Work is where my bike is

Identifying windows of opportunity for bike commuting in the heart of Germany's car industry

Sandra Vanessa Seethaler

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Submitted May 14, 2019

Supervisor: David Harnesk, LUCSUS, Lund University

Abstract

In Germany, country of diesel bans and postponed climate goals, the region of Baden-Württemberg, as the heart of the country's car industry, faces especial challenges. Due to its highly car-oriented transport system and topographical structure, the region is notorious for some of the country's worst air quality levels. In response to these issues, the regional government formulated a cycling strategy, aimed at doubling the bike's share in the region's modal split by 2020 – a goal that officially conceded, is not going to be reached.

Since car-oriented commuter traffic contributes considerably to the problem, I applied theory of planned behaviour and mixed methods to analyse what factors determine commuters' transport mode choices. Through my research, I deduced windows of opportunity and challenges for bike-commuting and related these to the content of Baden-Württemberg's cycling strategy.

A survey and interviews with commuters and political stakeholders revealed that the root of the problem lies in a high degree of weather exposure, as well as in a perceived low infrastructural development. This showed to be the root cause for the obstructive attitudes held by commuters about the bike, most importantly a low feeling of independence, a perceived time disadvantage, as well as a high expected accident risk and stress. Lastly, the bike's assets – its low costs, environmental and health/ fitness benefits – fail to make an impact, due to their low relevance for commuters.

The findings underline the need for infrastructure that commuters perceive as continuous and direct, on which commuters feel independent, safe, relaxed and time-efficient, something that the cycling strategy's current standard fails to achieve. Furthermore, the need for building awareness among car drivers regarding cyclists' safety in traffic became apparent. Overall, these findings can help to re-evaluate the focus and radicality of Baden-Württemberg's cycling strategy.

Keywords: Sustainable Mobility, Bike Commuting, Behaviour Analysis, Transport Planning, Sustainability Transition, Baden-Württemberg

Word count: 13 558

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Thank you to my family. I know you couldn't care less about what I write on this very page. I owe everything to you.

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Glossary

ADFC	German Cyclist Federation
BW	Federal State of Baden-Württemberg
NVBW	Regional Transport Agency of Baden-Württemberg
PBC	Perceived Behavioural Control
PT	Public Transport
RadKULTUR	Cycling culture programme (pillar of cycling strategy)
RadNETZ	Cycling network programme (pillar of cycling strategy)
RN	Road Network
RQ	Research Question
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
VM	Transport Ministry of the Federal State of Baden-Württemberg

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1 Introduction

In the light of the Paris Agreement, 185 countries have formally recognised the "the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available scientific knowledge" (UN, 2015, p. 1). At the heart of the agreement lies the aim to keep the global average temperature increase below 2°C and to pursue efforts to limit it to 1.5°C above pre-industrial levels (UN, 2015). Although the agreement leaves it to the individual countries to determine their contributions, all countries, especially the developed ones, have to mobilise extensive efforts for scaling down their CO_2 emissions, in order to have a realistic chance to meet the goals (UN, 2015).

In Germany, where the government has recently postponed its 2020 goals to reach a 40 % reduction in CO_2 emissions compared to 1990 levels, the transport sector is an especially crucial field for CO_2 reductions, accounting for 18 % of the country's overall emissions (BMU, 2019; BMU, n.d.). In 2017, 61 % of the CO_2 emissions in the transport sector came directly from private cars, which remain the number one mode of transport in the country, accounting for 55 % of all kilometres travelled (BMU, n.d; BMVI, 2018.).

As regards climate change mitigation, research shows that car-based infrastructure is no longer the future, due to several reasons. Firstly, despite substantial progress in developing less-polluting vehicles over the past two decades, overall car-emissions continue to increase, due to the widely observed rebound-effect (UBA, 2018). Secondly, electric cars are currently not charged with a substantial share of renewable energy in Germany and further not only create significant emission levels during the production stage, but also contain non-recyclable chemical elements (UBA, 2016b).

Therefore, different scholars argue for a different mobility model, the A-S-I model, which is depicted in Figure 1 (Perschon, 2012; GIZ, n.d.). It advocates for an increased focus on a) avoiding traffic, b) shifting traffic that cannot be avoided towards public transport and bikes where possible, and c) improving the energy efficiency of the remaining traffic (GIZ, n.d.). The advantage of such a system goes beyond its avoidance of CO_2 intensive electric car production and a reduced dependence on a renewable energy mix (Perschon, 2012). It is also beneficial in terms of noise reduction, improved air quality, reduced road fatalities and transport cost expenditures, as well as reduced land consumption of traffic infrastructure (Perschon, 2012).

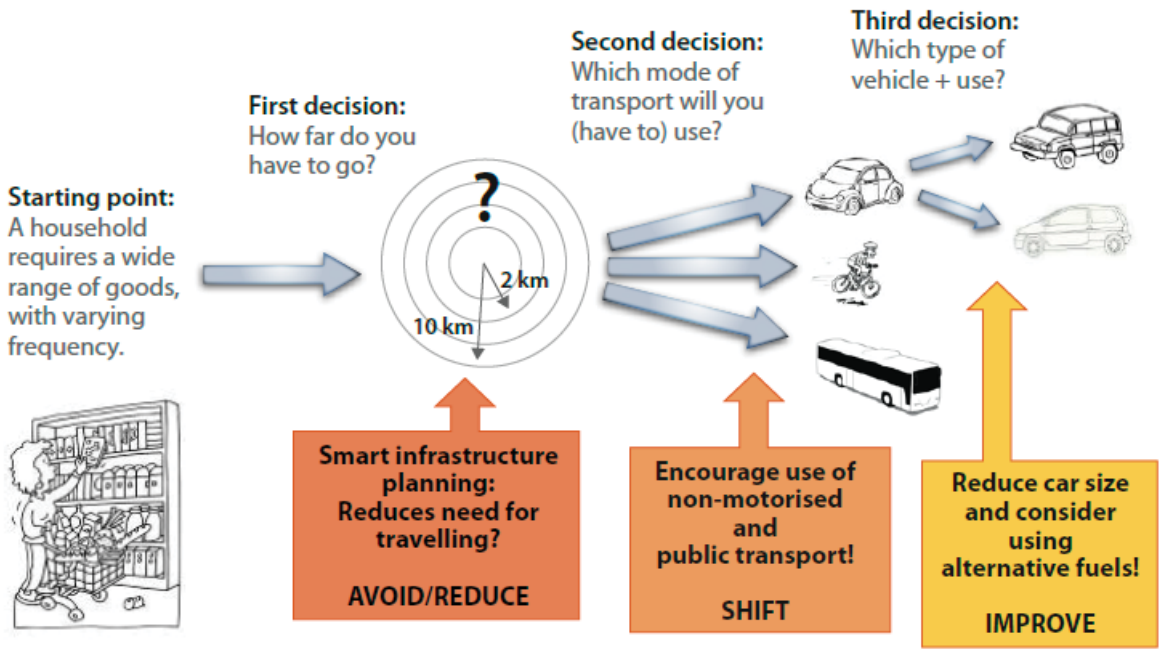

Figure 1: The A-S-I Model (GIZ, n.d.). The pyramid shows the transition towards a sustainable mobility system in three layers: at the base, lies the challenge to plan settlements and industrial zones in such a way that most trips stop being necessary – the motto being 'the best kind of traffic, is no traffic at all' (GIZ, n.d.). The remaining traffic that will still occur despite measures to avoid traffic should then be diverted away from cars towards more sustainable transport alternatives, eg. busses, trains, bicycles (GIZ, n.d.). The last level concerns the kind of traffic that can neither be avoided, nor diverted – but it can still be improved: electric vehicles, though not entirely green, are still substantially cleaner than their fossil fuel-run counterparts (GIZ, n.d.).

Looking at the 2nd level in Figure 1, the bike plays a particularly crucial role in achieving the objective of effectively diverting traffic towards more sustainable alternatives, due to its potential to cover the gap between individual's homes and train or bus stations (ISU, 2013). In this way, the bike is an important link in the transport chain, able to integrate anyone who lives within a cyclable distance of a regular bus or train service (ISU, 2013).

Recognising the important role that the bike can play in the mobility transition, the Federal State Government of Baden-Württemberg (BW), an especially car-dominated region, introduced a cycling strategy in 2016 (VM, 2016; Hawlitschek, 2011). This strategy set the aim of doubling the 2008 cycling trip ratio of 8% up to 16% by 2020 and further up to 20% by 2030 (VM, 2016). Progress is to be measured in five-year intervals, with the respective achievements being compared to the status quo analysis, which was conducted before the start of the policy (NVBW, 2010).

