (Berndt et al., 2021). Concerns about personal safety also affect ride-share service drivers, with passengers and other metered taxi drivers presenting threats and risks for the drivers (Giddy, 2022). In South Africa, personal safety and security are central challenges of ride-share services that need to be addressed for all individuals involved in using or providing these services.

Ride-share services are flexible, both in terms of supply and demand. When deciding to engage in a ride-share service trip, the decision whether to engage with ride-share services could be more

sensitive to the individual's frame of mind or surrounding factors. Yet, current research methods typically used to understand transport modal decisions have been primarily developed with more traditional transport modes in mind, such as private vehicle transport (namely car trips) or formal public transport modes, such as buses or trains. These transport modes, and their associated decisions, are comparatively stable to ride-share services.

This research aims to understand better how the individual's state of mind (at the moment of decision) may influence an individual's willingness to engage in ride-share services in South Africa. In the next section of this chapter, the background and motivation of this research is introduced, after which, the research problem, aims and objectives, significance, and scope are described. Finally, the structure of the thesis is outlined.

1.1 Background and Motivation

South Africa is the most southern country on the African continent. It shares borders with Namibia, Botswana, Zimbabwe, Mozambique, Lesotho, and Eswatini. Figure 1 shows a map of the country with the major cities of Bloemfontein, Cape Town, Durban, East London, Gqeberha, Johannesburg, and Pretoria marked.



Figure 1: Google Map of South Africa (URL: <https://www.google.com/maps/@-25.6669146,22.1885456,5.48z?hl=en&entry=ttu>; Date Accessed 07.10.2023)

Ride-share services have been active in South Africa since 2013, with the arrival of Uber (Henama and Sifolo, 2017). Ride-share services have many names, including e-hailing, Transportation Network Companies (TNC), ride-share, ride-sharing platforms, on-demand ride services, ride-sourcing

networks, and ride-hailing. Mitropoulos et al. (2021) state that there is no universally accepted definition to describe ride-share services and that each study is defined within its context. This work focuses on profit-driven app-enhanced ride-share services, referred to as ride-share services. This thesis uses the term 'ride-share service(s)' to focus on the usage and perceptions of the transport service that individuals can access.

1.1.1 Ride-Share Services and Transport Modes in South Africa

Ride-share services offer South Africans access to personal motorised transport without the financial burden of owning or maintaining a private vehicle, potentially filling a necessary gap in the transportation network (Vanderschuren and Baufeldt, 2018). Furthermore, ride-share services can help address the transport needs of South Africans that are currently not met by the available, mostly informal, public transportation modes.

The high levels of dissatisfaction with public transport modes in South Africa are well documented (Statistics South Africa, 2014; Statistics South Africa, 2021a). At the same time, private vehicle ownership remains comparatively low to international standards, with most households not owning a vehicle (Vanderschuren and Baufeldt, 2018). Vanderschuren and Baufeldt (2018) highlighted that almost 35% of 'high-income' households had no private vehicle. This is considerably lower than 'high-income' households in cities in Australia, the USA, or the UK (Currie and Delbosc, 2013; Nutley, 1996). However, with the large number of low-income households, the overall car ownership is less than half of the levels in the USA and Europe, for example.

Despite comparatively low levels of private vehicle ownership, formal public transport modes, such as busses (traditional and Bus Rapid Transit (BRT)) and trains, are still failing to increase ridership in South Africa (Statistics South Africa, 2021a). This is particularly true for Cape Town in the Western Cape, where this trend has been exaggerated, due to the collapse of the metro train system (Statistics South Africa, 2021a). The collapse of the train service in Cape Town was partly attributed to vandalism, caused by protest actions against poor service delivery (Khambule et al., 2019; Mchunu, 2012; Vhumbunu, 2021). The consequences of the train system collapsing for Cape Town include increased traffic congestion and a shift to transport modes that are less environmentally sustainable, such as paratransit modes, namely Minibus Taxis (MBTs) and private vehicles.

Ride-share services are particularly relevant for young adults, typically defined as between 18 and 35 years old. Young adults are likely to adapt early to new technologies, including ride-sharing services

(García-Melero et al., 2022; Sener and Zmud, 2019). Furthermore, young adults are more susceptible to switching between transport modes, as they are less likely to be in an established life phase with the multiple restrictions or family obligations that are typical of older adults. Furthermore, as young adults are exposed to more changes and choices (both essential and aspirational) in this time of their lives, they may experience uncertainty more frequently.

Ride-share services may present themselves as a possible compromise for young adults. Young adults' need or desire for private motorised transport can be fulfilled by ride-share services, while still avoiding car ownership. This compromise can be particularly relevant for what is known as the 'missing middle' in the South African transportation network (Vanderschuren and Baufeldt, 2018). Vanderschuren and Baufeldt (2018) define the 'missing middle' as South Africans participating in the economy but not earning enough to participate in all desired or necessary opportunities. A typical opportunity not accessible for the 'missing middle' in South Africa is tertiary education, which is generally not possible without securing financial funding.

Additionally, transport modes in South Africa are not well isolated from external events and factors. As described earlier, the collapse of the metro train system in Cape Town is one such example. These external events and factors affect how individuals experience the transport modes in South Africa, with public transport modes being more exposed than private ones.

External factors affecting dissatisfaction with transport modes in South Africa include personal safety and security (Statistics South Africa, 2021a). South Africans show high levels of dissatisfaction with personal safety and security on the way to the transport stops or stations, as well as during their trips, using different transport modes. South Africans, particularly females, **are warned against making trips alone or at night** (City of Cape Town, 2022). These are some of the uncertainties or perceived risks that individuals may be influenced by when deciding to engage in a particular transport mode.

The positioning of ride-share services concerning uncertainty and perceived risks is again unclear in South Africa. Users of ride-share services are typically less exposed than public transport users in South Africa. Still, ride-share services are not as resilient to uncertainties and perceived risks as private vehicle transport, due to the driver-passenger dynamic.

1.1.2 Transport Modal Decision Paradigms: Uncertainty and Perceived Risks

Ride-share services also offer an opportunity for an extension to the paradigms used in transport modal research. Generally, individuals' uncertainty and perceived risks of transport modal decisions

in South Africa have been largely unaddressed. This can be attributed to the main paradigms, accumulated in the transport research field, having not yet been extended to explicitly include uncertainty and perceived risks. Jones (2009) describes the different paradigms that have shaped and guided transport research in a five-paradigm model, shown in Figure 1. Jones (2009) explains that a paradigm shift to a newer paradigm typically replaces the central paradigm of a research field, which influences current and future research undertakings. However, Jones (2009) argues that paradigms have not so much as shifted in transport research but, instead, accumulated. This can be seen in the five layers of Figure 2.

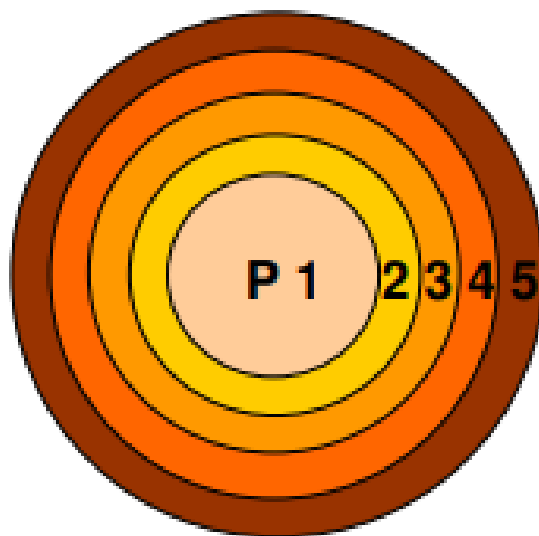


Figure 2: Five Paradigms of Transport Research and Policy (Jones, 2009, p.2)

The first paradigm that was dominant in the transport research field was that of vehicle-based investigations (P1), followed by person trip-based (P2), activity-based (P3) and dynamics-based (P4) paradigm. The final paradigm is attitude-based (P5).

P1 (vehicle-based investigations) focused on accommodating the expected increase in car ownership in developed countries. For example, in the discussion panel of Lynch et al. (1960), some identified models included the growth factor method and the gravity model. This paradigm (predict and provide) of attempting to meet the unrestricted use of private vehicles served the USA well. However, with cities in older developed countries, such as the UK and other cities in the European Union, the constraints of the built environment made it evident that car use would need to be managed rather than accommodated (Jones, 2009). This resulted in the addition of the next paradigm of focusing on moving people rather than moving vehicles.

Person-trip paradigm (P2) focuses on the efficiency of vehicle use, with the advantages of public transport modes and networks evident for denser cities. An example of such an approach can be seen in Kreibich (1979). Kreibich (1979) used a Monte-Carlo algorithm to model and predict modal split and trip distributions using census data for several city regions in Germany. Another characteristic of P2 is that it encourages a modal shift from private vehicle car trips to more efficient transport modes (Jones, 2009). However, walking and cycling trips were initially considered irrelevant as this paradigm focused on longer-distance trips (Jones, 2009).

Including the more human component of transport modal decisions is first seen in the third activity-based paradigm (P3). Key concepts and understandings under this paradigm include physiological factors, socio-economic roles and factors, and personal preferences. Various constraints, such as family obligations and scheduling requirements, as well as opportunities, such as trip avoidance through activity substitution, were also recognised in this paradigm. Concepts, such as space-time budgets, were put forth and used by researchers, for example, Anderson (1971), Hensher (1976) and Van der Hoorn (1979). Rather than focusing on increasing the mobility of individuals, the focus was on improving how accessible individuals are considering both space and time constraints.

The first three paradigms, P1-P3, each considered travel behaviours at one point in time. Yet how these travel behaviours change over time, responding to changes in the transport network or transport policies, is first discussed in P4, the dynamics-based perspective (Jones, 2009). P4 investigated the significance of habits and the considerable delays in transport modal decisions. Kitamura and Van der Hoorn (1987) show an example of P4 in their investigation focusing on the stability of weekly travel behaviour, including the effects of response lag. Researchers were, therefore, encouraged to understand better how individuals make and change their decisions over time. This resulted in an influx of ideas, concepts and understandings developed in social psychology for the fifth paradigm of attitude-based perspective (Jones, 2009).

The attitude-based (P5) paradigm considers the more subjective aspects of transport modal decisions. In this last shift, Jones (2009) contributes this expanded understanding to newer theories of behaviour understanding from psychology, such as the Theory of Planned Behaviour (Ajzen, 1991). By incorporating such theories, various factors influencing perceptions, preferences, and attitudes could be identified and investigated (Jones, 2009). This resulted in researchers, such as Verplanken et al. (1994), exploring the role of habits against attitudes. Verplanken et al. (1994) confirmed a trade-off between attitude and habit as a behaviour prediction in travel mode choices. If the individuals

have strong habits, the attitude-behaviour relation is weak, while when the habit is weak, the attitude-behaviour connection is dominant.

However, the paradigm accumulation has continued. The next nascent layer focuses on how individuals make decisions that involve uncertainty and perceived risks, incorporating theories and concepts such as Prospect Theory, Regret Theory and Quantum Probability Theory (QPT). For example, Zhong et al. (2020) investigated the impact of ride-hailing services on private car use in urban areas of Chinese cities using a Prospect Theory-based approach¹. However, the applications of Prospect and Regret Theory are not without their criticisms. Timmermans (2010) highlights that Prospect Theory does not have the necessary set of mechanisms or concepts for repeated travel choices under uncertainty². Such a criticism would also be valid for Regret Theory, which is very similar in structure. However, the application of QPT in travel decisions, to better capture the effects of uncertainty and perceived risk, is showing promise. For example, Hancock et al. (2020) compared the datasets against a utility model, decision field theory model, as well as quantum Hamiltonian and quantum amplitude models and found that the QPT models (i.e., quantum Hamiltonian and quantum amplitude) outperformed the utility and decision field models³.

Yet, research on ride-share services in South Africa has yet to extensively take into consideration the effects that uncertainty and perceived risks can have on the individual's decision-making process. Ride-share services are particularly suited to research approaches that include conceptualisations, specific to uncertainty and perceived risk, for two reasons. The first reason is that ride-share services are flexible in demand and supply. Individuals are, therefore, exposed to more variation in deciding whether to engage with these services. The second reason is that ride-share services are only semi-private, unlike car ownership, which is comparatively sheltered from external events and factors. This implies that some, but not all, uncertainty, and perceived risks associated with public transport modes, are also relevant to these services. However, how these uncertainties and perceived risks influence individuals' decisions to use ride-share services is not well established in the South African context.

In the next section, the research problem for this research is presented.

¹ Explained in more details in Chapter 2.

² Explained in more details in Chapter 2.

³ Explained in more details in Chapter 2.

1.2 Research Problem

Even though ride-share services are a well-established transport mode in South Africa, little is known about how young South African adults make ride-share service trip decisions involving uncertainties and perceived risks. A more realistic understanding of how uncertainties and perceived risks affect ride-share service decisions is needed if ride-share services are to successfully provide this 'middle ground' between gaps in the currently available public transport modes and car ownership. This knowledge can contribute towards a more multimodal transport culture.

Furthermore, there is a need within transport research to explore potential methods that investigate the role of uncertainties and perceived risks in transport modal decision-making. The leading five research paradigms, as described by Jones (2009), have, up until now, yet to extensively explore uncertainty and perceived risks in transport modal decisions. However, the next transport research paradigm, of including uncertainty and perceived risks, is well under development, with theories such as Prospect Theory, Regret Theory, and the concepts of Quantum Probability Theory (QPT) being explored by researchers to better investigate the effects of uncertainty and perceived risks on decisions. This will be explored further in Chapter 2, Section 2.2.2.

The following section presents the two main research aims of this thesis.

1.3 Research Aims and Objectives

This research explores how young South Africans respond to ride-share service trips involving personal security uncertainties and perceived risks. Specifically, identify and quantify who is affected by personal security uncertainty and perceived risks when deciding to use ride-share services.

Furthermore, this research aims to identify if differences in an individual's frame of mind can generate significant differences in the responses to ride-share service decisions involving uncertainty and perceived risks. This involves separating the survey respondents into four groups: a control group and three experimental groups.

The following key objectives for this research are:

1. To assess relevant characteristics of individuals that influence ride-share service decisions of young South Africans in a case study city. (Chapter 4)
2. To identify and compare how individuals make ride-share service decisions involving uncertainties and perceived risks in the case study city. (Chapter 6)

3. To experimentally compare groups of different initial states of mind and their willingness to use ride-share services. (Chapters 7 and 8)
4. Generate insights into who and when individuals change their willingness to engage in ride-share services in the South African case study city. Insights to be used to formulate strategies and mitigation measures to contribute to a multi-modal culture. (Chapter 9)

The research depends on collecting extensive data on how individuals make their ride-share service decisions. Therefore, this research relies on comprehensive questionnaires or surveys to capture the necessary data.

1.4 Research Significance

This research contributes to the body of knowledge on how uncertainty and perceived risks can influence ride-share service decisions in the South African context. This will provide a new understanding of how uncertainty and perceived risks, in ride-share service decisions, affect users' decisions and who are most affected by uncertainty and perceived risks. Transport planners and policymakers can use these insights on how uncertainty and perceived risks affect different individuals, to develop informed and realistic transport services, infrastructure, and user information. These insights may be used to incentivise individuals to engage in transport modes that are more efficient and sustainable for the cities.

Ride-share services, themselves, may greatly benefit from the findings of this work, as it will help them identify who and what increases or mitigates concerns about uncertainty and perceived risks. Such information and knowledge can be used within media campaigns and incentive programs to encourage individuals to engage in ride-share service trips, by better understanding how individuals are influenced by their frame of mind in the moment of decision, together with the associated uncertainty or perceived risks.

These insights are specific to South Africa's transport network. They will help transport stakeholders better understand how uncertainty and perceived risks affect ride-share service decisions, and what needs to be done to encourage a multi-modal transport culture by preventing or delaying car ownership in young adults.

Within the academic field, this research will, therefore, help address the shortage of research on ride-share services in South Africa. Furthermore, this research explores the more recent concepts and theories from the psychology fields in ride-share service decision investigations involving uncertainty

and perceived risks. The methodological approach and findings can provide a foundation for further studies into how uncertainty or perceived risks affect individuals in different transport modes.

1.5 Scope of Research

This research focuses on young South African adults' ride-share service decisions involving uncertainty or perceived risk. Individuals between the ages of 18-35 are, therefore, the focus population. The context of the South African transport network is expected to play a role in how uncertainties and perceived risks influence young adults and, therefore, is likely to generate context-specific knowledge. Research involving similar contextual elements, as in the broader South African context, will be able to use insights into how individuals are likely affected by the identified uncertainties and perceived risks.

Furthermore, while gender and sex are no longer seen by many as binary options in the liberal humanities literature, in this work, the terms are used in the traditional sense. In other words, the terms 'woman' and 'women' relate to females and 'man' and 'men' relate to males. While the questionnaire included the option for participants to name the gender identity they most identified with, the number of such participants was too small for meaningful statistical analysis. Therefore, other identified genders were not included in this work. Due to the importance of addressing gender-based violence in South Africa, the strict relation between gender and sex was deemed necessary.

In the next section, the structure of the thesis is outlined.

1.6 Structure of Thesis

The thesis contains ten chapters, the first of which introduces the research. Chapter 2 explores the relevant and current literature on ride-share services, focusing on South African examples. Furthermore, Chapter 2 describes and discusses the common theoretical underpinnings of these investigations, and theories that show promise or potential use for the aims and objectives of this work.

Chapter 3 describes and justifies the method and research approach used within this research. Details of the research philosophy and research approach are described. Furthermore, the research strategy and design are presented, including the criteria for the case study city, the *Belief States*, the potential factors appropriate for the investigation and the formulation of the ride-share service questions involving uncertainty and perceived risks. The chapter ends with an overview of the scientific method design for the experiments.

Chapter 4 presents the background and the motivation to use Cape Town as the case study city for this research. The Cape Town transport network, trends, and challenges are described. Additionally, an initial analysis of the ride-share services in Cape Town, using the NHTS 2020 data (Statistics South Africa, 2020), is presented. Finally, the selection and motivation for Cape Town as the case study is presented before a short summary of the chapter is provided.

Chapter 5 uses the background and details of Cape Town (presented in Chapter 3), together with the criteria for the different elements in the research design (presented in Chapter 4), to specify the Cape Town data and questions appropriate for the research design and experiments. Additionally, details of the data collection and data analysis approaches are described. Finally, details regarding the research ethics and necessary approvals are described.

Chapter 6 explores the responses in the collected data that did not have any pre-questions. Here, in this chapter, the results of the respondents are shown without any experimental effect. This is done for the ride-share service questions involving uncertainty and perceived risks, and the related transport perceptions, which are defined in Chapter 5.

Chapter 7 explores the effects that different initial *Belief States* have on the willingness to engage in ride-share service decisions involving uncertainty and perceived risks. The different initial *Belief States* are tested in two of the four designed experiments and are compared to the control data described in Chapter 6. Several illustrations are used to explore and highlight the changes visually.

Chapter 8 reflects on the perceived importance of related transport perceptions, when the pre-questions are the ride-share service questions involving uncertainty and perceived risks and compares it to the control data shown in Chapter 6. In other words, the chapter describes the effects of asking the ride-share service questions before the related transport perceptions influenced the perceived importance.

Chapter 9 presents the discussion chapter of the thesis, which pulls together all the findings from Chapters 5, 6, 7 and 8. The results are discussed and interpreted for their implications within the case study city and the relevant individuals.

Finally, Chapter 10 presents the conclusion of the thesis. Recommendations for future research directions are described based on the research findings. The conclusions of this research are also translated into practical policy suggestions for transport planners and policymakers. Further

recommendations for ride-share service companies are proposed that may address some of the uncertainty and perceived risks explored in the research.

2. Literature Review for Investigations into Young Adults' Ride-Share Service Decisions Involving Uncertainty and Perceived Risks

Ride-share services offer a way for young South African adults to use private vehicles without car ownership. However, limited research explicitly explores ride-share service trips involving uncertainty or perceived risks in South Africa. Furthermore, surrounding contextual elements (for example, being in an area perceived as dangerous or unfamiliar) or the individual's frame of mind, are aspects typically not incorporated into the design of investigations. Furthermore, how individuals make ride-share service decisions involving uncertainty or perceived risks, and if the individual's frame of mind influences these decisions, is not well established.

This literature review examines what is currently known about individuals who use ride-share services, focusing on South Africa. However, comparisons to different cities internationally are included to indicate variations in aspects of ride-share services and their impacts. This was done to ensure the scope stayed close to the topic of investigation, while still including insights and comparisons seen in the international literature. Thus, known factors, influencing individuals to engage with ride-share services, are identified in the first section of this chapter.

The second section of this chapter expands on the initial discussions of the five paradigms of transport research and policy of Jones (2009) that were introduced in Chapter 1. This section provides an overview of the theories successfully used in transport modal decision research. It will also consider the next step in applying theories closer to human decisions, especially when considering uncertainty and perceived risks in investigations of ride-share services in South Africa.

The third section of this chapter describes the identified research gap and proposes several hypotheses that will be investigated in this thesis. The last section summarises the discussions of this chapter.

2.1 Status Quo of Ride-Share Service Decision Investigations with a Focus on South Africa

The need for more academic research on ride-share services in South Africa is highlighted by Giddy (2019), Fenton et al. (2020) and Berndt et al. (2021). The lack of research in South Africa is contributed to poor cooperation between ride-share services and researchers, regarding the availability of data (Giddy, 2019).

Vanderschuren and Baufeldt (2018) were the first to estimate the ride-share service trip purposes using data from the National Household Travel Survey (NHTS, 2013) for the case study City of Cape Town. These trip purposes for Cape Town ride-share services were extrapolated from metered taxi trips, and the results are displayed in Figure 3, showing predominantly utilitarian trip purposes.

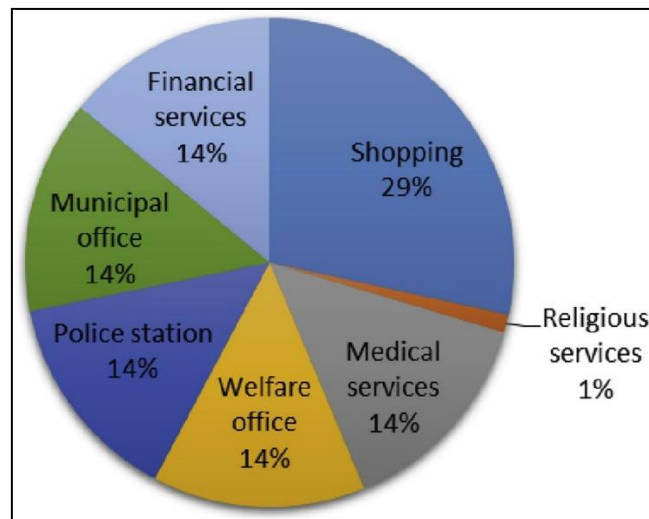


Figure 3: Vanderschuren and Baufeldt (2018) Estimated Trip Purposes for Ride-Share Services in Cape Town

Shopping trips were estimated to be the most popular reason for using ride-share services in Cape Town (29%). An equal share of 14% was then seen for the trip purposes of medical services, welfare offices, police stations, municipal offices, and financial services. A final 1% was estimated to be used for trips to religious services.

Vanderschuren and Baufeldt (2018) also estimated the lengths of these trips, noting that 44% of ride-share service trips would be less than 15 minutes, and 47% of trips would be between 16 and 30 minutes. A small minority (6%) of trips would be between 31 and 45 minutes, and only an estimated 3% of trips would be longer than 45 minutes.

These estimations align with the findings of Fenton et al. (2020) in their investigation of ride-share usage among university students in Johannesburg. They used a mixed-method approach consisting of an online questionnaire (sample size of 81) to establish qualitative general interactions with ride-share services and semi-structured interviews (sample size of five) to explore insights into the qualitative aspects and decision-making processes used in ride-share service decisions. Descriptive statistics, including multivariate and correlation analysis, were used to analyse the results.

Fenton et al. (2020) found that 61% of ride-share service trips were short, with the average trip length between 3-10 km. However, it is possible that the sample population of Johannesburg University

students skewed the trip length to shorter distances, due to limited disposable income or allowances. The second limitation of Fenton et al. (2020) is the small sample size of the semi-structured interviews. However, insights into challenges facing ride-share service users were still identified. The challenges identified are elaborated on later in this chapter. Moreover, the challenges identified in the semi-structured interviews were not demonstrated to be valid or statistically significant within the larger population of Johannesburg University students.

Longer trip distances in ride-share services have also been captured in South Africa. Giddy (2019) conducted an online survey using a social media platform (i.e. Facebook) to distribute the survey to neighbourhood groups. Basic descriptive statistics were used to analyse the results of the fixed-response questions. In contrast, the open-ended questions were analysed using a thematic content analysis, resulting in categories found in the responses, which were then quantified. Giddy (2019) found that 61% of the respondents stated that the typical distance for ride-share service trips was 0-15 km. A further 29% indicated that trips were between 16 km and 30 km, while 10% indicated trips longer than 31 km.

However, the respondents (Giddy, 2019) were also skewed towards middle-high income females, typically older than the sample population of Fenton et al. (2020). A second issue with the sampling done by Giddy (2019) was pointed out by Berndt et al. (2021). Berndt et al. (2021) highlighted that the selection bias of the platform used (namely Facebook) to distribute the surveys could not be adjusted or mitigated in Giddy (2019). This is despite Giddy (2019) attempting to distribute the survey to various neighbourhood groups. A strength of the investigation by Giddy (2019) is the sample size of 309, which is substantially larger than the study of Fenton et al. (2020).

The utilitarian expectations of ride-share trip purposes estimated by Vanderschuren and Baufeldt (2018) are not always seen in empirical research. Giddy (2019), for instance, captured the trip purposes of Uber trips (Table 1), indicating a much higher share of leisure trip purposes. However, among Giddy's respondents, 94% had vehicles or access to a private vehicle. The results, therefore, may only show a limited view of individuals with vehicles. The utilitarian ride-share service trips shown by Vanderschuren and Baufeldt (2018) are more likely to be completed by individuals without a vehicle or access to a private vehicle.

Table 1: Johannesburg Uber Trip Purposes

<i>Places to get to/from</i>	<i>Count</i>	<i>Percentage (%)</i>
<i>Night out</i>	238	77
<i>Party</i>	205	67
<i>Airport</i>	202	66
<i>Dinner</i>	181	59
<i>Friend/Family's house</i>	175	57
<i>Concert/Music event</i>	170	55
<i>Bar</i>	159	52
<i>Work</i>	119	39
<i>Sporting event</i>	115	37
<i>Bus/Train station</i>	92	30
<i>Hospital</i>	40	13
<i>Other</i>	16	5
<i>Access specific areas</i>	14	5

Source: Giddy (2019, p.122)

The usefulness of ride-share services for evening leisure activities is also seen in the investigation of university students in Johannesburg by Fenton et al. (2020), with most respondents using ride-share services for 'going out at night'. However, utilitarian trip purposes, such as commuting to the university, shopping, visiting friends, or going to the airport, are also captured in the results of Fenton et al. (2020). This empirical finding supports the prediction of Vanderschuren and Baufeldt (2018) that shopping trips are a significant purpose for ride-share services.

The limited literature on ride-share services in South Africa aligns, in some respects, with the international literature. Ride-share service users tend to be young adults (younger than 35 years) and have higher levels of education than the general population. This is true for cities in developed countries, such as the USA (Sikder, 2019) and South African cities (Giddy, 2019; Molobi et al., 2020).

In the South African context, Molobi et al. (2020) investigated ride-share services using the Technology Acceptance Model (TAM) by Davis (1989) in Johannesburg, South Africa. Molobi et al. (2020) further defined several external variables such as **age, gender, and level of education**. For the case study city of Johannesburg, they found that **females and younger age groups are more likely to use ride-share services**.

Molobi et al. (2020) found that ride-share service users tended to be younger, with roughly half of the respondents between 20-29 years old. Molobi et al. (2020) included areas that were not specifically tertiary educational areas, such as the Rosebank Mall (Gautrain Station) and Sandton City (Gautrain Station), to improve the sampling. However, Giddy's (2019) investigation into Uber usage in Johannesburg indicated that older adults also use ride-share services, with 20% of the respondents between 40 and 49, 18% between 50 and 59, and a further 6% over 60. Therefore, while most users

in South Africa are young adults, other age groups also utilise ride-share services. Furthermore, the difficulties of obtaining data on ride-share services in a survey format are also evident, due to the flexibility of these services, which are commonly decentralised for most requested trips.

Molobi et al. (2020) included several variables typical of a TAM investigation: perceived usefulness, perceived ease of use, self-efficacy, and the additional variable of perceived risks. Molobi et al. (2020) described perceived risks as the 'combined effects of probabilities, the uncertainty involved in a purchase decision, and the ramifications of taking an undesirable action' (Molobi et al., 2020, p.47). Perceived risk is more about the consumer's perception towards the uncertainty of purchasing the product or service that may result in doubt. While Molobi et al. (2020) found that perceived risk (of the purchase decision) was non-significant in their model, other uncertainties, and perceived risks, that explicitly refer to personal safety or security, were not explored.

The relationship between different uncertainties, perceived risks and ride-share services is complex. Fenton et al. (2020) argue that, while ride-share services provide a safe additional alternative for South Africans, these transport services' perceptions are subjective and meshed with the context of the cities where the ride-share services operate. Individuals must navigate ride-share service decisions involving these threats, and the resulting uncertainty and perceived risks.

As indicated, gender is a significant characteristic in ride-share service decisions. Gender is explored in detail in the next section, as the first factor of ride-share service usage in the broader context of transport modal decisions.

2.1.1 Gender in Transport Modal Decisions, with a Focus on Ride-Share Service Usage

Previous studies have identified differences between females and males in their experiences and travelling characteristics outside South Africa in several different transport modes (Ng and Acker, 2018; Vasquez-Henriquez, 2020). Differences between females and males have been found in the decisions and experiences of ride-share services. These differences between genders in transport investigations often depend on where the studies were conducted (McIlroy, 2023). For example, no gender differences were observed in young adults using ride-share services in Canada's Greater Toronto and Hamilton Areas (Habib, 2019). However, a study in Nepal shows that the gender of drivers and users can significantly impact ride-sharing services' success and individual experiences (Hamal and Huijsmans, 2022). They showed that in a society where gender norms influence the ability of females to engage with ride-share services, additional aspects need to be considered. A significant

factor in the success of ride-share services being accessible to females included having a large percentage of the available drivers being female, and normalising females being drivers through media campaigns.

Saxena and Yadav (2023) used focused group discussions in six locations to explore gender differences in multiple transport attributes in the context of India. They found that females were most likely to prioritise travel time and safety. At the same time, males perceived travel costs to have the most significant importance in their travel decisions. This was established through a Multi-Criteria Decision-Making (MCDM) approach, which included factors such as 'travel time', 'travel cost', 'convenience', 'accessibility', 'comfort level', 'safety' (understood to include both personal security and road safety), 'privacy' and 'hygiene and cleanliness' (Saxena and Yadav, 2023).

The role of gender in transport modal decisions and travel behaviours has also been found to differ between trends seen in the international literature and South Africa. Vanderschuren et al. (2019) show that, internationally, females tend to make shorter, more frequent trips that are often linked to other trips. Yet females and males in South Africa do not significantly differ in terms of travel distances and travel times. However, Vanderschuren et al. (2019) did find that transport mode use and trip purposes differed significantly between females and males for public transport modes, due to the differences in experiences of harassment, while on public transport modes. Therefore, the influence of gender may vary across different contexts.

In South Africa, some evidence shows that females are more likely to use ride-share services, due to the additional safety and security features, compared to other public transport modes. Giddy (2019) and Molobi et al. (2020) investigated ride-share service usage in Johannesburg, South Africa. Giddy's (2019) sample was skewed mainly toward females, with 81% of the respondents being female. Giddy (2019) speculated that the sample was skewed towards females due to ride-share services' safety and security advantages. Molobi et al. (2020) had less skew towards female participation in a survey, with 63% of respondents being female. However, Molobi et al. (2020) also found that females were likelier to use ride-share services. The issue of unbalanced gender in surveys is a known challenge. Research indicates that females are more likely than males to respond or participate in surveys (Smith, 2008). Other studies show that females are notably more likely to engage in surveys involving communication and exchanging information, while males, instead, seek information online (Jackson et al., 2001). This issue would be resolved if actual data from ride-share service companies were made available to researchers so that survey data could be calibrated.

Despite the limitations of survey data, insights into challenges were still found. Individuals, especially females, still have concerns regarding ride-share services. Giddy (2019) found that, when asked about specific locations, 37% of the respondents said they avoided using ride-share services at specific locations, due to concerns about violence or retaliation from metered taxi drivers. This is supported by Fenton et al. (2020), who investigated ride-share usage of university students in Johannesburg, South Africa, using a mixed methods approach involving a questionnaire and semi-structured interviews, where violence from metered taxis was specifically cited by the respondents.

Fenton et al. (2020) further found that, while females in South Africa use ride-share services to avoid walking trips that are perceived to be unsafe, this does not necessarily mean that the ride-share services themselves are completely free of concern. One female respondent stated that she still felt unsafe despite having good experiences with ride-share services. A second respondent expressed unwillingness to use **ride-share services alone** (Fenton et al., 2020). So, while ride-share services present a safer, more secure form of transport for many individuals overall, there is evidence that ride-share services have their own associated uncertainties or perceived risks. Individuals, especially females, may incorporate additional strategies and tactics, such as sharing a ride-share service trip with a trusted or known person or sharing their trip location with family members. Yet, how much these strategies or tactics contribute to the willingness to use ride-share services in South Africa, is also not well established.

The inconsistencies in gendered usage of ride-share services raise the question of whether there were characteristics, fundamental to gender, responsible for individuals perceiving their environment or options so differently and, thus, influencing their decisions. One theory from the psychology field is the 'Big Five' theory, which is a reliable and systematic approach to determining personality traits using factor analysis, and has been used to determine statistically significant differences between women and men (Eysenck, 1992). The five personality traits are:

1. Openness to experience,
2. Conscientiousness,
3. Extraversion,
4. Agreeableness, and
5. Neuroticism.

Research shows significant differences in traits between women and men (Back et al., 2006; Schmitt et al., 2008; Tellegen, 1984). A comprehensive study in 55 countries showed that women scored higher than men in four of the Big Five (Schmitt et al., 2008); women tend to be higher in conscientiousness, agreeableness, extraversion, and neuroticism. Considering decisions involving uncertainty and perceived risk, the difference in neuroticism becomes particularly interesting. High neuroticism can be described as heightened sensitivity to negative stimuli (Tellegen, 1984), likely influencing individuals' decisions involving uncertainty or perceived risks. This is supported in the literature, as women are generally found to be more risk-averse in the context of economic decisions or financial investments (Sarin and Wieland, 2016). However, Garrard et al. (2008) also captured differences in risk aversion between females and males, in cycling. Another transport-related example is shown by Kyriakidis et al. (2015), who found differences between females and males in the trust and use of automated vehicles, with females being more risk-averse than males to automated vehicles.

Furthermore, gender is likely to be an unavoidable differentiating factor in ride-share service decisions in South Africa due to the high levels of gender-based violence (Fenton et al., 2020). The perceived necessity to use private vehicle transportation to ensure safety and security was also noted by Giddy (2019) in a sample population that was 81% female. Therefore, the second factor of ride-share usage, explored in the next section, is the potential of owning one's private vehicle or having access to a private vehicle on ride-share service usage.

2.1.2 Access and Ownership to a Private Vehicle in Ride-Share Services Decisions

Various factors influence private vehicle ownership. These factors could include socio-demographic characteristics, life events of households, and location or relocation (Haque et al., 2019). Furthermore, researchers show that the built environment significantly impacted private vehicle ownership, even after considering the individual's socio-demographics (Ding et al., 2017; Van Acker and Witlox, 2010). Therefore, both city and individual factors contribute to whether personal vehicles are used and are explored in this section.

In the European literature, Van Acker and Witlox (2010) explore the role of private vehicle ownership and the built environment. The built environment was explored within several concepts, including spatial density (higher densities lend themselves to more efficient public transport modes and active modes, such as walking and cycling), spatial diversity (diverse land use has a similar effect to what higher density has on transport mode selection), spatial design (areas that lend themselves to walking

also have a negative influence on car usage) and accessibility (the ability to reach a specific location using a variety of transport modes). They show that private vehicle ownership mediates the relationship between the built environment and car ownership.

Van Acker and Witlox (2010) also show that the relationship between income and car ownership, at least in a European setting, is indirect. Therefore, car ownership is not automatic once individuals can afford a vehicle, as the built environment also plays a role in encouraging other modes of transport. Those with higher incomes were shown to travel further distances regardless of transport mode. The effect of the built environment on car ownership should be addressed in policies aiming to reduce private vehicle ownership. Effects of increasing density and diversity within the built environment are integral in enabling individuals to adopt more multi-modal decisions, namely, less private vehicle ownership.

Reducing private vehicle usage is one of the main target behaviours in transport policies (De-Toledo et al., 2022; Kent, 2014). However, the allure of the personal vehicle is not to be underestimated. Even with an attractive and economical public transport network, individuals may still wish to own personal vehicles. Innocenti et al. (2013) show that even in developed countries, decisions to own a car or the preference for private vehicle trips, often fail classical rationality or utility models. Usually, the decision to use a personal vehicle is not economic but related more to the human side of individuals. This is supported by Kent (2014), who found in an investigation of a series of semi-structured in-depth interviews of employees, at three companies in Sydney, that private vehicle usage is motivated by more than just utilitarian reasons, such as timesaving. Factors such as flexibility, freedom of movement, reliability and the sensory experience provided by the private space of the vehicle, proved to be important aspects that support the continued use of private vehicle trips over other types of transport modes, such as public transport modes or active transport modes, such as walking or cycling (Kent, 2014).

Furthermore, strong cognitive heuristics and biases are cited as reasons individuals favour personal vehicles over other modes of transport. Innocenti et al. (2013) found such cognitive heuristics and bias effects in car usage in a laboratory experience of university students in Italy. They investigated factors determining travel mode choice and found that the rational, logical, cost-effective transport mode selection was not typically made. Innocenti et al. (2013) explain this effect using the work of Kahneman's (2011) description of System 1 and System 2, which forms the basis for Prospect Theory, which will be explored in more detail in the second part of this chapter. System 1 refers to quick,

intuitive reasoning associated with lower cognitive effort, while System 2 refers to the slower, logical, and analytical processes associated with higher mental effort (Kahneman, 2011). Several future steps are recommended by Innocenti et al. (2013), including ‘investigating how providing more customer-focused and personalised information on transport modes can improve travellers’ awareness of the economic consequences of their choices’ (Innocenti et al., 2013, p. 167). The study thereby emphasises that transport policymakers need further understanding of how to better appeal to the rational decision processes of individuals, as rational choices are not being selected.

This is considered an important approach in European cities, where the public transportation networks are well established with, generally, higher levels of service, and rational arguments may persuade individuals to switch to more sustainable transport modes and reduce private vehicle usage. In South Africa, however, transport modes are often not of a service level that can be attractive to individuals based on an economic argument, and individuals switch to private vehicles as soon as possible.

The challenge of capturing a comprehensive understanding of which individuals use ride-share services is often influenced by whether respondents have access to a private vehicle or own the vehicle. The research that has been conducted, such as Giddy (2019) or Berndt et al. (2021), draws findings from sample groups that are over 80% car owners. Such samples may not fully represent the more frequent ride-share service users (no private vehicle) or the ‘missing middle’⁴ in South Africa.

Fenton et al. (2020) found evidence that ride-share services were mainly used for leisure activities **at night** and to ‘fill the gaps’, namely, when public transport modes are inaccessible or inefficient for individuals or when using their private vehicles is undesirable, due to inconveniences, such as parking or concerns like vehicle theft⁵. Individuals also typically used ride-share services after 20h00. These findings are based on a sample where approximately half of respondents own a private vehicle. While the study area had numerous transport options, the transport network was poorly integrated and sometimes unreliable or confusing. The motivating reasons for using ride-share services included a lack of public transport options and not wanting to drink and drive. This indicates that ride-share services may contribute to a multi-modal culture by supplementing the public transport network that is not well integrated, or during off-peak times.

⁴ The term ‘missing middle’ is described in Chapter 1.

⁵ This may be a particularly South African concern.

So, while it may not be cost-effective to use ride-share services for all trips, ride-share services offer individuals the advantages of private transport without all the obligations or costs. This is particularly relevant in South Africa, where most of the cities still experience spatial inequity from the heritage of apartheid planning and have been developed in a car-centric manner (Fenton et al., 2020; Vanderschuren and Baufeldt, 2018). The further failure to provide user-centric public transport services compounds the transport demand problem in South Africa (Fenton et al., 2020; Baufeldt and Vanderschuren, 2023).

For example, in Cape Town, the differences in travel time per trip for different modes are significantly different. This is especially true between private vehicles and public transport modes, such as trains, buses, and Minibus Taxis (MBT). Hitge and Vanderschuren (2015, p. 39) show, in Table 2, that public transport modes perform poorly in terms of time (including waiting and walking) and distance travelled when compared to private vehicle trips ('car'). Table 2 reveals that the travel time for all public transport modes is significantly more than for a private vehicle. However, the best public transport mode is MBT, which has the lowest relative to the car score of 2.20.

Table 2: Travel Time per Trip Component and Distance per Mode

Travel Time	Car	Train	Bus	MBT	All Public Transport
In-vehicle (mins.)	42.1	55.5	63.8	51.8	57.1
Waiting (mins.)	0.0	31.0	33.4	22.1	29.0
Walking (mins.)	0.0	35.5	23.8	18.5	27.3
Total (mins.)	42.1	122.0	121.0	92.4	113.4
Relative to car	1.00	2.90	2.88	2.20	2.70
Avg. distance (km)	24.65	30.06	26.17	27.19	27.81

Source: Hitge and Vanderschuren, 2015

Vanderschuren and Baufeldt (2018) illustrate that private vehicle ownership strongly correlates with household income, with the top 20% of households having substantially more vehicles than the following 20%. Figure 4 illustrates this discussion by showing four different groups of households with their average income. The group with the lowest household income accounts for 40% of the individuals in Cape Town, while the other three groups represent 20% of the households each (Vanderschuren and Baufeldt, 2018). Compared to the findings from Australia (Currie and Delbosc, 2013) and the UK and the USA (Nutley, 1996), the top 20% of income households in Cape Town had relatively low levels of private vehicle ownership, with 35% of these households not owning any

private vehicle. Yet only 1%-4% of high-income households in Australia have no vehicle (Currie and Delbosc, 2013). This is similar to findings in the USA and UK, where in low-income households, 84% had at least one private vehicle. This indicates a fundamental difference between the accessibility of private vehicle ownership in Cape Town and cities in developed countries, and is consistent with older studies (e.g., Nutley, 1996).

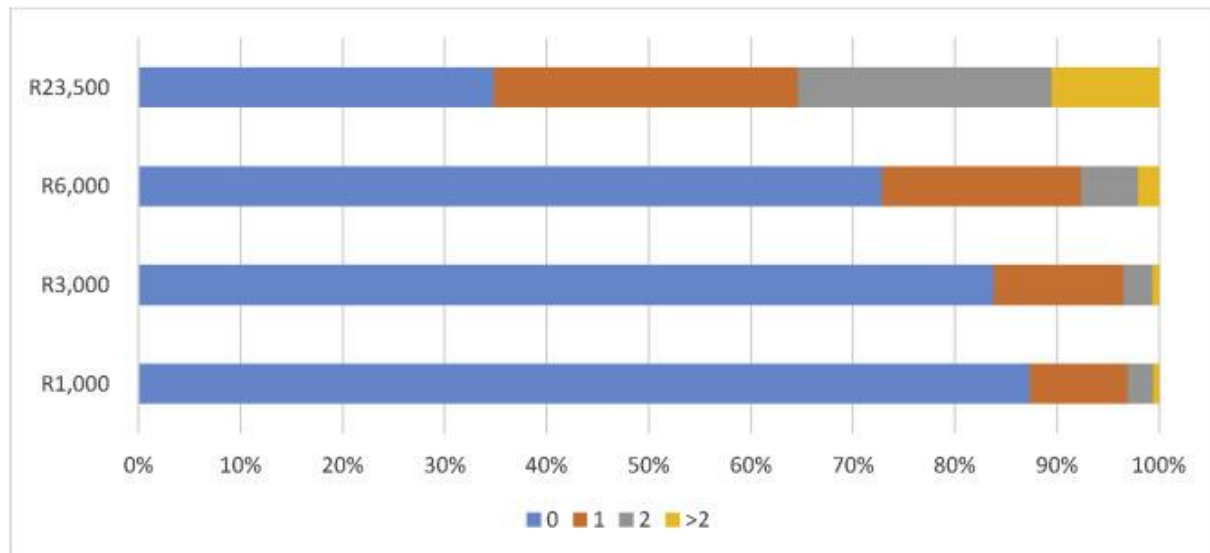


Figure 4: Private Vehicle Ownership for Different Income Groups in Cape Town: Average Income per Group Displayed (Vanderschuren and Baufeldt, 2018)

The result is that cities in South Africa, such as Cape Town, are experiencing increased car ownership and use. The annual increase in light passenger vehicles in Cape Town between 2001 and 2013 was 3.5%, despite the population growth rate for the same timeframe only being 2.6% (Behrens et al., 2015). However, there are opportunities to hinder individuals from switching to completely private vehicle trips in the South African context. The top three stressors leading to mode-switching were found to be changes in job locations (58%), changes in residences (23%) and acquiring a car for the first time (19%) in Cape Town (Adjei and Behrens, 2023). While the individuals who acquired a car for the first time switched completely to private vehicle transport, the other two stressors resulted in more diverse multi-modal behaviours (Adjei and Behrens, 2023). Adjei and Behrens (2023) conclude that if sustainable transport modes are to be encouraged, and single occupancy vehicle use reduced, individuals must be targeted before starting their job search. Therefore, young South African adults who do not currently have a private vehicle are likely to purchase one in the upcoming years. A large percentage of young South African adults at tertiary educational institutions fit this description.

In the South African context, it can be summarised that middle to high-income groups still use ride-share services, but mostly for leisure purposes, despite being car owners or having access to a private vehicle. In more mixed groups, such as the ride-share investigations that focus on tertiary students (i.e. lower levels of car ownership), ride-share services are also used for leisure activities; however, other more utilitarian trip purposes, such as commuting and shopping trips, are also seen. No further studies, in the South African context, were found that unpacked the relationship between access to a private vehicle and ride-share service usage for trips involving related uncertainty or perceived risks.

At the time of designing the survey, the COVID-19 pandemic developed. This affected the possibilities of investigating ride-share services and the kinds of uncertainty that could be explored. As an extended event that affected all aspects of public life, controlling for or mitigating the pandemic's effects was impossible in this research's investigation. The COVID-19 pandemic also presented itself as a new uncertainty or perceived risk, making it relevant to be included as an aspect of this research. The COVID-19 pandemic is described in the next section as the final major factor in ride-share service decisions.

2.1.3 The Special Event of the COVID-19 Pandemic

The COVID-19 pandemic caused great uncertainty. Businesses and markets were greatly affected by the COVID-19 pandemic, both internationally (Altig et al., 2020; Szczygielski et al., 2021) and locally (Anakpo and Mishi, 2021). In South Africa, the tourism industry was particularly hard hit (Rogerson, 2021; Rogerson and Rogerson, 2021; Sucheran, 2022). Educational institutions were also affected globally (Bozkurt et al., 2020; Hung et al., 2021; Tang, 2022) and locally in South Africa (Bozkurt et al., 2020; Naidoo and Cartwright, 2020). Overall, the effects of the COVID-19 pandemic on the South African economy were predicted to shift the income distribution curve so that more households would fall under the poverty line (Chitiga-Mabugu et al., 2021). The COVID-19 pandemic had a direct consequence on the way individuals were able to engage in public life. Most relevantly, the transport network in South Africa was also directly affected (Luke, 2020).

While governments issued regulations on how the health risk of COVID-19 could be mitigated, especially in public transport modes, implementing such mitigation measures was largely uncontrolled in South Africa (Venter et al., 2020). Therefore, South Africans were mostly left to mitigate (or not) their risk of COVID-19 by themselves and were either exposed (or not) by the behaviours of those around them. The main effect of the COVID-19 pandemic on the transport

networks was that public transport modes experienced significant drops in ridership, most notably during lockdowns globally (Jenelius and Cebecauer, 2020; Zhang et al., 2021). Public transport decreased between 50% to more than 90% in many cities during the first wave of lockdown of the COVID-19 pandemic (Gkiotsalitis and Cats., 2021; Shortall et al., 2021).

Understanding the effects of the COVID-19 pandemic on transport is now emerging, as lockdowns have been lifted and the 'new normal' is established. Researchers and governments look to understand what happened to individuals' transport modal decisions during the peaks of COVID-19, but more importantly, to understand the long-term impacts (Behrens and Newlands, 2022; Chakwizira, 2022). This section discusses the different levels of lockdowns in South Africa and the transport implementations, in detail, and an extract of the summary by Chakwizira (2022, p. 133) is presented in Table 3. Chakwizira (2022) unpacks the COVID-19 pandemic in South Africa and its effect, focusing on the transport systems.

Due to COVID-19, transport modal decisions were altered, or complete trip avoidance changes were seen. This is especially true during the lockdown periods, as transport demand and supply decreased (Beck and Hensher, 2020; Jenelius and Cebecauer, 2020; Venter et al., 2020; Zhang et al., 2021). The broader effects of COVID-19 on South Africa and sub-Saharan Africa are also substantial.

Behrens and Newlands (2022) focus on identifying the travel impacts of COVID-19 in sub-Saharan Africa using secondary big data, as well as data from a two-wave Delphi panel survey of regional experts (n=15). The results predict that the long-term impacts will be most felt by low-income households living in the peripheral areas of urban spaces, as public transport services may be reduced, thus reducing accessibility and mobility of passengers reliant on these transport services.

Table 3: Extract of Summary of COVID-19 Lockdown Levels in South Africa and Transport Implications

Level	Transport Restrictions	Movement Restrictions	Lockdowns Dates ⁶
COVID-19 pandemic declared a pandemic by the WHO on 11 March 2020 (Zibaseresht, 2020)			
Level 5: High virus spread, and/or low health system readiness	Bus services, taxi services, e-hailing and private motor vehicles - operate at restricted times, with limitations on vehicle capacity and stringent hygiene requirements	No inter-provincial movement of people, except for transportation of goods and exceptional circumstances (e.g. funerals)	26.03-30.04.2020.
Level 4: Moderate to high virus spread, with moderate readiness	Bus services, taxi services, e-hailing and private motor vehicles - operate at all times of the day, with limitations on vehicle capacity and stringent hygiene requirements		01.05- 31.05.2020 28.06-25.07.2021
Level 3: Moderate virus spread, with moderate readiness	Bus services, taxi services, e-hailing and private motor vehicles - operate at all times of the day, with limitations on vehicle capacity and stringent hygiene requirements. Limited passenger rail restored, with stringent hygiene conditions in place. Limited domestic air travel, with a restriction on the number of flights per day and authorisation based on the reason for travel		01.06-17.08.2020
Adjusted Level 3	No person can use, operate or perform any service on any form of public transport without wearing a face mask. Public places and transport operators and systems to be serviced with hand sanitisers. All land ports of entry of the Republic are closed, until February 15, 2021, including the ports of entry which were opened under Alert Level 1, except for ports of entry designated and permitted for cross-border and international travel and trade, as gazetted by Minister and in compliance with categories of goods, services and passengers allowed to transit	Curfew from 21h00-06h00 daily unless exempted through a travel permit up until February 1, 2021 Curfew from 23h00 until 04h00 daily unless exempted through a travel permit from February 2, 2021	29.12-28.02.2021 16.06-27.06.2021 26.07-12.09.2021
Level 2: Moderate virus spread, with high readiness	Domestic air travel restored. Car rental services restored	Movement between provinces at Level 1 and 2 restrictions	18.08-20.09.2020 31.05-15.06.2021* 13.09-30.09.2021*
Level 1: Low virus spread, high health system readiness	All modes of transport, with stringent hygiene conditions in place	Inter-provincial movement allowed, with restrictions on international travel	21.09-28.12.2020 01.03-30.05.2021* 1 October 2021*

Source: Chakwizira, 2022

⁶ Source: <https://www.gov.za/COVID-19/about/about-alert-system>. Adjusted levels indicated with *, except for Level 3 which has its own row in the table.

Behrens and Newlands (2022) stress that transport planning practices must be more resilient to uncertainty. Mitigation strategies and financial support for transport operators should be developed for the local contexts to improve transport planning practices to ensure the COVID-19 impacts are addressed. The uncertainty and effects of COVID-19 are very likely to continue into the post-COVID-19 world, with young adults, the 'missing middle', and those more disadvantaged and excluded being affected most.

The perceived risk of infection on the different transport modes was often cited in the international literature as the reason behind the dramatic change in transport mode decisions. Shared transport modes, typically public ones, such as buses, trains, and Bus Rapid Transport (BRT), were consequently avoided and replaced with alternatives, such as bike trips, motorbikes, walking, or private vehicle trips (Dingil and Esztergár-Kiss, 2021; Jenelius and Cebecauer, 2020; Scorrano and Danielis, 2021; Zafri et al., 2021a). The effects of COVID-19 on different shared modes are briefly explored to present an overview of the degree to which transport modes were affected.

Transport modes were further positively or negatively affected, depending on the local context and measures employed (Zafri et al., 2021b). In the Australian context, for instance, all shared modes were reported to have experienced a decline. These include public transport, rideshare, bike-share, and carshare, while private vehicle usage remained relatively high (Beck and Hensher, 2020). However, in South Africa, shared modes, such as MBTs, still operated at 100% capacity during the lockdown phases (Venter et al., 2020). Therefore, the impact of COVID-19 is strongly related to the city, the adopted COVID-19 policies, and the people.

Transport modes that presented less contact with fewer individuals were, generally, less negatively affected. Ride-share services can be considered in a grey zone regarding how these services may have been perceived during the COVID-19 pandemic. While these transport services present a reduced risk compared to typical public transport modes, they still involve the risk of infection from the driver to the passenger, or vice versa. Individuals are likely to respond, depending on their perception of the risk of COVID-19 from the driver and what alternative modes are available (Baufeldt and Vanderschuren, 2023).

Overall, Uber reported a loss of \$2.9 billion in the first quarter of 2020, indicating a dramatic drop in ridership (Scheepers and Bogie, 2020). The latest research by Lei and Ukkusuri (2022) raises further doubts and uncertainty about the future of ride-share services, due to the

COVID-19 policies, based on analysis in Chicago and New York cities. Using a Bayesian structural time series model, Lei and Ukkusuri (2022) investigated the influence of COVID-19 policies on ride-share services. They found that, while mobility and business restrictions resulted in a quick and consistent decline in ridership, lifting the restrictions did not result in a symmetrical recovery. Lei and Ukkusuri (2022) further indicated that while bike-sharing was predicted to be relatively stable, the results for ride-share services were less convincing to show a return to previous levels.

Not only is the impact of COVID-19 on ride-share services city-specific, but it is also socio-economic-specific. Gaber and Elsamadicy (2021) indicated that COVID-19 did not decline ridership for ride-share services in Egypt. However, this result is not assumed to be transferrable to other countries or cities. In an American study Brown and Williams (2021) show that ride-share services were unevenly distributed during the COVID-19 pandemic between higher-income areas and lower-income areas. Higher-income areas and those with more transit commuters showed greater trip reductions during the pandemic. However, older residents and a greater proportion of 'Black, Hispanic/Latin, and Asian' residents relied more heavily on ride-share services during the pandemic (Brown and Williams, 2021, p. 12). This highlights that the impact of COVID-19, and the related policies on ride-share services, is likely city and context-specific.

Whether similar differences were experienced in South Africa is unclear. However, it seems South Africans experienced the COVID-19 pandemic differently, primarily due to socio-economic factors such as income and age. Gittings et al. (2021) conducted semi-structured telephone interviews with South African adolescents and young adults. They found that young South African adults were particularly vulnerable to the consequences of the COVID-19 pandemic (Gittings et al., 2021). This was partially attributed to the higher uncertainty and risks experienced in many aspects of life in South Africa, especially for young adults studying at tertiary education institutions.

On a positive note, Hensher (2020) highlights that several opportunities can be established from the COVID-19 pandemic. Hensher (2020) sees the foremost opportunity in how companies and individuals work, namely, more from home. Benefits from the changes seen during the pandemic include reduced transport demand, reduced congestion, and less crowding on public transport modes. Yet Hensher (2020) warns that, unless efforts are made

to improve shared modes, the post-COVID-19 world might encourage individuals to abandon shared modes and opt for private vehicles as their preferred mode of transport. Considering the inflexibility of car ownership, these efforts need to be part of establishing the ‘new normal’.

The recommendations from Hensher (2020) may be valid for developed economies, but they are less likely to apply in less developed economies. Specifically, South Africa has a different potential for working from home and the COVID-19 consequences on transport modes. Venter et al. (2020) state that work trips had nearly recovered to pre-Covid levels, based on data from the *COVID-19 Community Mobility Report of 30 August 2020*⁷(Google, 2020a). They only found an 8% difference from the baseline, defined as the median value, for the corresponding day of the week during the five weeks, 3 January – 6 February 2020. This indicates that, unlike more developed economies, it is questionable whether work-at-home will be feasible for many workers in developing countries, in the long term.

The impacts of the lockdowns in South Africa can be seen in the *COVID-19 Community Mobility Report of 31 July 2020* (Google 2020b), where mobility trends for places of work were **37% lower than the baseline**. Based on Table 3, this corresponds with the effects of the Level 3 lockdown restrictions in South Africa. However, the last available *COVID-19 Community Mobility Report of 15 October 2022* (Google, 2022a) confirms the expectation of Venter et al. (2020), as mobility trends to places of work were **34% higher than the baseline. This indicates that COVID-19 had no long-term reduction of mobility due to increased working from home in South Africa, and indeed transport demand has increased.**

Furthermore, in Figure 5 the changes from the baseline in the data of Google’s *COVID-19 Community Mobility Report of 31 July 2020* (i.e. in lockdown) and *15 October 2022* (after hard lockdowns were over) for the Western Cape are insightful for the long-term impacts of the pandemic. This is done for four categories of mobility trends, namely ‘Workplaces’⁸; ‘Public Transport’⁹; ‘Supermarket and Pharmacy’¹⁰; ‘Retail and Recreation’¹¹(Google, 2020b; Google,

⁷ Available at: <https://www.google.com/covid19/mobility/>.

⁸ Described in report as ‘Mobility trends for places of work’ (Google, 2022a)

⁹ Described in report as ‘Mobility trends for places that are public transport hubs, such as underground, bus and train stations.’ (Google, 2022a)

¹⁰ Described in report as ‘Mobility trends for places such as supermarkets, food warehouses, farmers markets, specialty food shops and pharmacies.’ (Google, 2022a)

¹¹ Described in report as ‘Mobility trends for places such as restaurants, cafés, shopping centres, theme parks, museums, libraries and cinemas.’ (Google, 2022a)

2022a). All categories of mobility trends, except for 'Public Transport' have recovered from the declines seen during the lockdowns (31 July 2020) and have increased compared to the baseline. This validates the prediction of Venter et al. (2020) that the negative impacts of the COVID-19 pandemic on official public transport modes will remain in the long-term, at least for the Western Cape. Unfortunately, a comparison on national level for South Africa was not possible, as the data of several provinces (namely, Mpumalanga, North West, and Northern Cape) were marked to be of poor quality and having insufficient privacy thresholds (Google, 2022a). Thus, the overall values for South Africa in the *COVID-19 Community Mobility Report of 15 October 2022* (Google, 2022a) were judged to be unreliable.

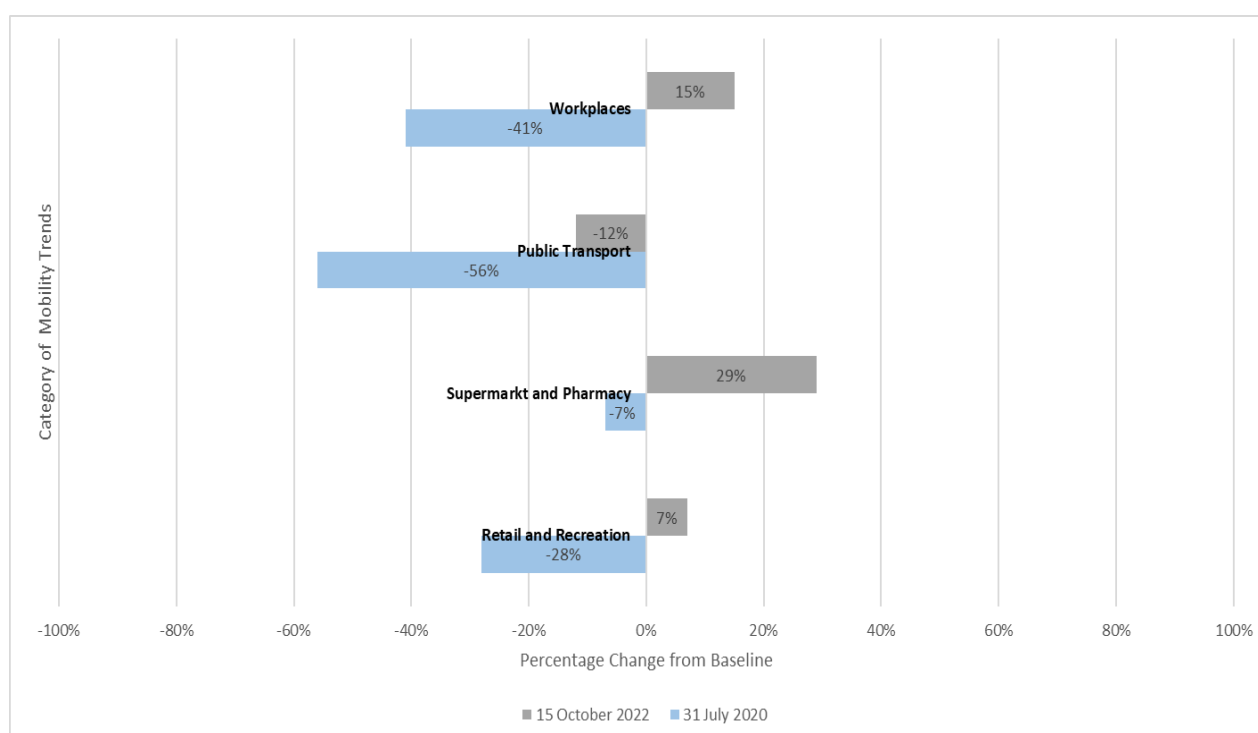


Figure 5: Western Cape Mobility Changes for Workplaces, Public Transport, Supermarket and Pharmacy, Retail and Recreation (Google, 2020; Google, 2022)

However, based on Google's *COVID-19 Community Mobility Report* for the same time periods (31 July 2020 and 15 October 2022), Hensher (2020) has accurately predicted the longevity of the home office for the Australian context. In the last available report for Australia, **public transport was 21% lower** than the baseline, and the category of **workplaces was 2% lower** than the baseline (Google, 2020c; Google, 2022b). While these reductions are not as severe as in the report for 31 July 2020 (41% lower than the baseline for public transport and 17% lower than the baseline for workplaces), it does show that the impact of COVID-19 on attending workplaces and public transport has remained in Australia, over the long term. This

clearly shows the difference in the long-term effects and opportunities between a developed country, such as Australia, and a developing country, such as South Africa.

Another aspect of the COVID-19 pandemic was the effect on road traffic collisions and related fatalities and injuries. Vanderschuren (2023) found a reduction in road fatalities in South Africa during the lockdowns, where overall road fatalities dropped below 10 000 persons (to 9 969 fatalities) in 2020 for the first time since the early 2000s. The reduction in road fatalities coincided with the weeks when hard lockdown measures were enforced, and mobility was nearly completely restricted (Vanderschuren, 2023). In Cape Town, during the hard lockdowns (April and May 2020), patients injured by road collisions decreased by 74% (Navsaria et al., 2021). Navsaria et al. (2021) also found that, in June 2020, a 32% decrease in patients injured by road collisions was maintained. While there may have been a decrease in road collision injuries, the findings for road fatalities are less positive for Cape Town. Vanderschuren (2023) completed a statistical analysis of data provided by the Road Traffic Management Corporation (RTMC) and found that, while there was a statistically significant reduction between 2019 (609 fatalities) and 2021 (538 fatalities), this does not hold when the data from 2017 (520 deaths) or 2018 (522 fatalities) is compared to 2021, as there is a statistically significant increase in fatalities. The effects of the COVID-19 pandemic can be individual to specific areas, with the general finding of reduced fatalities in South Africa not being valid for the area of Cape Town.

Significant environmental improvements were seen during the lockdowns of COVID-19 (Loh et al., 2021; Sharifi and Khavarian-Garmsir, 2020). The consequences of COVID-19 also have adverse side effects on the environment. Rume and Islam (2020, p. 3) provide an overview of both in Figure 6. Rume and Islam (2020) identify Personal Protection Equipment (PPE) as a negative side effect. The PPE associated with the COVID-19 pandemic did generate additional waste. Whether positive or negative, the environmental side-effects of COVID-19 were highly noticeable during COVID-19 lockdowns.

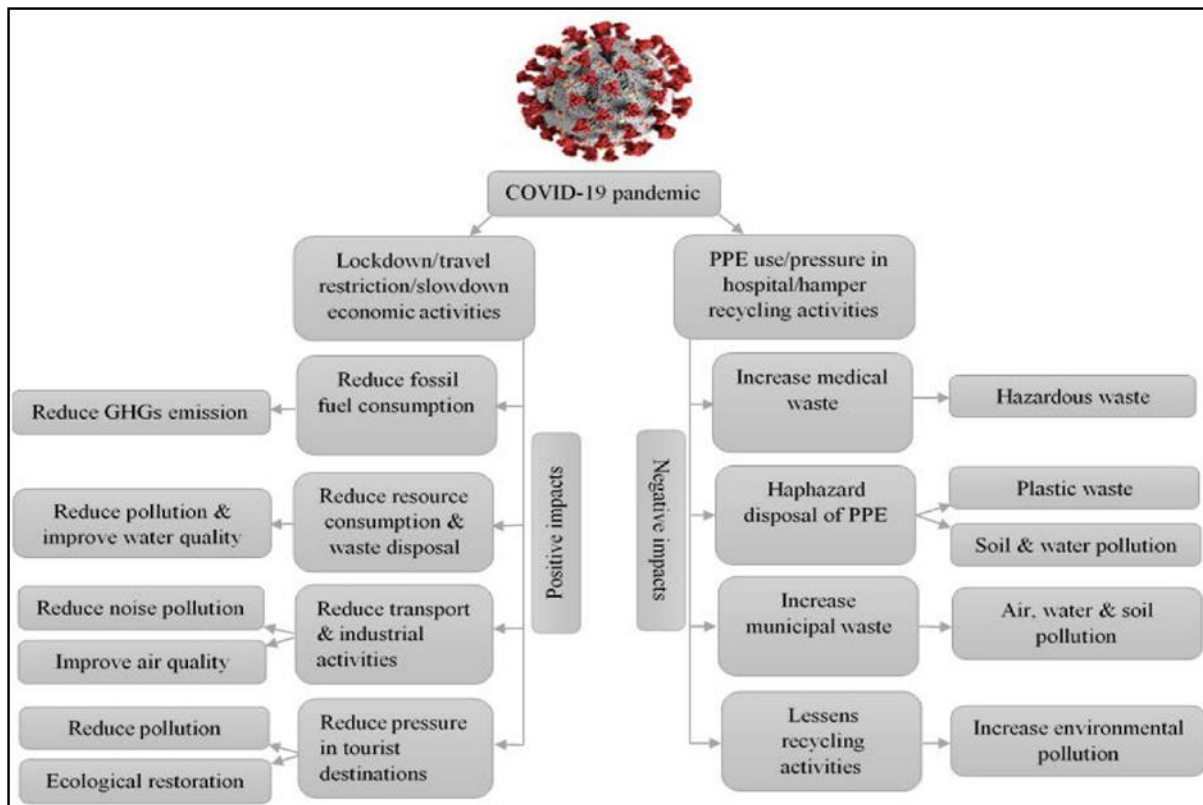


Figure 6: Positive and Negative Environmental Effects of the COVID-19 Pandemic

Source: Rume and Islam, 2020

The COVID-19 pandemic may be generally associated with positive factors, such as improved air quality, reduced traffic and significantly fewer road collision injuries and fatalities. However, it may also be associated with substantially higher levels of uncertainties and anxieties, especially in young adults (Bozkurt et al., 2020; Gittings et al., 2021; Naidoo and Cartwright, 2020). However, whether the COVID-19 pandemic impacted individuals' willingness to engage with ride-share service trips involving uncertainty or perceived risk, has not been explored.

The second part of this chapter explores theories and models suitable for ride-share service investigations. Focus is placed on theories and models that explicitly incorporate uncertainty or perceived risks in their understanding of decision-making processes.

2.2 Theoretical Framework: Paradigms, Theories and Methods for Ride-Share Service Investigations

Researchers in engineering, economics, psychology, and the social sciences have investigated and explored transport modal decisions and behaviours, adapting and combining approaches from different disciplines, depending on the researcher's prioritised criteria and background.

This has already been alluded to in the first chapter through the five paradigms of Jones (2009). This section expands the search for a theoretical framework to capture realistic human decisions and effects specific to decisions involving uncertainty or perceived risks in ride-share service decisions.

2.2.1 The Development of Theories Relevant to Ride-Share Service Investigations

The main theories commonly identified, from a transport engineer's perspective, are Expected Utility Theory (EUT) and Random Utility Maximization (RUM). EUT can be briefly described by understanding that every decision maker has some real-valued function, u . This function (u) defines that if, and only if, there is a statistically expected utility value that is greater for one option over another option, then the option with the higher expected utility value will be selected over the alternative with a lower expected utility value (Avineri and Prashker, 2004). RUM is very similar to EUT, except it allows for a certain amount of variation or randomness in the utility assessment of an agent's decisions in the model. Figure 7 (Walker and Ben-Akiva, 2002) illustrates the key components of a Random Utility Model.

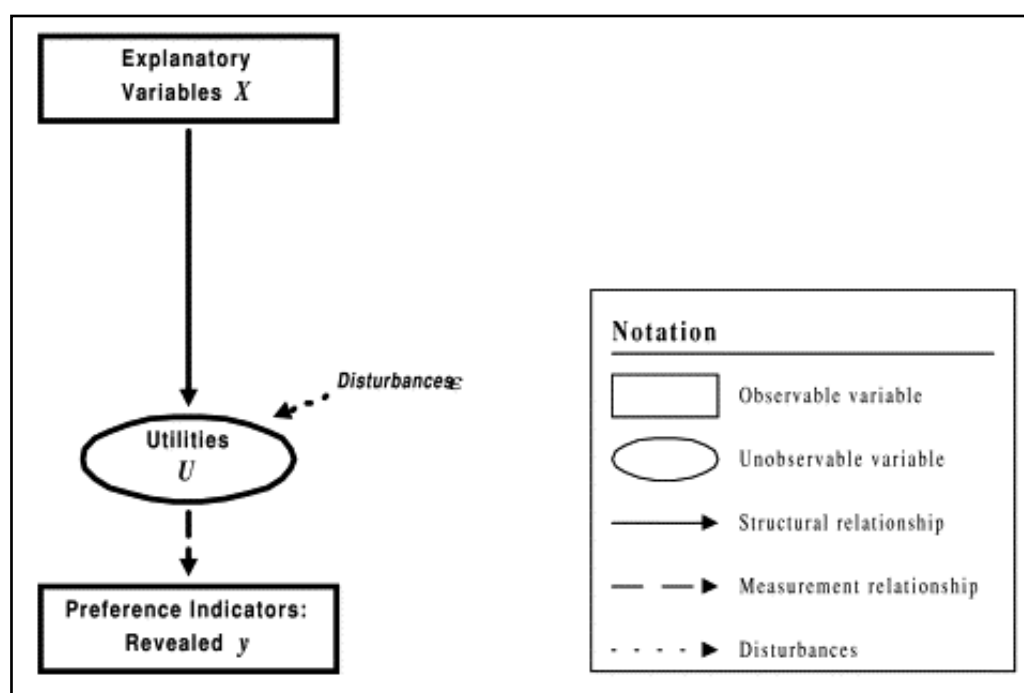


Figure 7: Random Utility Model
Source: Walker and Ben-Akiva (2002, p. 305)

EUT and RUM were typically used in research evaluating travel decision-making for transport modes other than those of ride-share services. For example, Ziemke et al. (2018) included a utility theory-based measure of accessibility. Ziemke et al. (2018, p.242) described accessibility as *'the ease with which activities may be reached from a given location using a particular*

transport system'. The utility theory-based measure of accessibility was one measure to assess the accessibility of Nelson Mandela Bay in South Africa (Ziemke et al., 2018), which required lower data requirements and resulted in the same quality of insights of areas with low levels of accessibility, compared to a household-based accessibility indicator approach.

Another South African example is provided by Teffo et al. (2019), who use a RUM-based approach, called the 'Best-Worst-Scaling' approach, to investigate the public transport (MBT, bus and train) needs in Cape Town's informal settlements. A survey of 290 randomly selected public transport commuters, from six different informal settlements in Cape Town, was used to investigate the most important features. Teffo et al. (2019) found that walking safety, personal safety, unsafe driving, overcrowding, and walking distance were the most important features, while there was no apparent trend of variance between men and women. However, a significant variance of choices between the mode users across the different locations was found. The findings indicate that the local environment may be more critical for public transport infrastructure upgrades than socio-demographic factors.

However, EUT and RUM approaches are, generally, seen less in ride-share service investigations, locally or internationally. This is likely as the arrival of ride-share services aligns with the shift in the transport and travel decision investigations towards more novel theories and models, such as Prospect Theory or Regret Theory. While EUT and RUM have been criticised for over-simplifying human behaviour, Prospect Theory and Regret Theory focus on understanding how humans make decisions, due to the prospect (likelihood) effect or the regret minimisation effect that these theories have captured.

The shift in the transport and travel decision research field, from EUT to Prospect or Regret theory, is discussed by Ramos et al. (2014). Ramos et al. (2014) highlighted that many researchers are interested in Prospect Theory or Regret Theory, due to the potential to capture more realistic behaviours (Ramos et al., 2014). Realistic theories could be understood in this chapter as theories and models considering human decisions under a more comprehensive paradigm. For example, Zhong et al. (2020) investigated the impact of ride-hailing services on private car use in urban areas of Chinese cities, using a prospect theory-based approach. Zhong et al. (2020), using panel data from 109 cities in China from 2010 to 2016, found that ride-share services negatively impacted the use of private vehicles in urban areas. However, this negative effect weakened over time and was heterogeneous across time

and cities. Once again, this indicates that the local context where the ride-share services operate is an important factor in how these transport services can affect the use of private vehicles.

While there is an increasing interest in these theoretical approaches, especially Prospect and Regret Theory, within the transport field (Avineri and Prashker, 2004; Li and Hensher, 2011; Ramos et al., 2014; Rasouli and Timmermans, 2014), it also has criticisms. Avineri and Prashker (2004) point out that, while individuals may not be utility maximisers, there is still more work to be done before individuals can be declared prospect maximisers. Rasouli and Timmerman (2014) raise the critical point of whether models and theories developed with gambling, simple pay-off games or lotteries can benefit from transport modal decision research. This criticism was previously seen in Timmermans (2010), who strongly argues that making travel decisions under uncertainty is unrelated to pay-off games or gambling with money. Timmermans (2010) highlights that Prospect Theory does not have the necessary set of mechanisms or concepts for repeated travel choices under uncertainty. Therefore, Prospect Theory does not provide a comprehensive theory for such decisions (Timmermans, 2010).

Ride-share service decisions are influenced by numerous factors, such as habits, car ownership, location of home and work, or limitations, for example, availability of transport modes, income, time, or circumstances (Berndt et al., 2021; Fenton et al., 2020; Giddy, 2019; Molobi et al., 2020; Vanderschuren and Baufeldt, 2018). It is unlikely that models developed from simple decision games will be appropriate, especially in investigations with higher levels of uncertainty or risk.

Researchers in the social sciences and psychology have specifically questioned the appropriateness of theories, such as EUT or RUM, for several decades (e.g., Gärling, 1998; Bonsall, 2004). Similarly, transport researchers have acknowledged the need for more realistic theories and better approaches within decision-making research (Avineri and Prashker, 2003; Li and Hensher, 2011; Van De Kaa, 2008). This is especially true for complex trip decisions, which often involve uncertainty or risks, such as making a trip in an area that is subject to high levels of congestion or public transport delays (Avineri and Prashker, 2004; Ramos et al., 2014; Rasouli and Timmermans, 2014; Avineri and Bovy, 2008).

Another theory that has succeeded in transport modal decision research aimed at developing a realistic understanding is the Theory of Planned Behaviour (Ajzen, 1991), which has also enjoyed dramatic adoption and application in numerous other fields (Ajzen, 2011). The Theory of Planned Behaviour (TPB) can be illustrated best in Figure 8. Figure 8 shows the central factor is the individual's intention to perform a specific behaviour. The intention is affected by the direct and indirect interaction of three factors: attitude toward the behaviour, subjective norm, and perceived behavioural control.

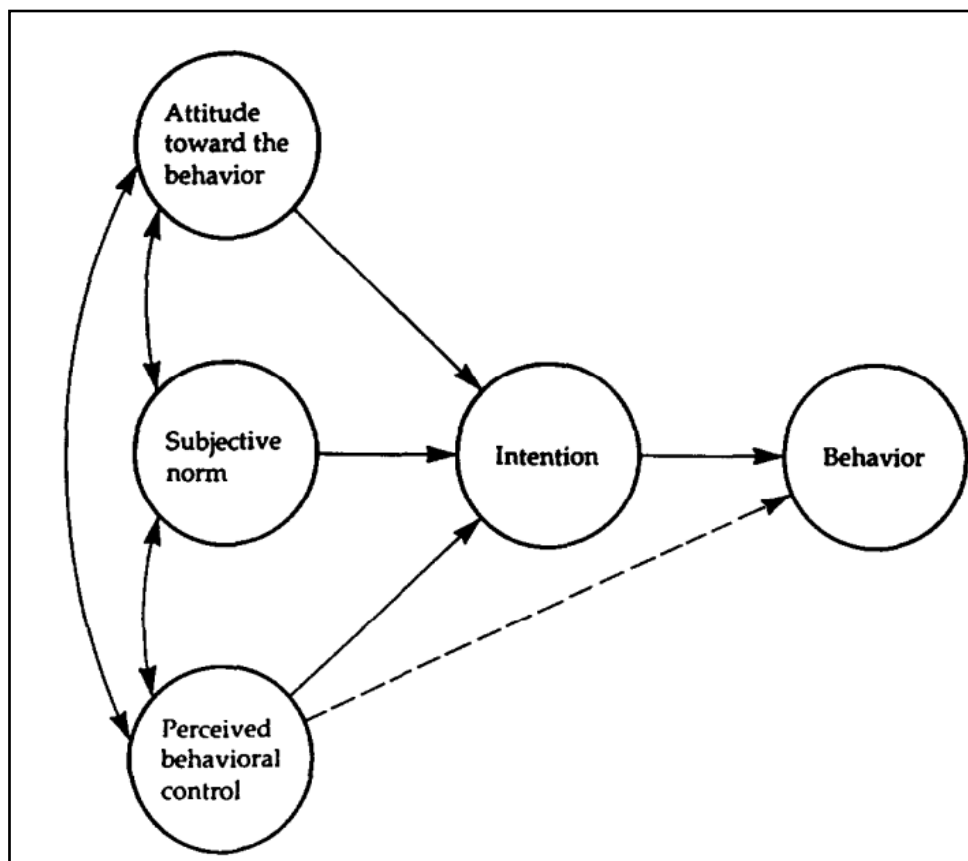


Figure 8: Theory of Planned Behaviour (Ajzen, 1991, p.182)

The basis of TPB is the theory of reasoned action, **which excludes behaviours in which individuals do not have complete control or freedom to choose the behaviours**. Furthermore, TPB does not consider the role of objective situational constraints, habits, or personal norms (Klöckner and Blöbaum, 2010). While this model is still a 'rational' model based on reasoned actions and processes, it does not assume that the beliefs of the individuals are formed in '*a rational, unbiased fashion or that they accurately represent reality*' (Ajzen, 2011, p.1116). This is a clear step away from the assumption of rational actors with all the necessary information, generally assumed in EUT or RUM approaches.

A similar theory to TBP that is used to understand behaviour is the Technology Acceptance Model (TAM) (Davis, 1989). Figure 9 shows TAM. Perceived ease of use positively affects both the individual's attitude towards using the technology, as well as the perceived usefulness of the technology. Both the attitude towards using the technology and its perceived usefulness impact the individuals' behavioural intention to use the technology, which, in turn, affects the individual's actual behaviour (i.e., use).

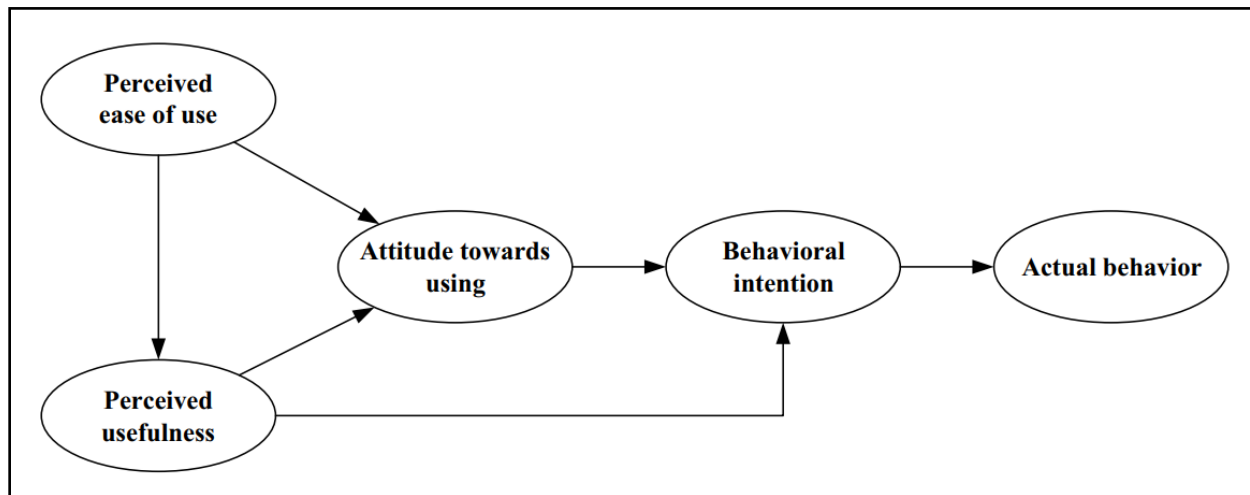


Figure 9: Technology Acceptance Model of Davis (1989)
Source: Wang et al. (2020, p. 400)

Berndt et al. (2021) use TPB and TAM to explore the intention to use ride-share services in South Africa. The study showed that South Africans had a positive attitude toward ride-share services, due to the Perceived Usefulness (PU) and the perceived behavioural control associated with the service (Berndt et al., 2021).

Theories such as TPB and TAM, among several others, have been consolidated and developed further in the Unified Theory of Acceptance and use of Technology Theory (Venkatesh et al., 2003). This theory mainly aims to understand how new technology will likely be accepted and used. While this is arguably an essential theory for times preceding or during the introduction of ride-share services in South Africa, the timing of this research undertaken in this thesis was well after the introduction of these services. Ride-share services have been well accepted in South Africa. For example, Uber is widely available in South Africa, in 40 cities, and is said to serve 80% of the urban population (Madubela, 2023). Bolt, another ride-share service in South Africa, reported that the number of weekly trips taken in South Africa has increased by 89% between 2021 and 2022 (Bolt, 2022).

Acceptance and use of ride-share services in South Africa are evident. However, how individuals react when the ride-share service trip involves uncertainty or perceived risk is not apparent. The role that uncertainty and perceived risks of ride-share service trips have, in the decisions of different individuals, remains unknown. Garcia-Sierra et al. (2015) summarise why realistic behaviours of individuals, especially when considering uncertainty or perceived risks, are not often captured well by models based on rational agents. Four main reasons include:

- 1) imperfect information and individuals' limited computational abilities,
- 2) asymmetric valuation of gains and losses and probabilities weighted non-linearly,
- 3) time-inconsistent preferences, and
- 4) social preferences and self-identity concerns (Garcia-Sierra et al., 2015, p.79).

Garcia-Sierra et al. (2015) further summarise six concepts specific to decisions under risk and uncertainty stemming from behavioural economics. Table 4 presents the concepts of framing, loss aversion, endowment, status quo effect, certainty effect and preference reversal.

Table 4: Extract Summarising Concepts of Bounded Rationality and Prospect Theory

Concept	Description
<i>Framing</i>	<i>How a set of options in a decision problem is formulated (i.e., "framed") and how it influences individuals' preferences.</i>
<i>Loss aversion</i>	<i>Individuals have asymmetric preferences for gains and losses. People put a higher value on losses than on same-sized gains, and dislike to take (even) small risks. In addition, people are risk averse over gains and risk seeking, over losses.</i>
<i>Endowment</i>	<i>Individuals are loss averse and value the things they own more than those they do not. This effect can be immediate and arbitrary (i.e., recently held things), though the longer the tenure, the higher the value assigned.</i>
<i>Status quo effect</i>	<i>Individuals stick to their original choices (i.e., status quo), even if the change would cause substantial improvement. This is a consequence of losses being disproportionately valued and the endowment effect.</i>
<i>Certainty effect</i>	<i>People prefer certain over uncertain or probabilistic outcomes, so choice outcomes framed as sure losses lead to risk-seeking behaviour (overestimating low probability outcomes or rare events). In contrast, choice outcomes framed as sure gains lead to risk averse behaviour (underestimating high probability outcomes).</i>
<i>Preference reversal</i>	<i>Individuals with stable, well-defined preferences can end up choosing an option that is not the one they value the most. Preference reversal can be induced by changing the reference point or introducing a decoy option into a set of options. The latter will tip the balance towards the non-decoy option, not chosen otherwise.</i>

Source: Garcia-Sierra et al. (2015, p.290)

Garcia-Sierra et al. (2015) conclude that, from the findings of bounded rationality, it can be said that travellers have several characteristics that result in behaviour that may fall outside of what can be considered rational utility decisions.

Some of these characteristics of travellers are:

- Emotional,
- Making errors and misinterpreting information,
- Overvaluing recent events,
- Following simple rules,
- Being guided by **references and frames**, and
- Sticking to habits.

These concepts have yet to be extensively explored in ride-share service investigations in South Africa. Furthermore, this reasoning and many of these concepts are seen in the next explored approach.

2.2.2 Nascent Theoretical Approaches in Uncertainty and Perceived Risks for Ride-Share Service Investigations

Another theoretical approach for investigations involving uncertainty and perceived risk, that is yet to be explored extensively in transport research, is Quantum Probability Theory (QPT).

A QPT approach is loosely defined for this research as adopting or applying concepts or formalities from QPT for investigations that involve areas not on a quantum spectrum.

Specifically, a QPT approach assumes stochasticity at the individual level by conceptualising their *Belief State* as an indefinite *Belief State* before a question is proposed. This differs from the typical utility models, such as RUM, that assume stochasticity as a random error term.

In the literature, such a QPT approach is often called quantum cognition (Pothos and Busemeyer, 2022). Other terms that refer to quantum approaches in decision or cognitive investigations include ‘quantum-like’ or quantum social science. This was done to distinguish the application of a QPT approach in decision or cognitive studies from investigations that argue that the brain works as a quantum computer (Ashtiani and Azgomi, 2015). Instead, **a QPT approach uses the mathematical principles from QPT as a framework to explain human decision-making processes and cognition.**

The concrete ingredients of any QPT approach or model are a space of possible thoughts/decisions with subspaces corresponding to possible outcome decisions. Furthermore, a *Belief State* (or state of mind) represents the individual’s state of mind with dynamics that specify how the *Belief State* changes from one decision to the next (Yearsley

and Busemeyer, 2016). Hancock et al. (2020) argue that a QPT approach in transport research is particularly suited to capture and formally explain the decisions and choices of individuals in different contexts, due to the flexibility provided by the developed models. This is supported by Pothos and Busemeyer (2022), who argue that **quantum models formalise several previously expressed ideas** (e.g., framing) **in heuristic terms**, enabling a unified explanation of contrasting findings. The formal structure provided in a QPT approach is what has been lacking, for transport researchers with an engineering background, for the more behavioural concepts stemming from psychology and the social sciences. For example, order effects on cognitive measurements have been admitted in surveys for decades (Schwarz and Sudman, 1992). However, order effects are still insufficiently understood (Wang et al., 2013). The potential for its application to this research is discussed below.

2.2.2.1 Outline of Main Components of a QPT Approach

Due to the complexity and depth of QPT, this section focuses on the aspects of QPT that could apply to ride-share service decisions involving uncertainty and perceived risks. This section briefly introduces the fundamental difference between QPT and the typical theories of EUT and RUM by describing what a QPT approach involves in theoretical aspects. Busemeyer and Wang (2015) argue that QPT has several principles that are interesting to decision investigations. However, in this work, the aspects of *Belief State vector $|\Psi\rangle$* , *incompatibility* and *superposition* are particularly interesting.

Generally, utility theories, such as EUT, are based on Classic Probability Theory (CPT). QPT approach models are fundamentally different to such CPT-based theories in that QPT approaches are intrinsically probabilistic. In other words, in a QPT approach, stochasticity is seen in the mind of the individual decision-maker. This is different in utility models where the stochasticity is assumed to be on the sampling level (Hancock et al., 2020). However, considering stochasticity at the level of the mind of the individual decision-maker provides a distinct theoretical shift away from the common underlying assumption of the utility models that individuals are rational, logical, and all-knowing beings. This is a substantial change in theories used to unpack human decisions and is especially relevant for decisions involving uncertainty or perceived risks.

First, the theoretical space of a QPT approach needs to be described. In a QPT approach, the ‘*belief-action*’ state of the respondent’s decision is modelled as a vector in a complex number

vector space, i.e., Hilbert Space (Trueblood and Busemeyer, 2012), representing all possible outcomes. In QPT, the specific terms for *questions* and *outcomes* are *observables* and *propositions* (Pothos and Busemeyer, 2013).

The *state vector* represents the individual's state of mind, $|\Psi\rangle$. Here, the *state vector* represents all current knowledge of the individual's cognitive state under consideration (Pothos and Busemeyer, 2013). The notation used in quantum approaches is a bracket notion called Dirac notation, where the *state vector* is a unit-length vector in a Hilbert space. Each one-dimensional sub-space, namely rays, in the vector space, corresponds to the most elementary *observable* possible. Pothos and Busemeyer (2013) illustrate a QPT approach with the example of a question about the individual's emotional state, such as whether they are happy.

For illustrative purposes, Pothos and Busemeyer (2013) assume the outcomes of the happiness question as one-dimensional subspaces. Figure 10 simplifies an individual's emotional state, with one ray corresponding to the individual being 'Happy' and the orthogonal ray, 'Unhappy'. Vectors representing opposing *observables* are represented orthogonally, or in other words, 90 degrees from each other in the Hilbert Space.

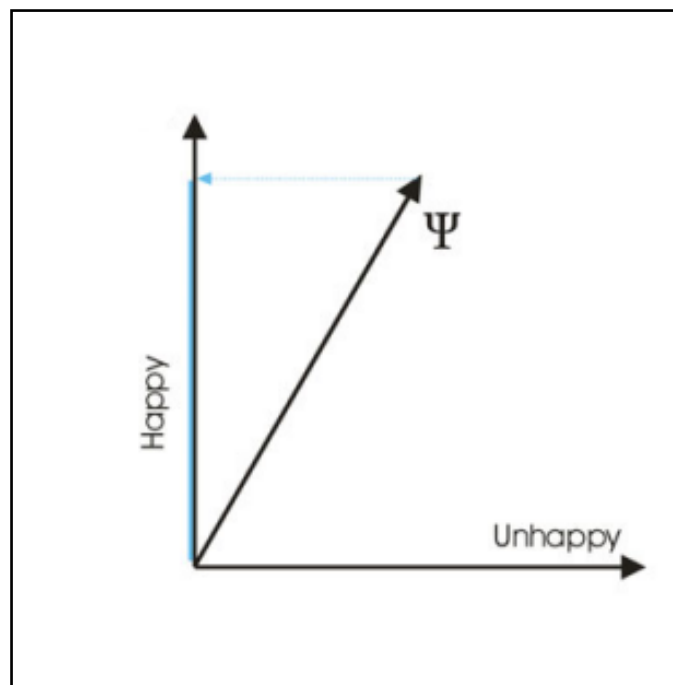


Figure 10: Basic Processes in a QPT Approach as Illustrated by Pothos and Busemeyer in 'Are You Happy?'
Source: Pothos and Busemeyer (2013, p. 258)

From this, the *Belief State* can be expressed as $|\Psi\rangle = a |happy\rangle + b |unhappy\rangle$, where a and b are constants referred to as amplitudes. These amplitudes are the components of the *state vector* on the different basis vectors. The amplitudes are used to calculate the probability of the *Belief State vector's* subspaces of happy or unhappy.

Pothos and Busemeyer (2013) explain that this is done by using projectors, and in their example, the projector for the 'happy' subspace is denoted as $P_{happy} |\Psi\rangle = a |happy\rangle$. The probability that the person is happy is then given by the squared length of the projector, $||P_{happy} |\Psi\rangle||^2$. Thus, the probability of the individual being 'happy' is expressed as $||P_{happy} |\Psi\rangle||^2 = |a|^2$, which is the squared magnitude of the amplitude of the state vector along the $|happy\rangle$ basis vector (Pothos and Busemeyer, 2013).

A QPT approach connects to conceptualising an individual deciding if they are happy by having an initial state of mind (before question) and a 'resolved' state of mind (decision made). In QPT, these states are called *superposition* (before question) and *basis states* (decision made). The *superposition* state reflects all the possibilities that can occur. In this example, this is all the possibilities of unhappiness or happiness.

This is a significant step away from theories, such as EUT, that rely on CPT at their core. In a CPT-based theory, the individual is intrinsically happy or unhappy. The only problem is that the outsider, doing the measuring, does not know if the individual is happy, so they assign probabilities to each possibility (Pothos and Busemeyer, 2013). The given answer by the participant is, therefore, a recording of the individual's decision.

The QPT approach entails a fundamentally different understanding of how individuals make decisions and allows for this in the theory's structure. Firstly, the *Belief State* $|\Psi\rangle$ represents a *superposition* state of mind. In the example, this means that the individual is in an undefined state of whether they are happy, as both (or all) possibilities are possible. This *superposition* state resolves itself as the individual decides, resulting in a basis state, where the **answer is created and certain** (Pothos and Busemeyer, 2013).

In a QPT approach, subspaces represent mutually exclusive outcomes, such as being happy – unhappy or employed – unemployed, as illustrated in Figure 11. Figure 11 shows the initial subspaces of happy-unhappy and the orthogonal subspaces of employed-unemployed. In this elaboration of the first example, the individual faces two questions. This will illustrate the

usefulness of another main concept in QPT: *incompatibility*. Figure 11 shows that the subspaces of happy-unhappy and employed-unemployed are nonorthogonal. These two subspaces are modelled as coplanar, due to the assumption that employed individuals are likely to be happy and those not employed are likely to be unhappy.

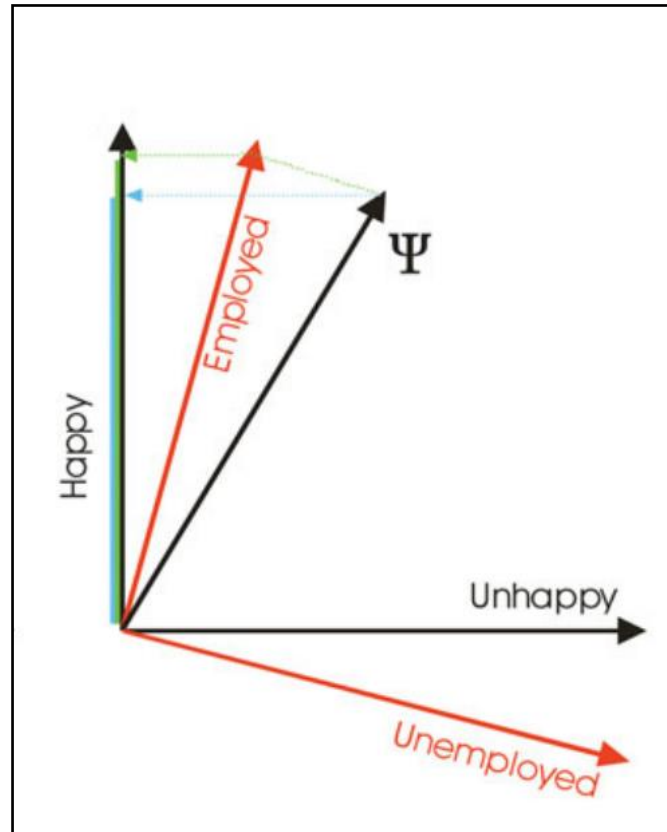


Figure 11: Basic Processes in a QPT Approach Illustrating Co-Planar Vectors in 2D of Subspaces, 'Unemployed' and 'Employed'

Source: Pothos and Busemeyer (2013, p. 258)

However, individuals are complex, and the additional question about employment status can give rise to uncertainty. For example, if the individual states that they are employed, they may experience uncertainty when deciding if they are happy, due to negative aspects of their job, such as long working hours or stressful deadlines (Pothos and Busemeyer, 2013). Conversely, suppose individuals decide that they are happy. In that case, they may experience uncertainty about their job and prefer dreaming about winning the lottery or financial freedom rather than being employed where they currently are. *If individuals are affected by the other question, the questions are incompatible* (Pothos and Busemeyer, 2013).

Of course, the subspaces of happy-unhappy and employed-unemployed can be *compatible* (i.e., not *incompatible*). This would result in the subspaces of 'Happy, Employed', 'Happy,

Unemployed', 'Unhappy, Employed', 'Unhappy, Unemployed'. The first three subspaces are shown in Figure 12.

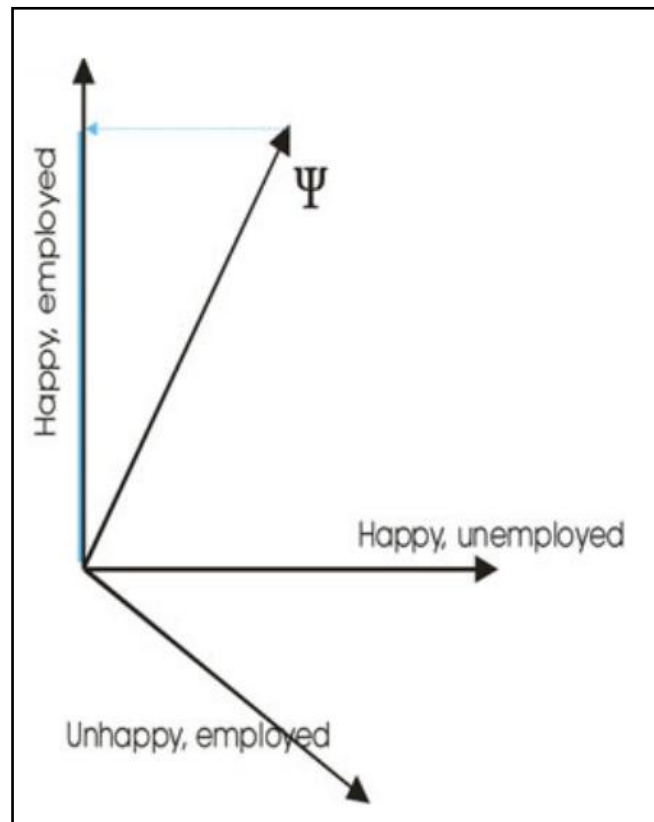


Figure 12: Basic Processes in a QPT Approach Illustrating Compatible Subspaces of the Three Vectors, 'Happy, Employed', 'Happy, Unemployed', 'Unhappy, Employed'¹²
Source: Pothos and Busemeyer (2013, p. 258)

If the questions are *compatible*, then there is no evidence of the initial question causing uncertainty in the following questions. In a QPT approach, the individual can simultaneously consider both questions (Pothos and Busemeyer, 2013) without experiencing uncertainty in the second decision, due to the first question. In ride-share service decisions, compatible questions are likely not to involve uncertainty or perceived risks, such as 'Do you use ride-share services?' (general, with no framing), followed by 'How often do you use ride-share services?' (no uncertainty between the first and second questions). However, questions that could be *incompatible* are 'Do you feel safe using ride-share services?' followed by 'Do you use ride-share services?'. In the last set of example ride-share service decisions, much higher levels of uncertainty and perceived risks could likely be expected to alter the created answers.

¹² The fourth vector of 'Unhappy, Unemployed' is not illustrated.

2.2.2.2 Motivation to Adopt a QPT Approach

The common motivation to use a QPT approach in investigations is the ability to formalise psychological concepts, such as uncertainty (Wang et al., 2013). Busemeyer and Bruza (2012) provide six concise reasons to adopt a QPT approach for human judgments or decisions; the first three of these reasons are particularly relevant to the scope of research undertaken in this thesis:

1. *'Judgments are based on indefinite states'*. (Busemeyer and Bruza, 2012, p.1)

In a QPT approach, decisions are conceptualised as being in a *superposition* state (i.e., indefinite state) at each moment in time before a decision is made. This differs from approaches, such as Bayesian networks, where the system changes from moment to moment, but each moment is still in a definite state before the decision is made (Busemeyer and Bruza, 2012). Therefore, the individual does not know their decision before making it.

2. *'Judgments create rather than record'*. (Busemeyer and Bruza, 2012, p.3)

This connects strongly to the first reason. In a QPT approach, the superposition (indefinite state) 'resolves' itself, and the decision is then made and is definite (Busemeyer and Bruza, 2012). This again differs from common practice, where the assumption is that the individual's decision is stored within the individual, and the investigator needs to extract the answer from the individual.

Busemeyer and Bruza (2012) point out that decision scientists, such as Payne et al. (1992), argue that beliefs and preferences are constructed rather than recalled from memory. This is also most likely true for decisions involving uncertainty and perceived risks. Other decisions that do not include uncertainty or perceived risks, and are independent of the context, can be assumed to be recalled from memory rather than created. Busemeyer and Bruza (2012) give the example of 'Have you ever read a certain book?' for a likely recalled answer.

3. *'Judgments disturb each other, introducing uncertainty'*. (Busemeyer and Bruza, 2012, p.4)

QPT assumes an indefinite state before the first question is asked. After the first question is asked, the indefinite state moves to a definite state, which is not the same as the indefinite state, thus changing the state that the following question is then answered. If the answers to the first and second questions do not impact each other, then the answers are considered

compatible. However, if the order of the questions does affect the answers created, then the measurements (i.e., the answers) are considered *incompatible*. Here, the theoretical structure of QPT allows for uncertainty in how individuals answer questions depending on the context of the questions and the state of mind that the individuals have when creating the answer to the question.

A QPT approach helps to address the criticisms of alternative theories, such as Prospect Theory, by providing a theory with the necessary concepts relevant and appropriate to repeated ride-share service decisions under uncertainty or perceived risk. To summarise, a QPT approach models decisions as being created instead of recalled, that an individual's *state of mind* and the order of questions (i.e., the context or content) may influence the answer that the individual creates, and that answers can either be *compatible* (the assumption in utility models) or *incompatible*. *Incompatible* answers are most likely to occur in conditions involving uncertainty or perceived risks. A QPT approach is, therefore, relevant and interesting when investigating ride-share service decisions involving uncertainty and perceived risk.

2.2.2.3 Examples of QPT Approach in Transport Modal Decision Investigations

Recently, researchers have introduced QPT into transport and travel decisions (Vitetta, 2016; Yu and Jayakrishna, 2018; Hancock et al., 2020; Di Gangi and Vitetta, 2021). These works will be briefly described and discussed to illustrate what has been established already.

Vitetta (2016) compares the theoretical understandings of the typical Random Utility Models (RUMs) against a Quantum Utility Model (QUM), highlighting that RUMs assume an all-knowing rational individual who considers mutually exclusive alternatives and selects the alternative with the highest perceived utility. In RUMs, the perceived utility is not perfectly known by the investigator, and therefore, a random variable is included to compensate for this. While QUMs are noted to be like RUMs, Vitetta (2016) highlights that QUMs allow for the choice probability to be defined as 'the sum of a probabilistic term (that does not depend on the unique or not-unique choice in the intermediate levels) and an interference term (that considers the possible not-unique choice in the intermediate levels)'. This additional term of interference allows estimating the choice probability in case of a not-unique decision in the intermediate level.

To explain what the terms 'unique', 'non-unique', and 'intermediate' mean, an example of an individual wishing to take a vacation trip may select a specific area to visit but does not yet

have a specific destination in mind. In this case, the individual has made a 'non-unique' pre-trip decision, where the non-unique pre-trip decision influences the 'intermediate' decisions that will follow.

Vitetta (2016) explores the application of QUMs in two cases. The first case is where the decision tree's intermediate levels are clearly defined, and the second is where the intermediate levels are not clearly defined and are chosen pre-trip by the user. These cases are tested in a route choice level involving origin, destination, departure time and mode for two networks for a route choice decision. The results of the QUMs are compared to RUMs of consolidated Logit, C-Logit and Probit models. The main advantage of the QUMs is the different simulation of clear (certain) and not-clear (uncertain) perceptions of the 'inner decision' (*Belief State*) for different route alternatives or options. Clear aspects could include reliable information regarding transport conditions and services, while unclear aspects could relate to unknown delays due to congestion. Vitetta (2016) found that **using QUM makes it possible to simulate the sequence of decisions in the cases of unique or not-unique pre-trip decisions in the intermediate levels**. The RUMs seen in the paper were able to simulate overlapping perceptions of alternatives but not able to simulate explicitly the not-clear perceptions of the inner decision levels.

To further this, Di Gangi and Vitetta (2021) proposed a model where they integrate the interference term from QUM with RUM to form a '**Quantum** Utility Model integrated with a **RUM**' (QUARUM) model for the path choice process. The combination of a QPT approach with a RUM approach is another example of how the transport research field accumulates paradigms, as identified by Jones (2009). The interference term is representative of the perception of alternatives during their generation, **where the interference is significant**. While the RUM calculates the errors in the perception of utility and possible overlaps in alternatives, the QUARUM calculates the interference between the perception of alternatives in a choice set in a decision. QUARUM was tested in an application using data from two actual transport systems. The two experiments involved the road networks of two Italian cities, namely Salerno, a city of 130 000 inhabitants, and Benevento, with a population of 62 000 persons. **The numerical results show that the interference term may include some aspects of the selection mechanism that are not accounted for when only using the covariance of the RUM approach** and reproduces the traffic count on the road networks better than seen

in the RUM. However, the authors highlight that further experiments are needed in different real-life transport systems and contexts to confirm these results.

The next example of a QPT approach in travel decision research is provided by Yu and Jayakrishnan (2018), where they use single-question scenarios to explore applying QPT concepts to improve the relationship between Stated Preference (SP) and Revealed Preference (RP). The case studies focus on single-question surveys and use hypothetical and real-world examples to demonstrate the feasibility and advantages of a QPT approach (Yu and Jayakrishna, 2018). By doing so, the authors provide methods for systematically considering question order effects and framing in the context of surveys using the principles and concepts from QPT. Yu and Jayakrishna (2018) provide examples of how models can calibrate and forecast for revealed preference when only stated preference data is available. First, they use a fictitious example to demonstrate a single survey question on a choice between two alternatives, and how such a survey can be modelled, using QPT. The second example, provided by Yu and Jayakrishna (2018), involves stated and revealed preference data of willingness to use a new subway line in Kyoto, Japan.

The data was collected from 20 000 randomly selected households through postcards. The number of respondents that responded in both surveys (stated and revealed) was 903, and respondents were categorised as non-transit users and transit users. Using this data, they could geometrically represent, as shown in Figure 13, for (originally) non-transit commuters and (originally) transit commuters. Both bases for the revealed data (r , shown in orange) can be obtained by rotating the bases of the stated data (q , shown in blue) counterclockwise. The authors state that **this indicates that both non-transit users and transit users overestimate their probability of using the new service.**

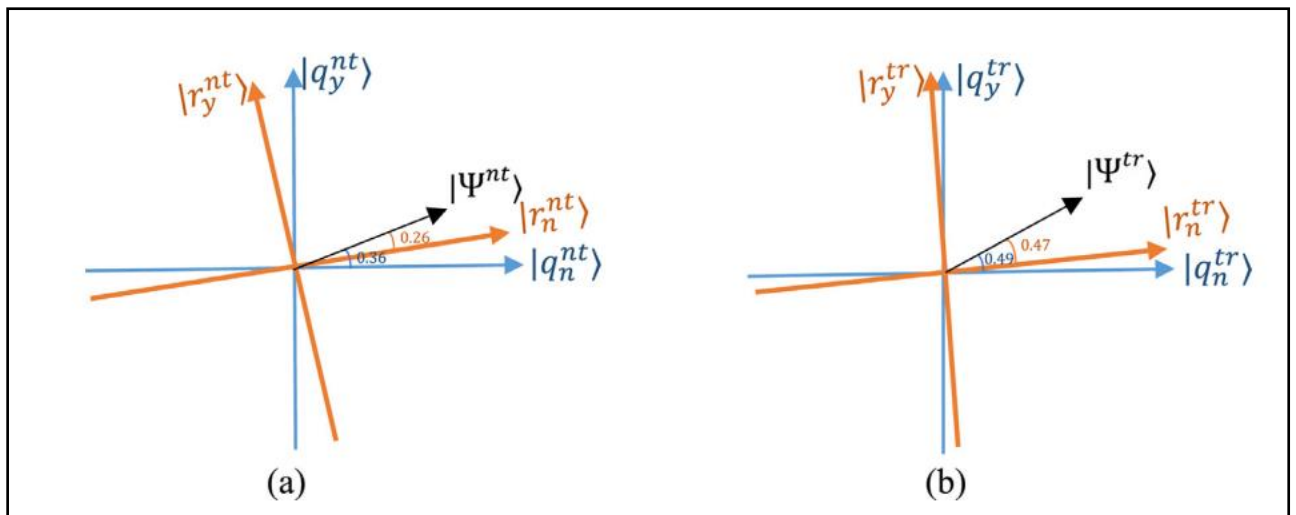


Figure 13: Yu and Jayakrishna (2018) Geometric Illustration of Stated and Revealed Data of Non-Transit (a) and Transit (b) Users. Source: Yu and Jayakrishna (2018, p.275)

Yu and Jayakrishna (2018) indicate that this counterclockwise rotation between stated and revealed data is worth exploring to see if it is a general phenomenon or not in survey data. Yu and Jayakrishna (2018) thus provide a QPT illustration for the differences between stated and revealed data. Another future research direction that Yu and Jayakrishna (2018) propose is investigating the sequencing effect of questions that seem, or are assumed, to be irrelevant. They provide a concrete example of asking participants to provide their socioeconomic background information at the survey's beginning or end. By uncovering these order effects, Yu and Jayakrishna (2018) argue that researchers can predict and correct for bias that may be unwillingly created in transport modal surveys.

The next example comes from Hancock et al. (2020), who use an approach based on the work of Busemeyer and colleagues and conceptualise the decision-maker's preference as a 'rippling wave pattern' until the decision has been made (i.e. applying the concept of superposition). They use this quantum probability framework to develop models that provide a better fit than traditional models for three travel behaviour datasets. The datasets include the Swiss value of time study (389 participants, nine binary route choice tasks), the UK value of time dataset (15 045 choices between two balanced alternatives, one cheaper, the other faster) and the UK best-worst dataset (391 public transport commuters, ten choices between three route alternatives in a stated preference survey).

Hancock et al. (2020) compared the datasets against various models, namely a utility decision field theory, quantum Hamiltonian and quantum amplitude models. They found that their **QPT**

models (i.e., quantum Hamiltonian and quantum amplitude) outperformed the utility and decision field models. However, they identified that a significant downfall of the QPT models is that the computation becomes infeasible for large numbers of alternatives. Yet, the authors suggest that quantum choice models could be applied to experimental paradigms in which a **nudge is involved in some decision or choice task.**

Hancock et al. (2020) provide an example of incompatible factors within transport. In their investigations, they model the transport mode choice between a car or a train as question A, with the nudge, or question B, asking whether the individual is environmentally friendly. They argue that if question B was asked before question A, the individuals were more likely to select a train trip than a car trip if they considered themselves environmentally friendly (and contrarywise for selection of car). This is explained graphically by Hancock et al. (2020, p. 168) in Figure 14.

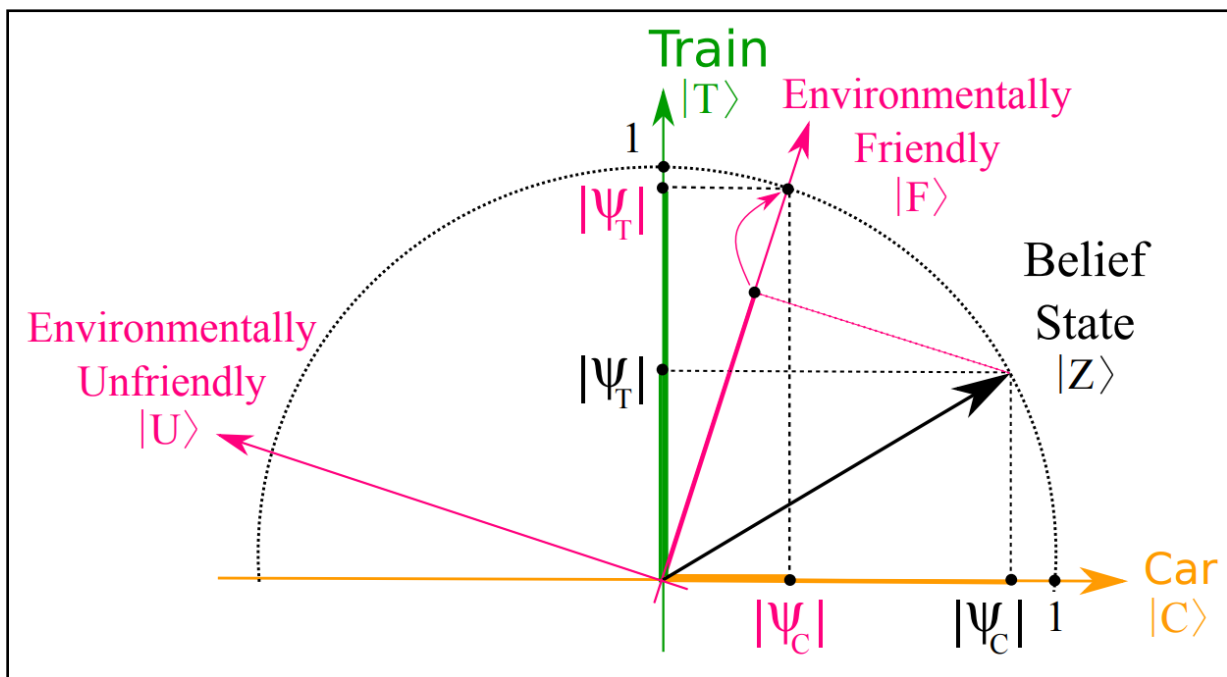


Figure 14: Application of QPT within Transport Research
Source: Hancock et al., 2020

As seen in Figure 14, the 'Belief State' is the state of the cognitive system represented in vector form. Hancock et al. (2020) demonstrated that models with a quantum framework can incorporate transformations to adjust for the choice context. This results in the models capturing different sensitivities to attributes and ordering effects in a typical route choice dataset. They argue that their **research serves as a proof of concept that quantum ideas can be integrated into transport choice models.**

This section has covered the main paradigms and theories currently used in transport modal research. The awareness for more realistic and human-inclusive theories, models and concepts in transport research has been outlined. The promise of a QPT approach to capture more realistic transport modal decisions has been described. Examples of the definitions of QPT used, and applying QPT to transport investigations, were also demonstrated.

The following section consolidates the identified research gap and proposes several quantitative hypotheses to be tested in this research.

2.3 The Research Gap and Hypotheses

Ride-share service decisions involving uncertainty and perceived risks have not been explored in South Africa. As seen in the South African context, taking a ride-share service '**alone**', '**at night**' or '**alone at night**' involves uncertainties and perceived risks. Therefore, these three specific trips involving uncertainty and perceived risks (namely alone; at night; alone at night) are used in this study. Furthermore, as shown in Section 2.1, gender, having access to a private vehicle and the COVID-19 pandemic are factors that are likely to influence an individual's willingness to engage with ride-share service trips involving uncertainty and perceived risks.

The potential of using a QPT approach allows for uncertainty and perceived risk decisions to be explored within a new modelling approach. This new approach allows for framing or question order to be explored. As mentioned in Section 2.2.2.2, there are several concepts that could be useful in better understanding how individuals make decisions involving uncertainty and perceived risks. These concepts are explored in the following proposed hypotheses:

H1: Uncertainty and perceived risks of personal security decrease the willingness to use ride-share services in young South African adults. (Chapter 6)

In the first hypothesis, *H1*, the uncertainty and perceived risks of personal security are explored in young South African adults using ride-share services for different factors (gender, accessing to a private vehicle, and COVID-19). This provides the basis for establishing that young South African adults do experience uncertainty and perceived risks that influence their willingness to engage in ride-share service trips involving uncertainty and perceived risks.

The second hypothesis focuses on testing the useability of the concepts of incompatibility (see Section 2.2.2.2) in ride-share service decisions involving uncertainty and perceived risks.

H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks. (Chapter 7)

The third hypothesis tests that compatible factors that have elements of positive emotional framing also have the potential to increase the willingness to engage in ride-share services. This shows that changes in willingness to engage in ride-share service trips involving uncertainty and perceived risks can also be affected by the emotional state of the decision-making process.

H3: Positive emotional framing in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty and perceived risks. (Chapter 7)

Finally, in *H4*, the reverse incompatibility is explored between the ride-share service decisions involving uncertainty and perceived risks and the identified incompatible factors.

H4: Ride-share service decisions involving uncertainty and perceived risks increase the perceived importance of incompatible factors. (Chapter 8)

Using these four hypotheses, how young South Africans decide on ride-share service trips involving uncertainty and perceived risks will be explored in the following chapters.

2.4 Résumé

This chapter reviews the ride-share service literature specific to the South African context. Focus was placed on elaborating on the three main factors of **gender, access to a private vehicle and the COVID- 19 pandemic** in ride-share services in South Africa.

Secondly, the theoretical landscape of applicable and potential theories for the focus of this research was described. As highlighted by Jones (2009), paradigms in transport are, instead, accumulated rather than shifted. The nature of this research demanded that theories have an explicit focus on incorporating human characteristics, such as being emotional, implementing simple rules in their decision-making, using references or frames in decisions, or simply sticking to habits.

These human characteristics, together with many of the concepts from the social sciences and psychology, are formalised in QPT approaches (e.g., Vitetta, (2016); Di Gangi and Vitetta,

(2021); Yu and Jayakrishna, (2018); Hancock et al. (2020)). The caveat is that a QPT approach is only likely advantageous in decisions involving uncertainty or perceived risks.

Lastly, four overarching hypotheses are proposed to test the concepts of a QPT approach in ride-share service decisions involving uncertainty and perceived risks in the South African context, drawing on the discussed literature in the first part of the chapter.

The next chapter outlines the method approach for this ride-share service decision investigation.

3 Methodology Overview and Research Design

In previous chapters, the main aims of this research were outlined to identify and quantify how young South Africans create their ride-share service decisions involving uncertainty and perceived risks. Additionally, this research aimed to consider how an individual's frame of mind affects the creation of ride-share service decisions, by testing the application of 'nudges' in the application of the concept of *incompatibility*.

The methodology describes the case study application, and details of the case study data collection and analysis, in three smaller chapters:

- Chapter 3, 'Methodology Overview and Research Design' (this chapter), outlines the methodology approach and research design overview.
- Chapter 4, 'Description of the Case Study: the City of Cape Town', provides details of Cape Town, why it is an appropriate case study, and connects Cape Town with the methodology outlined in Chapter 3.
- Chapter 5, 'City of Cape Town Data Collection and Data Analysis', describes and motivates the details of the selected *Belief States* and factors for the case study of Cape Town, and outlines the analysis approach, with details of the QPT modelling involving *Belief States* and *incompatibility*.

Chapters 3, 4, and 5 cover all the layers of the conceptual framework of the 'research onion' by Saunders et al. (2007), shown in Figure 15. The 'research onion' is a widely used conceptual framework that covers all aspects of the methodology. The layers of the onion, from outermost to innermost, include:

- Philosophy of researcher, examples: positivism, critical realism, interpretivism.
- Approach to theory development, examples: deduction, abduction, induction.
- Methodological choice, examples: qualitative, quantitative, mixed methods.
- Research strategies, examples: case study, experiment, survey, archival research.
- Time horizon, examples: cross-sectional, longitudinal.
- Techniques and procedures, namely: data collection and data analysis.

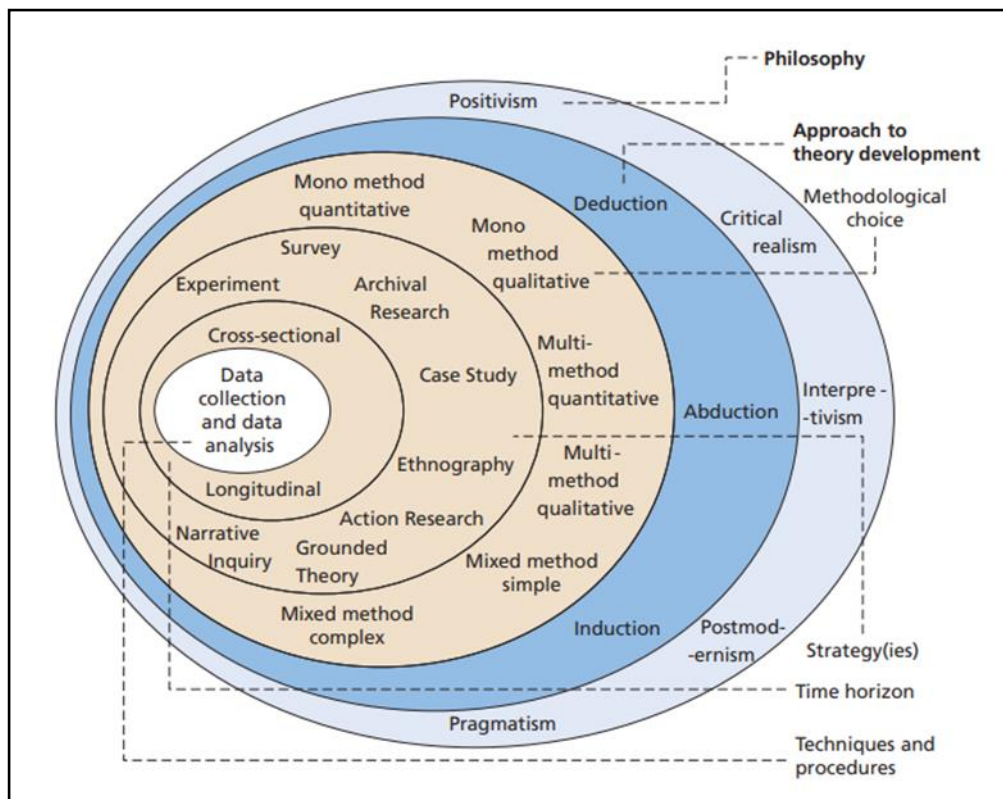


Figure 15: Research Onion of Saunders et al. (2007, p.124)

Figure 16 shows a visualisation of which chapters of this thesis cover the different sections of the 'research onion'. Chapter 3 focuses on the outside layer of the 'research onion', which is the researcher's *philosophy*. This is followed by the *approach to the theory development* (namely deduction in this study). Saunders et al. (2007) then suggest considering the *methods approach* (namely, mainly quantitative, with some qualitative aspects) and *the strategies* (namely, online surveys containing various experiments of case study city). All these aspects, based on the Saunders et al. (2007) 'research onion', are presented in Chapter 3.

Chapter 4 describes the context and details of the **case study** of Cape Town, focusing on relevant aspects of the city, and providing a detailed background to the transportation landscape, in terms of transport policies and guidelines, transport modal trends, and transport-related challenges of Cape Town. Chapter 4 concludes with the motivation of using Cape Town as the case study city for the ride-share service investigations of South African young adults.

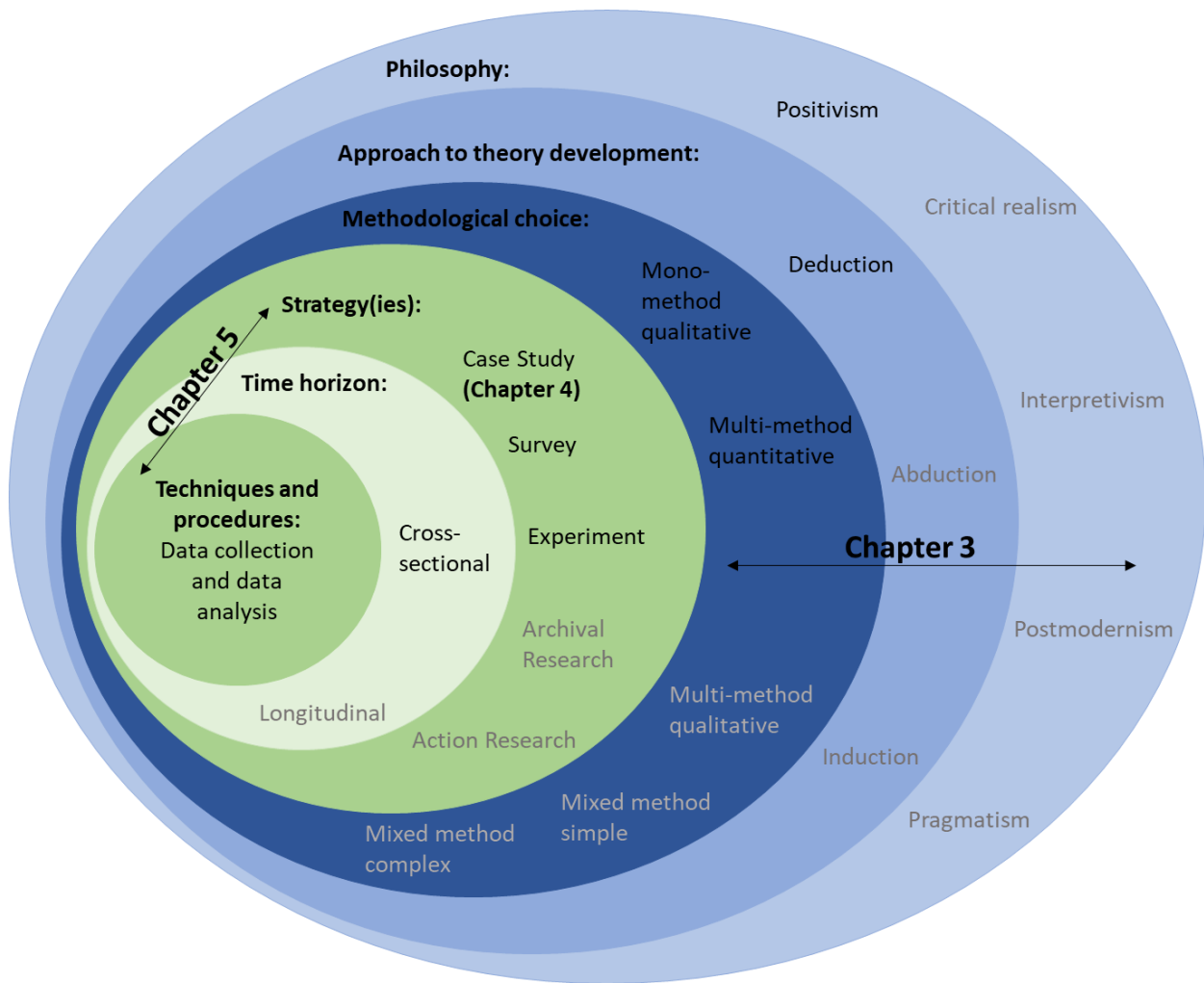


Figure 16: Overview of 'Research Onion' (Saunders et al., 2007) for Investigation as Described in Chapters 3, 4 and 5.

Chapter 5 links the case study Cape Town with the described methodology in terms of the *Belief States* (*Gender, Access to a Private Vehicle, COVID-19*), identified factors (related and unrelated factors), and ride-share service questions involving uncertainty and risk (namely, using ride-share services for trips at night, alone, and alone at night). Furthermore, Chapter 5 covers the research **time horizon** (namely cross-sectional), as well as the research **techniques and procedures**, namely the data collection and survey execution. The approach to the data analysis, using the QPT concepts, is shown in Section 5.6. Thus, Chapters 3, 4 and 5 describe all methodology aspects of this research, including the case study and data collection and analysis.

The research philosophy is the first aspect discussed in the next section.

3.1 Research Philosophy of Postpositivism

As a researcher with an engineering background, the research philosophy that aligns with this work is positivism, or, more accurately, postpositivism, as shown in Figure 16. Positivism is the

philosophy that advocates for the usefulness of the scientific method for answering research questions, including those of a social science nature. Ponterotto (2005, p.128) defined positivism as 'a form of philosophical realism adhering closely to the hypothetico-deductive method'. Postpositivism is the response to some of the challenges identified within positivism in that it acknowledges that reality is objective and can only be imperfectly perceived (Lincoln et al., 2011; Park et al., 2020). Therefore, postpositivism is different from positivism as it goes the next step by acknowledging that an absolute truth of knowledge is, undoubtedly, challenged when investigating the behaviours and actions of humans (Creswell, 2009).

Another critical aspect of postpositivism is that the focus tends to be on theory falsification rather than theory verification, as seen in positivism (Ponterotto, 2005). This is based on the understanding of philosophers, such as Popper (2014), favouring theory falsification instead of the more traditional positivist notion of theory verification. Guba and Lincoln (1994, p.107) capture the reason for this succinctly, as '*...a million white swans can never establish, with complete confidence, the proposition that all swans are white, one black swan can completely falsify it*'.

Adopting the notion of theory falsification is particularly true of this research, which questions various assumptions typically used in theories, such as RUM, in transport modal decisions of young adults. In the previous chapter, the assumptions to be explored include, for example, the assumption that ride-share service decisions involving uncertainty and perceived risks could be argued to be more likely to be created than recorded (and retrieved). This research aims to demonstrate that the typical assumptions used in transport modal decision investigations do not hold for ride-share service decisions involving uncertainty and perceived risks. **Therefore, using the analogy of Guba and Lincoln (1994), this research is looking for black swans.**

In postpositivism, knowledge is still primarily acquired through empirical research based on measurement and observation. Additionally, in postpositivism, addressing the issue of *context stripping* is a key component (Guba and Lincoln, 1994). *Context stripping* is another criticism of positivism, which is especially relevant for investigating human behaviours. In such investigations, human actions are connected to meanings and purposes and are relevant. In postpositivism, it is considered necessary to acknowledge or address such contextual factors or elements. Specifically, the implications of the research findings are considered within the

context in which they are found. This also holds for the aims of this research. The following section describes the research approach.

3.2 Research Approach of Deduction

The research approach used in this study is **deductive**. The proposed theory is that in ride-share service decisions involving uncertainty or perceived risks, the rational, and logical assumptions are insufficient to capture realistic human decisions, including critical contextual elements. The critical contextual elements of the individuals' decisions can be built into the investigations by creating relevant *Belief States*. Specific hypotheses have been formulated in Chapter 2, Section 2.3. To test these hypotheses, scientific experiments are carried out in an **online survey**, which allows the statistical testing necessary to confirm or reject the hypotheses for the case study city.

Therefore, the research approach is further justifiable as being **mainly quantitative**. Quantitative research allows the researcher (more easily than qualitative research) to determine if there are statistically significant changes between different *Belief States* in their responses, as well as the (quantifiable) effects of the different factors on the target ride-share service questions involving uncertainty or perceived risk. Furthermore, the quantitative approach was selected as it is more accepted and used in transport research (Haghani et al., 2021; Avineri and Prashker, 2003). The research, consisting of the concepts of *Belief States* and *incompatibility*, needed to be considered rigorous and valid in relation to the existing studies, which are, generally, based on quantitative approaches. Therefore, a quantitative approach fulfils the research aims and hypotheses of this thesis, while also remaining relevant to the field of research.

However, qualitative approaches often provide insights missed by quantitative approaches and help to address *context stripping*, as mentioned in the previous section in the discussion of postpositivism. Therefore, **appropriate qualitative aspects were included** to ensure that insights or information were identified. One tactic to include this within the scope of this research was to provide respondents with opportunities to comment on the quantitative questions they were asked. This was done in the survey by giving the respondents opportunities to add feedback or comments in a free-text space. The feedback collected by these 'open comment/feedback' questions was used to elaborate on the statistical findings.

3.3 Research Strategy and Design

The research strategy, as shown in Figure 16, was to **conduct an online survey** for the **developed case study experimental design** for ride-share service decisions in Cape Town. Due to the nature of the research, it was impossible to exclude or control the context of the cities where the individuals and the ride-share services find themselves. The following subsections describe the characteristics or criteria for *a potential case study city* that is appropriate for investigations involving *Belief States* and *incompatibility*. How the creation of *Belief States* can be included in ride-share service decisions, as well as the *criteria for identifying potential factors to be included for testing incompatibility in ride-share service decisions*, is described. Next, aspects surrounding the formulation of the ride-share service questions suitable for testing the concept of *incompatibility* are described, followed by a section that describes the scientific method design of the experiments. In the final subsection, how the designed experiments capture the QPT conceptualisation of the different *Belief States* and *incompatibility*, are defined.

In the next section, **an ideal case study city is described** through possible characteristics that would lend themselves to being appropriate for an *incompatibility* investigation.

3.3.1 Characteristics of Case Study City for *Belief State* and *Incompatibility* Investigations

As demonstrated in Chapter 2, the decisions of individuals and the perceptions and provisions of ride-share services are influenced by the cities in which they operate. Therefore, much variability is involved in the potential design and characteristics of investigating decisions to engage with ride-share services.

This section draws on the discussions in Chapter 2 to outline criteria for selecting characteristics of a case study city that are suitable for investigations involving the concept of *Belief States* and *incompatibility*. The first characteristic of the case study city is that the ride-share services are operating and are well-established. For the purposes of this research, this includes more than one ride-share service provider for an extended period. This will help represent the stable ride-share service dynamics and avoid any initial effects of the arrival of ride-share services being included (Sadowsky and Nelson, 2017). This is also required to ensure that enough respondents, with sufficient experience with ride-share services, can be reliably questioned.

The second characteristic of the case study is that there are differences in how various individuals experience the case study city. Chapter 2 describes how differences in individual experiences are due to socio-economic variations. However, which socio-economic factor is appropriate for inclusion in the research depends on the case study and the focus of the investigation. The identification of appropriate socio-economic factors is necessary for the formation of the *Belief States*. If all individuals in a city experienced or interacted with ride-share services in the case study city with no restraints, specific uncertainties, or perceived risks, then applying the concept of *Belief States* is likely to result in one type of *Belief State* that is applicable to the decision at hand for all inhabitants.

In the next section, the elements of the *Belief States*, and the selected related and unrelated factors for testing *incompatibility* (the ‘nudges’) are incorporated into the design of the experiments of this study.

3.3.2 Creation of *Belief States*

This research tests two main concepts from QPT for their usability in ride-share service decisions. Firstly, defining and using *Belief States* are investigated for their usefulness in conceptualising how individuals make decisions. Secondly, *incompatibility* is explored by identifying and including related factors that may be used to understand decisions involving uncertainty or perceived risk better. *Compatibility* is explored through unrelated factors.

For the creation of the *Belief States*, aspects of individuals that tend to result in similar behaviours, tendencies or attitudes are relevant in defining the *Belief States* relevant to the investigation. Since the target population of this study is young South African adults, relevant aspects in their decisions need to be identified and tested. Typically, in modal transport research, these are the socio-economic or demographic elements of the population (Van Acker et al., 2010). Typical examples of such aspects include:

- **Gender**¹³, conceptually illustrated in Figure 17;
- **Age**¹⁴,
- Life phase of the individual (example: single/married/with children or not), and
- Income.

¹³ Included in this study and will be elaborated on in case study description (Chapter 5, Section 5.1.1)

¹⁴ Included in this study as target population group

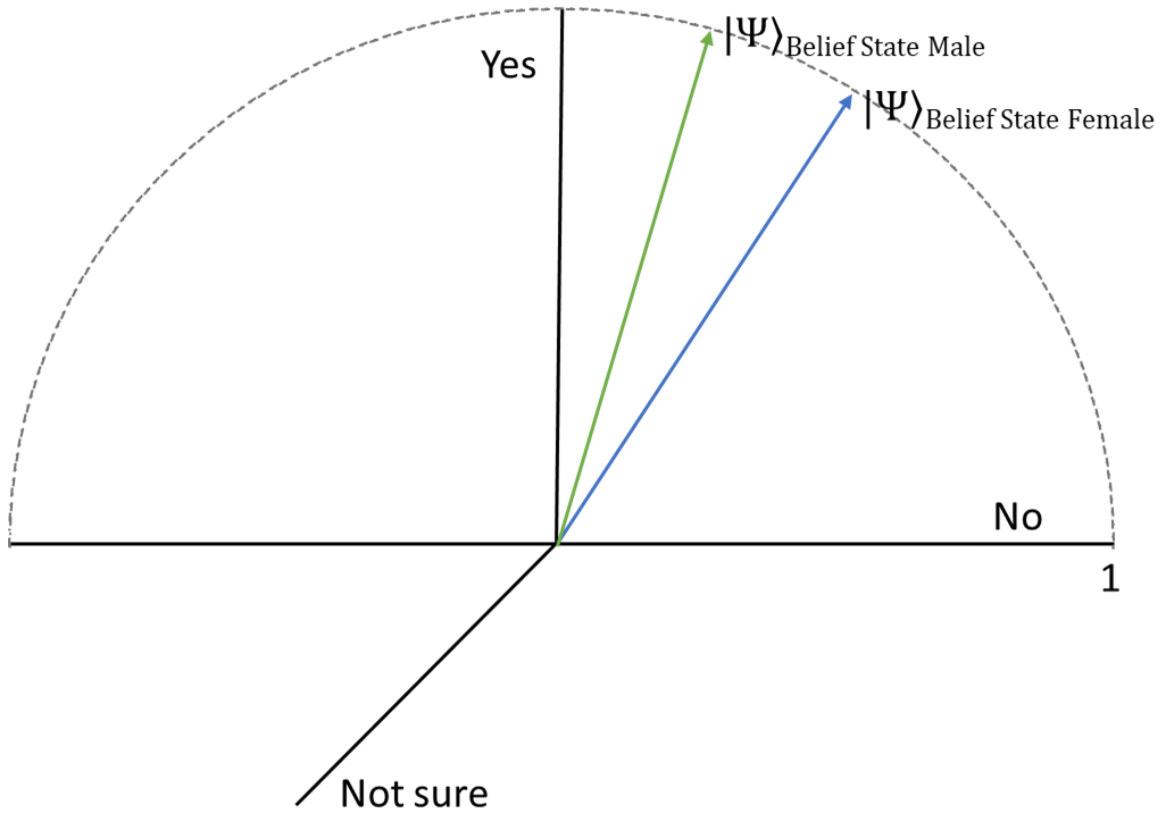


Figure 17: Visualisation of Gender Forming Different Belief States for Females and Males in a Ride-Share Service Decision with Three Orthogonal Rays of 'Yes', 'No' and 'Not Sure'.

The *Belief State* for a specific ride-share service decision could be illustrated, based on the selected elements:

$$|\Psi_{\text{Elements}}\rangle = a|\text{Yes}\rangle + b|\text{No}\rangle + c|\text{Not sure}\rangle$$

Figure 17 shows an illustrative example of how the *Belief States* of gender could be represented. The *Belief State* for females and males are represented by two different *Belief State* vectors that have a unit length. As described in Chapter 2, Section 2.2.2, projectors are used to determine the probability of the subspace. For the example of the female *Belief State* responding 'yes', the projector would be denoted as $P_{f(\text{yes})} |\Psi_f\rangle = a_f |\text{Yes}\rangle$.

In turn, the probability of females answering 'yes', 'no', 'not sure' is expressed as:

- Probability of Female_{yes} = $||P_{f(\text{yes})} |\Psi_f\rangle||^2 = |a_f|^2$,
- Probability of Female_{no} = $||P_{f(\text{no})} |\Psi_f\rangle||^2 = |b_f|^2$,
- Probability of Female_{not sure} = $||P_{f(\text{not sure})} |\Psi_f\rangle||^2 = |c_f|^2$.

While the probability of males answering 'yes', 'no', 'not sure' is expressed as:

- Probability of Male_{yes} = $||P_{m(\text{yes})} |\Psi_m\rangle||^2 = |a_m|^2$,

- Probability of Male_{no} = $||P_{m(no)}|\Psi_m||^2 = |b_m|^2$,
- Probability of Male_{not sure} = $||P_{m(not sure)}|\Psi_m||^2 = |c_m|^2$.

Other elements that could be considered are special events or ‘key events’, as defined by Muggenburg et al. (2015). Muggenburg et al. (2015, p.151) identified the following four types of key events ‘(i) life events in private or professional careers, ii) adaption of long-term mobility decisions, (iii) exogenous interventions, and (iv) other long-term processes, which are not key events (e.g., socialisation).’

These socio-economic factors and key events can be considered elements of different conceptual *Belief States* of the individuals. The following section describes identifying the unrelated and related factors in an *incompatibility* investigation.

3.3.3 Identification of Potential Factors of *Incompatibility* and Positive Framing

Incompatibility is only likely to occur when individuals are faced with information that cannot be considered simultaneously for questions that involve uncertainty and perceived risk.

Therefore, the selection of the related and unrelated (transport modal or ride-share service) factors in the experiments must be based on the current understanding of these factors in the literature. Related (transport modal or ride-share service) factors were identified as generally accepted to be linked to transport modal decisions or factors that influence the individual’s transport modal decisions.

Examples of related factors to modal decisions are:

- **Time of trip,**
- Duration of the trip,
- Cost of trip,
- (functional) Safety of mode,
- **Security of mode,**
- Ease of accessibility of mode,
- **Reliability of mode,** and
- Frequency of mode.

Unrelated factors were identified as factors that are not commonly considered within investigations of modal decisions. These unrelated factors have no or weak evidence of a

connection or influence on modal decisions and are, theoretically, likely to demonstrate compatibility with the ride-share service decisions involving uncertainty and perceived risks.

Examples of unrelated factors that could be used in positive framing to modal decisions are:

- Opinions or preferences to unrelated transport things or activities,
 - Example: opinions of best or worst foods; sports, entertainment, hobbies.
- Emotional state of the individuals at the time of the investigation,
 - Example: individuals have a positive, neutral, or negative emotional state (Cassotti et al., 2012; Seo and Barrett, 2007).

Naturally, the unrelated factors to modal decisions are less restricted than the related factors. This allows for some creativity in formulating the questions involving the selected factors. In this research, the unrelated factors were chosen to invoke a (potentially) positive frame of mind, taking inspiration from the work of Seo and Barrett (2007) and Cassotti et al. (2012).

Seo and Barrett (2007) explored the link between affective experience and decision-making performance in a stock investment simulation, and found that feelings were, generally, not bad for the decision-making performance, but rather that the impact of the feelings on the decision-making performance depends on the individual's ability to identify their current feelings and self-adjust for any biases from the identified emotional state. Furthermore, Seo and Barrett (2007) found that individuals who experienced more intense feelings achieved higher decision-making performance. Seo and Barrett (2007) also highlight previous work that shows that people in more positive states of mind tend to categorise stimuli in a more flexible, inclusive manner, which can increase creativity and, thus, performance in complex tasks.

Cassotti et al. (2012) investigated the effects of positive and negative imagery on the decisions of individuals through an investigation using an emotional priming paradigm. Participants were first presented with either pleasant or unpleasant photographs before being asked to perform a financial decision-making task unrelated to the content of the photos. Cassotti et al. (2012) found that a positive emotional context can reduce loss aversion and strongly reinforced the dual-process view that the framing effect stems from an affective heuristic belonging to intuitive System 1 (of Tversky and Kahneman (1981), described in Chapter 2, Section 2.1.2).

The next section describes the formulation of the ride-share service questions relevant to investigating the *incompatibility* of ride-share services in South Africa.

3.3.4 Formulation of Ride-Share Service Questions Relevant to *Incompatibility*

The ride-share service questions appropriate for an *incompatibility* investigation require that individuals experience uncertainty or perceived risks relevant to the creation of their ride-share service decision. Evidence of *incompatibility* is only likely to occur when individuals cannot consider information simultaneously.

In this investigation, this translates to ride-share service questions involving aspects of uncertainty or perceived risk. The types of uncertainty and perceived risks of interest to this work have been identified as those stemming from personal security concerns, which have been pinpointed as being relevant for ride-share services in South Africa in Chapter 2.

Personal security, such as being involved in a criminal attack while using a ride-share service, may be viewed as being more likely, in certain circumstances, namely while taking a trip alone or late at night (Giddy, 2019; Fenton et al., 2020).

In the South African context, the high rates of gender-based violence connect directly to the personal security uncertainty and perceived risks of ride-share service decisions. This is especially applicable for trips where the individual is **either alone, at night, or making the trip late at night**.

Therefore, the identified uncertainty or perceived risks for the ride-share service questions in this research involve the aspects of **alone, at night, or alone at night**.

3.3.5 Scientific Method Design of Experiments

The research strategy follows the scientific method with control and experimental groups. This allows for the comparison of the different variables through statistical analyses.

In an *incompatibility* decision investigation, the questions are often limited in number (Hancock et al., 2020). Generally, there are only two questions, typically named *question A* and *question B*, which are asked directly after each other. Figure 18 illustrates the general format.

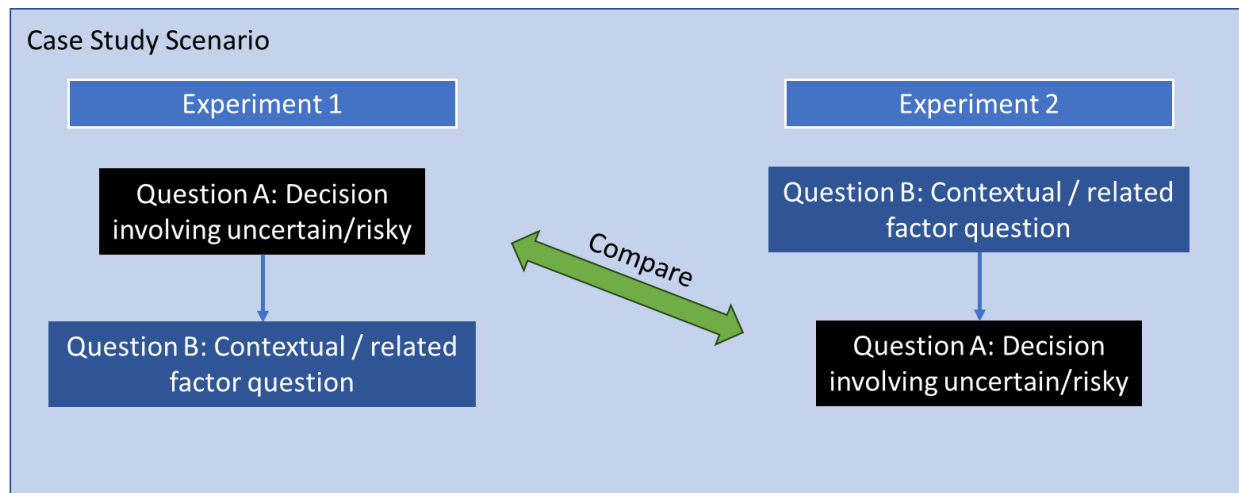


Figure 18: Typical Structure of Incompatibility Questions using Question A and Question B.

However, in this research, **question sets** are used. **Question sets** are defined as several questions ($n > 1$) grouped that have the same nature of questions, namely:

- ride-share service questions involving uncertainty or perceived risk,
- related factor questions, and
- or unrelated factor questions.

This is illustrated in Figure 19. These question sets were used for two main reasons. Firstly, transport modal decision research, in general, and ride-share service research, specifically, typically involves many aspects or questions for modelling purposes (personal information, willingness to pay, the value of time, preferred time of departure and so forth) (Innocenti et al., 2013).

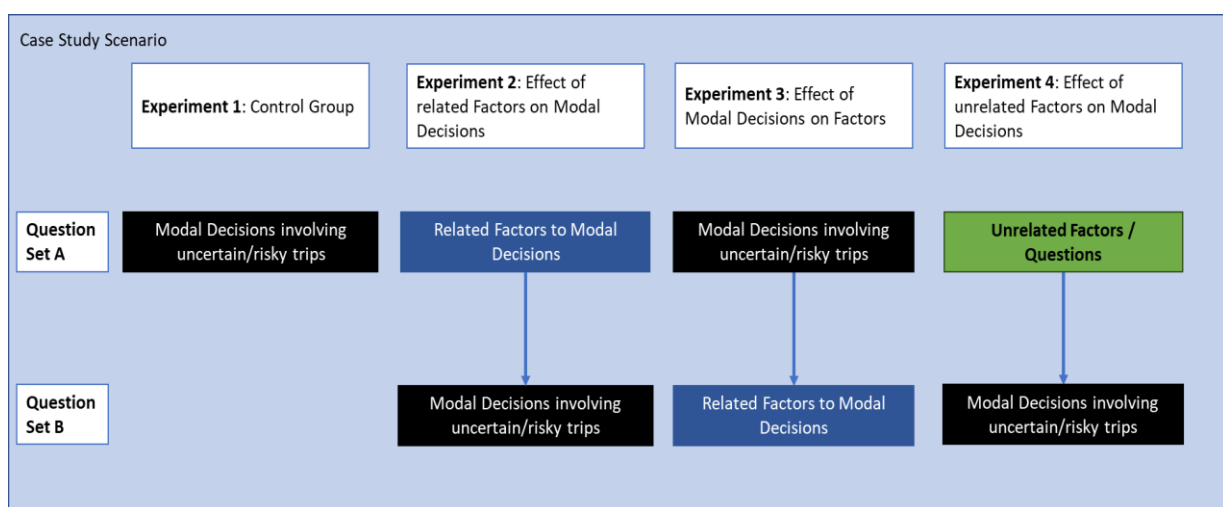


Figure 19: Proposed Question Set Approach to Incompatibility Investigations.

Thus, if *incompatibility* effects are present, then these effects still need to be evident, even if questions are asked in sets, rather than directly after each other, which is what is typically done in the psychology and social science fields.

Secondly, this research aims to capture realistic responses and avoid creating a ‘toy model’ of decisions (Busemeyer and Wang, 2015). While ‘toy models’ are useful and used widely across scientific disciplines as highly idealised and simple models (Reutlinger et al., 2016), this research is aimed at gaining realistic results for young South African adults. This will likely reduce the captured *incompatibility* effects, as the opposing (incompatible) questions are not asked directly after each other in pairs. **However, if *incompatibility* is found, it can be argued to be more ontic or realistic than simply an order effect.** Furthermore, the findings should be considered robust enough for acceptance in the engineering-centred transport research field.

The *Belief States* of the experiments, shown in Figure 19, can be described in relation to each other. The control initial *Belief State*, Ψ_i , is valid for Experiment 1 and Experiment 3 for the *Ride-Share Service Questions*:

$$|\Psi_i\rangle \equiv |\Psi_{\text{Experiment 1}}\rangle \equiv |\Psi_{\text{Experiment 3}}\rangle$$

As Experiment 1 and Experiment 3 have no preceding questions, the initial *Belief States* are identical to each other. For the initial state for the *Ride-Share Service Questions* of Experiment 2, a different initial *Belief State* is created through the preceding *Transport Factors Questions*:

$$|\Psi_{\text{Experiment 2}}\rangle \neq |\Psi_i\rangle$$

The initial *Belief State* for the *Ride-Share Service Questions* of Experiment 4 includes compatible factors with the *Ride-Share Service Questions*, therefore:

$$|\Psi_{\text{Experiment 4}}\rangle \equiv |\Psi_i\rangle \text{ and } |\Psi_{\text{Experiment 4}}\rangle \neq |\Psi_{\text{Experiment 2}}\rangle$$

Figure 20 illustrates the comparisons for the modal decisions involving uncertain/risky trips using green arrows. The data of ‘*Modal Decisions involving uncertain/risky trips*’ of Experiment 1 and Experiment 3 are combined to form the ‘control data’, as both data sets have no ‘*Related Factors to Modal Decisions*’ or ‘*Unrelated Factors/Questions*’ preceding them. The black line indicates this in Figure 20. This ‘control data’ is then compared to the ‘*Modal Decisions involving uncertain/risky trips*’ of Experiment 2 and then Experiment 4.

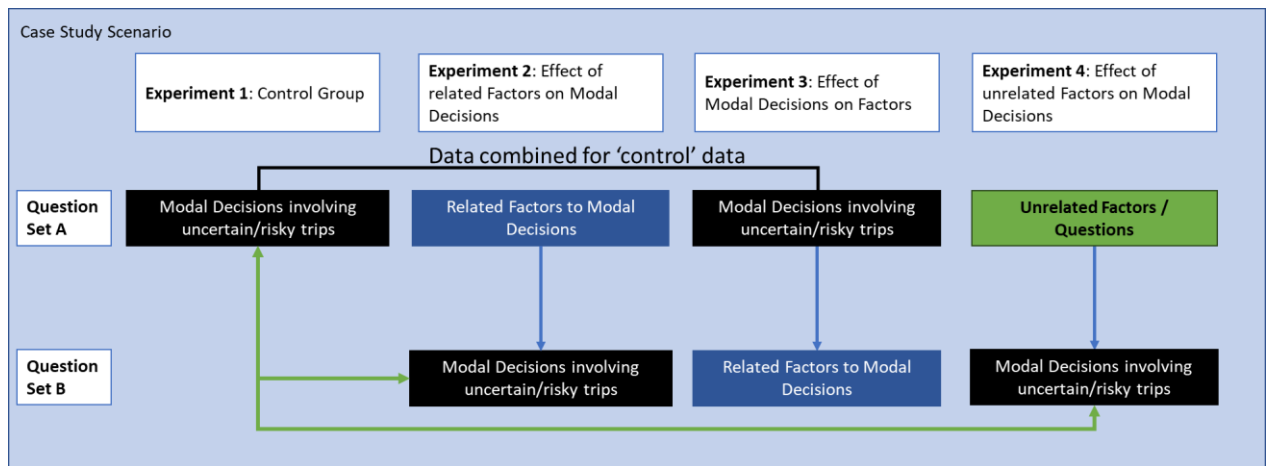


Figure 20: Comparisons for Incompatibility Effects on Modal Decisions Involving Uncertain/Risk (shown by green arrows).

Similarly, Figure 21 shows the comparison to determine if the question set of 'Modal Decisions involving uncertain/risky trips' had any *incompatibility* effects on the *related factors* (namely 'Related Factors to Modal Decisions').

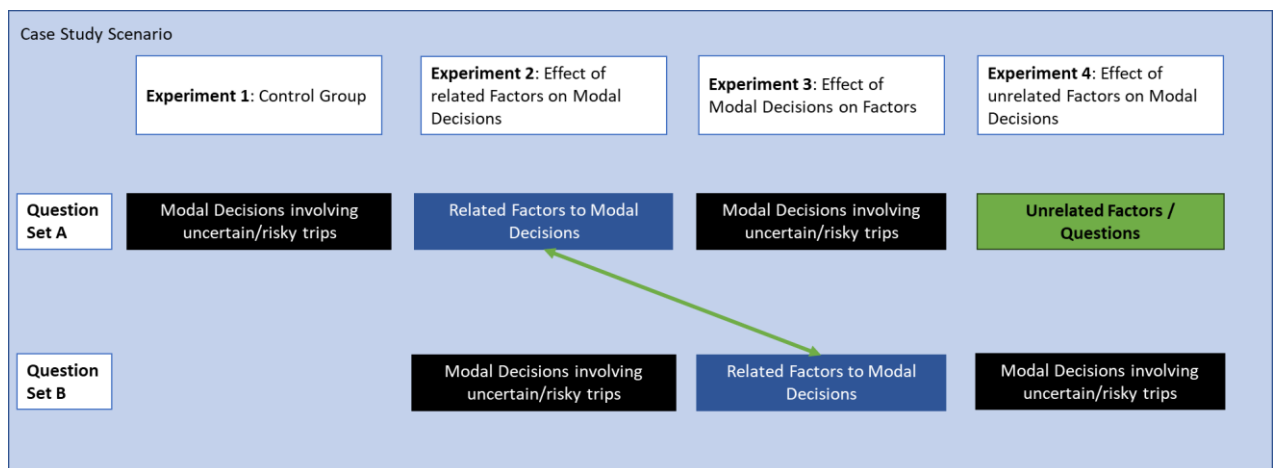


Figure 21: Comparisons for Incompatibility Effects on Related Factors to Modal Decisions (indicated by green arrow).

The respondents of this research knew the survey wanted to capture their decisions and perceptions of different aspects. However, the respondents were naïve regarding the experimental aims and comparisons between the different experiment groups (Cassotti et al., 2012).

The next section explains how the experiments connect to the modelling of the *Belief States*, and the tests for *incompatibility* are described and modelled.

3.3.6 Application of QPT Concepts: Design of *Belief States* and *Incompatibility* in Experiments

The focus of the research is how individuals make ride-share service decisions involving uncertainty and perceived risks. Experiment 2, shown in Figure 5, explores the potential of

incompatibility in modal decisions involving uncertainty and perceived risks. In Figure 22, the *Belief State*, without *incompatibility*, is shown in (a). In (b), the selected factors for the related factors are successfully chosen, resulting in *incompatibility* shown by a change in willingness to engage in the ride-share service decision involving uncertainty and perceived risks (indicated by the orange vector).

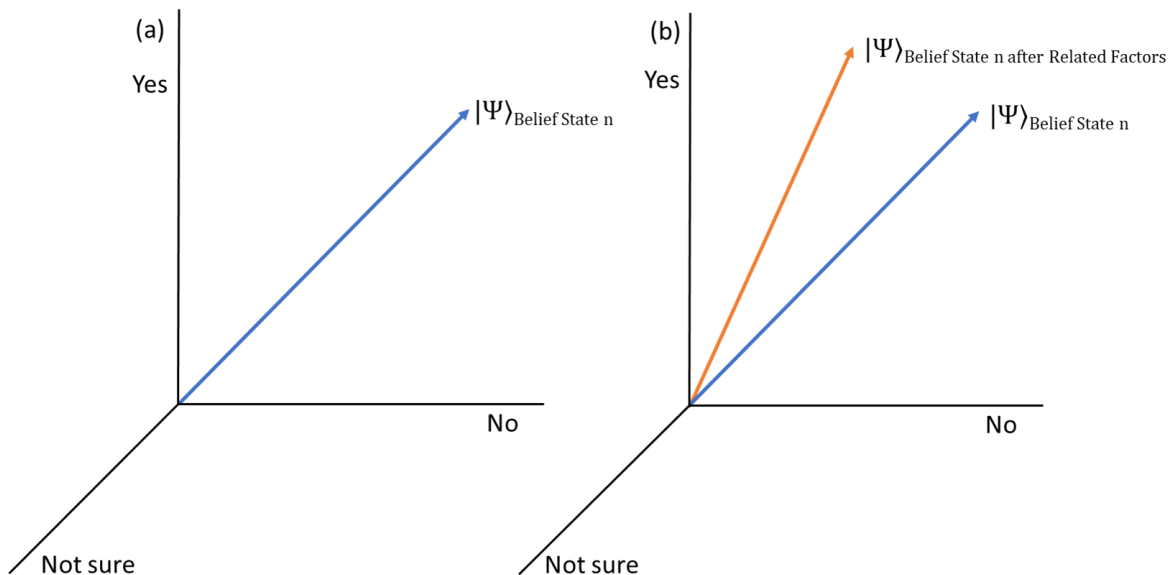


Figure 22: Experiment 2 with (a) Illustrating Ride-Share Service Decision Belief State and (b) Illustrating the Change in Belief State due to Incompatibility.

Experiment 4 tests for positive framing of compatible factors to investigate if any effects of positive emotional framing can be seen using unrelated factors (compatible factors) to ride-share service decisions involving uncertainty and perceived risks. Furthermore, it is tested, using the data from Experiments 2 and 3, if the *incompatibility* is bi-directional and if the responses to the related factors could experience a change in perceived importance, due to the pre-questions of the ride-share service decisions involving uncertainty and perceived risks. A simplification of this potential *incompatibility* is illustrated in Figure 23, (c) and (d), where the *Belief State* vector of the perceptions of the related factors' position is altered.

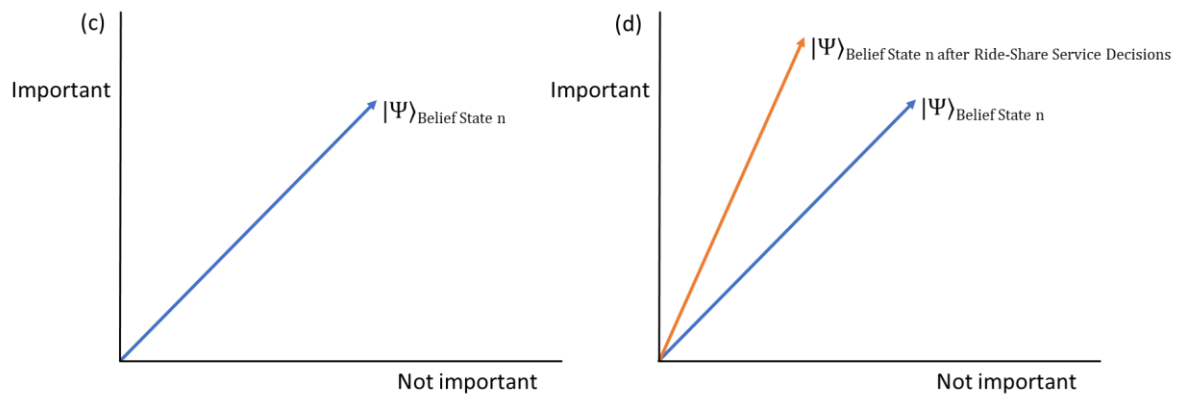


Figure 23: Experiment 3 with (c) Illustrating Related Factors Belief State and (d) Illustrating Change in Belief State Due to Incompatibility with Ride-Share Service Decisions.

A short summary of this chapter is provided in the next section.

3.4 Résumé

This chapter outlines the research method developed and adopted in the research of this thesis using the conceptual framework of the 'research onion' (Saunders, 2007). In this first of three methodology chapters, the research design and methodology overview were presented. The research philosophy was described as postpositivism, and the research approach was described as deductive.

The research strategy and design involved an online survey in the appropriate case study city. The necessary characteristics of the case study city and the selected characteristics of the individuals were also outlined, such as the presence and operation of the targeted transport mode which, in this research, is ride-share services, and variation in how different population groups experience the case study city, specifically regarding ride-share services.

Criteria and the theoretical approach of designing the *Belief States* (for example, socio-economic factors) and identifying the potential factors (namely related and unrelated factors) for exploring *incompatibility* were described. The outline of the scientific method design of the experiments is motivated and described.

The visualisation of the different experiments using the vectors of the different *Belief States* is presented. First, the *Belief States* of investigation of the ride-share service decisions are shown before a simplification of the *Belief States* of the perceptions of the related factors is provided.

The exact background of the case study city and detailing of the case study specific *Belief States*, related and unrelated factors, ride-share service questions involving uncertainty and perceived risk and experiments, follow in Chapters 4 and 5.

4. Description of the Case Study: The City of Cape Town

The City of Cape Town is a paradox. It is one of the most beautiful and desirable destinations, with a tourism industry that, in 2019, was estimated to have a Gross Value Added (GVA) of R56.2 billion (Cape Town Tourism, 2020). However, it is also a dangerous city. Lamb (2018) highlights several safety and security challenges facing people in Cape Town. Challenges include having some of the highest rates of reported violent crimes (murder, attempted murder, and common assault) in South Africa. Unlike other cities in South Africa, where the murder rates have somewhat stabilised, the murder rates in Cape Town continue to increase (Lamb, 2018). Other challenges include gang and drug-related activities (Lamb, 2018). Even according to South African standards, Cape Town is beautiful but dangerous.

Additionally, gender-based violence and rape have remained a consistent problem in Cape Town. In the *'State of Urban Safety in South Africa Report,'* the severe nature of these problems can be seen (SACN, 2019). Figure 24 shows the trends of the leading crimes in Cape Town.

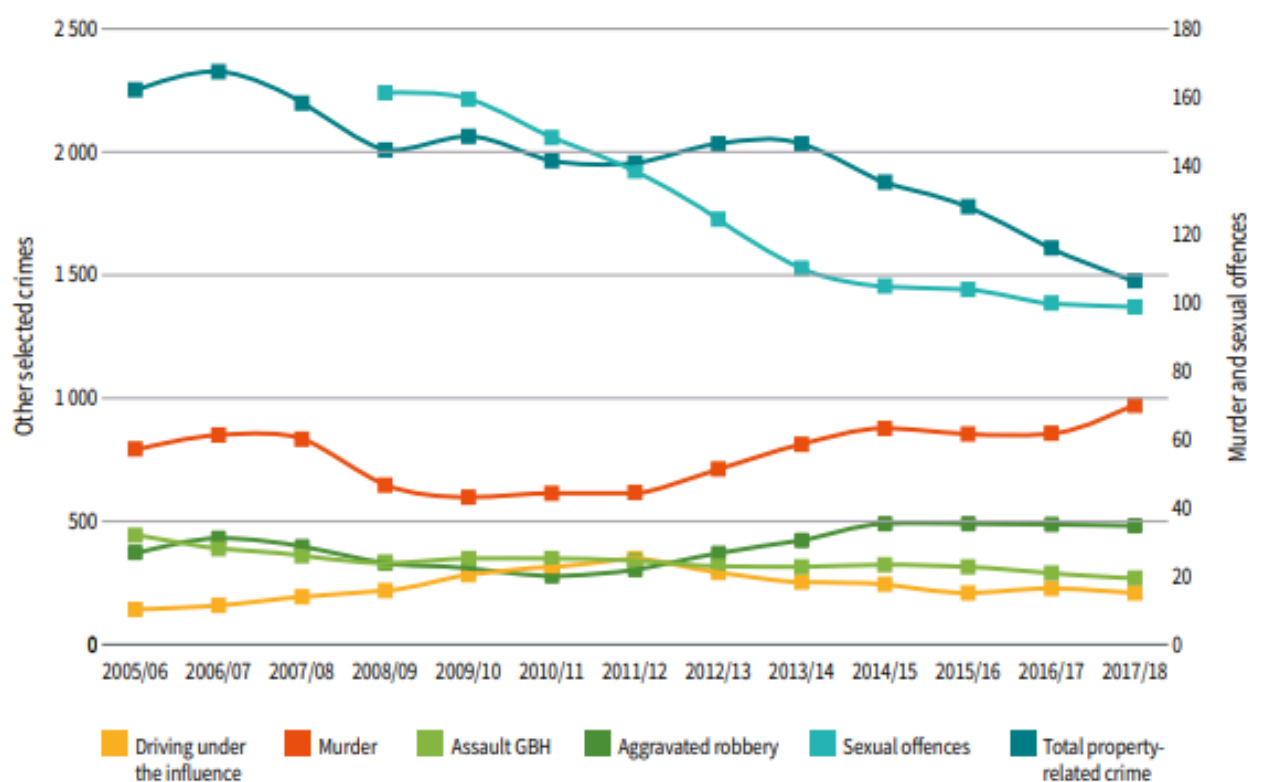


Figure 24: Long-term Trends in Crime Rates per 100 000 Individuals in Cape Town
Source: SACN, 2019

The decreasing trend in reported sexual offences in Cape Town should be handled cautiously; these numbers only reflect the reported cases and not the reality (Pierce-Jones, 2022). Counsellors in Cape Town believe there needs to be a higher level of trust in the police and judicial system, since the lack of these contributes to an under-reporting of cases (Pierce-Jones, 2022). So, while the figures in Cape Town are decreasing, the reality may be otherwise.

This claim is justified by the national trends that show that sexual offences are not decreasing. Despite the 'crime holiday' effect of the COVID pandemic on crime in South Africa, crime levels quickly returned to previous rates, or higher, once the strict lockdown levels were lifted (SAPS, 2022). When the effects of the more stringent lockdowns are excluded, an increase of 5%, on a national level, can be seen in the category of 'all sexual offences' between 2019/2020 and 2021/2022 (SAPS, 2022). Gender-based violence and rape remain significant long-term challenges in South Africa.

On the economic front, there are also challenges. These challenges include high levels of inequality, unemployment, and poverty. Levels of inequality in Cape Town have increased in the last decades from a Gini coefficient of 0.57 in 2010 (Lloyd et al., 2021) to an estimated 0.63 in 2018 (Vanderschuren et al., 2021). According to the available data from the World Bank's Development Indicators, this is the highest ranking, currently, implying that South Africa is the most unequal nation globally (Carlitz and Makhura, 2021; World Bank Group, 2022).

In the third quarter of 2021, Cape Town had an official strict unemployment rate of 27.5% and an expanded unemployment rate of 30.2% (Statistics South Africa, 2021b). The increasing disparity has contributed to social unrest and dissatisfaction with public services.

4.1 Cape Town Transport and Status Quo of Trends in Transport Modes

This section describes the Cape Town transportation network by discussing the national and local transport policies and guidelines. Cape Town's contextual challenges that affect the public transport modes are discussed in the following subsection. Insights into the Western Cape's main transport modes are presented in Section 4.1.3, highlighting significant trends and changes relevant to Cape Town's transport modal split, and dissatisfaction with the main transport modes in Section 4.1.4. Section 4.1.5 presents a Cape Town-specific analysis using the NHTS 2020 data for ride-share service trips.

4.1.1 National and Local Transport Policies and Guidelines

Several national policies and documents in South Africa aim to address the various transport challenges. For passenger transport in South Africa, policies and documents, on a national level, include the National Transport Policy White Paper (1996); *Moving South Africa: The Action Agenda – A Strategic Framework for Transport in South Africa* (NDoT, 1999), and *DoT Strategic Plan* (2014-2019), among several others (NDoT, 2016). The most recent and comprehensive national plan is the **National Transport Master Plan 2050** (NATMAP 2050) by the National Department of Transport (NDoT, 2016). The NATMAP 2050 provides a long-term framework for sustainable transportation. The goal of NATMAP 2050 is to fill the transport needs and gaps in South Africa. However, the NATMAP 2050 does not expand on ride-share services much and only notes that more needs to be done to better integrate ride-share services into transport policies and implementations.