This status quo analysis shows comprehensive data regarding modal splits that are differentiated according to different types of trips and social groups, as well as a survey on how people perceive the state of the infrastructure (NVBW, 2010). What is missing, is a comprehensive understanding of what

makes people in BW choose a certain transport mode over other available options (NVBW, 2010). In the light of Transport Minister Hermann publicly acknowledging the foreseeable failure to reach the 2020 16 % goal, this is a crucial shortcoming: without understanding the major factors that influence people's transport choice, the federal state government cannot tailor the focus of its transport policies towards a solution that people are willing to accept (BMVI Pressestelle, 2019).

This is precisely the research gap that this thesis seeks to fill, by conducting a behaviour analysis guided by Theory of Planned Behaviour (TPB). Specifically, this thesis focuses on transport mode choices of commuters. I have chosen this focus, because commuting is a wide-spread phenomenon with 55% of BW's working population working in another municipality than they live (Winkelmann, 2008). The fact that 62% commute by private cars, shows how significant the impact of work-related commuting trips is on the regional CO_2 balance and its prevailing air quality issues (Winkelmann, 2010).

As a result of the above outlined context, the aim of my research can be summarised as follows: for the cycling strategy to be as impactful as possible, I aim to understand which factors lead to commuters choosing their transport mode. This enables me to deduct from these insights, what windows of opportunity exist for the bike, specifically with an eye on its potential as a last-mile connector. This means that my research is guided by a solution-oriented approach – rather than simply trying to understand the problem of a car-based mobility sector. I aim on going a step further by deducting a roadmap to change that is based on an understanding of individuals' decision-making patterns between the available transport modes.

In this way, the research questions (RQs) that I seek to answer throughout this thesis are formulated as follows:

> RQ1: Which factors lead to commuters choosing a particular transport mode over another?
>
> RQ2: Based on an understanding of RQ 1, where do the windows of opportunity lie for the bike, especially when looking at its potential as a last-mile connector?
>
> RQ3: What implications do the insights from RQ 1 & RQ 2 have on the conceptualisation of the cycling strategy and BW's regional transport planning in general?

1.1 Thesis Structure

After having introduced the problematics of a car-based transport system and having sketched a pathway towards a more sustainable way of managing our mobility needs, the next chapter introduces the cycling strategy and gives account of how current mobility behaviours are shaped. Following this, I present the theoretical framework that guides this research and elaborate on the methods which I use to gather data. Thereafter follows the heart of this thesis, where I display the results of my research, addressing RQ 1. The discussion seeks to provide answers to RQ 2 & RQ 3, through a deductive analysis of the research findings that seek to a) identify windows of opportunity for the bike, and b) discuss the implications of the findings on BW's cycling strategy.

1.2 Connection to Sustainability Science

Kates et al. (2001) define sustainability science as a field that seeks to understand nature-society interactions across all scales. This is especially important in the light of so-called wicked problems, thus persistent problems that are "rooted in the deep structure of the societal system and are a manifestation of the system's unsustainability" (Frantzeskaki & Loorbach, 2014, p. 21). For this reason, Clark & Dickson (2003) add that sustainability needs to be achieved "in a dialogue between scientists and the people engaged in the practice" (p. 8059). In this way, sustainability science not only tackles the challenge of "bridging the gap between science and practice" (Polk, 2014, p. 440), but also ensures "scientific rigor, practical legitimacy and usability of the results" (p. 442).

This thesis is written precisely in the light that the afore-quoted sustainability scientists described. The wickedness of the case as a structural problem can be seen with the car-based transport system defining how we build our cities and how we move within and beyond them. At the same time, it is individual people operating in this built system, making their own individual choices on how to move within the given infrastructure, cultural norms and framing conditions. Thus, understanding their perceptions, the roots of their choices, bridges exactly that gap between science and people that Polk (2014) described.

2 The Case: Contemporary Mobility & Role of the Cycling Strategy

The main aim of this chapter is to introduce the bike's standing in BW's mobility system today and to pinpoint how exactly the cycling strategy wants to develop the current status quo towards its end goal of achieving a 20 % cycling share in BW's modal split by 2030. In the discussion, I relate the research results to the context introduced in this chapter.

2.1 Mobility in Germany and BW Today

BW's current mobility system with the car at its centre is the result of more than a century-long development, since Carl Benz applied for patent in 1886 (Hawlitschek, 2011). While people's low mobility-lifestyles initially required little need for Benz's invention, the car's success story began as the symbol of Germany's (and BW's) economic boom in the 1950s (Hawlitschek, 2011). Germany's regained prosperity enabled both the government to make major infrastructure investments and a large share of individuals to purchase a car, facilitating the car-centred traffic system still found today (Neumaier, Trischler & Kooper, 2017).

Consequently, the number of licensed private cars grew from 4.5 million in 1960 to 30 million in 1990 and mobility increased to 41.2 km per person per day as of 2016 (Neumaier, Trischler & Kooper, 2017; KIT 2018). In this way, the car has become a status symbol for many people in the country and a symbol of freedom (Hawlitschek, 2011).

As a result, in Germany and in BW, transport policies and traffic planning are centred primarily on the car, with BW's regional government spending 1.5 billion Euros on car infrastructure in 2018, compared to an annual budget of 15 million Euros for communal cycling infrastructure (VM, 2019; VM, 2016). Due to this, a mere 16% of state roads, 13% of country roads and 9% of county roads are equipped with cycling paths in BW (BMVI, 2014). In addition to this deficit, where roads are equipped with cycling paths, they oftentimes lack consistent signposting, continuous routing and basic security standards (VM, 2016). These are issues that BW's Ministry of Transport (VM) also attributes to a lack of coordination between municipalities, in whose authority 80 % of the cycling infrastructure is situated (VM, 2016).

Due to the dominance of the car both socio-culturally and politically, and due to the outlined deficiencies in terms of bike infrastructure, BW currently has the 3rd highest car and the 5th lowest cycling rates among the 16 German federal states, with a cycling share of 11 % in the modal split as of 2017 (BMVI, 2014; BMVI, 2018). This is despite the fact that BW also hosts a number of predominant student cities where cycling shares are higher than 20 % (VM, 2016).

When investigating deeper into the people behind these numbers, however, a recent study unfolds a paradox on how individuals perceive the current mobility crisis (Forsa, 2017). On the one hand, 95 % expect a well-designed transport policy to pursue the goal of protecting the environment and the climate, and 80 % expect public authorities to invest more in cycling infrastructure (Forsa, 2017). On the other hand, just about 50 % welcome more rights for cyclists at the car's expense and 46 % found that car drivers had too many expenses (Forsa, 2017). Similarly, when asked about concrete policy measures in response to the mobility crisis, 61 % rejected higher parking fees, 65 % rejected a city toll, 68 % rejected to cap the number of cars that are allowed to enter cities and 51 % favoured a free car traffic flow at the expense of pedestrian lights (Forsa, 2017).

The national government of Germany and the regional government of BW operate on a similar paradox as the individuals they are representing. While on the one hand adopting ambitious climate goals, both governments on the other hand have been politically protecting the car's status and the car industry's standing (VM, 2019; BMU, 2019). After the industry's integrity had come under attack in the light of the currently unfolding diesel affair, the main political reaction to the scandal has been a boost in political support for electric cars in the form of an e-mobility fund (BMVI, 2017). Such a manoeuvre can be explained by what Hawlitschek (2011) observed as framing the ongoing success and economic power of the car industry as a precondition to the country's and region's continued wealth and prosperity.

Nevertheless, several factors underline the bike's potential, even under current conditions. Firstly, a study from Portland uncovered that 60 % of the population would generally be interested in using the bike for transportation but are concerned about unsafe conditions (PBOT, 2006). While the exact numbers might be divided up in a slightly different manner in BW, the study from Portland made it clear that there is a large potential for the bike, which is currently not taken advantage of.

Another factor is that around 40 to 50 % of the travelled routes in Germany are under five km long, which are distances that are in a range the bike can cover (UBA, 2016a). Moreover, looking at routes that are longer than five km, where the bike thus needs to be combined with public transport (PT), we find BW's share of PT use to be slightly above the national average (BMVI, 2014. This proves a (relatively seen) reasonable attractiveness of trains, trams and busses in the region.

2.2 The Cycling Strategy's Pathway to Change

The VM calculated that the state government's 20 % goal can only be reached if 25 to 30 % more people start using the bike, if current cyclists use their bike 25 to 30 % more often and if the share of e-bikes is increased up to 25 to 30 %, so to increase the bike's range for longer trips (2016). Since, as outlined in the section above, the problem is of both infrastructural and socio-cultural nature, BW's cycling strategy seeks to attain these threefold necessary increases by covering two different lines of action. On the one hand, the cycling network programme "RadNETZ" seeks to connect all municipalities with an overland bike network and financially supports municipalities in developing cycling infrastructure within their jurisdiction (VM, 2016). On the other hand, the campaign "RadKULTUR" devotes resources into a marketing offensive, to create a "cycling culture" (VM, 2016).

With the adoption of the RadKULTUR, the VM recognises that the "transport mode choice not only happens on the basis of rational criteria, but also on the basis of personal habits, information on alternatives and social acceptance" (VM, 2016, p. 77). To support the transition, RadKULTUR encompasses several communicative measures directed at individual citizens and actors from the political, economic and administrative domain on both state and municipal level (VM, 2016). These communicative measures range from classic target group-oriented social media campaigns, to activities such as a cycling rally, traffic safety presentations and communication material which municipalities or local businesses can use in their role as multiplicators (VM, 2016). Concrete examples of how cycling is marketed and communicated as part of RadKULTUR can be found in appendix 1.

RadNETZ seeks to create a "region-wide, comprehensive system of hierarchically staged cycling nets with defined quality standards" (VM, 2016, p. 26). Attaining these standards is also meant to facilitate the VM's 'vision zero', a 40 % decrease in the number of traffic deaths between 2010 and 2020 (VM, 2016). Figure 2 shows guiding criteria that forms the basis of the cycling strategy's quality standards: requirements for cycling infrastructure depend on the number of vehicles passing a road every hour and the speed limit for cars on the respective roads.

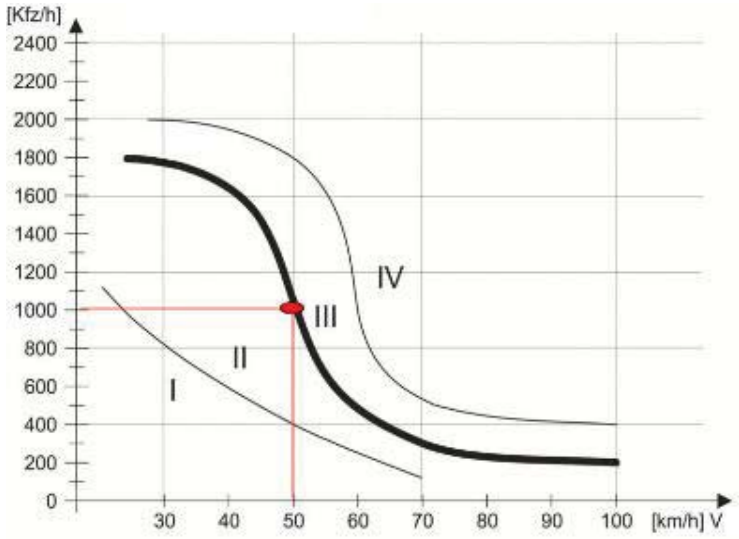

Figure 2: Cycling Infrastructure Quality Standards (PGV, 2009). The figure depicts the hierarchically staged quality standards that RadNETZ is based on. While the x axis refers to the speed limits on the respective roads, the y axis represents the average number of vehicles passing the road per hour. For least frequented roads with low speed limits (stage I) cycling traffic is mixed with car traffic, without protective strips or other special infrastructure (PGV, 2009). Stage II zones require 1.5-meter-wide protective strips or alternatively cycling is permitted on the pavement (PGV, 2009). Stage III zones require either a 1.85 m wide cycling path marked on the car road, a common cycling and pedestrian sidewalk (min. 2.5 m wide) or a 2 m-wide cycling path separated from the road with at least 0.75 m distance from the car lane (PGV, 2009). Lastly, stage IV zones require separated cycling paths under all circumstances (PGV, 2009).

However, the VM emphasises that the defined standards are subject to ongoing developments and might need to be adapted in response to a) an increase in cycling traffic, b) increasing speed of cycling traffic due to e-bikes, and c) a need for wider cycling paths due to an increased use of cargo bikes (VM, 2016). This is important as to the VM's objective to achieve a "fault-tolerant cycling infrastructure system with sufficient dimensions for different types of bikes" (VM, 2016, p. 69).

By defining these region-wide quality standards, including standards for signposting, and institutionalising inter-municipal cooperation, the VM wants to overcome the current inconsistency between bike infrastructure and signposting standards and coordinate cycling infrastructure planning between municipalities (VM, 2016). Such coordination is necessary, since, where needed, RadNETZ funds municipalities for filling in overland bike paths with local infrastructure (VM, 2016).

Further funds are also invested in the expansion of bike parking (VM, 2016). The regional government aims to expand overall bike parking capacities equal to 10 % of the population in each municipality by 2025 (VM, 2016). Of these, 50 % are planned to be roofed and half of the roofed parking is to be secured (VM, 2016). Additionally, to facilitate the combination of bike+PT for longer distances, the VM plans to increase the capacity of facilities near train or bus stations by 5,000 annually, through which the intake radius of these PT stations is expanded towards six kilometres

(VM, 2016). Furthermore, the cycling strategy aims at improving the infrastructural conditions of e-bikes (and those of cargo bikes), since e-bikes can expand this radius up to 10 km. For this, the VM takes into account their special requirements for cycling path width, protected parking and charging stations (VM, 2016). Other measures to improve bike+PT include the harmonisation of cycle carriage regulations in the PT network, free cycle carriage in trains outside of rush hours by 2020 and the expansion of bike sharing capacities up to two bikes per 1,000 residents by 2025 (VM, 2016).

3 Theory

In this chapter, I introduce the underpinning theoretical framework of this research, namely theory of planned behaviour, and relate it to the affiliated concepts of attitude, self-efficacy, perceived behavioural control and experience.

Finding a suitable theoretical entry point for this project involved a clear decision as to where I wanted to position the focus of my research - whether on the individual or on the structural level. During initial readings, I came across a large body of recent research analysing cycling as a social practice (Larsen, 2017; Spotswood, Chatterton, Tapp, & Williams, 2015; Vivanco, 2018). In simplified terms, the difference between Theory of Planned Behaviour (TPB) and Social Practice Theory is that the former sees behaviour as a product of an individual's intention (Ajzen, 1991), while the latter sees behaviour as a practice that derives from cultural traditions (Reckwitz, 2002).

It should be noted that my decision to apply TPB does not mean that I do not recognise the interrelation between structure and agent, as put forth by Giddens' Structuration Theory (Giddens, 1984). Yet, my position is that one can make meaningful contributions by looking at the issue from the perspective of one or the other and base this decision on where one identifies a research gap.

Using TPB, enables me to understand how the cycling strategy can "win over" the individual commuters, while recognising that each individual's attitudes, social norms and perceived control factors are also the result of the social system around them (Ajzen, 1991). In this way, TPB allows me to centre my research on the individual, both without negating the influence of the socio-cultural structure at hand and without losing sight of the individual within the given structure.

3.1 Theory of Planned Behaviour

TBC was introduced by Icek Ajzen in 1985 as a further development of Ajzen's and Martin Fishbein's 1967 Theory of Reasoned Action (TRA) (Ajzen, 2011). It adds the third behaviour-determining concept of 'Perceived Behavioural Control' to TRA's two original concepts of attitude and subjective norms (Ajzen, 1991). Figure 3 depicts the essence of TPB, stating that if an individual has a positive expectation of a behaviour's outcomes, experiences social norms to be in favour of that behaviour, and finds that he/she can carry out that behaviour with reasonable effort, he/she is likely to develop an intention to actually perform it (Ajzen, 1991). Further, as can be seen in Fig. 3, Ajzen draws a connection between intention and behaviour: he claims that the stronger an individual's intention about a certain behaviour, the likelier the behaviour is put into practice, provided that an individual has the needed skills and enabling conditions to perform it (1991).