However, the challenges facing transport in Cape Town and, generally, in South Africa, remain largely unaddressed. This is acknowledged in the NATMAP 2050. The NATMAP 2050 (NDoT, 2016) states that passenger transport in South Africa is still not user-focused and remains inefficient. Furthermore, passenger transport systems remain unsustainable and are, consequently, degrading. Transport modes remain poorly integrated, and accessibility is still low (NDoT, 2016). Some contributing challenges and issues mentioned in the NATMAP 2050 for passenger transport include urban sprawl, as well as the lack of land use and transport integration. These contributing factors make public transport inefficient and unattractive compared to private vehicle trips (Cooke and Behrens, 2015). Other issues identified in the NATMAP 2050 include reliability and resilience, due to under-investment and a lack of safety and operational compliance standards for general passenger transport (NDoT, 2016). These overarching issues and challenges impact on transport modes' ability to operate sustainably, attractively, and efficiently - they are complex and require an integrated spatial planning and development approach.

On a local level, the City of Cape Town has several transport strategies, plans and frameworks. For the scope of this research, the following documents from the City of Cape Town are of most interest: *Travel Demand Management Strategy* (City of Cape Town, 2017), the *Comprehensive Integrated Transport Plan 2018-2023* (City of Cape Town, 2020 Annual Update), the *Integrated Public Transport Network (IPTN) Plan 2032* (City of Cape Town, 2014)

and the *Transit Oriented Development Strategic Framework* (City of Cape Town, 2016). The City of Cape Town aims to reduce congestion and encourage participation in formal public transport modes and non-motorised transport, such as cycling. An explicit aim of the city is to reduce private single-occupancy trips caused by private vehicle trips.

4.1.2 Public Transport Modes in Cape Town – Fundamental Challenges

4.1.2.1 Spatial Challenges of Cape Town

Land densities in Cape Town vary significantly in the city, which can create a false positive impression, when summarised. Densities in well-located and sought-after locations close to economic opportunities remain comparatively lower than in other areas. In contrast, undesirable areas far from economic opportunities have increased their densities (Scheba et al., 2021). Scheba et al. (2021) report that, while the densities of the Cape Flats range between 17 458 and 31 414 people per km², the lower-density areas range between 2 000–4 000 people per km².

For public transport modes, it is difficult to achieve a high level of service and, hence, the cost-efficiency of public transport is low, resulting in the need for heavy subsidies. Clark and Crous (2002) summarise the role apartheid had in influencing the development of public transportation in Cape Town. They highlight that public transport, mainly rail and bus infrastructure and services, was developed to link the townships, designated on the far edges of the city, to the economic centres, isolating the workers from the cities while benefiting from their contributions.

Spatial planning in Cape Town also has much room for improvement. Since the end of apartheid, the planning of low-income housing projects and commercial and industrial developments has not improved the city's density or spatial efficiency (Clark and Crous, 2002). As such, spatial planning continues to contribute to the unsustainability of public transport modes.

Due to the long distances and inefficiency of spatial planning, public transport modes are cost-inefficient and rely heavily on governmental subsidies (Clark and Crous, 2002; Cooke and Behrens, 2015). Cooke and Behrens (2015) show, using an operating cost model, that BRT services can be financially sustainable in South Africa by prioritising density articulation in the current BRT corridors, or by reducing their length and catchment areas. For other public

transport modes, similar findings have been seen by Molai and Vanderschuren (2003), who argued that the built environment in Cape Town does not support the implementation of efficient and effective public transport modes.

This inefficiency of public transport and inequality does not need to remain the status quo. Recent research by Moyo et al. (2021) show that land use driven policies are particularly effective in addressing social and economic challenges in Cape Town. However, the land needs to be allocated differently. Moyo et al. (2021) recommend that some low-income housing units be implemented closer to the city centre to improve accessibility to the low-skill jobs of the city centre. For this to be successful, commitment to investing in low-income housing in developed areas, with access to transport infrastructure, will be needed from all stakeholders (Moyo et al., 2021). The solution to the transport challenges is, therefore, interwoven with the land use challenges in Cape Town. There are, however, numerous policies that focus on the transport challenges alone.

4.1.2.2 Transport Modes Challenges in Cape Town

During apartheid, public transport focused on getting workers in and out of the economic centres. The transport network within the city prioritised private motorised transportation, over public transportation modes. This resulted in most of the population remaining unserved for all trips outside of commuting trips. From this one-dimensional planning, the Minibus Taxi (MBT)¹⁵ industry grew to meet the needs of most of the population in Cape Town.

The MBT industry significantly contributes to the transport network and continues to serve many people. However, violence within the MBT industry is common (Bähre, 2014; Jefthas, 2002). This contributes to the uncertainty and perceived risk associated with the transport network in Cape Town.

Although bus services continue today, in recent years, the train network has mostly collapsed (City of Cape Town, 2020). Details of the changes in the train network will be discussed in the trends of transport modes in Section 4.2.3. Furthermore, the economic and criminal challenges in Cape Town also affect the public transport modes. This is especially true during civil actions, which often disrupt and destroy public transport modes during protests (Khambule et al., 2019; Mchunu, 2012; Vhumbunu, 2021).

¹⁵ In the NHTS (2013, 2020) this mode is simply referred to as 'taxi'.

The city also implemented a Bus Rapid Transit (BRT) system in Cape Town. Cape Town’s BRT service, called *MyCiTi*, was launched as a pilot project in May 2010 as a shuttle service for the FIFA World Cup (Miller, 2018). The first phase of the BRT system for Cape Town was launched in May 2011 (Grey and Behrens, 2013). BRT in Cape Town was seen as a measure to reduce congestion by attracting individuals with private vehicles to these services. Furthermore, it was also implemented as a public transport mode with higher service levels, while remaining accessible and efficient. This has yet to be achieved. Personal vehicles have increased from 39.3% to 42.8% for work trips (City of Cape Town, 2020).

The adoption of BRT in Cape Town and, generally, in South Africa has been sub-par, both in adoption and sustainability, when compared to the expectations based on the success of BRT systems in South American cities, such as Bogota or Mexico City (Scordia and Munoz-Raskin, 2019). This is unfortunate, as the BRT was implemented to address several of the transport challenges in Cape Town.

Cape Town remains the most congested city in South Africa. Cape Town experienced a 32% congestion drop in 2020, due to the COVID-19 pandemic, while post-COVID-19, this reduced to 22% in 2021 compared to the 2019 baseline (TomTom, 2022). The congestion is also reflected in the increases in time spent travelling. Figure 25 shows the percentage changes between 2014 and 2018 for the time work trips take in Cape Town.

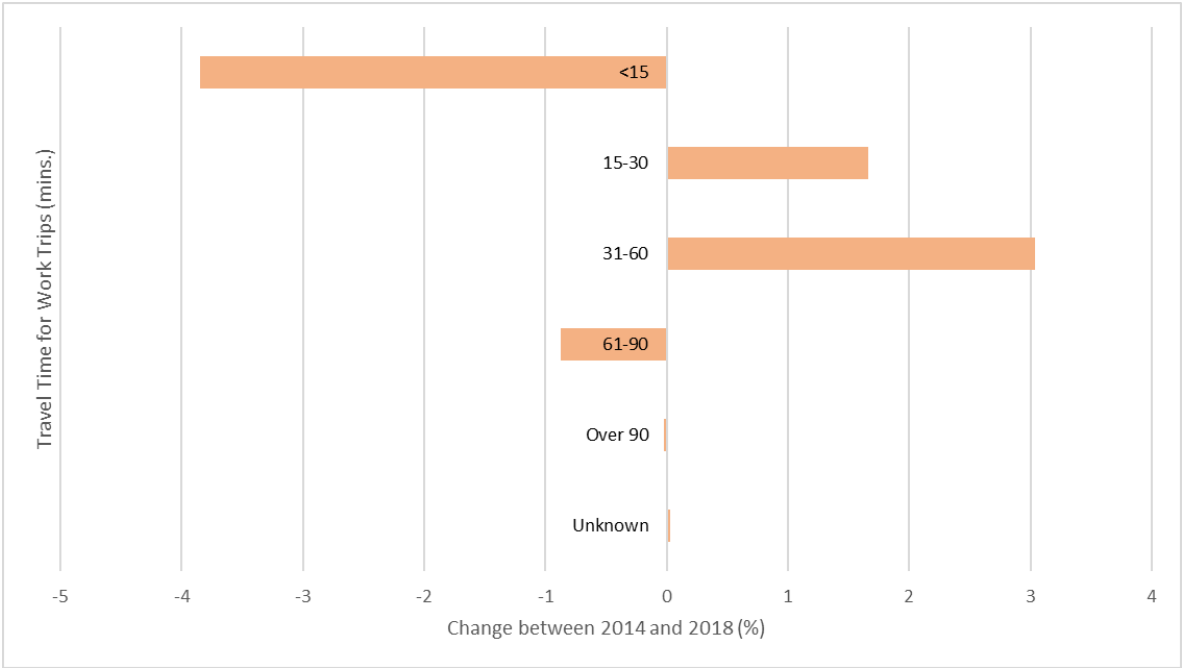


Figure 25: Percentage Change in Travel Time to Work for Cape Town
Source: City of Cape Town, 2020; Statistics South Africa, General Household Survey 2014 and 2018

Figure 25 shows that the travel time getting to work has increased by slightly over 3% for trips between 31-60 minutes, while trips taking less than 15 minutes have decreased by nearly 4%. These changes indicate that congestion in Cape Town is worsening. The changes go directly against the City of Cape Town's *Travel Demand Management Strategy* (City of Cape Town, 2017). One of the main issues identified in the *Travel Demand Management Strategy* is the private vehicle trips of single occupants. These are mostly 'work' trips. So, while the policies and strategies correctly identify the problem, the transport system has been unable to attract individuals with personal vehicles to other transport modes.

The next expectation of BRT was that it would be financially self-sufficient. However, the BRT service in Cape Town remains highly subsidised and, for many trips, not time-effective enough to attract individuals with access to private vehicles. As mentioned, Cooke and Behrens (2015) argue that South African city officials should either prioritise density articulation in the BRT corridors or consider reducing the BRT's corridor lengths and catchment areas to improve the financial sustainability of the BRT system. However, a practical solution to BRT's challenges will unlikely be implemented for users, in the short term. This is another example of how land use planning and development do not support public transport modes to be efficient.

In the next section, the trends in the main transport modes are described on a provincial level, using the 2013 and 2020 National Household Travel Survey (NHTS) (Statistics South Africa, 2014; Statistics South Africa, 2021a). The focus is on the Western Cape, as this is the province of Cape Town and, therefore, also of this research. Cape Town typically has around 64% of the Western Cape's population (Small, 2017). This shows which transport modes have increased or declined on a provincial level to provide a general overview of the transport trends in this area.

4.1.3 Trends in Transport for the Western Cape

This section explores the transport modes using the data from the **National Household Travel Surveys (NHTS)** from 2013 and 2020 (pre-COVID-19)¹⁶(Statistics South Africa, 2014; Statistics South Africa, 2021a). These two national surveys provide data from before the first ride-share services in Cape Town¹⁷, which commenced in 2013, and again after a substantial time since

¹⁶ Data collection was from 27 January 2020 to 19 March 2020. While the data collection was initially scheduled until 20 March, with a 'mop-up' for the week of 23-27 March, all activities were cancelled due to the start of the COVID-19 pandemic.

¹⁷ The data of the NHTS 2013 was collected from the beginning of January 2012 until December 2012 (NHTS, 2013). Uber first launched in Johannesburg and then Cape Town in the second half of 2013 (Cutcher, 2013).

competitors, such as Bolt¹⁸ (previously known as Taxify), joined the market. The transport modes in the Western Province include MBTs, buses, trains (Metrorail), a BRT system, walking, private vehicles, traditional metered taxis (taxis), car hire, ride-share services, and cycling.

While this study focuses on ride-share services, a brief overview of the trends in the main transport modes is presented to illustrate the overall transport trends.

The disruptive nature of ride-share services was initially met with some resistance from various groups within the city. The most substantial opposition was from the metered taxi sector (Adebayo, 2019; Carmody and Fortuin, 2019; Henama and Sifolo, 2017). The city responded to the arrival of ride-share services by impounding vehicles used for ride-share services (Phakathi, 2016). Whether the conflict has declined or is being resolved is still to be determined. However, in the NATMAP 2050 (NDoT, 2016), one of the critical challenges described is that the existing transport legislation does not fully provide for services, such as ride-share services, indicating that an official solution is still to be implemented.

On a household level, various factors can influence the choice of transport mode. This is the first aspect of transport in the Western Cape that is described in Figure 26.

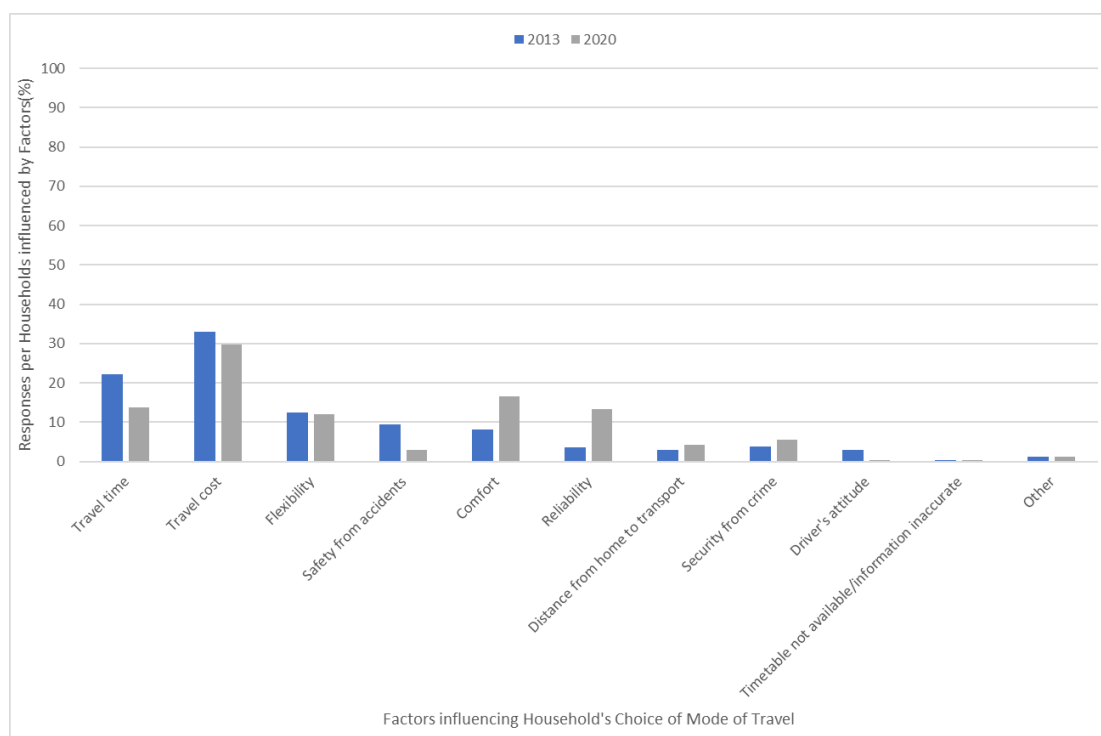


Figure 26: Factors Influencing Household's Choice of Mode of Transport for 2013 and 2020 in the Western Cape

Source: Statistics South Africa, 2021a

¹⁸ Taxify started operations at the end of January 2015 (ITweb, 2015).

Travel cost remains the most significant factor influencing households' transport mode selection in the Western Cape, despite decreasing slightly. Comfort, as a factor in Figure 26, displaces travel time as the second most influential factor. **There is also a noticeable increase in reliability as a factor, putting it on par with travel time.** Comfort and reliability have become more influential, since 2013, than other factors. Trips take longer, due to increasing congestion levels. Understandably, individuals prioritise comfort and reliability. Furthermore, concerns regarding road safety decreased over the same period. However, an **increase in the concern around crime** is also seen.

The next aspect described using the NHTS (Statistics South Africa, 2014 and 2021a) is the changes in the transport modal split. Table 5 shows the percentages of households' main transport modes in the Western Cape for 2013 and 2020. The most significant decline is seen in walking as a transport mode with only 3.8% in 2020 from 17.1% in 2013. The most noteworthy increase is seen in MBTs, with a change of 19,3%, followed by private vehicle drivers ('Car/bakkie/truck driver') with 10,4%.

Table 5: Main Modes of Travel Usually Used by Households in Western Cape for 2013 and 2020

	2013 (%)	2020 (%)	% Change
Train	10.5	3.1	-7.4
Bus	7.3	8.5	+1.2
MBT	25.7	45.0	+19.3
Car/bakkie/truck driver	22.0	32.4	+10.4
Car/bakkie/truck passenger	15.4	6.3	-9.1
Walking all the way	17.1	3.8	-13.3
Other	2.0	1.0	-1.0

Source: Statistics South Africa, 2014; Statistics South Africa, 2021a

Another perspective can be gained by exploring the transport modal split of educational and work trips. These two types produce most of the trips taken. In 2020, NHTS educational trips accounted for 33.2% of the primary purposes for travelling, and work trips were 37.4%. Furthermore, these trips have changed over time.

Table 6 shows the percentage change in the main modes of transport in the Western Cape for trips to educational institutions. This ranges from pre-school to higher educational institutions. Table 6 is skewed towards the decisions of individuals without private vehicle access because many of the trips are performed by individuals legally not allowed to drive yet.

Table 6: Changes in Main Modes of Transport for Educational Trips (All Learners) in Western Cape

Mode of Transport		2013 (%)	2020 (%)	% Change
Public Transport	Train	4.5	0.9	-3.6
	Bus	6.2	6.3	+0.1
	MBTs	10.9	13.7	+2.8
Private Transport	Car/truck company car driver	1.9	6.8	+4.9
	Car/ truck passenger	24.2	18.2	-6
Walk all the way		50.4	53.3	+2.9
Other		1.9	0.8	-1.1

Source: Statistics South Africa, 2014 and 2021a

While on a household level (Table 5), the transport mode of walking declined significantly, an increase in walking can be seen for educational trips in Table 6. This may point to the lack of available and attractive transport modes for individuals under the legal driving age and, therefore, without access to a private vehicle.

Table 7: Changes in Main Mode of Transport for Work Trips in Western Cape

Mode of Transport		2013 (%)	2020 (%)	% Change
Public Transport	Train	13.3	2.2	-11.1
	Bus	7.2	6.5	-0.7
	MBTs	15.1	20.3	+5.2
Private Transport	Car/truck/ company car driver	35.4	46.2	+10.8
	Car/ truck passenger	10.8	9.8	-1.0
Walk all the way		16.8	14.0	-2.8
Other		1.4	1.0	-0.4

Source: Statistics South Africa, 2014; Statistics South Africa, 2021a

Table 7 demonstrates even more significant changes in the transport modal split for work trips. Table 7 shows that the most prominent transport mode is private transport – ‘car/ truck company car driver’ with 46.2%. This is an increase of nearly 11% since 2013 for private transport drivers. The other most prominent transport mode is MBTs, which now provide just over 20% of the work trips. The significant decrease in trains and the slight decrease in buses indicate that formal transport modes, in the Western Cape, fail to provide attractive services to individuals. The significant train decrease is linked to deteriorating services and protest action, leading to high levels of dissatisfaction (Statistics South Africa, 2021a). This highlights how decisions change, once individuals have the potential to drive themselves.

In Section 4.2.4, transport mode problems and levels of dissatisfaction are explored in more detail to determine some of the motivating factors behind these shifts in transport modes.

4.1.4 Problems of Transport Modes and Factors of Dissatisfaction in the Western Cape

As ride-share services are perceived only as ‘semi-private’ or ‘semi-public’, the security perceptions of the main transport modes are presented. This forms a baseline of what ride-share services are being compared to, within the context of transport modes in Cape Town. This helps provide a relative scale of how the perceptions of different transport modes vary and what could be considered a relatively secure transport mode in the Western Cape.

The changes in the reported transport-related problems in the Western Cape can indicate the central transport challenges from a user’s perspective. Figure 27 shows the percentage changes between 2013 and 2020 for the Western Cape transport-related problems (Statistics South Africa, 2014; Statistics South Africa, 2021a). Unsurprising, the most significant change in transport-related problems is the unavailability of trains. The second largest increase can be seen in congestion. This is also, unsurprisingly, from the significant increases in private vehicle driver modal share and trips described previously. The reported problems of ‘overload’ and ‘MBTs too expensive’ have been reduced. These transport-related problems have declined or are no longer so frequently experienced (Statistics South Africa, 2014; Statistics South Africa, 2021a). The most significant changes in the public transport modes between 2013 and 2020 in the Western Cape were seen in **trains - the most significant decrease**, and **MBTs - the largest increase**.

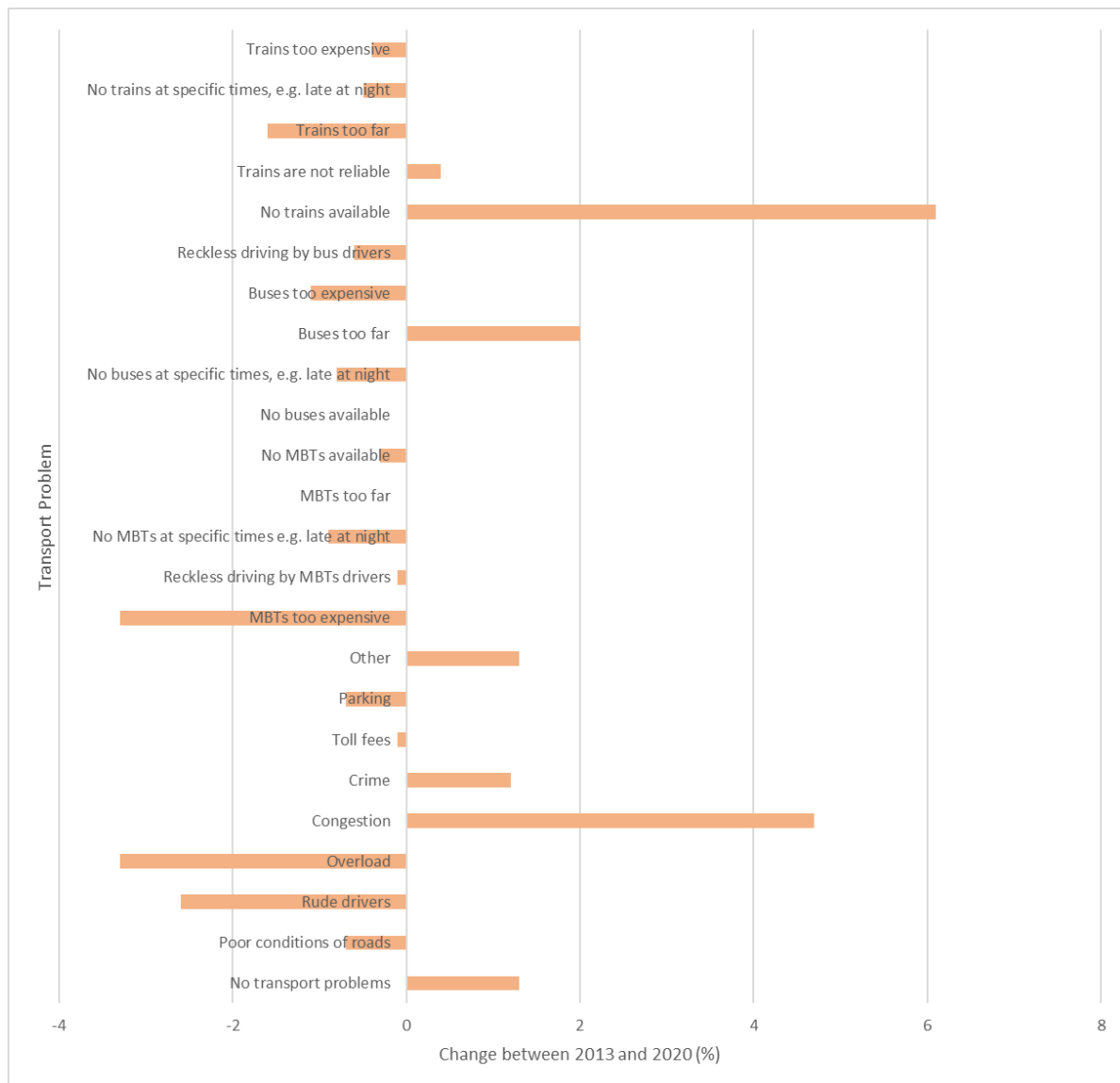


Figure 27: Percentage Change Between 2013 and 2020 in Reported Transport Problems by Households for the Western Cape

Source: Statistics South Africa, 2014; Statistics South Africa, 2021a

A closer look at the dissatisfaction changes for these two modes in the Western Cape is shown in Figure 28 and Figure 29, respectively. The train fare is the only dissatisfaction factor for trains that has improved between 2013 and 2020. This is a minor concern for the users when considering the other elements of dissatisfaction. Figure 28 shows substantial increases in most of the other factors. Six of the factors measure over 80% dissatisfaction. These six factors refer directly to the operative aspects of the trains, such as the frequency of trains (peak and off-peak times), travel time and punctuality. The one factor above 80%, not directly related to the service of the trains, is the factor of 'security to/from the train station'. The factor of 'security at the train station' and 'security on the train' are also high at 74% and 76.1%, respectively. The drop in trains as a transport mode is unsurprising given these high levels of dissatisfaction.

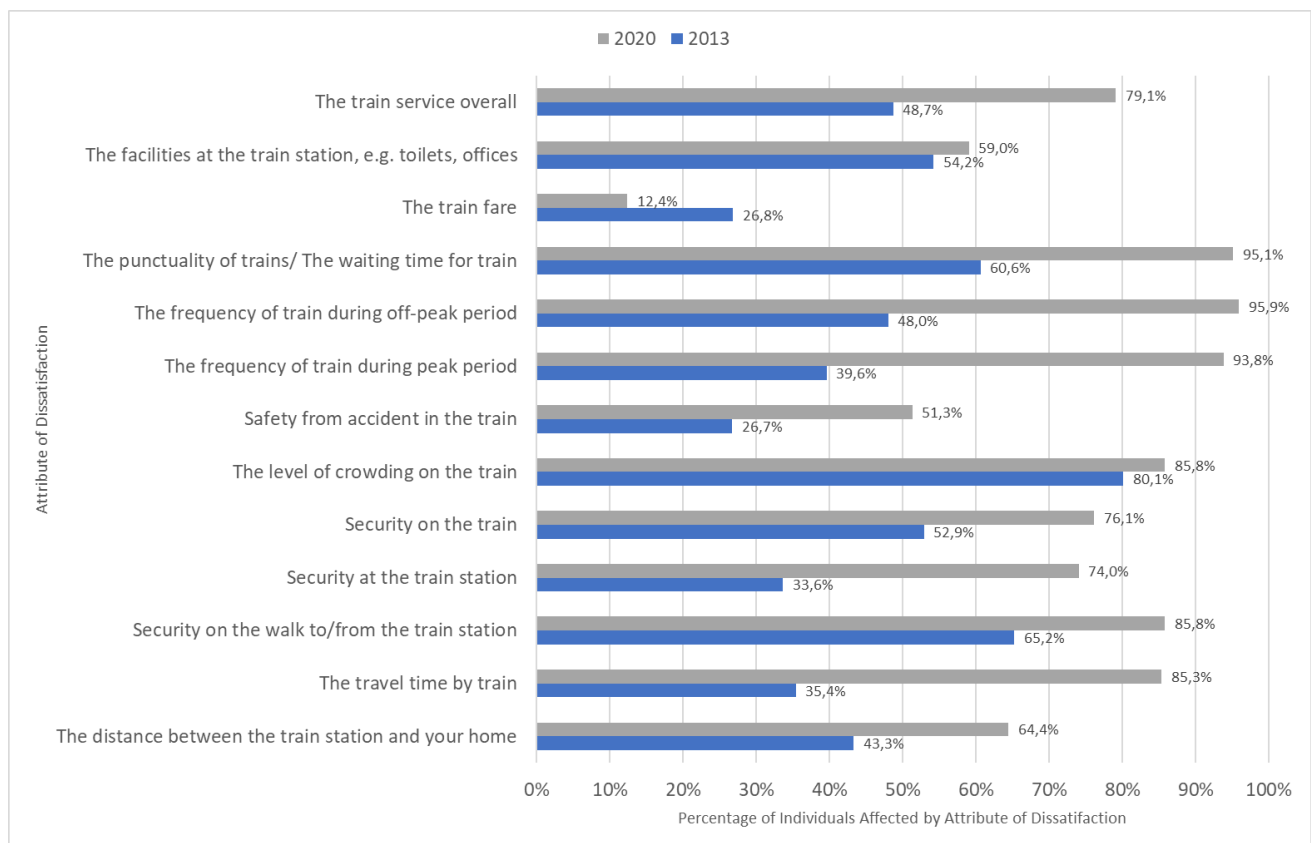


Figure 28: Dissatisfaction with Train Service in Western Cape 2013-2020
Source: Statistics South Africa, 2014; Statistics South Africa, 2021a

The changes and dissatisfaction of MBT services are the opposite of the changes and values in trains. Figure 29 shows the dissatisfaction with MBTs in the Western Cape between 2013 and 2020. In all but three factors, levels of dissatisfaction decreased for MBTs in the Western Cape. However, some factors still have high levels of dissatisfaction. For example, in 2020, 56.9% were dissatisfied with the facilities at the MBT ranks, and 43.3% were still dissatisfied with the level of crowding in the MBTs. A common aspect that is seen again is the increase in dissatisfaction with the 'security on the walk to/from the MBTs rank'. This was also seen in the corresponding factor within the train services. The highest dissatisfaction factor, and the factor that increased the most, is the dissatisfaction with the facilities at the MBTs ranks. The frequency of trips during peak and off-peak and the waiting time had the lowest dissatisfaction. Figure 29 shows that the changes since 2013 in the MBT service, within the Western Cape, have decreased dissatisfaction with MBTs services.

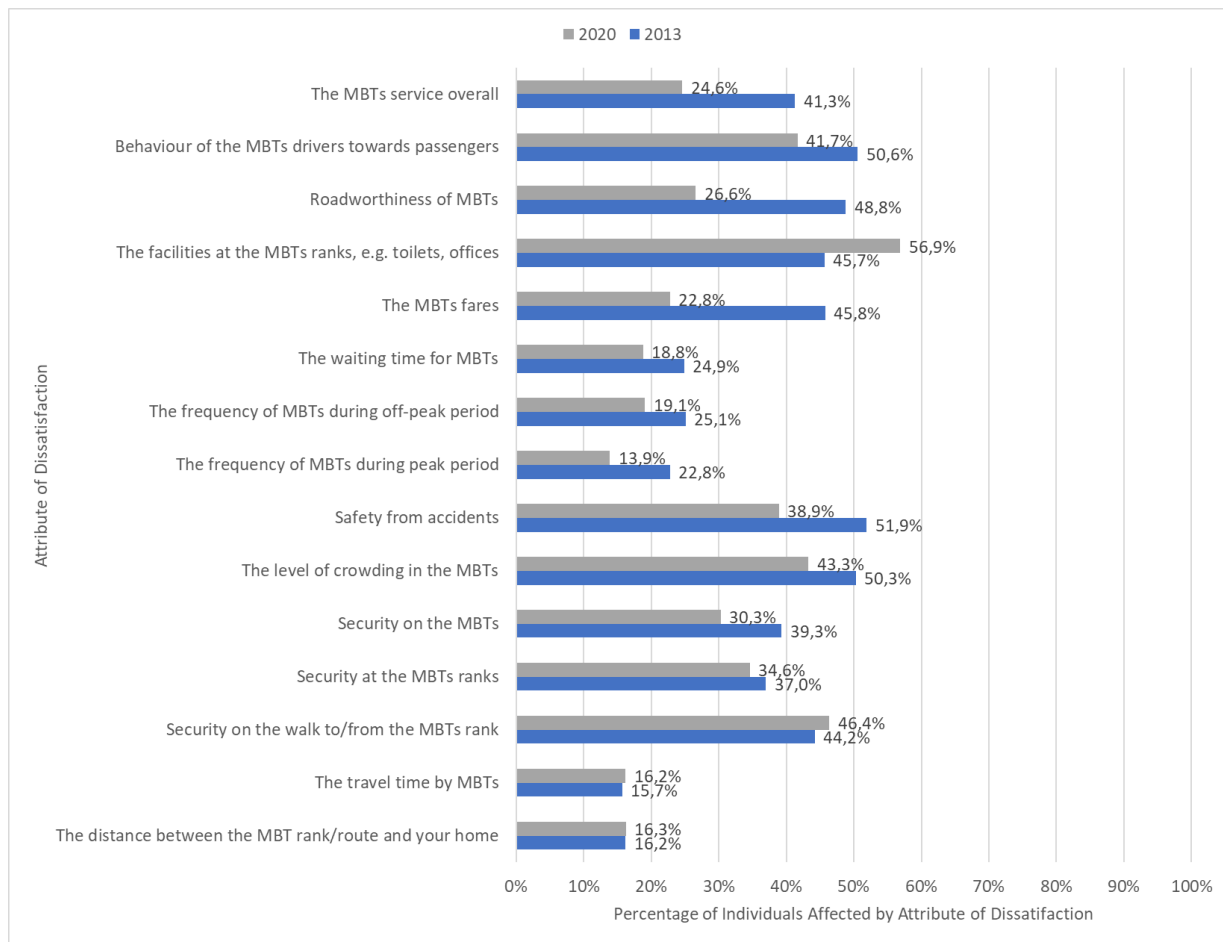


Figure 29: Dissatisfaction of MBTs in Western Cape 2013-2020
Source: Statistics South Africa, 2014; Statistics South Africa, 2021a

Figure 28 and Figure 29 show the evident importance of the transport mode frequency of trips and waiting time for individuals in the Western Cape. Also, considering the changes in the transport modal split, trip frequency and short waiting times can be regarded as valued characteristics in individuals' decisions. **A common problem is the dissatisfaction with the security of walking to/from the station or MBT rank. This can be seen in trains (i.e. worst public transport) and MBTs (i.e. the best public transport mode¹⁹).** While this factor is not within the control of the transport mode operators to improve, it indicates a more significant problem that negatively impacts public transport modes' participation in the Western Cape.

The dissatisfaction with the security of walking to/from the station or MBT rank, the security at the stop or station, and the security on the transport mode, are summarised in Table 8. Table 8 shows that the security of walking to and from the transport stop or station in the Western Cape has increased dissatisfaction for all modes. It also has the highest value of

¹⁹ Based on dissatisfaction levels.

dissatisfaction concerning security of 85.8% for trains. MBTs show substantially less security dissatisfaction at the stop or station, and during the trip. The bus dissatisfaction has similar levels of security dissatisfaction at the stop or station, and the walk to or from the transport stop or station, while comparatively moderate dissatisfaction with security during the trip. It is also insightful that decreases in dissatisfaction were only seen for MBTs. Both bus and train increased in all security dissatisfaction aspects.

Table 8: Dissatisfaction of Main Transport Modes in the Western Cape

		2013 (%)	2020 (%)	% Change
Security on the walk to/from the transport mode stop/station	MBTs	44.2	46.4	2.2
	Bus	43.7	49.2	5.5
	Train	65.2	85.8	20.6
Security at the stop or station	MBTs	37	34.3	-2.7
	Bus	46.7	50.7	4
	Train	33.6	74	40.4
Security on transport mode	MBTs	39.3	30.3	-9
	Bus	32.6	38.6	6
	Train	52.9	76.1	23.2

Source: Statistics South Africa, 2014 and 2021a

In the next section, a short analysis of what types of trips are completed by ride-share services in Cape Town is discussed.

4.1.5 Analysis of Ride-Share Services in Cape Town Using NHTS 2020 Data

This section describes a short analysis of the ride-share service trips in the Cape Town area based on the National Household Travel Survey database (Statistics South Africa, 2020). This analysis links to previous work done by Vanderschuren and Baufeldt (2018).

Vanderschuren and Baufeldt (2018) calculated, from the data of the NHTS 2003 (Statistics South Africa, 2005) and NHTS 2013 (Statistics South Africa, 2013), that the total portion of metered taxis in Cape Town was stable at around 2% of all trips. In the most recent data of NHTS of 2020 (Statistics South Africa, 2020), Cape Town's portion of combined metered taxis and ride-share services has remained surprisingly consistent. This is despite many thinking that the arrival of ride-share services would result in many more individuals switching from other modes to ride-share services. Figure 30 shows that metered taxis and ride-share services each have 1%.

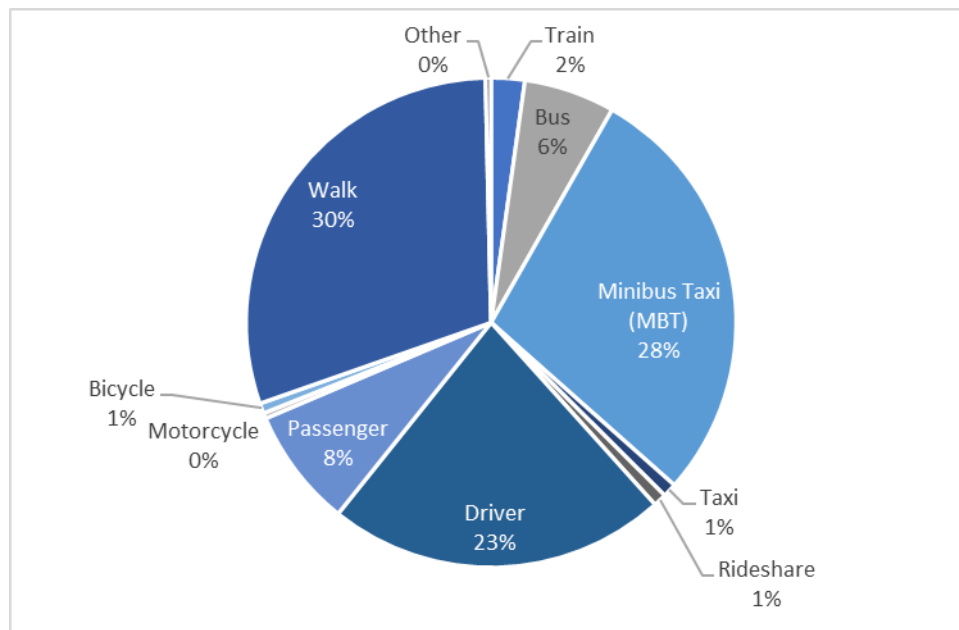


Figure 30: Cape Town Transport Modal Split from NHTS 2020 Data
Source: Statistics South Africa, 2020

The number of trips in Cape Town between 2013 and 2020 increased from 2.26 million trips a day to 2.35 million trips a day. Although metered taxis lost the market share between 2013 (2%) to 2020 (1%), partly due to the arrival of ride-share platforms, their overall trips per day in Cape Town remain essentially the same, with around 20 000 person trips. According to the NHTS (Statistics South Africa, 2020), the volume of ride-share trips in Cape Town, in the period just before COVID-19, was 20 290 trips per day.

An interesting perspective can be gained by looking at the transport modes of the top 20% of income households and the bottom 20% of the income of households in Cape Town. In Cape Town, nearly all the top 20% of income households use private vehicles as their main transport mode, either as drivers or passengers. The bottom 20% of income households in Cape Town have a more diverse transport modal choice.

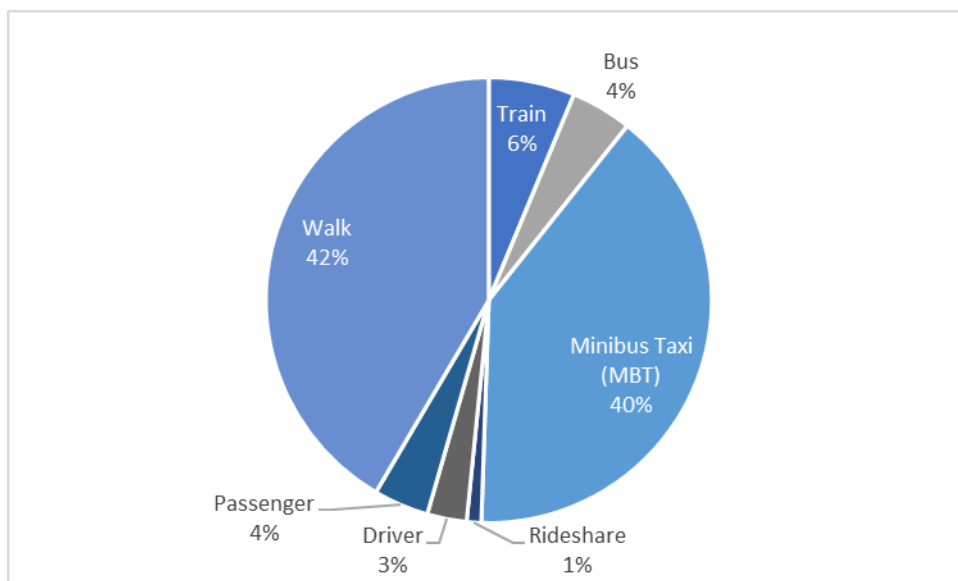


Figure 31: Transport Modal Split for Bottom 20% of Income Households

Source: Statistics South Africa, 2020

Figure 31 shows the transport modal choice of the bottom 20% of income households from the NHTS 2020 data (Statistics South Africa, 2020). Figure 31 also shows that ride-share services are a small but present transport mode in the bottom 20% of income households in Cape Town. Interestingly, while ride-share services are identified, other transport modes, such as metered taxis, are absent in the bottom 20% of income households.

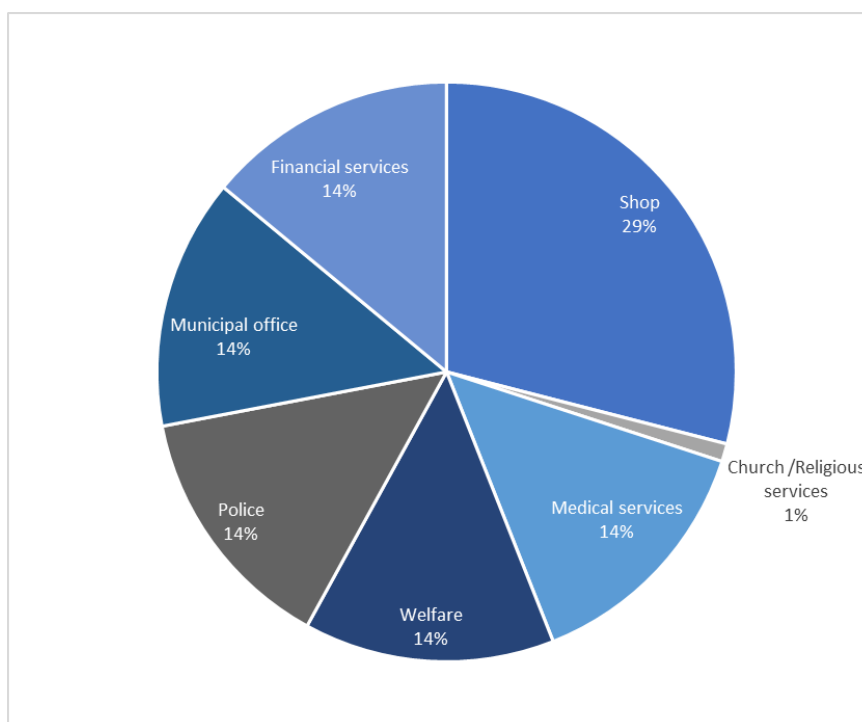


Figure 32: Estimated Trip Purposes for Ride-Share Trips, Based on 2013 NHTS Data

Source: Vanderschuren and Baufeldt, 2018

Vanderschuren and Baufeldt (2018) further estimated the trip purposes for ride-share services, as shown in Figure 32, based on the NHTS data 2013 (Statistics South Africa, 2013). Trip purposes for ride-share services were estimated to be diverse with shopping trips being the majority trip purpose with 29%. Other trip purposes, for ride-share services, included 14% for each of the following categories: financial services, municipal office, police, welfare, and medical services. An additional 1% of ride-share services were estimated to be used for church/religious services.

This estimation can now be compared to the results in the NHTS 2020 data (Statistics South Africa, 2020). Figure 33 shows the actual trip purposes for ride-share services in Cape Town. The most considerable ride-share trip purposes were ‘Shopping’ and ‘Medical’. This largely agrees with what Vanderschuren and Baufeldt estimated (2018). However, a major difference is the higher percentage that uses ride-share services for religious services or ‘Church’. While Vanderschuren and Baufeldt (2018) only estimated that 1% would be used for such trips, the NHTS data 2020 shows that this trip purpose covers 9% of the trips. Most Cape Town individuals identify as Christians (Farrar et al., 2019). Christian services, typically, occur on the weekends, predominantly on Sundays, when most public transport modes are either not operating or provide reduced services. Therefore, the 9% for ‘Church’ trips is understandable.

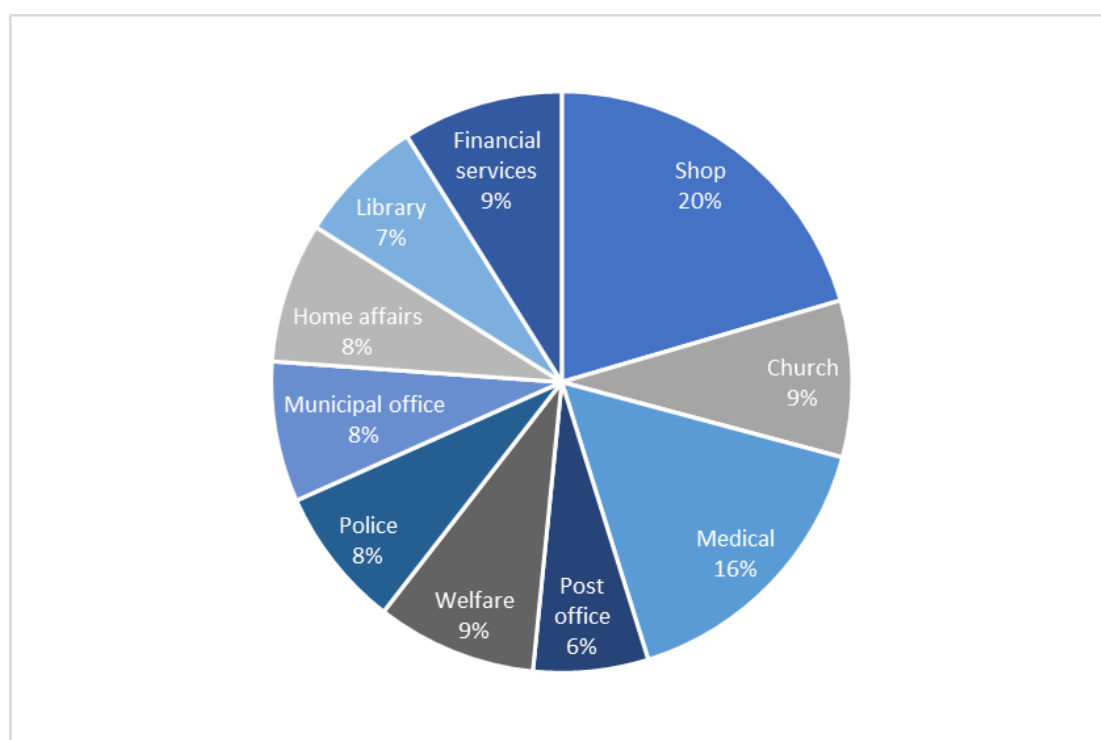


Figure 33: Trip Purposes for Ride-Share Service Trips
Source: NHTS data, 2020

A deeper understanding of ride-share services in Cape Town is difficult to gain from the NHTS, as the focus of the NHTS is not on unpacking the ride-share services, as such, but instead on unpacking the transport needs, attitudes, and choices of households and individuals in South Africa. Data requests to ride-share companies, to strengthen this section, were unanswered, even after several attempts during this multi-year study.

4.2 Selection and Motivation of the Case Study: Investigation of Cape Town

Cape Town is a suitable case study city for an incompatibility investigation of ride-share services. As described, various ride-share services are well-established in the city. Furthermore, as discussed in this chapter, many characteristics of life in Cape Town result in individuals having different experiences and perceptions.

Explicitly, there are substantial differences between using a private motor vehicle or a public transport mode, as shown in Chapter 2 (Hitge and Vanderschuren, 2015). This would directly influence how accessible Cape Town is perceived to be, with individuals with access to a private vehicle having higher levels of accessibility than individuals restricted to public transport modes. Thus, access to a private vehicle is a factor that is included in the formations of the *Belief States*, which are fully explained in Chapter 5. Furthermore, high levels of gender-based violence exist in society, resulting in differences between females and males in their perceptions of transport services and their experiences. This forms the second factor in the *Belief States*. Lastly, due to the timing of the investigations, the special event of the COVID-19 pandemic was included as a factor relevant in the formation of the *Belief States*, which is also elaborated on in Chapter 6.

For many individuals in Cape Town, various factors, such as safety or security, are overruled by economic restrictions or a lack of better alternatives, as discussed by Vanderschuren et al. (2019). For many individuals with limited financial means, transport mode selection decisions are sometimes inflexible as the individuals cannot afford other transport modes. They, therefore, cannot adjust their decisions of which transport mode they will take, despite having concerns, uncertainties, or perceived risks. This results in decisions being (artificially) compatible (i.e., related factors to transport mode decisions can be considered simultaneously) in the QPT concepts of 'incompatibility'. This is one clear disadvantage for the incompatibility investigations in Cape Town as a case study. Ideally, in the case study city,

individuals' decisions should not be restricted so severely that they cannot change their decisions even when safety or security concerns are high.

However, within this research, the focus is on individuals with the (potential) ability to act on their perceptions (middle- and higher-income groups), as well as individuals that can be described as within the 'missing middle' income group (Vanderschuren and Baufeldt, 2018). The University of Cape Town's student body fits these requirements. Roughly half of the respondents owned or had access to a private vehicle, indicating that they are most likely part of the middle- or higher-income group, due to the strong relationship between socio-economic groups and car ownership in South Africa (Vanderschuren and Baufeldt, 2018). Furthermore, data from the university shows that roughly half of the students received financial aid in 2021 (University of Cape Town, 2021). These students could be considered as part of the 'missing middle'. *Therefore, while the students are not representative of an average South African, they represent individuals of the 'missing middle' who may be able to change their transport modal decisions and are, therefore, the target population of this work.*

4.3 Résumé

The first section of this chapter focuses on the background and transport modes of the selected case study city of Cape Town. The background of Cape Town and the detailed review of the transport network of Cape Town provides the motivation that Cape Town is a suitable case study city for an incompatibility investigation of ride-share service decisions.

The second section of this chapter consolidates why ride-share services in Cape Town are an appropriate case study for this research. Ride-share services are well-established and there are various factors that influence how individuals experience ride-share services in Cape Town. Furthermore, the targeted population of students at the University of Cape Town, gives a balanced mix of those with and without access to a private vehicle, as well as varying socio-economic means, from 'missing middle' economic groups to higher-income groups.

In the next chapter, the creation of the *Belief States* through the elements of *Personal Factors* is described. *Gender, Access to a Private Vehicle* and *COVID-19 Scenarios* are also described.

5. City of Cape Town Data Collection and Analysis

This chapter uses the methodology outlined in Chapter 3 in the application of the case study City of Cape Town (described in Chapter 4). Section 5.1 describes the *Belief States* investigating young adults' decisions regarding ride-share services in Cape Town. The motivation and assumptions behind each of the factors are provided.

Next, the Cape Town case study-specific related and unrelated factors, for use in Experiments 2, 3 and 4, are identified and described in Section 5.2. In Section 5.3, the exact formulation of the ride-share service questions used in the experiments are presented. The details of Sections 5.1 to Section 5.3 are then used to populate the experiment design (outlined in Chapter 3) in Section 5.4 for Cape Town. Details of the data collection are described in Section 5.5, including the survey tool, timeline, and considerations of the COVID-19 pandemic. Further exact details of the survey structure, including instructions and content, as well as an overview of the responses, are presented in Sections 5.5.3 and 5.5.4, respectively.

Section 5.6 presents the data analysis approach, while Section 5.7 elaborates on the research ethics that were considered in the research. Section 5.8 concludes the chapter with a short summary.

5.1 Creation of *Belief States* for Incompatibility Investigations

The elements of the *Belief States* selected for these investigations are referred to as the *Personal Factors* in this thesis.

The three *Personal Factors* are:

1. *Gender*: female, male (socio-demographic factor),
2. *Access to a Private Vehicle*: access, no access (context of the individual),
3. *COVID-19*: before COVID-19, during COVID-19, after COVID-19 (special event / exogenous intervention).

The selection and motivation of these three *Personal Factors* are discussed in the following subsections.

5.1.1 Personal Factor 1: Gender

Gender is a relevant factor in both ride-share service decisions in Cape Town and transport modal decisions within the international literature, as shown in Chapter 2. Three further motivating arguments are:

- Significant empirical differences in personality traits, including women scoring higher on neuroticism (increased sensitivity to negative emotions) than men, and
- Research indicates significant differences between women and men in risk-taking,
- High levels of gender-based violence, rape, and harassment towards women, generally in South Africa, as well as specifically in Cape Town.

These motivations for including gender as an element in the *Belief States* are closely linked with how individuals experience uncertainty and perceived risks and actual differences in the risk of gender-based violence in ride-share service decisions.

The following section describes the second element of the *Belief States* for young adults in Cape Town.

5.1.2 Personal Factor 2: Access or No Access to a Private Vehicle

The second factor is owning or having access to a personal vehicle. Generally, researchers focus on individuals who ‘own’ vehicles. This work expands the definition to individuals who may not own the vehicle but have access to it, for most of their trips. This is often the case for young adults or students who are not yet working, to have access to a vehicle owned by family or friends. As this research focuses on young adults, this extension was necessary. Even if individuals do not own vehicles, their transport modal decisions are still heavily influenced if they have access to a personal vehicle for most of their trips.

Access to a private vehicle, as a factor, is motivated for three main reasons:

- Transport modal choices tend not to change if an individual can access a private vehicle.
- The interwoven effect that the built environment and private vehicle trips or ownership have on each other, and
- The trend of increasing private vehicles in Cape Town.

These three motivating reasons connect with the transport network of Cape Town, as well as the spatial influences of the city. Access to a private vehicle also acknowledges the recent changes in the transport modal split, trending to increased private vehicle trips.

5.1.3 *Personal Factor 3: COVID-19 Scenarios of 'Before', 'During', 'After'*

At the time of the survey design (early 2020), there was limited literature on the effects of the COVID-19 pandemic on transport modal decisions, as it was still unfolding. COVID-19 as a factor brought in new complex uncertainty within transport modal decisions and was, therefore, considered essential to be investigated within this work.

The effect of COVID-19 was seen as twofold:

- A new health risk associated with engaging in public life, and
- The related consequences of COVID-19 include lockdowns, changes in work and study and restrictions on public life.

The latter effect of COVID-19 could either be simple or complex, as individuals associate COVID-19 with other events, for example, general economic decline or increased levels of anxiety or uncertainty (Bozkurt et al., 2020; Naidoo and Cartwright, 2020). Therefore, the three scenarios were created: 'before COVID-19'; 'during COVID-19'; 'after COVID-19'.

The following section describes and justifies related and unrelated factors for this investigation.

5.2 Identification of Related and Unrelated Factors of Incompatibility for Case Study

This section describes the selected related and unrelated transport modal factors relevant for an incompatibility investigation in Cape Town's ride-share services for young adults. The next subsection describes the related factors, while the following subsection describes the unrelated factors for this investigation.

5.2.1 Related Factors of Incompatibility: Transport Factors

The related factors identified and used in this work are referred to as the *Transport Factors*. Four related factors are selected for use within the experiments. These *Transport Factors* include *Sustainable Transport*, *Reliability ('Being On Time')*, *Road Safety* and *Crime in Cape Town*.

These *Transport Factors* were formulated as questions in the surveys:

1. How important is sustainable transport to you? (Answer options: very important; important; average; not so important; not important at all),
2. How important is being on time for you? (Answer options: very important; important; average; not so important; not important at all),
3. Which statement do you think is most correct about road safety in Cape Town?
(Answer options: the roads in Cape Town are safe; the roads in Cape Town are sometimes safe and sometimes dangerous; the roads in Cape Town are dangerous),
4. Which statement do you think is most correct about crime levels in Cape Town?
(Answer options: the crime in Cape Town is high; the crime in Cape Town is average; the crime in Cape Town is low).

These related factors are individually described and justified in the following subsections.

5.2.1.1 Sustainable Transport in Cape Town

Climate change is an accepted and known challenge worldwide. The United Nations (2016) has set the goal that by 2030, transport systems and modes should be accessible, safe, affordable, and sustainable for all, as well as, improving road safety and the needs of those in vulnerable situations, including women, children, persons with disabilities and older persons.

Many societies have consequently emphasised moving toward more sustainable transport modes (Litman, 2007). This includes city transport networks (Pojani and Stead, 2015). South African cities do not perform well in comparison to other cities. Currie and De Gruyter (2018) compared 98 cities in eight world regions. They used a range of indicators to determine the sustainability of each city. The selected indicators used were based on De Gruyter et al. (2017) and were grouped into four categories: environmental, social, economic, and system effectiveness. Table 9 shows the indicators and related desirability (Currie and De Gruyter, 2018, p. 328).

Table 9: Indicators for Sustainable Transport Evaluation

Category	Indicator	Desirability
Environmental	Quantity of energy consumed	Less is desirable
	Mass of total pollutants emitted (e.g., NOx, VOC, CO ₂)	Less is desirable
	Land area consumed by public transport facilities	Less is desirable
Social	Travel participation	More is desirable
	Average user trip distance	Less is desirable
	Affordability	Less is desirable
	Transport-related deaths	Less is desirable
Economic	Annual operating cost	Less is desirable
	Cost recovery (proportion of costs recovered)	More is desirable
	Passenger km travelled per unit GDP	More is desirable
	Average time per trip	Less is desirable
System Effectiveness	The average occupancy rate of passenger vehicles	More is desirable
	Annual public transport trips per capita	More is desirable
	Public transport mode split	More is desirable
	Public transport fleet size	More is desirable

Source: Currie and De Gruyter, 2018

Based on the indicators shown in Table 9, Johannesburg and Cape Town were two of the worst performing, being ranked at 94 and 89, respectively (Currie and De Gruyter, 2018). Furthermore, Cape Town was named one of the top three cities that performed the worst within the social indicators. Cities that performed worse than Cape Town in the overall rankings include Casablanca (90), Los Angeles (91), San Diego (92), Kuala Lumpur (93), Denver (95), Shizuoka (96), and Dubai (97). The cities with the top ratings include Prague (1), Dakar (2), Tokyo (3), Manila (4) and Osaka (5).

Many indicators can be used, and several definitions for sustainable transport (Litman, 2007). Litman (2007) suggests, in Table 10, that the most important indicators are economic, social, and environmental (2007, p. 10):

Table 10: Sustainable Transport Categories and Indicators (Litman, 2007)

Category	Indicators
Economic	Per capita mobility (daily or annual person-miles or trips)
	Mode split (personal travel: non-motorised, automobile, and public transport; freight: truck, rail, ship, and air)
	Average commute travel time and reliability
	Average freight transport speed and reliability
	Per capita congestion cost
	Total per capita transport expenditures (vehicles, parking, roads, and transit services)
Social	Per capita traffic crashes and fatalities
	Quality of transport for disadvantaged people (disabled, low incomes, children, etc.)
	Affordability (the portion of household budgets devoted to transport)
	Overall satisfaction rating of the transport system (based on objective user surveys)
	Universal design (consideration of disabled people's needs in transport planning)
Environmental	Per capita energy consumption, disaggregated by mode
	Energy consumption per freight ton-mile
	Per capita air pollution emissions (various types), disaggregated by mode
	Per capita land devoted to transport facilities (roads, parking, ports, and airports)
	Air and noise pollution exposure and health damages
	Impervious surface coverage and stormwater management practices

Generally, within transport, encouraging a modal split with a decreasing share of private motorised transport and increasing proportions of walking, cycling, public transport and shared trips (carpooling and lift clubs) is considered moving towards a more sustainable transport modal split.

The ability to act on the desire to participate in more sustainable transport modes, such as trains, depends on sustainable transport modes' availability and quality of service. In Cape Town, recent changes on the household level indicate changes away from highly sustainable transport modes, such as 'train' and 'walking all the way', to the most unsustainable transport mode of private vehicle (driver) trips (Statistics South Africa, 2021a). Even 'private vehicle (passenger)' has declined (Statistics South Africa, 2021a). The most significant increase in public transport modes was seen in MBTs (Statistics South Africa, 2021a). This change is less optimal considering the heavy investment in the BRT of Cape Town.

5.2.1.2 Reliability ('being on time') in Cape Town Ride-Share Service Decisions

While young adults may be more willing to use more time-consuming transport services, they will still value the reliability of transport modes. This is supported by Bates et al. (2001), who found that punctuality is highly valued in personal travel, which is sometimes overlooked, due to challenges in collecting empirical data. The predictability of a transport mode, or what an individual can expect from the transport mode and how it matches with their experience, can include aspects such as time of departure, time of arrival and quality of the trip. The predictability of a transport mode may be more critical for young adults than the amount of time a trip may take (from door to door). This is supported by findings by Vanderschuren and Awotar (2012) specific to the target sample population of the University of Cape Town community. Vanderschuren and Awotar (2012) found that between 88% and 96% of the users of the University of Cape Town's shuttle service, namely the 'Jammie Shuttle', were frustrated, at least sometimes. Implementing real-time information systems, such as real-time tracking of available busses in real-time, made available on digital information boards at the shuttle stops and other convenient locations on campus sites, reduced these frustration levels in 44% of the students and 15% of the staff. Furthermore, the respondents indicated they would pay for such information.

The predictability and real-time information provided in ride-share services is, therefore, a particularly relevant and attractive aspect of the ride-share services for users. Das and Ngobeni (2017) showed that over 50% of their respondents perceived the waiting time for ride-share services as a 'reasonable period of time' in Cape Town. As the driver's progress can be seen in real-time in the app by the user, the user's expectations can also be better managed. There is an additional advantage of being dropped off directly at the destination with no 'last mile' barrier to overcome. Even for individuals with access to private vehicles, there is an additional time-saving benefit of not needing to park the vehicle.

The discussion of the National Household Travel Survey (Statistics South Africa, 2021a) in Chapter 4 shows that transport modes in the Western Cape, that have high levels of dissatisfaction with waiting time and punctuality, have dramatically decreased in ridership in recent years. In contrast, transport modes with lower dissatisfaction with these aspects have gained ridership. Therefore, *Reliability* is justified as a related *Transport Factor* and was

phrased in the surveys as ‘*being on time*’. Next, the final *Transport Factor of Road Safety* is described for Cape Town.

5.2.1.3 Road Safety in Cape Town

South Africa has one of the worst road safety levels in the world (Vanderschuren, 2008; Sinclair and Zuidgeest, 2016; Vanderschuren et al., 2020). However, road safety in the Western Cape has improved. Vanderschuren et al. (2020) show, in Figure 1, that the Western Cape had a road fatality rate of 30 per 100,000 population in 2005. This improved to 19 fatalities per 100,000 in 2015. Vanderschuren et al. (2020, p. 1176) show that the Western Cape (WC) is the most improved out of South Africa's nine provinces. However, the European average is 9.3 deaths per 100,000 inhabitants (World Health Organization, 2015). Road safety is, therefore, still a major challenge for the country and the city, and much still needs to be addressed.

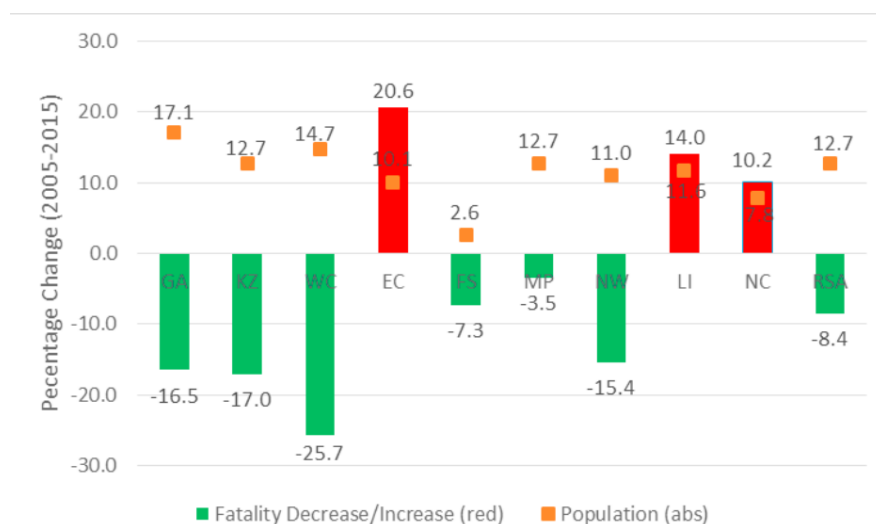


Figure 34: Percentage Changes in Road Fatalities and Population per Province in South Africa²⁰
Source: Vanderschuren et al., 2020.

In the Western Cape, all road users are affected by low levels of road safety, not only individuals in vehicles. In Cape Town, pedestrians account for 57% of road fatalities (Western Cape Government, 2021a). Furthermore, vulnerable road users, especially children, are also significantly impacted in Cape Town (Albertyn et al., 2019; Bass et al., 1995; Isaac et al., 2015; Koekemoer et al., 2017).

²⁰Gauteng (GA), KwaZulu Natal (KZ), Western Cape (WC), Eastern Cape (EC), FS=Free State, MP=Mpumalanga, LI=Limpopo, NC=Northern Cape, RSA=Republic of South Africa.

Alcohol plays a significant role in these pedestrian fatalities (Matzopoulos, 2005; Peden et al., 2013; Pirie, 2014). However, the issue is not simply drunk pedestrians. Matzopoulos (2005) reports that 40% of cyclist fatalities and 58% of driver fatalities tested positive for alcohol. Alcohol abuse is a general problem in the transport network.

However, while some of the contributing factors of high road fatalities and injuries are preventable, such as drunk driving, other contributing factors require significant changes in the transport network.

Research shows that a lack of sensitivity to the area's context or land uses often contributes to poor road behaviour by users and poor road safety (Beukes et al., 2011). A typical South African sight is pedestrians crossing highways at grade²¹, which is unthinkable in other countries (Sinclair and Zuidgeest, 2016; Zuidgeest et al., 2015). The problem of pedestrians needing to cross highways has not been resolved, and this problem is increasing in Cape Town (Dada et al., 2019). This speaks again to the mismatch between the road users' needs and the road network's design, which has been demonstrated by Beukes et al. (2011).

Road safety concerns also extend to specific transport modes. The levels of dissatisfaction with the main transport modes for road safety within the NHTS of 2013 and 2020 can be seen per transport mode in Figure 35, which shows that both MBTs and buses experienced decreased levels of dissatisfaction in the category of 'safety from accidents' for the Western Cape.

²¹In other words, not using the pedestrian bridges but walking directly across the highway from one side to the other side.

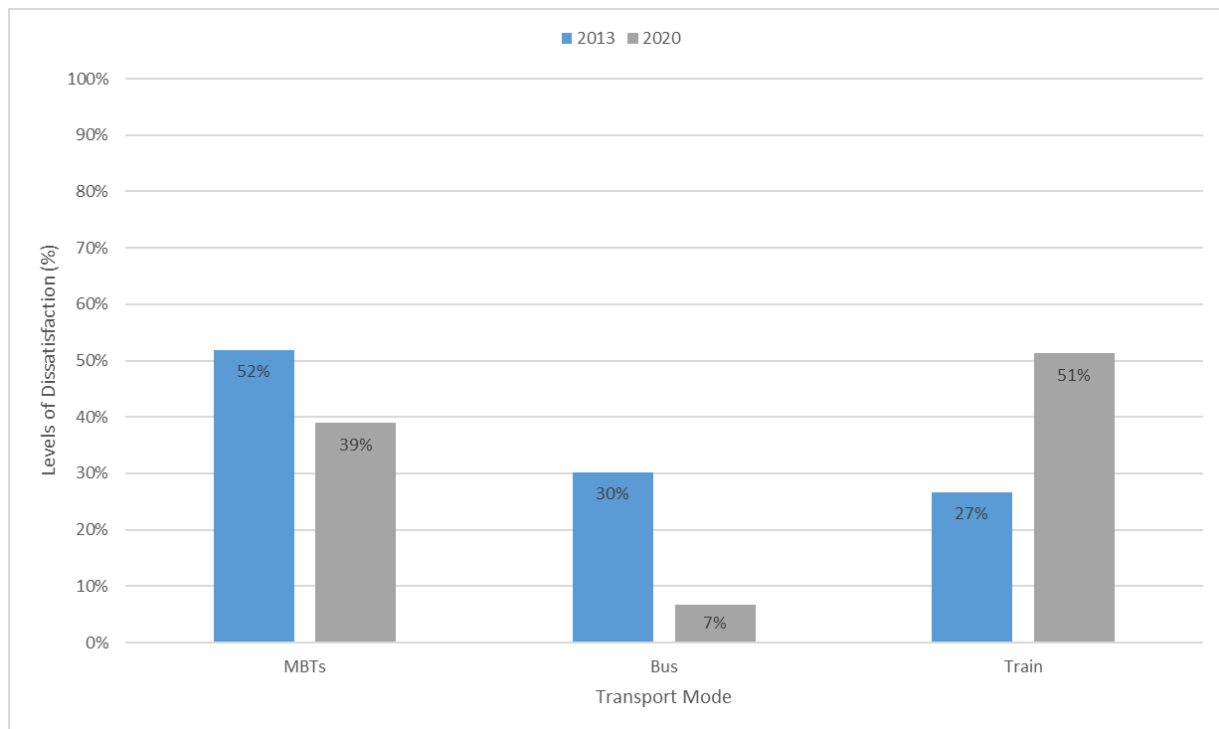


Figure 35: Dissatisfaction with Safety from Accidents per Main Transport Mode in Western Cape
Source: Statistics South Africa, 2013 and 2020

Trains have seen a significant increase in dissatisfaction, with ‘safety from accidents’ at 24.5%. This is unsurprising considering the latest ‘*State of Safety Report*’ (Railway Safety Regulator, 2019). Safety and security incidents have increased despite an overall reduction in railway network traffic since 2012/2013. While ‘safety from accidents’ as a dissatisfaction factor has decreased for both MBTs and buses, commuters are more aware of the lack of safety in train services.

The 2013 NHTS (Statistics South Africa, 2014) states that, in 2003, ‘safety from accidents’ was the most important factor influencing the household’s choice of transport, with a massive 46.5% in the Western Cape. However, ‘safety from accidents’ in the Western Cape has fallen from 9.5% in 2013 to 3% in 2020, as a motivating factor in households’ transport mode selection.

Despite significant road safety challenges in Cape Town, individuals seem to be less concerned about road safety in recent years. However, road safety is still clearly a related factor, as defined in Chapter 3. *Road Safety* is included as a related factor in the *Transport Factors* due to the international relevance of the factor and the high levels of road fatalities and injuries in Cape Town.

5.2.1.4 Crime in Cape Town

Lemanski (2004, p. 101) stated that, in Cape Town, 'fear of crime is spatially, socially, and temporally distributed'. How individuals perceive crime at night is complex as Cape Town has varying crime levels, from areas considered safe and secure to other areas that are not. Individuals also have different exposures to crime.

This results in different perceptions of crime and the individual's probability of experiencing crime within a trip for a particular transport mode. How the fear of crime could affect the way in which individuals engage with ride-sharing apps, or do not, is relatively unknown and is likely to depend on the individual's perspective. Factors that likely influence the individual perspective include past experiences and familiarity with using transport modes and, within the urban environment in general, gender (Vanderschuren et al., 2019), and socio-economic status (Lemanski, 2004).

While crime has a strong spatial component in Cape Town, the fear of crime is generally thought to be experienced in all areas (Loukaitou-Sideris, 2010). Crime and the fear of crime are documented factors influencing how individuals travel or move about in a city (Loukaitou-Sideris, 2010; Vanderschuren et al., 2019). In this section, a framework of understanding the relationship between crime and the fear of crime is explored to identify relevant factors that will be used within the investigations to test how individuals respond to decisions when faced with security aspects. Loukaitou-Sideris (2010, p. 104) provides a conceptual relationship between perceived fear and travel behaviour. This is replicated in Figure 36 (Loukaitou-Sideris, 2010).

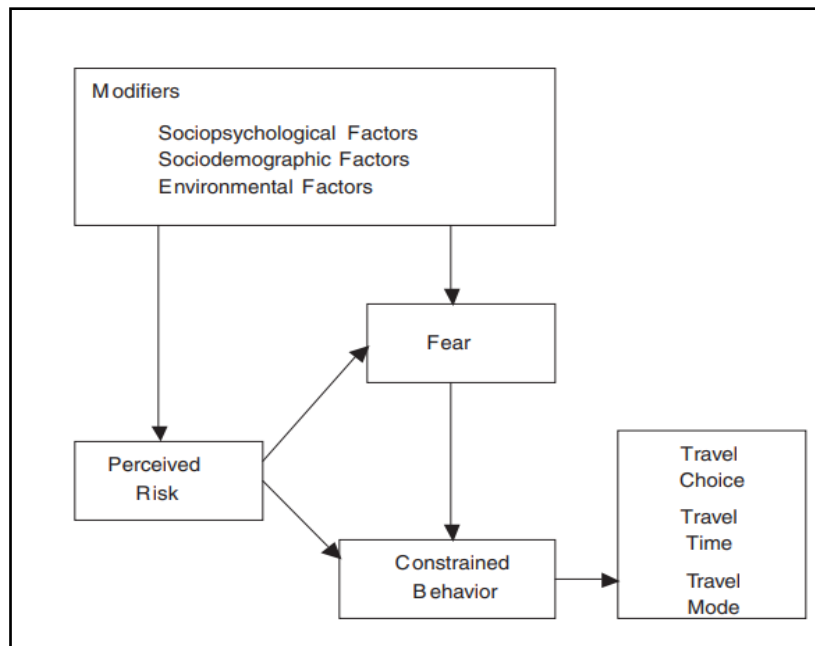


Figure 36: Conceptual Relationship between Perceived Level of Fear and Travel Behaviour
Source: Loukaitou-Sideris, 2010

As seen on the bottom right-hand side in Figure 36, both transport modes ('Travel Mode') and trips ('Travel Time' and 'Travel Choice') are mentioned as how individuals' behaviours are constrained depending on their fear and perceived risk. In the scope of ride-share services, an active effort that can be seen is when an individual shares their ride-share service trip with friends or family to mitigate the chances and consequences of being attacked during the trip.

On the left-hand side of Figure 36, socio-psychological factors, such as self-confidence and experience, are shown. Women in Cape Town are exposed to high levels of gender-based violence, rape, and harassment (Lamb, 2018). A negative perception of crime and uncertainty about personal security or safety is evident among females in Cape Town (Vanderschuren et al., 2019). Negative perceptions of crime and personal security influence the individuals' transport experiences in Cape Town.

'At night' is used as an environmental factor, within the conceptual relationship between the perceived level of fear and travel behaviour, in this research. The factor, 'at night', may also be linked to periods with fewer available public transport modes, however, it is included here, as travelling at night is associated with a perceived higher chance of being exposed to crime or attacks. Travelling at night is found within both the local (Czeglédy, 2004; Ingle, 2009; Magidimisha-Chipungu, 2022; Statistics South Africa, 2014; Vanderschuren et al., 2019) and the international literature (Bauer et al., 2003; Carver and Veitch, 2020; Nadimi et al., 2021;

Olvera et al., 2021, Pellicer-Chenoll et al., 2021) to be a common aspect that is found to be a deterrent to many, as individuals either are uncertain about their exposure to crime, or risk of safety (transport collision/injury).

Furthermore, as mentioned in Chapter 4, security concerns are noticeable in all public transport modes in the Western Cape. Thus, *Crime in Cape Town* is selected as a related factor in the *Transport Factors* for the investigation.

5.2.2 Unrelated Factors of Incompatibility: Good Mood Questions

As described in Chapter 3, the unrelated factors in this research are used to invoke a positive frame of mind (Cassotti et al., 2012; Seo and Barrett, 2007). These unrelated factors are referred to as the *Good Mood Questions*. As with the *Transport Factors*, four *Good Mood Questions* were formulated:

- Name a favourite book/movie/series of yours²².
- What is your favourite food?
- Where is the best place to go out in Cape Town?
- Do you think that Cape Town is one of the most beautiful cities in the world?

These four questions were a mix of opinions of the individual (first two questions) and the case study city (last two questions).

The following section describes the formulation of the ride-share service questions relevant to an incompatibility investigation. In this thesis, these modal transport questions, involving uncertainty or perceived risks, are referred to as *the Ride-Share Service Questions*.

5.3 Formulation of *Ride-Share Service Questions* Involving Uncertainty or Perceived Risk

As discussed in Chapters 2 and 4, travelling 'alone' or 'at night' is likely associated with uncertainty or perceived risks. Vulnerable groups, such as women, are often told not to travel alone and to avoid making night trips if they have uncertainties or perceive their environment as risky (City of Cape Town, 2022).

Therefore, the *Ride-Share Service Questions* that are defined for this investigation are:

- Would you take a ride-share service trip **at night**?
- Would you take a ride-share service trip **alone**?

²² Despite the formulation being that of an instruction rather than a question, the collection of these four tasks to the respondents are still referred to as the *Good Mood Questions*.

- Would you take a ride-share service trip **alone at night**?

These *Ride-Share Service Questions* encapsulate uncertainties and perceived risks of making a trip to Cape Town, emphasising personal security. The focus is on capturing the respondents' willingness to engage with ride-share services in Cape Town in the different experiments involving the *Transport Factors* (related) and *Good Mood Questions* (unrelated).

In the next section, the various items are used to complete the experiment design for this investigation.

5.4 Ride-Share Services in Cape Town: Method Design of Experiments

The design of the experiments needed to consider the three *Personal Factors* of *Gender*, *Access to a Private Vehicle* and *COVID-19* ('before', 'during', 'after'). As the first two *Personal Factors* are directly related to the individual, these simply needed to be captured in the online survey.

However, the *Personal Factor* of *COVID-19* presented more of a challenge of being incorporated into the method design of the experiments. This was especially true considering that little was known at the time of the data collection regarding the effects of COVID-19 on ride-share service decisions. The factor of COVID-19 had to be included in such a way, so that if COVID-19 was found to be irrelevant in the experiments, the data could be rejoined per experiment. Figure 37 shows the four experiments with the defined *Ride-Share Service Questions*, related *Transport Factors*, and unrelated factors of the *Good Mood Questions*. In other words, there were three Experiment 1s: Experiment 1: 'before COVID-19', Experiment 1: 'during COVID-19' and Experiment 1: 'after COVID-19'. Similarly, there were also three groups for Experiment 2, Experiment 3, and Experiment 4. Individuals were randomly assigned only one experiment in one of the *COVID-19 conditions*. In this manner, the survey for the respondents would remain sufficiently short and manageable for the participants.

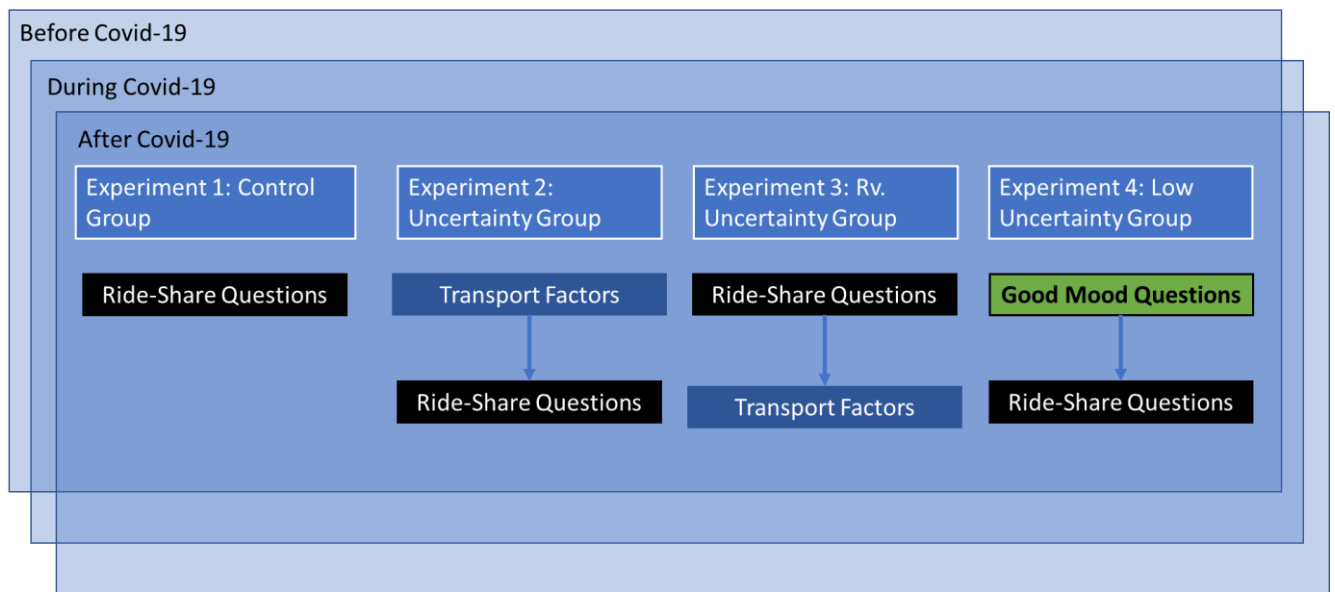


Figure 37: High-level Overview of the Experiment Design

The first group, shown in Figure 37, is *Experiment 1: Control Group*. The control group answered only the questions that referred to the usage and experience of their ride-share services, with no other set of questions with factors of uncertainty in, before, or after these questions. Specifically, the *Ride-Share Service Questions* are the focus of Experiment 1 (see Section 5.3). *Experiment 1: Control Group* for each *COVID-19 condition* was also designed within the experiment to provide a baseline against which the other groups could be measured.

Experiment 2: Uncertainty Group formed the first test group for the 'before COVID-19', 'during COVID-19' and 'after COVID-19' conditions. Here, the *Ride-Share Service Questions* were preceded by the *Transport Factor Questions*. The questions were formulated to bring to the individuals' minds their experiences, perspectives, or circumstances that they experienced (see Section 5.2.1).

The following experimental group, *Experiment 3: Rv. (Reverse) Uncertainty Group* tested the effect of asking the *Ride-Share Service Questions* before the *Transport Factor Questions*. Any statistically significant differences would indicate if it were possible that *Ride-Share Service Questions* could impact the initial *Belief State* and, therefore, the *Transport Factors*. Significant differences between the answers of Experiments 2 and 3 for each *COVID-19 condition* are discussed further in Chapter 6.

The final experimental group was selected to test the unrelated questions' effect and if it is possible to reduce the uncertainty or perceived risk while answering the *Ride-Share Service*

Questions. This was done with the *Good Mood Questions*. Up until this point, the experiments aimed to capture individuals' ride-share service decisions and related uncertainties, either from a neutral *Belief State* (*Experiment 1*) or a 'heightened' (uncertain) *Belief State* (*Experiments 2 and 3*). For Experiment 4, the opposite of the other experiments is explored. The *Good Mood Questions* were formulated to put the participants in a positive frame of mind (see Section 5.2.2).

The following section describes the data collection approach and details of this research.

5.5 Data Collection

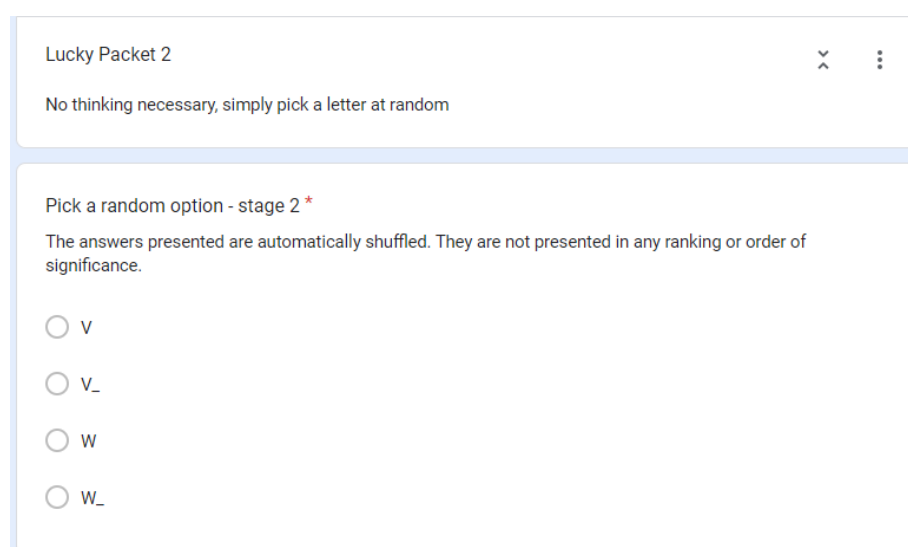
The time horizon for such an investigation was cross-sectional to increase convenience for the participants. Furthermore, the experiments were not designed to capture individuals' changes over time, so a longitudinal approach was unnecessary. The exact timeline and tools used for the data collection of this research are elaborated on in Section 5.5.1.

Simple, convenience or stratified random sampling techniques are appropriate for this investigation. As the online survey distribution was sent through the university's Department of Student Affairs to the email addresses of all university members (students, staff, and other associates with a university email address), the sampling technique used in this research was **simple/convenience sampling**. This sampling technique is considered achievable, cheaper and is commonly done (Peterson, 2001) and appropriate for research focusing on basic psychological processes (Lucas, 2003; Kardes, 1996). All invited participants had the opportunity to participate in the surveys. This allowed for a high number of respondents. However, due to technical limitations, stratified random sampling was not possible. The necessary ethical procedures and formal processes of the University of Cape Town were followed in the preparation of the surveys. This included the ethics process in the Faculty of EBE and the research access to students process of the University of Cape Town's Department of Student Affairs. Both processes were approved.

The sample inclusion and exclusion criteria of the ideal respondent had various aspects. Inclusion criteria included living in Cape Town for at least parts of the year to be familiar with the ride-share services and transport network. This was ensured by the invited respondents, either working or studying at the University of Cape Town. Furthermore, for the investigations of this work, individuals who stated that they had used ride-share services already were

included in the later analyses. Due to the defined *Belief States*, individuals who did not describe themselves as female or male were excluded. Further exclusion criteria included individuals over the age of 35, which is discussed in more detail in Section 5.5.4.

Due to the limitations of Google Forms, individuals were asked to randomly self-assign themselves to the experiment through a 'lucky packet' question that asked them to pick a random letter. An example of a 'lucky packet' is shown in Figure 38. In the pilot runs of the survey, it was found that letters earlier in the alphabet had more substantial order effects than letters later in the alphabet. Thus, the 'dummy' letters of V and W were used. To further reduce the number of letters used, underscores were added to create the necessary third and fourth 'dummy' variables (i.e., V_, W_).



The screenshot shows a Google Form titled "Lucky Packet 2". Below the title is the instruction "No thinking necessary, simply pick a letter at random". A horizontal separator line follows. Below the line, the text "Pick a random option - stage 2 *" is displayed, followed by a note: "The answers presented are automatically shuffled. They are not presented in any ranking or order of significance." Below this, there are four radio button options: "V", "V_", "W", and "W_".

Figure 38: Example of 'Lucky Packet' to Randomly Assign Participants to Different Experiments in the Surveys.

The exact details of the responses and the sample sizes are described in detail in Section 5.5.4. In the next section, the survey tool and timeline are described in Section 5.5.1.

5.5.1 Survey Tool and Timeline

Data collection could be conducted in person to guide the respondents through the surveys or online. However, online surveys were considered more appropriate because of the reduced risk of COVID-19 and to ensure that the respondents have as similar survey experiences as possible without the interpersonal interactions influencing the responses (West and Blom, 2017; Hopkins and King, 2010).

The surveys of the three scenarios of 'before COVID-19', 'during COVID-19' and 'after COVID-19' were drafted in two Google Forms. The first Google Form contained the surveys of 'before

COVID-19' and 'during COVID-19'. The second Google Form contained the survey of 'after COVID-19'. This was done due to the complexity of the three scenarios of 'before COVID-19', 'during COVID-19' and 'after COVID-19' and the four experiments. Due to the technical limitations of Google Forms, it was not practical to draft all three surveys in one Google Form.

The implications of using the two Google Forms are that the surveys were split into two sets of distribution and data collection. The first Google Form was emailed to the University of Cape Town community on 27 April 2021 and left accessible until 29 May 2021. Figure 39 shows the cleaned responses per day of the first Google Form, consisting of 'before COVID-19' and 'during COVID-19'. Most of the responses were received in the first three days of distribution. The second Google Form was distributed via email on 12 May 2021 and left accessible until 2 June 2021. As with the first Google Form, most of the responses for the survey 'after COVID-19' were received in the first three days of distribution.

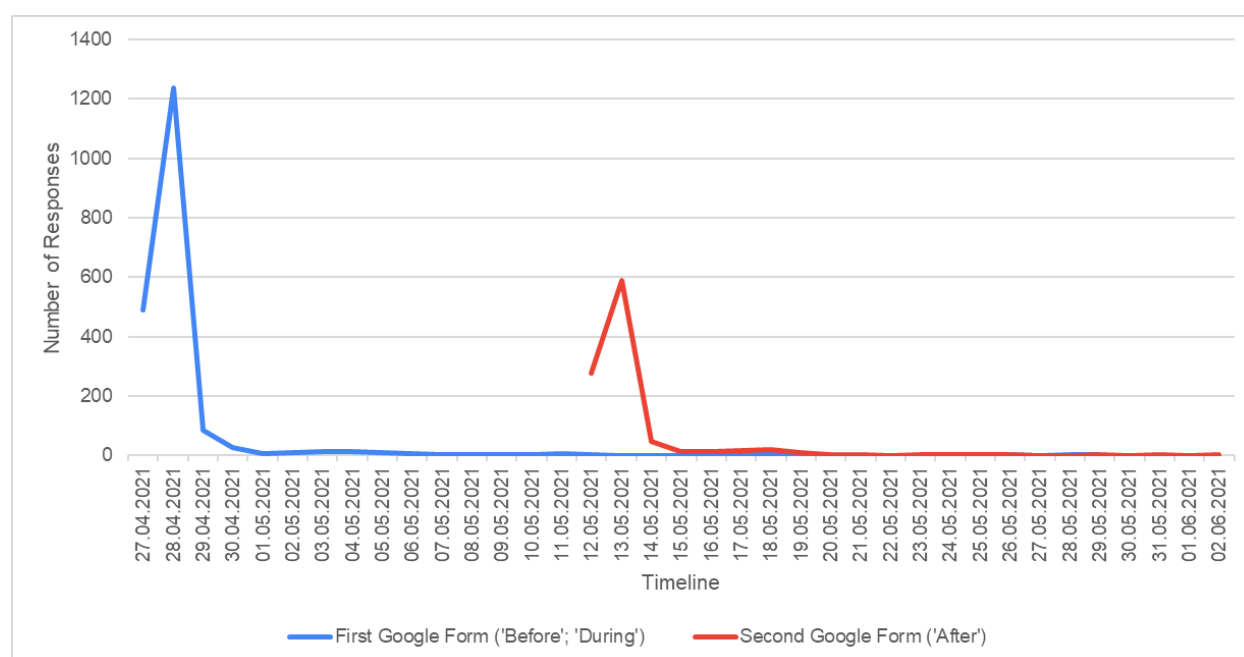


Figure 39: Responses of First Google Form, Consisting of 'Before COVID-19' and 'During COVID-19' Scenarios and Second Google Form, Consisting of 'After COVID-19'

Care was taken to allow sufficient time to prevent respondents who had previously participated from using their memory recall to (mindlessly) click the answers in the survey. Based on research by H hne (2022), two weeks was decided to be enough time to avoid such effects. Furthermore, considering that most of the respondents completed the first Google Form in the first three days, the time between the two Google Forms was, for most of the respondents, closer to a month than two weeks.

In the next section, the numerous considerations for conducting research during the pandemic times are described.

5.5.2 Survey Considerations: COVID-19 Pandemic

The surveys were distributed online to maximise the potential individuals the survey could reach and reduce any risk of infection. During the time of survey distributions, South Africa was in lockdown level 1, with the main hard lockdowns of the first two waves of COVID-19 already over (Presidency of South Africa, 2021). Table 3 in Chapter 2 describes the different levels of restrictions used in South Africa during the COVID-19 pandemic. However, at the time of research, it was unclear if more 'hard lockdowns' (for example, Level 5 or 4) were coming, and many individuals considered the pandemic to be 'over'. Furthermore, it was also unclear if individuals associated the COVID-19 pandemic with only the hard lockdowns or a more extended period, for example, until courses at the University of Cape Town had stabilised and expectations were clear, or if they perceived the pandemic to last right up until the National State of Disaster was lifted.

However, the National State of Disaster was still in place, and warnings of the third wave had already been raised (Venter et al., 2021). Furthermore, shortly after the surveys were conducted, the third wave of COVID-19, caused by the Delta variant, forced South Africa into Level 2 lockdown at the end of May (Karim and Baxter, 2022). Karim and Baxter (2022, p. 102) illustrate this in Figure 40. The third wave continued, and by 28 June 2021, lockdown restrictions peaked at a level of 4 (Government of South Africa, 2022). Level 1 was reinstated on 1 October 2021, and the National State of Disaster was lifted on 5 April 2022 (Government of South Africa, 2022), officially ending the emergency state caused by the pandemic.

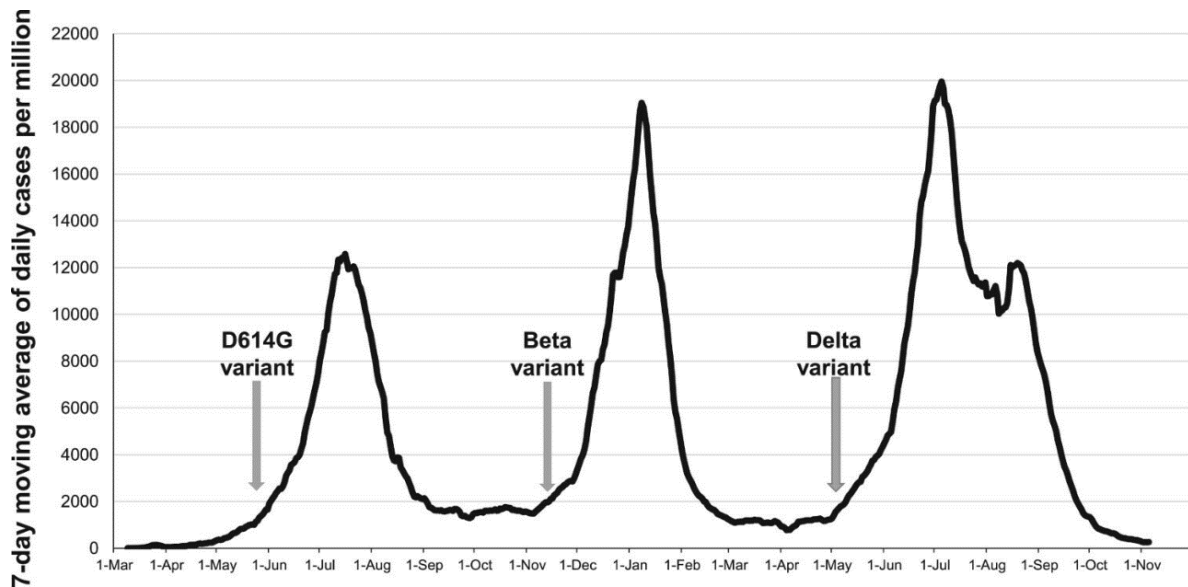


Figure 40: Covid Peaks of South Africa (1 March 2020 to 1 November 2021)
Source: Karim and Baxter, 2022

To deal with this complication of how individuals perceived ‘before’, ‘during’ and ‘after COVID-19’, the surveys stated clearly, with each question, which scenario the individual should consider when answering the question. Therefore, from this perspective, the surveys were still conducted during the pandemic and the scenario of ‘after COVID-19’ was not yet established. This was emphasized in the formulation of the questions in the ‘after COVID-19’ survey by using future tense in all questions. The ‘after COVID-19’ scenario was, therefore, a ‘future scenario’ for participants to respond to. This is an important aspect as one individual’s understanding of when ‘before’, ‘during’, or ‘after’ COVID-19 may vary according to the effects that they personally felt due to the pandemic, which varied considerably, mainly due to socio-economic factors (Behrens and Newlands, 2022; Gittings et al., 2021; Venter et al., 2020). The ‘before COVID-19’ questions were phrased in the past tense, while the ‘during COVID-19’ questions were phrased in the present tense. The aim of the factor of *COVID-19* was to test how this factor of *COVID-19* impacted the *Belief State* of the individual and, therefore, the creation of the decisions.

The next section outlines the survey structure, focusing on the instructions and content.

5.5.3 Survey Structure: Instructions and Content

The surveys consisted of multiple sections or pages. Figure 41 shows a high-level overview of the surveys in Google Forms. The first page consisted of the informed consent form,

containing the elements discussed in Chapter 3, Section 3.6, and the respondents' active agreement that they consent to the data collection.

The following section (block '2' in Figure 41) asked the respondents a general question about how COVID-19 has impacted their movement in Cape Town ('Yes, very much!'; 'Yes, a bit'; 'Maybe'; 'No'). The next question asked if the individual had access to a car for most of their trips ('yes', 'no'). This acted as a filter to split the respondents into individuals with access to a private vehicle and individuals without access to a private vehicle. After this step, the respondents were randomly divided into different experiments, shown in the black box (block 6) in Figure 3.

Another decision experiment was presented to the respondents in the next section (block 7), regarding differences between ride-share service providers. However, this experiment was later excluded from the refined scope to focus purely on the willingness of individuals to engage with ride-share services. This data will be explored separately, out of the scope of the thesis.

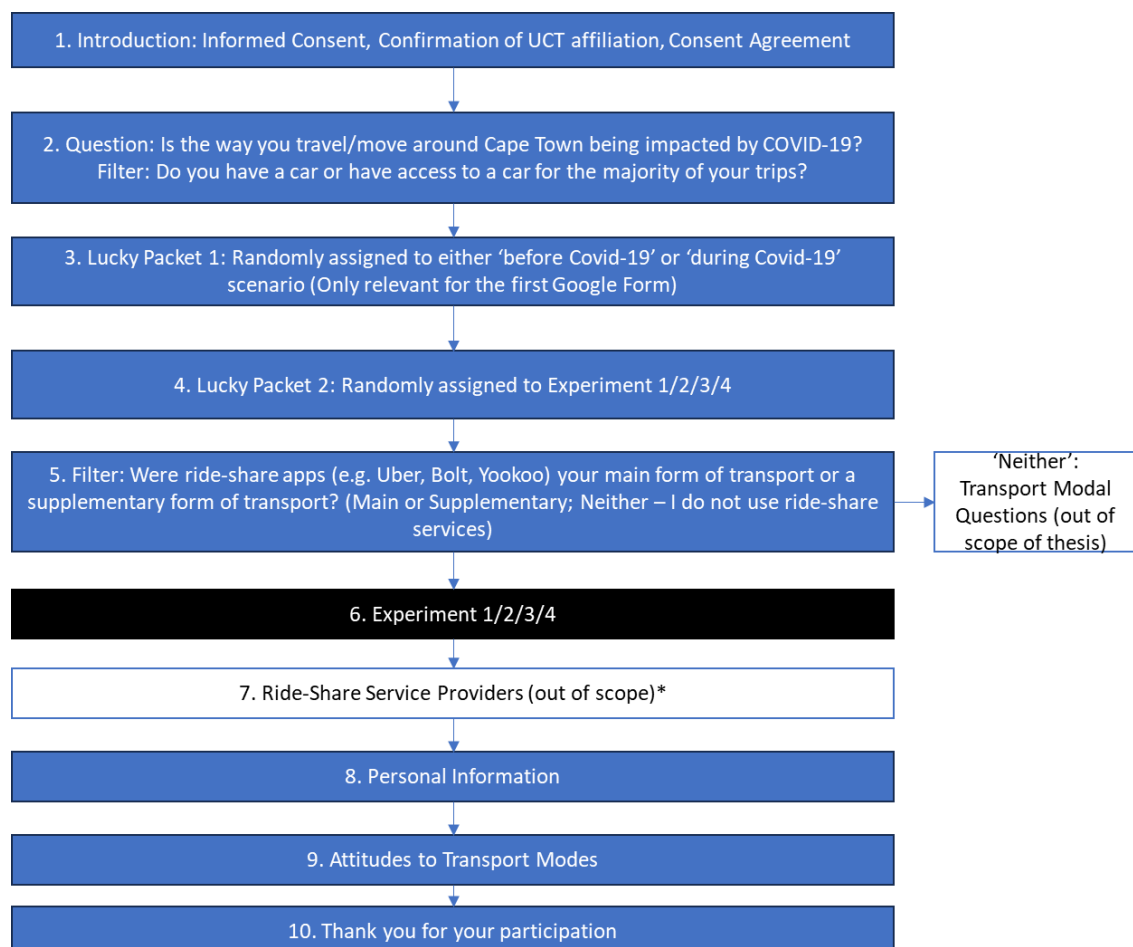


Figure 41: Overview of Survey Structure

In the eighth section of each of the surveys, personal questions were asked. These included questions such as age, gender, and level of education of respondents. Additionally, all participants were asked nine transport mode attribute questions (block 9), that are typically included in transport modal investigations (König et al., 2018; Redman et al., 2013). These included:

- Cleanliness,
- Image of transport mode,
- Road safety,
- Health risks (including COVID-19),
- Personal security,
- Reliability of transport mode,
- Frequency of transport mode,
- Travel time,
- Travel cost.

Finally, the respondents were thanked for their participation. As each respondent only answered one experiment for one COVID-19 scenario, it was expected that the surveys should take **between 3-8 minutes**. For Experiment 1 ('before', 'during', 'after COVID-19'), the survey was estimated to be done within 3 minutes, while the Experiments (2, 3, 4) were estimated to take around 8 minutes.

To avoid question order effects within the questions themselves, all answers to all questions were randomly shuffled (Chiang et al., 2015) which was a feature available in Google Forms. The *Transport Factor Questions* and the *Good Mood Questions* of Experiments 2, 3, and 4 were not asked in a leading manner. Care was taken that questions, even when concerned about negative aspects, such as crime, were phrased as neutrally as possible. The possible answers were also phrased as neutrally as possible. Open feedback options were provided in several places to ensure participants could respond freely if they disagreed with the suggested answers. Furthermore, participants had the opportunity to provide additional feedback in open response blocks after the *Ride-Share Service Questions* of Experiments 1-4, and again near the end of the survey.

In the surveys, the focus was on individuals who either use ride-share services as their main mode of transport or as a supplementary mode (block 5). Individuals who did not use ride-

share services (n=256) were out of the scope of the main investigation of the experiments and were, therefore, excluded from the subsequent analyses. However, these individuals were assigned to questions regarding their transport modal preferences and attitudes to take advantage of the opportunity to collect such data for separate studies, which can be explored in future research papers.

In the next section, an overview of the responses is presented.

5.5.4 Overview of Responses and Sample Sizes

This section describes the characteristics of the respondents. A total of 3 125 participants responded to the survey, of which 661 were excluded for not fulfilling inclusion criteria (namely duplicates from the same individual, no consent given, gender not stated as female or male, no experience with ride-share services, or over 35 years of age). Therefore, 2 464 students were used for further analysis and are described here.

Figure 42 illustrates three aspects of the respondents: whether they had access to a private vehicle, their gender, and their education level. These figures in this section refer to the cleaned data that was then used in the rest of the study and the associated analyses.

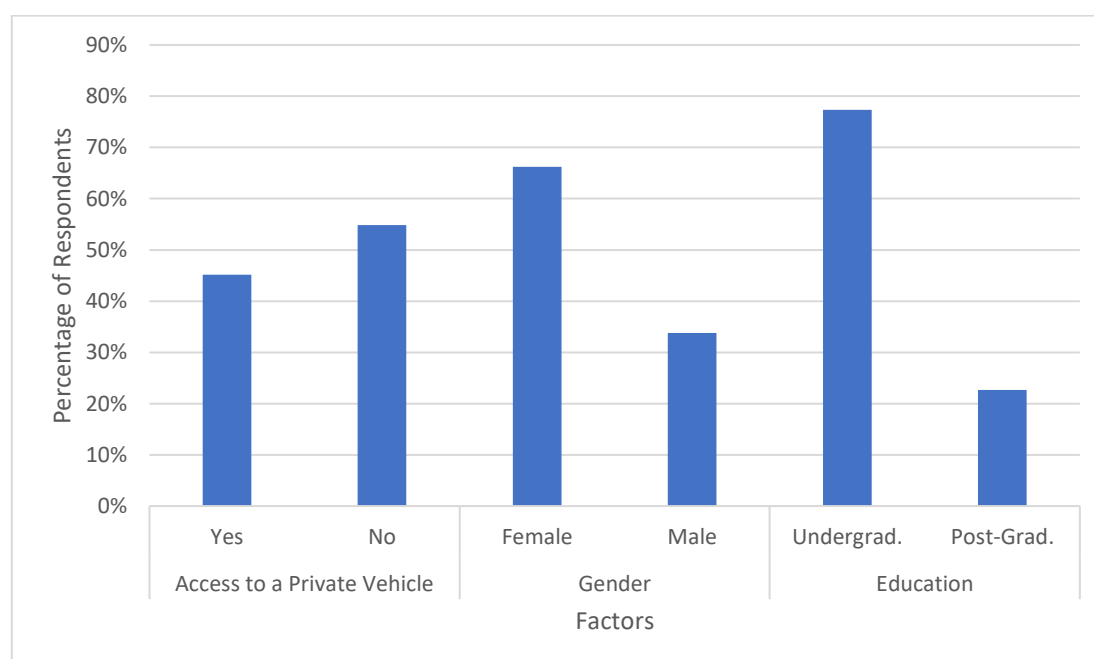


Figure 42: Aspects of Respondents (Cleaned Data)

Most of the respondents did not have access to a private vehicle (n= 1352, 55%) and were mostly undergraduates (n= 1905, 77%). The responses were skewed towards females (n=1632, 66%), which was linked to the proportionally higher responses from the Humanities

Faculty (shown in Figure 43). The higher respondents from the Humanities Faculty (n=758, 30,8%) could be linked to requirements of the humanities (especially the Psychology Department) regarding participation in research surveys (namely SRPP points). Furthermore, as mentioned in Chapter 2, women are more likely to respond to surveys, contributing to a skew (Smith, 2008).

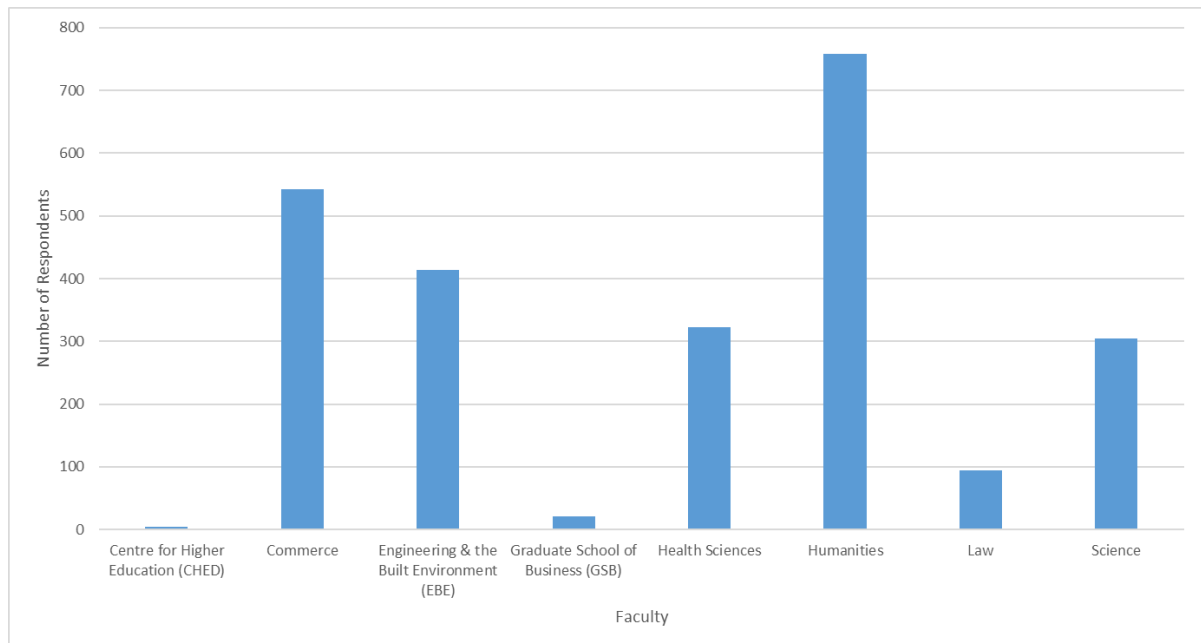


Figure 43: Faculty of Respondents

In Figure 44, the age distribution of the respondents is shown. Most of the respondents were 21 or younger (n= 1622, 66%), and 90% of the respondents were under the age of 26 (n= 2230). The data was cleaned only to have participants between 18-35 (n= 2464). This was defined as the target population, and participants older than 35 (n= 97) were excluded from the analysis, firstly because the research scope was on the potential effect that ride-share services have on young adults, i.e., <35 years old.

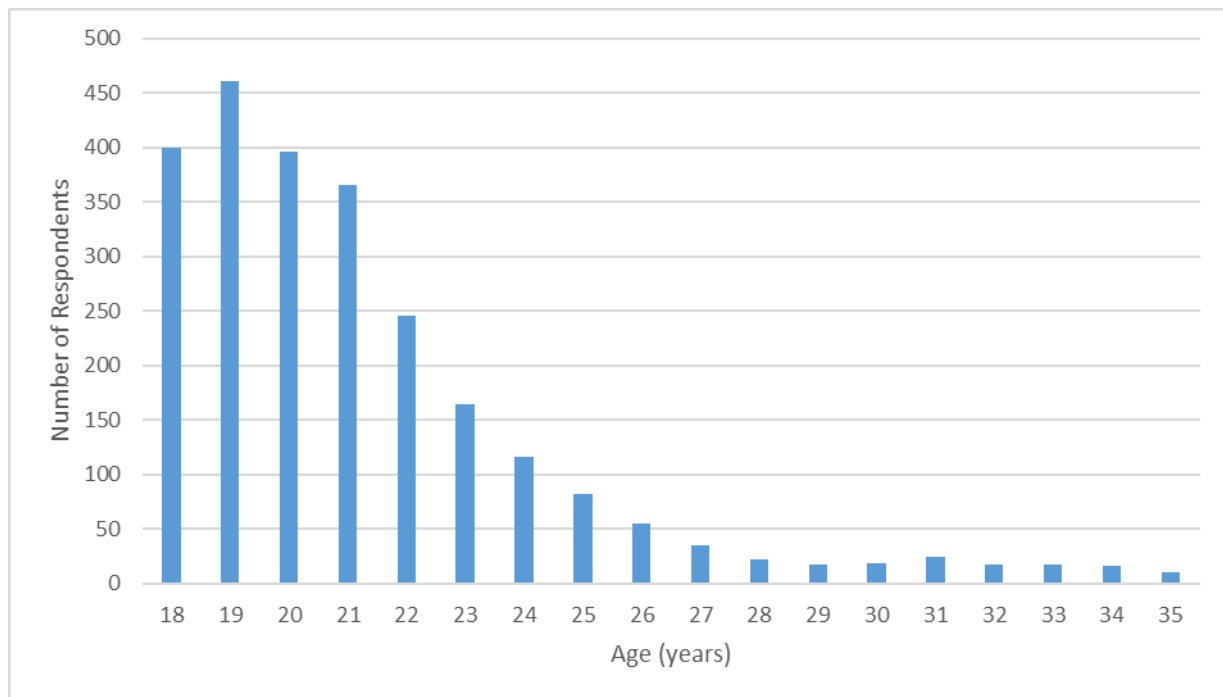


Figure 44: Age of Respondents

Secondly, the number of participants over 35 ($n = 97$) did not generate large enough sample sizes per experiment and *Belief State*. In the scenario of ‘before COVID-19’, individuals with access to a private vehicle resulted in the following sample sizes for the four experiment groups (Experiment 1,2,3,4) of nine respondents (four male, five female), three respondents (one male, two females), eight respondents (no male, eight females), five respondents (one male, four females), respectively. For individuals without access to a private vehicle and over the age of 35 years, the sample sizes were further reduced to ‘before COVID-19’ and ‘during COVID-19’ for all experiments with 14 respondents. These sample sizes of the respondents older than 35 years were insufficiently small, with $n < 5$ for many of the *Belief States* and all with $n < 30$; further analysis of individuals over 35 was considered not feasible.

5.5.4.1 Travel Characteristics of Respondents

Due to the timing of the surveys, the first question that was asked, after the respondents had given their consent, was to help inform how much the COVID-19 pandemic was still impacting their travel or movement in Cape Town. Figure 45 shows the results of the cleaned data for the respondents. Unsurprisingly, females and males with access to a private vehicle were more likely to report ‘no change’ with 37.7% and 42.7%, respectively, compared to those without access to a private vehicle with 26.7% and 31.2% respectively. For the rest of the categories of respondents, those without access responded slightly more than those with

access to a private vehicle. No specific category of answer varied dramatically between the different respondents (gender and/or access to a private vehicle status).

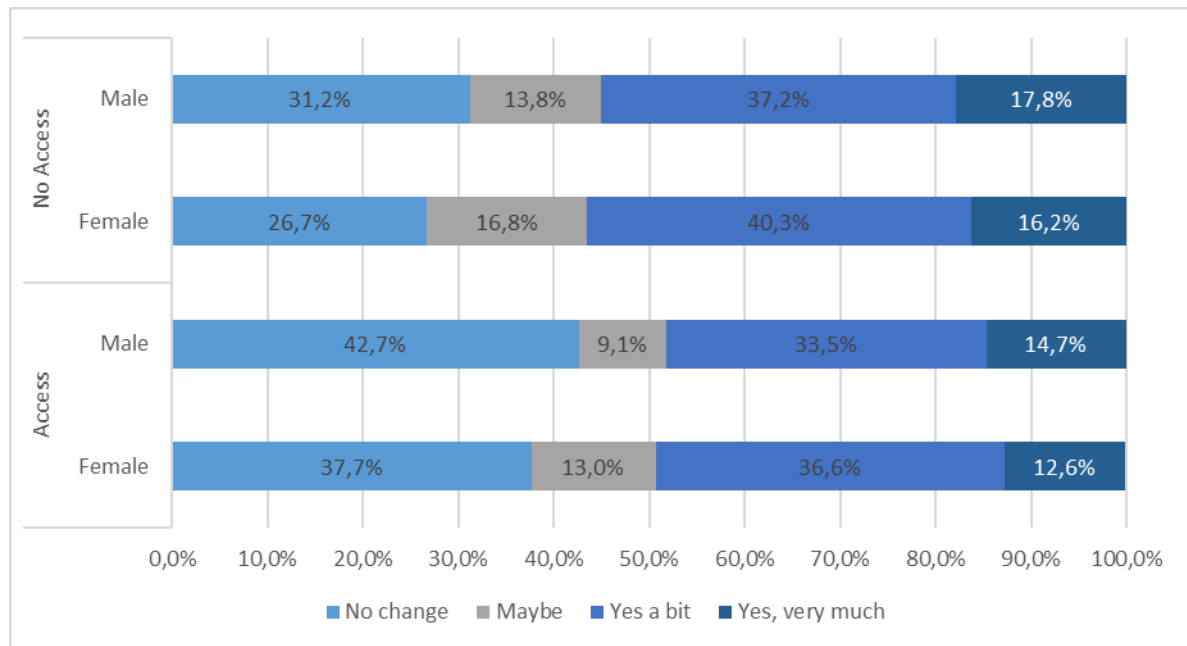


Figure 45: Respondents Perceived COVID-19 Impacting their Travel or Movement in Cape Town at the Time of the Survey (*n* (male with no access) = 471; *m* (female with no access) = 881; *o* (male with access) = 361; *p* (female with access) = 751)

To establish some basic understanding of the sample group and verify that individuals were active users of ride-share services, additional questions were asked before and after the specific *Ride-Share Service Questions*. Firstly, to verify if individuals were active users of ride-share services, they were asked if ride-share services were their main or supplementary form of transport. Here, the provided answer included main and supplementary, where the individuals continued with the ride-share related questions and experiments. The third option was ‘neither – I do not use ride-share services’, where they were then directed to a transport modal set of questions (as shown in Figure 41), which is out of the scope of this work.

If the respondents responded with a ‘main’ or ‘supplementary’ form of transport, they were then asked about the frequency of their ride-share service trips in a typical week. The frequency of ride-share service trips in the respondents per *Gender* (female; male), and *Access to a Private Vehicle* (individuals with access to private vehicle; individuals without access to private vehicle) is shown in Figure 46. Pearson Chi-Square tests of the frequency data showed that both the factor of *Gender* ($p=0.008$) and *Access to a Private Vehicle* ($p<0.001$) were statistically significant, however, *COVID-19* was not with $p=0.118$.

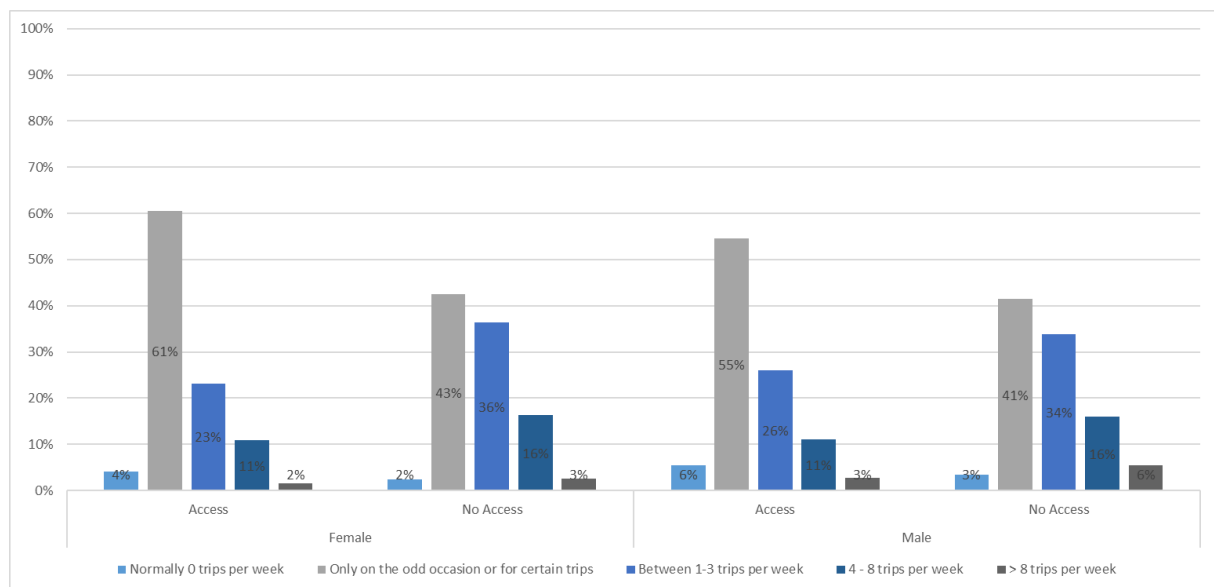


Figure 46: Frequency of Ride-Share Service Trips per Gender and Access to a Private Vehicle (Female Access, n=751; Female No Access, m=881; Male Access, o=361; Male No Access, p=471)

The specific *Ride-Share Service Questions* followed (as defined in Section 5.3). Next, there was a free text field for any feedback or comments about the respondents' experience of ride-share services. This acted as a nudge for the respondents to reflect on their experiences and provide any qualitative inputs that they were willing to provide. The next question then asked to rate their experience of ride-share services as either positive, negative, or mixed. Pearson Chi-Square tests showed that *Gender* and *COVID-19* were significant factors in all experiment groups, ranging between $p < 0.001$ and $p = 0.012$, but *Access to a Private Vehicle* was not significant (p ranging between $p = 0.604$ and $p = 0.815$), nor were the differences between the experiment groups, with $p = 0.825$ for females and $p = 0.810$ for males. Therefore, Figure 47 shows the results with factors of *Gender* and *COVID-19*.

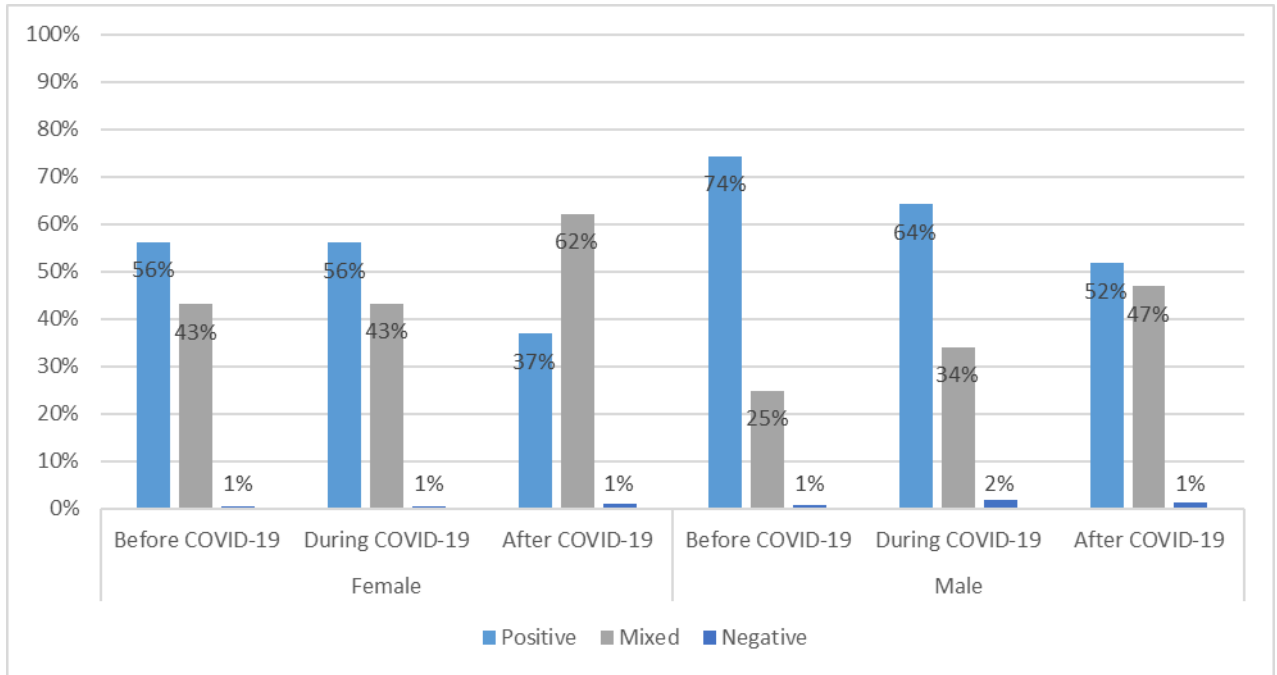


Figure 47: Responses to 'What was your Experience of Ride-Share Services' (Female: Before COVID-19, n=510; During COVID-19, m=593; After COVID-19, o=279; Male: Before COVID-19, p=250; During COVID-19, q=303; After COVID-19, r=303)

The results of the perceived experience of ride-share services in Figure 47 can be used to demonstrate the *Belief States* per *Gender* between the different *COVID-19* scenarios. Using the guidance and formula from Section 2.2.2, the *Belief States* of females for different *COVID-19* scenarios can be calculated with their amplitudes:

$$|\Psi\rangle_{\text{Before Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.75; b=0.66; c=0.08$$

$$|\Psi\rangle_{\text{During Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.75; b=0.66; c=0.08$$

$$|\Psi\rangle_{\text{After Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.61; b=0.79; c=0.10$$

Figure 48 visualises the results for females²³. Similarly, for males, the *Belief States* for the different *COVID-19* scenarios can be calculated with their amplitudes:

$$|\Psi\rangle_{\text{Before Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.86; b=0.50; c=0.09$$

$$|\Psi\rangle_{\text{During Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.80; b=0.58; c=0.13$$

$$|\Psi\rangle_{\text{After Covid-19}} = a |Positive\rangle + b |Mixed\rangle + c |Negative\rangle, \text{ where } a=0.72; b=0.68; c=0.11$$

Figure 49 visualises the results for males²⁴.

²³ *Belief States* shown are proportionally accurate but not to scale due to the resizing of figures.

²⁴ *Belief States* shown are proportionally accurate but not to scale due to the resizing of figures.

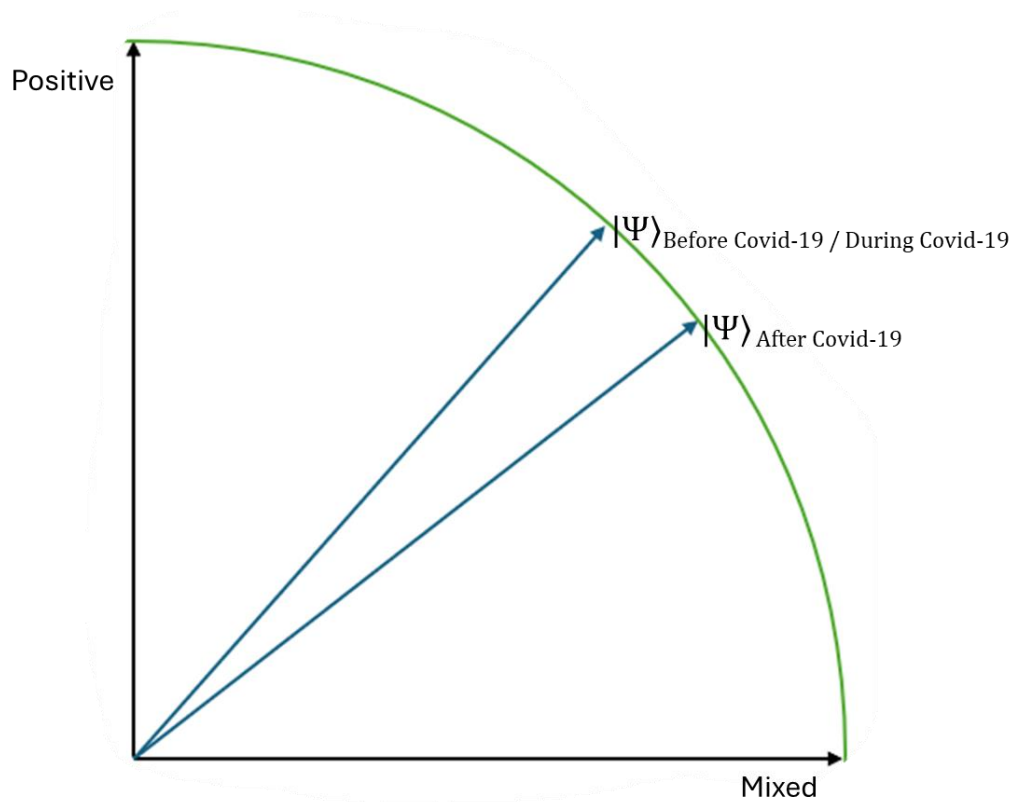


Figure 48: Female Belief States of their Perceived Experience of Ride-Share Services for 'Positive' and 'Mixed'²⁵

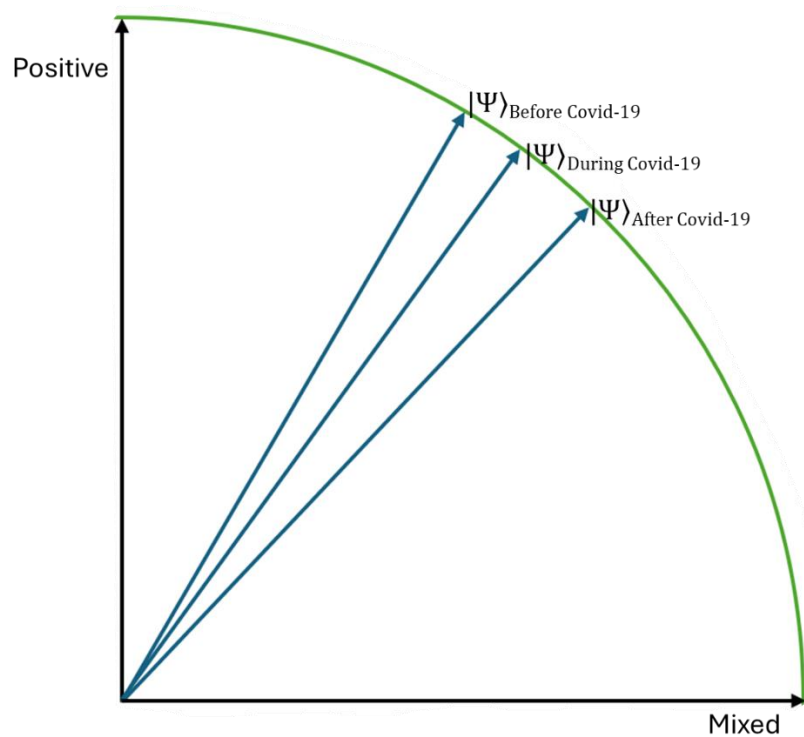


Figure 49: Male Belief States of their Perceived Experience of Ride-Share Services for 'Positive' and 'Mixed'²⁶

²⁵ Z-axis for 'Negative' not shown due to very small and consistent amplitude values

²⁶ Z-axis for 'Negative' not shown due to very small and consistent amplitude values

Using the QPT modelling of the *Belief States*, the differences between the *Belief States* of females and males, for their overall impression of their experience of ride-share services, can be visualised in a novel manner. Females demonstrate no difference in the *Belief State* of ‘before COVID-19’ compared to ‘during COVID-19’. However, males show distinct *Belief States* for each of the COVID-19 scenarios. The scenario ‘before COVID-19’ is perceived by both genders to be the most positive COVID-19 scenario, while ‘after COVID-19’ is higher in the mixed perception (good and bad experiences) for both genders.

The overall sample sizes were considered sufficient, however, for some of the analyses, which relied on all three *Belief State* factors (*Gender*, *Access to a Private Vehicle*, *COVID-19* phase). The sample sizes were not sufficient to generate the necessary cell counts in the loglinear models (Field, 2013). This is explicitly described in Chapter 6 and Chapter 7.

Table 11 shows the breakdown of the respondents for each experiment, in each scenario and for individuals with and without access to a private vehicle. This is for the cleaned data that excluded those who did not use ride-share services, were over 35 years old, or did not state their gender as female or male.

Table 11: Number of Respondents per Experiment for each Scenario

Access to a Private Vehicle	Scenario	Gender	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Access to a Private Vehicle	<i>Before COVID-19</i>	<i>Female</i>	52	75	86	78
		<i>Male</i>	33	15	49	31
	<i>During COVID-19</i>	<i>Female</i>	53	44	42	38
		<i>Male</i>	33	16	28	27
	<i>After COVID-19</i>	<i>Female</i>	67	45	92	79
		<i>Male</i>	33	28	41	27
No Access to a Private Vehicle	<i>Before COVID-19</i>	<i>Female</i>	69	49	53	48
		<i>Male</i>	38	25	33	26
	<i>During COVID-19</i>	<i>Female</i>	80	73	109	90
		<i>Male</i>	44	33	62	36
	<i>After COVID-19</i>	<i>Female</i>	86	59	97	68
		<i>Male</i>	43	24	75	32

In the next section, the data analysis approach and details are described.

5.6 Data Analysis

This section describes the data analysis selected for the various comparisons and hypothesis tests. The tool that was used to analyse the data was Statistical Package for the Social Sciences (SPSS). SPSS is a commonly used program within the social sciences and has the functionality to conduct all the statistical tests needed in the case study experimental design.

These analyses include:

- the verification of the elements of the *Belief States*,
- determining incompatibility in the ride-share service questions,
- determining incompatibility in the related factors.

Furthermore, for each analysis, checks are done for Type I and Type II errors. Field (2013) describes Type I errors (determined with α -level) as when there seems to be an effect, but, in fact, there is not. On the other hand, Type II errors (determined with β -level and power) are when there seems to be no effect, but, in fact, there is an effect (Field, 2013).

The details of each of these analyses are described in the following subsections.

5.6.1 Verification of Elements of *Belief States*

Before the in-depth analyses of the experiments are carried out, the selected elements of the *Belief State* need to be verified. This is done in Chapter 6. The elements of the *Belief State* need to generate statistically significant differences in the formulated ride-share service questions. Data from the control data is used to ensure no confounding effects from related or unrelated factors. If no statistically significant differences are found for an element of the *Belief State*, then there is no justification for maintaining the element in the proposed *Belief State*. Figure 50 illustrates the verification of the elements of the *Belief States*.

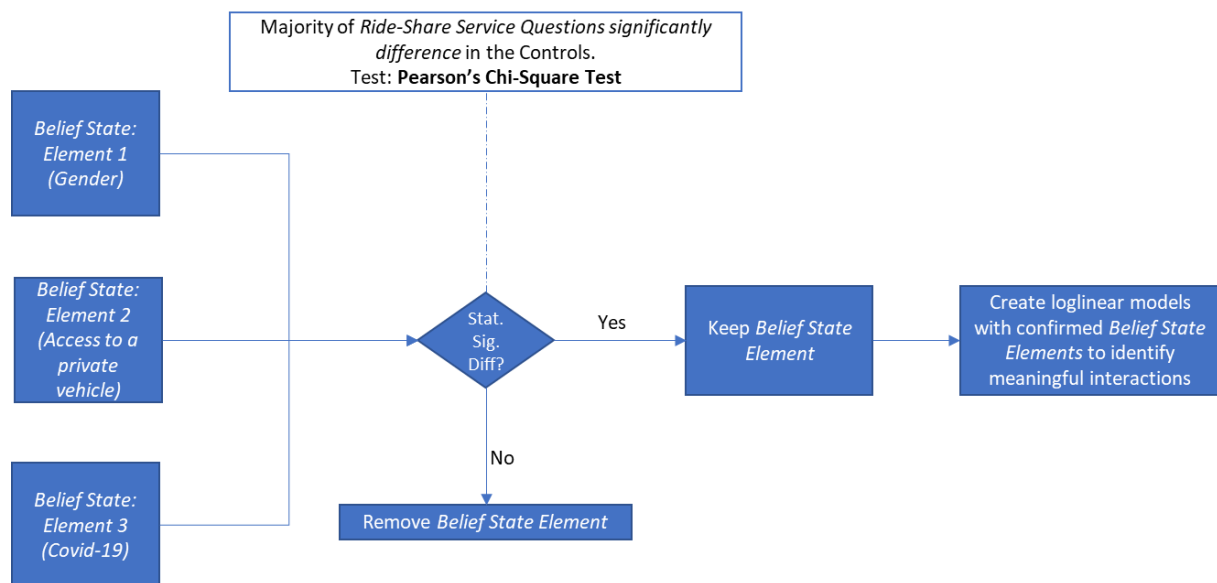


Figure 50: Verification Approach for the Elements of the Belief States

In this analysis, the data involved was categorical and, therefore, Pearson's Chi-Square test was used to determine statistically significant differences at a significance level of 5%. The minimum frequency and the expected counts were confirmed to be not below 5 (Field, 2013), before the tests were carried out. Once the elements of the *Belief State* have been confirmed or excluded, the next level of analysis can be done.

Each *Personal Factor* was analysed for the three *Ride-Share Service Questions*. Pearson Chi-Square tests were used to determine if significant differences existed between the *Personal Factors* and the responses to the three *Ride-Share Service Questions*. Furthermore, only the responses of Experiment 1 and Experiment 3 were used. This was to prevent any effect of the treatments in Experiment 2 (pre-questions of *Transport Factors*) and Experiment 4 (pre-questions of *Good Mood Questions*) from interfering with the results of the *Ride-Share Service Questions*. From this analysis, all *Personal Factors* were found to be valid.

Loglinear models were created to adequately investigate the interactions of the factors in the *Ride-Share Service Questions*. This statistical approach was appropriate, due to the categorical nature of the data collection and the number of factors in the research (Field, 2013). The findings from the loglinear models of the Controls are presented per *Personal Factor*, for better readability, in Section 6.1.1 for *Gender*, Section 6.2.1 for *Access to a Private Vehicle*, and Section 6.3.1 for *COVID-19*.

Crosstabs (SPSS functionality) were performed to determine if there were significant differences in the *Transport Factors* per *Personal Factor*. A significance level of 5% was

defined, and the p-value for statistically significant results was set at $p < 0.05$. This is a typical and generally accepted level for statistically significant results in such investigations (Field, 2013). This significance level is maintained throughout the work.

The data analysis appropriate to the multi-dimensional *Belief States* for the ride-share service questions are loglinear models. This was based on the collected data type (Field, 2013). Additionally, as Field (2013) mentioned, odds ratios are another way of describing differences between the responses, which have also been included.

The following section describes the data analysis approach for determining incompatibility in the ride-share service questions.

5.6.2 Data Analysis Approach for Determining Incompatibility in *Ride-Share Service Questions*

The analysis applied to the effects of the related and unrelated factors on the *Ride-Share Service Questions* is similar (Experiment 2 and Experiment 4, respectively). This analysis involved all elements of the *Belief State* and the *Ride-Share Service Questions*, so a loglinear analysis was deemed appropriate (Field, 2013). The main target is to determine if evidence of incompatibility can be found in the different *Belief States*. Figure 51 illustrates this part of the research method.

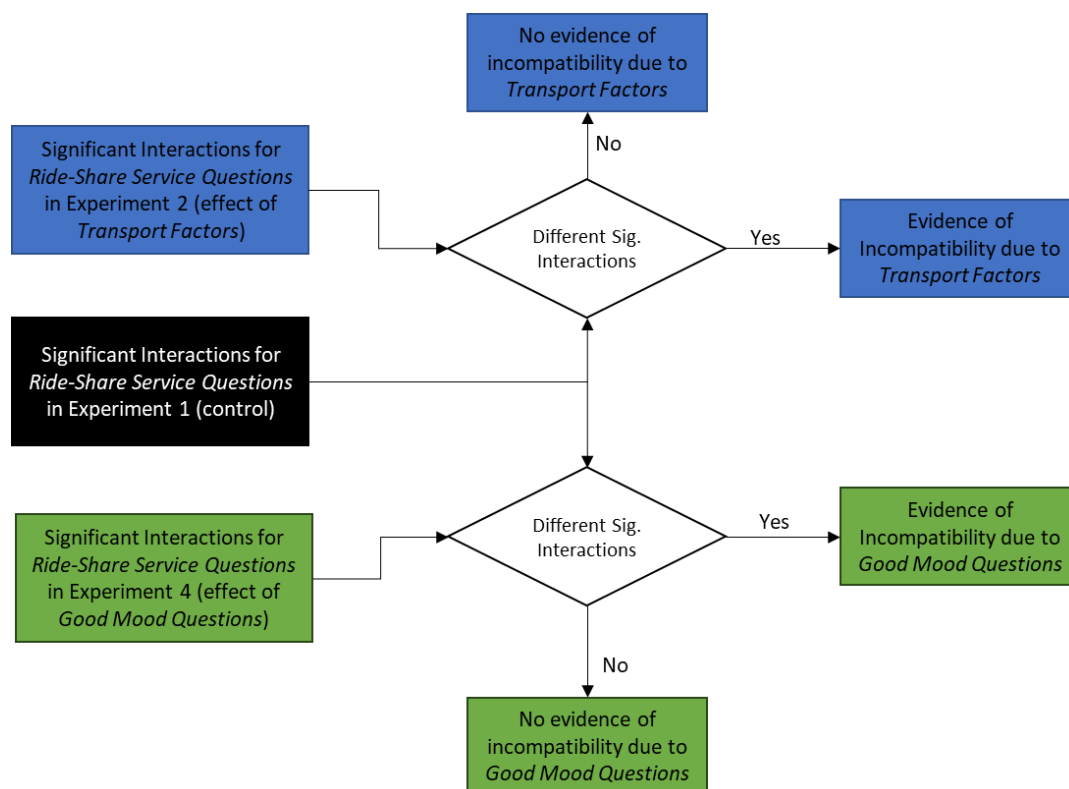


Figure 51: Research Method for Related and Unrelated Factors for Incompatibility Effects in Ride-Share Service Questions

The significant interactions found in the *Ride-Share Service Questions* in Experiment 1 (Control) are compared to the significant interactions found in Experiment 2 (*Transport Factors* are asked before *Ride-Share Service Questions*) to determine if there is evidence of incompatibility. If the significant interactions differ in being significant or non-significant between Experiment 1 and Experiment 2, then evidence of incompatibility for the related factors of the *Transport Factors* has been determined. If the significant interactions in Experiment 1 and 2 are the same, then no difference in the way the individuals have created their answers can be argued for. Thus, no evidence of incompatibility is then found. Similarly, the significant interactions of Experiment 1 are compared to the results of Experiment 4 (*Good Mood Questions* before *Ride-Share Service Questions*) to determine if the unrelated factors resulted in different significant interactions within the loglinear models.

The next section describes the analysis approach to determine if the ride-share service questions significantly impacted the related factors statistically. This indicates if there is also incompatibility possible within the related factors.

5.6.3 Data Analysis Approach for Determining Incompatibility with Related Factors

Using the Crosstabs functionality of SPSS, Pearson's Chi test (Field, 2013) was calculated for each related factor. The sample sizes are smaller when all three elements of the *Belief States* are considered.

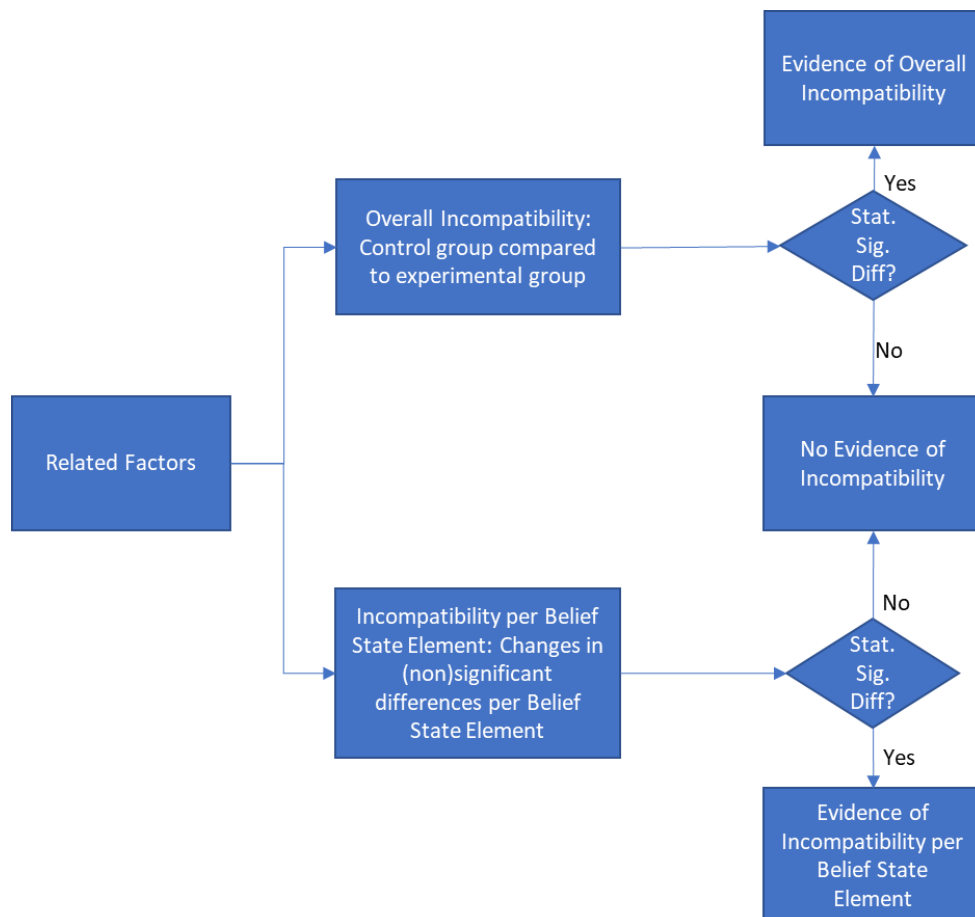


Figure 52: Evidence of Incompatibility – Overall and per Belief State Elements for Related Factors

Figure 52 demonstrates that the related factors are analysed in two ways. Firstly, the responses to the related factors were compared between the control group (namely the responses from Experiment 2) and the experiment group (namely the responses from Experiment 3). Significant differences in the responses were calculated.

Secondly, the experiment and control groups' responses were analysed per *Belief State* element for each related factor. If the (non)-significance in the experimental group was different from the (non)-significance in the control group, outcomes are evidence of incompatibility. For example, if a *Belief State* element resulted in non-significant results in the experimental and control groups for a related factor, then no evidence of incompatibility was found. However, if a *Belief State* element resulted in a significant result in either the control or the experimental group, but not in the other, evidence of incompatibility can be argued for.

5.7 Research Ethics and Approvals

The research undertaken in this study complies with the University of Cape Town ethical requirements. The research ethics in the data collection process were carefully reviewed

internally by the supervisor and the department and externally by an expert in ethics. Furthermore, the ethics review board reviewed and approved the survey as part of the research program in 2018 and renewed it again in 2021 before distributing the surveys to the university's email addresses. This was done due to the additional application process of the university's Department of Student Affairs. The Department of Student Affairs reviewed and approved the investigation to be distributed.

The informed consent form is the first aspect of the survey that addresses ethical concerns. This is mandatory and acknowledges the respondents' rights to be protected during the data collection (Creswell, 2009). Sarantakos (2005) outlines key elements that should be included in the informed consent form:

- Identification of the researcher,
- Provision of contact details for any questions from respondents,
- Clear purpose of the research,
- The benefits of participating in the survey,
- Any risks involved in participating in the survey,
- Confirmation and guarantee of confidentiality of the data and the individual, and
- Inform and assure that the respondents may withdraw from the survey any time.

All these aspects can be seen in the two Google Forms Appendix A survey. No vulnerable populations were targeted, and respondents had to be over 18 to participate in the survey. To ensure that the survey was understandable, accessible, and acceptable to respondents, three reviews by individuals, that were typical of the student body, were also carried out. Furthermore, the confidentiality and anonymity of the participants and their responses have been maintained to ensure no harmful effects or consequences to the participants.

5.8 Résumé

This chapter focused on the data identification, collection and analyses of the Cape Town experiments, using *Belief States* to investigate the concept of incompatibility in ride-share services.

The creation of the Cape Town *Belief States*, using the three factors of gender, access to a private vehicle and COVID-19 are presented in Section 5.1. These three factors are motivated

as being relevant and appropriate based on the ideas and concepts set out in Chapter 3 and Chapter 4.

Related (*Transport Factors*) and unrelated factors (*Good Mood Questions*) are presented for ride-share services in Cape Town in Section 5.2, while the exact formulation of the *Ride-Share Service Questions* are shown in Section 5.3. The *Ride-Share Service Questions* consisted of ‘Would you take a ride-share service trip **at night** / **alone** / **alone at night**’.

In Section 5.4, the full experiments with all developed factors and questions are presented for the Cape Town investigation. Details of the data collection are shown in Section 5.5 including descriptions of the survey tool, survey timeline, and COVID-19 pandemic considerations. Further details of the survey structure and content, as well as the overview of the responses and sample sizes, are shown in Sections 5.5.3 and 5.5.4, respectively.

Finally, the approach to the data analyses is outlined in Section 5.6, followed by the research ethics and approval consideration in Section 5.7.

Next, in Chapter 6, the findings in control groups are shown to provide a baseline for the comparison to the experiment findings (showed in Chapter 7 and Chapter 8).

6. Control Group Findings of *Ride-Share Service Questions* and Related Questions of *Transport Factors*

Chapter 6 demonstrates the usefulness of the three *Personal Factors* of the *Belief State* in the investigations. The three *Personal Factors* are *Gender*, *Access to a Private Vehicle* and *COVID- 19*²⁷. The differences and similarities for each *Personal Factor* in the *Ride-Share Service Questions* ('Would you take a ride-share service trip alone; at night; alone at night?') and the *Transport Factors* (*Sustainable Transport*; *Reliability* ('being on time'); *Road Safety*; and *Crime*) are explored and tested. The focus in this chapter is, therefore, on determining where significant differences are seen per *Personal Factor* in the *Ride-Share Service Questions* and *Transport Factors* in the control data (i.e. *Ride-Share Service Questions* are only asked²⁸ or are asked before *Transport Factors*²⁹) and then exploring these differences using the *Belief States*. This provides evidence that the selected *Personal Factors* are meaningful in the *Belief States* of the individuals for specific *Ride-Share Service Questions*.

The *Transport Factors* were designed as the pre-questions. Therefore, there is no need to validate the *Transport Factors* per *Personal Factors*. However, the *Transport Factors* are tested for significant differences per *Personal Factor* to determine whether there are statistically significant differences. Furthermore, these results provide a baseline for the investigations into the effects of incompatibility, which appear later in Chapter 7, for incompatibility in the *Ride-Share Service Questions* caused by the *Transport Factors*, and in Chapter 8, for the incompatibility in the *Transport Factors* caused by the *Ride-Share Service Questions*.

To improve the chapter's readability, the differences in the control groups of the *Ride-Share Service Questions* and the *Transport Factors* are presented per *Personal Factor*. So, the chapter begins with *Gender*, then *Access to a Private Vehicle*, and, finally, differences regarding *COVID- 19*. Each *Personal Factor* is described in terms of the proportions of responses and significance per group.

Since this chapter describes the findings for the control groups for the *Ride-Share Service Questions* and *Transport Factors*³⁰ using the three *Personal Factors*, it addresses *H1*

²⁷ To improve readability, the *Personal Factors* are not labelled *Personal 1, 2, 3* but are written, by their short description, in italics. For example, *Gender*. The same is done for *Transport Factors*, for example, *Sustainable Transport*.

²⁸ Experiment 1

²⁹ Experiment 3

³⁰ Experiment 2

(Chapter 2): Uncertainty and perceived risks of personal security decrease the willingness to use ride-share services in young South African adults. (Chapter 6). Here, the Null Hypothesis for *H1* is that no statistical differences are found in ride-share service questions involving uncertainty and perceived risk (namely, *Ride-Share Service Questions*) for different *Personal Factors*. The Alternative Hypothesis for *H1* is that significant differences in the *Ride-Share Service Questions* for the different *Personal Factors* are found. By investigating the *Personal Factors* in the willingness of the *Ride-Share Service Questions*, insights into how and which individuals alter their decisions are found.

The next section explores the first of the three *Personal Factors*, namely *Gender*, in the *Ride-Share Service Questions* and the *Transport Factors*.

6.1 Gender: Ride-Share Service Questions and Transport Factors

Gender has been identified as an important aspect of individuals in the *Ride-Share Service Questions* previous Chapters 2 and 4. This section explores the collected data from a gender perspective for the *Ride-Share Service Questions* in Section 6.1.1 and for the *Transport Factors* in Section 6.1.2.

6.1.1 Gender and Ride-Share Service Questions: Responses, Statistical Analysis and Belief States

Figure 53 illustrates how females and males perceive the *Ride-Share Service Questions* in Cape Town. Females (n=886) are typically less likely than males to be willing to say 'yes' to all three *Ride-Share Service Questions*. Males (m=512) responded with 'yes' to 'at night', 'alone' and 'alone at night' with 82.6%, 83.6% and 75.8%, respectively. Most females are also willing to use ride-share services 'at night' and 'alone' with 66.3% and 65.5%, respectively. However, females are much less likely to respond with 'yes' to the combined question 'alone at night', with only 37.9% answering with 'yes'. Among males, an average of 8.8% responded 'not sure' in the three *Ride-Share Service Questions*. Conversely, females responded, on average, 13.2% for 'not sure' in the three *Ride-Share Service Questions*.

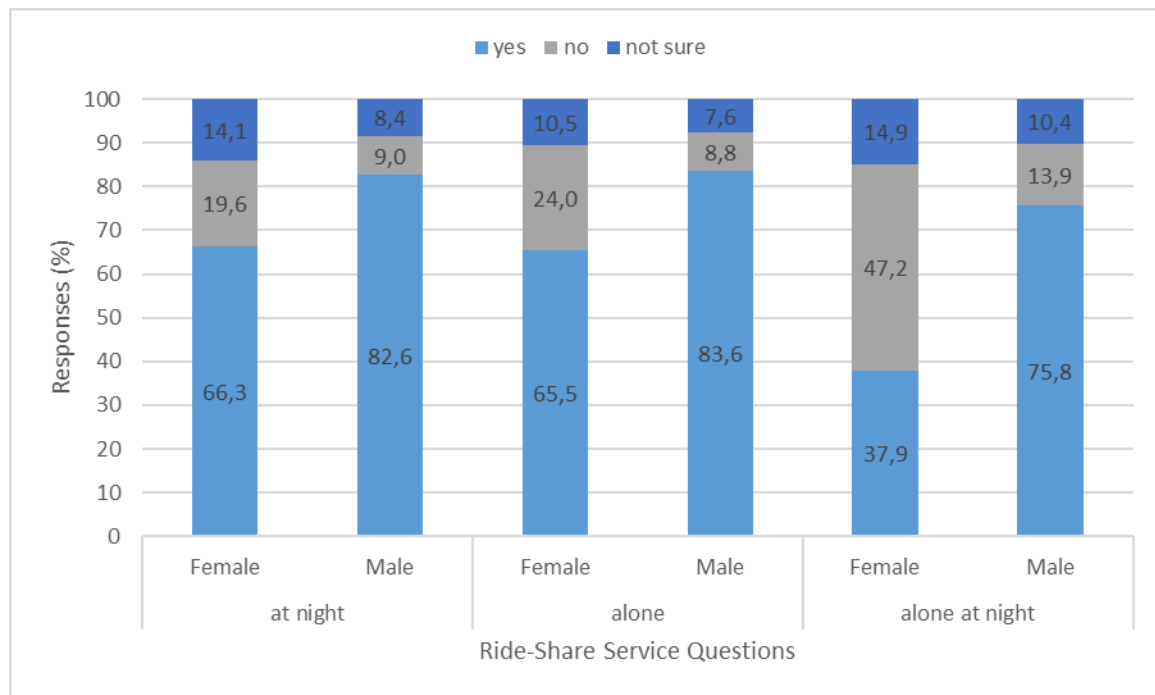


Figure 53: Gender and Ride-Share Service Questions in Percentages (female, n=886; male, m=512)

The amplitudes are calculated for the *Belief States* of females and males for the *Ride-Share Service Questions*. The *Belief State* is defined: $|\Psi\rangle_{\text{Gender}} = a | \text{Yes} \rangle + b | \text{No} \rangle + c | \text{Not Sure} \rangle$.

The results are summarised in Table 12.

Table 12: Amplitudes of Female and Male Belief States of Ride-Share Service Questions

Ride-Share Service Question	Gender	a	b	c
At night	Female	0.81	0.44	0.38
	Male	0.91	0.30	0.29
Alone	Female	0.81	0.49	0.32
	Male	0.91	0.30	0.28
Alone at night	Female	0.62	0.69	0.39
	Male	0.87	0.37	0.32

The *Belief States* for ‘at night’, ‘alone’ and ‘alone at night’ are illustrated in Figure 54. While the *Belief States* of males are the same for ‘alone’ and ‘at night’, distinct *Belief States* are seen for each *Ride-Share Service Question* in females. **This indicates that females perceive different personal security risks when taking a ride-share service trip ‘at night’ compared to ‘alone’, which males do not perceive.** However, ‘alone at night’ generated different *Belief States* for both females and males. Most relevant, the female *Belief State* for each risk indicates a far

greater amplitude to say ‘no’ when compared to all other *Belief States*, and a slightly larger amplitude to be ‘not sure’ of an answer.

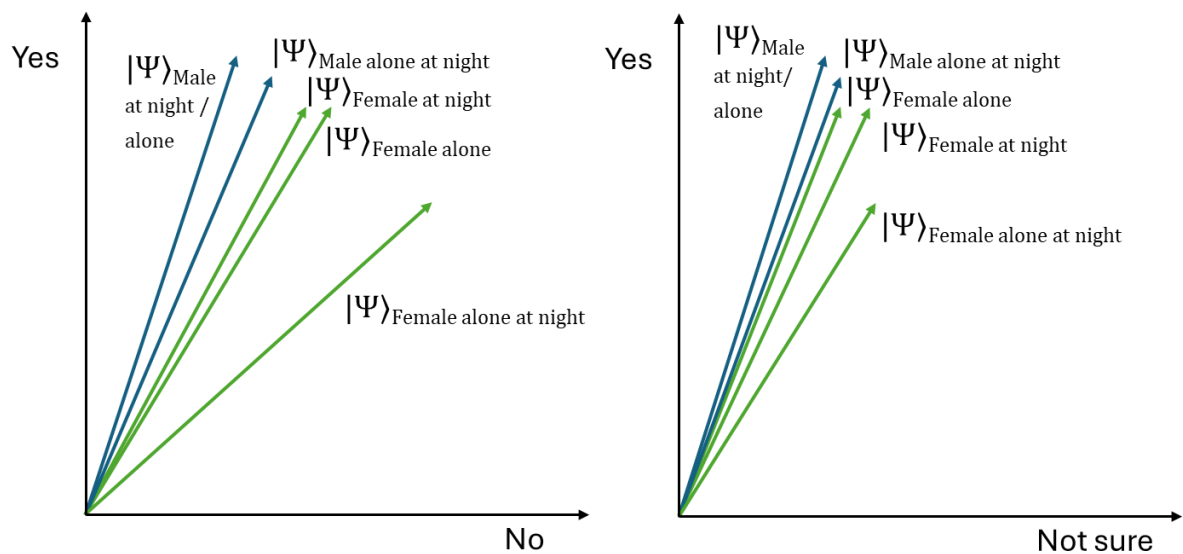


Figure 54: ‘Alone’ and ‘At Night’ Belief States for Females and Males for ‘Yes’ - ‘No’ and ‘Yes’-‘Not sure’

Table 13 confirms that these proportional differences are statistically significant ($p < 0.001$) using the Pearson Chi-Square test for *Gender* in all three of the *Ride-Share Service Questions*. There is a significant relationship between *Gender* and the responses to the *Ride-Share Service Questions* for travelling ‘at night’ $\chi^2 (2) = 44.238$, $p < 0.001$ and for ‘alone’ $\chi^2 (2) = 58.542$, $p < 0.001$. A significant relationship is also found between *Gender* and travelling ‘alone at night’ $\chi^2 (2) = 19.808$, $p < 0.001$.

Table 13: Summary of Statistical Analysis of Gender in Ride-Share Service Responses (Controls, $n=1398$)

Personal Factor	Ride-Share Service Question	Pearson Chi-Square	Degree of Freedom	p-Value
Gender	‘at night’	44.238	2	<0.001
	‘alone’	58.542	2	<0.001
	‘alone at night’	19.808	2	<0.001

The results of the three *Ride-Share Service Questions* confirm that females and males respond to ‘at night’, ‘alone’, and ‘alone at night’ significantly differently. *Gender* is, therefore, maintained as a significant factor in the *Belief States*. This is unsurprising considering the large differences in response proportions shown in Figure 53. Odds ratios were calculated to quantify how much more likely it is that males say ‘yes’ to a *Ride-Share Service Question* than their female counterparts.

Table 14: Summary of Odds Ratios for Gender in Controls

Ride-Share Service Questions	Interaction	Description	Odds Ratios
'at night'	Gender x 'at night'	Male vs Female	2.41
'alone'	Gender x 'alone'	Male vs Female	2.68
'alone at night'	Gender x 'alone at night'	Male vs Female	5.11

Table 14 summarises these odds ratios. The odds ratios show that males are always more likely to be willing to use ride-share services than females, with the odds ratios for 'at night', 'alone', 'alone at night' with 2.41, 2.68, and 5.11, respectively. **For 'alone at night', the odds ratio is approximately double that of 'alone' or 'at night', at 5.11.** Females experience 'alone at night' substantially differently from 'alone' or 'at night' compared with males. These results support the idea that females and males experience ride-share services that involve elements of uncertainty significantly differently from each other. **For trips 'alone at night', the uncertainty or perceived risks for females indicate that the ride-share services do not currently adequately meet the personal security concerns of females.**

6.1.2 Gender and Transport Factors: Responses, Statistical Analysis and Belief States

This section illustrates how females and males perceive the different *Transport Factors* in Cape Town. The control data for *Transport Factors* are taken from Experiment 2. This prevents any effect of the *Ride-Share Service Questions* on the *Transport Factors* in Experiment 3 from influencing the resulting discussions of *Transport Factors*.

Figure 55 shows the relative importance of *Sustainable Transport* and *Reliability* per Gender in the control data. Figure 55 illustrates that females (n=345) and males (m=141) perceive the importance of *Sustainable Transport* and *Reliability* similarly. Approximately 60% of females and males perceive the importance of *Sustainable Transport* to be above average.

In terms of *Reliability*, males have a slightly larger percentage than females, who perceive *Reliability* as being 'very important' (61,7% versus 53,9%) or 'important' (26,2% versus 32,5%). Both females and males perceive *Reliability* as a highly important aspect, with over 85% responding with 'very important' and 'important'.

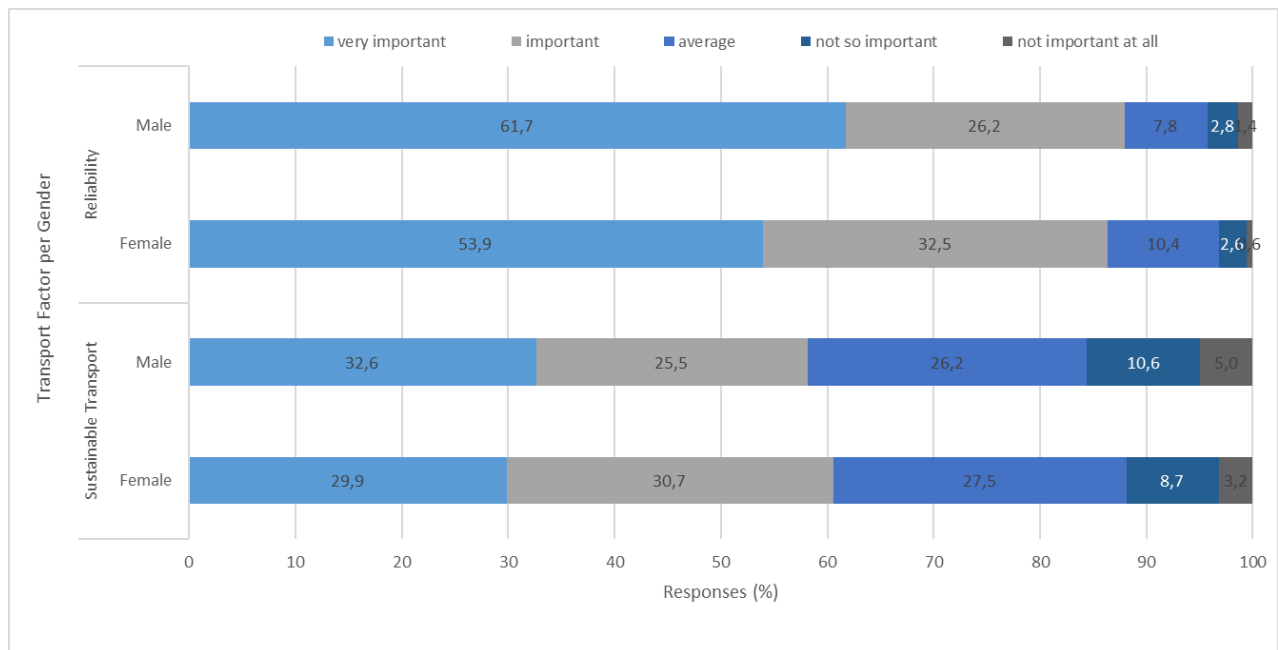


Figure 55: Gender - Sustainable Transport and Reliability (female, n=345; male, m=141)

Figure 56 shows the perceptions of *Crime* (i.e., crime is low in Cape Town ('low'); crime is average in Cape Town ('average'); and crime is high in Cape Town ('high')) and *Road Safety* (i.e., the roads in Cape Town are safe ('safe'); the roads in Cape Town are sometimes safe, sometimes dangerous ('average'); and the roads are dangerous in Cape Town ('dangerous')). As discussed in the previous chapters, *Road Safety* and *Crime* are areas of challenge in Cape Town. Therefore, it is interesting that most females and males perceive *Road Safety* as 'average' (females n=345, 71,0% 'average'; males m=141, 70,2% 'average'). **This suggests that the current road safety level in Cape Town has been normalised or considered acceptable by most of the respondents.**

Furthermore, there is little difference between the perceptions of females and males in *Road Safety* and *Crime*. *Road Safety* is similar for responses to 'safe' (14,8% for females versus 17,0% for males), 'average' (71,0% for females versus 70,2% for males), and 'dangerous' (14,2% for females versus 12,8% for males), and for *Crime* responses to 'low' (3,8% for females versus 6,4% for males), 'average' (34,5% for females versus 41,1% for males), and 'high' (61,7% for females versus 52,5% for males).

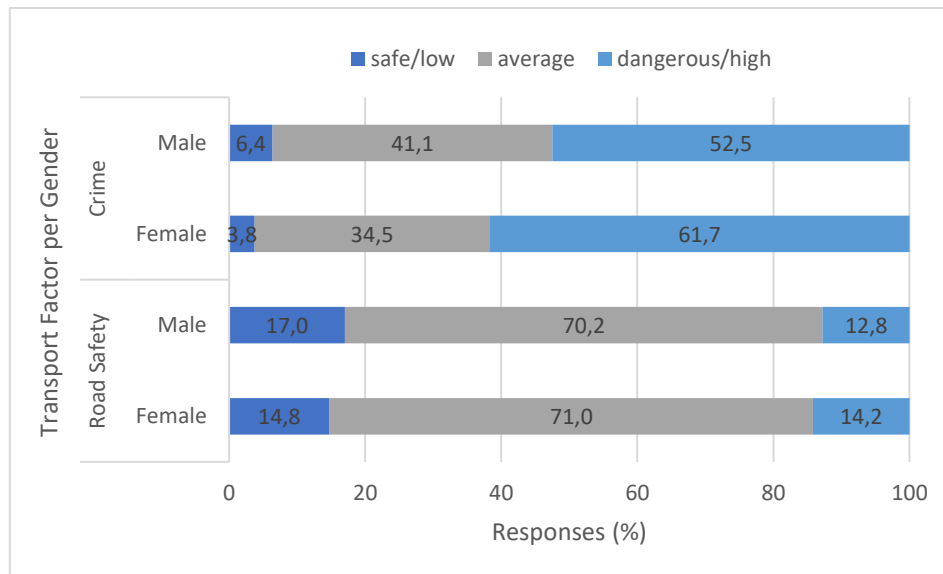


Figure 56: Gender - Crime and Road Safety (female, n=345; male, m=141)

Table 15 summarises the statistical findings for *Gender* in the *Transport Factors*. Table 15 shows that none of the *Transport Factors* generates significant differences between genders (i.e., $p < 0.05$). There is a non-significant relationship between *Gender* and the responses to the *Transport Factors*. For *Sustainable Transport*, the relationship is non-significant, $\chi^2 (4) = 2.496$, $p = 0.645$. For *Reliability*, the relationship is also non-significant, $\chi^2 (3) = 1.638$, $p = 0.651$. A non-significant relationship is also found between *Gender* and *Road Safety*, $\chi^2 (2) = 0.484$, $p = 0.785$. Similarly, the relationship between *Gender* and *Crime* is non-significant, $\chi^2 (2) = 4.177$, $p = 0.124$. **In the control data, when there is no uncertainty or risk preceding the *Transport Factors*, *Gender* is not a significant factor in the *Transport Factors*.** The implication is that, where or when uncertainty or risk is comparatively low, *Gender* is not a significant factor in the *perceptions of transport-related topics*.

Table 15: Summary of Chi Tests for Gender and Transport Factors

Transport Factor	Pearson Chi-Square	df	p-Value
Sustainable Transport	2.496	4	0.645
Reliability ³¹	1.638	3	0.651
Road Safety	0.484	2	0.785
Crime	4.177	2	0.124

³¹ As the data had 30% of cell with expected count of less than 5 for the five categories ('not important at all', 'not so important', 'average', 'important' and 'very important'), the categories were collapsed to four categories ('not important', 'average', 'important' and 'very important') as suggested by Field (2013).

The next section explores the control data from the perspective of *Access to a Private Vehicle*.

6.2 *Access to a Private Vehicle: Ride-Share Service Questions and Transport Factors*

In Chapters 2 and 4, *Access to a Private Vehicle* was identified as a potential factor that could influence the perceptions and decisions of individuals. Therefore, in this section, the role of having access to a private vehicle is explored in the *Ride-Share Service Questions* and the *Transport Factors*.

6.2.1 *Access to a Private Vehicle and Ride-Share Service Questions: Responses and Statistical Analysis*

Figure 57 illustrates how individuals with (n=609) and without access (m=789) to a private vehicle perceive the *Ride-Share Service Questions* in Cape Town. Individuals without access are willing to use ride-share services 'at night', 'alone' and 'alone at night' with 73.1%, 74% and 54.6%, respectively. In comparison, individuals with access to a private vehicle responded with slightly lower proportions: 71.1%, 69.6% and 48.1%, respectively.

Figure 57 further shows that the responses from individuals with and without access to a private vehicle were particularly similar for 'at night' and 'alone'. However, for 'alone at night', individuals with access to a private vehicle were more likely to say 'no' compared to trips 'at night' or 'alone'. In 'alone at night', 40.6% of the respondents with access to a private vehicle replied with 'no'. This is roughly double the percentage seen in respondents with access to a private vehicle 'at night', with 18.6%, or 'alone', with 20.4% for 'no'.

Individuals without access to a private vehicle were less likely to select 'yes' for 'alone at night'. However, 54% of respondents without access to a private vehicle still indicated that they would take a ride-share trip 'alone at night'.