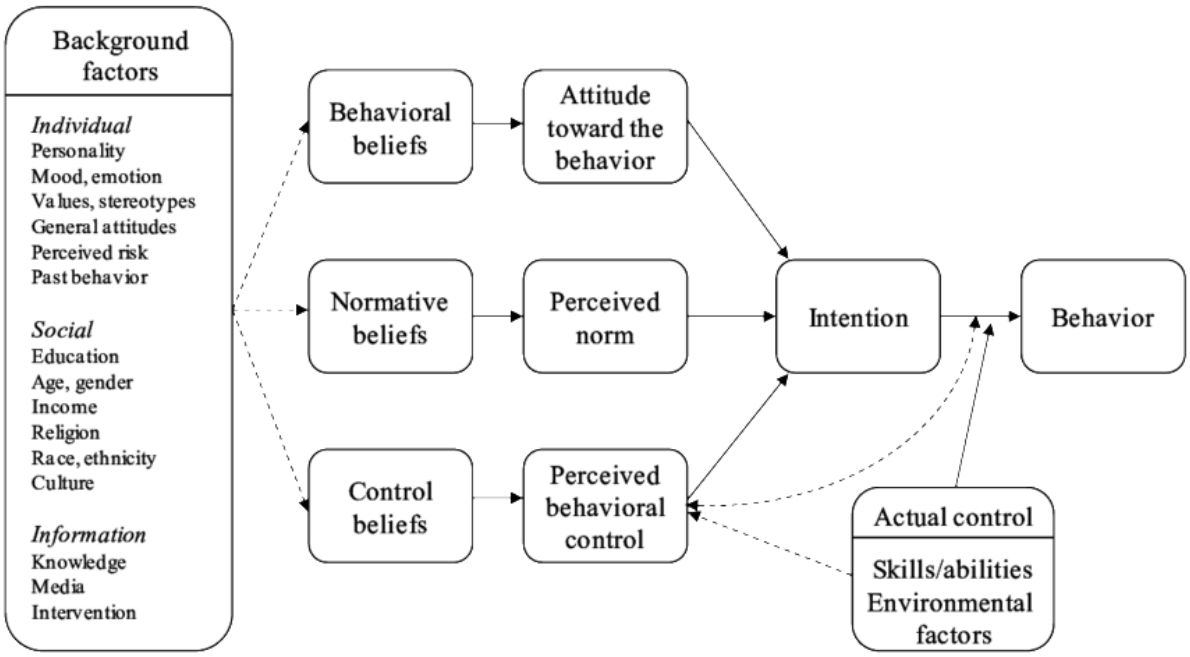

Figure 3: A Visual Overview of the Theory of Planned Behaviour (Fishbein & Ajzen, 2010, p. 22). As can be seen, TPB does not perceive individuals as isolated beings, but as individual minds within the context of their socio-cultural background. Their individual traits, social surroundings and the information they come into contact with, shape their beliefs about a behaviour, normative social expectations and their ability to perform a behaviour (Fishbein & Ajzen, 2010). The attitudes an individual develops about the behaviour, the norms they subjectively perceive and their perceived behavioural control all directly derive from these beliefs (Fishbein & Ajzen, 2010). TPB theorises that these three factors construct an individual's intention and that the stronger the intention, the likelier a behaviour is carried out, provided that an individual is able to do so (Ajzen, 1991).

Due to TPB's wide application in behaviour change research, meta-analyses have been able to statistically evaluate its predictive capacity. In a reflection of his theory, Ajzen cited meta-analyses finding correlations between the three predictive concepts and intention between 60% and 70%, as well as a 67% correlation between intention and behaviour (2011). Consequently, there are additional variables determining one's intention, as well as one's behaviour, that TPB does not capture (Sommer, 2011).

It is for precisely this reason that Ajzen and Fishbein explicitly left open the possibility of adding new predicting concepts, a fashion in which TPB was itself developed (Ajzen, 2011). One factor that has not yet received substantial attention as a concept related to TPB is the concept of experience. Research on the positive effects of cycling experience on cycling intention is mainly informed by research from Sigurdardottir et al. (2013). Their research has proven to be a relevant influencing factor, that when added to a TPB-based analysis, can lead to more precise determinations of intention-behaviour relationships (Sigurdardottir, Møller, Kaplan & Teasdale, 2013).

3.1.1 Behavioural Beliefs & Attitudes

Ajzen (1991) holds that "attitudes develop reasonably from the beliefs people hold about the object of the attitude" and that these beliefs are formed by "associating it with certain attributes" or linking it to certain outcomes (p. 191). Hence, positive/negative attributes we ascribe to a behaviour lead to correspondingly positive/negative attitudes of the behaviour (Ajzen, 1991). Consequently, since we expect positive consequences of behaviours that we associate with positive attributes, we favour performing them over other less-positively perceived ones (Ajzen, 1991). This means that commuters who associate positive attributes with the bike or expect positive outcomes from their commuting by bike, are more likely to develop the intention to commute by bike. However, the relevance of each attitude depends on how strongly a person believes in it, which can vary between individuals (Ajzen, 1991). The impact of each belief towards a behaviour is measured in the following way:

Attitudes = strength of behavioural belief x evaluation of belief's attribute

3.1.2 Normative Beliefs & Subjective Norms

Ajzen (1991) described normative beliefs as "concerned with the likelihood that important referent individuals or groups approve or disapprove of performing a given behaviour" (p. 195). According to Ajzen (1991), social norms are measured by asking individuals questions regarding the degree to which important others would approve/disapprove of a particular behaviour. Therefore, if a commuter perceives his/her social environment to respond positively to him/her commuting by bike, then he/she is more likely to develop the intention to commute by bike. However, the relevance of subjective norms depends on an individual's motivation to comply with these, a factor that can differ from person to person (Ajzen, 1991). The role of subjective norms on an individual's behaviour is commonly calculated using the following formula:

Social Norms = Normative Belief x Motivation to Comply

3.1.3 Control Beliefs & Perceived Behavioural Control

Perceived Behavioural Control (PBC) is a concept that relates to the theory of self-efficacy and was incorporated by Ajzen to add on TRA, thereby forming the new TPB (Ajzen, 1991). It is important to distinguish between actual and perceived behavioural control. While the former points towards the "resources and opportunities available" for individuals to achieve a certain behaviour, the latter concerns the individual's confidence to execute a certain behaviour (Ajzen, 1991, p. 183). While actual behavioural control can potentially undermine the execution of a behaviour, regardless of an

individual's intention, perceived behavioural control relates with intention through its implications on the degree of expected efforts that need to be made to execute a behaviour (Ajzen, 1991).

PBC emerges from so-called 'control beliefs', a term that seeks to describe the obstacles or impediments, which an individual anticipates in relation to performing a behaviour, as well as the resources and opportunities one possesses to carry it out (Ajzen, 1991). These control beliefs can either be based on individual experiences or on second-hand information obtained through one's social environment (Ajzen, 1991).

Hence, concerning cycling, actual behavioural control factors preventing commuters from cycling might relate to a commuter's lack of access to a bike or inability to ride a bike. On the other hand, PBC factors relating to bike commuting might concern infrastructural factors that make cycling an undertaking requiring a degree of effort, that either does or does not compromise the commuter's intention. Similar to the other factors, the relevance of each PBC factor depends on how powerful individuals perceive it to be. The PBC of each factor is measured separately and as follows:

PBC = Control Belief x Perceived Power of the Control Factor

3.1.4 Concept of Experience

Research has proven that how commuters experience their journey is an important influencing factor on their mobility choices (Sigurdardottir et al., 2013). According to Sigurdardottir et al. (2013), there is a direct correlation between how individuals experience commuting with a specific mode of transport (or their expectation on how they would experience it) and their intention of using that specific mode of transport. In the context of this research, I incorporate this concept into my TPB analysis, by asking commuters how they experience their commuting with the transport mode of their choice and how they expect this experience to be different, if they commuted with other transport alternatives. Applying this concept offers me a more holistic understanding of commuters' transport mode choices, allowing me to understand how the interplay of attitude, social norms and PBC factors form an image of experience among individual commuters.

3.2 Summary

My analysis of commuters' transport choices will be guided by exploring:

a) which attitudes commuters have of the different transport modes and how relevant different attitudes are for their transport mode choice,

b) what rates of approval/disapproval commuters perceive different social groups to hold towards different transport modes and how relevant these are for their transport mode choice,

c) which (infrastructural) control factors commuters perceive as given concerning different transport modes and how relevant each factor is for their transport mode choice,

d) how commuters experience their commuting with a given transport mode and how they expect their experience to change with the use of other transport modes.

4 Methodology

To collect and analyse primary and secondary data, I applied mixed methods, which means that the research incorporates a combination of both quantitative and qualitative methods. According to Creswell & Plano (2007), mixed methods are used when neither qualitative nor qualitative data alone can provide a sufficiently comprehensive image of the research object. Though more time-consuming to apply, mixed methods "provide strengths that offset the weaknesses of both quantitative and qualitative research" (Creswell & Plano, 2007, p.12). By applying mixed methods in this research, I benefit from obtaining data that reflects a large body of commuters on standardised questions, without having to compromise a more nuanced, holistic understanding of commuters' experiences.

4.1 Data Collection

4.1.1 Survey

As a first step in gathering primary data, I conducted a survey with the objective to obtain standardised results reflecting the attitudes, social norms and control factors that commuters in BW hold and perceive towards different transport modes (RQ 1). In this way, the survey structure followed precisely the TPB logic outlined in the theory chapter: the first section focused on gathering certain personal and mobility-specific data. A second section asked respondents about their commuting practices. Section three provided a list of nine beliefs/attitudes, to which respondents could agree or disagree in relation to the different transport modes, in addition to rating their importance. Section four asked respondents about the level of acceptance that they perceive different transport modes to get in different social circles and how much importance they attach to the feedback of different social circles. In the last section, respondents were given a list of eight to ten control factors. They had to tick off those factors, they thought applied to specific transport modes, in addition to rating their importance. The full survey is enclosed in appendix 2 for more detail.

The survey was generated on Google forms. To recruit respondents, I used different sampling strategies. Since all people who live and work in BW are potential study subjects, provided that they work in a different municipality than they live, I posted the survey in several Facebook groups targeted towards people who live in different areas of the state. I pointed out that they were only invited to take part in the survey if they were indeed commuters. Each Facebook group had around 10,000 to 50,000 members. In this way, a large share of responses was gathered through consecutive sampling, although the sampling strategy used to target the Facebook groups was purposive. In

addition, I shared the survey in my network, requesting to spread the survey. In this way, I also gained responses through convenience and snowball sampling. In total, 91 survey responses were selected for analysis.