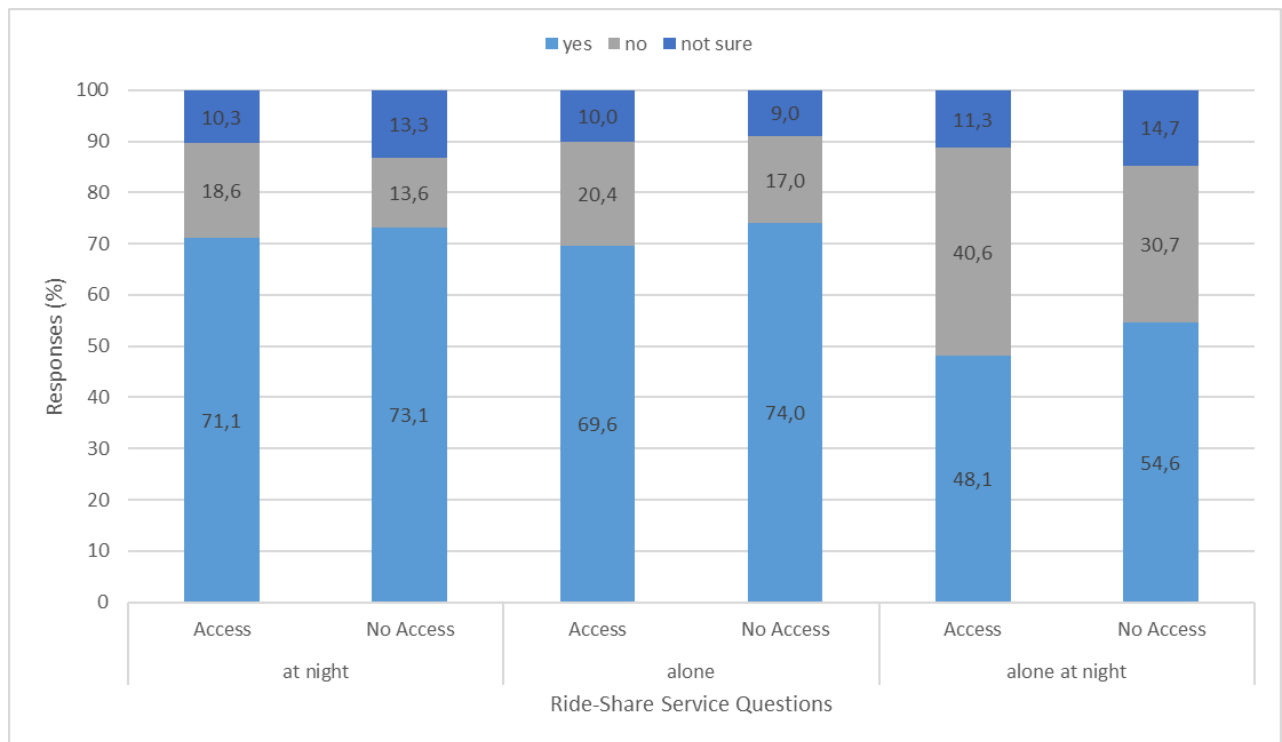


Figure 57: Access to a Private Vehicle and Ride-Share Service Questions in Percentages (Access, n=609; No Access, m=789)

The amplitudes are calculated for the *Belief States* of individuals with and without access to a private vehicle for the *Ride-Share Service Questions*, with the results summarised in Table 16. The *Belief State* is defined as $|\Psi\rangle_{\text{Access to Private Vehicle}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$.

Table 16: Amplitudes of Female and Male Belief States of Ride-Share Service Questions

Ride-Share Service Question	Access to a Private Vehicle	a	b	c
At night	Access	0.84	0.43	0.32
	No Access	0.85	0.37	0.36
Alone	Access	0.83	0.45	0.32
	No Access	0.86	0.41	0.30
Alone at night	Access	0.69	0.64	0.34
	No Access	0.74	0.55	0.38

Figure 58 shows the *Belief States* for individuals with access, and those without access to a private vehicle, for the *Ride-Share Service Questions* of 'at night', 'alone' and 'alone at night'. From the perspective of 'yes'-'no', there was more variation in the *Belief States* with values ranging from 0.86 to 0.69 for 'a' amplitudes and 'b' amplitudes ranging from 0.37 to 0.64. However, the perspective of 'yes'-'not sure' demonstrated more similarities, with individuals with access to a private vehicle having nearly identical amplitudes for 'at night' (a=0.84, c=0.32) and 'alone' (a=0.83, c=0.32).

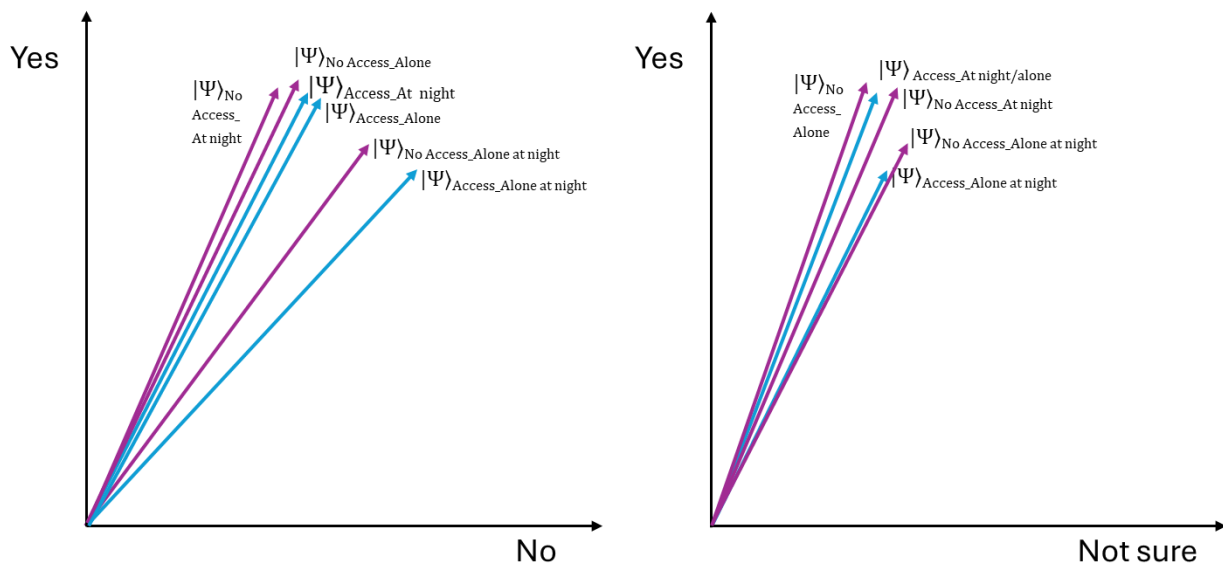


Figure 58: 'Alone', 'At Night' and 'Alone at Night' Belief States for Access and No Access for 'Yes' - 'No' and 'Yes'-'Not sure'

Table 17 summarises the Pearson Chi-Square test results for *Access to a Private Vehicle* for the *Ride-Share Service Questions*. There was a significant relationship between *Access to a Private Vehicle* and the responses to the *Ride-Share Service Questions* for 'at night', $\chi^2(2) = 8.154$, $p = 0.017$. However, for a 5% significance level, no significant association is found for travelling 'alone', $\chi^2(2) = 3.423$, $p = 0.181$. This indicates that, on an aggregated level, individuals with and without access to a private vehicle respond to using ride-share services similarly for 'alone'. This indicates that the uncertainty and perceived risk of personal security for the ride-share service trips 'alone' are perhaps not perceived as critically as ride-share service trips that occur after daylight ('at night' or 'alone at night').

There is also a significant relationship between access to a private vehicle and the responses to the *Ride-Share Service Questions* for travelling 'alone at night', $\chi^2(2) = 15.374$, $p < 0.001$. Two of the three questions result in significant differences between individuals with and without access to a private vehicle ('at night' with $p = 0.017$; 'alone at night' with $p < 0.001$). This meets the criteria defined in Chapter 5 to maintain *Access to a Private Vehicle* as a factor in the incompatibility investigations. **Therefore, the Null Hypothesis for H1.2 (namely $H_{01.2}$) is rejected.**

Table 17: Summary of Statistical Analysis of Access to a Private Vehicle in Ride-Share Service Responses (Controls, n=1398)

Personal Factor	Ride-Share Service Question	Pearson Chi-Square	Degree of Freedom	p-Value
Access to a Private Vehicle	'at night'	8.154	2	0.017
	'alone'	3.423	2	0.181
	'alone at night'	15.374	2	<0.001

The odds ratios are calculated to quantify how much more likely individuals without access to a private vehicle respond with 'yes' to a *Ride-Share Service Question*, than individuals with access to a private vehicle. Table 18 summarises the odds ratios, showing that individuals without access to a private vehicle are more willing to use ride-share services 'at night' (Odd Ratio of 1.10) and 'alone at night' (Odd Ratio of 1.30) than individuals with access to a private vehicle. No odds ratio is presented for 'alone', as there is no significant difference between individuals with and without access to a private vehicle. Therefore, no significant difference is seen between individuals with and without access to a private vehicle for trips 'alone'.

Table 18: Summary of Odds Ratios for Access to a Private Vehicle in Controls

Ride-Share Service Questions	Interaction	Description	Odds Ratios
'at night'	Access to a Private Vehicle x 'at night'	No access vs Access	1.10
'alone at night'	Access to a Private Vehicle x 'alone at night'	No access vs Access	1.30

Despite the uncertainty or risks associated with ride-share services 'at night' or 'alone at night', individuals without access to a private vehicle still make the trips. This indicates that ride-share services are an important transport mode for late-night trips in Cape Town for individuals without access to a private vehicle. The odds ratios are comparatively small compared to those calculated and shown in Table 14 for *Gender*, indicating that *Access to a Private Vehicle* has a relatively lesser effect when compared to *Gender*.

6.2.2 Access to a Private Vehicle and Transport Factors: Responses and Statistical Analysis

This section illustrates how individuals with (n=223) and without access (m=263) to a private vehicle perceive the different *Transport Factors* in Cape Town. Figure 59 shows *Sustainable Transport* and *Reliability* per *Access to a Private Vehicle* in the control group (Experiment 2). Figure 59 shows that individuals with and without access to a private vehicle respond similarly

to the importance of reliability and sustainability of transport. This is especially true when compared to Figure 55, where the differences between females and males for *Reliability* were larger. For *Sustainable Transport*, individuals with access to a private vehicle responded slightly less with 'very important' (27.8% for those with access versus 33.1% for those without access) but more with 'average' (29.6%) than those without access to a private vehicle (25.1%). However, more than 50% of individuals with and without access to a private vehicle perceived *Sustainable Transport* as having importance higher than 'average'.

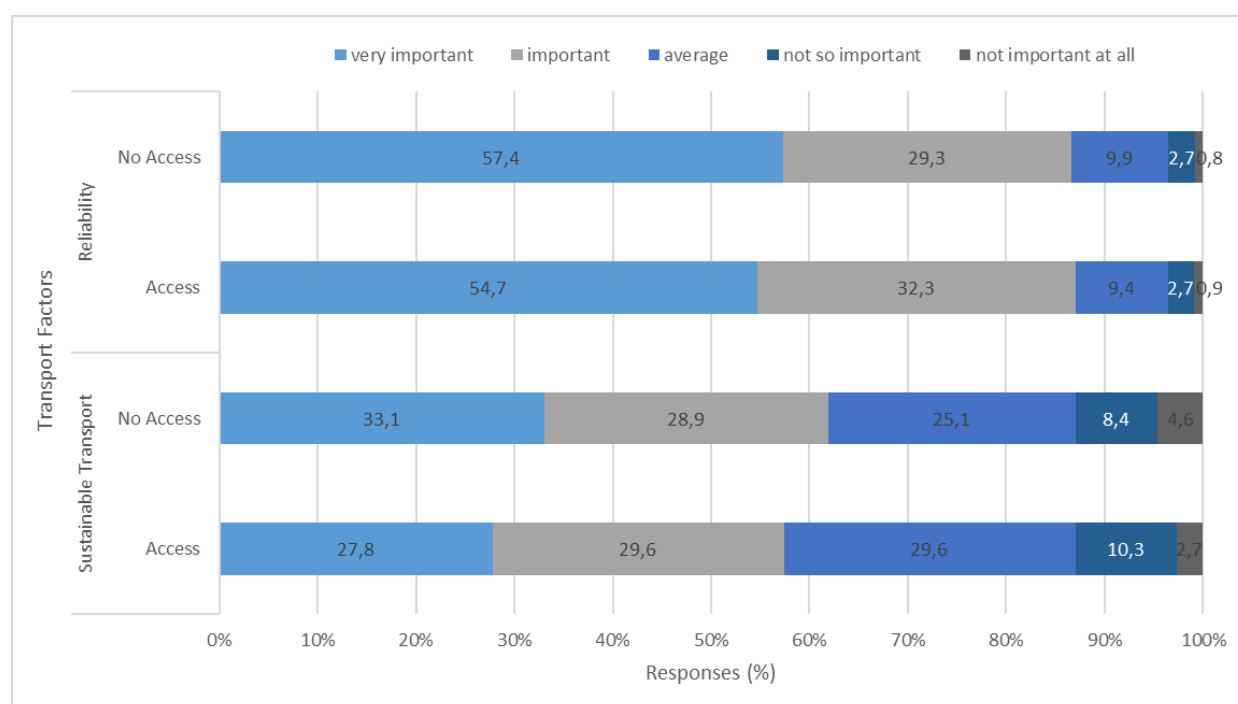


Figure 59: Access to a Private Vehicle - Sustainable Transport and Reliability (Access, n=223; No Access, m=263)

Figure 60 shows the perceptions of individuals, with (n=223) and without access (m=263) to a private vehicle to *Crime* and *Road Safety*. A greater proportion of individuals with access to a private vehicle perceive *Crime* as 'high' (62.3%) compared to individuals without access to a private vehicle (56.3%). Furthermore, individuals with access to a private vehicle are slightly less likely to perceive *Crime* as 'low' in Cape Town (those with access, 3.1%, versus those without access, 5.7%).

Most individuals, with and without access to a private vehicle, responded with 'average', with 73.1% and 68.8%, respectively. However, the larger differences can be seen in 'safe' and 'dangerous'. Individuals with access to a private vehicle perceived *Road Safety* as less 'safe', with only 9.9% thinking that roads in Cape Town are safe. This is less than half of the 20.2% seen in individuals without access to a private vehicle who think the roads in Cape Town are

safe. Furthermore, 17% of individuals with access to a private vehicle believe that the roads in Cape Town are 'dangerous', compared to the 11% of individuals without access to a private vehicle.

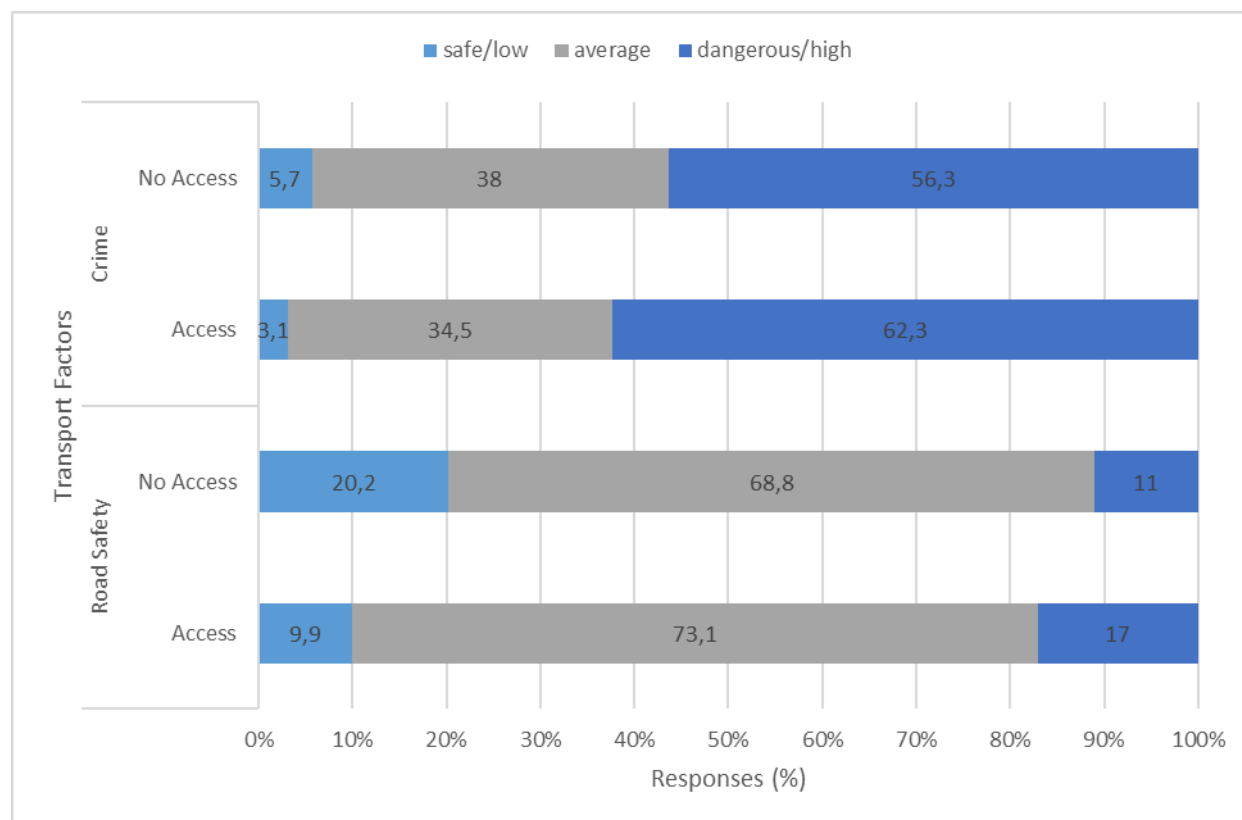


Figure 60: Access to a Private Vehicle - Crime and Road Safety (Access, n=223; No Access, m=263)

Table 19 summarises the statistical findings when comparing *Access to a Private Vehicle* in terms of *Transport Factors*. Table 19 shows that only one of the *Transport Factors* demonstrated a significant difference between individuals with and without access to a private vehicle. There is a significant relationship between *Access to a Private Vehicle* and the responses to the *Transport Factors* for *Road Safety* $\chi^2 (2) = 11.752$, $p=0.003$. However, a non-significant relationship is seen between *Access to a Private Vehicle* and *Sustainable Transport* $\chi^2 (4) = 2.496$, $p=0.645$, while a similar result is seen for the non-significant relationship between *Access to a Private Vehicle* and *Reliability* $\chi^2 (4) = 0.569$, $p=0.966$. Lastly, a non-significant relationship is seen between *Access to a Private Vehicle* and *Crime* $\chi^2 (2) = 2.908$, $p=0.234$.

Table 19: Summary of Chi Tests for Access to a Private Vehicle and Transport Factors

Transport Factor	Pearson Chi-Square	df	p-Value
Sustainable Transport	2.496	4	0.645
Reliability	0.569	4	0.966
Road Safety	11.752	2	0.003
Crime	2.908	2	0.234

Therefore, individuals with and without access to a private vehicle do not perceive the importance of *Sustainable Transport* significantly differently. While young adults are aware of the importance of sustainable transport, 45.1% of all survey participants reported having access to a private vehicle, which is generally considered the least sustainable mode, as described in Chapter 2. The perceived importance of *Sustainable Transport*, however, varies in other population groups in Cape Town (for example, older adults) and is most likely to be different in other cities, facing different challenges and priorities.

In the control data, when there is no uncertainty or risk preceding the *Transport Factors*, *Access to a Private Vehicle* is only a significant factor for *Road Safety*. The implication is that, for transport networks with comparatively low uncertainty or risk, *Access to a Private Vehicle* still needs to be considered when investigating decisions and perceptions around *Road Safety*. However, the other three *Transport Factors* appear to be less impactful in terms of how individuals perceive transport-related topics.

The next section explores the control data from the perspective of *COVID-19*.

6.3 COVID-19: Ride-Share Service Questions and Transport Factors

In Chapters 2 and 4, *COVID-19* was identified as a potential factor that could influence the perceptions and decisions of individuals. Therefore, in this section, the role of the scenarios of 'before Covid.19', 'during COVID-19' and 'after COVID-19' are explored in terms of the *Ride-Share Service Questions* and the *Transport Factors*.

6.3.1 COVID-19 and Ride-Share Service Questions: Responses and Statistical Analyses

Figure 61 shows the responses *before* (n=413), *during* (m=451), and *after COVID-19* (o=534) for the *Ride-Share Service Questions* in Cape Town. The highest willingness to use ride-share services was captured in 'at night' 'before COVID-19', while the lowest willingness was captured in 'alone at night' 'after COVID-19'.

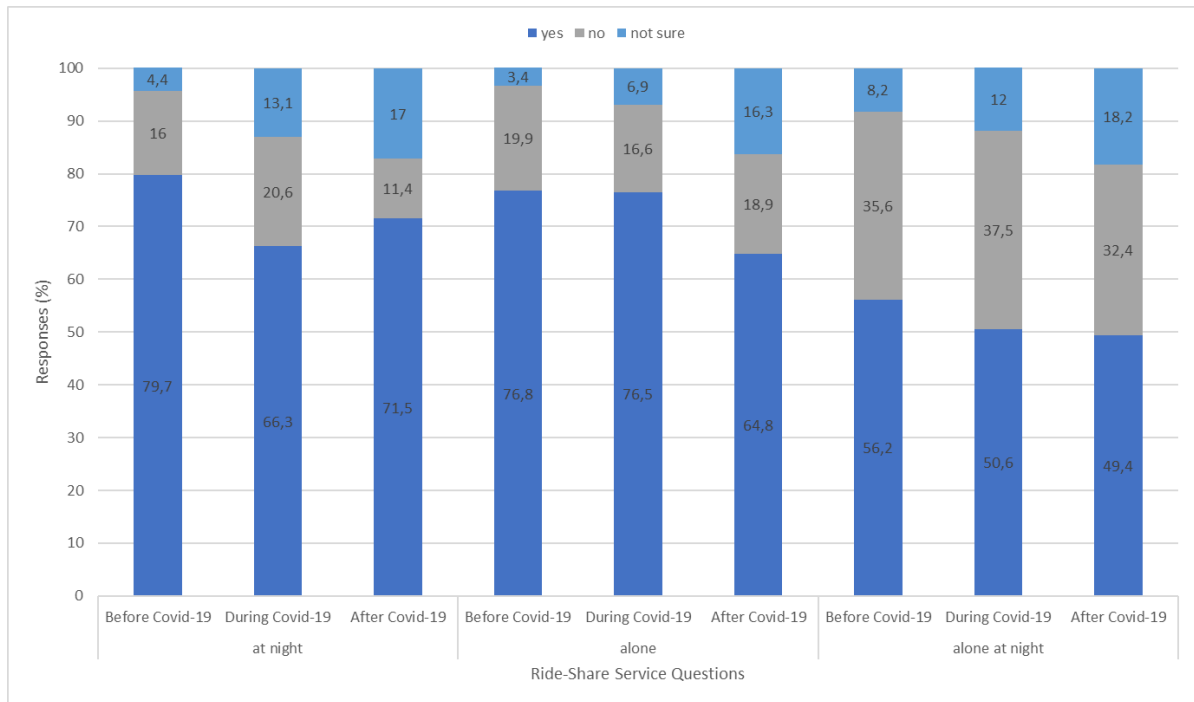


Figure 61: COVID-19 and Ride-Share Service Questions in Percentages (Before, n=413; During, m= 451; After, o=534)

The amplitudes are calculated for the *Belief States* of 'before COVID-19', 'during COVID-19' and 'after COVID-19' for the *Ride-Share Service Questions*, with the results summarised in Table 20. The *Belief State* is defined as $|\Psi\rangle_{\text{COVID-19 Scenario}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$.

Table 20: Amplitudes of 'Before COVID-19', 'During COVID-19' and 'After COVID-19' Belief States of Ride-Share Service Questions

Ride-Share Service Question	COVID-19 Scenarios	a	b	c
At night	'Before COVID-19'	0.89	0.40	0.21
	'During COVID-19'	0.81	0.45	0.36
	'After COVID-19'	0.85	0.34	0.41
Alone	'Before COVID-19'	0.88	0.45	0.18
	'During COVID-19'	0.87	0.41	0.26
	'After COVID-19'	0.80	0.43	0.40
Alone at night	'Before COVID-19'	0.75	0.60	0.29
	'During COVID-19'	0.71	0.61	0.35
	'After COVID-19'	0.70	0.57	0.43

In the previous *Belief States* shown in Figure 54 and Figure 58, the perspective 'Yes'-'No' generally showed the *Belief States* being more distinct from each other, however, this does not hold for the *COVID-19* scenarios. Figure 62 shows that, for all *Ride-Share Service Questions*,

the *Belief States* are grouped closely together from the perspective of ‘Yes’-‘No’. The *COVID-19* scenarios seemed to have less of an influence on individuals certain of their responses.

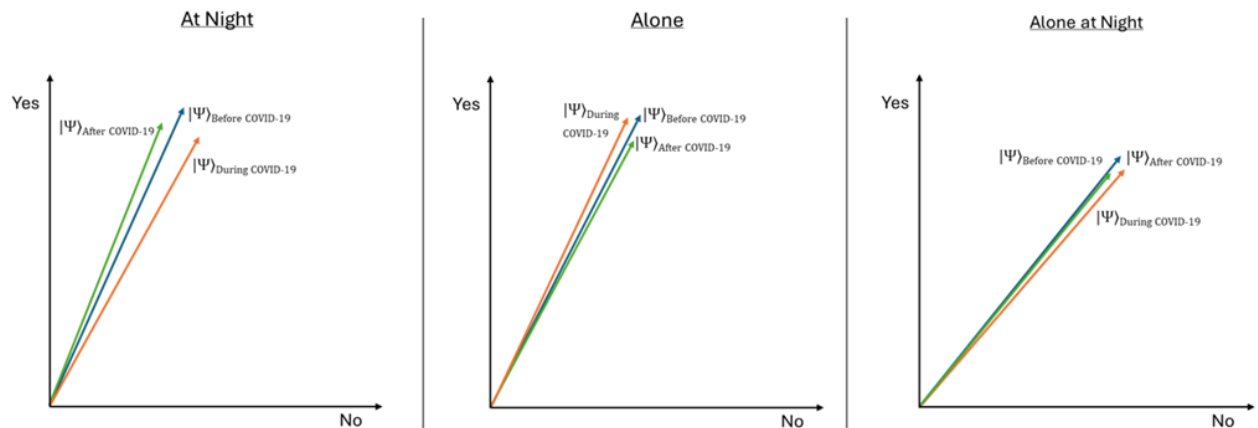


Figure 62: ‘At Night’, ‘Alone’ and ‘Alone at Night’ Belief States of COVID-19 Scenarios for ‘Yes’ - ‘No’

However, from the perspective ‘Yes’-‘Not sure’, shown in Figure 63, the *Belief States* are less clustered, with ‘before COVID-19’ least unsure and ‘after COVID-19’ most unsure.

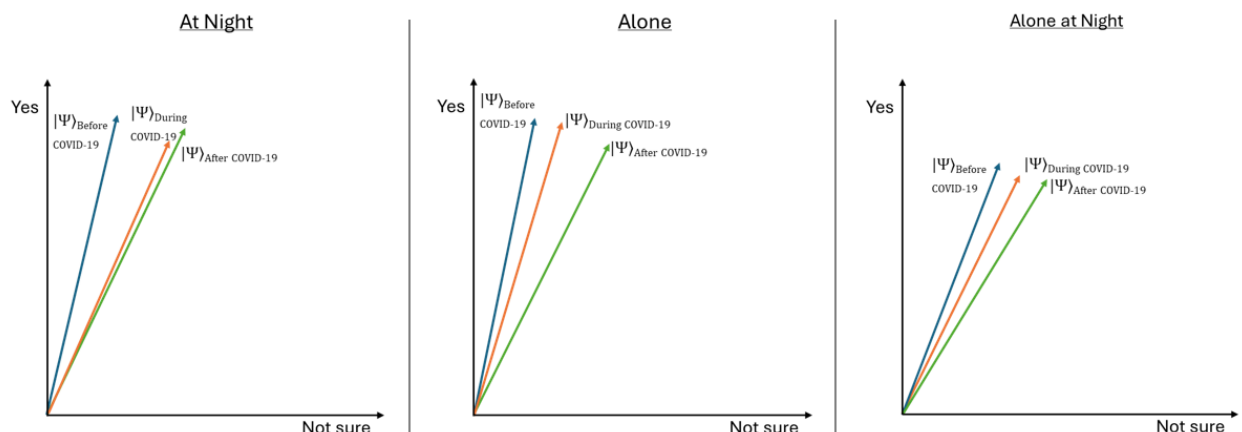


Figure 63: ‘At Night’, ‘Alone’ and ‘Alone at Night’ Belief States of COVID-19 Scenarios for ‘Yes’ - ‘Not sure’

Table 21 summarises the results of the statistical analysis for *COVID-19* for the *Ride-Share Service Questions*. These findings are taken from the Pearson Chi-Square Tests for each *Ride-Share Service Question*. There is a significant relationship between *COVID-19* and the responses to the *Ride-Share Service Questions* for travelling ‘at night’, $\chi^2(4) = 50.356$, $p < 0.001$. A significant relationship is also seen for travelling ‘alone’ $\chi^2(4) = 53.428$, $p < 0.001$. There is also a significant relationship between *COVID-19* and the responses to the *Ride-Share Service Questions* for travelling ‘alone at night’ $\chi^2(4) = 22.260$, $p < 0.001$. All three *Ride-Share Service*

Questions result in significant differences ($p < 0.001$ for ‘at night’, ‘alone’, alone at night’). Therefore, the Null Hypothesis for H1.3 (namely $H_{01.3}$) is rejected.

Table 21: Summary of Statistical Analysis of COVID-19 in Ride-Share Service Responses (Controls, $n=1398$)

Personal Factor	Ride-Share Service Question	Pearson Chi-Square	Degree of Freedom	p-Value
COVID-19	‘at night’	50.356	4	<0.001
	‘alone’	53.428	4	<0.001
	‘alone at night’	22.260	4	<0.001

Odds ratios are calculated to quantify how much more likely individuals ‘before COVID-19’ say ‘yes’ to a *Ride-Share Service Question* rather than ‘during COVID-19’ (‘at night’ with 1.99; ‘alone’ with 1.01, ‘alone at night’ with 1.25) or ‘after COVID-19’ (‘at night’ with 2.51; ‘alone’ with 1.79, ‘alone at night’ with 1.31). Table 22 summarises these odds ratios.

Table 22 shows that the largest odds ratios for *COVID-19* occurred ‘at night’, with the odds ratio for **before-during COVID-19** of 1.99 and **before-after COVID-19** of 2.51. It was expected that ‘after COVID-19’ the willingness to use ride-share services would return roughly to the same as ‘before COVID-19’. This is not the case, with the odds ratio **before-after COVID-19** being the highest of the two comparisons³² for all three *Ride-Share Service Questions*. This indicates that individuals perceive ‘after COVID-19’ to be a different state of belief than ‘before COVID-19’; not a ‘return to normal’.

Table 22: Summary of Odds Ratios for COVID-19 in Controls

<i>Ride-Share Service Questions</i>	Interaction	Description	Odds Ratios
‘at night’	COVID-19 conditions x ‘at night’	Before – During COVID-19	1.99
		Before – After COVID-19	2.51
‘alone’	COVID-19 conditions x ‘alone’	Before – During COVID-19	1.01
		Before – After COVID-19	1.79
‘alone at night’	COVID-19 conditions x ‘alone at night’	Before – During COVID-19	1.25
		Before – After COVID-19	1.31

An interesting overall odds ratio is **before-during COVID-19** for ‘alone’, which is close to 1.00. This indicates hardly any difference between ‘before COVID-19’ and ‘during COVID-19’ for ‘alone’. It also shows no statistically significant difference between the ‘yes’ responses of

³² Before-during Covid-19 and before-after Covid-19 comparisons

‘before COVID-19’ and ‘during COVID-19’. However, when *Gender* and *Access to a Private Vehicle* are considered, the odds ratios for ‘alone’ show differences for some individuals in terms of **before-during COVID-19**. Table 23 shows the more detailed odds ratios for ‘alone’ **before-during COVID-19**.

Table 23: Control Odds Ratios for 'alone' for Gender and Access to a Private Vehicle

Ride-Share Service Question	Access to a Private Vehicle	Gender	Odds Ratio of Yes: Before-During COVID-19
‘alone’	Yes	Female	1.03
		Male	1.25
	No	Female	1.04
		Male	2.03

Table 23 shows that the difference between ‘before COVID-19’ and ‘during COVID-19’ did not affect individuals equally. Females with and without access to a private vehicle indicate hardly any differences, with odds ratios of 1.03 and 1.04, respectively. This could mean that ‘during COVID-19’ did not present females with any additional uncertainty or perceived risk for trips ‘alone’.

However, males with and without access to a private vehicle generate odds ratios greater than 1.00. Males without access to a private vehicle have the largest odds ratio of 2.03. Males without access to a private vehicle are much less likely to use ride-share services ‘alone’ ‘during COVID-19’ than ‘before COVID-19’. This odds ratio is expected to be comparatively large, as **COVID-19 introduced uncertainty or perceived risk in the ride-share service of ‘alone’, perhaps for the first time, in males without access to a private vehicle.** Before COVID-19, taking a ride-share trip ‘alone’ was considered as particularly low in any uncertainty or perceived risk for males without access to a private vehicle.

The results of females without access to a private vehicle suggest that they are not particularly discouraged ‘during COVID-19’ compared to ‘before COVID-19’. **However, males without access to a private vehicle are noticeably discouraged.** Most interestingly, ‘after COVID-19’ results in higher odds ratios, suggesting that individuals perceived the aftermath of COVID-19 with notably higher levels of uncertainty or perceived risk. The uncertainty is likely not only related to the health risk of *COVID-19*. Instead, individuals are more uncertain, due to the

economic and social consequences that the COVID-19 pandemic is likely to have on them (Behrens and Newlands, 2022; Bozkurt et al., 2020; Naidoo and Cartwright, 2020).

These findings pertain only to ride-share trips that involve the three types of uncertainty of ‘at night’, ‘alone’ and ‘alone at night’. It does not mention general ride-share service decisions or the overall frequency of ride-share service trips. Venter (2020) pointed out that transport modes in South Africa were differently affected when compared to transport modes in other countries. Venter (2020) used the MBTs as one such example. MBTs operated at full capacity during the pandemic, with little enforcement of restrictions. Venter (2020) expected a slow return to the formal transport modes post-COVID-19, while MBTs had already recovered to pre-COVID-19 levels. **The surprisingly high odds ratios for ‘after COVID-19’, in Table 22, indicate that, at least for uncertain or risky ride-share trips, individuals have a different *Belief State* and, consequently, are likely to be slow to return to the pre-COVID-19 engagement of ride-share services.**

While the health risk and economic impact of the pandemic were highest ‘during COVID-19’, the effects of the pandemic on how individuals experience uncertainty and risk for the *Ride-Share Service Questions* are most influential for ‘after COVID-19’. **The data suggests that individuals experience a different *Belief State* when considering ride-share service decisions involving uncertainty and perceived risk for ‘after COVID-19’ compared to ‘before COVID-19’.** This will be explored further in Chapter 7, where the potential incompatibility effects from the pre-questions of *Transport Factors* and *Good Mood Questions* on the *Ride-Share Service Questions* are examined.

In the next section, the significance of *COVID-19* in the *Transport Factors* is explored in the control data.

6.3.2 *COVID-19* and *Transport Factors*: Responses and Statistical Analysis

This section illustrates how individuals ‘before’ (n=164), ‘during’ (m=166), and ‘after COVID-19’ (o=156) perceive the different *Transport Factors* in Cape Town. **Error! Reference source not found.** shows Sustainable Transport and Reliability per COVID-19 in the control group. **Error! Reference source not found.** shows that Reliability has a slight decrease in the perception of being ‘very important’ and ‘important’ ‘during COVID-19’. This makes sense, as public life was reduced, and most appointments were cancelled, rescheduled, or held online.

However, over 80% of all individuals in all three COVID-19 ('before', 'during', 'after') perceive Reliability as either 'very important' or 'important'.

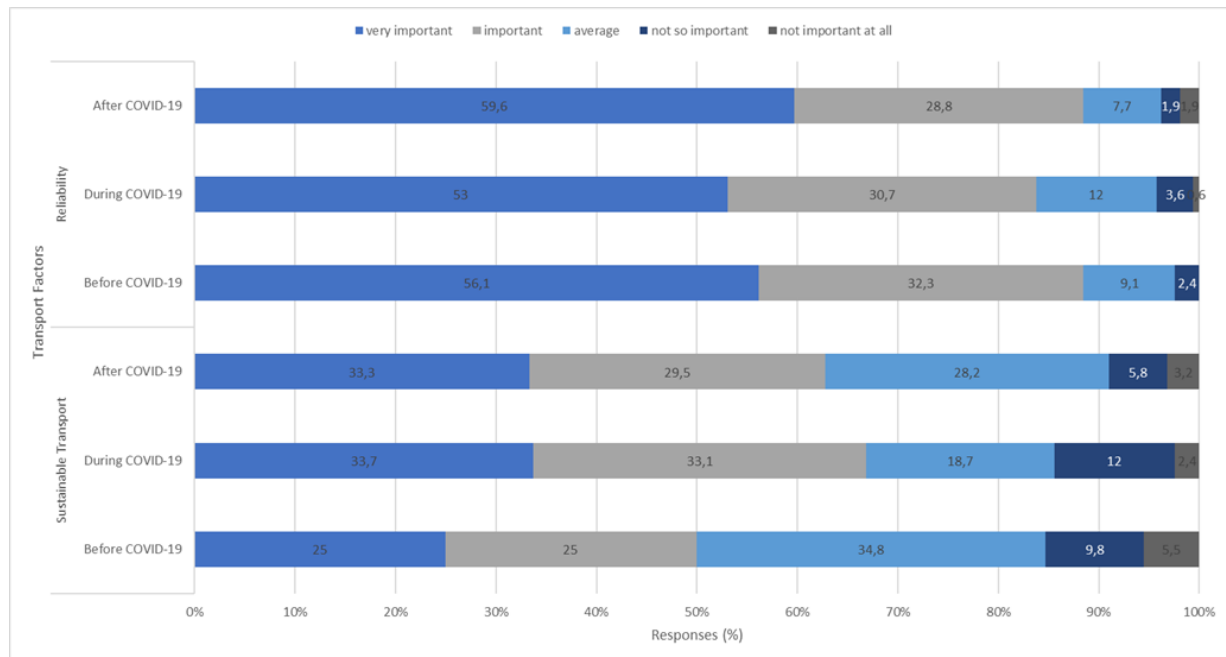


Figure 64: COVID-19 - Sustainable Transport and Reliability (Before, n=164; During, m=166; After, o=156)

The effect of *COVID-19* on the perception of *Sustainable Transport* is most interesting. An apparent increase is seen in 'during COVID-19' ('very important', 33.7%; 'important', 33.1%) and 'after COVID-19' ('very important', 33.3%; 'important', 29.5%) in 'very important' and 'important', compared to 'before COVID-19' ('very important', 25%; 'important', 25%). This shows that the awareness around sustainability from the strict COVID-19 lockdowns changed how important individuals perceived *Sustainable Transport*, and that this awareness held for 'after COVID-19'. However, as discussed in Section 2.1.3, while some opportunities from the COVID-19 pandemic to create a more sustainable transport system have been captured in other countries, this opportunity seems to have been missed for the transport system in the Western Cape. This is despite the positive change in attitudes towards sustainable transport.

Figure 65 illustrates the perceptions of *Crime* and *Road Safety* per *COVID-19*. Figure 65 shows the perceptions of *Crime* and *Road Safety* in Cape Town. Despite crime dropping significantly during the hard lockdowns, the statistics were only published well after the hard lockdowns, as previously mentioned. At the time of the data collection, the individuals were (probably) not aware of the crime drop during the hard lockdowns, and therefore, the perception of *Crime* was found to be similar in 'before', 'during' and 'after' COVID-19.

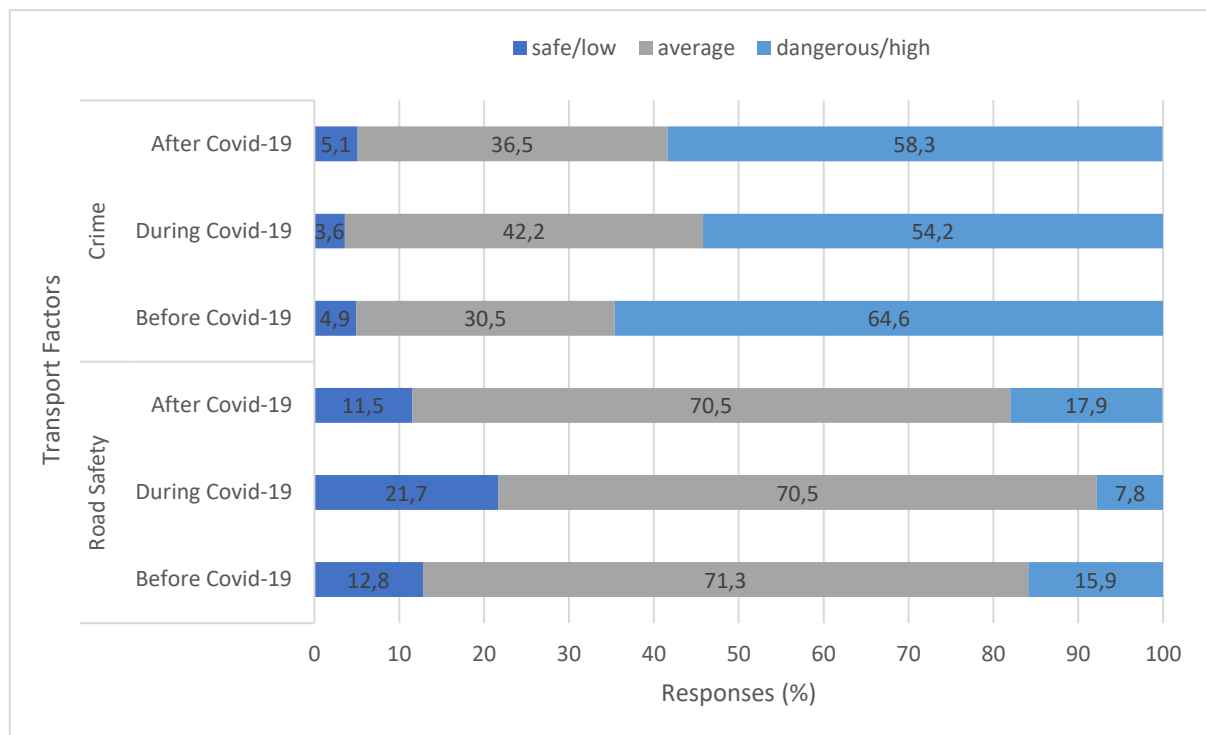


Figure 65: COVID-19 - Crime and Road Safety (Before, n=164; During, m=166; After, o=156)

The restrictive lockdowns in South Africa visibly affected the traffic volumes. This is reflected in the perceptions of *Road Safety* 'during COVID-19' (n=166). A larger proportion of respondents perceived Cape Town roads as 'safe' (21.7%), and a smaller proportion as 'dangerous' (7.8%), 'during COVID-19'. However, this effect was temporary, as the perception of *Road Safety* returned to 'before COVID-19' levels (12.8% 'safe'; 71.3% 'average'; 15.9% 'dangerous') to 'after COVID-19' (11.5% 'safe'; 70.5% 'average'; 17.9% 'dangerous'). It is possible that this is seen in the responses because the respondents assumed that typical traffic volumes would reassume after the hard lockdowns were over.

Table 24 summarises the statistical findings for *COVID-19* in the *Transport Factors*. Table 24 shows that some of the *Transport Factors* demonstrate significant relationships with *COVID-19*. There is a significant relationship between *COVID-19* and *Sustainable Transport*, $\chi^2 (8) = 18.165$, $p=0.020$. Furthermore, there is a significant relationship between *COVID-19* and *Road Safety*, $\chi^2 (4) = 13.224$, $p=0.010$. For *Reliability*, the relationship with *COVID-19* is non-significant, $\chi^2 (4) = 2.775$, $p=0.596$. Similarly, the relationship between *COVID-19* and *Crime* is non-significant, $\chi^2 (4) = 5.102$, $p=0.277$.

Table 24: Summary of Chi Tests for COVID-19 and Transport Factors

Transport Factor	Pearson Chi-Square	df	p-Value
Sustainable Transport	18.165	8	0.020
Reliability ³³	2.775	4	0.596
Road Safety	13.224	4	0.010
Crime	5.102	4	0.277

COVID-19 was significant in the *Transport Factors* of *Sustainable Transport* and *Road Safety*. These are likely related to the more visible side-effects of the COVID-19 pandemic, such as reduced traffic volumes (Beck and Hensher, 2020; Jenelius and Cebecauer, 2020; Venter et al., 2020; Zhang et al., 2021) or the environmental benefits from reduced human activities (Loh et al., 2021; Ryan et al., 2020; Sharifi and Khavarian-Garmsir, 2020).

Less visible effects, such as the decrease in crime during the COVID-19 lockdowns, which had the potential to have influenced the responses to *Crime* (as the fourth *Transport Factor*) and were only published after the pandemic and well after the data was collected, did not generate a significant difference. Thus, while the crime levels in Cape Town improved during COVID-19, individuals were unaware of this and possibly did not suspect it. This is possibly what is captured in the non-significant result of *Crime* in Table 24.

COVID-19 also showed to have no significant impact on perceptions of *Reliability*. This indicates that there was no change in how individuals perceived the importance of *Reliability* as in-presence activities translated to online activities, which also required individuals to 'being on time'. Within the student context, lectures on campus were shifted to online meetings, which also required students to be punctual.

6.4 Résumé

In this chapter, the responses to the *Ride-Share Service Questions* and the *Transport Factors* in the control data were illustrated and discussed per *Personal Factors* of *Gender*, *Access to a Private Vehicle*, and *COVID-19*. The focus of this chapter was to answer *H1* from Chapter 2, through the analyses of data from the Controls. By exploring the responses for each *Personal Factor*, insights into how uncertainty and perceived risks differ for the different *Ride-Share*

³³ As the data had 25% of cell with expected count of less than 5 for four categories ('not important', 'average', 'important' and 'very important'), the categories were collapsed to three categories ('not important/average', 'important' and 'very important') as suggested by Field (2013).

Service Questions have been seen. *Gender*, in particular, highlighted that the different *Ride-Share Service Questions* had very different results between females and males. By exploring the *Personal Factors* in the *Ride-Share Service Questions*, insights into the underlying uncertainty and perceived risks for different individuals have been shown.

Furthermore, this chapter presented the responses to the *Transport Factors* of Experiment 3 to provide a baseline for the incompatibility discussions for *H4* in Chapter 8. When no uncertainty and perceived risks are involved, *Gender* does not generate any differences in the *Transport Factors*. However, one difference was found between individuals with and without access to a private vehicle for *Road Safety*, while *COVID-19* showed two differences in the *Transport Factors* in *Sustainable Transport* and *Road Safety*.

These significant differences per *Personal Factors* were investigated for the *Ride-Share Service Questions*. **All three *Personal Factors* were determined to be statistically significant, indicating that the Null hypothesis for H1 can be rejected.** Additionally, odds ratios were calculated for the significant interactions to quantify the differences in the categorical data.

Gender was the first *Personal Factor* explored in the *Ride-Share Service Questions*. **In all three *Ride-Share Service Questions*, significant differences were found between females and males. Males were more likely than females to say ‘yes’ to using ride-share services for ‘at night’, ‘alone’ and ‘alone at night’, with the respective odds ratios of 2.41, 2.68, and 5.11.** The willingness of females to use ride-share services involving uncertainty and perceived risks were significantly lower than what was seen in males. Furthermore, the data was explored through the calculation of the amplitudes of the *Belief States* for each *Personal Factor* and consequential illustration. A key advantage of this visualisation is the identification of *Belief States*, using the different perspectives (‘yes’-‘no’ and ‘yes’-‘not sure’). By using this approach, it can be seen, for example, that males have the same *Belief State* for ‘at night’ and ‘alone’ for ‘yes’-‘no’ and ‘yes-not sure’, while for females no *Belief State* overlapped. **This suggests that for males, there is no difference in perceived personal security ‘at night’ and ‘alone’, while females experience distinct different states.** Additionally, females had higher levels of ‘not sure’ responses than males. Therefore, not only is the willingness to use ride-share services for trips, involving uncertainty and perceived risks, different between females and males, but also the perceived uncertainty of making this type of decision is different between females and males.

Access to a Private Vehicle was the second *Personal Factor* explored in the *Ride-Share Service Questions*. In two of the three *Ride-Share Service Questions*, significant differences were found between individuals with and without access to a private vehicle. Individuals without access to a private vehicle are more likely than individuals with access to a private vehicle to say 'yes' to ride-share trips 'at night' and 'alone at night', with the respective odds ratios of 1.11 and 1.30. No significant difference between individuals with and without access to a private vehicle is found for 'alone'. For *Access to a Private Vehicle*, the perspective of 'yes'- 'not sure' showed *Belief States* being the same for individuals with access for 'at night' and 'alone'. This indicates that individuals with access to a private vehicle, experience the same levels of willingness and indecisiveness ('not sure') for these ride-share service decisions. However, for individuals without access to a private vehicle, this does not hold, and the reported indecisiveness ('not sure') is specific to the *Ride-Share Service Question*.

COVID-19 was the third *Personal Factor* to be explored in the *Ride-Share Service Questions*. In all *Ride-Share Service Questions*, significant differences were found between 'before COVID-19', 'during COVID-19' and 'after COVID-19'. Individuals are more likely to say 'yes' to ride-share trips 'at night', 'alone', and 'alone at night' 'before COVID-19' than 'during COVID-19' or 'after COVID-19'. However, the odds ratios for before-after COVID-19 are consistently more considerable than before-during COVID-19. Before-during COVID-19: odds ratios for 'at night', 'alone' and alone at night' are 1.99, 1.01 (overall odds ratio), and 1.25. For before-after COVID-19, the respective odds ratios are 2.51, 1.79, and 1.31.

For *COVID-19*, the perspective of 'yes'- 'no' showed that the *Belief States* were closely clustered for 'alone' and 'alone at night', with some variation seen in 'at night'. However, the more dynamic differences are captured in the 'yes'- 'not sure' perspective for *COVID-19*, with the amplitudes of 'not sure'. 'Before COVID-19' demonstrates the lowest levels of indecisiveness, while 'after COVID-19' captures the largest amplitude for 'not sure' in all three *Ride-Share Service Questions*.

From the numerous significant findings, shown in Table 13, Table 17, Table 21 and the further explorations of *Personal Factors* in the *Ride-Share Service Questions*, the Null-Hypothesis of H1 is rejected. The α -level is 0.05 for Type I errors, while the β was calculated with $n=1398$, post-hoc, using the Goodness of Fit test to be 0.07, which meant the test power was 0.93 and thus larger than 0.8, which is an acceptable level to ensure no Type II errors (Field, 2013). **The**

young individual's willingness to engage in ride-share services is indeed decreased by uncertainty and perceived risks of personal security, when considering different *Personal Factors*.

Statistically significant differences ($p < 0.05$) per *Personal Factor* are also analysed for the *Transport Factors*. This provides the baseline for the discussions in Chapter 8. In the control data, no statistically significant differences are seen in the *Transport Factors* for *Gender*. For *Access to a Private Vehicle*, a statistically significant difference is seen for *Road Safety*, with individuals with access to a private vehicle perceiving road safety as more dangerous and less safe. Lastly, for *COVID-19*, statistically significant differences are found in *Sustainable Transport* and *Road Safety*. An increase in the perceived importance of *Sustainable Transport* is seen during (highest value) and after COVID-19. *Road Safety* is perceived as statistically safer and less dangerous during COVID-19. However, this is a temporary effect, as the perception of *Road Safety* 'after COVID-19' returned to 'before COVID-19' proportions.

The next chapter, Chapter 7, describes and explores the effects of asking *Transport Factors* and *Good Mood Questions* before the *Ride-Share Service Questions*. Evidence of incompatibility in the *Ride-Share Service Questions* is identified and discussed.

7. The Effect of *Transport Factors* and *Good Mood Questions* on *Ride-Share Service Questions* to Capture Incompatibility Effects

Chapter 7 builds on the information and discussions presented in Chapter 6, which focused on the data with no pre-questions. As this chapter focuses on the incompatibility effect, the results from the *Ride-Share Service Questions* from Experiment 2 (i.e. *Transport Factors* as pre-questions) and Experiment 4 (i.e. *Good Mood Questions* as pre-questions) are compared and explored to the responses without pre-questions (namely Experiments 1 and 3). **The *Ride-Share Service Questions* from Experiments 1 and 3 are called the ‘Controls’ in this chapter for brevity’s sake.**

This chapter describes and discusses two sets of the *Ride-Share Service Questions* that had pre-questions. The pre-questions are the *Transport Factors* in Experiment 2 and the *Good Mood Questions* in Experiment 4. **The effects of asking transport-related perceptions, namely the *Transport Factors* on the *Ride-Share Service Questions*, are first explored.** These results and discussion provide the material for answering hypothesis *H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks.*

The focus is on identifying the ‘black swans’³⁴. As the responses were heavily skewed towards females, the consequential analysis was split by gender. Therefore, the Null-Hypothesis for *H2* is that, for both females and males, no significant increase in willingness (or decrease in indecisiveness, namely ‘not sure’) can be found between the responses of the *Ride-Share Service Questions* of the Controls³⁵ and Experiment 2 for *Access to a Private Vehicle* and *COVID-19*. The Alternative-Hypothesis for *H2* is that significant increases in willingness (or decrease with indecisiveness, namely ‘not sure’) can be found between the responses of the *Ride-Share Service Questions* of Controls and Experiment 2 for *Access to a Private Vehicle* and *COVID-19*.

Next, the effects of the *Good Mood Questions* (as compatible factors) on the *Ride-Share Service Questions* are presented in Section 7.2. These results and discussion provide the material for answering *H3: Positive emotional framing*³⁶ *in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty*

³⁴ Reference to the discussion in Chapter 3, Section 3.1.

³⁵ See Chapter 6

³⁶ Namely the *Good Mood Questions*.

and perceived risks. The hypothesis, *H3*, is in essence investigating how positive framing of compatible questions may influence responses to *Ride-Share Service Questions*. The emotional states of individuals are not typically included in such investigations. Therefore, Experiment 4 provides novel insights into including some aspects of ride-share service decisions, and the results thereof. The Null-Hypothesis for *H3* is that, for both females and males, no significant changes in willingness (or with indecisiveness) can be found between the responses of the *Ride-Share Service Questions* of the Controls and *Good Mood Questions* (Experiment 4) for *Access to a Private Vehicle* and *COVID-19*. The Alternative-Hypothesis for *H3* is that significant changes in willingness (or with indecisiveness) can be found between the responses to the *Ride-Share Service Questions* of Controls and *Good Mood Questions* (Experiment 4) for *Access to a Private Vehicle* and *COVID-19*.

Throughout this chapter, the data is descriptively displayed using percentages per response for the *Ride-Share Service Questions*, and then discussed in terms of the statistical significance, either using the loglinear models (female data) or Pearson Chi-Square tests (male data). If any evidence of incompatibility can be seen from the changes in the statistical significance of the *Personal Factors* in specific *Ride-Share Service Questions*, these are explored through the mathematical and illustrative *Belief States*. The illustrations using the *Belief States* provide novel applications in ride-share service decisions and provide insights into how individuals create different *Belief States* for the *Ride-Share Service Questions*.

In the next section, the responses to the *Ride-Share Service Questions*, after the pre-questions of the *Transport Factors*, are illustrated.

7.1 *Ride-Share Service Questions after Transport Factors: Responses, Statistical Analysis and Belief States of Incompatibility*

As per the previous chapters, results are presented according to the *Personal Factors* (*Gender*, *Access to a Private Vehicle*, *COVID-19*). The first *Personal Factor* discussed is *Gender*.

7.1.1 *Gender in Ride-Share Service Questions after Transport Factors*

Figure 66 shows the responses to the *Ride-Share Service Questions* after participants are first asked the set of *Transport Factors*³⁷. Females (n=345) are less likely than males (m=141) to say 'yes' in all *Ride-Share Service Questions*. Males said, 'yes' to 'at night', 'alone' and 'alone at

³⁷ Experiment 2

night’ with 86.5%, 81.6% and 78.7%, respectively. Female responses are consistently less likely to say, ‘yes’ to ‘at night’, ‘alone’, and ‘alone at night’, with 67.5%, 65.8% and 40.0%, respectively. Females ‘not sure’ of their decisions had an average of 11.5% in the *Ride-Share Service Questions*, while males had an average of 8.03% for ‘not sure’.

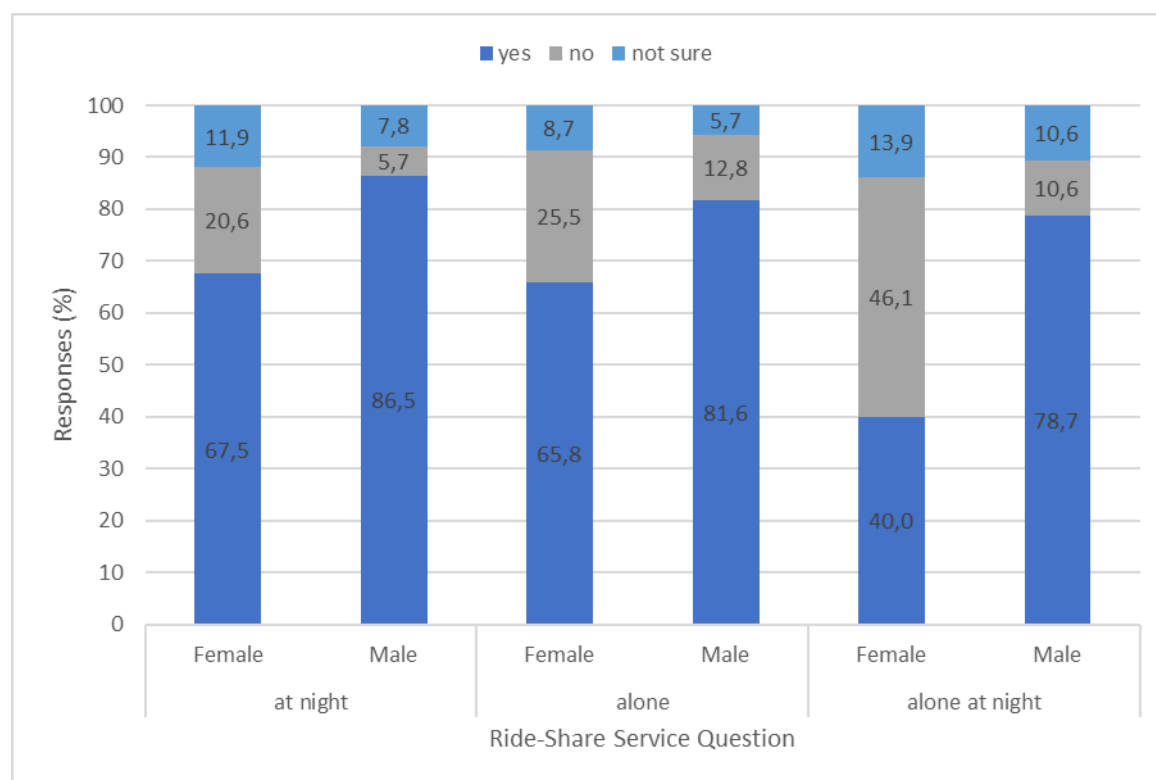


Figure 66: Gender – Ride-Share Service Questions after Transport Factors in Percentages (female, n=345; male, m=141)

For a more detailed investigation, it is necessary to discuss each gender separately, since a loglinear model of males and females combined was impossible, due to insufficient cell counts for some of the males in the loglinear model (i.e. cell counts <5) in the *Ride-Share Service Questions* after *Transport Factors* (males with access, n =59; males without access, m=82). The sample size for females in the *Ride-Share Service Questions* after *Transport Factors* is large enough so that a loglinear model is still possible (females with access, n=172; females without access, m=235).

However, it is still possible to present and test the responses of males in terms of *Access to a Private Vehicle* and *COVID-19* using Pearson Chi-Square tests for each *Ride-Share Service Question* after *Transport Factors*, when the responses were collapsed from three categories (‘yes’, ‘no’, ‘not sure’) to two categories (‘yes’, ‘no or not sure’). While this meant additional analyses, the significance of these two *Personal Factors* in the *Ride-Share Service Questions* after the *Transport Factors* could be established. Unfortunately, this does mean that a direct

comparison between genders, of the significant interactions of the loglinear models of the Controls, is impossible.

The following sections report the statistically significant differences for the *Ride-Share Service Questions*, beginning with a focus on females.

7.1.1.1 Females in Ride-Share Service Questions after Transport Factors

Table 25 shows the significant interactions for this loglinear model of Experiment 2. An overview of all possible interactions is provided for completeness in Appendix C.1.1 for 'at night', Appendix C.1.2 for 'alone' and Appendix C.1.3 for 'alone at night'. Table 25 additionally highlights the interactions in *Ride-Share Service Questions* after *Transport Factors*, *COVID-19*, and *Access to a Private Vehicle*. Differences in the responses, when considering *COVID-19* as a factor, are significant in the *Ride-Share Service Questions* for 'at night', $\chi^2(4) = 17.550$, $p = 0.002$, and 'alone', $\chi^2(4) = 19.566$, $p < 0.001$, respectively. Additionally, *Access to a Private Vehicle* is significant for 'alone at night', $\chi^2(2) = 25.431$, $p < 0.001$.

The interaction **Access to a Private Vehicle x COVID-19** is significant in all three *Ride-Share Service Questions*. For females 'at night' a significant interaction between *Access to a Private Vehicle* and *COVID-19* was found, $\chi^2(2) = 14.973$, $p < 0.001$. Similar significant results were also seen for 'alone', $\chi^2(2) = 14.135$, $p < 0.001$ and 'alone at night' $\chi^2(2) = 13.920$, $p < 0.001$. However, the **Access to a Private Vehicle x COVID-19** interaction indicates an unusually high proportion of individuals without access to a private vehicle participating in the 'after COVID-19' survey. The question of whether the individual had *access to a private vehicle* was asked, and then the *COVID-19 conditions* were randomly assigned through a selection of dummy variables in the first survey. In the second survey, all participants were assigned to 'after COVID-19'. Therefore, there is no meaning to this interaction, other than that it *may indicate that individuals without access to a private vehicle are significantly more motivated to participate in the second survey*³⁸. Therefore, this interaction is not discussed further, as this interaction is not an active part of the experiment.

³⁸ As both surveys offered a chance to be randomly selected for a R500 voucher, this may once again point to the economic differences between individuals with access to a private vehicle not being so easily motivated by such an incentive, while individuals without access to a private vehicle will still take the time on a second survey for another chance at being selected for the voucher.

Table 25: Significant Interactions for Females for Ride-Share Service Questions after Transport Factors (n=345)

Ride-Share Service Question	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
'at night'	Vehicle Access*COVID-19	2	14.973	<0.001	2
	COVID-19*Night	4	17.550	0.002	2
'alone'	Vehicle Access*COVID-19	2	14.135	<0.001	2
	COVID-19*Alone	4	19.566	<0.001	2
'alone at night'	Vehicle Access*COVID-19	2	13.920	<0.001	2
	Vehicle Access*Alone at Night	2	25.431	<0.001	2

In the next section, these findings for females are compared to the Controls to quantify the effect of the pre-questions of the *Transport Factors*.

Female Incompatibility in Ride-Share Service Questions after Transport Factors

The significant interactions in the loglinear models of the female data in the Controls (shown in Appendix B.1) are compared with Experiment 2 (*Transport Factors* as pre-questions) results, shown in Table 25, to determine if asking *Transport Factors* before the *Ride-Share Service Questions* impacted the responses. Table 26 shows the results for *Access to a Private Vehicle*, and Table 27 shows the results for *COVID-19*. Table 26 shows that *Access to a Private Vehicle* had one difference in the *Ride-Share Service Questions* when comparing the loglinear models. In the female Controls, **Access to a Private Vehicle x 'at night'** is a significant interaction. **However, this interaction is non-significant if *Transport Factors* are asked before the *Ride-Share Service Questions*.** Both the female Controls and female Experiment 2 data show significant interactions of *Access to a Private Vehicle* and the *Ride-Share Service Questions* of 'alone at night', and no difference in the non-significant interactions of *Access to a Private Vehicle* and 'alone'.

Table 26: Changes in Interactions for Females and Access to a Private Vehicle

Significant Interactions	Ride-Share Service Question	Female Controls (n=886)	Female Experiment 2 (m=345)
		Is interaction significant in Controls?	Is interaction significant in Ride-Share Service Questions after <i>Transport Factors</i> (Experiment 2)?
Access to a Private Vehicle x 'Ride-Share Service Questions'	'at night'	Yes	No
	'alone'	No	No
	'alone at night'	Yes	Yes

Table 27 shows one difference in significance in the interaction when comparing the Controls and Experiment 2 for the **COVID-19 x ‘alone at night’**. While females in the Controls have a significant interaction for COVID-19 x ‘alone at night’, females who were first asked the *Transport Factors* and then the *Ride-Share Service Questions* did not generate a significant interaction.

Table 27: Changes in Interactions of Females in COVID-19

Significant Interactions	<i>Ride-Share Service Question</i>	Female Controls	Female Experiment 2
		Is interaction significant in Controls?	Is interaction significant in Experiment 2?
COVID-19 x ‘Ride-Share Service Questions’	‘at night’	Yes	Yes
	‘alone’	Yes	Yes
	‘alone at night’	Yes	No

The following section discusses these changes and their implications for incompatibility within the female *Ride-Share Service Questions*.

Discussion of Incompatibility in Females in *Ride-Share Service Questions*

Evidence of incompatibility in the *Ride-Share Service Questions* for females is seen in differences in the significance of interactions between *Access to a Private Vehicle* and COVID-19. *Access to a Private Vehicle* was significant for ‘at night’ in the females of the Controls. However, in the results of the females, when *Transport Factors* are asked before ‘at night’, *Access to a Private Vehicle* no longer results in significant differences in the responses. In other words, **females, with and without access to a private vehicle, do not make statistically different decisions from each other when considering ‘at night’ after they have considered their perceptions of *Transport Factors*.**

Figure 67 uses the data from the loglinear model for the Controls and Experiment 2 (*Ride-Share Service Questions* asked after *Transport Factors*) to show the similarity of the responses between females with and without access in Experiment 2, compared to the female Controls. However, the actual proportion differences are still relatively small, with all responses of ‘yes’, ranging between 64% to 69% in the Controls and Experiment 2. Females responded significantly differently in the Controls (Chapter 6) (females with access: 64.3% ‘yes’, 23.0% ‘no’, 12.8% ‘not sure’; versus females without access: 67.8% ‘yes’, 17.0% ‘no’, 15.2% ‘not sure’), while in Experiment 2 the statistical differences were non-significant for females per

Access to a Private Vehicle (females with access: 68.6% ‘yes’, 19.6% ‘no’, 11.8% ‘not sure’ versus females without access; 66.6% ‘yes’, 21.5% ‘no’, 12.0% ‘not sure’).

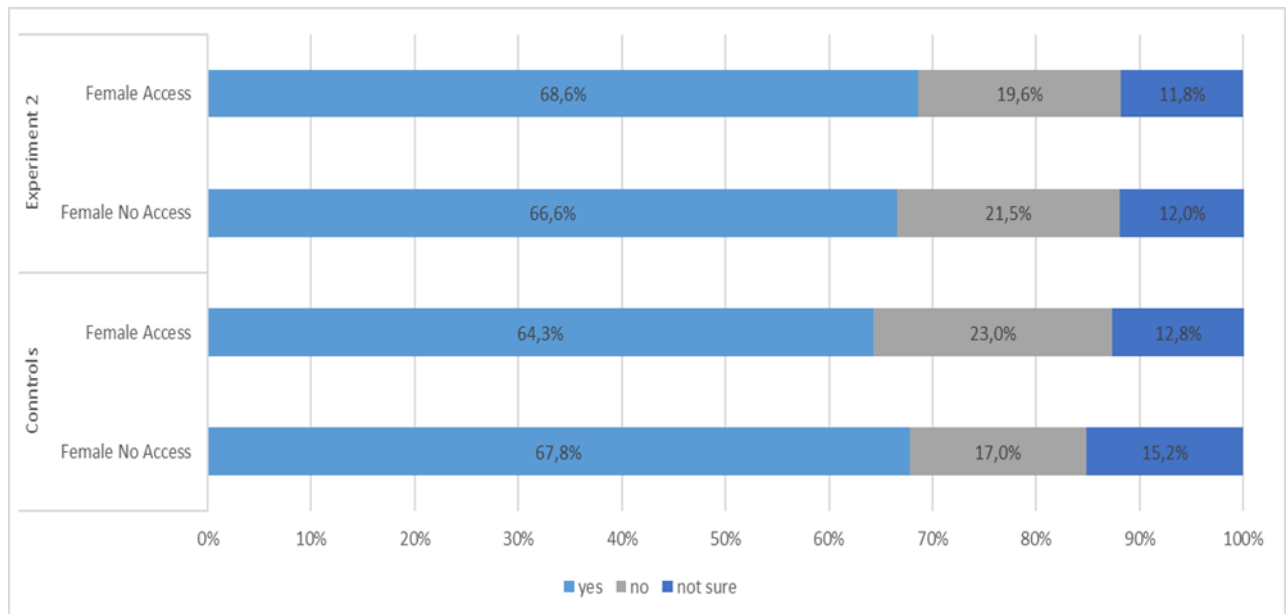


Figure 67: Percentage for ‘at night’ in Controls and Experiment 2 for Females per Access to a Private Vehicle (Controls No Access, $n=494$; Controls Access, $m=392$; Experiment 2 No Access, $o=181$; Experiment 2 Access, $p=164$)

Using the data from Figure 67, *Belief States* can be generated to explore how females with and without access to a private vehicle responded in the Controls (Chapter 6) and Experiment 2 (after *Transport Factors*). First, the *Belief States* of females with no access ‘at night’ are illustrated for the Controls and Experiment 2 (after *Transport Factors*) in Figure 68 on the top row. The *Belief State* generated for ‘at night’, after first considering the *Transport Factors*, shows that females without access to a private vehicle are more likely to say no, while less uncertain of their decision. This may suggest that females without access to a private vehicle, when they consider incompatible factors to the ride-share service decision of ‘at night’, are more readily committed to a definite answer such as ‘yes’ or ‘no’.

Next, the *Belief States* of females with access to a private vehicle are shown for ‘at night’ from the Controls and Experiment 2 on the bottom half of Figure 68. In Experiment 2, females with and without access to a private vehicle have similar *Belief States*, with fewer uncertain responses compared to the *Belief States* of the Controls. However, the *Belief State* for females with access to a private vehicle indicates a higher ‘yes’ amplitude, which differs from the response seen in the *Belief State* of females without access to a private vehicle.

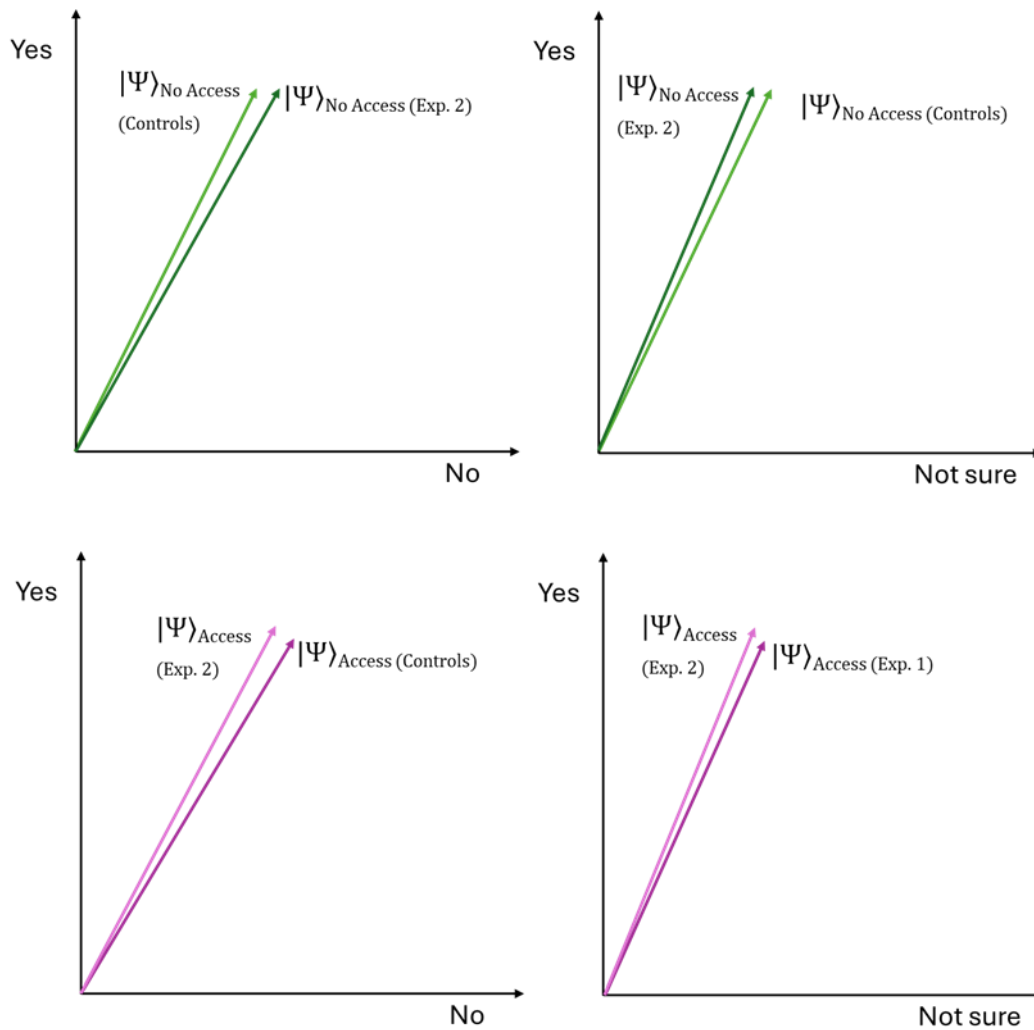


Figure 68: 'At Night' Belief States for Females per Access to a Private Vehicle for 'Yes' - 'No' and 'Yes'-'Not sure'

The incompatible *Transport Factors*, therefore, appear to reduce females' uncertainty about making a ride-share service decision 'at night'. *Access to a Private Vehicle* is no longer a significant factor in Experiment 2 because of the more positive responses by females with access to a private vehicle, indicating that incompatible factors increase the willingness to engage in ride-share services trips 'at night' (*H2*). However, this increased willingness is only seen in specific individuals, namely females with access to a private vehicle, and not females without access to a private vehicle.

Interestingly, in the responses to the *Transport Factors*, *Access to a Private Vehicle* was the only significant factor for *Road Safety* (shown in Chapter 6). This may imply that willingness to engage in ride-share services 'at night' between females with and without access to a private vehicle can be linked to incompatibility caused by the pre-question of *Road Safety*.

A possible explanation for females with access to a private vehicle being more willing to use ride-share services 'at night', after considering *Road Safety* in Cape Town, is that there is an association between ride-share services and a reduction of drunk driving. Females with access to a private vehicle can perceive the opportunity to use ride-share services as more attractive for situations where they may not be able to drive themselves, than compared to the Controls where *Road Safety* is not a pre-question.

The advantage of using ride-share services after consuming alcohol is not likely to be a consideration for females who do not have access to a private vehicle, as they are not drivers. This is a possible explanation for the changes in females in *Ride-Share Service Questions* after *Transport Factors* for 'at night'. However, further investigations would be needed to confirm this hypothesis.

The second change in significant interactions in the female data is seen in '**alone at night**', where **COVID-19 is calculated as a significant factor in the Controls and non-significant in the Ride-Share Service Question 'alone at night' after the Transport Factors**. This is shown in Table 27, shown above.

Figure 69 illustrates the responses to the female Controls and Experiment 2, exploring whether asking the *Transport Factors* before the *Ride-Share Service Questions* impacts the responses to 'alone at night' for COVID-19. For females in the Controls, responses varied from 'before' (41.8% 'yes', 48.8% 'no', 9.4% 'not sure'), 'during' (36.6% 'yes', 50.0% 'no', 13.3% 'not sure') and 'after' (36.1% 'yes', 43.5% 'no', 20.4% 'not sure'). Among females in Experiment 2, the responses also varied from 'before' (36.6% 'yes', 48.9% 'no', 14.5% 'not sure'), 'during' (42.6% 'yes', 44.0% 'no', 13.4% 'not sure') and 'after' (41.1% 'yes', 45.2% 'no', 13.7% 'not sure'). What is interesting to see is that while 'before COVID-19' in the Controls had the most willingness to use ride-share services at 'alone at night', in Experiment 2, 'before COVID-19' had the least positive responses compared to the other two scenarios of 'during' and 'after COVID-19'.

In Chapter 6, COVID-19 differed significantly in *Sustainable Transport* ($p=0.017$) and *Road Safety* ($p=0.009$). As mentioned previously, these are the two *Transport Factors* that had effects that could be visibly affected by the general population during the hard lockdowns that were implemented during the pandemic. What is interesting is that such significance in COVID-19 is not present in Experiment 2, due to the more consistent levels of 'not sure' in 'before' (14.5%), 'during' (13.4%), and 'after' (13.7%). The data suggests that asking *Transport Factors*

before the *Ride-Share Service Question* for ‘alone at night’ resulted in more consistent levels of indecisiveness between the different scenarios of *COVID-19*. This suggests that the decision is created by the individual rather than recorded, as the effect of *COVID-19* scenarios was mitigated by the incompatibility between the *Transport Factors* and the *Ride-Share Service Question* ‘alone at night’.

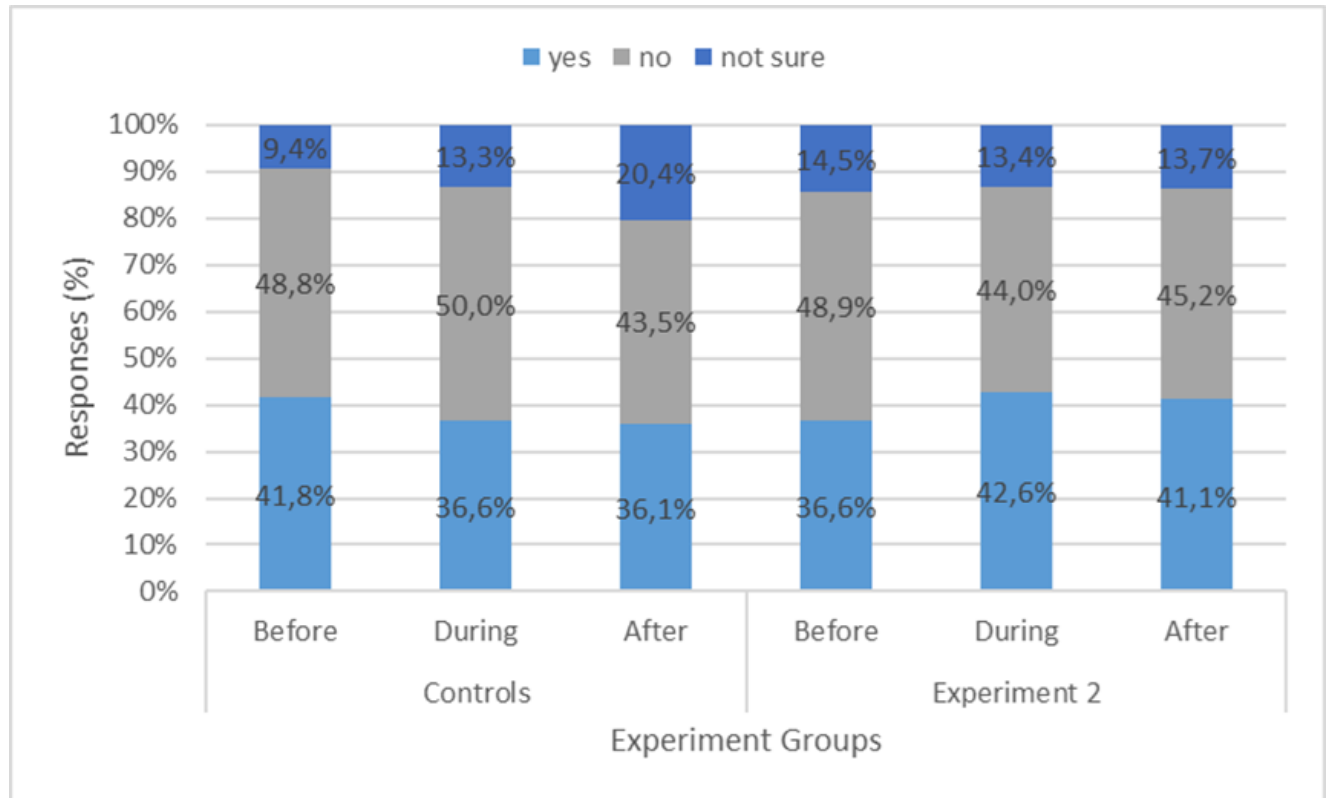


Figure 69: Percentage for ‘alone at night’ in Controls and Experiment 2 for Females per *COVID-19* (Controls: Before, $n=260$; During, $m=284$; After, $o=342$; Experiment 2: Before, $p=124$; During, $q=117$; After, $r=104$)

Using the data from Figure 69, *Belief States* are generated to explore how females in the different *COVID-19* scenarios responded in the Controls (Chapter 6) and Experiment 2 (after *Transport Factors*) for ‘alone at night’. The amplitudes are calculated for the *Belief States* of ‘before *COVID-19*’, ‘during *COVID-19*’ and ‘after *COVID-19*’ for the ‘alone at night’. The female *Belief State* is defined as: $|\Psi\rangle_{\text{COVID-19}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$. The results are summarised in Table 12.

Table 28: Amplitudes of Female Belief States of 'Alone at Night' per COVID-19 in Experiment 2 and Controls

COVID-19	Experiment	a	b	c
Before COVID-19	Experiment 2	0.60	0.70	0.38
	Controls	0.65	0.70	0.31
During COVID-19	Experiment 2	0.65	0.66	0.37
	Controls	0.60	0.71	0.36
After COVID-19	Experiment 2	0.64	0.67	0.37
	Controls	0.60	0.66	0.45

The change of COVID-19 being a significant factor in the Controls and non-significant in Experiment 2 is best captured in the 'yes'-'not sure' perspective, shown in Figure 70, as it shows the larger changes in amplitudes. The 'yes'-'no' perspective only shows some variation for 'during COVID-19' (between Experiment 2 and Controls).

In the Controls, the different COVID-19 scenarios captured *Belief States* of different levels of those who could not give a definite answer, with 'before COVID-19' having the smallest amplitude of 'not sure' (c=0.31) and 'after COVID-19' having the largest 'not sure' amplitude (c=0.45). However, if females first considered the incompatible *Transport Factors*, before answering 'alone at night', the amplitudes of 'not sure' were the same for 'during' and 'after COVID-19' (c=0.37) and very similar to 'before COVID-19' (c=0.38).

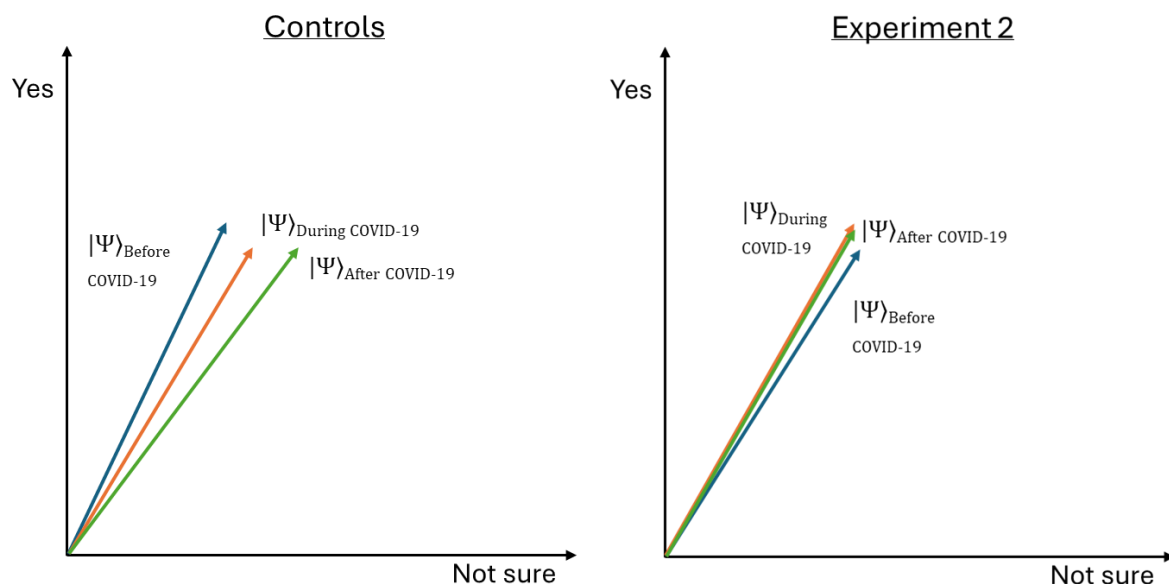


Figure 70: 'Alone at Night' Belief States for Females per COVID-19 for 'Yes'-'Not sure'

The visualisations of the *Belief States* in Figure 70 suggest that asking the *Transport Factors* before the *Ride-Share Service Question* for 'alone at night' for females results in similar levels

of those 'not sure', thus, indicating here that incompatible questions may mitigate the uncertainty of the *COVID-19* factor compared to the Controls.

In the next section, the responses of the males for the *Ride-Share Service Questions* after the *Transport Factors* are presented and discussed.

7.1.1.2 Males in Ride-Share Service Questions after Transport Factors

As discussed above, the sample size of the males who answered the *Ride-Share Service Questions* after *Transport Factors* did not meet the necessary criteria for a loglinear model. Thus, the data of the male Controls and for *Ride-Share Service Questions* after *Transport Factors* are tested using Pearson Chi-Square tests. Please refer to Appendix C.1.1 for 'at night', Appendix C.1.2 for 'alone', Appendix C.1.3 for 'alone at night'. The results are discussed in the next section.

Male Incompatibility in Ride-Share Service Questions after Transport Factors

Table 29 summarises the results of the Pearson Chi-Square tests for males in the Control and *Ride-Share Service Questions* after *Transport Factors* (Experiment 2). A difference in significance is seen between the Controls and Experiment 2 and emphasised in Table 29. In the Controls, there was a significant relationship for 'alone' with $\chi^2(2) = 7.295$, $p = 0.026$. However, in Experiment 2 this relationship was non-significant for 'alone' after *Transport Factors*, with $\chi^2(2) = 3.989$, $p = 0.136$.

Table 29: Male Comparison: Controls and Ride-Share Service Questions after Transport Factors

Personal Factor	Ride-Share Service Question	Controls Male (n=512) p-Value	Male Experiment 2 (m=141) p-Value
Access to a Private Vehicle	'at night'	0.685 (non-significant)	0.600 (non-significant)
	'alone'	0.266 (non-significant)	0.958 (non-significant)
	'alone at night'	0.926 (non-significant)	0.818 (non-significant)
COVID-19	'at night'	0.172 (non-significant)	0.685 (non-significant)
	'alone'	0.026 (significant)	0.136 (non-significant)
	'alone at night'	0.709 (non-significant)	0.377 (non-significant)

The implications of these changes in significance for incompatibility are discussed in the following section for males in the *Ride-Share Service Questions*.

Discussion of Evidence of Incompatibility in Males in *Ride-Share Service Questions*

The single difference noted in Table 29 is the significant factor of *COVID-19* in 'alone' ($p=0.026$) in the Controls compared to the non-significant seen in the *Ride-Share Service Questions* after the *Transport Factors* ($p=0.136$). Figure 71 illustrates the percentages of the male responses to the question of 'alone' in the male Controls where *COVID-19* is significant, and then in Experiment 2, where the question is asked after the *Transport Factors*.

Figure 71 illustrates the responses to the male Controls and Experiment 2, exploring whether asking the *Transport Factors* before the *Ride-Share Service Questions* impacts the responses to 'alone' for *COVID-19*. For males in the Controls, the 'not sure' responses differed between 'before *COVID-19*', 'during *COVID-19*' and 'after *COVID-19*', with 2.0%, 6.6% and 13.0%, respectively. The responses of 'yes' in the Controls for the different phases of *COVID-19* were also somewhat different, with 90.2%, 82.0% and 79.7%, respectively. However, in Experiment 2, when the *Ride-Share Service Question* of 'alone' is asked after the *Transport Factors*, the effect of *COVID-19* is minimal. For 'before' (87.5% 'yes', 10.0% 'no', 2.5% 'not sure'), 'during' (85.7% 'yes', 12.2% 'no', 2.0% 'not sure') and 'after' (73.1% 'yes', 15.4% 'no', 11.5% 'not sure'), the responses were similar.

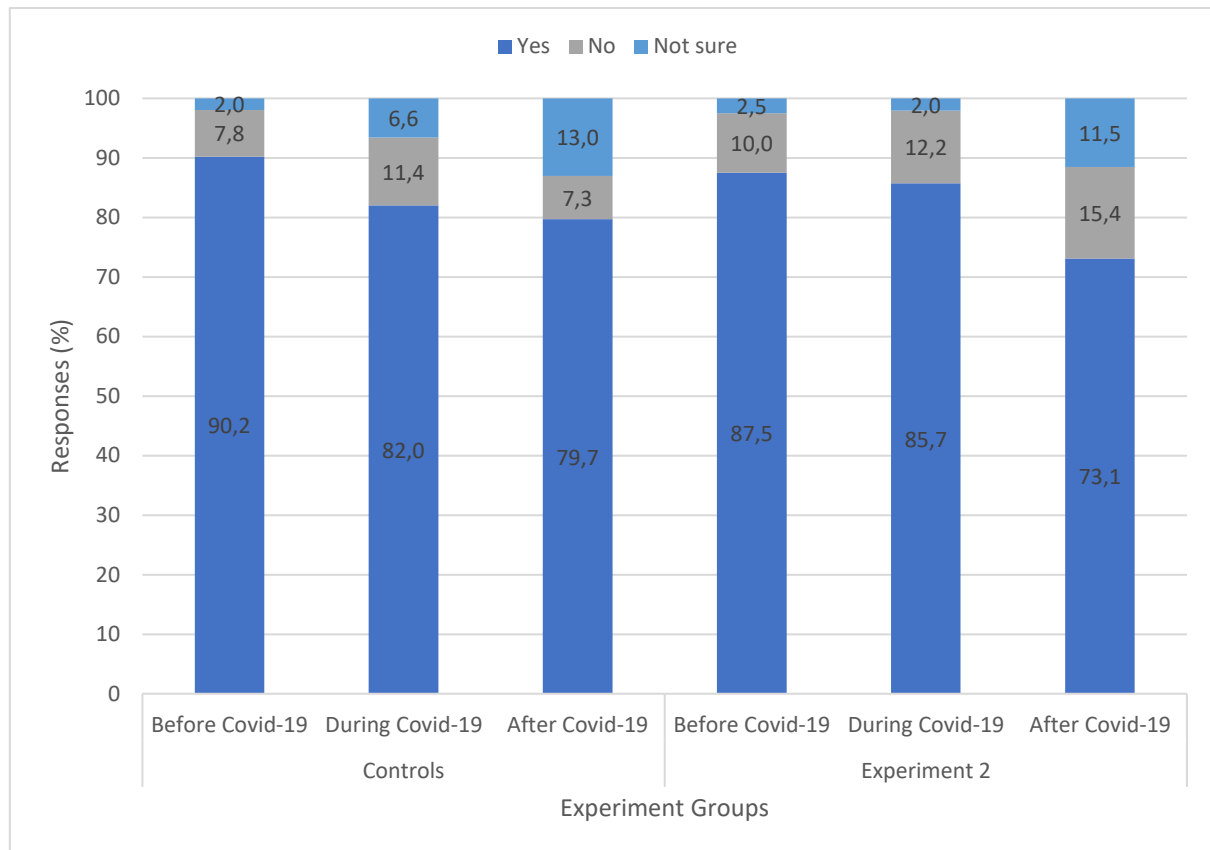


Figure 71: Percentage for 'alone' in Controls and Experiment 2 for Males COVID-19 (Controls, n=512; Experiment 2, m=141)

Using the data from Figure 71, *Belief States* are explored to see how males per COVID-19 responded in the Controls (Chapter 6) and Experiment 2 (after *Transport Factors*). The amplitudes are calculated for the male *Belief States* for 'alone' per COVID-19. The male *Belief State* is defined as: $|\Psi\rangle_{\text{COVID-19}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$. The results are summarised in Table 30.

Table 30: Amplitudes of Male Belief States for 'Alone' per COVID-19

COVID-19	Experiment	a	b	c
Before COVID-19	Experiment 2	0.94	0.32	0.16
	Controls	0.95	0.28	0.14
During COVID-19	Experiment 2	0.93	0.35	0.14
	Controls	0.91	0.34	0.26
After COVID-19	Experiment 2	0.85	0.39	0.34
	Controls	0.89	0.27	0.36

From the perspective of 'yes'-'not sure' shown in Figure 72, males had more distinct *Belief States* in the Controls, while in Experiment 2, the *Belief States* for 'before COVID-19' and

‘during COVID-19’ were very similar. Only the ‘after COVID-19’ responses retained the larger ‘not sure’ amplitude in Experiment 2.

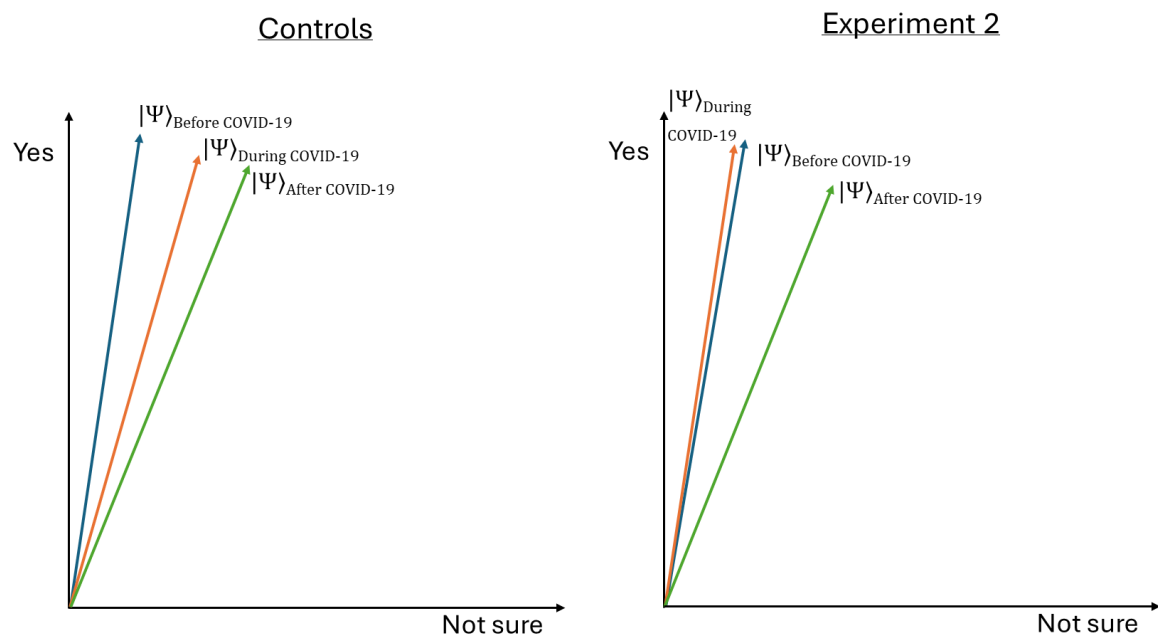


Figure 72: ‘Alone’ Belief States for Males per COVID-19 for ‘Yes’-‘Not Sure’ shown for Controls and Experiment 2

A more detailed look at the *Belief States* shows that the *Transport Factors* had the largest effect on the responses of ‘during COVID-19’. This is captured in Figure 73 where each *COVID-19* scenario is shown in the perspective of ‘yes’-‘not sure’. For ‘before COVID-19’ and ‘after COVID-19’ little or no change is seen in the *Belief States* in the Controls and Experiment 2. However, in ‘during COVID-19’, a smaller amplitude for ‘not sure’ is shown. This suggests that *Transport Factors* reduced the indecisiveness of males, especially for the scenario of ‘during COVID-19’ so that *COVID-19* was no longer a significant factor (Table 29).

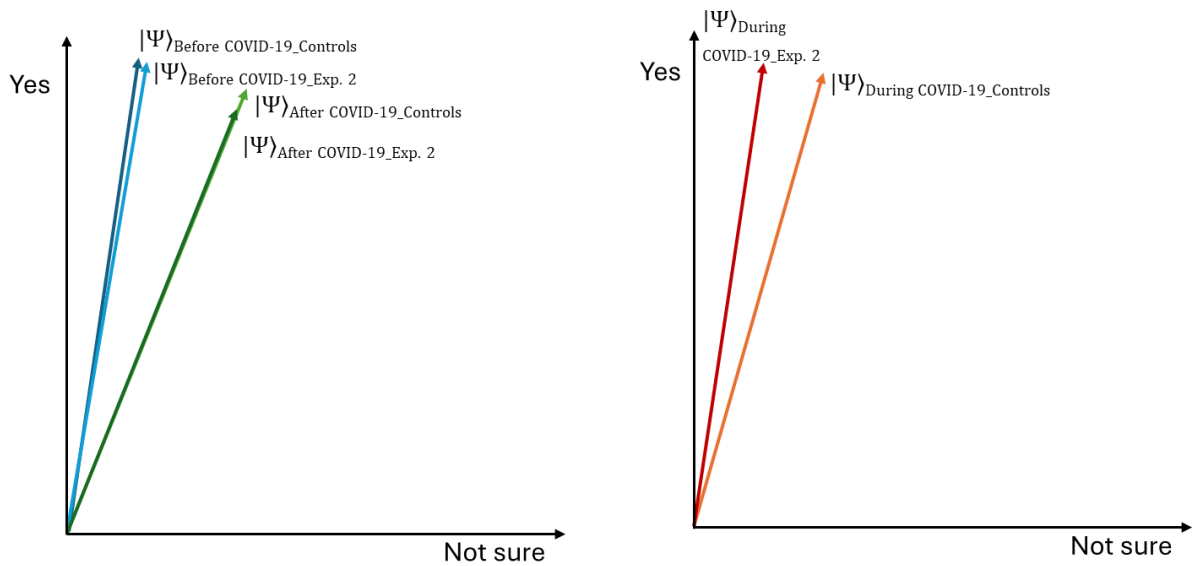


Figure 73: 'Alone' Belief States for Males for 'Yes'-'Not Sure' for 'before'/'after COVID-19' (left) and 'during COVID-19' (right)

This finding in 'alone' for males is like that seen in females for 'alone at night' in Section 7.1.1.1.2, which also showed that *COVID-19* was not a significant factor in Experiment 2, despite being a significant factor in the Controls.

7.1.1.3 Gender Comparison in Incompatibility in Ride-Share Service Questions after Transport Factors

When considering *Access to a Private Vehicle* in the *Belief State*, only females showed one example of incompatibility in 'at night', which was significant in the Controls but non-significant after *Transport Factors*. The male data did not show any evidence of incompatibility, but this may be due to the insufficiently small sample sizes for the design of the experiment.

However, for both females and males, *COVID-19* went from being a significant factor in the Controls to a non-significant factor when *Transport Factors* were asked before the *Ride-Share Service Questions*. For females, this occurs in 'alone at night', while for males, the *Ride-Share Service Question* of 'alone' indicates this change.

These results show that asking *Transport Factors* before the *Ride-Share Service Questions* influences the *Belief State* of the individuals. Factors that were significant in the Controls are non-significant in Experiment 2. Specifically, females demonstrated two cases of incompatibility (*Access to a Private Vehicle* for 'at night'; *COVID-19* for 'alone at night'). Males, on the other hand, demonstrated one case of incompatibility in *COVID-19* for 'alone'.

The broad take-away from the findings of *Access to a Private Vehicle* is that, while females may experience incompatibility in their decisions, which is dependent on whether they have access to a private vehicle, no such incompatibility is found in males. This may imply that, for females, having access to a private vehicle influences their level of perceived uncertainty and perceived risks and, therefore, their ride-share service decisions and behaviours. Furthermore, from the *Belief States*, shown in Figure 67, the incompatibility seen from the *Transport Factors* resulted in more willingness in females both without access and with access to a private vehicle to use ride-share services ‘at night’.

However, for males, having access to a private vehicle does not influence their ride-share service decisions. This difference could indicate the different levels of uncertainty and perceived risks that females experience, and that private vehicle access is a way that females mitigate their uncertainty and perceived risks of using ride-share services. In short, males, regardless of having access to a private vehicle, are likely to have ride-share service experiences that greatly differ to those of females in terms of uncertainty and perceived risks.

This points to an important caveat in the existing understanding that, while females in South Africa may be more likely to identify as ride-share service users than males (for example, Molobi et al., 2020), their experience of ride-share services still involves significantly more uncertainty and perceived risks than their male counterparts. Furthermore, the experience of ride-share services for females is dependent on having access to a private vehicle, while for males it is not. This is substantiated by the incompatibility seen in females, which, based on the QPT theory, is only likely to happen under conditions of uncertainty or (perceived) risks, as discussed in Chapter 2.

From the findings of *COVID-19*, evidence of incompatibility can be seen in both females and males. As seen in the female *Belief States* in Figure 70 (‘alone at night’), asking the *Transport Factors* before the question of ‘alone at night’ resulted in more stable levels of ‘not sure’ compared to the Controls. In the Controls, ‘before COVID-19’ had the lowest levels of ‘not sure’, while ‘after COVID-19’ had the highest levels of females ‘not sure’. In Figure 72 for males, in the Controls more distinct *Belief States* are seen for ‘before’, ‘during’ and ‘after COVID-19’, while in Experiment 2 results, the *Belief States* of ‘before’ and ‘during COVID-19’ are similar. This indicates that males also experienced uncertainty and perceived risks for the ride-share service decision ‘alone, indicated by the incompatibility captured in the comparison

of the results of the Controls and Experiment 2 of *Transport Factors*, which was dependent on *COVID-19*.

The following Sections 7.1.2 and 7.1.3 present *Access to a Private Vehicle* and *COVID-19*, respectively. Due to the skewed female-male participant numbers, the overall results reflect the female findings in this section. While this is acknowledged, the analyses and discussions of *Access of a Private Vehicle* and *COVID-19* are presented for completeness, using both female and male data combined. No additional *Belief States* are generated, as the most specific *Belief States* (per *Gender*) have already been shown in this section.

7.1.2 *Access to a Private Vehicle* in *Ride-Share Service Questions* after *Transport Factors*

This section presents an overall view of the data per *Access to a Private Vehicle* for the three *Ride-Share Service Questions* after *Transport Factors* for both females and males combined. A comparison between individuals, both female and male, with and without access to a private vehicle is presented between the data of the Controls and the *Ride-Share Service Questions*. Changes in the significance of *Access to a Private Vehicle* are identified with Pearson's Chi-Square tests and are discussed.

Figure 74 shows the results of the *Ride-Share Service Questions* after *Transport Factors* for both females and males. Compared to the Controls (shown in Chapter 6, Section 6.2.1), the responses are similar, with individuals without access to a private vehicle being more willing to engage in ride-share services ('at night': 75.3% yes; 'alone': 73.8% 'yes'; 'alone at night': 60.5%) than those with access to a private vehicle ('at night': 70.4% yes; 'alone': 66.4% 'yes'; 'alone at night': 40.4%). However, individuals with access to a private vehicle show a greater difference in 'yes', for 'alone at night' (40.4%), compared to the Controls (48.1%).

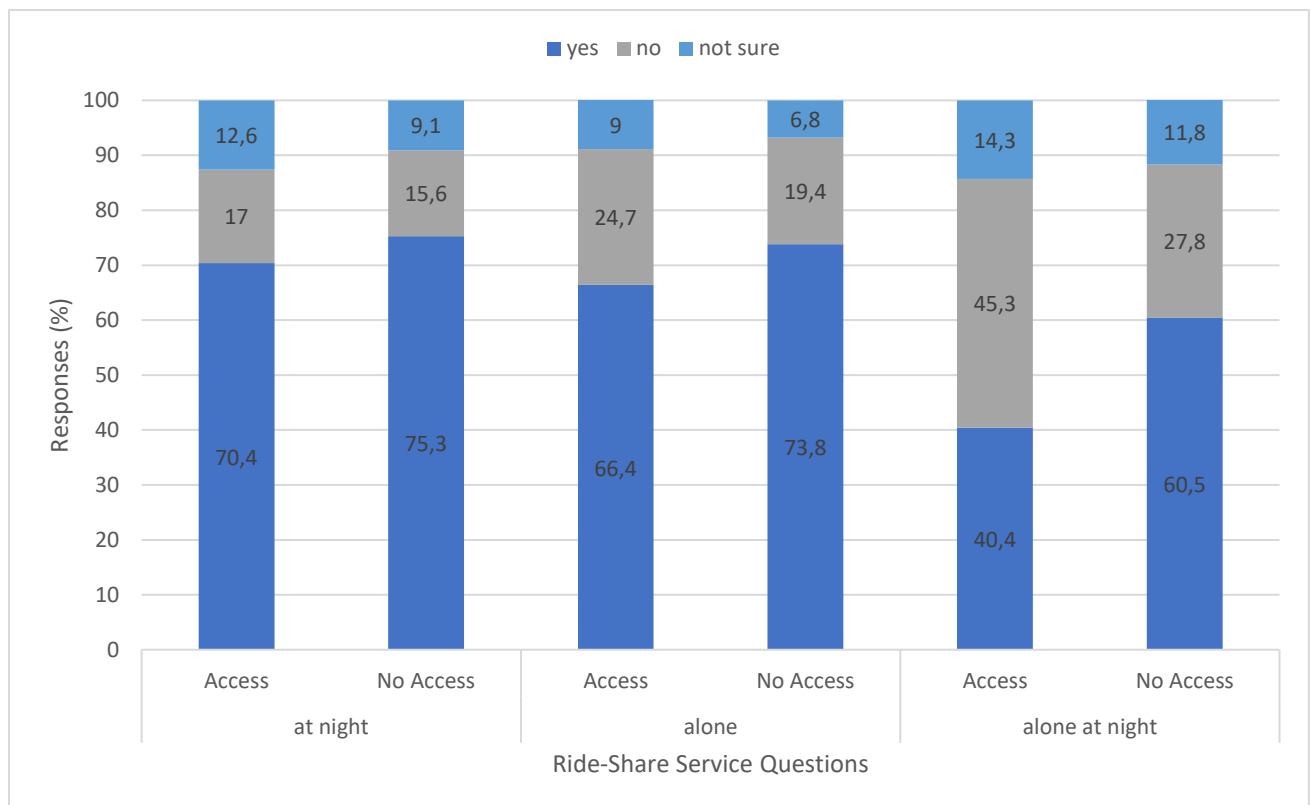


Figure 74: Access to a Private Vehicle - Ride-Share Service Questions after Transport Factors All Participants in Percentages (Access, n=223; No Access, m=263)

The following section compares the significance of *Access to a Private Vehicle* in the Controls (female and male) and in the *Ride-Share Service Questions after Transport Factors* (female and male).

7.1.2.1 Incompatibility per Access to a Private Vehicle in Ride-Share Service Questions after Transport Factors

Pearson Chi-Square tests were used to compare the significance of *Access to a Private Vehicle*. These tests were conducted for all *Ride-Share Service Questions* in the Controls and in Experiment 2, using all data (females and males). The necessary cell counts (minimum cell count of >5), and minimum values are achieved in all Pearson's Chi-Square tests in these comparisons. Table 31 shows the p-values of the tests.

Table 31: Pearson's Chi-Square Test for Access to a Private Vehicle in Controls and Ride-Share Service Questions after Transport Factors

Personal Factor	Ride-Share Service Question	Controls (n=1398) p-Value	Experiment 2 (m=486) p-Value
Access to a Private Vehicle	'at night'	0.017 (significant)	0.391 (non-significant)
	'alone'	0.181 (non-significant)	0.205 (non-significant)
	'alone at night'	<0.001 (significant)	<0.001 (significant)

One difference in significance can be seen between the Controls and the *Ride-Share Service Questions* after *Transport Factors* for 'at night'. While *Access to a Private Vehicle* is significant in the Controls with $\chi^2(2) = 8.154$, $p=0.017$, it is non-significant, with $\chi^2(2) = 1.877$, $p=0.391$, when the question of 'at night' is asked after *Transport Factors*. This aligns with the female findings (Section 7.1.1.1), as the data is largely skewed towards females, as mentioned before.

Access to a Private Vehicle is **consistently non-significant** for 'alone' in Controls with $\chi^2(2) = 3.423$, $p=0.181$ and Experiment 2, with $\chi^2(2) = 3.173$, $p=0.205$. Therefore, no significant change is seen. *Access to a Private Vehicle* is **consistently significant** for 'alone at night' in Controls with $\chi^2(2) = 15.374$, $p<0.001$ and Experiment 2, with $\chi^2(2) = 20.489$, $p<0.001$. Therefore, no incompatibility can be argued for.

7.1.2.2 Discussion of Incompatibility per Access to a Private Vehicle in Ride-Share Service Questions after Transport Factors

As mentioned in the discussion of females (Section 7.1.1.1), the lack of significant difference with respect to *Access to a Private Vehicle* after the *Transport Factor* for 'at night' is surprising. The mitigating effort of the *Transport Factors* on *Access to a Private Vehicle* can be seen as encouraging individuals to use ride-share services 'at night'. **This shows that if individuals (mostly females) reflect on surrounding transport-related topics, such as sustainability, reliability, road safety and crime, their Belief State is changed so that there is no difference in the decisions of individuals with and without access to a private vehicle for the decision of 'at night'. This is evidence of incompatibility in ride-share service decisions of 'at night'.**

The ride-share service question of 'alone' is interesting that it is non-significant in both the Controls and Experiment 2, indicating that the uncertainty and perceived risks associated with ride-share service trips 'alone' may adequately address the concerns of those with access to a private vehicle.

The other ride-share service question of 'alone at night' also demonstrated a significant difference between individuals with and without access to a private vehicle in both the Controls and Experiment 2. This may suggest that the uncertainty or risk perceived in the ride-share service decision 'at night' is most easily overcome, while the decisions for 'alone at night' are not susceptible to any incompatibility between the decision 'alone at night' and the defined *Transport Factors*. This may hint towards individuals, especially females, using simple rules or being guided by references and frames (Garcia-Sierra et al., 2015) for their ride-share service decisions for 'alone at night', as discussed in Chapter 2.

7.1.3 COVID-19 in Ride-Share Service Questions after Transport Factors

In the *Ride-Share Service Questions after Transport Factors*, the responses are like the Controls (Chapter 6, Section 6.3), with 'at night' and 'alone' showing a higher willingness to engage in ride-share services 'before-COVID-19', 'during COVID-19' and 'after COVID-19' than in 'alone at night'. Figure 75 shows the responses per COVID-19 scenario for the *Ride-Share Service Questions after the Transport Factors*.

However, as shown in Figure 75, the willingness to engage in *Ride-Share Services* tended to be lower in 'after COVID-19' for 'at night' (64.7% 'yes'), 'alone' (59% 'yes') and 'alone at night' (47.4% 'yes') compared to 'before COVID-19' with 'at night' (79.9% 'yes'), 'alone' (73.2% 'yes') and 'alone at night' (50.6% 'yes'). The willingness to engage in Ride-Share Services in 'after COVID-19' was also lower compared to 'during COVID-19' for 'at night' (74.1% 'yes'), 'alone' (78.3% 'yes') and 'alone at night' (55.4% 'yes'). This may indicate that the individuals who participated in the 'after COVID-19' survey were less certain and perhaps more anxious about the future, as the 'after COVID-19' questions were phrased in the future tense.

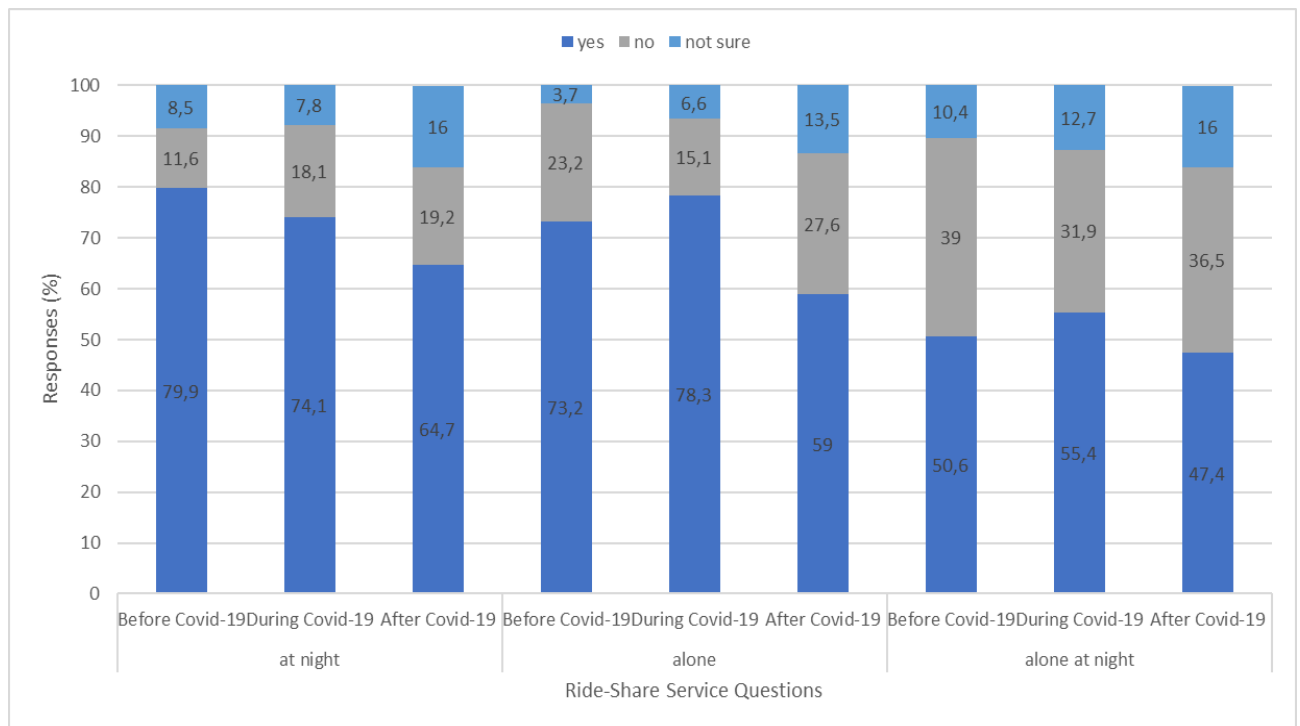


Figure 75: COVID-19 - Ride-Share Service Questions after Transport Factors in Percentages (Before, n=164; During, m= 166; After, o=156)

In the next section, the statistical significance of *COVID-19* as a factor is explored in the *Ride-Share Service Questions*.

7.1.3.1 Incompatibility per COVID-19 in Ride-Share Service Questions after Transport Factors

As for *Access to a Private Vehicle*, Pearson Chi-Square tests are performed again for the *Ride-Share Service Questions* in both the Controls and those responding after considering the *Transport Factors* (Experiment 2). Both female and male data is included in the comparisons. Table 32 shows the summary of these results.

Table 32: Pearson's Chi-Square Test for COVID-19 in Controls and Ride-Share Service Questions after Transport Factors

Personal Factor	Ride-Share Service Question	Controls (n=1398) p-Value	Experiment 2 (m=486) p-Value
COVID-19	'at night'	<0.001 (significant)	0.017 (significant)
	'alone'	<0.001 (significant)	<0.001 (significant)
	'alone at night'	<0.001 (significant)	0.378 (non-significant)

COVID-19 was significant in the Controls for 'at night' with $\chi^2(4) = 50.356$, $p < 0.001$, as well as for 'alone' with $\chi^2(4) = 53.428$, $p < 0.001$ and 'alone at night' with $\chi^2(4) = 22.260$, $p < 0.001$. *COVID-19* remained a significant factor in Experiment 2 for 'at night' with $\chi^2(4) = 12.062$, $p = 0.017$ and 'alone' with $\chi^2(4) = 20.810$, $p < 0.001$. However, *COVID-19* is non-significant for 'alone at night', with $\chi^2(4) = 4.210$, $p = 0.378$, despite being significant in the Control. After

considering the *Transport Factors*, individuals respond similarly in the scenarios of ‘before COVID-19’, ‘during-COVID-19’ and ‘after COVID-19’ for ‘alone at night’. There is, therefore, a change in significance. This is discussed in more detail in the next section.

7.1.3.2 Discussion of Incompatibility per COVID-19 in Ride-Share Service Questions after Transport Factors

Once again, the results seen in the overall comparison are like the results of the females shown in Section 7.1.1.1. The pre-questions of the *Transport Factors* did not change the willingness of individuals to engage in ride-share services ‘alone at night’, as the percentages of ‘yes’ remain comparatively low compared to ‘at night’ and ‘alone’.

However, asking individuals about the *Transport Factors* before ‘alone at night’ mitigate the statistical significance of *COVID-19* as a factor. This may suggest that directly related factors, such as those presented in *Transport Factors*, have a larger part in how individuals create their decision of ‘alone at night’ than *COVID-19* did.

7.2 Ride-Share Service Questions after Good Mood Questions

In this section, the results of the effect of the *Good Mood Questions* on the *Ride-Share Service Questions* are described. The Controls for the *Ride-Share Service Questions* have already been presented in Chapter 6. Therefore, this section focuses on describing the results of the *Ride-Share Service Questions* after *Good Mood Questions* (Experiment 4) and comparing them to the results already described in Chapter 6. This is done per *Personal Factor*, starting with *Gender*, for the three *Ride-Share Service Questions*. For an overview of all possible interactions and full descriptions of the analysis, please refer to Appendix C.2.1 for ‘at night’, Appendix C.2.2 for ‘alone’, Appendix C.2.3 for ‘alone at night’, for the female analyses.

As in the *Ride-Share Service Questions* after the *Transport Factors*, the insufficient number of males in the *Ride-Share Service Questions* after the *Good Mood Questions* does not allow a direct comparison using loglinear models. However, females can be investigated using loglinear models, as the minimum accepted cell counts are achieved in the *Ride-Share Service Questions* after *Good Mood Questions*. Pearson Chi-Square tests are performed on the Controls data (Chapter 6) and Ride-Share Services after *Good Mood Questions* for the male comparison.

The following section presents the findings of incompatibility influenced by the *Good Mood Questions* in the *Ride-Share Service Questions* per Gender.

7.2.1 Gender: *Ride-Share Service Questions* after *Good Mood Questions*

Figure 76 shows the responses to the *Ride-Share Service Questions* after participants are asked the *Good Mood Questions*. Similar patterns emerge as those seen in the Controls, described in Chapter 6, Section 6.1.1. Specifically, females were less likely than males to participate in all *Ride-Share Service Questions*. Females said ‘yes’ to ‘at night’, ‘alone’ and ‘alone at night’ with 68.8%, 66.6% and 38.2%, respectively. As seen in the Controls, ‘alone at night’ shows a notable reduction. Males said ‘yes’ with 84.4%, 84.4% and 71.5%, respectively.

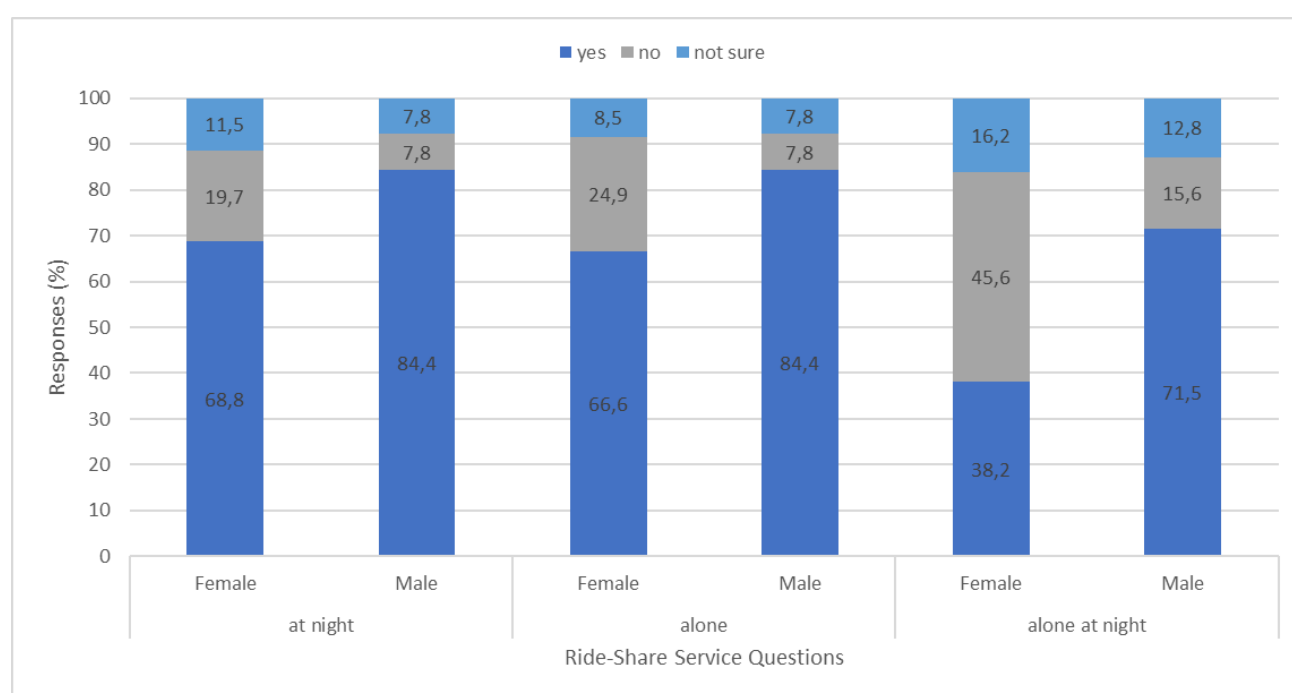


Figure 76: Gender - *Ride-Share Service Questions* after *Good Mood Questions* in Percentages (female, n=401; male, m=179)

The next section explores the data for females and discusses the evidence of incompatibility in the *Ride-Share Service Questions* after the *Good Mood Questions*.

7.2.1.1 Females in *Ride-Share Service Questions* after *Good Mood Questions*

Table 33 shows the significant interactions for the *Good Mood Questions* loglinear model. The interaction **Vehicle Access x COVID-19** is again (see Section 7.1.1.1) significant in all three *Ride-Share Service Questions*, with $\chi^2(2) = 30.133$, with $p < 0.001$ for ‘at night’, with $\chi^2(2) = 29.822$, with $p < 0.001$ for ‘alone’, and with $\chi^2(2) = 27.536$, with $p < 0.001$ for ‘alone at night’. As previously discussed, this is due to a significantly larger proportion of females, without access to a vehicle, taking part in the second distributed survey. The second distributed survey

contained only 'after COVID-19'. Therefore, the interaction is not discussed further, as this interaction is not an active part of the experiment.

Table 33 shows that for *Ride-Share Service Questions* after *Good Mood Questions*, *COVID-19* and *Access to a Private Vehicle* have significant interactions. *COVID-19* is significant in the *Ride-Share Service Questions* for 'at night' and 'alone', with $\chi^2(4) = 16.385$, $p=0.003$ and $\chi^2(4) = 22.113$, $p<0.001$, respectively. While *Access to a Private Vehicle* is significant for 'at night' with $\chi^2(2) = 6.447$, $p=0.040$ and 'alone at night', with $\chi^2(2) = 17.698$, $p<0.001$.

Table 33: Significant Interactions for Females in Ride-Share Service Questions after Good Mood Questions (Exp. 4, n=401)

Ride-Share Service Question	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
'at night'	Vehicle Access*COVID-19	2	30.133	<0.001	2
	Vehicle Access*Night	2	6.447	0.040	2
	COVID-19*Night	4	16.385	0.003	2
'alone'	Vehicle Access*COVID-19	2	29.822	<0.001	2
	COVID-19*Alone	4	22.113	<0.001	2
'alone at night'	Vehicle Access*COVID-19	2	27.536	<0.001	2
	Vehicle Access*Alone at Night	2	17.698	<0.001	2

In the next section, these findings for females are compared to the significant interactions found in the Controls to compare where interactions changed in significance.

Female Incompatibility in Ride-Share Service Questions after Good Mood Questions

The significant interactions of the Controls are compared with the results shown in Table 33 per *Access to a Private Vehicle* and *COVID-19*. This is done to determine if asking *Good Mood Questions* before the *Ride-Share Service Questions* impacts the significance of the results to the *Ride-Share Service Questions*. Table 34 shows the results for *Access to a Private Vehicle*, indicating that *Access to a Private Vehicle* has no changes in the significant interactions in the *Ride-Share Service Questions* after *Good Mood Questions*. The same significant interactions in the Controls are seen in the *Ride-Share Service Questions* after *Good Mood Questions*. **Thus, no evidence of any influence on the responses is seen in the results stemming from the *Good Mood Questions*.**

Table 34: Changes in Significant Interactions for Females & Access to a Private Vehicle

Significant Interactions	Ride-Share Service Question	Controls Female (n=886)	Female Experiment 4 (m=401)
		Is interaction significant in Controls?	Is interaction significant in Experiment 4?
Access to a Private Vehicle x 'Ride-Share Service Questions'	'at night'	Yes	Yes
	'alone'	No	No
	'alone at night'	Yes	Yes

Table 35 shows the results for *COVID-19*. There is one difference in significant interactions: for the **COVID-19 x 'alone at night'** interaction. While females in the Controls had a significant interaction for **COVID-19 x 'alone at night'**, females who were first asked the *Good Mood Questions*, and then the *Ride-Share Service Questions*, did not generate a significant interaction.

Table 35: Changes in Significant Interactions between Females and COVID-19

Significant Interactions	Ride-Share Service Question	Controls Female (n=886)	Female Experiment 4 (m=401)
		Is interaction significant in Controls?	Is interaction significant in Experiment 4?
COVID-19 x 'Ride-Share Service Questions'	'at night'	Yes	Yes
	'alone'	Yes	Yes
	'alone at night'	Yes	No

The following section discusses this change and the implications for the female *Ride-Share Service Questions*.

Discussion of Incompatibility in Females in *Ride-Share Service Questions* after *Good Mood Questions*

The *Good Mood Questions* are designed with little or no uncertainty or perceived risk. Furthermore, the *Good Mood Questions* are unrelated to ride-share service decisions, however, the *Good Mood Questions* are designed to explore how positive emotion could influence ride-share service decisions involving uncertainty and perceived risks.

Table 34 shows no differences in the significance of *Access to a Private Vehicle* in the *Ride-Share Service Questions* of the Controls or after the *Good Mood Questions*. The influence of the *Good Mood Questions* in the *Ride-Share Service Questions* is, therefore, insubstantial in the interactions of *Access to a Private Vehicle*.

However, Table 35 shows that, for *COVID-19*, one change of significance is seen in ‘alone at night’ between the Controls and Experiment 4, when the *Ride-Share Service Questions* are asked after the *Good Mood Questions*. While in the Controls, for ‘alone at night’, *COVID-19* is significant, in Experiment 4, *COVID-19* is no longer a significant factor. **The *Good Mood Questions*, therefore, influence how females in different scenarios of *COVID-19* consider their most risky ride-share service decision.**

Figure 77 explores the differences in the responses to better understand how *Good Mood Questions* influence the responses so that *COVID-19* is non-significant. Figure 77 shows that, for females, asking the *Good Mood Questions* before the *Ride-Share Service Question* for ‘alone at night’ resulted in more consistent responses within the scenarios of ‘before’, ‘during’ and ‘after *COVID-19*’. Furthermore, the data suggests that a more positive initial *Belief State*, created by the introduction of the *Good Mood Questions*, positively influenced willingness to participate in ride-share services ‘alone at night’. This is supported by the higher ‘yes’ responses to ‘alone at night’ in Experiment 4 (‘before’: 53%; ‘during’: 48.2%; ‘after’: 44.7%) compared to the Controls (‘before’: 41.8%; ‘during’: 36.6%; ‘after’: 36.1%).

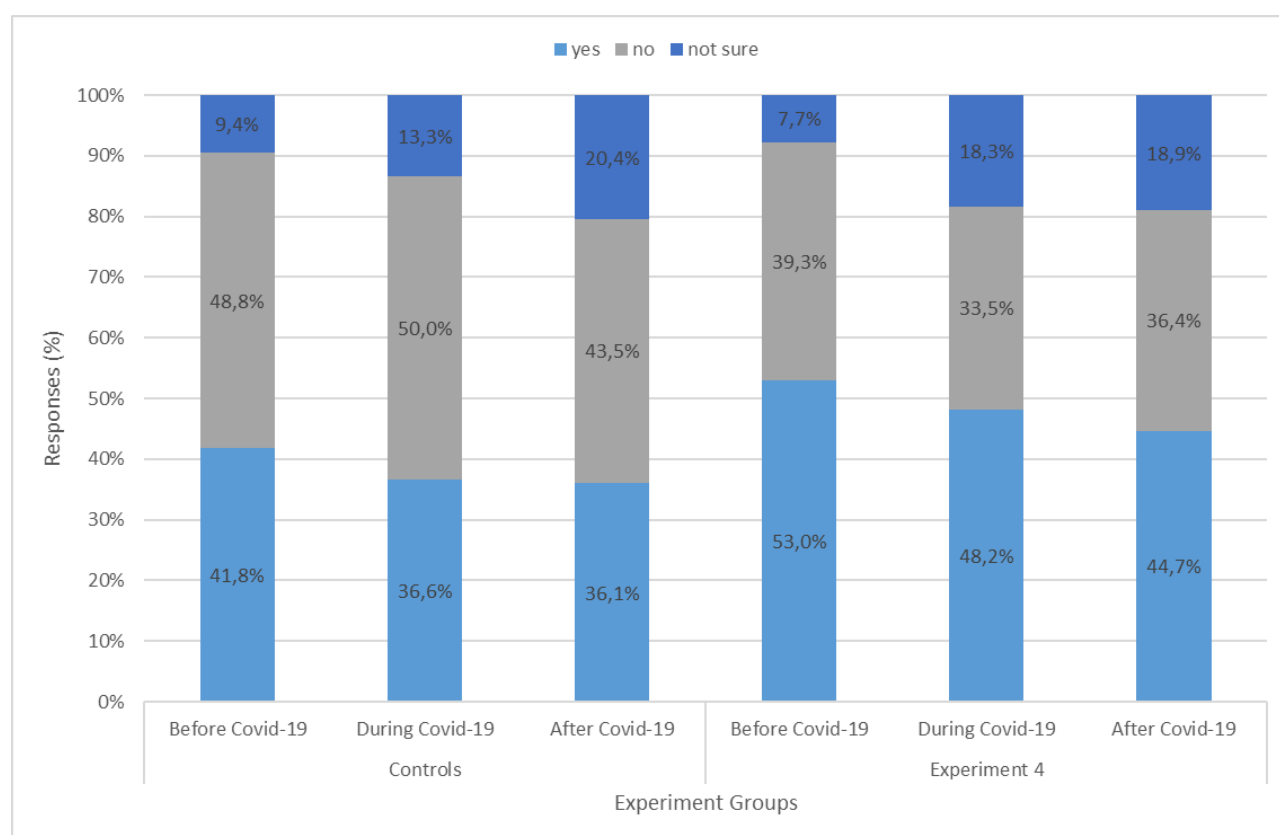


Figure 77: Percentage for ‘alone at night’ in Controls and Experiment 4 for Females per *COVID-19* (Controls, Before, $n=153$; During, $m=167$; After, $o=192$; Experiment 4, Before, $p=126$; During, $q=128$; After, $r=147$)

Using the data from Figure 77, *Belief States* can be generated to explore how females in ‘before’, ‘during’, and ‘after COVID-19’ responded in the Controls (Chapter 6) and Experiment 4 (after *Good Mood Questions*). The amplitudes are calculated for the female *Belief States* for the *Ride-Share Service Questions* per *COVID-19*. The female *Belief State* is defined as: $|\Psi\rangle_{\text{COVID-19}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$. The results are summarised in Table 36.

Table 36: Amplitudes of Female Belief States of ‘Alone at Night’ per COVID-19 in Experiment 4 and Controls

Ride-Share Service Question	Experiment	a	b	c
Before COVID-19	Experiment 4	0.73	0.63	0.28
	Controls	0.65	0.70	0.31
During COVID-19	Experiment 4	0.69	0.58	0.43
	Controls	0.60	0.71	0.36
After COVID-19	Experiment 4	0.67	0.60	0.43
	Controls	0.60	0.66	0.45

This is done to better understand how, by first presenting females with the *Good Mood Questions*, COVID-19 was no longer a significant factor in Experiment 4, despite being a significant factor in the Controls (Table 35). The *Belief States* of females per *COVID-19* scenario for the Controls and Experiment 4 (after *Good Mood Questions*) are illustrated in Figure 78. The *Good Mood Questions* effect on the *Belief States* in all three COVID-19 scenarios shows an increased willingness to engage in ride-share service trips ‘alone at night’. This suggests that, despite *Good Mood Questions* being expected to be compatible, the positive emotional effect is seen for the *Personal Factor* of *COVID-19*. This suggests that the COVID-19 pandemic had an emotional impact for females which was captured in ‘alone at night’ (highest uncertainty and perceived risks), resulting in this difference.

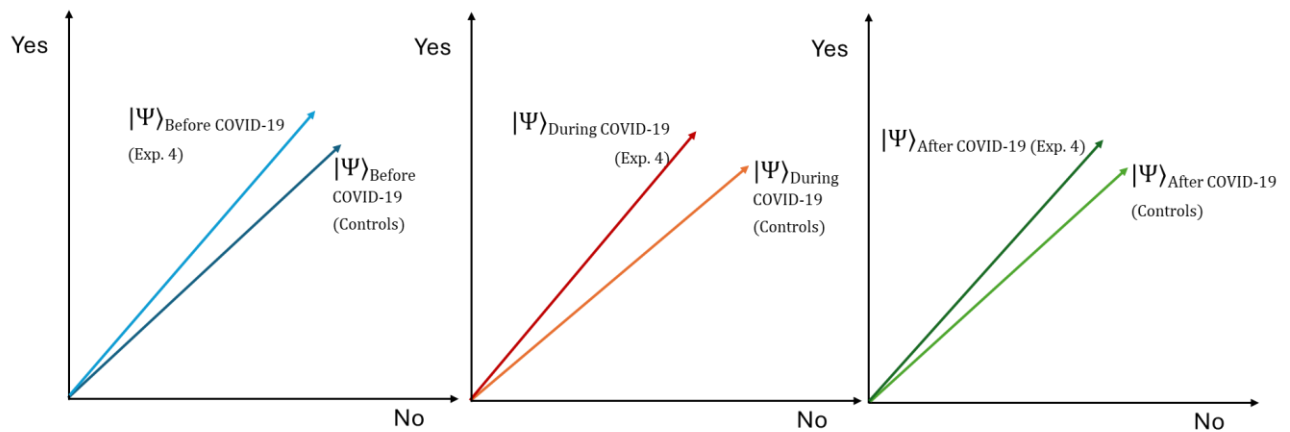


Figure 78: 'Alone at Night' Belief States for Females per COVID-19 for 'Yes'-'No'

This finding aligns with the discussions shown in Chapter 2, which highlights that the COVID-19 pandemic increased levels of stress and anxiety in young adults, especially females. **The Good Mood Questions were designed to recall positive associations and potentially reduce the effects of uncertainty or perceived risk. This difference in the significance of COVID-19 suggests that a more positive initial Belief State mitigates the effect of COVID-19 on females 'alone at night'.**

When considering other research, this finding aligns with that of Sobkow et al. (2020). Sobkow et al. (2020) found that when participants were asked to imagine and describe three positive consequences of the COVID-19 pandemic, the participants significantly decreased preventive behaviours. Sobkow et al. (2020) concluded that, by using highly positive or optimistic imagery, individuals were less willing to take protective behaviours. This indicates that young females in Cape Town may well consider not using ride-share services 'alone at night' as a preventative measure against possible harm or danger. Of course, the difference in this research was that the *Good Mood Questions* were not directly related to COVID-19 measures and were only general positive imagery. **This may indicate that even general positive imagery may be sufficient to reduce individuals' willingness to engage in protective behaviours or decisions, at least in theory.**

Additionally, the effects of COVID-19 on ride-share service decisions may have a negative emotional component, which might explain why a positive emotional initial state mitigated the significant impact of COVID-19. This is supported by Gittings et al. (2021), who showed the severe negative mental and emotional impacts that the COVID-19 pandemic caused on young adults in their stress and anxiety levels. Furthermore, Gittings et al. (2021) highlight the great

uncertainty in young adults, especially regarding continuing their education caused by the COVID-19 pandemic.

7.2.1.2 Males in Ride-Share Service Questions after Good Mood Questions

The male data for the Controls and *Ride-Share Service Questions after Good Mood Questions* are tested using Pearson Chi-Square tests for *Access to a Private Vehicle* and *COVID-19*. This is discussed in the next section.

Male Evidence of Incompatibility in Ride-Share Service Questions after Good Mood Questions

Table 37 shows the summary of the Pearson Chi-Square tests for males in the Controls data and the data of *Ride-Share Service Questions after Good Mood Questions*. The p-values for the male Controls to the *Ride-Share Service Questions after the Good Mood Questions* (Experiment 4) are shown. One value is highlighted in Table 37, where a difference in significant outcome is seen between the Controls and Experiment 4. For *COVID-19* for 'alone', a difference is seen, where in the Controls, the relationship is significant $\chi^2(2) = 7.295$, $p=0.026$, while *COVID-19* is non-significant in the *Ride-Share Service Questions after Good Mood Questions*, with $\chi^2(2) = 1.714$, $p=0.424$. **This finding is like those calculated for females in the *Ride-Share Service Question of 'alone at night' for COVID-19, discussed in Section 7.2.1.1.1.***

Table 37: Comparison of Male Data between Controls and Ride-Share Service Questions after Good Mood Questions

Personal Factor	Ride-Share Service Question	Controls Male (n=512) p-Value	Male Experiment 4 (m=179) p-Value
Access to a Private Vehicle	'at night'	0.685 (non-significant)	0.772 (non-significant)
	'alone'	0.266 (non-significant)	0.344 (non-significant)
	'alone at night'	0.926 (non-significant)	0.210 (non-significant)
COVID-19	'at night'	0.172 (non-significant)	0.995 (non-significant)
	'alone'	0.026 (significant)	0.424 (non-significant)
	'alone at night'	0.709 (non-significant)	0.085 (non-significant)

The following section discusses the implications of this change in significance for incompatibility for males in the *Ride-Share Service Questions after Good Mood Questions*.

Discussion of Evidence of Incompatibility in Males in Ride-Share Service Questions after Good Mood Questions

There is one difference in significance factors between the male Controls and the *Ride-Share Service Question* of ‘alone’ after the *Good Mood Questions* for COVID-19. Figure 79 explores the responses in ‘alone’ in the Controls and after the *Good Mood Questions*. In the Controls, a decreasing response to ‘yes’ and an increase response to ‘not sure’ is seen in males. However, when ‘alone’ is asked after the *Good Mood Questions*, the ‘yes’ answers for ‘before COVID-19’, ‘during COVID-19’ and ‘after COVID-19’ are more consistent and do not generate a statistically significant difference for COVID-19.

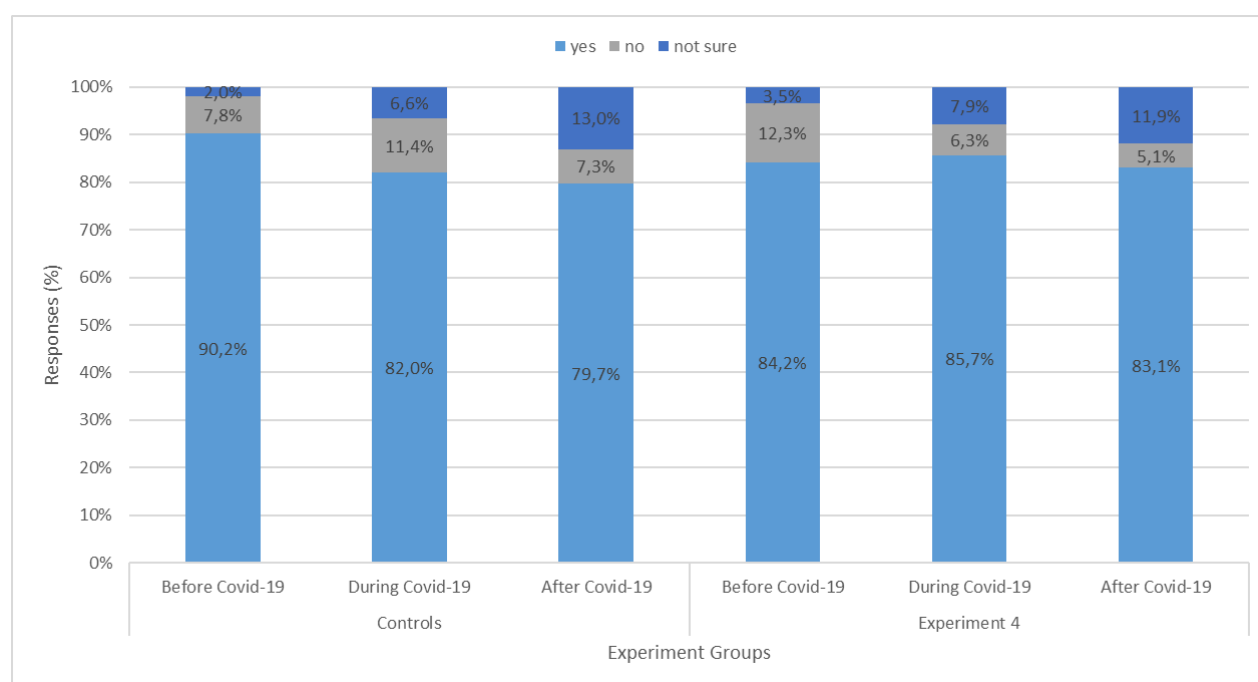


Figure 79: Percentage for ‘alone’ in Controls and Experiment 4 for Males per COVID-19 (Controls, Before, n= 153, During, m=167; After, o=192; Experiment 4, Before, p=57; During, q=63; After, r=59)

Using the data from Figure 79, *Belief States* can be generated to explore how males responded in the Controls (Chapter 6) and Experiment 4 (after *Good Mood Questions*) when in ‘before’, ‘during’, and ‘after COVID-19’. The amplitudes are calculated for the male *Belief States* for ‘alone’ per COVID-19. The male *Belief State* is defined: $|\Psi\rangle_{\text{COVID-19}} = a |Yes\rangle + b |No\rangle + c |Not\ Sure\rangle$. The results are summarised in Table 38.

Table 38: Amplitudes of Male Belief States of 'Alone' per COVID-19 in Experiment 4 and Controls

COVID-19	Experiment	a	b	c
Before COVID-19	Experiment 4	0.92	0.35	0.19
	Controls	0.95	0.28	0.14
During COVID-19	Experiment 4	0.93	0.25	0.28
	Controls	0.91	0.34	0.26
After COVID-19	Experiment 4	0.91	0.23	0.34
	Controls	0.89	0.27	0.36

Therefore, by first presenting males with the *Good Mood Questions*, COVID-19 was no longer a significant factor in Experiment 4, despite being a significant factor in the Controls (Table 37). Evaluating *Belief States* allows us to further explore this difference. The *Belief States* of males per COVID-19 for the Controls and Experiment 4 (after *Good Mood Questions*) are illustrated in Figure 80. The effect of *Good Mood Questions* on the *Belief States* in 'during' and 'after COVID-19' shows an increased willingness to engage in ride-share service trips 'alone at night'. Interestingly, this positive effect is not seen in 'before COVID-19', which shows a larger 'no' amplitude.

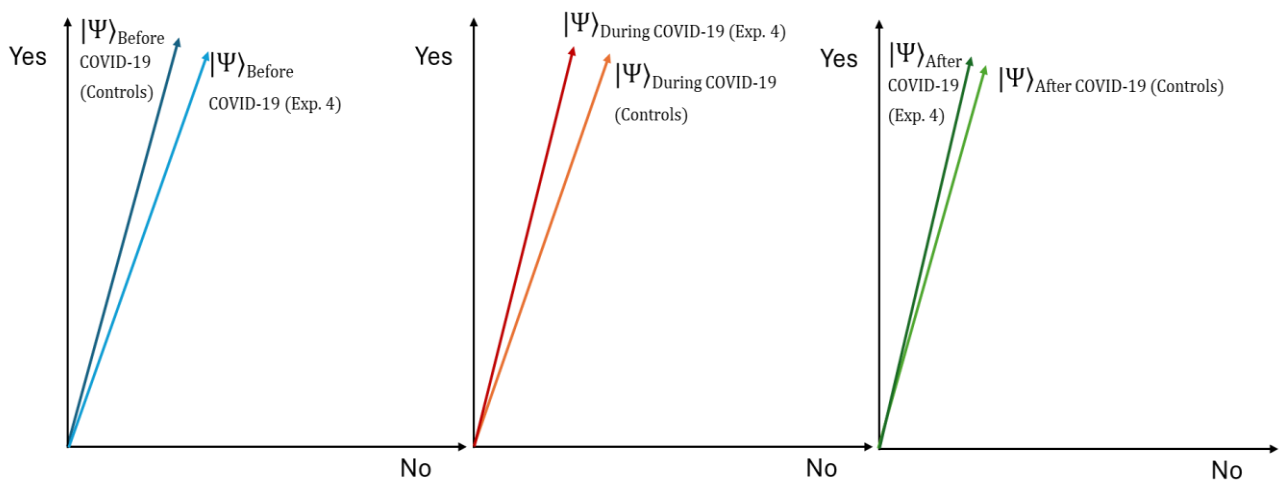


Figure 80: 'Alone' Belief States for Males per COVID-19 for 'Yes'-'No'

This suggests that for 'during' and 'after COVID-19', despite *Good Mood Questions* expected to be compatible, a positive emotional effect is seen for males in the *Ride-Share Service Question* 'alone', which resulted in COVID-19 not being a significant factor in Experiment 4. This aligns with the findings seen in Section 7.2.1.1.2 for females and indicates that the responses to the COVID-19 pandemic included an emotional component for males and is also captured in their most sensitive *Ride-Share Service Question* of 'alone'. This finding aligns with

the discussions shown in Chapter 2, which highlights that the COVID-19 pandemic increased levels of stress and anxiety in young adults and shows that the pandemic also had an emotional burden on males. However, considering the smaller sample sizes of Experiment 4, these findings should be used with care, and further verifications of such effects should be carried out.

7.2.1.3 Gender Comparison in Incompatibility in Ride-Share Service Questions after Good Mood Questions

The effects of the *Good Mood Questions* on the *Ride-Share Service Questions* are limited to one change of significance in females and one change of significance in males. Both these differences in significance are found in the factor of *COVID-19*, where *COVID-19* is a significant factor in the Control to a non-significant factor in Experiment 4. **For females, the change in the significance of *COVID-19* is seen in ‘alone at night’, while in males, the change is seen in ‘alone’.**

7.2.2 Access to a Private Vehicle per Ride-Share Service Questions after Good Mood Questions

This section presents an overall comparison of individuals (females and males) with and without access to a private vehicle of the Controls data and the *Ride-Share Service Questions* after *Good Mood Questions*. Changes in the significance of *Access to a Private Vehicle* are identified with Pearson Chi-Square tests and discussed.

Figure 81 shows the results of the *Ride-Share Service Questions* after *Good Mood Questions*. Compared to the Controls (Chapter 6), the responses are similar, with individuals without access to a private vehicle being more willing to engage in ride-share services for ‘at night’ (74% ‘yes’, 13% ‘no’, 13% ‘not sure’), for ‘alone’ (75% ‘yes’; 17% ‘no’, 8% ‘not sure’) and for ‘alone at night’ (55% ‘yes’, 28% ‘no’, 17% ‘not sure’) than those with access to a private vehicle for ‘at night’ (73.2% ‘yes’, 19.3% ‘no’, 7.5% ‘not sure’), for ‘alone’ (68.9% ‘yes’; 22.5% ‘no’, 8.6% ‘not sure’) and for ‘alone at night’ (41.4% ‘yes’, 45.4% ‘no’, 13.2% ‘not sure’).

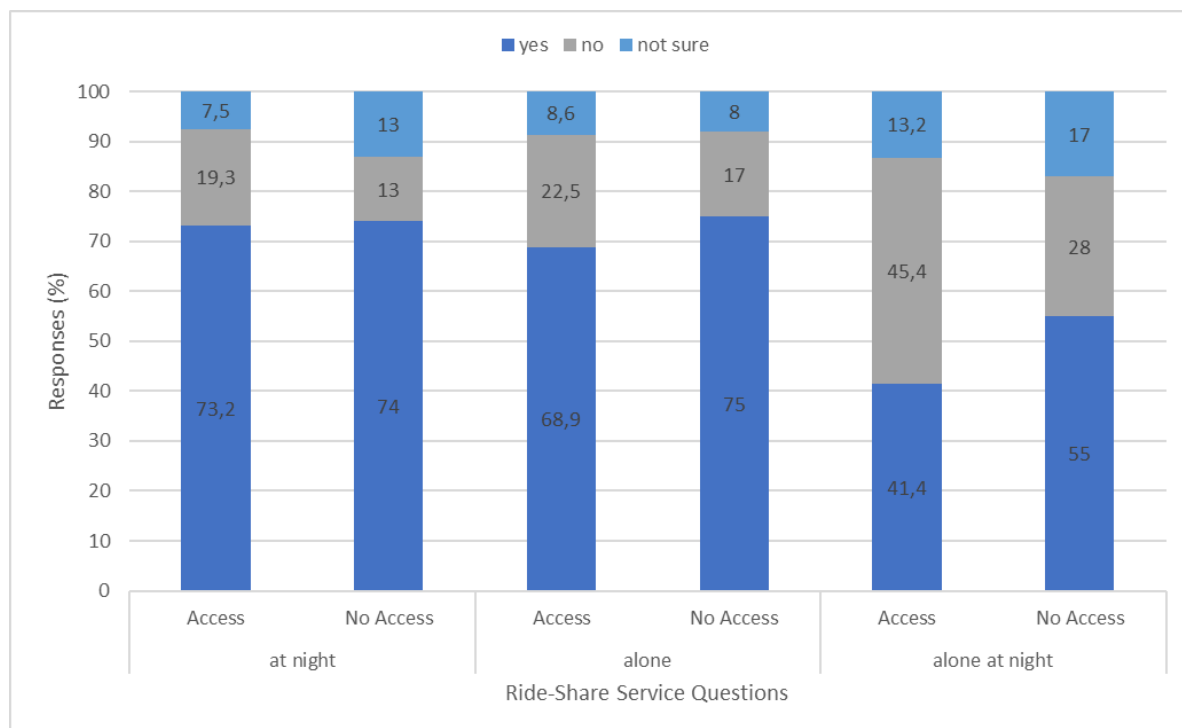


Figure 81: Access to a Private Vehicle – Ride-Share Service Questions after Good Mood Questions in Percentages (Access, n=280; No Access, m=300)

The following section compares the significance of *Access to a Private Vehicle* in the Controls and in the *Ride-Share Service Questions* after *Good Mood Questions*.

7.2.2.1 Evidence of Incompatibility per Access to a Private Vehicle in Ride-Share Service Questions after Good Mood Questions

The Pearson Chi-Square test compares the significance of *Access to a Private Vehicle* in the Controls and in the *Ride-Share Service Questions* after *Good Mood Questions* (Experiment 4). This is done as the necessary cell counts and minimum values are achieved in all Pearson's Chi-Square tests.

Table 39 shows no differences in the significance of *Access to a Private Vehicle* are seen between the Controls and the *Ride-Share Service Questions* after *Good Mood Questions*. *Access to a Private Vehicle* is significant for 'at night' in the Controls and Experiment 4. For 'alone', *Access to a Private Vehicle* is non-significant in the Controls with $\chi^2(2) = 3.423$, $p=0.181$ and Experiment 4, $\chi^2(2) = 3.027$, $p=0.220$. For 'alone at night', *Access to a Private Vehicle* remains significant, with $\chi^2(2) = 15.374$, $p<0.001$, for the Controls and for Experiment 4, with $\chi^2(2) = 18.868$, $p<0.001$.

Table 39: Pearson's Chi-Square Test for Access to a Private Vehicle in Controls and Ride-Share Service Questions after Good Mood Questions

Personal Factor	Ride-Share Service Question	Controls (n=1398) p-Value	Experiment 4 (m=580) p-Value
Access to a Private Vehicle	'at night'	0.017 (significant)	0.020 (significant)
	'alone'	0.181 (non-significant)	0.220 (non-significant)
	'alone at night'	<0.001 (significant)	<0.001 (significant)

As in the comparisons of female only and male only, no incompatibility is seen in *Access to a Private Vehicle* after *Good Mood Questions* when all participants (females and males) are considered.

7.2.2.2 Discussion of Incompatibility per Access to a Private Vehicle in Ride-Share Service Questions after Good Mood Questions

The *Good Mood Questions* have been shown to be compatible with the factor of *Access to a Private Vehicle* overall, and for females and males separately. This is, unsurprisingly, due to the unrelated nature of the *Good Mood Questions* and the overall (females and males) comparison.

The next section describes the overall comparison between the Controls and the *Ride-Share Service Questions* after the *Good Mood Questions* for *COVID-19*.

7.2.3 COVID-19: Ride-Share Service Questions after Good Mood Questions

In the *Ride-Share Service Questions*, after *Good Mood Questions*, the responses are like those in the Controls, shown in Chapter 6, Section 6.3.1, with 'at night' and 'alone' showing a higher willingness to engage in ride-share services 'before-COVID-19', 'during COVID-19' and 'after COVID-19', than in 'alone at night'. Figure 82 shows the responses per *COVID-19* for the *Ride-Share Service Questions* after the *Good Mood Questions*.

Figure 82 mirrors the results in the Controls closely, with an average of 73.8% of individuals willing to use ride-share services 'at night' and an average of 72.2% of individuals willing to use ride-share services 'alone'. Like the Controls, a reduction in willingness to use ride-share services 'alone at night' is seen with an average of 48.6% of the individuals, after the *Good Mood Questions*, responding with 'yes'.

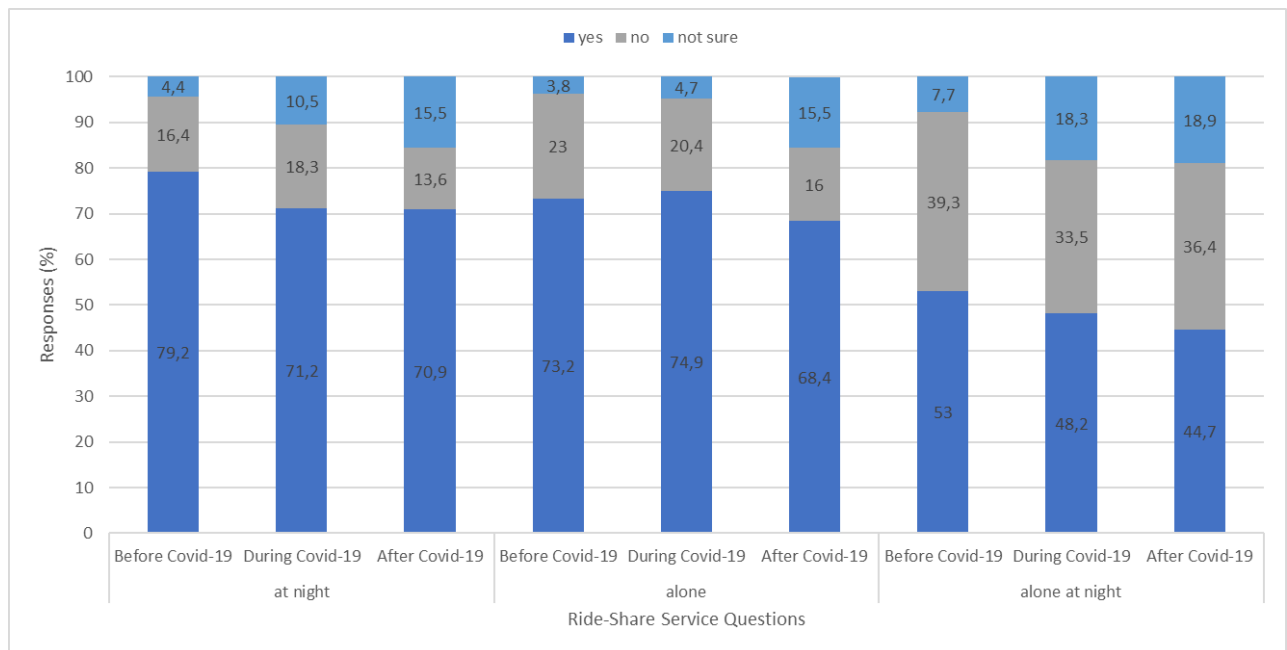


Figure 82: COVID-19 – Ride-Share Service Questions after Good Mood Questions in Percentages (Before, n=183; During, m=191; After, o=206)

The next section investigates the statistical significance of *COVID-19* in the responses to the *Ride-Share Service Questions* after the *Good Mood Questions*. The results are compared to the Controls to determine any evidence of incompatibility.

7.2.3.1 Evidence of Incompatibility per COVID-19 in Ride-Share Service Questions after Good Mood Questions

The Pearson Chi-Square test compares the significance of *COVID-19* in the Controls and in the *Ride-Share Service Questions* after *Good Mood Questions* (Experiment 4). This is done as the necessary cell counts and minimum values are achieved in all Pearson's Chi-Square tests. Table 40 shows the p-values of the tests.

Table 40: Pearson's Chi-Square Test for COVID-19 in Controls and Ride-Share Service Questions after Good Mood Questions

Personal Factor	Ride-Share Service Question	Controls (n=1398) p-Value	Experiment 4 (m=580) p-Value
COVID-19	'at night'	<0.001 (significant)	0.007 (significant)
	'alone'	<0.001 (significant)	<0.001 (significant)
	'alone at night'	<0.001 (significant)	0.015 (significant)

No difference in the significance of *COVID-19* is seen between the Controls and the *Ride-Share Service Questions* after *Good Mood Questions*. In the Controls, *COVID-19* is significant in 'at night' with $\chi^2(4) = 50.356$, $p < 0.001$, 'alone' with $\chi^2(4) = 53.428$, $p < 0.001$ and 'alone at night' with $\chi^2(4) = 22.260$, $p < 0.001$. Similarly, in Experiment 4, *COVID-19* is significant in 'at night'

with $\chi^2(4) = 14.229$, $p=0.007$, 'alone' with $\chi^2(4) = 23.495$, $p<0.001$ and 'alone at night' with $\chi^2(4) = 12.267374$, $p=0.015$.

7.2.3.2 Discussion of Incompatibility per COVID-19 in Ride-Share Service Questions after Good Mood Questions

The *Good Mood Questions* are compatible with the factor of *COVID-19* overall. This is unsurprising in an overall comparison. The overall comparison misses the incompatibility identified for females in 'alone at night' and for males in 'alone'. **This shows the value of the Personal Factor of Gender in the Belief State of the decisions involving uncertainty or risk, even with unrelated questions, such as those used in Good Mood Questions.**

The following section consolidates the findings of incompatibility in the *Ride-Share Service Questions*.

7.3 Résumé

This chapter explores the effect that pre-questions have on the *Ride-Share Service Questions*. The pre-questions of *Transport Factors* and *Good Mood Questions* are used to test if evidence of incompatibility can be found in the *Ride-Share Service Questions* by differences in the significance of the *Personal Factors* (*Gender*, *Access to a Private Vehicle*, *COVID-19*). This involves Experiment 2 data, for the effects of the *Transport Factors*, and Experiment 4 data, for the effects of the *Good Mood Questions*.

In the *Ride-Share Service Questions* after *Transport Factors* (Experiment 2), females and males demonstrated changes in the significance of the *Personal Factors*. The female-only Controls model has *Access to a Private Vehicle* as a significant factor, which becomes non-significant when 'at night' is asked after the *Transport Factors*. This change was seen because females, specifically those with access to a private vehicle, were encouraged to engage more with ride-share services 'at night'. This, therefore, resulted in females, with and without access to a private vehicle, responding with no statistically significant difference after the *Transport Factors*. However, no such change was seen in males per *Access to a Private Vehicle*.

However, females and males can be influenced by the pre-questions of *Transport Factors*, to respond more similarly per *COVID-19* scenario. This is seen in the second significant change after *Transport Factors* when *COVID-19* goes from being significant in the Controls to non-significant after *Transport Factors*. Females demonstrated this in 'alone at night', while males

demonstrated this in 'alone'. By using the *Belief States*, it was seen that after *Transport Factors*, individuals had more similar amplitudes of 'not sure' when compared to the amplitudes in the Controls.

The findings of the *Ride-Share Service Questions* after *Transport Factors* show that incompatibilities in ride-share service decisions are specific to the individuals. **Females and males both generated at least one case where a significant change was seen in one of the Personal Factors (Access to a Private Vehicle, COVID-19) so that the Null hypothesis for H2 can be tentatively rejected.** However, the results of this investigation point to a need for more specific and perhaps more explicit phrasing of the uncertainty and perceived risks that are wished to be investigated for more conclusive results. For Experiment 2, the α -level is 0.05 for Type I errors, while the β was calculated with $n=486$, using the Goodness of Fit test, to be 0.04, which meant the post-hoc test power was 0.96 and thus larger than 0.8, which is an acceptable level to ensure no Type II errors (Field, 2013).

As expected, the impact of *Good Mood Questions* on *Ride-Share Service Questions* is limited. The *Good Mood Questions* were designed to be utterly unrelated to ride-share service decisions. However, the design of the *Good Mood Questions* was to attempt to create a positive mood in the participants in Experiment 4. This resulted in a mitigating effect on the significant differences found with *COVID-19* for males in 'alone' and females in 'alone at night'. This indicates that the impacts of *COVID-19* within the *Ride-Share Service Questions* are mitigated by a more favourable initial emotional state of mind. However, this is only identified due to multiple analyses using the *Personal Factors* of the *Belief State* of individuals. A consistency between Experiment 2 and Experiment 4 is seen, as the change in the significance of *COVID-19* is consistently seen for females in 'alone at night' and males in 'alone'.

This is seen again in the conditional rejection of *H3* in the results of the *Ride-Share Service Questions* after *Good Mood Questions*, where only one significant change was found for females and males per *COVID-19*. However, the results also indicate that such investigations are useful when there are unusual circumstances, such as presented by the *COVID-19* pandemic. While responses regarding *Access to a Private Vehicle* produced no incompatibilities for females and males, *COVID-19* did for both genders. **Thus, the Null hypothesis of H3 can be partially rejected. Namely, for females ('alone at night') and males ('alone'), significant changes in willingness (or indecisiveness) can be found between the responses to the Ride-**

Share Service Questions of the Controls and Good Mood Questions (Experiment 4) for COVID- 19. However, for Access to a Private Vehicle the Null hypothesis of H3 cannot be rejected, as no evidence of incompatibility was found. For Experiment 4, the α -level is 0.05 for Type I errors, while β was calculated, post-hoc with $n=486$, using the Goodness of Fit to be 0.04, which meant the test power was 0.96 and thus larger than 0.8, which is an acceptable level to ensure no Type II errors (Field, 2013).

According to Pothos and Busemeyer (2022), incompatibility is most likely in decisions with high uncertainty or perceived risk. From the experiments of *Transport Factors* and *Good Mood Questions*, incompatibility is found in females for ‘at night’ and ‘alone at night’, yet, for males, the decision most likely to be incompatible is ‘alone’. Furthermore, it is interesting that ‘alone at night’ does not seem to present males with a particularly incompatible decision.

The results of the effects of the *Ride-Share Service Questions* on the responses of the *Transport Factors* are explored in the following chapter, Chapter 8.

8. Effects of *Ride-Share Service Questions* on *Transport Factors*

Chapter 7 showed the effects of the *Transport Factors* and the *Good Mood Questions* on the *Ride-Share Service Questions*. In this chapter, the impacts of the *Ride-Share Service Questions* ('at night', 'alone', 'alone at night') on the *Transport Factors* (*Sustainable Transport*, *Reliability* 'being on time', *Road Safety*, *Crime*) are explored.

The results presented here will show if the *Ride-Share Service Questions* lead to differences in the perceptions of *Transport Factors*. These differences can suggest that individuals think differently about *Transport Factors* after being first asked *Ride-Share Service Questions*. **Thus, Experiment 2 acts as the control group for the *Transport Factors* as there are no 'pre-questions'. The data from Experiment 3 provides the results for the experiment group, as the *Transport Factors* are asked after the *Ride-Share Service Questions*.**

This chapter, therefore, contributes to addressing *H4: Ride-share service decisions involving uncertainty and perceived risks increase the perceived importance of incompatible factors*. Therefore, the Null-Hypothesis for *H4* is that no significant differences can be found between the responses of the *Transport Factors* of Experiment 2 and Experiment 3, either overall or per *Personal Factor*. The Alternative-Hypothesis for *H4* is that significant differences can be found between the responses of the *Transport Factors* of Experiment 2 and Experiment 3, either overall or per *Personal Factor*.

First, statistical differences between the experiment group and the control group are reported overall for the *Transport Factors*. The effects of the *Ride-Share Questions* on the *Transport Factors* are then investigated using the Pearson Chi-Square tests, per *Personal Factor* of *Gender*, *Access to a Private Vehicle* and *COVID-19*. Additionally, each section explores the identified incompatibility using the construct of the *Belief States* in the *Transport Factors* (*Sustainable Transport*, *Reliability* ('being on time'), *Crime in Cape Town*, *Road Safety in Cape Town*).

8.1 Overall Differences in *Transport Factors* after *Ride-Share Service Questions* Compared to Control Group

Table 41 shows that *Reliability* ('being on time') is the only *Transport Factor* that results in a significant difference, $\chi^2(4) = 10.679$, $p=0.030$ between the control group and the experiment group responses at the 5% significance level, using Pearson Chi-Square. However, *Sustainable*

Transport with $\chi^2 (4) = 7.989$, $p=0.092$, and *Road Safety* with $\chi^2 (2) = 5.357$, $p=0.069$ indicate a significant difference at the 10% significance level. *Crime in Cape Town* shows no evidence of any difference between the control and experiment responses with $\chi^2 (2) = 1.155$, $p=0.561$.

Table 41: Summary of p-Values for Overall Comparison between Control Group (n=486) and Experiment Group (m=767)

Transport Factor	Pearson Chi-Square	Degree of Freedom	p-Value
Sustainable Transport	7.989	4	0.092 (significant at 10% significance level)
Reliability ('being on time')	10.679	4	0.030
Road Safety	5.357	2	0.069 (significant at 10% significance level)
Crime in Cape Town	1.155	2	0.561

Therefore, in the following sections, *Sustainable Transport*, *Reliability ('being on time')* and *Road Safety* are investigated further using the construct of the *Belief States* in Sections 8.2, 8.3 and 8.4, respectively.

8.2 Comparisons per Personal Factors of Sustainable Transport

The overall comparison in Table 41, between the perceptions of *Sustainable Transport* in the experiment and the control group, indicated a significant difference at the 10% significance level ($p=0.092$).

To explore this, Table 42 shows the p-values of the comparison between the experiment and control groups, per *Gender*, *Access to a Private Vehicle* and *COVID-19* for *Sustainable Transport*. Overall, *Gender* showed findings of females resulting in a non-significant difference, with $\chi^2 (4) = 6.376$, $p=0.173$. Furthermore, for males, a non-significant difference was found, with $\chi^2 (4) = 3.551$, $p=0.470$.

Next, *Access to a Private Vehicle* resulted in one significant (at 10% significance level) and one non-significant result. For individuals without access to a private vehicle, a significant difference at the 10% significance level is noted, with $\chi^2 (4) = 8.795$, $p=0.066$. For individuals with access, a non-significant difference was found, with $\chi^2 (4) = 2.148$, $p=0.708$.

Furthermore, in 'before COVID- 19', another significant difference at the 10% significance level is noted, with $\chi^2 (4) = 9.014$, $p=0.061$. For 'during COVID-19', a non-significant difference was found, with $\chi^2 (4) = 6.384$, $p=0.172$. For 'after COVID-19', a non-significant difference was found, with $\chi^2 (4) = 4.950$, $p=0.292$.

Table 42: Sustainable Transport Comparison per Personal Factors between Experiment Group and Control Group using Pearson Chi-Square

Sustainable Transport	Group	Pearson Chi-Square	Degree of Freedom	p-Value
Gender	Female	6.376	4	0.173 (non-significant)
	Male	3.551	4	0.470 (non-significant)
Access to a Private Vehicle	Access	2.148	4	0.708 (non-significant)
	No Access	8.795	4	0.066 (significant at 10% significance level)
COVID-19	'Before COVID-19'	9.014	4	0.061 (significant at 10% significance level)
	'During COVID-19'	6.384	4	0.172 (non-significant)
	'After COVID-19'	4.950	4	0.292 (non-significant)

Figure 83 further explores the specific proportions of responses to the *Ride-Share Service Questions* on *Sustainable Transport* for individuals without access to a private vehicle. Figure 83 shows that the largest difference in individuals without access to a private vehicle, between the experiment group and the control group, is seen in the category of 'very important', with 39% in the experiment group compared to 33% in the control group. This indicates that **asking *Ride-Share Service Questions* before the question of the importance of sustainable transport influences how important individuals, without access to a private vehicle, perceive sustainable transport. However, there appears to be no difference for individuals with access to a private vehicle.**

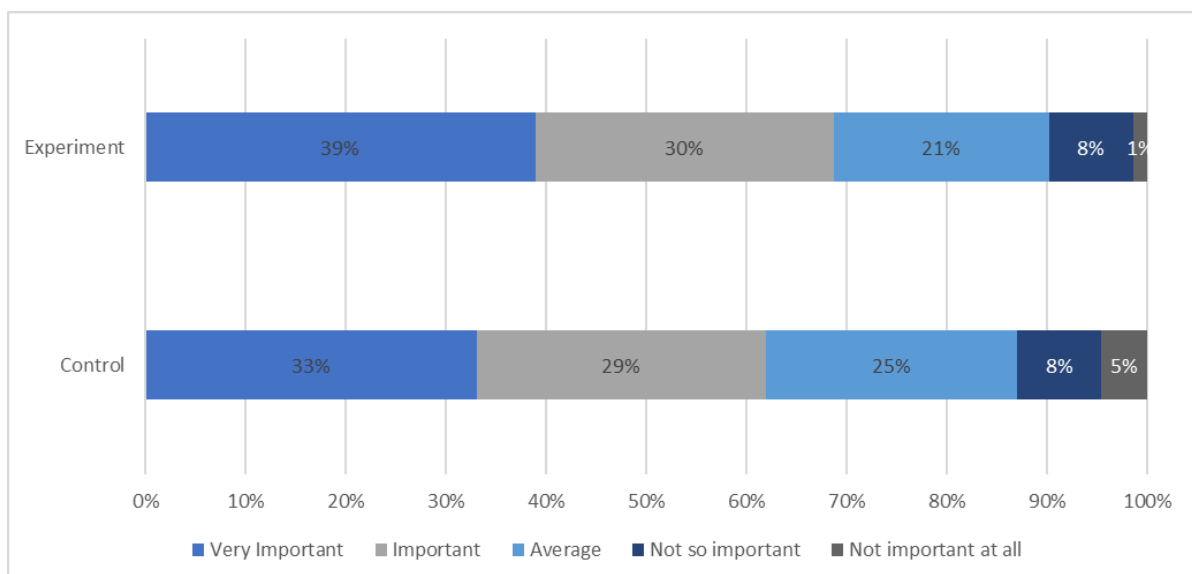


Figure 83: Sustainable Transport for Individuals without Access to a Private Vehicle (Control No Access, n=263; Experiment No Access, m= 429)

Using the data from Figure 83, the *Belief States* for individuals without access to a private vehicle can be created.

The amplitudes are calculated for the *Belief States* of individuals without access to a private vehicle in the control and in the experiment group, with the results summarised in Table 43. The responses were grouped as ‘important’ (‘very important’ and ‘important’), ‘average’ and ‘Not important’ (‘not so important’ and ‘not important at all’) to maintain the three-axis approach. This approach is also used in Section 8.3. The *Belief State* is defined as $|\Psi\rangle_{\text{No Access}} = a |Important\rangle + b |Average\rangle + c |Not Important\rangle$.