4.1.2 Interviews

To add depth to the standardised data gathered in the survey, I conducted interviews in two different stages and targeted towards two different audiences. First stage interviews addressed RQ 1 and sought to understand how commuters experience their journey with different transport modes. Since the survey focused on the three 'traditional' components of TPB, these interviews sought to capture the added factor of experience in a qualitative manner.

To recruit interview partners, I incorporated a sixth section in the above-described survey, outlining my research focus in this stage and asking respondents to leave their email-addresses, in case they were interested in taking part. In total, 34 respondents were willing to be part of this second, smaller and qualitative sample. Consecutively, I sampled the interviewees by generating short profiles of each of these 34 respondents, based on their individual answers in the survey, and ordering them in different categories according to their most frequently used transport mode. Based on these short profiles, and a rough initial analysis of the overall survey responses with graphs and pivot tables, I purposively selected a sample of four participants, representing a commuting experience by car, PT, bike and a combination of the three transport modes. I also considered the different shortcomings and advantages they perceived concerning the different transport modes. This was to make sure that the selected interviewees offer a perspective that reflects the general tendencies of the survey results. The short profiles of these participants are enclosed in appendix 3, so to offer a possibility to retrace the perspectives they could provide.

The interviews consisted of three parts: at first, the commuters were asked to sketch their commuting journey on a large sheet of paper. Then, they were asked to mark points on the sketch that they associate with positive and negative experiences. Subsequently, the specific experiences and the perceived root of the positive/negative experiences were discussed. Thereafter, I asked them how they expected their commuting experience to change, if they used other transport modes. At last, their own views on the current political debate and necessary future developments were discussed. The full guide for the interviews with survey participants can be found in appendix 4.

The second stage of interviews targeted a different audience with a different content. My goal was to inform RQ 3 by discussing the quantitative and qualitative results obtained from commuters with

relevant stakeholders of the cycling strategy – see appendix 5. In total I conducted 3 interviews with representatives of stakeholders that could offer different perspectives to the topic. I interviewed a representative of BW's branch of the German Cyclist Association (ADFC), which is the representator of the cyclists' interests. To get insights from the actor on the ground, I interviewed a representative of the region-wide governmental transport agency (NVBW), which is in charge of implementing the cycling strategy. Lastly, to get insights on the political steering of the strategy, I interviewed a representative from BW's Ministry of Transport (VM), which has to balance different outside factors against the objective it wants to achieve with the cycling strategy.

4.2 Data Analysis

I applied cross-sectional data analysis methods for processing the statistics, according to the different TPB concepts that were part of the survey. To identify possible correlations between different factors, analysis went beyond the simple calculation of mean and standard deviation variables, but rather involved regression lines and scatterplots (Wooldridge, 2002). Additionally, the analysis was influenced by hypothesis testing, where I assessed the statistical significance of specific pre-conceived premises (Snijders, 2001).

Furthermore, I used the contrast table method, showing a) factors ordered by relevance depicting the different transport modes' performances and associated correlations with commuters' motivation to commute by different transport modes, and b) a categorisation of all factors according to their contribution to use/non-use of a transport mode (strengths vs. weaknesses), applying the calculations introduced in the theory chapter (Miles, Huberman & Saldaña, 2014).

In the next step, I identified windows of opportunity and challenges for the bike and the combination of bike+PT, by applying a deductive method. I looked at a) current weaknesses of the car, b) factors the bike performed well in, c) the bike's weakness in high relevance factors. Lastly, I undertook a comparative analysis of the cycling strategy's content introduced in chapter 2 and the interventions necessary to exploit the windows of opportunities and mitigate the challenges, as discussed with the different interviewees.

4.3 Generalisability, Limitations & Reflexivity

Due to the use of non-probability recruitment methods for the survey, I acknowledge a certain degree of bias in the responses, relating to a) the type of people found in my network and in my network's network, b) the type of people who are members of the targeted Facebook groups and who reacted on my survey. Furthermore, an estimated population size of 2.5 million (based on the

number of inhabitants in BW, the share of employed inhabitants and the share of commuters among employees) and an estimated response distribution of 70 % towards the car, the sample of 91 responses offers a confidence level of 90 % and a margin of error of 7.9 %. Therefore, an accurate depiction of the whole group of commuters in BW cannot be claimed and goes beyond the scope of this thesis.

Similarly, due to the purposive sampling of interviews with survey participants, it is needless to say, that these five interviews in no way claim to be representative and are largely the product of a) the type of people who participated in the survey, and b) the type of people who were interested to share their contact information. I acknowledge that a higher number of survey participant interviews would have been desirable. Such qualitative findings are, however, not intended to be generalisable and instead serve a more in-depth understanding of individual cases to as much of an extent, as was possible within the scope of this thesis.

Similarly, the perspectives obtained by means of the three expert interviews surely cannot reflect the entire spectrum of perspectives that can be found among experts. Nevertheless, they represent a small range of differing (and converging) viewpoints among differently positioned stakeholders. Again, the experts interviewed are the product of a) the type of people I, with my own positionality and unconscious bias, chose to contact, b) the type of people that were willing to agree to an interview in this research.

Furthermore, not all aspects that influence individual mobility choices in the region could receive adequate consideration, due to the limited scope of the research project. This concerns, for instance, the topographical factor of a state situated on the foothills of the Alps and a deeper exploration of the effects of habit. In this way, the study can in no way claim a complete understanding of the totality of all factors that could possibly be involved.

Lastly, I need to point out my positionality within the case, since I have close ties to the region. Hence, I cannot be characterised as a neutral observant. Rather, I have a certain stake in the regional mobility issue and my research is driven by my personal commitment to contribute to change in this field. I recognise the normativity of both my own standpoint regarding how an ideal mobility system should look like (see introduction), the normativity of the (non-)scientist research subjects (survey participants, interviewees) and the normativity within the field of sustainability science where environmentally sustainable, resource-conservative and low-invasive systems, practices or solutions are automatically considered ‘better’ (Ziegler & Ott, 2011).

4.4 Ethical Considerations

Due to the ongoing mobility debates in BW, the sensitivity of the research topic was evident. As a researcher, I was continuously aware of and highly alerted to the high probability of survey and interview participants that are directly affected by dieselgate and the associated diesel bans. Under no circumstances, did I want to generate a sense of confrontation between me as a sustainability researcher and the survey participants or interviewees, many of them daily car-commuters. I decided to handle the sensitivity of this topic, by not approaching the research from an angle of why people do not bike, but rather to try to understand what makes them want to use the car. In this way, to identify windows of opportunity for the bike, I used deductive methods, where I produced knowledge based on an understanding of what individuals value in different kinds of transport modes and how they experience commuting with these.

Another ethical aspect to consider is the question of consent, transparency and confidentiality. At the start of the survey, participants were informed about the content of the study, about anonymous data processing and confidentiality, as well as that no third parties are involved (see appendix 2). The five survey participants that I interviewed were presented a consent form, informing them about the above-mentioned points, as well as the fact that the interview is recorded, and the thesis will be published (see appendix 6). The consent form was signed by all interview participants prior to the interview. The expert interviewees were presented a similar consent form with the difference being that I asked for permission to openly reference the interview with them as a source, which all, except the VM representative, agreed to (see appendix 7).

5 Results

In this chapter, I present the results of this study, which are based on primary data, namely a survey, interviews with individual survey respondents and interviews with stakeholders of BW's cycling strategy. The first part of this chapter presents a TPB-based survey analysis, as part of which I identify factors that lead to commuters choosing one transport mode over another (RQ 1).

5.1 Quantitative Findings

Looking at Table 1, my survey sample was one of various characteristics. Out of 91 respondents, 44 % identified as female and 56 % identified as male. Furthermore, both age and population size at respondents' places of residence, as well as commuting distance were somewhat evenly spread across the entire spectrums. Nevertheless, the largest age group of the sample is between 25 and 40 years and commuters most frequently travel distances of 20-30 km to work. The largest share of commuters commutes either from villages with less than 5,000 inhabitants or from big cities with more than 100,000 inhabitants.

Table 1: Characteristics of Survey Sample (own illustration, 2019). This table gives an overview of the commuter sample that these findings are based on. It depicts specific characteristics of the sample, such as gender, age, population size at place of residence, type of work and commuting distance. The share of commuters who embody a specific characteristic is depicted in absolute numbers, out of a total sample of 91.

Gender	Age	Population Size at Place of Residence	Type of Work	Commuting Distance
Female: 40	Under 25: 13	Under 5 Tsd inhabitants: 20	Non-physical indoor: 73	Under 10 km: 15
Male: 51	25-40: 39	5-10 Tsd inhabitants: 21	Physical indoor: 10	10-20 km: 13
	41-55: 29	10-20 Tsd inhabitants: 11	Physical outdoor: 7	20-30 km: 26
	Over 55: 10	20-50 Tsd inhabitants: 11	Non-physical outdoor: 1	30-50 km: 20
		50-100 Tsd inhabitants: 10		Over 50 km: 17
		Over 100 Tsd inhabitants: 18		

As can be seen in Figure 4, out of the 91 commuters who participated in the survey, the largest share commuted by car at least several times a week, while PT was the second most frequently used mode of transport. In contrast, the bike, either alone or in combination with PT was the least used transport mode.