Table 43: Amplitudes of Belief States of Individuals without Access to a Private Vehicle for Sustainable Transport

Transport Factor	No Access to a Private Vehicle	a	b	c
Sustainable Transport	Experiment	0.83	0.46	0.30
	Control	0.79	0.50	0.36

Figure 84 shows the *Belief States* for individuals with access and those without access to a private vehicle for *Sustainable Transport*. From the perspective of ‘Important’-‘Average’, it can be seen that the *Belief State* of the control group has a smaller amplitude for ‘important’ ($a=0.79$) than the experiment group ($a=0.83$). Similarly, from the perspective of ‘Important’-‘Not Important’, it can be seen that the *Belief State* of the control group has a larger amplitude for ‘not important’ ($c=0.36$) than the experiment group ($c=0.30$). Figure 84 shows the resulting *Belief State* of the experiment, for individuals without access to a private vehicle, was in both perspectives, perceiving *Sustainable Transport* to be slightly more important than the control group.

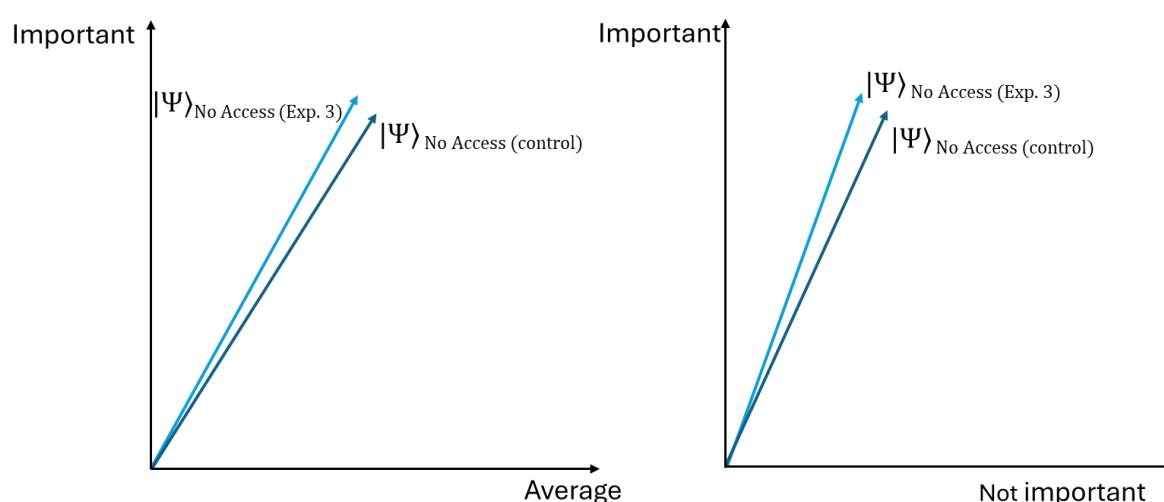


Figure 84: Belief States of Sustainable Transport for Individuals Without Access to A Private Vehicle in Experiment and Control

Next, the research explores the specific proportions of responses to the *Ride-Share Service Questions* on *Sustainable Transport* due to the significant difference at the 10% significance level in the scenario ‘before COVID-19’ ($p=0.061$). In Figure 85, most of the control group individuals (35%) perceived sustainable transport as ‘average’, while in the experiment group, most individuals (35%) perceived sustainable transport as ‘important’. This data suggests that *Ride-Share Service Questions* had a positive influence on how most of the individuals perceived *Sustainable Transport* in the experiment group, compared to the control group in the scenario of ‘before COVID-19’.

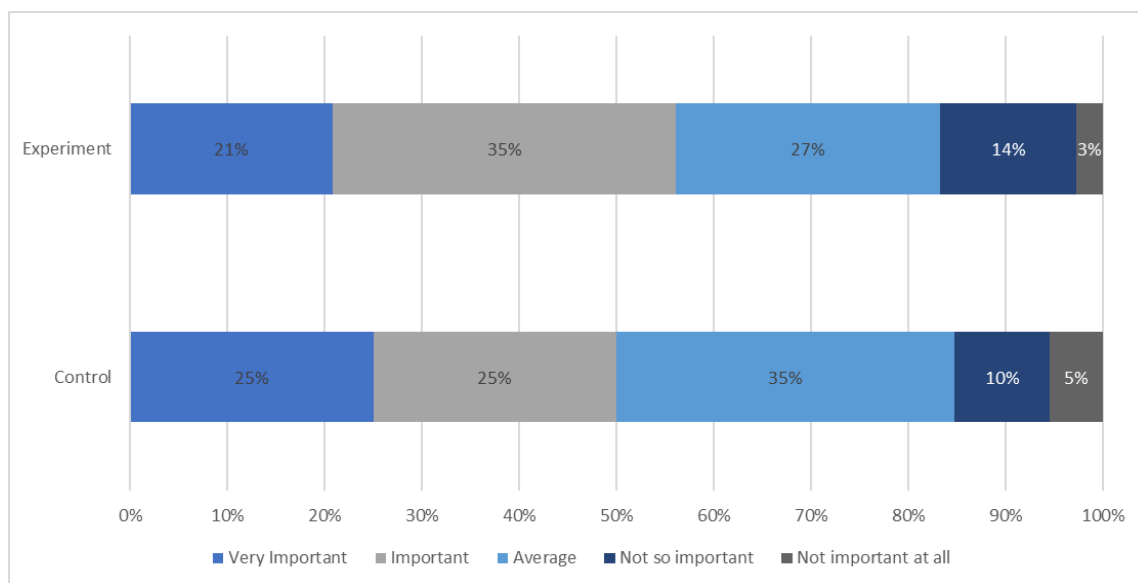


Figure 85: Sustainable Transport in ‘before COVID-19’ in Experiment and Control Groups (Control $n=164$; Experiment $m=221$)

The amplitudes are calculated for the *Belief States* of ‘before COVID-19’ with the results summarised in Table 44. The *Belief State* is defined as $|\Psi\rangle_{\text{Before COVID-19}} = a |Important\rangle + b |Average\rangle + c |Not\ Important\rangle$.

Table 44: Amplitudes of ‘Before COVID-19’ Belief States for Sustainable Transport in Control and Experiment Group

Transport Factor	Before COVID-19	a	b	c
Sustainable Transport	Experiment	0.75	0.52	0.41
	Control	0.71	0.59	0.39

Figure 86 shows the *Belief States* for *Sustainable Transport* in the control and experiment groups. From the perspective of ‘Important’-‘Average’, it can be seen that the *Belief State* of the control group has a smaller amplitude for ‘important’ ($a=0.791$) than the experiment group ($a=0.75$). From the perspective of ‘Important’-‘Not Important’, it can be seen that the *Belief*

State of the control group has a smaller amplitude for ‘not important’ ($c=0.39$) than the experiment group ($c=0.41$). Figure 86 shows that the resulting *Belief States* for *Sustainable Transport* for ‘before COVID-19’, for the experiment group and the control, were almost identical in the perspective of ‘important’-‘not important’. However, in the perspective of ‘important’-‘average’, the experiment group shows a *Belief State* that perceives *Sustainable Transport* with more importance compared to the control group.

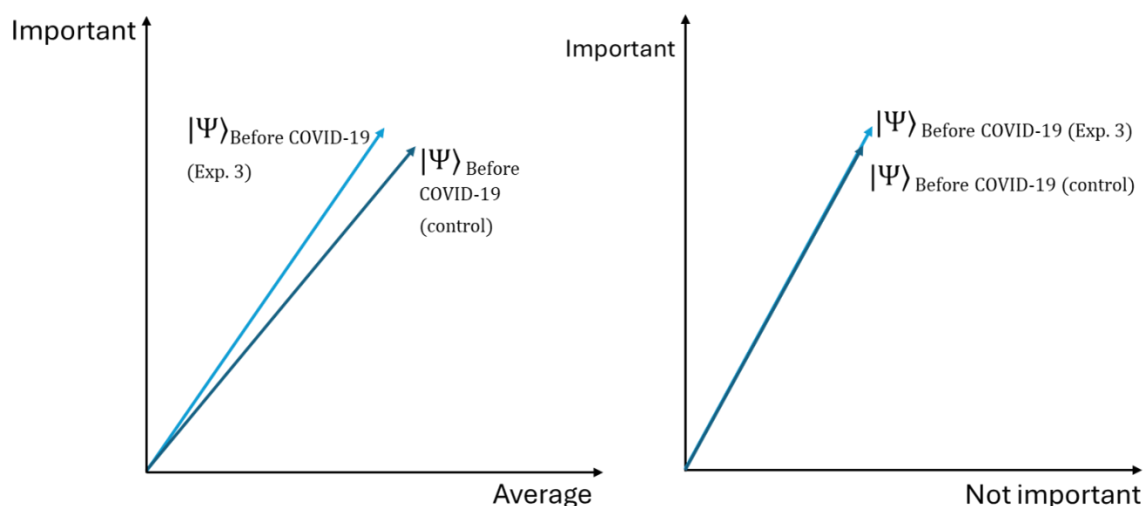


Figure 86: *Belief States of Sustainable Transport for ‘Before COVID-10’ in Experiment and Control*

This exploration suggests that some effect of the *Ride-Share Service Questions* on the perceptions of *Sustainable Transport* can be argued for. However, these results were only significant at the 10% significance level. Also, the results are limited, with differences only being seen in **individuals without access to a private vehicle** and ‘before COVID-19’, which is trivial.

Individuals without access to a private vehicle are, therefore, found to be influenced by the pre-questions of *Ride-Share Services Questions*, while individuals with access to a private vehicle are not. This may suggest that individuals with access to a private vehicle do not experience incompatibility in their perceptions of *Sustainable Transport*, while individuals without access to a private vehicle do. Similarly, in ‘before COVID-19’, an effect in the experiment group is seen, but in ‘during’ and ‘after COVID-19’, no significant difference is seen. This may suggest that individuals in the ‘before COVID-19’ experienced some incompatibility between the *Ride-Share Service Questions*, which was not experienced by the other groups of ‘during COVID-19’ and ‘after COVID-19’.

In conclusion, by using the construct of the *Belief States* of the *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*), limited but significant differences are seen in the perceptions of *Sustainable Transport* between the experiment group and the control group. This suggests that, while limited, incompatibility in *Sustainable Transport* can be demonstrated, to some degree, for two of the three *Personal Factors* (namely, *Access to a Private Vehicle* and *COVID-19*).

The next section explores the *Transport Factor* of *Reliability* in a similar manner.

8.3 Comparisons per *Personal Factors* of *Reliability* ('being on time')

Table 45 shows the results of *Personal Factors* for *Reliability* ('being on time'). There are two results that show significant differences at the 5% significance level. For females, a significant difference was found, with $\chi^2 (3) = 10.052$, $p=0.018$. However, for males, a non-significant difference was found, with $\chi^2 (3) = 1.645$, $p=0.649$.

A non-significant difference was found for individuals with access to a private vehicle, with $\chi^2(3) = 3.466$, $p=0.325$. However, a significant result at the 10% significance level is noted with individuals with no access to a private vehicle, with $\chi^2(3) = 6.573$, $p=0.087$.

A non-significant difference was found for 'before COVID-19', with $\chi^2 (2) = 0.269$, $p=0.874$. Furthermore, a non-significant difference was also found for 'after COVID-19', with $\chi^2 (2) = 2.300$, $p=0.317$. However, a significant difference was found for 'during COVID-19' with $\chi^2 (2) = 10.313$, with $p=0.006$. The responses to these three differences are illustrated and explored in Figure 87 for females, Figure 89 for individuals without access to a private vehicle, and Figure 91 for 'during COVID-19'.

Table 45: Reliability Comparison per Personal Factors between Experiment Group and Control Group

Reliability	Group	Pearson Chi-Square	Degree of Freedom	p-Value
Gender	Female	10.052	3	0.018
	Male	1.645	3	0.649
Access to a Private Vehicle	Access	3.466	3	0.325
	No Access	6.573	3	0.087 (significant at 10% significance level)
COVID-19	'before COVID-19'	0.269	2	0.874
	'during COVID-19'	10.313	2	0.006
	'after COVID-19'	2.300	2	0.317

Figure 87 shows the responses to the perceived importance of *Reliability* ('being on time') for females in the control and the experiment groups. The experiment group has a noticeably

larger proportion of ‘very important’, with 62%, compared to the control group with 54%. Asking the *Ride-Share Service Questions* before the *Reliability* (‘being on time’) question had a positive effect on the perceived importance of ‘being on time’ as ‘very important’ for females but not males. Once again, this indicates that the effects of asking *Ride-Share Service Questions* on the *Transport Factors* may be limited, but are significant for certain *Personal Factors*.

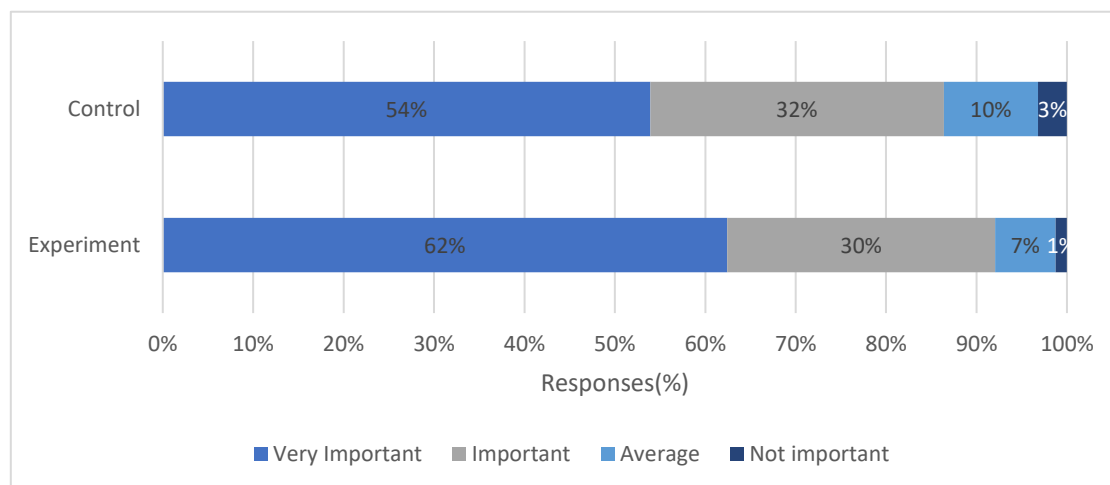


Figure 87: Reliability (‘being on time’) in Females in Experiment and Control Groups (Control n= 345; Experiment m=479)

The amplitudes are calculated for the *Belief States* of females for *Reliability*, with the results summarised in Table 46. The *Belief State* is defined as $|\Psi\rangle_{\text{Female}} = a | \text{Important} \rangle + b | \text{Average} \rangle + c | \text{Not Important} \rangle$.

Table 46: Amplitudes of Female Belief States for Reliability (‘Being on Time’)

Transport Factor	Female	a	b	c
Reliability	Control	0.93	0.32	0.17
	Experiment	0.96	0.26	0.10

Figure 88 shows the *Belief States* for *Reliability* in the control and experiment groups. From the perspective of ‘Important’-‘Average’, it can be seen that the *Belief State* of the control group has a smaller amplitude for ‘important’ ($a=0.93$) than the experiment group ($a=0.96$). From the perspective of ‘Important’-‘Not Important’, it can be seen that the *Belief State* of the control group has a larger amplitude for ‘not important’ ($c=0.17$) than the experiment group ($c=0.10$). Figure 88 shows that the experiment group generates a *Belief State* that perceives *Sustainable Transport* with more importance than the control group. This is the case for both perspectives.

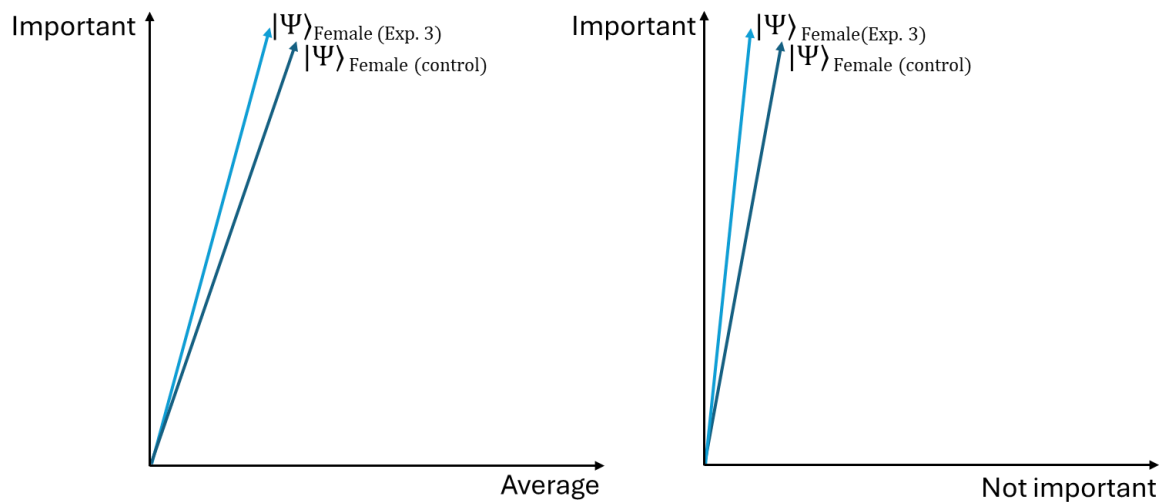


Figure 88: Belief States of Reliability for Females in Experiment and Control

This is seen in a similar manner in Figure 89, where the experiment group of individuals without access to a private vehicle shows 66% ‘very important’ compared to the control with 57%.

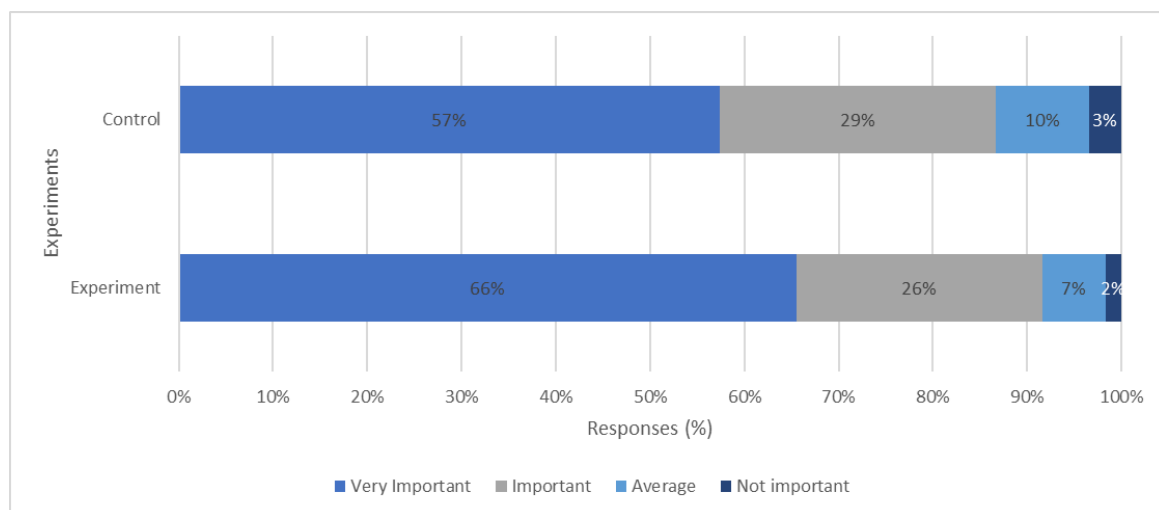


Figure 89: Reliability (‘Being on Time’) in Individuals without Access to a Private Vehicle in Experiment and Control Groups (Control n= 263; Experiment m=429)

The amplitudes are calculated for the *Belief States of Reliability* for individuals without access to a private vehicle, with the results summarised in Table 47. The *Belief State* is defined as $|\Psi\rangle_{\text{Reliability}} = a | \text{Important} \rangle + b | \text{Average} \rangle + c | \text{Not Important} \rangle$.

Table 47: Amplitudes of Belief States of Reliability for Individuals without Access to a Private Vehicle

Transport Factor	No Access to a Private Vehicle	a	b	c
Reliability	Control	0.93	0.32	0.17
	Experiment	0.96	0.26	0.14

Figure 89 shows the *Belief States* for *Reliability* for individuals without access to a private vehicle. From the perspective of ‘Important’-‘Average’, it can be seen that the *Belief State* of the control group has a smaller amplitude for ‘important’ ($a=0.93$) than the experiment group ($a=0.96$). From the perspective of ‘Important’-‘Not Important’, it can be seen that the *Belief State* of the control group has a larger amplitude for ‘not important’ ($c=0.17$) than the experiment group ($c=0.14$). Figure 89 shows that the experiment group generates a *Belief State* that perceives *Reliability* (‘being on time’) with somewhat importance, rather than the control group, in both perspectives.

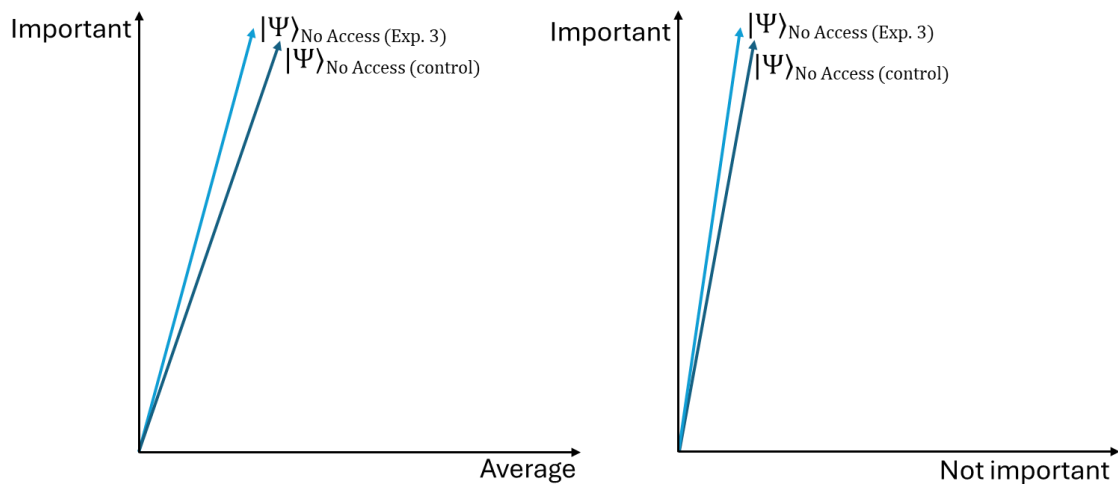


Figure 90: Belief States of Reliability for Individuals Without Access to a Private Vehicle in Experiment and Control

In ‘during COVID-19’, this difference in the responses of ‘very important’ is again seen in the experiment group, with 63%, versus the control group, with 53%.

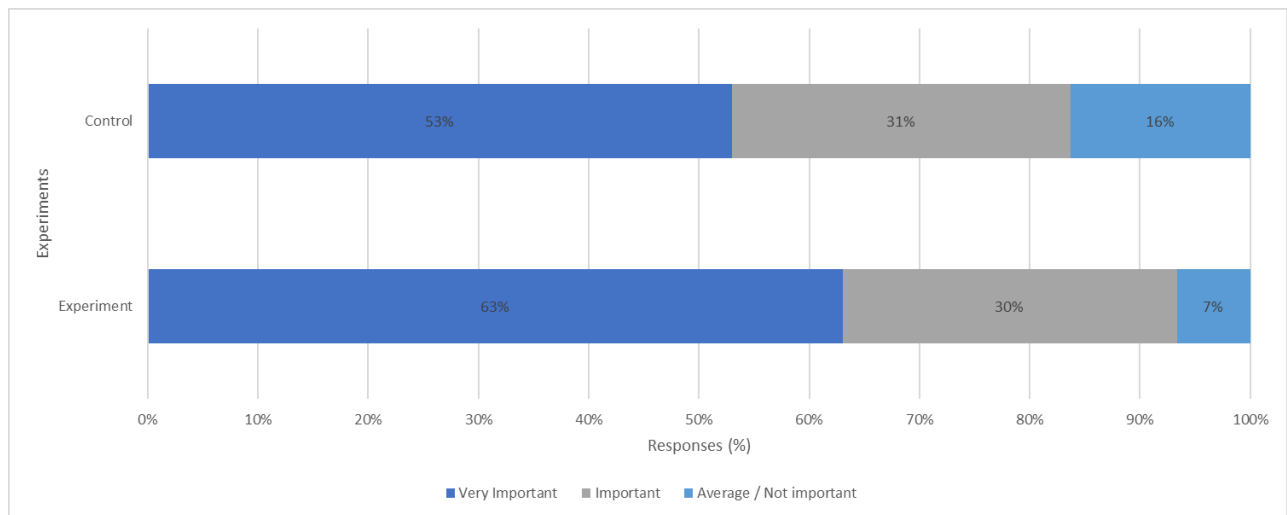


Figure 91: Reliability ('being on time') in 'During COVID-19' in Experiment and Control Groups (Control n=166; Experiment m=241)

The amplitudes are calculated for the *Belief States of Reliability* for 'during COVID-19', with the results summarised in Table 48. The *Belief State* is defined as $|\Psi\rangle_{\text{Reliability}} = a | \text{Important} \rangle + b | \text{Average}^{39} \rangle$

Table 48: Amplitudes of Belief States of Reliability for 'During COVID-19'

Transport Factor	During COVID-19	a	b	c
Reliability	Control	0.92	0.32	0.00
	Experiment	0.96	0.26	0.00

Figure 92 shows the *Belief States* for 'during COVID-19' for *Reliability*. From the perspective of 'Important'-'Average', it can be seen that the *Belief State* of the control group has a smaller amplitude for 'important' ($a=0.92$) than the experiment group ($a=0.96$). Furthermore, the control group had a larger amplitude for 'average/not important' ($b=0.32$), than the experiment group ($b=0.26$). Figure 92 shows that the experiment group generates a *Belief State* that perceives *Reliability* with clearly more importance than the control group.

³⁹ Category of 'average' and 'not important' were combined to ensure sufficient cell counts in Pearson Chi-Test.

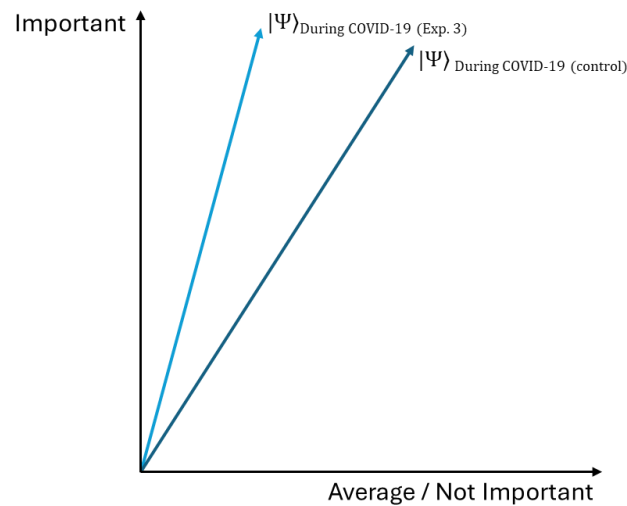


Figure 92: Belief States of Reliability for ‘During COVID-19’ in Experiment and Control

By using the construct of the *Belief States* of the *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*), limited, but significant differences, are seen in the perceptions of the *Reliability* between the experiment group and the control group. This suggests that, while limited, incompatibility in the *Reliability* can be demonstrated for all three *Personal Factors*.

In the next section, *Road Safety* is investigated per *Personal Factors*.

8.4 Comparisons per *Personal Factors* of *Road Safety*

Table 49 shows the results of the comparisons for *Road Safety* for each *Personal Factor* between the experiment and control groups. One difference at the 10% significance level is seen in females, with $\chi^2(2) = 4.899, p=0.086$. For males, a non-significant result was seen with $\chi^2(2) = 2.865, p=0.239$. Both individuals with and without access had non-significant results with $\chi^2(2) = 2.720, p=0.257$. and $\chi^2(2) = 2.668, p=0.263$, respectively.

One statistical difference at the 5% significance level is seen for ‘before COVID-19’, with $\chi^2(2) = 6.752, p=0.034$. However, ‘during’ and ‘after’ were non-significant with $\chi^2(2) = 0.316, p=0.854$ and $\chi^2(2) = 2.560, p=0.278$, respectively.

These two differences are illustrated in Figure 93 and Figure 95.

Table 49: Road Safety Comparison per Personal Factors between Experiment Group and Control Group

Road Safety	Group	Pearson Chi-Square	Degree of Freedom	p-Value
Gender	Female	4.899	2	0.086 (significant at 10% significance level)
	Male	2.865	2	0.239
Access to a Private Vehicle	Access	2.720	2	0.257
	No Access	2.668	2	0.263
COVID-19	'before COVID-19'	6.752	2	0.034
	'during COVID-19'	0.316	2	0.854
	'after COVID-19'	2.560	2	0.278

Figure 93 illustrates the responses of females in the experiment and control groups. In both groups, the proportions of 'safe' remains consistent, with 14% of the experiment group indicating 'safe' and 15% in the control group. The experiment group has a larger proportion of 'average' (76%) and a lower proportion of 'dangerous' (9%) compared to the control group (71% 'average', 14% 'dangerous'). The effect of the *Ride-Share Service Questions*, therefore, can be summarised as having a slight positive effect on the road safety perception in females.

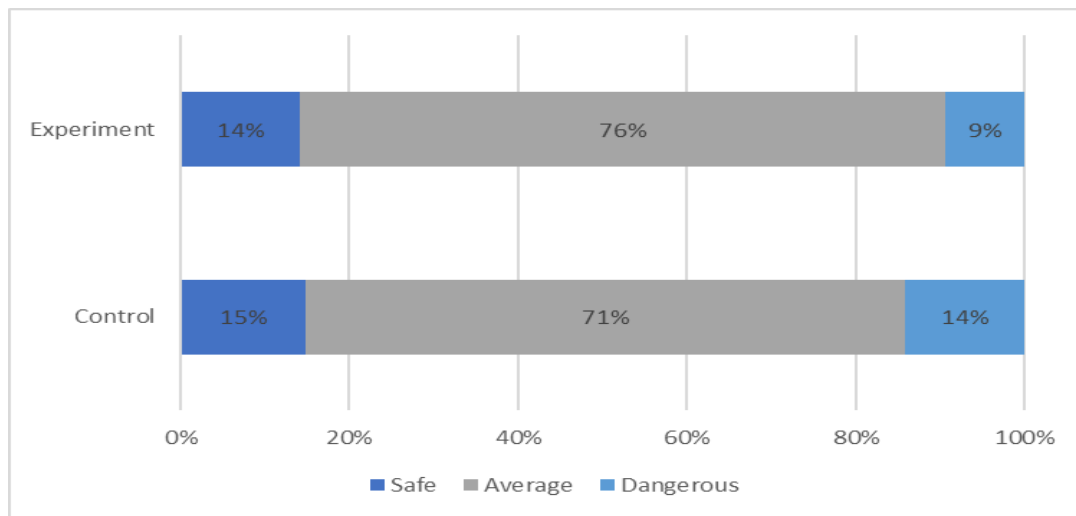


Figure 93: Road Safety in Females in Control and Experiment Groups (Control n=345; Experiment m=479)

The amplitudes are calculated for the *Belief States* of *Road Safety* for females, with the results summarised in Table 50. The *Belief State* is defined as $|\Psi\rangle_{\text{Road Safety}} = a |Safe\rangle + b |Average\rangle + c |Dangerous\rangle$.

Table 50: Amplitudes of Female Belief States of Road Safety

Transport Factor	Female	a	b	c
Road Safety	Control	0.39	0.84	0.37
	Experiment	0.37	0.87	0.30

Figure 94 shows the *Belief States* for *Road Safety* for females in Experiment and Control. From the perspective of ‘Average’ –‘Safe’, it can be seen that the *Belief State* of the control group has a larger amplitude for ‘safe’ ($a=0.39$) than the experiment group ($a=0.37$). From the perspective of ‘Average’-‘Dangerous’, it can be seen that the *Belief State* of the control group has a larger amplitude for ‘dangerous’ ($c=0.37$) than the experiment group ($c=0.30$). Figure 94 shows that the experiment group generates a *Belief State* that perceives *Road Safety* to be more ‘normalised’ (average) than the control group.

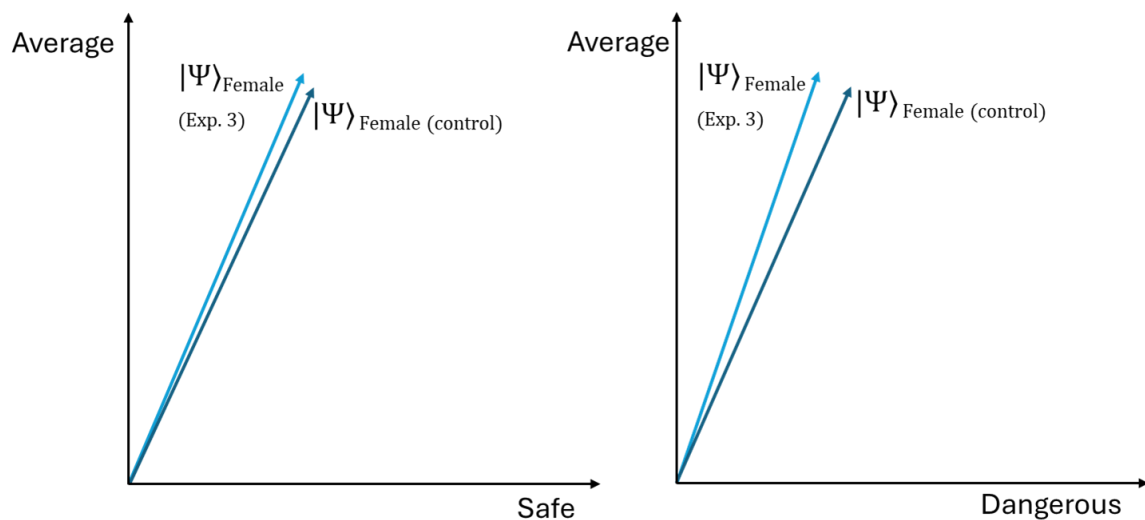


Figure 94: *Belief States of Road Safety for Females in Experiment and Control*

Next, the final illustration is provided for *Road Safety* in ‘before COVID-19’ in Figure 95. In this perspective, the ‘average’ proportions in the experiment and control group are similar with 72% and 71%, respectively. However, the experiment group has a larger proportion of those that selected ‘safe’, with 19% compared to the 13% of the control group, and a smaller proportion in ‘dangerous’, with 9%, compared to the control group, with 16%.

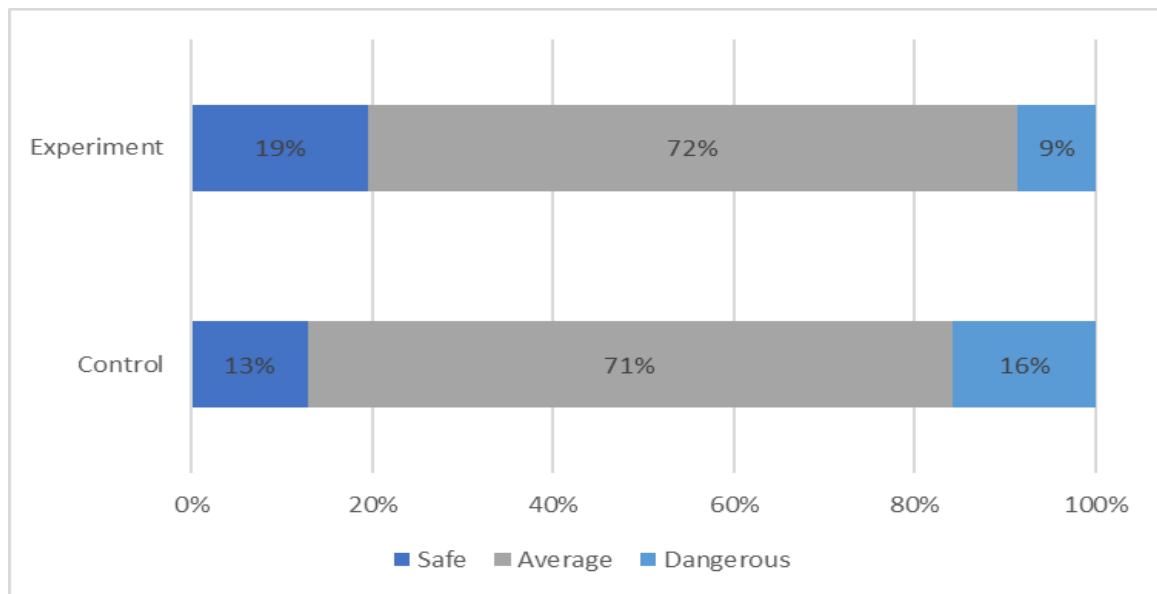


Figure 95: Road Safety in 'before COVID-19' in Control and Experiment Groups (Control n=164; Experiment m=221)

The amplitudes are calculated for the *Belief States* of *Road Safety* for 'before COVID-19', with the results summarised in Table 51. The *Belief State* is defined as $|\Psi\rangle_{\text{Road Safety}} = a |Safe\rangle + b |Average\rangle + c |Dangerous\rangle$.

Table 51: Amplitudes of Belief States of Road Safety for 'Before COVID-19'

Transport Factor	Before COVID-19	a	b	c
Road Safety	Control	0.36	0.84	0.40
	Experiment	0.44	0.85	0.30

Figure 96 shows the *Belief States* for 'before COVID-19' for *Road Safety*. From the perspective of 'Average' – 'Safe', it can be seen that the *Belief State* of the control group has a smaller amplitude for 'safe' ($a=0.36$) than the experiment group ($a=0.44$). From the perspective of 'Average' – 'Dangerous', it can be seen that the *Belief State* of the control group has a larger amplitude for 'dangerous' ($c=0.40$) than the experiment group ($c=0.30$). Figure 96 shows that the experiment group generates a *Belief State* that perceives *Road Safety* that is more positive, i.e. less dangerous and more safe, compared to the *Belief State* of the controls.

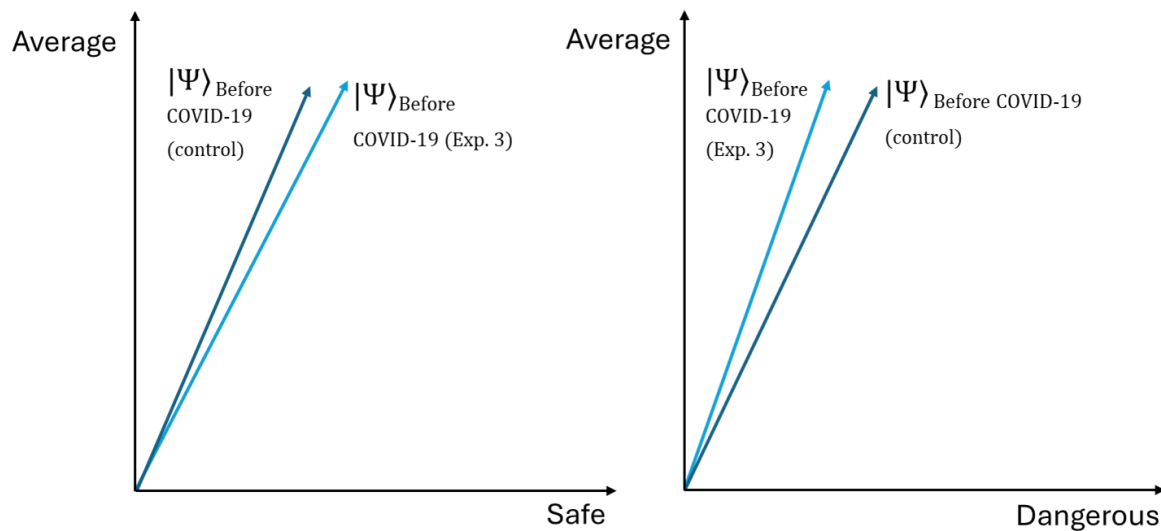


Figure 96: Belief States of Road Safety for 'Before COVID-19' in Experiment and Control

By using the construct of the *Belief States* of the *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*), limited, but significant differences, are seen in the perceptions of the *Road Safety* between the experiment group and the control group. This suggests that, while limited, incompatibility in *Road Safety* can be demonstrated for all two *Personal Factors* (namely, *Gender* and *COVID-19*).

The following section summarises the main outcomes of this chapter.

8.5 Résumé

The effects of asking the *Ride-Share Service Questions*, before asking the perceptions of the *Transport Factors* (*Sustainable Transport, Reliability ('being on time'), Road Safety, Crime*) compared to the controls, is limited. This was to be expected as the *Transport Factors* were not designed to involve uncertainty and perceived risks. However, despite this, some statistically significant differences at both 5% and 10% significance levels were captured using the construct of the *Personal Factors*. The differences in both the overall and per *Personal Factor* investigations show that there are indeed some 'black swans' and, therefore, the Null-Hypothesis of *H4* can be rejected.

However, considering the few findings at 5% significance level, while such effects in incompatible factors can exist, these findings are incredibly difficult to find. **The findings of this research suggest that, unless there are elements of uncertainty and perceived risks in the incompatible factors, it is unlikely that investigating these kinds of effects will generate insightful findings. Therefore, it is likely that incompatibility investigations should be**

restricted to decisions involving uncertainty and perceived risks, such as seen in Chapter 7, and not the related (incompatible) factors that have little or no uncertainty and (perceived) risks in them.

A post-hoc power test was conducted for the results with α -level is 0.05 for Type I errors, while the β was calculated using the Goodness of Fit test to be 0.18 with $n=1253$, which meant the test power was 0.82 and thus larger than 0.8, this is an acceptable level to ensure no Type II errors (Field, 2013).

Sustainable Transport demonstrated two differences at the 10% significance level in individuals without access to a private vehicle ($p=0.066$) and in 'before COVID-19' ($p=0.061$). In both cases, **the experiment group (i.e with the *Ride-Share Service Questions* as pre-questions) indicated a higher perception of the importance of *Sustainable Transport* compared to the control group.**

Reliability ('being on time') demonstrated two differences at the 5% significance level in females ($p=0.018$) and 'during COVID-19' ($p=0.006$). A further difference at the 10% significance level in individuals without access to a private vehicle ($p=0.087$) was also seen. In all cases, **the experiment group indicated a higher perception of the importance of *Reliability ('being on time')* compared to the control group.**

Road Safety demonstrated one difference at the 5% significance level in 'before COVID- 19' ($p=0.034$) and a second difference at the 10% significance level in females ($p=0.086$). **In females, the experiment group indicated a more moderated perception of the importance of *Road Safety*, compared to the control group, with more responses in the 'average' category, while with 'before COVID-19', the experiment group had a more positive perception of *Road Safety*, with a larger proportion of 'safe' and a smaller proportion of 'dangerous' compared to the controls.**

Lastly, for completeness, in the *Transport Factor of Crime*, no statistical difference was seen between the experiment and control group. Therefore, no further explorations were required. This indicates that individuals do not link ride-share services with levels of crime in Cape Town. There may be a link between making ride-share service decisions and the other *Transport Factors of Sustainable Transport, Reliability ('being on time')* and *Road Safety* perceptions. However, it is limited to specific *Personal Factors*.

In the next chapter, the main discussion of the thesis is presented.

9. Discussion: Summary and Interpretations of Key Findings

Overall, this research is aimed at exploring ride-share service decisions of young adults in Cape Town, involving uncertainty and perceived risks. Furthermore, the research explored whether these types of decisions are ‘created’ rather than ‘recalled’. In other words, are young adults in Cape Town creating these ride-share service decisions based on their current frame of mind or *Belief State*? Or, as seen in utility theories (such as EUT or RUM), is it still sufficient to assume that these decisions are ‘recalled’ from the memory of the individual?

This chapter will first discuss the implications of incorporating the QPT concepts of *Belief States (Personal Factors)* into ride-share service decisions involving uncertainty and perceived risk (namely the *Ride-Share Service Questions*) in Section 9.1. Following this, Section 9.2 focuses on the incompatibility experiments. The first experiment involved the related *Transport Factors*’ effects on the responses to the *Ride-Share Service Questions*, followed by the second experiment, which involved the unrelated positive framing effects of the *Good Mood Questions* on the *Ride-Share Service Questions*. Lastly, Section 9.3 discusses the effects that the *Ride-Share Service Questions* had on the responses to the *Transport Factors*. This chapter then consolidates all these findings in Section 9.4.

Ride-share services in Cape Town are a minor transport mode, with roughly 1% of the transport modal split⁴⁰ in the 2020 data of the NHTS (Statistics South Africa, 2020). However, ride-share services have the potential to meet the needs of the missing middle of South Africa (Vanderschuren and Baufeldt, 2018). This aligns with the findings of the characteristics of the respondents of the four experiments in this research (Chapter 5), which showed that the majority of both female and male respondents, without access to a private vehicle, used ride-share service for multiple trips per week, while the majority of those with access to a private vehicle only reported using ride-share services for the odd occasion or only for specific trip types (i.e., not on a weekly basis).

The experience of ride-share services seen in the respondents, in general, was very favourable, with only roughly 1% of all individuals describing their experiences with ride-share services as ‘negative’. The majority of male respondents described their experiences with ride-share services as ‘positive’, while females indicated a more mixed response between ‘positive’ or

⁴⁰ As discussed in Chapter 4.

‘mixed’ (i.e., having both ‘positive’ and ‘negative’ ride-share service experiences). Furthermore, the respondents’ overall experiences of ride-share services were less ‘positive’ and more ‘mixed’ for both females and males ‘after COVID-19’ than ‘before’ or ‘during COVID-19’, as seen in Chapter 5, Section 5.5.4.1.

The respondents were randomly assigned to four different experiments. The first experiment group focused only on the *Ride-Share Service Questions*. The second experiment group had the pre-questions of *Transport Factors* before the *Ride-Share Service Questions*, while the third experiment had the *Ride-Share Service Questions* as the pre-questions and the *Transport Factors* as the second set of questions. Finally, the fourth experiment had the respondents first answer the *Good Mood Questions*, as pre-questions, before the *Ride-Share Service Questions*. The experimental surveys investigated the role of personal security uncertainty and perceived risks in ride-share service decisions of young adults in Cape Town. To do so, relevant characteristics of young adults that influence ride-share service decisions were incorporated into the conceptualisation of the *Belief States* (*Gender, Access to a Private Vehicle, COVID-19*) in the different experiments. By comparing the differences in responses of the four experimental groups, the data was explored for evidence of incompatibility in ride-share service decisions involving uncertainty and perceived risks. This research explored ‘created’ rather than ‘recorded’ ride-share service decisions, using the QPT concept of *Belief States* and *incompatibility* in several experiments distributed through online surveys to university students in Cape Town.

The advantages of the approach used in this research are the nuanced findings that were identified using the conceptualisation of the *Belief States*, supported by the statistical analysis identifying significant differences in the responses between different individuals. Thus, the research highlights those young adults in Cape Town that experience incompatibility in their ride-share service decisions involving personal security uncertainty and perceived risks.

The following section presents detailed discussions around each hypothesis of this thesis.

9.1 Findings for Uncertainty and Perceived Risks Using the Concept of *Belief States*

This section describes the construction and implementation of the *Belief States* in the investigations, through *H1*, which was the focus of Chapter 6.

H1: Uncertainty and perceived risks of personal security decrease the willingness to use ride-share services in young South African adults.

The three factors selected for this study that were used to measure the *Belief State* were based on the characteristics of young adults in the case study of Cape Town and included the timing of the data collection (namely during the COVID-19 pandemic). In this study, these factors were referred to as *Personal Factors* and consisted of *Gender* (female, male), *Access to a Private Vehicle* (individuals with access to a private vehicle, individuals without access to a private vehicle), and *COVID-19* ('before COVID-19', 'during COVID-19', 'after COVID-19'). The uncertainty and perceived risks related to personal security were presented in the *Ride-Share Service Questions* and focused on 'at night', 'alone' and 'alone at night'.

The *Belief State* factor of *Gender* was the most important factor in better understanding how individuals responded to the *Ride-Share Service Questions* ('at night', 'alone', 'alone at night'). Differences between male and female responses to *Ride-Share Service Questions* were the largest for all three options ('at night', 'alone' and 'alone at night') rather than between those with and without *Access to a Private Vehicle*, or between responses to 'before', 'during' and 'after COVID-19'. This was to be expected due to the high incidents of gender-based violence in Cape Town (SACN, 2019).

However, it was surprising that even with ride-share services' additional safety and security features, such as trip-sharing notifications that may be sent to family or friends, females' uncertainty or perceived risk is not adequately mitigated, as seen by the large differences between females and males. This indicates that more needs to be done within the ride-share services, especially for females travelling 'at night' and, most critically, for those travelling 'alone at night' (Baufeldt and Vanderschuren, 2023).

Furthermore, females with access to a private vehicle were particularly wary of trips 'alone at night' compared to females without access to a private vehicle. This could indicate that females use access to a private vehicle to mitigate their uncertainty and perceived risks, especially about personal security. Alternatively, it may suggest that, while females do not have access to a private vehicle, they tolerate their uncertainty and perceived risks, as they do not have a better alternative.

In the South African context, gender has been debated in the literature as being a significant factor in many decisions, especially regarding travel or transport decisions, as discussed in Chapter 2 and expanded on in Chapter 4. Previous qualitative research on ride-share services in South Africa provided some indication that females and males might respond differently regarding ride-share services (Fenton et al., 2020; Giddy, 2019). However, this is the first study that provides strong statistical evidence that females and males respond differently to ride-share services involving uncertainty and perceived risk, such as trips ‘at night’, ‘alone’ and ‘alone at night’. This finding is particularly interesting as nearly all previous research has indicated that ride-share services are perceived as safer options for females compared to other forms of public transportation or walking (Fenton et al., 2020; Giddy, 2019). However, the data suggests that ride-share services may, instead, simply be the ‘lesser evil’.

The inclusion of *Access to a Private Vehicle* as a *Belief State* factor was especially important, due to the lack of insight between South Africans with and without access to a private vehicle in their ride-share service decisions and behaviours in the existing literature. As seen in Chapter 2, overall, the literature on ride-share services in South Africa is limited, and some of those studies use samples that are highly skewed to middle-higher income groups and or those with access to a private vehicle (e.g., Giddy, 2019). With the respondents of this work having a balanced split between individuals with (45%) and those without access to a private vehicle (55%), this work contributes to a more comprehensive understanding of how private vehicle access influences both perceptions and decisions around ride-share service trips involving uncertainty and perceived risk.

The investigations conducted in this study clearly show that having access to a private vehicle or not impacts how individuals decide on the *Ride-Share Service Questions* of ‘at night’ and ‘alone at night’. The data suggests that having access to a private vehicle reduces the likelihood of individuals undertaking a ride-share service trip that involves personal security uncertainty and perceived risks. However, there is no significant difference for ride-share service trips ‘alone’. This suggests that for ride-share service trips ‘alone’, but not explicitly ‘at night’, the existing measures in ride-share services are sufficient for addressing the uncertainty and perceived risks between individuals with and without access to a private vehicle.

The *Belief State* factor of *COVID-19* also generated interesting findings in the control data presented in Chapter 6. All *Ride-Share Service Questions* differed significantly when prompted as ‘before’, ‘during’ and ‘after’ the pandemic. The surprising finding in *COVID-19* was that ‘after *COVID-19*’ had the largest difference in willingness to say ‘yes’ to the *Ride-Share Service Questions*. This implies that individuals did not expect a ‘return to normal’. This is particularly interesting, as it implies that ‘after *COVID-19*’ is not a resolution of uncertainties for individuals, especially those without access to a private vehicle. Rather, this research shows that ‘after *COVID-19*’ presents individuals with different and, possibly, new uncertainties.

The data suggests that deciding on ride-share services, especially ‘at night’, is heavily influenced by which *COVID-19* scenario the respondents had. This is most likely due to the types of restrictions that were in place during the hard lockdowns. Furthermore, the effects on ride-share service trip decisions involving personal security uncertainty and perceived risks, are likely to be maintained, or increase in the future, as suggested by the data captured for ‘after *COVID-19*’. This finding aligns with other literature and models that have explored the effects of *COVID-19* on ride-share services in a post-*COVID-19* scenario (for example, Baufeldt and Vanderschuren, 2023, Beck and Hensher, 2020; Lei and Ukkusuri, 2022).

It was demonstrated that males without access to a private vehicle were noticeably discouraged from using ride-share services ‘during *COVID-19*’ (compared to ‘before *COVID-19*’) for trips ‘alone’ compared to their female counterparts. This may suggest that ‘during *COVID-19*’ uncertainty and perceived risks that were introduced for males were a particularly new experience compared to females who seem not to have such a difference in their experience of these decisions between ‘before *COVID-19*’ and ‘during *COVID-19*’, especially for ‘alone’.

Having shown that the *Personal Factors* were influential in the *Belief States* of the individuals, the next section discusses the findings and implications of incompatibility in ride-share service decisions involving uncertainty and perceived risks, using the related *Transport Factors* and the unrelated *Good Mood Questions* as pre-questions to the *Ride-Share Service Questions*.

9.2 Findings for Incompatibility and Positive Framing in *Ride-Share Service Questions*

The results presented in Chapter 7 focused on evaluating the second and third hypotheses. The second hypothesis, *H2*, explored the QPT concept of incompatibility for young South Africans.

H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks.

The incompatible factors (i.e., related factors) used in the experiments were referred to as the *Transport Factors*. Based on the characteristics of the Cape Town case study, the *Transport Factors* were formulated to ask the respondents their perceptions of *Sustainable Transport, Reliability* ('being on time'), *Road Safety* and *Crime*.

Experiment 2 explored the concept of incompatibility in transport decisions (*Ride-Share Service Questions*) and related perceptions (*Transport Factors*). The respondents were first presented with the *Transport Factors* before the *Ride-Share Service Questions* in the surveys. These results were then compared to the data of respondents who answered the *Ride-Share Service Questions* with no pre-questions (Chapter 6).

Due to the skew towards female respondents identified in the earlier chapter and initial results, the data was separated by *Gender*. When individuals were first asked the *Transport Factors* and then the *Ride-Share Service Questions*, several differences were seen in the responses to the *Ride-Share Service Questions*. Females demonstrated a change in the significance of interactions for both *Access to a Private Vehicle* in the *Ride-Share Service Question* of 'at night' (significant in the control data⁴¹ to non-significant in Experiment 2) and in *COVID-19* in the *Ride-Share Service Question* of 'alone at night' (significant in the control data to non-significant in Experiment 2). These findings suggest that related factors, or *Transport Factors*, influence ride-share service decisions involving uncertainty and perceived risks for females. Most interestingly, when females reflect on related factors, presented in *Transport Factors*, the incompatibility that is captured is always positive, with females responding with more willingness to engage in ride-share service trips involving uncertainty and perceived risks.

⁴¹ Chapter 6 discussions

Males also demonstrated one case of incompatibility. In the *Ride-Share Service Question* of ‘alone’, the factor of *COVID-19* was significant in the control data but non-significant in Experiment 2. However, due to the relatively small sample sizes in the male Experiment 2 data, care should be taken when interpreting this finding. Furthermore, the limited findings in the male data confirm that males, generally, experience less uncertainty and perceived risks in ride-share service trips ‘at night’, ‘alone’ and ‘alone at night’. This can be drawn from the much higher proportions of males willing to take ride-share service trips under these conditions compared to females.

Next, the third hypothesis, H3, considers the potential effects of positive framing:

H3: Positive emotional framing in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty and perceived risks.

The responses to the *Ride-Share Service Questions* after the *Good Mood Questions* (Experiment 4) were analysed using log-linear models (female data) or Pearson Chi-Square tests (male data). This was done to determine if further differences in *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*) could be seen (as compared to the control data reported in Chapter 6) in the responses to *Ride-Share Service Questions* when they were asked after *Good Mood Questions*. The *Good Mood Questions* were formulated based on previous research, such as Cassotti et al. (2012), Seo and Barrett (2007), and Sobkow et al. (2020). While the *Good Mood Questions* are unrelated to *Ride-Share Service Questions*, they were designed to be emotionally positive, potentially influencing responses.

Females demonstrated only one difference in the significance of interactions relative to the Controls. This was captured for *COVID-19* in the *Ride-Share Service Question* of ‘alone at night’ (significant in the control data to non-significant in Experiment 4). This finding suggests that the *COVID-19* pandemic may have an emotional component for females, due to the higher levels of uncertainty and anxiety, as reported in the literature reviewed in Chapter 2 and Chapter 4. It is interesting that the *Good Mood Questions* were able to mitigate the associations of the *COVID-19* pandemic to result in a significant difference for the *Ride-Share Service Question* that involved the highest levels of unwillingness for females. This presents a novel finding that captures a positive emotional effect on ride-share service decisions for females in South Africa.

Males also demonstrated one case where positive framing resulted in a change of significant factors. In the *Ride-Share Service Question* of 'alone', the factor of *COVID-19* was significant in the control data but non-significant in Experiment 4. However, as with the *Ride-Share Service Question* responses, these results should be handled with caution, due to the relatively small sample sizes in the male Experiment 4 data.

The next section looks at the findings and discussions surrounding the final hypothesis, *H4*.

9.3 Findings for Incompatibility in *Transport Factors* Caused by *Ride-Share Service Questions* (Chapter 8)

The final hypothesis investigated whether differences could be seen in the responses of the *Transport Factors* (containing no uncertainty and perceived risks) when the *Ride-Share Service Questions* (containing uncertainty and perceived risks) act as the pre-questions:

H4: Ride-share service decisions involving uncertainty and perceived risks increase the importance of incompatible factors.

In Chapter 8, the responses to the *Transport Factors* (after *Ride-Share Service Questions*) were analysed using Pearson Chi-Square tests to determine if differences in the responses of the *Transport Factors* could be seen per *Personal Factor* (*Gender*, *Access to a Private Vehicle*, *COVID-19*) compared to the control data (Chapter 6, Sections 6.1.2, 6.2.2, 6.3.2).

The results regarding perceptions of *Crime* indicated that the *Ride-Share Service Questions* did not affect the responses. The *Ride-Share Service Questions* appeared to influence the *Transport Factors* of *Sustainable Transport* and *Road Safety*. However, these differences were only captured at the 10% significance level. *Ride-Share Service Questions* resulted in a slight increase in the level of perceived importance for both *Sustainable Transport* and *Road Safety*, as rated by respondents. Finally, for *Reliability* (i.e., 'being on time'), differences were detected at the 5% significance level supporting *H4*, indicating incompatibility. Further analysis indicated that the effects were limited to changes in the perceived importance of females and 'during COVID-19'. Access to a private vehicle also appeared to affect *Reliability* ('being on time'), although the latter is supported at the 10% significance level.

Therefore, while the effects of the *Ride-Share Service Questions* on the responses to the *Transport Factors* are limited, they do exist. This provides a first indication that incompatibility can also be found in decisions that do not focus on uncertainty and perceived risks but are

related to decisions that do involve uncertainty and perceived risks (i.e., *Ride-Share Service Questions*). However, the limited number of significant findings suggest that such aspects only need to be considered when there is a strong connection between the individual, the related question and the question involving uncertainty and perceived risks. This may also speak to the importance of decisions made on a habit or attitude-based approach (Verplanken et al., 1994), where, if the individuals have strong habits, the attitude-behaviour relation is weak, while when the habit is weak, the attitude-behaviour connection is dominant.

The effects of the *Ride-Share Service Questions* on *Sustainable Transport*⁴² (individuals without access to a private vehicle; ‘before COVID-19’), *Reliability* (females, individuals without access to a private vehicle⁴³, ‘during COVID-19’) and *Road Safety* (females⁴⁴, ‘before COVID-19’) were specific and limited. It is interesting to note that in all the captured differences, asking *Ride-Share Service Questions* before the specific *Transport Factors* resulted in an increase in the perceived importance of the *Transport Factor*. This may suggest that, in certain investigation circumstances, asking ride-share service questions that involve uncertainty and perceived risks may induce an increased perception of importance in related aspects. However, these effects may only affect certain decisions for certain *Belief States* (as demonstrated here through the *Personal Factors* of *Gender*, *Access to a Private Vehicle* and *COVID-19*).

This study does show evidence that care should be taken when investigating ride-share service questions involving uncertainty and perceived risks and related aspects, especially for individuals who are dependent on ride-share services (i.e. individuals without access to a private vehicle) or more susceptible to uncertainty (i.e. females) or the context of the investigation (i.e. ‘before COVID-19’ and ‘during COVID-19’).

9.4 Consolidation of the Interpretations of Findings

The data suggests that young adults making ride-share service decisions involving personal security uncertainty and perceived risks (i.e. ‘Would you use ride-share services at night/alone/alone at night?’) can be affected by their frame of mind, i.e. *Belief State*, formulated through the *Personal Factors* (*Gender*, *Access to a Private Vehicle*, *COVID-19*), at the time of creating the decision.

⁴² Significant differences at 10% significance level

⁴³ Significant differences at 10% significance level

⁴⁴ Significant differences at 10% significance level

The key finding is that ride-share service decisions involving uncertainty and perceived risk are not as static as what may be assumed. This is shown visually in Figure 97. When creating ride-share service decisions involving uncertainty and perceived risks, *Gender* is the most central factor, which is further influenced by whether the individual has access to a private vehicle and what COVID-19 scenario they responded to.

Out of the two sets of pre-questions, unsurprisingly, the related *Transport Factors*, generated the more convincing evidence of incompatibility. However, only females had evidence of incompatibility caused by the *Transport Factors* for *Access to a Private Vehicle*, which is indicated by the dotted line in Figure 97. No line is seen between *Good Mood Questions* and *Access to a Private Vehicle* for *Good Mood Questions*, as both females and males did not show any evidence of incompatibility for this factor in the Experiment 4 results.

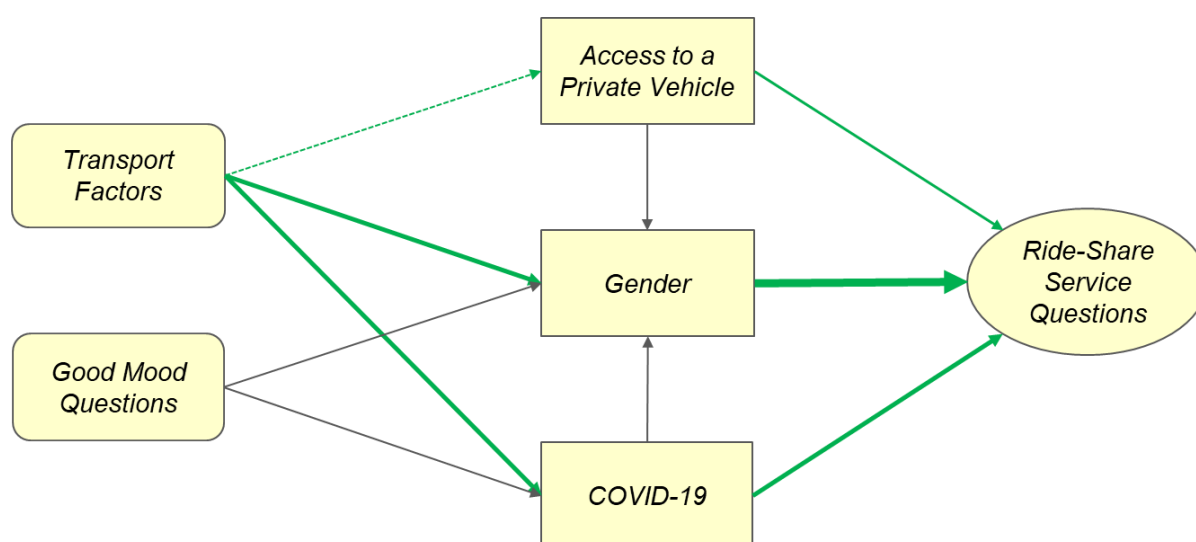


Figure 97: Summary of Interpretations

When looking at all the findings, from the overall results of Chapter 6 to the more detailed investigations of Chapters 7 and 8, *Gender* was clearly the most present and influential factor in how individuals created their ride-share service decisions involving uncertainty and perceived risks. *COVID-19* also influenced decisions in findings for both females and males, and in both *Transport Factors* and *Good Mood Questions*, while only females had evidence of incompatibility per *Access to a Private Vehicle* from Experiment 2 with the *Transport Factors*.

All of these ‘black swans’⁴⁵ evidence argues that ride-share service decisions in Cape Town are indeed created rather than recalled (see Section 2.2.2) and are influenced by not only who is

⁴⁵ See Chapter 3, Section 3.1.

making them but also how these individuals are thinking in the moment of decision. A short summary of this chapter now follows.

9.5 Résumé

This chapter discusses the highlights of the Cape Town ride-share service analysis of Chapter 4, the respondents' characteristics from Chapter 6 and the key findings from Chapters 6, 7 and 8. Based on the findings, interpretations and implications for practical applications are also provided. These outcomes can be grouped into the four hypotheses used in the thesis. The main takeaway from the various investigations is that, indeed, ride-share service decisions are not static but are created in the moment and are, therefore, subject to surrounding influences. This even holds in the Cape Town context, with its personal security challenges.

An overview of the hypotheses and the outcomes are presented in Table 52. The hypotheses, their outcomes and the related evidence are mentioned together.

Table 52: Overview of Hypotheses with Outcomes and Evidence

Evidence	Significance	Conclusion
H1: Uncertainty and perceived risks of personal security decreases the willingness to use ride-share services in young South African adults.		
Gender	At night**, Alone**, Alone at night**	Reject Null Hypothesis
Access to a Private Vehicle	At night**, Alone at night**	
COVID-19	At night**, Alone**, Alone at night**	
H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks.		
Female: At night	<i>Access to a Private Vehicle* in the control group but non-significant in the responses of the experiment group</i>	Reject Null Hypothesis
Female: Alone	<i>COVID-19* in the control group but non-significant in the responses of the experiment group</i>	
Male: Alone	<i>COVID-19** in the control group but non-significant in the responses of the experiment group</i>	
H3: Positive emotional framing in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty and perceived risks.		
Females: COVID-19	Alone at night**	Null hypothesis partially rejected (rejected for COVID-19, accepted for Access to a Private Vehicle)
Males: COVID-19	Alone**	
H4: Ride-share service decisions involving uncertainty and perceived risks increase the importance of incompatible factors.		
Sustainable Transport	Individuals without access to a private vehicle*** 'Before COVID-19'***	Reject Null Hypothesis
Reliability ('being on time')	Overall** (experiment group compared to control) Females** 'During COVID-19'**	
Road Safety	'Before COVID.19'** Females***	
Crime	(no findings)	
Note: ***significant at 0.10. **significant at 0.05. *significant at 0.01		

H1: Uncertainty and perceived risks of personal security decreases the willingness to use ride-share services in young South African adults.

This hypothesis is accepted and supported by the findings of the investigations and shows that *Gender, Access to a Private Vehicle* and *COVID-19* are influential in how individuals decide whether to engage in ride-share service trips that involve uncertainty and perceived risks. The differences captured in the investigations, however, are not always intuitive and require further exploration to develop a better understanding of how different individuals make their decisions.

H2: Incompatible factors of ride-share service decisions increase the willingness to engage in ride-share service trips involving uncertainty and perceived risks.

The *H2* was the heart of this research and was presented in Chapter 7. *H2* is accepted as there is evidence for incompatibility for both females and males. Females showed that *Access to a Private Vehicle* had an unexpected effect on not only how willing females were to use ride-share services for trips involving uncertainty and perceived risks ('at night'), but also that females with access to a private vehicle were the ones that showed higher levels of incompatibility in the results. Females also showed incompatibility in the *COVID-19* for '*alone at night*'.

Furthermore, despite showing much higher levels of willingness to engage in ride-share services involving uncertainty and perceived risks, even males generated some evidence of incompatibility (*COVID-19* in '*alone*'). In the findings of incompatibility, the *Transport Factors* did increase the willingness of some respondents to engage in ride-share service trips involving uncertainty and perceived risks.

H3: Positive emotional framing in pre-questions of ride-share service decisions increases the willingness to engage in ride-share service trips involving uncertainty and perceived risks.

The Null hypothesis was only partially rejected as the results of the positive emotional framing were less convincing: only *COVID-19* indicated some evidence for both genders. Furthermore, findings comparing male respondents should be handled with caution, due to the relatively small sample size of the males. However, the limited findings do indicate that there is an emotional component, when it comes to ride-share service decisions involving uncertainty and

perceived risks, that may be overcome with positive emotional framing. This finding can be used by ride-share service companies or other relevant stakeholders to run media campaigns that highlight and incorporate 'seemingly' unrelated positive aspects to increase willingness to engage in ride-share service trips.

H4: Ride-share service decisions involving uncertainty and perceived risks increase the perceived importance of incompatible factors.

The last hypothesis investigated if changes could be captured in the related incompatible factors, namely the *Transport Factors*, caused by asking the *Ride-Share Service Questions* before them. This hypothesis was also accepted as some differences, between the responses to *Transport Factors* with no pre-questions and the responses to *Transport Factors* with the pre-questions of *Ride-Share Service Questions*, were seen at either the 5% significance level or the 10% significance level. The effect of the *Ride-Share Service Questions* on *Reliability* was particularly interesting, and the results show a strong incompatibility between *Reliability* ('being on time') and the *Ride-Share Service Questions*. This potentially indicates how factors that are closely linked to the (perceived) benefits of ride-share services are most likely to show positive incompatibility (i.e. increased perceived importance of *Reliability*).

However, despite expectations, the *Transport Factor* of *Crime* did not result in any significant findings. This may be due to the general phrasing of the *Crime* question in the surveys. However, it is also possible that compatibility exists in unexpected places.

The next chapter outlines the final conclusions and limitations of the research and provides recommendations for future research.

10. Conclusion and Recommendations

This final chapter presents this study's conclusion and its limitations. Furthermore, several recommendations for practice (Section 10.2) and for future research (Section 10.3) are presented.

Being the pioneering research of its kind in Cape Town, this study's selection of factors, including *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*) and *Transport Factors* (*Sustainable Transport, Reliability ('being on time'), Road Safety, Crime*), was constructed based on established transportation knowledge. The research also introduced the conceptualisation of different *Belief States* for individuals based on the identified *Personal Factors*. The *Ride-Share Service Questions* explored the concept of *incompatibility*, focusing on ride-share service decisions involving uncertainty and perceived risk by young adults in Cape Town. The results of the four experiments, combined with the *Belief States* based on the three *Personal Factors*, unveiled new insights into how and which individuals make ride-share service decisions involving uncertainty or perceived risk in Cape Town.

The research findings underscore significant gender differences in ride-share service decisions. Males, for instance, demonstrate a high level of willingness to take ride-share service trips that involve personal security uncertainty and perceived risks, such as 'at night', 'alone' or 'alone at night'. Interestingly, for males, access to a private vehicle does not sway their ride-share service decisions involving uncertainty and perceived risks, unlike in females. This suggests that the potential of ride-share services to delay or postpone private vehicle ownership in young adults, as proposed in Chapter 1, maybe more feasible for males than for females in Cape Town.

The research findings have significant implications for future research and policy. For instance, the data reveals that females with access to a private vehicle are significantly less likely to engage in ride-share service trips that involve uncertainty and perceived risks, than those without access to a private vehicle. This suggests that, while young South African males may be able to transition from private vehicle behaviours to adopting ride-share services in developing multimodal transport behaviours, the same may not be as feasible for females once they have access to a private vehicle. This insight could inform future research and policy on promoting multimodal transport behaviours among females in Cape Town, and possibly in other parts of (South) Africa.

The findings also show that even females with access to a private vehicle making ride-share service decisions involving uncertainty and perceived risks can be positively influenced by related factors or incompatible factors. In the design of the experiments, it was shown that this can be achieved, for example, by asking pre-questions of how they perceive the importance of sustainable transport, how important 'being on time' (*Reliability*) is, or what they think of the road safety in their area. This new understanding could be used to inform and guide media campaigns to support ride-share service companies, especially when rolling out new personal security measures, to improve perceptions and willingness to use their services. Alternatively, cities could consider encouraging individuals to use ride-share services to supplement the public transport system for periods when these modes are not cost-efficient or when females do not feel safe using them. By doing so, cities, especially ones such as Cape Town, may be able to delay or avoid further private vehicle ownership by young adults.

There is much more work to be done by ride-share service companies to improve the uncertainty and perceived risks of females using ride-share services, especially decisions around travel 'at night' and 'alone at night'. These two types of trips were particularly insightful in indicating that the current personal security measures are insufficient for these travel conditions, as the largest differences between females with access to a private vehicle and those without access to a private vehicle are seen. **The difference between females, with and without access to a private vehicle, clearly indicates that there is more to be done to improve the experience for young South African females considering taking trips at night.**

One positive insight for ride-share service companies in South Africa, especially in the Cape Town context, is that the current implemented personal security measures seem to be sufficient for trips 'alone' by females, as no large difference between respondents with or without access to a private vehicle was found. Another positive finding of the research is that young males are highly willing to use ride-share services 'at night', 'alone' and 'alone at night', especially when considering the reported levels of dissatisfaction with the main public transport modes, shown in Chapter 4, Section 4.1.4. **Therefore, ride-share services do indeed present a less uncertain and (perceived) risk mode of transport in the Cape Town context, particularly for males.**

Finally, another major outcome of this research is that *COVID-19* had a significant effect on ride-share service decisions. These results indicate that individuals were less willing to use

ride-share services involving uncertainty and perceived risks in the scenario of 'after COVID- 19', phrased in the surveys' future tense. The fact that the *Good Mood Questions* were able to generate a significant change in one of the *Ride-Share Service Questions*, for both females and males, indicates that 'after COVID-19' was associated with negative emotions, which were then partly mitigated by the positive framing of the *Good Mood Questions*. This, again, shows that ride-share service decisions involving uncertainty and perceived risks are created in the moment of the decision, taking into consideration the current thoughts of the individual rather than recalling a static pre-made decision.

Next, the limitations of this research are presented.

10.1 Limitations of Research

A significant limitation of the research, regarding the transferability of knowledge to the broader ride-share service decisions of South Africans, is that a sample of university students in Cape Town will not fully represent the South African, or Cape Town, populations. University students are higher educated (finished high school), and typically have access to more socio-economic resources compared to the majority of South Africans of the same age. While this may not be so significant in other countries, the socio-economic gap is prominent in South Africa and is reported to be increasing. This critical shortcoming cannot be ignored. Further research, involving participants outside of academic institutions, would be needed to establish how representative or transferable the findings are for the general population.

Care should also be taken in the transferability of the findings of this work to cities which have substantial different transport cultures from that of Cape Town, South Africa. Most importantly these could be factors, such as rates of gender-based violence, availability of alternative public transport modes and culture of cycling or using other forms of active mobility (also referred to as Non-Motorised Transport (NMT)). These variations in context may have significant implications on how individuals, especially women, experience uncertainty and perceived risks in their ride-share service decisions.

Another consideration, for the transferability of the Belief State approach used in this thesis, is the type of questions that can be modelled in this way. In the approach used in this work, the axes of each Belief State were modelled to be orthogonal to each other. The questions used in this work were, however, easy to formulate into distinct answers (yes, no, I am not

certain). These distinct answers allow for the orthogonal modelling of the Belief States. However, this may not suit all research questions or investigations. To elaborate, the example described in Section 2.2.2.1, given by Pothos and Busemeyer (2013), show that individuals were either 'happy' (y-axis) or 'unhappy' (x-axis). However, if Pothos and Busemeyer were interested in the degree individuals were happy, i.e. happy, very happy or extremely happy, then the modelling of these questions may be more suited to a different approach.

Due to the scarcity of data from ride-share app companies, no actual data could be incorporated into the investigations, or used to enhance or validate the data collected within this research. Supplementary data from the National Household Travel Survey (Statistics South Africa, 2020) was used for the analysis in Chapter 4.

While this study has a specific scope and several limitations, especially considering the wider population of South Africa, it does focus on the users who are, according to the literature (Molobi et al., 2020; Vanderschuren and Baufeldt, 2018), most likely users of ride-share services, namely the 'missing middle', as well as those who are likely to experience uncertainty in their decisions.

Furthermore, the approach in the phrasing of the *Transport Factors*, especially *Crime*, may have been too conservative and not explicit enough, as it resulted in unexpected compatibility results. The respondents do not associate ride-share services as a contributing factor to general crime in Cape Town, indicating a positive perception of the role of ride-share services in Cape Town. However, a more exact description of the type of 'crime' related to ride-share services, namely, gender-violence based crimes, could have been a more closely related factor to possible incompatibility in perceptions.

Another limitation of this research was that the respondents were skewed towards females, and in some of the experiment groups, the number of males was relatively small. This limited the type of analyses that could be done and prevented a more direct comparison between females and males.

Next, several recommendations for practice in Cape Town and South Africa, in general, are described in the next section.

10.2 Recommendations for Practice

This section provides the practical recommendations that ride-share service companies and other stakeholders can use to improve and start addressing the challenges faced by young South Africans, especially young females.

Additional interventions can be taken by ride-share service providers in Cape Town to help address the unwillingness of females to use ride-share services. Based on Baufeldt and Vanderschuren (2023), measures, plus further additionally developed concepts, and strategies include:

- Providing females with the option to select ‘female only’ drivers, especially during off-peak times, and incentivising female drivers to be available during these times for such requests.
- Providing more integrated security emergency services within the app, to ensure fast response by emergency services (police, private security firms or medical services).
- Performing extensive background checks on drivers to prevent repeat offenders.

Ride-share services have the potential to capture more trips, and contribute to the transport network being more conducive to multi-modal behaviours if meaningful additional personal security measures are efficiently put into place.

Additionally, ride-share services may consider a media campaign or promotion to encourage individuals without access to a private vehicle to (re-)engage with ride-share services in post-COVID-19 Cape Town. Individuals without access to a private vehicle clearly showed higher levels of uncertainty and, therefore, unwillingness to use ride-share services ‘at night’, ‘alone’, ‘alone at night’ in ‘after COVID-19’ conditions. An initiative from the ride-share services to re-establish a positive service experience might help mitigate the negative influence that the pandemic has had on young adults. Based on the research findings, these may be attainable through exploring related or incompatible concepts to their typical media campaigns.

Lastly, directions for future investigations are presented in Section 10.3.

10.3 Recommendations for Future Research Directions

There are endless possible research directions. However, three key areas of research, based on the concepts in this work, are described in the following sections.

10.3.1 *Belief State and Incompatibility Direction*

There are numerous directions for future research with respect to *Belief State* and incompatibility in ride-share service decision-making in South Africa. Firstly, additional elements (examples from Chapter 3 include the life-cycle phase of the individual, as well as income) in the *Belief State* construct can be explored to see if other aspects can create more insights into how uncertainty and perceived risks are dealt with in ride-share service decisions in South Africa. Alternatively, the same *Belief State* elements evaluated in this research (i.e., *Gender, Access to a Private Vehicle and COVID-19*) can be applied to a different city that may have substantially different characteristics, either locally (for example Johannesburg or Durban) or internationally (for example New York, Shanghai, or Stockholm). **This direction has a very interesting potential, as differences and similarities could be used to better understand how ride-share services are experienced in different cities, in terms of uncertainties and perceived risks.**

One of the major lessons learnt from this research is that the incompatible factors should not be 'leading' but need to be as specific to the decision as possible. This was seen by the compatibility between *Crime in Cape Town* and *Ride-Share Service Questions*. On a general level, it is very likely that individuals see crime in Cape Town as compatible with ride-share service decisions involving uncertainty and perceived risks. However, a more specific crime-type question is likely to have shown clearer insights. For the case of ride-share services, an example of this re-phrasing for *Crime* would be 'What are gender-based violence levels in Cape Town' with potential answers of 'low', 'average', 'high'.

Understanding how uncertainties or perceived risks influence ride-share service decisions will become more important as cities strive to better integrate active mobility (also known as Non-Motorised Transport), public transport, shared transport services (including autonomous ride-share services and carpooling, such as MOIA in Hamburg, Germany) and private transport. Therefore, more detailed knowledge of how individuals decide when there is uncertainty or perceived risks is needed to encourage multimodal transport selection and sustainable travel behaviours.

10.3.2 *Ride-Share Services: Demand and Supply Direction*

This research has focused on questions of uncertainty on the demand side of ride-share services and, specifically, whether individuals are willing to use ride-share services, 'at

night’/’alone’/’alone at night’ (*Ride-Share Service Questions*). This leaves many more demand aspects to be investigated. For example, other ride-share service uncertainties from the demand side of ride-share services might be where the trip is being requested from, or the target destination. Do individuals feel different levels of uncertainty when requesting a ride-share service in a known or familiar location, compared to an unfamiliar location? Or does this not invoke uncertainty in the ride-share service decision? Does this hold for all three *Personal Factors* (*Gender, Access to a Private Vehicle, COVID-19*) or other relevant factors of the individuals? Such questions contribute to developing a more realistic understanding of ride-share service decisions. Furthermore, as transport networks aim to become more seamless (specifically concepts such as Mobility as a Service), this knowledge would give insights into how to encourage the uptake of multimodal transport behaviours.

Furthermore, the supply side of ride-share services has yet to be explored. A driver’s decision to accept trips may also be subject to various uncertainties. In Cape Town, drivers may be unwilling to accept trips where they think the individuals may pose a risk to their personal security or request a destination location that raises concerns for the driver. Another example of uncertainty, from the supply side, is if ‘price surges’ occur before an individual intends to make a ride-share trip. Moreover, if users requesting ride-share service trips can see if the available drivers are far or near them (and at what distances the drivers considered far or near), how might this influence their decisions before requesting a trip? Such knowledge will contribute to ride-share services, improving their service and ability to deal with both driver and user challenges and concerns. In doing so, ride-share services can better address specific local challenges to improve their integration in that city.

The direction of demand and supply investigations are particularly appropriate for large-scale behavioural models using machine learning and artificial intelligence. Due to the large amount of data ride-share service companies have access to, such research should be encouraged internally. However, this approach would remain challenging for researchers outside these organisations as long as this data is not made available to external researchers.

10.3.3 Exploring the ‘New Normal’ in Cape Town

At the time of the data collection, the COVID-19 pandemic ‘State of Emergency’ was still in place. The National State of Disaster officially ended on 5 April 2022, with the emergency state

of the COVID-19 pandemic officially over in Cape Town. **How individuals respond to the decisions, investigated in this research, could now be verified to see if the reduced willingness to engage in ride-share services ‘at night’, ‘alone’, ‘alone at night’ ‘after COVID-19’ is still less than ‘before COVID-19’. Alternatively, have the uncertainties of the post-COVID-19 pandemic been resolved as individuals re-engage in typical activities?**

This verification can be investigated in three ways. Firstly, individuals can be asked comparatively with the *Ride-Share Service Questions* being rephrased for ‘before COVID-19’ and ‘currently’. Secondly, individuals may be asked the *Ride-Share Service Questions* with either no reference to COVID-19 (control group) or simply as ‘post-COVID-19 pandemic’ (experimental group). Thirdly, data from ride-share services could be used to identify revealed behaviour. Unfortunately, such data was not made available by ride-share service providers in time to be included in this study. These three approaches would have different implications on how the *Belief State* of the individuals’ is conceptualised in the investigations. **All three approaches would generate insights into how uncertainties in the post-pandemic Cape Town are now experienced.**

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Appendix A: Copy of Google Forms

Google Form 1: 'Before COVID.19' and 'During COVID-19'

Google Form 2: 'After COVID-19'

Travel Decisions of Ride-Share Apps

Hello, my name is Jennifer Louisa Baufeldt and I am a PhD student in the Department of Civil Engineering at the University of Cape Town.

I am contacting you because you are a UCT staff member or student and I am collecting data which focuses on better understanding users' experience and expectations of ride-share apps (e.g., Uber, Bolt and Yookoo) to better understand the travel decisions of UCT students and staff, and how COVID-19 has impacted these decisions. By investigating how individuals make decisions under uncertain conditions, the research aims to develop a more realistic understanding of how travel decisions could be modelled. The study is purely for academic purposes only.

The survey focuses on understanding peoples' experiences of uncertainty and ride-share apps. The survey should take about between 3 -8 minutes. I am looking for your personal opinions and there may be questions that are not relevant to you.

I have ethical clearance from the University of Cape Town to collect this data. I will make sure that all data is treated completely confidentially, and all participants are fully anonymised.

This study complies with international best practice on data collection and protection, the data will be treated according to international guidelines and best practice for personal data protection and not sold to third parties. Identifying data will be destroyed at project end.

There is no payment or reimbursement for taking part in this research. I do not anticipate that there is any risk of harm to you in participating in this research.

Please understand that you do not have to participate, i.e., your participation is voluntary. The choice to participate is yours alone. You are free to choose not to participate, and if you choose to participate but wish to withdraw your consent at any time, you are free to do so. However, I would be grateful if you would assist me by completing the survey.

Although this research will not be implementing changes to the transport system you are using, it is anticipated that, by improved understanding of how individuals make travel decisions under uncertainty, better transport solutions may be developed in the future.

Please note that we have ethical clearance from the University of Cape Town to collect this data. I will make sure that all data is treated completely confidentially and will be fully anonymised.

CONSENT: Prior to completing the question below that asks for your consent to participate, please read the following:

I am 18 years or older.

I am voluntarily agreeing to participate in this research study.

I understand that even if I agree to participate now, I can withdraw at any time or refuse to

answer any question without any consequences of any kind. This can be done by not submitting the Google Form.

I understand that I will not benefit directly from participating in this research.

I understand that all information I provide for this study will be treated confidential.

I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview, which may reveal my identity or the identity of people I speak about.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information. (Email: BFLJEN001@myuct.ac.za)

I understand by completing this questionnaire I am consenting to participate in this study.