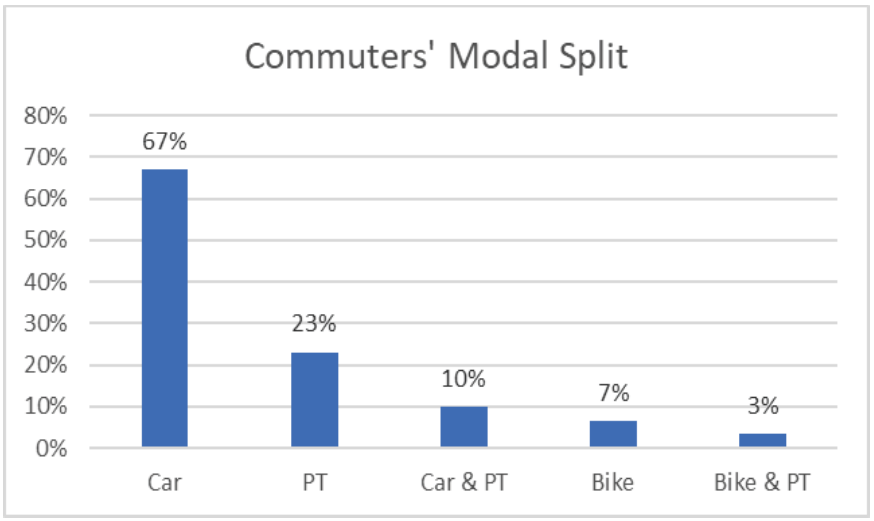

Figure 4: Modal Split among Commuters (own illustration 2019). This figure depicts the share of survey respondents who use the respective transport modes, alone or in combination, at least several times per week. The car is by far the most frequently used mode of transport with two-thirds of the respondents regularly commuting by car. In contrast, the bike is only regularly used by 10 %, alone or in combination with PT.

These numbers show the car's dominance in terms of actual frequency of use. We can get a more nuanced picture by looking at the share of respondents who, in theory, are motivated to use the respective transport modes. The concept of motivation in this survey corresponds to TPB's emphasis of intention as the main motive for behaviour and is thus important as a basis of analysis. In Figure 5, we see that the share of commuters motivated to use the car (69 %) is smaller than the share of commuters who frequently use it (77 %, includes the share of those who combine the car and PT). In contrast, the share of commuters who indicated that they were motivated to commute by bike was double the share of commuters who frequently commute by bike.

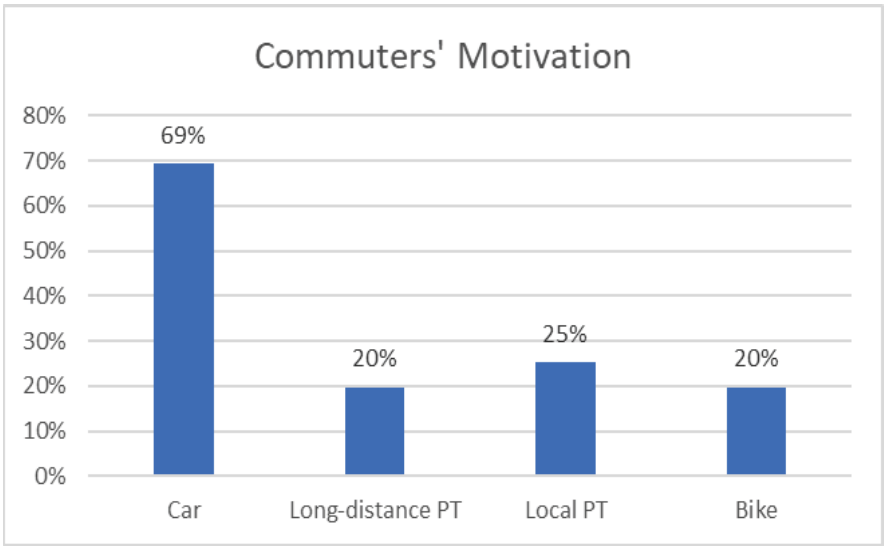

Figure 5: Commuters' Motivation per Transport Mode (own illustration, 2019). This figure depicts the share of survey respondents who are either highly or very highly motivated to commute by the different depicted transport modes. The survey allowed for multiple indications of high or very high motivation. Almost 70 % of the respondents are motivated to commute by car, while local PT, long-distance PT and bike receive similar lower motivation rates, ranging from 20 to 25 %.

Behavioural motivation showed a statistically significant correlation to actual behaviour. For instance, motivation to commute by bike and frequency of bike commuting correlate with an r^2 value of 0.3187. If we take the dependent variable of frequency and only look at the two extremes of commuters who never commute by bike and commuters who commute by bike on a daily basis, we have higher correlations: with an r^2 value of 0.8016 for non-cycling commuters and an r^2 value of 0.7236 for daily cycling commuters, the correlations rise up to 80 and 72 %, respectively.

The concept of habit was considered an additional influencing factor. The degree of habit that survey participants indicated had a mean of 2.96 (on a scale from 1 to 5, 5 being the highest degree of habit). This shows that while many survey respondents repeat the same commuting behaviour, the degree of automatism they perceive is on the medium spectrum. Since their commuting behaviour is thus somewhat conscious and subject to re-evaluation, it can change, provided that relevant factors point in favour of another transport mode.

Moreover, demographic factors influence transport mode choices: the younger generation tends to use the bike to a substantially larger share, than the older generations. From the survey respondents under 25 years, 23 % commuted by car at least several times a week – a share that is more than twice as high as the overall average of survey responses. In addition to the age component, commuters' transport mode choices also show correlations regarding gender: women are more likely to commute by PT, whereas men are more likely to commute by car and bike at least several times per week.

Furthermore, commuters doing physical work showed higher bike commuting rates, but lower PT commuting rates than commuters doing non-physical work. Moreover, under 10 km of distance the bike experiences its highest user rates (27 %), while PT is strongest regarding commuting distances of 10 to 20 km (38 %). Consequently, the car's lowest user rate is concerning distances of under 10 km (53 %). Yet, contrary to what one might expect, the size of commuters' place of residence did not show a statistical correlation with frequency of car and non-car use.

A last factor studied were employment benefits that commuters could access. The share of commuters receiving different kinds of benefits is depicted in Figure 6 and refers to different kinds of transport allowances, such as reduced PT tickets (PT benefits), company cars or returns on expenses

for the use of one's private car (car benefits), provided bike sharing memberships or company bikes (bike benefits). The financial incentives that result from such employment benefits show a statistical correlation with commuters' transport mode choices, in terms of an increased use of the transport modes that the transport allowances are targeted at. For example, Figure 7 shows that when looking at PT benefits, which is the most common type of transport benefits granted to commuters, we can see a substantially increased use of both PT alone and PT + car in combination.

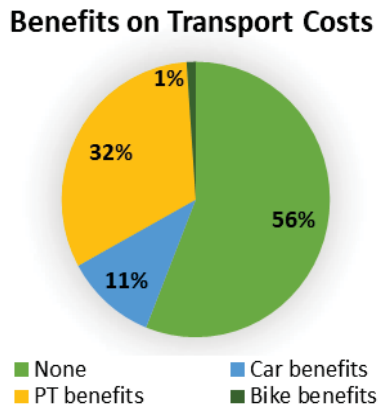

Figure 6: Commuters' Transport Benefits (own illustration, 2019). More than half of the respondents have no access to benefit schemes. Those that have access, mostly received PT benefits, while bike-related benefits, such as company bikes or bike-sharing memberships are uncommon.

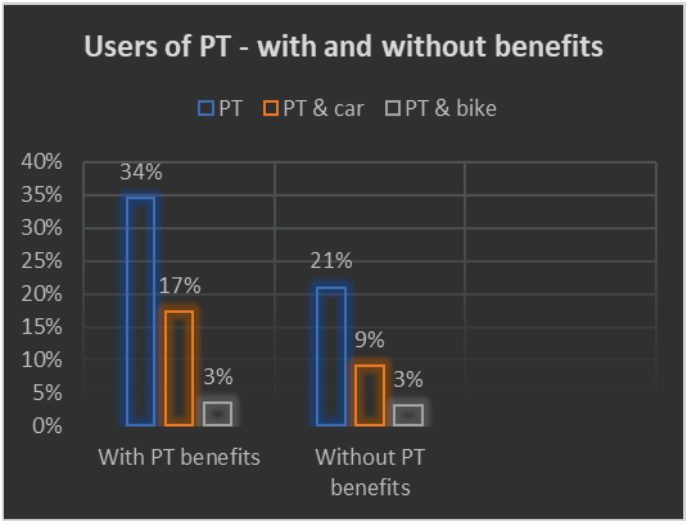

Figure 7: Users of PT – with and without benefits (own illustration, 2019). We can see a substantially risen share of PT use and PT+car use among people with PT benefits, compared to their commuting colleagues without such benefits.

5.1.1 Car and Bike: Identifying Relevant Factors

The survey enquired several factors regarding commuters' attitudes, social norms and PBC. Participants were asked to indicate which factors they thought applied to which transport modes and how relevant each factor was to them. Table 2 presents an overview of the factors and the share of commuters that attributed these to the bike and the car (1.00 = 100 %). The factors are ordered by their mean relevance (4 = highest relevance).

Firstly, we can see that social norms were perceived as substantially less relevant than attitude and PBC factors. Overall, what appears to be most important for commuters regarding their transport mode choice is time and independence in terms of attitudes, and a complete and well-developed road network with sufficient parking space in terms of PBC. In addition to this, having access to the vehicle and the ability to operate it, which can be seen more as actual behaviour control factors, were equally relevant to commuters.

Another insight from Table 2 is that the share of respondents who attribute different attitudes, social norms and PBC factors to the car is substantially higher than the share of respondents attributed those same factors to the bike. The only exceptions are the three attitude factors of cost reduction, support for the environment and support for one's health/ fitness, which a higher share of commuters found applicable to the bike than the car. The highest discrepancies between bike and car performances are found concerning the factors of time saving (attitude), independence (attitude), weather shelter (attitude), sufficiency of luggage space (PBC) and personal safety (attitude) in favour of the car. Nevertheless, equally high discrepancies are seen concerning the factors of support for the environment and support for one's health/ fitness in favour of the bike.

Lastly, looking at the r^2 values in Table 2, gives indication of the degree of correlation between the applicability of each measured factor and commuters' motivation to commute by car/bike. Correlations tended to be higher when factors where measured against commuters' motivation to commute by car and there were fewer factors with significant correlations to commuters' motivation to commute by bike. Concerning the bike, correlations were highest concerning the factors of time saving (attitude), independence (attitude), well-developed road network (RN) (PBC) and personal safety (attitude) and to a slightly lesser degree concerning the factors of sufficient amount of time (PBC) and complete RN (PBC). Therefore, what can be concluded is that commuters who tend to find these factors as applicable to the bike, tend to have a higher motivation to commute by bike.

Table 2: Relevance and Performance of Measured Factors on Bike and Car (own illustration, 2019). This table shows a list of factors that I measured in the survey: attitudes (green), social norms (blue), PBC (red). The factors are ordered by their relevance, with 4 as the highest and 1 as the lowest score (derived from the mean of the power attributed to each of them by survey respondents).In the third & fifth column one can see how bike & car perform in the different categories: the quotient of respondents that indicated a factor applied to car/bike divided by the number of total respondents. The fourth and sixth column depict the r^2 value, so the statistical correlation found between the respective factors and the motivation among commuters to commute by bike/ car.

Enquired Factors	Relevance (mean)	Performance of Bike	R^2 value	Performance of Car	R^2 value
Time Saving	3.66	0.11	0.9118	**0.81**	0.8429
Sufficient Time	3.60	0.22	0.6344	**0.82**	0.7453
Sufficient Parking	3.53	0.55	0.1146	**0.63**	0.8213
Access to Vehicle	3.48	0.76	0.0447	**0.90**	0.7358
Complete RN	3.47	0.35	0.7987	**0.95**	0.1155
Independence	3.46	0.24	0.9838	**0.87**	0.9385
Ability to Operate	3.42	0.77	0.0509	**0.95**	0.5572
Well-developed RN	3.42	0.30	0.9838	**0.86**	0.1444
Weather Shelter	3.32	0.00	---	**0.86**	0.9772
Sufficient Money	3.26	0.65	0.0359	**0.81**	0.9214
Stress Reduction	3.22	0.23	0.4038	**0.55**	0.6243
Luggage Space	3.18	0.18	0.0572	**0.93**	0.6403
Personal Safety	3.01	0.12	0.9425	**0.78**	0.7795
Cost Reduction	2.98	**0.62**	0.1462	0.30	0.8073
Sufficient Signposting	2.93	0.31	0.5061	**0.88**	0.0088
Available Information	2.65	0.54	0.1222	**0.80**	0.3556
Accident Risk	2.49	0.02	0.3402	0.20	0.2505
Support Environment	2.43	**0.67**	0.0409	0.05	0.018
Support Health/Fitness	2.22	**0.81**	0.1943	0.02	0.6
Family Norms	1.98	0.53	0.4304	**0.96**	0.9175
Friends Norms	1.70	0.55	0.2788	**0.89**	0.647
Colleague Norms	1.65	0.53	0.002	**0.91**	0.9468
Media Norms	1.34	0.53	0.1894	0.53	0.3708
Advertisement Norms	1.33	0.57	0.176	**0.70**	0.0886

5.1.2 Local and long-distance PT: Identifying relevant factors

PT is a somewhat special case within this study context. Just like the bike stands in competition with the car regarding short distance commuting, PT competes with the car regarding all commuting distances. The bike relies on an attractive long-distance PT network, since longer-distance commuters are otherwise discouraged from combining the two transport modes. On the other hand, the bike also competes with local PT, as it needs to attract short-distance commuters, so to make space in the local PT system for those, whose distances are too long to bike or who are unable to bike (Zühlke, personal interview, 01.04.2019).

Table 3 depicts a list of the enquired PT-related factors ordered by relevance and the performance of local and long-distance PT, measured by the share of respondents who attributed a specific factor to them. We can see a stark difference in relevance concerning different factors, with social norms perceived less relevant than attitude factors, and attitude factors perceived less relevant than PBC factors. Moreover, the r^2 values unveiled significant correlations between respondets' motivation to commute by local and long-distance PT and the applicability of the measured factors – with exceptions concerning the factor of support for one's health/ fitness and several social norms factors.

When comparing Table 3 with Table 2 we see the following: the performance of long-distance PT was lower than the performance of the car, concerning all factors except the factors of reduced accident risk (attitude), support for the environment (attitude) and media norms. In turn, the highest discrepancies in favour of the car between the performance of the car and long-distance PT could be found regarding the factors of independence (attitude), time saving (attitude), well-developed RN/ well- connected transport network (PBC), sufficient time (PBC) and weather shelter (attitude).

When comparing local PT and the bike, performances are more mixed and do not clearly point towards either transport mode. The biggest discrepancies in favour of the bike are found concerning the attitude factors of support for one's health/ fitness and cost reduction. Somewhat lower discrepancies were found concerning the attitude factors of independence, support for the environment and several social norms factors. In turn, the highest discrepancies in favour of local PT were found concerning the attitude factors of reduced accident risk, weather shelter and personal safety. Somewhat lower discrepancies were found concerning the factors of full road/ transport network (PBC) and luggage space (PBC). Generally, discrepancies between bike and local PT were significantly lower than between the car and long-distance PT and between the car and the bike.

Table 3: Relevance and Performance of Measured Factors on local and long-distance PT (own illustration, 2019). The table shows a list of attitudes (green), social norms (blue), PBC (red) factors that I measured in the survey. The factors are ordered by their relevance, with 4 being the highest and 1 being the lowest score (derived from the mean of the power attributed to each of them by the survey respondents).In the third and fifth column one can see how local and long-distance PT score perform in the different categories: the quotient of respondents that indicated that the factor applied to local/long-distance PT divided by the number of total respondents. The fourth and sixth column depict the r^2 value, so the statistical correlation found between the respective factors and the motivation to commute by local/long-distance PT.