I agree with all the above.

** Indicates required question*

1. Are you a UCT student / staff member? *

Mark only one oval.

- ☐ Yes - I am a current UCT student / staff member
- ☐ Yes - I am a past UCT student / staff member (UCT Alumni)
- ☐ No - I am not a UCT student or staff

2. Have you read the introduction to the survey and agree to give your consent? *

Mark only one oval.

- ☐ Yes *Skip to question 3*
- ☐ No *Skip to section 44 (Thank you for your participation!)*

Let's begin...

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

3. Is the way you travel / move around Cape Town being impacted by COVID-19? *

Information about COVID-19: <https://covid19.who.int/>

Mark only one oval.

- ☐ Yes, very much! - my movement around Cape Town is impacted a lot by COVID-19
- ☐ Yes, a bit - my movement around Cape Town is impacted by COVID-19
- ☐ Maybe - I am not sure or cannot really say if my movement around Cape Town is impacted by COVID-19
- ☐ No - for me there is no real difference, my movement around Cape Town is normal

4. Do you have a car or have access to a car for the majority of your trips? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 5*
- ☐ No *Skip to question 9*

Lucky Packet 1

No thinking necessary, simply pick a letter at random

5. Pick a random option - stage 1 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ W *Skip to question 7*
- ☐ V *Skip to question 8*

Skip to question 8

Lucky Packet 3

No thinking necessary, simply pick a letter at random

6. Pick a random option - Final stage 3 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ W *Skip to question 157*

☐ V *Skip to question 161*

Lucky Packet 2

No thinking necessary, simply pick a letter at random

7. Pick a random option - stage 2 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ V *Skip to question 12*

☐ V_ *Skip to question 77*

☐ W *Skip to question 87*

☐ W_ *Skip to question 101*

Lucky Packet 2

No thinking necessary, simply pick a letter at random

8. Pick a random option -Stage 2 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ V *Skip to question 109*

☐ V_ *Skip to question 118*

☐ W *Skip to question 135*

☐ W_ *Skip to question 149*

Lucky Packet 1

No thinking necessary, simply pick a letter at random

9. Pick a random option - stage 1 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ V Skip to question 10

☐ W Skip to question 11

Lucky Packet 2

No thinking necessary, simply pick a letter at random

10. Pick a random option - stage 2 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ V Skip to question 13

☐ V_ Skip to question 82

☐ W Skip to question 88

☐ W_ Skip to question 105

Lucky Packet 2

No thinking necessary, simply pick a letter at random

11. Pick a random option - stage 2 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ V *Skip to question 110*
- ☐ V_ *Skip to question 123*
- ☐ W *Skip to question 136*
- ☐ W_ *Skip to question 153*

Do you use ride-share apps?

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

12. BEFORE COVID-19: Were ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Supplementary form of transport - I used it for some trips BEFORE COVID-19
Skip to question 14
- ☐ Neither - I did not use ride-share apps BEFORE COVID-19 *Skip to question 21*

Do you use ride-share apps?

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

13. BEFORE COVID-19: Were ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around BEFORE COVID-19
Skip to question 14
- ☐ Supplementary form of transport - I used it for some trips BEFORE COVID-19
Skip to question 14
- ☐ Neither - I did not use ride-share apps BEFORE COVID-19 *Skip to question 49*

Ride-Share App Trips

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

14. BEFORE COVID-19: How many trips did you make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, BEFORE COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, BEFORE COVID-19
- ☐ Between 1-3 trips per week, BEFORE COVID-19
- ☐ 4 - 8 trips per week, BEFORE COVID-19
- ☐ More than 8 trips per week, BEFORE COVID-19

15. BEFORE COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps for trips late at NIGHT, BEFORE COVID-19
- ☐ No, I would not use ride-share apps for trips late at NIGHT, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, BEFORE COVID-19

16. BEFORE COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-sharing apps at night

17. BEFORE COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, BEFORE COVID-19
- ☐ No, I would not use ride-share apps ALONE, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, BEFORE COVID-19

18. BEFORE COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, BEFORE COVID-19
- ☐ No, I would not use ride-share apps at night when I am alone, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps at night when I am alone, BEFORE COVID-19

19. Any feedback / comments about your experience of ride-share apps?

Optional Feedback

20. BEFORE COVID-19: What was your experience of ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, BEFORE COVID-19 *Skip to question 6*
- ☐ Negative, BEFORE COVID-19 *Skip to question 6*
- ☐ Mixed - both positive and negative experiences, BEFORE COVID-19
Skip to question 6

Skip to question 6

Supplementary Trips

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Supplementary trips = trips that you make with other modes of transport, besides your car / main mode of transport

21. BEFORE COVID-19: Would you use any SUPPLEMENTARY MODE(S) of transport? (Normally, and when your car was not available) *

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ No supplementary mode
- ☐ Other: _____

22. BEFORE COVID-19: What approximate % of all your trips did you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Goldem Arrow Bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti Bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
No supplementary mode	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

23. BEFORE COVID-19: How many trips did you make with your supplementary mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, BEFORE COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, BEFORE COVID-19
- ☐ Between 1-3 trips per week, BEFORE COVID-19
- ☐ 4 - 8 trips per week, BEFORE COVID-19
- ☐ More than 8 trips per week, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

24. BEFORE COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ No, I would not use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

25. BEFORE COVID-19: Would you use your supplementary mode(s) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) ALONE, BEFORE COVID-19
- ☐ No, I would not use supplementary mode(s) ALONE, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) ALONE, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

26. BEFORE COVID-19: For trips when you are alone and it's night, would you use your supplementary mode(s) at night? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) at night when I am alone, BEFORE COVID-19
- ☐ No, I would not use supplementary mode(s) at night when I am alone, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) at night when I am alone, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

27. BEFORE COVID-19: Was your experience of your supplementary mode(s) positive? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, BEFORE COVID-19 *Skip to question 6*
- ☐ Negative, BEFORE COVID-19 *Skip to question 6*
- ☐ Mixed - both positive and negative experiences, BEFORE COVID-19
Skip to question 6
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19 *Skip to question 6*

Skip to question 6

Supplementary Trips

Please think about life DURING COVID-19 and answer the questions to the best of your ability.

Supplementary trips = trips that you make with other modes of transport, besides your car / main mode of transport

28. DURING COVID-19: Do you use any SUPPLEMENTARY MODE(S) of transport? *

(For everyday or when your car is not available)

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share app (such as Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ No supplementary mode
- ☐ Other: _____

29. DURING COVID-19: What approximate % of all your trips do you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Goldem Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Not relevant - I do not have a supplementary mode of transport	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

30. DURING COVID-19: How many trips do you make with your supplementary mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, DURING COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, DURING COVID-19
- ☐ Between 1-3 trips per week, DURING COVID-19
- ☐ 4 - 8 trips per week, DURING COVID-19
- ☐ More than 8 trips per week, DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

31. DURING COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary modes for trips late at NIGHT, DURING COVID-19
- ☐ No, I would not use supplementary modes for trips late at NIGHT, DURING COVID-19
- ☐ I am not sure if I would use supplementary modes for trips late at NIGHT, DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

32. DURING COVID-19: Would you use your supplementary mode ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary modes ALONE, DURING COVID-19
- ☐ No, I would not use supplementary modes ALONE, DURING COVID-19
- ☐ I am not sure if I would use supplementary modes ALONE, DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

33. DURING COVID-19: For trips when you are alone and it's night, would you use your supplementary mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary modes at night when I am alone, DURING COVID-19
- ☐ No, I would not use supplementary modes at night when I am alone, DURING COVID-19
- ☐ I am not sure if I would use supplementary modes at night when I am alone, DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

34. DURING COVID-19: What is your experience of your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, DURING COVID-19 *Skip to question 6*
- ☐ Negative, DURING COVID-19 *Skip to question 6*
- ☐ Mixed - both positive and negative experiences, DURING COVID-19
Skip to question 6
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19
Skip to question 6

Skip to question 6

Supplementary Trips

Please think about how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Supplementary trips = trips that you make with other modes of transport, besides your car / main mode of transport

35. BEFORE COVID-19: Did you use any SUPPLEMENTARY MODE(S) of transport? *

(For everyday or when your car was not available)

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share app (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Not relevant - I do not have a supplementary mode of transport
- ☐ Other: _____

36. BEFORE COVID-19: What approximate % of all your trips did you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Not relevant - I do not have a supplementary mode of transport	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

37. BEFORE COVID-19: How many trips did you make with your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, BEFORE COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, BEFORE COVID-19
- ☐ Between 1-3 trips per week, BEFORE COVID-19
- ☐ 4 - 8 trips per week, BEFORE COVID-19
- ☐ More than 8 trips per week, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

38. BEFORE COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ No, I would not use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) for trips late at NIGHT, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

39. BEFORE COVID-19: Would you use your supplementary mode(s) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) of transport ALONE, BEFORE COVID-19
- ☐ No, I would NOT use supplementary mode(s) of transport ALONE, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) of transport ALONE, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

40. BEFORE COVID-19: For trips when you are alone and it's night, would you use your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) of transport at night when I am alone, BEFORE COVID-19
- ☐ No, I would NOT use supplementary mode(s) of transport when it's night and I am alone, BEFORE COVID-19
- ☐ I am not sure if I would use supplementary mode(s) of transport when it's night and I am alone, BEFORE COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19

41. BEFORE COVID-19: What was your experience of your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, BEFORE COVID-19 *Skip to question 96*
- ☐ Negative, BEFORE COVID-19 *Skip to question 96*
- ☐ Mixed - both positive and negative experiences, BEFORE COVID-19
Skip to question 96
- ☐ Not relevant - I did not have a supplementary mode of transport BEFORE COVID-19
Skip to question 96

Skip to question 96

Supplementary Trips

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Supplementary trips = trips that you make with other modes of transport, besides your car / main mode of transport

42. DURING COVID-19: Do you use any SUPPLEMENTARY MODE(S) of transport? *

(For everyday or when your car was not available)

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Train
- ☐ Minibus taxi
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share app (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Not relevant - I do not have a supplementary mode of transport
- ☐ Car (rent / borrow)
- ☐ Other: _____

43. DURING COVID-19: What approximate % of all your trips do you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0%- Not Relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Not relevant - I do not have a supplementary mode of transport	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

44. DURING COVID-19: How many trips do you make with your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week DURING COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, DURING COVID-19
- ☐ Between 1-3 trips per week DURING COVID-19
- ☐ 4 - 8 trips per week DURING COVID-19
- ☐ More than 8 trips per week DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

45. DURING COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) for trips late at NIGHT DURING COVID-19
- ☐ No, I would not use supplementary mode(s) for trips late at NIGHT DURING COVID-19
- ☐ I am not sure if I would use supplementary mode(s) for trips late at NIGHT DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

46. DURING COVID-19: Would you use your supplementary mode(s) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) of transport ALONE DURING COVID-19
- ☐ No, I would NOT use supplementary mode(s) of transport ALONE DURING COVID-19
- ☐ I am not sure if I would use supplementary mode(s) of transport ALONE DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

47. DURING COVID-19: For trips when you are alone and it's night, would you use your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) of transport at night when I am alone DURING COVID-19
- ☐ No, I would NOT use supplementary mode(s) of transport at night when I am alone DURING COVID-19
- ☐ I am not sure if I would use supplementary mode(s) of transport at night when I am alone DURING COVID-19
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19

48. DURING COVID-19: What was your experience of your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive DURING COVID-19 *Skip to question 144*
- ☐ Negative DURING COVID-19 *Skip to question 144*
- ☐ Mixed - both positive and negative experiences DURING COVID-19
Skip to question 144
- ☐ Not relevant - I do not have a supplementary mode of transport DURING COVID-19
Skip to question 144

Skip to question 144

Main & Supplementary Trips

Please think about how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Supplementary trips = trips that you make with other modes of transport, besides your main mode(s) of transport

49. BEFORE COVID-19: What were your different modes of transport? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share app (eg. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Minibus Taxi
- ☐ Private car (owned)
- ☐ Other:

50. BEFORE COVID-19: What approximate % did you use your different modes of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Goldem Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share app (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Private car (owned)	☐	☐	☐	☐	☐
No supplementary modes	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

51. BEFORE COVID-19: How many trips did you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, BEFORE COVID- 19	Between 1-3 trips per week, BEFORE COVID- 19	4 - 8 trips per week, BEFORE COVID- 19	More than 8 trips per week, BEFORE COVID- 19	Not relevant, BEFORE COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

52. BEFORE COVID-19: Would you use transport late at NIGHT ? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant, BEFORE COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

53. BEFORE COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant, BEFORE COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

54. BEFORE COVID-19: For trips when it is night and you are alone, would you use transport ? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant, BEFORE COVID- 19 - mode not available or other reason
At night and alone: Main modes of transport	☐	☐	☐	☐
At night and alone: Supplementary modes of transport	☐	☐	☐	☐

55. BEFORE COVID-19: What was your experience of transport? *

Mark only one oval per row.

	Positive, BEFORE COVID- 19	Negative, BEFORE COVID- 19	Mixed - both positive and negative experiences, BEFORE COVID-19	Not relevant BEFORE COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

*Skip to question 6***Main & Supplementary Trips**

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Main modes - your typical mode of transport, what you normally use

Supplementary modes - modes of transport that you sometimes use

56. DURING COVID-19: What are your different modes of transport? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Private vehicle (owned)
- ☐ No supplementary modes of transport
- ☐ Other: _____

57. DURING COVID-19: What approximate % do you use your different modes of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride- share apps (e.g. Uber, Bolt, Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Private car (owned)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

58. DURING COVID-19: How many trips do you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, DURING COVID- 19	Between 1-3 trips per week, DURING COVID- 19	4 - 8 trips per week, DURING COVID- 19	More than 8 trips per week, DURING COVID- 19	Not relevant DURING COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

59. DURING COVID-19: Would you use transport late at NIGHT ? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant, DURING COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

60. DURING COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant DURING COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

61. BEFORE COVID-19: For trips when it is night and you are alone, would you use transport ? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant BEFORE COVID- 19 - mode not available or other reason
At night and alone: Main modes of transport	☐	☐	☐	☐
At night and alone: Supplementary modes of transport	☐	☐	☐	☐

62. DURING COVID-19: What is your experience of transport? *

Mark only one oval per row.

	Positive, DURING COVID- 19	Negative, DURING COVID- 19	Mixed - both positive and negative experiences, DURING COVID-19	Not relevant DURING COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

*Skip to question 6***Main & Supplementary Trips**

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Main modes - your typical mode of transport, what you normally use
 Supplementary modes - modes of transport that you sometimes use

63. DURING COVID-19: What are your different modes of transport? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Private car (owned)
- ☐ Other: _____

64. DURING COVID-19: What approximate % do you use your different modes of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Private car (owned)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

65. DURING COVID-19: How many trips do you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, DURING COVID- 19	Between 1-3 trips per week, DURING COVID- 19	4 - 8 trips per week, DURING COVID- 19	More than 8 trips per week, DURING COVID- 19	Not relevant DURING COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

66. DURING COVID-19: Would you use transport late at NIGHT ? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant DURING COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

67. DURING COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant DURING COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

68. DURING COVID-19: For trips when it is night and you are alone, would you use transport? *

Mark only one oval per row.

	Yes, DURING COVID- 19	No, DURING COVID- 19	I am not sure, DURING COVID- 19	Not relevant BEFORE COVID- 19 - mode not available or other reason
At night and alone: Main modes of transport	☐	☐	☐	☐
At night and alone: Supplementary modes of transport	☐	☐	☐	☐

69. DURING COVID-19: What is your experience of transport? *

Mark only one oval per row.

	Positive, DURING COVID- 19	Negative, DURING COVID- 19	Mixed - both positive and negative experiences, DURING COVID-19	Not relevant DURING COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

*Skip to question 144***Main & Supplementary Trips**

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

70. BEFORE COVID-19: What were your different modes of transport? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Private car (owned)
- ☐ Other: _____

71. BEFORE COVID-19: What approximate % did you use your different modes of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Private car (owned)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

72. BEFORE COVID-19: How many trips did you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, BEFORE COVID- 19	Between 1-3 trips per week, BEFORE COVID- 19	4 - 8 trips per week, BEFORE COVID- 19	More than 8 trips per week, BEFORE COVID- 19	Not relevant BEFORE COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

73. BEFORE COVID-19: Would you use transport late at NIGHT? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant BEFORE COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

74. BEFORE COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant BEFORE COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

75. BEFORE COVID-19: For trips when it is night and you are alone, would you use transport? *

Mark only one oval per row.

	Yes, BEFORE COVID- 19	No, BEFORE COVID- 19	I am not sure, BEFORE COVID- 19	Not relevant BEFORE COVID- 19 - mode not available or other reason
At night and alone: Main modes of transport	☐	☐	☐	☐
At night and alone: Supplementary modes of transport	☐	☐	☐	☐

76. BEFORE COVID-19: What was your experience of transport? *

Mark only one oval per row.

	Positive, BEFORE COVID- 19	Negative, BEFORE COVID- 19	Mixed - both positive and negative experiences, BEFORE COVID-19	Not relevant BEFORE COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

Skip to question 96

General Questions

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

77. BEFORE COVID-19: How important was sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

78. BEFORE COVID-19: How important was being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

79. BEFORE COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town were safe, BEFORE COVID-19
- ☐ The roads in Cape Town were dangerous, BEFORE COVID-19
- ☐ The roads in Cape Town were sometimes safe and sometimes dangerous, BEFORE COVID-19

80. BEFORE COVID-19: Which statement do you think is most correct about crime levels in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level was high in Cape Town, BEFORE COVID-19
- ☐ Crime level was average in Cape Town, BEFORE COVID-19
- ☐ Crime level was low in Cape Town, BEFORE COVID-19

81. BEFORE COVID-19: What was the best way(s) for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car
- ☐ Other: _____

Skip to question 12

General Questions

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

82. BEFORE COVID-19: How important was sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see: https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

83. BEFORE COVID-19: How important was being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

84. BEFORE COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town were safe, BEFORE COVID-19
- ☐ The roads in Cape Town were dangerous, BEFORE COVID-19
- ☐ The roads in Cape Town were sometimes safe and sometimes dangerous, BEFORE COVID-19

85. BEFORE COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level was high in Cape Town, BEFORE COVID-19
- ☐ Crime level was average in Cape Town, BEFORE COVID-19
- ☐ Crime level was low in Cape Town, BEFORE COVID-19

86. BEFORE COVID-19: What was the best way(s) for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car
- ☐ Other: _____

Skip to question 13

Do you use ride-share apps?

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

87. BEFORE COVID-19: Were ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around BEFORE COVID-19
Skip to question 89
- ☐ Supplementary form of transport - I used it for some trips BEFORE COVID-19
Skip to question 89
- ☐ Neither - I did not use ride-share apps BEFORE COVID-19 *Skip to question 35*

Skip to question 166

Do you use ride-share apps?

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

88. BEFORE COVID-19: Were ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around BEFORE COVID-19
Skip to question 89
- ☐ Supplementary form of transport - I used it for some trips BEFORE COVID-19
Skip to question 89
- ☐ Neither - I did not use ride-share apps BEFORE COVID-19 *Skip to question 70*

Skip to question 166

Ride-Share App Trips

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

89. BEFORE COVID-19: How many trips did you make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

Mark only one oval.

- ☐ Normally 0 trips per week, BEFORE COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, BEFORE COVID-19
- ☐ Between 1-3 trips per week, BEFORE COVID-19
- ☐ 4 - 8 trips per week, BEFORE COVID-19
- ☐ More than 8 trips per week, BEFORE COVID-19

90. BEFORE COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps for trips late at NIGHT, BEFORE COVID-19
- ☐ No, I would not use ride-share apps for trips late at NIGHT, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, BEFORE COVID-19

91. BEFORE COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-sharing apps at night

92. BEFORE COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, BEFORE COVID-19
- ☐ No, I would not use ride-share apps ALONE, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, BEFORE COVID-19

93. BEFORE COVID-19: For trips when you are alone and it's night, would you use ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night and when I am alone, BEFORE COVID-19
- ☐ No, I would not use ride-share apps at night and when I am alone, BEFORE COVID-19
- ☐ I am not sure if I would use ride-share apps at night and when I am alone, BEFORE COVID-19

94. Any feedback / comments about your experience of ride-share apps?

Optional feedback

95. BEFORE COVID-19: What was your experience of ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, BEFORE COVID-19 *Skip to question 96*
- ☐ Negative, BEFORE COVID-19 *Skip to question 96*
- ☐ Mixed - both positive and negative experiences, BEFORE COVID-19
Skip to question 96

Skip to question 96

General Questions

Please think back to how life was BEFORE COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

96. BEFORE COVID-19: How important was sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

97. BEFORE COVID-19: How important was being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, BEFORE COVID-19
- ☐ Important, BEFORE COVID-19
- ☐ Average, BEFORE COVID-19
- ☐ Not so important, BEFORE COVID-19
- ☐ Not important at all, BEFORE COVID-19

98. BEFORE COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town were safe, BEFORE COVID-19
- ☐ The roads in Cape Town were dangerous, BEFORE COVID-19
- ☐ The roads in Cape Town were sometimes safe and sometimes dangerous, BEFORE COVID-19

99. BEFORE COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level was high in Cape Town, BEFORE COVID-19
- ☐ Crime level was average in Cape Town, BEFORE COVID-19
- ☐ Crime level was low in Cape Town, BEFORE COVID-19

100. BEFORE COVID-19: What was the best way(s) for you to get around Cape Town? *

Tick the best options in your experience

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car
- ☐ Other: _____

Skip to question 6

General Questions

Here, we would like you to reflect on your favourite things.

101. Name a favourite book / movie / series of yours. *

102. What is your favourite food? *

103. What is the best place to go out in Cape Town? *

104. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ Yes *Skip to question 12*

☐ No *Skip to question 12*

☐ Maybe *Skip to question 12*

Skip to question 12

General Questions

Here, we would like you to reflect on your favourite things.

105. Name a favourite book / movie / series of yours. *

106. What is your favourite food? *

107. What is the best place to go out in Cape Town? *

108. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 13*
- ☐ No *Skip to question 13*
- ☐ Maybe *Skip to question 13*

Skip to question 13

Do you use ride-share apps?

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

109. DURING COVID-19: Are ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

Mark only one oval.

- ☐ Main form of transport - my normal way to get around DURING COVID-19
Skip to question 111
- ☐ Supplementary form of transport - I use it for some trips DURING COVID-19
Skip to question 111
- ☐ Neither - I do not use ride-share apps DURING COVID-19
Skip to question 28

Skip to question 13

Do you use ride-share apps?

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

110. DURING COVID: Are ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around DURING COVID-19
Skip to question 128
- ☐ Supplementary form of transport - I use it for some trips DURING COVID-19
Skip to question 128
- ☐ Neither - I did not use ride-share apps DURING COVID-19
Skip to question 56

Ride-Share App Trips

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

111. DURING COVID-19: How many trips do you make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, DURING COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, DURING COVID-19
- ☐ Between 1-3 trips per week, DURING COVID-19
- ☐ 4 - 8 trips per week, DURING COVID-19
- ☐ More than 8 trips per week, DURING COVID-19

112. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps for trips late at NIGHT, DURING COVID-19
- ☐ No, I would NOT use ride-share apps for trips late at NIGHT, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, DURING COVID-19

113. DURING COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-share apps at night

114. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, DURING COVID-19
- ☐ No, I would NOT use ride-share apps ALONE, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, DURING COVID-19

115. DURING COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, DURING COVID-19
- ☐ No, I would NOT use ride-share apps at night when I am alone, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps at night when I am alone,, DURING COVID-19

116. Any other feedback / comments about your experience of ride-share apps?

Optional feedback

117. DURING COVID-19: What is your experience of ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, DURING COVID-19 *Skip to question 6*
- ☐ Negative, DURING COVID-19 *Skip to question 6*
- ☐ Mixed - both positive and negative experiences, DURING COVID-19
Skip to question 6

Skip to question 6

General Questions

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

118. DURING COVID-19: How important is sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

119. DURING COVID-19: How important is being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

120. DURING COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town are safe, DURING COVID-19
- ☐ The roads in Cape Town are dangerous, DURING COVID-19
- ☐ The roads in Cape Town are sometimes safe and sometimes dangerous, DURING COVID-19

121. DURING COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level is high in Cape Town, DURING COVID-19
- ☐ Crime level is average in Cape Town, DURING COVID-19
- ☐ Crime level is low in Cape Town, DURING COVID-19

122. DURING COVID-19: What is the best way(s) for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking, DURING COVID-19
- ☐ Cycling, DURING COVID-19
- ☐ Golden Arrow bus, DURING COVID-19
- ☐ Minibus taxis, DURING COVID-19
- ☐ Train, DURING COVID-19
- ☐ Jammie Shuttle, DURING COVID-19
- ☐ Metered taxi, DURING COVID-19
- ☐ Ride-share apps (eg. Uber, Bolt, Yookoo), DURING COVID-19
- ☐ MyCiti bus, DURING COVID-19
- ☐ Private car, DURING COVID-19
- ☐ Other: _____

Skip to question 109

General Questions

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

123. DURING COVID-19: How important is sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

124. DURING COVID-19: How important is being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

125. DURING COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town are safe, DURING COVID-19
- ☐ The roads in Cape Town are dangerous, DURING COVID-19
- ☐ The roads in Cape Town are sometimes safe and sometimes dangerous, DURING COVID-19

126. DURING COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level is high in Cape Town, DURING COVID-19
- ☐ Crime level is average in Cape Town, DURING COVID-19
- ☐ Crime level is low in Cape Town, DURING COVID-19

127. DURING COVID-19: What is the best way(s) for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking, DURING COVID-19
- ☐ Cycling, DURING COVID-19
- ☐ Golden Arrow bus, DURING COVID-19
- ☐ Minibus taxis, DURING COVID-19
- ☐ Train, DURING COVID-19
- ☐ Jammie Shuttle, DURING COVID-19
- ☐ Metered taxi, DURING COVID-19
- ☐ Ride-share apps (eg. Uber, Bolt, Yookoo), DURING COVID-19
- ☐ MyCiti bus, DURING COVID-19
- ☐ Private car, DURING COVID-19
- ☐ Other: _____

Skip to question 110

Ride-Share App Trips

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

128. DURING COVID-19: How many trips do you make with ride-share apps in an average week? (1 trip = 1 ride; e.g. Uber, Bolt, Yookoo) *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, DURING COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, DURING COVID-19
- ☐ Between 1-3 trips per week, DURING COVID-19
- ☐ 4 - 8 trips per week, DURING COVID-19
- ☐ More than 8 trips, DURING COVID-19

129. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps late at NIGHT, DURING COVID-19
- ☐ No, I would not use ride-share apps late at NIGHT, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps late at NIGHT, DURING COVID-19

130. DURING COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-share apps at night

131. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, DURING COVID-19
- ☐ No, I would NOT use ride-share apps ALONE, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, DURING COVID-19

132. DURING COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, DURING COVID-19
- ☐ No, I would NOT use ride-share apps at night when I am alone, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps at night when I am alone, DURING COVID-19

133. Any other feedback / comments about your experience of ride-share apps?
Optional feedback

134. DURING COVID-19: How is your experience of ride-share apps (e.g. Uber, Bolt, * Yookoo)?

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, DURING COVID-19 *Skip to question 6*
- ☐ Negative, DURING COVID-19 *Skip to question 6*
- ☐ Mixed, both positive and negative DURING COVID-19 *Skip to question 6*

Skip to question 6

Do you use ride-share apps?

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

135. DURING COVID-19: Are ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around DURING COVID-19
Skip to question 137
- ☐ Supplementary form of transport - I use it for some trips DURING COVID-19
Skip to question 137
- ☐ Neither - I do not use ride-share apps DURING COVID-19
Skip to question 42

Skip to question 137

Do you use ride-share apps?

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

136. DURING COVID-19: Are ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around DURING COVID-19
Skip to question 137
- ☐ Supplementary form of transport - I use it for some trips DURING COVID-19
Skip to question 137
- ☐ Neither - I do not use ride-share apps DURING COVID-19
Skip to question 63

Skip to question 6

Ride-Share App Trips

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

137. DURING COVID-19: How many trips do you make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, DURING COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, DURING COVID-19
- ☐ Between 1-3 trips per week DURING COVID-19
- ☐ 4 - 8 trips per week DURING COVID-19
- ☐ More than 8 trips per week DURING COVID-19

138. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late AT NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps for trips late at NIGHT, DURING COVID-19
- ☐ No, I would not use ride-share apps for trips late at NIGHT, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, DURING COVID-19

139. DURING COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-share apps at night

140. DURING COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, DURING COVID-19
- ☐ No, I would NOT use ride-share apps ALONE, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, DURING COVID-19

141. DURING COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, DURING COVID-19
- ☐ No, I would NOT use ride-share apps at night when I am alone, DURING COVID-19
- ☐ I am not sure if I would use ride-share apps when I am alone, DURING COVID-19

142. Any feedback / comments about your experience of ride-share apps?

Optional feedback

143. DURING COVID-19: How is your experience of ride-share apps (e.g. Uber, Bolt, * Yookoo)?

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, DURING COVID-19 *Skip to question 144*
- ☐ Negative, DURING COVID-19 *Skip to question 144*
- ☐ Mixed - both positive and negative experiences, DURING COVID-19
Skip to question 144

Skip to question 144

General Questions

Please think about how life is DURING COVID-19 and answer the questions to the best of your ability.

Ride-share apps = e.g. Uber, Bolt, Yookoo :)

144. DURING COVID-19: How important is sustainable transport to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

145. DURING COVID-19: How important is being on time for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, DURING COVID-19
- ☐ Important, DURING COVID-19
- ☐ Average, DURING COVID-19
- ☐ Not so important, DURING COVID-19
- ☐ Not important at all, DURING COVID-19

146. DURING COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town are safe, DURING COVID-19
- ☐ The roads in Cape Town are dangerous, DURING COVID-19
- ☐ The roads in Cape Town are sometimes safe and sometimes dangerous, DURING COVID-19

147. DURING COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level is high in Cape Town, DURING COVID-19
- ☐ Crime level is average in Cape Town, DURING COVID-19
- ☐ Crime level is low in Cape Town, DURING COVID-19

148. DURING COVID-19: What is the best way(s) for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car
- ☐ Other: _____

Skip to question 6

General Questions

149. Name a favourite book / movie / series of yours. *

150. What is your favourite food? *

151. What is the best place to go out in Cape Town? *

152. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 109*
- ☐ No *Skip to question 109*
- ☐ Maybe *Skip to question 109*

Skip to question 109

General Questions

153. Name a favourite book / movie / series of yours. *

154. What is your favourite food? *

155. What is the best place to go out in Cape Town? *

156. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 110*
- ☐ No *Skip to question 110*
- ☐ Maybe *Skip to question 110*

Skip to question 110

Ride-Share App Providers

157. Which ride-share apps have you used in the past? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I have not used ride-share apps
- ☐ Other: _____

158. Which ride-share apps are you using currently or would consider using in the future? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I don't use ride-share apps now and won't in the future
- ☐ Other: _____

159. Do you prefer metered taxi or ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes - I prefer metered taxi
- ☐ Yes - I prefer ride-share apps
- ☐ No - they are the same for me
- ☐ Other: _____

160. Any feedback / comments you would like to share?

Optional Feedback

Skip to question 166

Ride-Share App Providers

161. Which ride-share apps have you used in the past? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I have not used ride-share apps
- ☐ Other: _____

162. Yookoo is one of the latest ride-share apps in Cape Town. It includes a student version, anti-gender violence features, facial recognition among other features (App: Yookoo Rider). Did you know about Yookoo already? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes
- ☐ No
- ☐ I think I might have heard of it, but I am not sure

163. Which ride-share apps are you using currently or would consider using in the future? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I don't use ride-share apps now and won't in the future
- ☐ Other: _____

164. Do you prefer metered taxi or ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes - I prefer metered taxi
- ☐ Yes - I prefer ride-share apps
- ☐ No - they are the same for me
- ☐ Other: _____

165. Any feedback / comments you would like to share?

Optional Feedback

Skip to question 166

Personal Information

You are almost done! Here, we would like to know a bit more about who you are.

166. Age (please type in answer) *

167. Are you an undergraduate, post-graduate or staff at UCT? *

Mark only one oval.

☐ Undergraduate

☐ Post-graduate

☐ Staff

☐ Other:

168. What is your term residence postal code?

Optional question: You can skip this question if you do not feel comfortable sharing this information. Example, postal code for UCT is: 7701. Please DO NOT type in your whole address.

169. What is your home residence postal code?

Optional question: You can skip this question if you do not feel comfortable sharing this information. Please type "same" if it does not differ from term residence code. Example, postal code for UCT is: 7701. Please DO NOT type in your whole address.

170. Which Faculty of UCT are you in? *

In alphabetical order:

Mark only one oval.

- ☐ Centre for Higher Education (CHED)
- ☐ Commerce
- ☐ Engineering & the Built Environment (EBE)
- ☐ Graduate School of Business (GSB)
- ☐ Health Sciences
- ☐ Humanities
- ☐ Law
- ☐ Science
- ☐ PASS department
- ☐ Not applicable - I am not a current or past UCT student / staff member

171. Gender *

Mark only one oval.

- ☐ Female
- ☐ Male
- ☐ Prefer not to say
- ☐ Other: _____

172. How important are the following factors when you are choosing a transport mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval per row.

	Not relevant	1 - I barely think about this when selecting my transport mode	2 - I consider it together with other factors	3 - I select my transport mode based mostly on this factor
Cleanness (absence of dirt, litter, graffiti)	☐	☐	☐	☐
Image (or perception) of the transport mode	☐	☐	☐	☐
Road safety	☐	☐	☐	☐
Health risk (including COVID-19)	☐	☐	☐	☐
Personal security	☐	☐	☐	☐
Reliability of transport mode	☐	☐	☐	☐
Frequency of transport mode	☐	☐	☐	☐
Travel time	☐	☐	☐	☐

Travel cost

☐☐☐☐

173. Race *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ Black

☐ White

☐ Coloured

☐ Indian

☐ Mixed

☐ Prefer not to say

☐ Asian

☐ Other: _____

174. To qualify for the Lucky Draw of a R500 Woolworths voucher, please provide your UCT student / staff number in the space below. We need this information, so that we can contact you if you win the Lucky Draw.

Optional: This information will be treated as highly confidential and is not included in the analyses.

Thank you for your participation!

Please submit your form by clicking on "submit" button below. Thank you for your time and effort :)

This content is neither created nor endorsed by Google.

Google Forms

Travel Decisions of Ride-Share Apps

Hello, my name is Jennifer Louisa Baufeldt and I am a PhD student in the Department of Civil Engineering at the University of Cape Town.

I am contacting you because you are a UCT staff member or student and I am collecting data which focuses on better understanding users' experience and expectations of ride-share apps (e.g., Uber, Bolt and Yookoo) to better understand the travel decisions of UCT students and staff, and how COVID-19 has impacted these decisions. By investigating how individuals make decisions under uncertain conditions, the research aims to develop a more realistic understanding of how travel decisions could be modelled. The study is purely for academic purposes only.

The survey focuses on understanding peoples' experiences of uncertainty and ride-share apps. The survey should take about between 3 -8 minutes. I am looking for your personal opinions and there may be questions that are not relevant to you.

I have ethical clearance from the University of Cape Town to collect this data. I will make sure that all data is treated completely confidentially, and all participants are fully anonymised.

This study complies with international best practice on data collection and protection, the data will be treated according to international guidelines and best practice for personal data protection and not sold to third parties. Identifying data will be destroyed at project end.

There is no payment or reimbursement for taking part in this research. I do not anticipate that there is any risk of harm to you in participating in this research.

Please understand that you do not have to participate, i.e., your participation is voluntary. The choice to participate is yours alone. You are free to choose not to participate, and if you choose to participate but wish to withdraw your consent at any time, you are free to do so. However, I would be grateful if you would assist me by completing the survey.

Although this research will not be implementing changes to the transport system you are using, it is anticipated that, by improved understanding of how individuals make travel decisions under uncertainty, better transport solutions may be developed in the future.

Please note that we have ethical clearance from the University of Cape Town to collect this data. I will make sure that all data is treated completely confidentially and will be fully anonymised.

CONSENT: Prior to completing the question below that asks for your consent to participate, please read the following:

I am 18 years or older.

I am voluntarily agreeing to participate in this research study.

I understand that even if I agree to participate now, I can withdraw at any time or refuse to

answer any question without any consequences of any kind. This can be done by not submitting the Google Form.

I understand that I will not benefit directly from participating in this research.

I understand that all information I provide for this study will be treated confidential.

I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview, which may reveal my identity or the identity of people I speak about.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information. (Email: BFLJEN001@myuct.ac.za)

I understand by completing this questionnaire I am consenting to participate in this study.

I agree with all the above.

** Indicates required question*

1. Are you a UCT student / staff member? *

Mark only one oval.

- ☐ Yes - I am a current UCT student / staff member
- ☐ Yes - I am a past UCT student / staff member (UCT Alumni)
- ☐ No - I am not a UCT student or staff (past or current)

2. Have you read the introduction to the survey and agree to give your consent? *

Mark only one oval.

- ☐ Yes *Skip to question 3*
- ☐ No *Skip to section 24 (Thank you for your participation!)*

Let's begin...

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

3. Is the way you travel / move around Cape Town being impacted by COVID-19? *

Information about COVID-19: <https://covid19.who.int/>

Mark only one oval.

- ☐ Yes, very much! - my movement around Cape Town is impacted a lot by COVID-19
- ☐ Yes, a bit - my movement around Cape Town is impacted by COVID-19
- ☐ Maybe - I am not sure if my movement around Cape Town is impacted by COVID-19
- ☐ No - for me there is no real difference, my movement around Cape Town is normal

4. Do you have a car or have access to a car for the majority of your trips? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 6*
- ☐ No *Skip to question 7*

Lucky Packet 2

No thinking necessary, simply pick a letter at random

5. Pick a random option - Final stage 2 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ W *Skip to question 77*
- ☐ V *Skip to question 81*

Lucky Packet 1

No thinking necessary, simply pick a letter at random

6. Pick a random option - stage 1 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ V Skip to question 8
- ☐ V_ Skip to question 45
- ☐ W Skip to question 55
- ☐ W_ Skip to question 69

Lucky Packet 1

No thinking necessary, simply pick a letter at random

7. Pick a random option - stage 1 *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ V Skip to question 9
- ☐ V_ Skip to question 50
- ☐ W Skip to question 56
- ☐ W_ Skip to question 73

Do you use ride-share apps?

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

8. AFTER COVID-19: Do you think ride-share apps (e.g. Uber, Bolt, Yookoo) your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around AFTER COVID-19
Skip to question 10
- ☐ Supplementary form of transport - I will use it for some trips AFTER COVID-19
Skip to question 10
- ☐ Neither - I will not use ride-share apps AFTER COVID-19 *Skip to question 17*

Do you use ride-share apps?

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

9. AFTER COVID-19: Will ride-share apps (e.g. Uber, Bolt, Yookoo) be your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around AFTER COVID-19
Skip to question 10
- ☐ Supplementary form of transport - I will use it for some trips AFTER COVID-19
Skip to question 10
- ☐ Neither - I will not use ride-share apps AFTER COVID-19 *Skip to question 31*

Ride-Share App Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

10. AFTER COVID-19: How many trips do you think you will make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, AFTER COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, AFTER COVID-19
- ☐ Between 1-3 trips per week, AFTER COVID-19
- ☐ 4 - 8 trips per week, AFTER COVID-19
- ☐ More than 8 trips per week, AFTER COVID-19

11. AFTER COVID-19: Would you use ride-share apps (eg. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, i would use ride-share apps for trips late at NIGHT, AFTER COVID-19
- ☐ No, I would not use ride-share apps for trips late at NIGHT, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, AFTER COVID-19

12. AFTER COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I will always use ride-share apps, AFTER COVID-19
- ☐ For trips at night, I will often use ride-share apps, AFTER COVID-19
- ☐ For trips at night, I will seldom use ride-share apps, AFTER COVID-19
- ☐ Not relevant, I will not use ride-share apps at night, AFTER COVID-19

13. AFTER COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, AFTER COVID-19
- ☐ No, I would not use ride-share apps ALONE, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, AFTER COVID-19

14. AFTER COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, AFTER COVID-19
- ☐ No, I would not use ride-share apps at night when I am alone, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps at night when I am alone, AFTER COVID-19

15. Any other feedback / comments about your experience of ride-share apps?

Optional feedback

16. AFTER COVID-19: What do you think your experience of ride-share apps (e.g. Uber, Bolt, Yookoo) will be? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, AFTER COVID-19 *Skip to question 5*
- ☐ Negative, AFTER COVID-19 *Skip to question 5*
- ☐ Mixed - both positive and negative experiences, AFTER COVID-19
Skip to question 5

Skip to question 5

Supplementary Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

17. AFTER COVID-19: Would you use any SUPPLEMENTARY MODE(S) of transport? *
(Normally, and when your car is not available)

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ No supplementary mode
- ☐ Other: _____

18. AFTER COVID-19: What approximate % of all your trips will you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-Share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
No supplementary mode	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

19. AFTER COVID-19: How many trips will you make with your supplementary mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, AFTER COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, AFTER COVID-19
- ☐ Between 1-3 trips per week, AFTER COVID-19
- ☐ 4 - 8 trips per week, AFTER COVID-19
- ☐ More than 8 trips per week, AFTER COVID-19

20. AFTER COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ No, I would not use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ I am not sure if I would use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ Not relevant - I will not have a supplementary mode of transport AFTER COVID-19

21. AFTER COVID-19: Would you use your supplementary mode(s) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) ALONE, AFTER COVID-19
- ☐ No, I would not use supplementary mode(s) ALONE, AFTER COVID-19
- ☐ I am not sure if I would use supplementary mode(s) ALONE, AFTER COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19

22. AFTER COVID-19: For trips when you are alone and it's night, would you use your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary mode(s) at night when I am alone, AFTER COVID-19
- ☐ No, I would not use supplementary mode(s) at night when I am alone, AFTER COVID-19
- ☐ I am not sure if I would use supplementary mode(s) at night when I am alone, AFTER COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19

23. AFTER COVID-19: What do you think your experience of your supplementary mode(s) would be? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, AFTER COVID-19 *Skip to question 5*
- ☐ Negative, AFTER COVID-19 *Skip to question 5*
- ☐ Mixed - both positive and negative experiences, AFTER COVID-19
Skip to question 5
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19 *Skip to question 5*

Skip to question 5

Supplementary Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

24. AFTER COVID-19: Will you use any SUPPLEMENTARY MODE(S) of transport? *

(For everyday or when your car was not available)

Tick only the relevant ones for you.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share app (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti Bus
- ☐ Car (rent / borrow)
- ☐ Not relevant - I do not have a supplementary mode of transport
- ☐ Other: _____

25. AFTER COVID-19: What approximate % of all your trips will you use your SUPPLEMENTARY MODE(S) of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Goldem Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Not relevant - I do not have a supplementary mode of transport	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

26. AFTER COVID-19: How many trips will you make with your supplementary mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Normally 0 trips per week, AFTER COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, AFTER COVID-19
- ☐ Between 1-3 trips per week, AFTER COVID-19
- ☐ 4 - 8 trips per week, AFTER COVID-19
- ☐ More than 8 trips per week, AFTER COVID-19
- ☐ Not relevant - I will not have a supplementary mode of transport AFTER COVID-19

27. AFTER COVID-19: Would you use your supplementary mode(s) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ No, I would not use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ I am not sure if I would use my supplementary mode(s) for trips late at NIGHT, AFTER COVID-19
- ☐ Not relevant - I will not have a supplementary mode of transport AFTER COVID-19

28. AFTER COVID-19: Would you use your supplementary mode(s) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary modes of transport ALONE, AFTER COVID-19
- ☐ No, I would NOT use supplementary modes of transport ALONE, AFTER COVID-19
- ☐ I am not sure if I would use supplementary modes of transport ALONE, AFTER COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19

29. AFTER COVID-19: For trips when you are alone and it's night, would you use your supplementary mode(s)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use supplementary modes of transport at night when I am alone, AFTER COVID-19
- ☐ No, I would NOT use supplementary modes of transport at night when I am alone, AFTER COVID-19
- ☐ I am not sure if I would use supplementary modes of transport at night when I am alone, AFTER COVID-19
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19

30. AFTER COVID-19: What do you think your experience of your supplementary mode(s) will be? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, AFTER COVID-19 *Skip to question 64*
- ☐ Negative, AFTER COVID-19 *Skip to question 64*
- ☐ Mixed - both positive and negative experiences, AFTER COVID-19
Skip to question 64
- ☐ Not relevant - I did not have a supplementary mode of transport AFTER COVID-19
Skip to question 64

Skip to question 64

Main & Supplementary Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

31. AFTER COVID-19: What will your different modes of transport be? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Personal car (owned)
- ☐ Other: _____

32. AFTER COVID-19: What approximate % will you use your different modes of transport?

*

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Golden Arrow bus	☐	☐	☐	☐	☐
Minibus taxi	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride-share app (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti Bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Personal car (owned)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

33. AFTER COVID-19: How many trips will you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, AFTER COVID- 19	Between 1-3 trips per week, AFTER COVID- 19	4 - 8 trips per week, AFTER COVID- 19	More than 8 trips per week, AFTER COVID- 19	Not relevant AFTER COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

34. AFTER COVID-19: Would you use transport late at NIGHT ? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

35. AFTER COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

36. AFTER COVID-19: For trips when you are alone and it's night, would you use transport? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
At night alone: Main modes of transport	☐	☐	☐	☐
At night alone: Supplementary modes of transport	☐	☐	☐	☐

37. AFTER COVID-19: What do you think your experience of transport modes will be? *

Mark only one oval per row.

	Positive, AFTER COVID- 19	Negative, AFTER COVID- 19	Mixed - both positive and negative experiences, AFTER COVID-19	Not relevant AFTER COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

Skip to question 5

Main & Supplementary Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

38. AFTER COVID-19: What will your different modes of transport be? (main and supplementary modes) *

Tick only relevant modes

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt or Yookoo)
- ☐ MyCiti bus
- ☐ Car (rent / borrow)
- ☐ Private car (owned)
- ☐ Other: _____

39. AFTER COVID-19: What approximate % will you use your different modes of transport? *

If the options are not relevant for you, select "0% - Not relevant".

Mark only one oval per row.

	0% - Not relevant	1% -25%	25%-50%	50% -75%	75%-100%
Walking	☐	☐	☐	☐	☐
Cycling	☐	☐	☐	☐	☐
Goldem Arrow bus	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐
Jammie Shuttle	☐	☐	☐	☐	☐
Metered taxi	☐	☐	☐	☐	☐
Ride- sharing apps (e.g. Uber, Bolt or Yookoo)	☐	☐	☐	☐	☐
MyCiti bus	☐	☐	☐	☐	☐
Car (rent / borrow)	☐	☐	☐	☐	☐
Private car (owned)	☐	☐	☐	☐	☐

40. AFTER COVID-19: How many trips will you make per week? *

Mark only one oval per row.

	Normal 0 trips per week, AFTER COVID- 19	Between 1-3 trips per week, AFTER COVID- 19	4 - 8 trips per week, AFTER COVID- 19	More than 8 trips per week, AFTER COVID- 19	Not relevant AFTER COVID- 19
Main mode(s)	☐	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐	☐

41. AFTER COVID-19: Would you use transport late at NIGHT ? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
At NIGHT: Main modes of transport	☐	☐	☐	☐
At NIGHT: Supplementary modes of transport	☐	☐	☐	☐

42. AFTER COVID-19: Would you use transport ALONE? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
ALONE: Main modes of transport	☐	☐	☐	☐
ALONE: Supplementary modes of transport	☐	☐	☐	☐

43. AFTER COVID-19: For trips when you are alone and it's night, would you use transport? *

Mark only one oval per row.

	Yes, AFTER COVID- 19	No, AFTER COVID- 19	I am not sure, AFTER COVID- 19	Not relevant AFTER COVID- 19
At night alone: Main modes of transport	☐	☐	☐	☐
At night alone: Supplementary modes of transport	☐	☐	☐	☐

44. AFTER COVID-19: What will your experience of transport be? *

Mark only one oval per row.

	Positive, AFTER COVID- 19	Negative, AFTER COVID- 19	Mixed - both positive and negative experiences, AFTER COVID-19	Not relevant AFTER COVID- 19
Main mode(s)	☐	☐	☐	☐
Supplementary mode(s)	☐	☐	☐	☐

Skip to question 64

General Questions

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

45. AFTER COVID-19: How important will sustainable transport be to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

46. AFTER COVID-19: How important will being on time be for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

47. AFTER COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town will be dangerous, AFTER COVID-19
- ☐ The roads in Cape Town will be safe, AFTER COVID-19
- ☐ The roads in Cape Town will be sometimes safe and sometimes dangerous, AFTER COVID-19

48. AFTER COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level will be high in Cape Town, AFTER COVID-19
- ☐ Crime level will be average in Cape Town, AFTER COVID-19
- ☐ Crime level will be low in Cape Town, AFTER COVID-19

49. AFTER COVID-19: What will be the best way for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car
- ☐ Other: _____

Skip to question 8

General Questions

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

50. AFTER COVID-19: How important will sustainable transport be to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

51. AFTER COVID-19: How important will being on time for you be? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

52. AFTER COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town will be dangerous, AFTER COVID-19
- ☐ The roads in Cape Town will be safe, AFTER COVID-19
- ☐ The roads in Cape Town will be sometimes safe and sometimes dangerous, AFTER COVID-19

53. AFTER COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level will be high in Cape Town, AFTER COVID-19
- ☐ Crime level will be average in Cape Town, AFTER COVID-19
- ☐ Crime level will be low in Cape Town, AFTER COVID-19

54. AFTER COVID-19: What will be the best way for you to get around Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow Bus
- ☐ Minibus taxis
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share apps (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti Bus
- ☐ Private car
- ☐ Other: _____

Skip to question 9

Do you use ride-share apps?

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

55. AFTER COVID-19: Will ride-share apps (e.g. Uber, Bolt, Yookoo) be your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around AFTER COVID-19
Skip to question 57
- ☐ Supplementary form of transport - I used it for some trips AFTER COVID-19
Skip to question 57
- ☐ Neither - I did not use ride-share apps AFTER COVID-19 *Skip to question 24*

Skip to question 86

Do you use ride-share apps?

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

56. AFTER COVID-19: Will ride-share apps (e.g. Uber, Bolt, Yookoo) be your main form of transport or a supplementary form of transport? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Main form of transport - my normal way to get around AFTER COVID-19
Skip to question 57
- ☐ Supplementary form of transport - I will use it for some trips AFTER COVID-19
Skip to question 57
- ☐ Neither - I will not use ride-share apps AFTER COVID-19 *Skip to question 38*

Skip to question 86

Ride-Share App Trips

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

57. AFTER COVID-19: How many trips will you make with ride-share apps (e.g. Uber, Bolt, Yookoo) in an average week? (1 trip = 1 ride) *

Mark only one oval.

- ☐ Normally 0 trips per week, AFTER COVID-19
- ☐ Only on the odd occasion or for certain trips - occasionally 1 or 2 trips, AFTER COVID-19
- ☐ Between 1-3 trips per week, AFTER COVID-19
- ☐ 4 - 8 trips per week, AFTER COVID-19
- ☐ More than 8 trips per week, AFTER COVID-19

58. AFTER COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) for trips late at NIGHT? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps for trips late at NIGHT, AFTER COVID-19
- ☐ No, I would not use ride-share apps for trips late at NIGHT, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps for trips late at NIGHT, AFTER COVID-19

59. AFTER COVID-19: For trips at NIGHT, how often do you tend to use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ For trips at night, I always use ride-share apps
- ☐ For trips at night, I often use ride-share apps
- ☐ For trips at night, I seldom use ride-share apps
- ☐ Not relevant - I do not use ride-sharing apps at night

60. AFTER COVID-19: Would you use ride-share apps (e.g. Uber, Bolt, Yookoo) ALONE? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps ALONE, AFTER COVID-19
- ☐ No, I would not use ride-share apps ALONE, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps ALONE, AFTER COVID-19

61. AFTER COVID-19: For trips when you are alone and it's night, would you use ride-share apps (e.g. Uber, Bolt, Yookoo)? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes, I would use ride-share apps at night when I am alone, AFTER COVID-19
- ☐ No, I would not use ride-share apps at night when I am alone, AFTER COVID-19
- ☐ I am not sure if I would use ride-share apps at night when I am alone, AFTER COVID-19

62. Any other feedback / comments about your experience of ride-share apps?
Optional feedback

63. AFTER COVID-19: What do you think your experience of ride-share apps will be? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Positive, AFTER COVID-19 *Skip to question 64*
- ☐ Negative, AFTER COVID-19 *Skip to question 64*
- ☐ Mixed - both positive and negative experiences, AFTER COVID-19
Skip to question 64

Skip to question 64

General Questions

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

64. AFTER COVID-19: How important will sustainable transport be to you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance. For definition of "sustainable transport" see:

https://en.wikipedia.org/wiki/Sustainable_transport

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

65. AFTER COVID-19: How important will being on time be for you? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Very important, AFTER COVID-19
- ☐ Important, AFTER COVID-19
- ☐ Average, AFTER COVID-19
- ☐ Not so important, AFTER COVID-19
- ☐ Not important at all, AFTER COVID-19

66. AFTER COVID-19: Which statement do you think is most correct about road safety in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ The roads in Cape Town will be dangerous, AFTER COVID-19
- ☐ The roads in Cape Town will be safe, AFTER COVID-19
- ☐ The roads in Cape Town will be sometimes safe and sometimes dangerous, AFTER COVID-19

67. AFTER COVID-19: Which statement do you think is most correct about crime in Cape Town? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Crime level will be high in Cape Town, AFTER COVID-19
- ☐ Crime level will be average in Cape Town, AFTER COVID-19
- ☐ Crime level will be low in Cape Town, AFTER COVID-19

68. AFTER COVID-19: What will be the best way(s) for you to get around Cape Town? *

Tick the best options in your experience

Tick all that apply.

- ☐ Walking
- ☐ Cycling
- ☐ Golden Arrow bus
- ☐ Minibus taxi
- ☐ Train
- ☐ Jammie Shuttle
- ☐ Metered taxi
- ☐ Ride-share (e.g. Uber, Bolt, Yookoo)
- ☐ MyCiti bus
- ☐ Private car

Skip to question 5

General Questions

Here, we would like you to reflect on your favourite things.

69. Name a favourite book / movie / series of yours. *

70. What is your favourite food? *

71. What is the best place to go out in Cape Town? *

72. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐ Yes *Skip to question 8*

☐ No *Skip to question 8*

☐ Maybe *Skip to question 8*

Skip to question 8

General Questions

Here, we would like you to reflect on your favourite things.

73. Name a favourite book / movie / series of yours. *

74. What is your favourite food? *

75. What is the best place to go out in Cape Town? *

76. Do you think that Cape Town is one of the most beautiful cities in the world? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes *Skip to question 9*
- ☐ No *Skip to question 9*
- ☐ Maybe *Skip to question 9*

Skip to question 9

Ride-Share App Providers

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

77. Which ride-share apps have you used in the past? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I have not used ride-share apps
- ☐ Other: _____

78. Which ride-share apps are you using currently or would consider using in the future? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I don't use ride-share apps now and won't in the future
- ☐ Other: _____

79. Do you prefer metered taxi or ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes - I prefer metered taxi
- ☐ Yes - I prefer ride-share apps
- ☐ No - they are the same for me
- ☐ Other: _____

80. Any feedback / comments you would like to share?

Optional Feedback

Skip to question 86

Ride-Share App Providers

Please imagine life AFTER COVID-19, when there are no more COVID-related Lockdowns or restrictions. Life has established a NEW NORMAL. Please answer the following questions to the best of your ability.

Ride-share apps = examples: Uber, Bolt, Yookoo :)

81. Which ride-share apps have you used in the past? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I have not used ride-share apps
- ☐ Other: _____

82. Yookoo is one of the latest ride-share apps in Cape Town. It includes a student version, anti-gender violence features, facial recognition among other features (App: Yookoo Rider) Did you know about Yookoo already? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes
- ☐ No
- ☐ Maybe I think I heard of it

83. Which ride-share apps are you using currently or would consider using in the future? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Tick all that apply.

- ☐ Uber
- ☐ Bolt
- ☐ Yookoo
- ☐ None, I don't use ride-share apps now and won't in the future
- ☐ Other: _____

84. Do you prefer metered taxi or ride-share apps? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

- ☐ Yes - I prefer metered taxi
- ☐ Yes - I prefer ride-share apps
- ☐ I am not sure if there is a difference or not
- ☐ No - they are the same for me
- ☐ Other: _____

85. Any feedback / comments you would like to share

Optional Feedback

Skip to question 86

Personal Information

You are almost done! Here, we would like to know a bit more about who you are.

86. Age (please type in answer) *

87. Are you an undergraduate, post-graduate or staff at UCT? *

Mark only one oval.

☐ Undergraduate

☐ Post-graduate

☐ Staff

☐ Other:

88. What is your term residence postal code?

Optional question: You can skip this question if you do not feel comfortable sharing this information. Example, postal code for UCT is: 7701. Please DO NOT type in your your whole address.

89. What is your home residence postal code?

Please type "same" if it does not differ from term residence code. Optional question: You can skip this question if you do not feel comfortable sharing this information. Example, postal code for UCT is: 7701. Please DO NOT type in your your whole address.

90. Which Faculty of UCT are you in? *

In alphabetical order:

Mark only one oval.

- ☐ Centre of Higher Education (CHED)
- ☐ Commerce
- ☐ Engineering & the Built Environment (EBE)
- ☐ Graduate School of Business (GSB)
- ☐ Health Sciences
- ☐ Humanities
- ☐ Law
- ☐ Science
- ☐ PASS department
- ☐ Not applicable - I am not a current or past UCT student / staff member

91. Gender *

Mark only one oval.

- ☐ Female
- ☐ Male
- ☐ Prefer not to say
- ☐ Other: _____

92. How important are the following factors when you are choosing a transport mode? *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval per row.

	Not relevant	1 - I barely think about this when selecting my transport mode	2 - I consider it together with other factors	3 - I select my transport mode based mostly on this factor
Cleanness (absence of dirt, litter, graffiti)	☐	☐	☐	☐
Image (or perception) of the transport mode	☐	☐	☐	☐
Road safety	☐	☐	☐	☐
Health risk (including COVID-19)	☐	☐	☐	☐
Personal security	☐	☐	☐	☐
Reliability of transport mode	☐	☐	☐	☐
Frequency of transport mode	☐	☐	☐	☐
Travel time	☐	☐	☐	☐

Travel cost

☐☐☐☐

93. Race *

The answers presented are automatically shuffled. They are not presented in any ranking or order of significance.

Mark only one oval.

☐

Black

☐

White

☐

Coloured

☐

Indian

☐

Mixed

☐

Prefer not to say

☐

Asian

☐

Other: _____

94. To qualify for the Lucky Draw of a R500 Woolworths voucher, please provide your UCT student / staff number in the space below. We need this information, so that we can contact you if you win the Lucky Draw.

Optional: This information will be treated as highly confidential and is not included in the analyses.

Skip to section 24 (Thank you for your participation!)

Thank you for your participation!

Please submit your form by clicking on "submit" button below. Thank you for your time and effort :)

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Appendix B

B.1 Loglinear Models of *Ride-Share Service Questions of Controls*

B.1.1 *Ride-Share Service Question: 'at night'*

For the Controls, the four-way loglinear analysis produced a final model that retained **Access to a Private Vehicle x COVID-19** interaction, the **Gender x 'at night'** interaction, **Access to a Private Vehicle x 'at night'**, and the **COVID-19 x 'at night'** interaction. These are shown in Table 53.

Table 53: Partial Associations for Interactions of 'at night'(n=1398)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Controls	Gender*Vehicle Access*COVID-19	2	3.770	0.152	3
	Gender*Vehicle Access*At Night	2	1.707	0.426	3
	Gender*COVID-19*At Night	4	3.266	0.514	3
	Vehicle Access*Covid*At Night	4	2.923	0.571	4
	Gender*Vehicle Access	1	0.127	0.721	4
	Gender*COVID-19	2	0.682	0.711	4
	Vehicle Access*COVID-19	2	31.256	<0.001	3
	Gender*At Night	2	46.892	<0.001	4
	Vehicle Access*At Night	2	8.388	0.015	4
	COVID-19*At Night	4	56.749	<0.001	3
	Gender	1	101.283	<0.001	2
	Vehicle Access	1	23.240	<0.001	2
	COVID-19	2	16.231	<0.001	2
	At Night	2	889.470	<0.001	2

The **Access to a Private Vehicle x COVID-19** interaction is significant with the Chi-Square, $\chi^2(2) = 31.256$, $p < 0.001$. The **COVID-19 x 'at night'** interaction is significant, with the Chi-Square, $\chi^2(4) = 56.749$, $p < 0.001$. The **Gender x 'at night'** interaction is significant with the Chi-Square $\chi^2(2) = 46.892$, $p < 0.001$. The **Access to a Private Vehicle x 'at night'** interaction is significant with the Chi-Square, $\chi^2(2) = 8.388$, $p = 0.015$.

The Goodness-of-Fit of this model for 'at night' is $\chi^2(19) = 12.226$, $p = 0.876$. This indicates that the model is a good fit, with the results not being significantly different from the model. Table 54 describes the significant interactions with odds ratios.

Table 54: Controls Odds Ratios for 'at night' of Significant Interactions of Control Loglinear Model for Females and Males

Ride-Share Service Question	Interaction	Description	Odds Ratio for Yes
'at night'	COVID-19 x 'at night'	Before - During COVID-19	1.99
		Before - After COVID-19	2.51
	Gender x 'at night'	Male vs Female	2.42
	Access to a Private Vehicle x 'at night'	No Access vs Access	1.11 1.38 times 'I am not sure', individuals without access: to individuals with access

Table 54 shows that in the Controls, individuals are 1.99 times more likely to say that they would use ride-share services at night 'before COVID-19' than 'during COVID-19'. Furthermore, they are 2.51 times more likely to use ride-share services 'at night' 'before COVID-19' than 'after COVID-19'. The uncertainty of 'during COVID-19' is expected to generate a reduced willingness to use ride-share services, either due to the reduced demand for trips, or the concern of infection. However, the decline in ride-share service trips 'at night' 'after COVID-19' was not expected. The odds ratios are summarised later in this section in more detail, in Table 55, per *Gender* and *Access to a Private Vehicle*.

The next significant interaction in Table 54 compares males' and females' decisions to take ride-share service trips 'at night'. As described in Chapter 3 and Chapter 4, *Gender* was expected to be the most significant factor. In Chapter 4, Section 4.3.1, these factors were summarised as the prominent levels of gender-based violence and harassment of women in Cape Town, the differences in personality traits, and the differences in risk-taking. Males are 2.42 times more likely to say 'yes' to taking ride-share services 'at night' than females. This confirms a statistical difference in how females and males decide on ride-share service trips 'at night'.

The last significant interaction in Table 54 is between individuals with and without access to a private vehicle. Individuals without access to a private vehicle are 1.11 times more likely to be willing to use ride-share services 'at night' than individuals with access to a private vehicle. Such a difference is expected as individuals without access to a private vehicle may not have other alternatives for late-night trips.

Another interesting odds ratio is found between individuals with access and those without. Individuals without access are 1.38 times more uncertain about their decision 'at night' than

individuals with access to a private vehicle. Table 55 looks at the odds ratios per *Access to a Private Vehicle* and *Gender* for **before-during COVID-19** and **before-after COVID-19**.

Table 55: Control Odds Ratios for 'at night' per Gender and Access to a Vehicle: Before-During COVID-19, Before-After COVID-19

Ride-Share Service Question	Access to a Private Vehicle	Gender	Odds Ratio of Yes: Before-During COVID-19	Odds Ratio of Yes: Before - After COVID-19
'at night'	Yes	Female	1.99	1.41
		Male	2.06	1.55
	No	Female	2.15	1.72
		Male	2.25	1.91

The odds ratios in Table 55 highlight that all individuals are likelier to reply with 'yes' to 'before COVID-19' than 'during COVID-19' or 'after COVID-19'.

The **Access to a Private Vehicle x COVID-19** interaction indicates an unusually high proportion of females and males, without access to a private vehicle, participating in the final survey compared to the previous survey described in Chapter 4, Section 4.4.1. The question of access to a private vehicle was asked, and then the *COVID-19 conditions* were randomly assigned through a selection of dummy variables in the first survey. In the second survey, all participants were assigned to 'after COVID-19'. Therefore, there is no meaning to this interaction. It may indicate that individuals without access to a private vehicle are significantly more motivated to participate in the second survey⁴⁶. It does, however, explain the dramatic effect seen in 'after COVID-19', as individuals without access to a private vehicle are shown, in Table 55, to be more affected by *COVID-19* than individuals with access to a private vehicle.

B.1.2 Ride-Share Service Question: 'alone'

The four-way log-linear analysis produced a final model for the Controls that retained the **COVID-19 x Access to a Private Vehicle** interaction, **Gender x 'alone'** interaction, and the **COVID-19 x 'alone'** interaction. The **COVID-19 x Access to a Private Vehicle** interaction is significant, with the Chi-Square, $\chi^2(2) = 30.798$, $p < 0.001$. The **Gender x 'alone'** interaction is significant with the Chi-Square $\chi^2(2) = 62.854$, $p < 0.001$. The **COVID-19 x 'alone'** interaction is significant with the Chi-Square, $\chi^2(4) = 54.301$, $p < 0.001$. Table 56 shows the interactions for 'alone'.

⁴⁶ As both surveys offered a chance to be randomly selected for a R500 voucher, this may once again point to the economic differences between individuals with access to a private vehicle not being so easily motivated by such an incentive, while individuals without access to a private vehicle will still take the time on a second survey for another chance at being selected for the voucher.

Table 56: Partial Associations for Interactions of 'alone' (n=1398)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Controls	Gender*Vehicle Access*COVID-19	2	2.110	0.348	3
	Gender*Vehicle Access*Alone	2	5.843	0.054	3
	Gender*COVID-19*Alone	4	5.701	0.223	3
	Vehicle Access*COVID-19 *Alone	4	3.647	0.456	4
	Gender*Vehicle Access	1	0.107	0.743	4
	Gender*COVID-19	2	0.070	0.966	4
	Vehicle Access*COVID-19	2	30.798	<0.001	4
	Gender*Alone	2	62.854	<0.001	4
	Vehicle Access*Alone	2	3.080	0.214	4
	COVID-19*Alone	4	54.301	<0.001	3
	Gender	1	101.283	<0.001	2
	Vehicle Access	1	23.240	<0.001	2
	COVID-19	2	16.231	<0.001	2
	Alone	2	917.342	<0.001	2

The Goodness-of-Fit of this model for 'alone' was $\chi^2(16) = 12.797$, $p = 0.688$. The model is, therefore, a good fit, with the results not being significantly different from the model. The significant interactions are explored with odds ratios in Table 57.

Table 57: Control Odds Ratios for 'alone' of Significant Interactions of Control Loglinear Model for Females and Males

Ride-Share Service Question	Interaction	Description	Odds Ratio for Yes
'alone'	Gender x 'alone'	Male vs Female	2.69
	COVID-19 conditions x 'alone'	Before-During COVID-19	1.01
		Before-After COVID-19	1.79

The first odds ratio in Table 57 shows that males are 2.69 times more likely to take trips 'alone' than females in the Controls. Table 57 shows that for the Controls, hardly any difference was found for 'alone' between **before-during COVID-19**. However, there is a noticeable difference, with individuals being 1.79 times more likely to take ride-share trips 'alone' 'before COVID-19' than 'after COVID-19'.

Table 58 explores the significant interactions in more depth. It shows the odds ratios for females and males, comparing **before-during COVID-19** and **before-after COVID-19** for individuals with and without access to a private vehicle.

Table 58: Control Odds Ratios for 'alone' of Significant Interactions of Control Loglinear Model for Females and Males

Ride-Share Service Question	Access to a Private Vehicle	Gender	Odds Ratio of Yes: Before-During COVID-19	Odds Ratio of Yes: Before -After COVID-19
'alone'	Yes	Female	1.03	1.72
		Male	1.25	2.54
	No	Female	1.04	1.78
		Male	2.03	1.11

The responses from females in the Controls for ‘alone’ are consistent for females with or without access to a private vehicle, with the odds ratios of 1.03 and 1.04 for **before-during COVID-19** and 1.72 and 1.78 for **before-after COVID-19**, respectively.

Males with access to a private vehicle had larger odds ratios for taking a trip ‘alone’ **before-after COVID-19** than **before-during COVID-19**. For males without access to a private vehicle, the **before-after COVID-19** odds ratio is 1.11, indicating a comparatively small decrease in taking ride-share service trips ‘alone’ ‘after Covid- 19’ than ‘before COVID-19’. However, males without access to a private vehicle are 2.03 times more willing to use ride-share services ‘alone’ ‘before COVID-19’ than ‘during COVID-19’.

B.1.3 Ride-Share Service Question: ‘alone at night’

The four-way log-linear analysis produced a final model for the Controls that retained the **Gender x ‘alone at night’** interaction, **Access to a Private Vehicle x ‘alone at night’** interaction and the **COVID-19 x ‘alone at night’** interaction. As usual, the **COVID-19 x Access to a Private Vehicle** is also reported, which has already been described in Section B.1.1 The **Gender x ‘alone at night’** interaction is significant, with the Chi-Square, $\chi^2(2) = 210.161$, $p < 0.001$. The **Access to a Private Vehicle x ‘alone at night’** interaction is significant with the Chi-Square, $\chi^2(2) = 16.006$, $p < 0.001$. The **COVID-19 x ‘alone at night’** interaction is significant with the Chi-Square, $\chi^2(4) = 23.498$, $p < 0.001$. The **COVID-19 x Access to a Private Vehicle** interaction is significant, with the Chi-Square, $\chi^2(2) = 31.600$, $p < 0.001$. As before, the significant interaction of **COVID-19 x Access to a Private Vehicle** is not described further. Table 59 shows the interactions of the loglinear model.

Table 59: Partial Associations for Interactions of ‘alone’ (n=1398)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Controls	Gender*Vehicle Access*COVID-19	2	4.537	0.103	3
	Gender*Vehicle Access*Alone at Night	2	1.349	0.509	4
	Gender*COVID-19*Alone at Night	4	2.539	0.638	4
	Vehicle Access*COVID-19*Alone at Night	4	2.870	0.580	3
	Gender*Vehicle Access	1	0.384	0.536	4
	Gender*COVID-19	2	0.487	0.784	5
	Vehicle Access*COVID-19	2	31.600	<0.001	4
	Gender*Alone at Night	2	210.161	<0.001	3
	Vehicle Access*Alone at Night	2	16.006	<0.001	4
	COVID-19*Alone at Night	4	23.498	<0.001	4
	Gender	1	101.283	<0.001	2
	Vehicle Access	1	23.240	<0.001	2
	COVID-19	2	16.231	<0.001	2
	Alone at Night	2	343.297	<0.001	2

The Goodness-of-Fit of this model for ‘alone at night’ was $\chi^2(19) = 11.185$, $p = 0.917$. The model is a good fit, with the results not being significantly different from the model. Table 60 shows the odds ratios of the significant interactions.

Table 60: Control Odds Ratios for 'alone at night' of Significant Interactions of Control Loglinear Model for Females and Males

Ride-Share Service Question	Interaction	Description	Odds Ratios
'alone at night'	COVID-19 conditions x 'alone at night'	Before-During COVID-19	1.25
		Before-After COVID-19	1.31
	Gender x 'alone at night'	Male vs Female	5.12
	Access to a Private Vehicle x 'alone at night'	No Access vs Access	1.30

The Controls show that ‘alone at night’ for both **before-during COVID-19** and **before-after COVID-19** generate odds ratios greater than one. These odds ratios are consistently moderate when compared to the previous two *Ride-Share Service Questions* of ‘at night’ and ‘alone’. Table 61 shows a summary of these values.

Table 61: Summary of Odds Ratios for Control Ride-Share Service Questions of COVID-19 Comparisons

Ride-Share Service Question	Before-During COVID-19	Before-After COVID-19
‘at night’	1.99	2.51
‘alone’	1.01	1.79
‘alone at night’	1.25	1.31

The next significant interaction of **Gender x ‘alone at night’** generate the largest odds ratio of **5.12** in the results. This confirms a dramatic difference in how males are more willing to use ride-share services ‘alone at night’ than females. The interaction of **Gender x ‘Ride-Share Service Question’** is significant for all three *Ride-Share Service Questions*. For ‘at night’, the odds ratio between males and females is 2.42; for ‘alone’, the odds ratio is 2.69.

The last significant interaction within the Controls for ‘alone at night’ is **Access to a Private Vehicle x ‘alone at night’**. Here, individuals without access to a private vehicle are 1.3 times more likely, than individuals with access to a private vehicle, to use ride-share service trips ‘alone at night’. Table 62 looks at the odds ratios of **before-after COVID-19** and **before-during COVID-19** for females and males, separately, for those with and without access to a private vehicle.

Table 62: Control Odds Ratios for ‘alone at night’ per Access and Gender: Before-During COVID-19 and Before-After COVID-19

Ride-Share Service Question	Access to a Private Vehicle	Gender	Odds Ratio for Yes: Before-During COVID-19	Odds Ratio for Yes: Before -After COVID-19
‘alone at night’	Yes	Female	1.31	1.26
		Male	1.20	1.45
	No	Female	1.34	1.36
		Male	1.39	1.61

Table 62 shows that all individuals are more likely to use ride-share services ‘alone at night’ ‘before COVID-19’ than ‘during COVID-19’ or ‘after COVID-19’.

Appendix C

C.1 Female Loglinear Models of Ride-Share Service Questions after Transport Factors

C.1.1 Female Loglinear Model: ‘at night’ after Transport Factors

The three-way log-linear analysis produced a final model for females of Experiment 2 that retained the **Access to a Private Vehicle x COVID-19** interaction and the **COVID-19 x ‘at night’** interaction. The **Access to a Private Vehicle x COVID-19** interaction is significant with the Chi-Square, $\chi^2(2) = 14.973$, $p < 0.001$. The **COVID-19 x ‘at night’** interaction is significant, with the Chi-Square, $\chi^2(4) = 17.550$, $p = 0.002$. Table 63 shows all the interactions.

Table 63: Partial Associations for Interactions of ‘at night’(n=345)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 2 Female	Vehicle Access*COVID-19	2	14.973	<0.001	2
	Vehicle Access*Night	2	2.029	0.363	2
	COVID-19*Night	4	17.550	0.002	2
	Vehicle Access	1	0.838	0.360	2
	COVID-19	2	1.809	0.405	2
	Night	2	175.994	<0.001	2

The Goodness-of-Fit of this female only model for ‘at night’ is $\chi^2(6) = 5.641$, $p = 0.465$, for the *Ride-Share Service Questions* after the *Transport Factors*. The model is, therefore, a good fit, with the expected counts of the model not being significantly different from the actual counts of the data.

The **Access to a Private Vehicle x COVID-19** interaction is due to an unusually high number of females with no car access participating in Experiment 2 in the ‘after COVID-19’ survey. Therefore, this interaction is not investigated further here. Table 64 describes the second interaction of **COVID-19 x ‘at night’** in more detail using odds ratios of the expected counts from the model.

Table 64: Experiment 2 Odds Ratios for 'at night' of Significant Interactions of Experiment 2 Loglinear Model for Females

Ride-Share Service Question	Interaction	Description	Odds Ratios of Yes
'at night'	COVID-19 x 'at night'	Before-During COVID-19	1.40
		Before-After COVID-19	2.81

In the *Ride-Share Service Questions* after the *Transport Factors*, females are 1.4 times more likely to be willing to use ride-share services 'at night' 'before COVID-19' than 'during COVID-19'. Furthermore, females are 2.81 times more likely to be willing to use ride-share services 'at night' 'before COVID-19' than 'after COVID-19'.

C.1.2 Female Loglinear Model: 'alone' after *Transport Factors*

The three-way log-linear analysis produced a final model for females of Experiment 2 that retains the **Access to a Private Vehicle x COVID-19** interaction and the **COVID-19 x 'alone'** interaction. Table 65 shows the results. The **COVID-19 x Access to a Private Vehicle** interaction is significant, with the Chi-Square, $\chi^2(2) = 14.135$, $p < 0.001$. The **COVID-19 x 'alone'** interaction is significant with the Chi-Square, $\chi^2(4) = 19.566$, $p < 0.001$. As before, the significant interaction **Access to a Private Vehicle x COVID-19** is not described further.

Table 65: Partial Associations for Interactions of 'alone' (n=345)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 2 Female	Vehicle Access*Alone	2	3.570	0.168	2
	Vehicle Access*COVID-19	2	14.135	<0.001	2
	COVID-19*Alone	4	19.566	<0.001	2
	Vehicle Access	1	0.838	0.360	2
	Alone	2	181.007	<0.001	2
	COVID-19	2	1.809	0.405	2

The Goodness-of-Fit of this female only model for 'alone' was $\chi^2(6) = 11.699$, $p = 0.069$. The model fits the data, with the results not being significantly different from the model. Table 66 shows the odds ratios of the significant interaction of **COVID-19 x 'alone'**.

Table 66: Experiment 2 Odds Ratios for 'alone' of Significant Interactions of Experiment 2 Loglinear Model for Females (n=345)

Ride-Share Service Question	Interaction	Description	Odds Ratios of Yes
'alone'	COVID-19 x 'alone'	Before-During COVID-19	0.72
		Before-After COVID-19	2.02

Surprisingly, females of Experiment 2 are more likely to be willing to use ride-share services 'alone' 'during COVID-19' than 'before COVID-19'. However, they are less inclined to do so 'after COVID-19'.

C.1.3 Female Loglinear Model: 'alone at night' after *Transport Factors*

The three-way log-linear analysis produced a final model for females of Experiment 2 for 'alone at night' that retains the **Access to a Private Vehicle x COVID-19** interaction and the **Access to a Private Vehicle x 'alone at night'** interaction. Table 67 shows the results. The **Access to a Private Vehicle x COVID-19** interaction is significant with the Chi-Square, $\chi^2(2) = 13.920$, $p < 0.001$. The **Access to a Private Vehicle x 'alone at night'** interaction is significant with the Chi-Square, $\chi^2(2) = 25.431$, $p < 0.001$. As in the other sections, the interaction **Access to a Private Vehicle x COVID-19** is not described further.

Table 67: Partial Associations for Interactions of 'alone at night' (n=345)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 2 Female	Vehicle Access*COVID-19	2	13.920	<0.001	2
	Vehicle Access*Alone at Night	2	25.431	<0.001	2
	COVID-19*Alone at Night	4	4.178	0.382	2
	Vehicle Access	1	0.838	0.360	2
	COVID-19	2	1.809	0.405	2
	Alone at Night	2	69.466	<0.001	2

The Goodness-of-Fit of this female only model for 'alone at night' is $\chi^2(8) = 7.300$, $p = 0.505$. The model fits the data well, with the results not being significantly different from the model. Table 68 shows the odds ratio of the significant interaction in Experiment 2 for females.

Table 68: Experiment 2 Significant Interactions for 'alone at night' for Females

Ride-Share Service Question	Interaction	Description	Odds Ratio
'alone at night'	Access to a Private Vehicle x 'alone at night'	No Access vs Access	3.11

Females in Experiment 2, without access to a private vehicle, are 3.11 times more likely to use ride-share services 'alone at night' than females with access to a private vehicle. However, for females in Experiment 2 'alone at night', *COVID-19* is non-significant.

C.2 Female Loglinear Models of Ride-Share Service Questions after *Good Mood Questions*

C.2.1 Female Loglinear Model for 'at night' after *Good Mood Questions*

The three-way log-linear analysis produced a final model for females of Experiment 4 that retains the **Access to a Private Vehicle x COVID-19** interaction, the **COVID-19 x 'at night'** interaction and the **Access to a Private Vehicle x 'at night'** interaction. Table 69 shows the results. The **Access to a Private Vehicle x COVID-19** interaction is significant, with the Chi-Square, $\chi^2(2) = 30.133$, $p < 0.001$. The **Access to a Private Vehicle x 'at night'** interaction is significant with the Chi-Square, $\chi^2(2) = 6.447$, $p = 0.040$.

The **COVID-19 x 'at night'** interaction is significant, with the Chi-Square, $\chi^2(4) = 16.385$, $p = 0.003$. As before, the interaction **Access to a Private Vehicle x COVID-19** is not described further.

Table 69: Partial Associations for Interactions of 'at night' (n=401)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 4 Female	Vehicle Access*COVID-19	2	30.133	<0.001	2
	Vehicle Access*Night	2	6.447	0.040	2
	COVID-19*Night	4	16.385	0.003	2
	Vehicle Access	1	0.302	0.583	2
	COVID-19	2	1.980	0.372	2
	Night	2	218.999	<0.001	2

The Goodness-of-Fit of this model for 'at night' was $\chi^2(4) = 3.653$, $p = 0.455$. The model is a good fit, with the results not being significantly different from the model. Table 70 describes the significant interactions with odds ratios.

Table 70: Experiment 4 Odds Ratios for 'at night' for Significant Interactions of Female Experiment 4 Loglinear Model

Ride-Share Service Question	Interaction	Description	Odds Ratios for Yes
'at night'	COVID-19 x 'at night'	Before-During COVID-19	1.81
		Before-After COVID-19	1.78
	Access to a Private Vehicle x 'at night'	No access vs Access	1.01
			1.91 for 'not certain'

In Experiment 4, females are always more likely to use ride-share services 'at night' 'before COVID-19' than 'during COVID-19' or 'after COVID-19'. While females with and without access to a private vehicle are just as likely as each other to use ride-share services 'at night', the data indicates that females without access to a private vehicle are much more uncertain ('not sure') than females with access to a private vehicle.

C.2.2 Female Loglinear Model for 'alone' after *Good Mood Questions*

The three-way log-linear analysis produced a final model for females of Experiment 4 that retains the **Access to a Private Vehicle x COVID-19** interaction and the **COVID-19 x Alone** interaction. Table 71 shows the results. The **Access to a Private Vehicle x COVID-19** interaction is significant with the Chi-Square, $\chi^2(2) = 29.822$, $p < 0.001$. The **COVID-19 x Alone** interaction is significant with the Chi-Square, $\chi^2(4) = 22.113$, $p < 0.001$. As before, the interaction, **COVID-19 x Access to a Private Vehicle**, is not described further.

Table 71: Partial Associations for Interactions of 'alone'(n=401)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 4 Female	Vehicle Access*Alone	2	5.883	0.053	2
	Vehicle Access*COVID-19	2	29.822	<0.001	2
	COVID-19*Alone	4	22.113	<0.001	2
	Vehicle Access	1	0.302	0.583	2
	Alone	2	218.347	<0.001	2
	COVID-19	2	1.980	0.372	2

The Goodness-of-Fit of this model for 'alone' is $\chi^2(6) = 7.597$, $p = 0.269$. The model is a good fit, with the results not being significantly different from the model.

Table 72: Experiment 4 Odds Ratios for 'alone' for Significant Interactions of Female Experiment 4 Loglinear Model

Ride-Share Service Question	Interaction	Description	Odds Ratios for Yes
'alone'	COVID-19 conditions x 'alone'	Before - During COVID-19	0.94
		Before - After COVID-19	1.29

Table 72 shows that in Experiment 4, the effect of the *Good Mood Questions* results in females being more likely to take ride-share service trips 'during COVID-19' than 'before COVID-19'. Additionally, the positive effect on the perceptions of taking ride-share services 'alone' is also seen in the **before-after COVID-19** odds ratio. Compared to the Controls (Chapter 5), females with access to a private vehicle have an odds ratio of 1.72, while females without access to a private vehicle have an odds ratio of 1.78.

C.2.3. Female Loglinear Model for 'alone at night' after *Good Mood Questions*

For the *Ride-Share Service Question* of 'alone at night', the three-way loglinear analysis produced a final model for females of Experiment 4 that retains the **Access to a Private Vehicle x COVID-19** interaction and the **Access to a Private Vehicle x 'alone at night'** interaction. Table 73 shows the results. The **Access to a Private Vehicle x COVID-19** interaction is significant with $\chi^2(2) = 27.536$, $p < 0.001$. The **Access to a Private Vehicle x 'alone at night'** interaction is significant with $\chi^2(2) = 17.698$, $p < 0.001$. As before, the interaction, **Access to a Private Vehicle x COVID-19**, is not described further.

Table 73: Partial Associations for Interactions of 'alone at night'(n=401)

Experiment Group	Interaction	Degrees of Freedom	Partial Chi-Square	p-Value	No. of Iterations
Experiment 4 Female	Vehicle Access*COVID-19	2	27.536	<0.001	2
	Vehicle Access*Alone at Night	2	17.698	<0.001	2
	COVID-19*Alone at Night	4	9.050	0.060	2
	Vehicle Access	1	0.302	0.583	2
	COVID-19	2	1.980	0.372	2
	Alone at Night	2	62.586	<0.001	2

The Goodness-of-Fit of this model for 'alone at night'. is $\chi^2(8) = 11.918$, $p = 0.155$. The model is a good fit, with the results not being significantly different from the model. Table 74 shows the odds ratio for yes between individuals with and without access to a private vehicle for 'alone at night'.

Table 74: Odds Ratio for 'alone at night' for Significant Interactions of Female Experiment 4 Loglinear Model

Ride-Share Service Question	Interaction	Description	Odds Ratio for Yes
'alone at night'	Access to a Private Vehicle x 'alone at night'	No Access vs Access	1.93