*) SN factors were measured for PT in general, without explicitly separating long-distance & local PT

Enquired Factors	Relevance (mean)	Performance of local PT	R^2 value	Performance of long-distance PT	R^2 value
Nearby Access	3.74	0.72	0.8076	0.38	0.8336
Well-connected DTA points	3.74	0.40	0.9096	0.26	0.9611
Sufficient Time	3.73	0.29	0.9387	0.20	0.9714
Sufficient Frequency	3.71	0.29	0.7857	0.16	0.8746
Full Transport Network	3.69	0.57	0.9111	0.40	0.6965
Time Saving	3.66	0.18	0.9589	0.12	0.7076
Independence	3.46	0.05	0.8124	0.04	0.9971
Sufficient Money	3.32	0.66	0.7163	0.53	0.7965
Weather Shelter	3.32	0.35	0.7915	0.25	0.9563
Available Information	3.10	0.49	0.9641	0.31	0.8679
Stress Reduction	3.22	0.30	0.6429	0.16	0.9591
Personal Safety	3.01	0.40	0.9044	0.34	0.9658
Cost Reduction	2.98	0.23	0.8661	0.15	0.9522
Sufficient Luggage Space	2.92	0.40	0.9416	0.33	0.6867
Minimise Accident Risk	2.49	**0.60**	0.8762	**0.43**	0.8302
Support Environment	2.43	0.48	0.7737	0.37	0.6526
Support Health/Fitness	2.22	0.10	0.386	0.08	0.1772
Family Norms	1.98	*0.37**	0.9036	*0.37**	0.528
Friends Norms	1.70	*0.37**	0.6783	*0.37**	0.3303
Colleague Norms	1.65	*0.37**	0.9686	*0.37**	0.3166
Media Norms	1.34	*0.62**	0.0272	*0.62**	0.3741
Advertisement Norms	1.33	*0.60**	0.4E-06	*0.60**	0.8247

5.1.3 Identifying Current Strengths and Weaknesses

After having identified relevant factors, I want to unfold those factors that constitute dominant strengths and weaknesses of different modes of transport. For this, I multiplied a factor's mean relevance with the performance quotients of the respective vehicle, both based on Table 2 and 3. Below, Table 4 depicts these coefficients, with the factors ordered by decreasing coefficient value. Factors for which a respective mode of transport received a coefficient above 2.00 are coloured green (strengths), while factors with coefficients below 1.00 are coloured red (weaknesses).

Comparing bike and car, we can see that the factors that constitute pre-conditions to use the vehicles (ability & access) are equally highly ranked (albeit with different values). Yet, the car has a long list of infrastructural (PBC) strengths, while the bike's assets are currently limited to the two mentioned pre-conditions, as well as its affordability and positive environmental and health effects. Other obstacles for the bike currently include perceived stress, a low feeling of personal safety and high accident risk, lack of weather shelter, perceived time disadvantage, and low feeling of independence. These are important to overcome, since the latter three factors are current strengths of the car. In this way, the bike can currently not live up to what the car offers to commuters.

Comparing the bike to local PT, with the logic in mind that those people with cyclable distances should be diverted away from local PT to make space for people that rely on local PT as the only alternative to the car, shows that local PT rated substantially better in terms of personal safety and accident risk minimisation. Basic infrastructural factors, such as nearby access and full transport network are assets for local PT, whereas basic bike infrastructure (complete & well-developed RN) do not receive comparably high scores.

Looking at long-distance PT in comparison to the car, which stand in competition to one another for long commuting distances, we can see that long-distance PT has a long list of weak scores, in comparison to the predominant green colour of the car coefficient column. This is especially concerning, in terms of infrastructural PBC factors, where the car generally receives high scores. Long-distance PT also seems to have an image problem, as almost all attitude factors are ranked low. Yet, it has an asset compared to the car in terms of a reduced accident risk perceived by the respondents. This is important since some of the car's few clear weaknesses are safety concerns, alongside stress and high costs. The latter two, however, are also weak points of PT.

Table 4: Power of factors contributing to Transport Mode (non)-Use (own illustration, 2019). This table shows the power of each measured attitudes, social norms, PBC factor on car/ bike use. For this, the mean relevance of each factor was multiplied with the performance quotient. Accordingly, the highest possible score is 4 (relevance of 4.00 x performance quotient of 1.00) and the lowest possible score is 0 (relevance of 1.00 x performance quotient of 0.00). What we can see from this table, is – aside from the fact that the car has significantly more strengths than PT and bike – that the perceived strengths and weaknesses of the different transport modes relate to different factors.

	Bike Coefficient		Local PT coefficient		LD PT coefficient		Car coefficient
Access to Vehicle	2.64	Nearby Access	2.69	Sufficient Money	1.76	Complete RN	3.30
Ability to Operate	2.63	Sufficient Money	2.19	Full Transport Network	1.50	Ability to Operate	3.25
Sufficient Money	2.12	Full Transport Network	2.10	Nearby Access	1.42	Access to Vehicle	3.13
Sufficient Parking	1.94	Available Information	1.52	Reduce Accident Risk	1.07	Independence	3.01
Cost Reduction	1.85	Reduce Accident Risk	1.50	Personal Safety	1.02	Time Saving	2.96
Health/ Fitness	1.80	Well-connected Net	1.50	Well-connected Net	0.98	Luggage Space	2.96
Support Environment	1.63	Personal Safety	1.20	Available Information	0.96	Sufficient Time	2.95
Available Information	1.43	Luggage Space	1.17	Luggage Space	0.96	Well-developed RN	2.94
Complete RN	1.21	Support Environment	1.17	Support Environment	0.90	Weather Shelter	2.86
Family Norms	1.05	Weather Shelter	1.16	Media Norms	*0.83**	Sufficient Money	2.64
Well-developed RN	1.03	Sufficient Frequency	1.08	Weather Shelter	0.83	Sufficient Signposting	2.58
Friends Norms	0.94	Sufficient Time	1.08	Advertisement Norms	*0.80**	Personal Safety	2.35
Sufficient Signposting	0.91	Stress Reduction	0.97	Sufficient Time	0.75	Sufficient Parking	2.22
Colleague Norms	0.87	Media Norms	*0.83**	Family Norms	*0.73**	Available Information	2.12
Independence	0.83	Advertisement Norms	*0.80**	Friends Norms	*0.63**	Family Norms	1.90
Sufficient Time	0.80	Family Norms	*0.73**	Colleague Norms	*0.61**	Stress Reduction	1.77
Advertisement Norms	0.76	Cost Reduction	0.69	Sufficient Frequency	0.59	Friends Norms	1.51
Stress Reduction	0.74	Time Saving	0.66	Stress Reduction	0.52	Colleague Norms	1.50
Media Norms	0.71	Friends Norms	*0.63**	Cost Reduction	0.45	Advertisement Norms	0.93
Luggage Space	0.57	Colleague Norms	*0.61**	Time Saving	0.44	Cost Reduction	0.89
Time Saving	0.40	Support Health/Fitness	0.22	Independence	0.19	Media Norms	*0.71*
Personal Safety	0.36	Independence	0.17	Support Health/Fitness	0.18	Reduce Accident Risk	0.50
Reduce Accident Risk	0.05					Support Environment	0.12
Weather Shelter	0.00					Health/Fitness	0.04

5.2 Relating Qualitative to Quantitative Findings

After having identified the factors that are most relevant for commuters' mobility choices, as well as the specific strengths and weaknesses of each available transport option, this section seeks to add the needed depth to the quantitative data presented in the previous section. The qualitative depth gained from interviews with survey respondents allows to incorporate concrete field experiences of commuters. This helps to understand what the above-listed strengths and weaknesses mean in practice and how they together form an experience with a certain transport mode that is either facilitating or obstructive.

5.2.1 Experiences with the Bike

An interplay of numerous of the above-listed weak points leads to a commuting experience that currently stands in the way of the bike becoming a transport mode for the masses. One commuter, who bikes 6 km to work from a suburb area into a large city describes his experience as follows:

> *"On the main road into the city there is a cycling path painted on the car lane. But I would never drive on it voluntarily. Although there are no indicated cycling paths on smaller streets, I prefer to ride on them because I don't feel safe on the bigger one. […] When I reach the city centre, I drive parallel to suburban train rails, where people are entering and exiting and there is so much bustle. After passing that section I drive on a relatively narrow road, where I feel so stressed that I often end up driving on the footway, even though I'm not allowed to do so. But there are too many cars on that road, even at six o'clock in the morning and I keep being chased by them. […] My wife has the same issue: she has a nice cycling path along the river, but after crossing the bridge it ends abruptly. There is a cycling path marked on a big road, but no one pays attention to the bikers. There is a traffic refuge in the middle, so cars cannot go on the other side to overtake her, then it becomes really squeezed." (E12)*

This commuter's experience precisely reflects the bike's deficiencies that also became evident in the survey, where cycling was perceived as stressful, unsafe and prone to accidents. In his recount, the commuter relates these attributes to concrete infrastructural deficits. Nevertheless, he sums up why he is still motivated to commute by bike, in spite of these obstructive experiences:

> *"I enjoy riding my bike and I can climb on it whenever I want. On the bike, I have my peace and quiet. The only thing I have to pay attention to, is not to get ridden over." (E12)*

This reflects the high value placed on the independence factor in the survey, which most of the other respondents, however, attributed to the car. When I asked the interviewee what improvements he hoped for, he listed that a) cycling paths should be physically separated from the roads, instead of simply being marked onto them, and b) cycling paths should be continuous and not suddenly end – routeing should be fully thought through.

Another commuter's comment regarding the question on how he experiences the bike ride for the 2 km distance between the train station and his place of work, was "I deal with it". He explained that he has the option to take a detour route where there is a proper cycling road, or to take a direct, short route along the tram rails. Some of his colleagues choose the former one, but he opts for the latter, although he concedes that it gives him a lot of stress:

> *"It is definitely the more challenging route, one has to constantly be on alert with the tram, cars that take you over, people come in and out of shops or the tram. But it's shorter." (M13)*

This comment corresponds to the high value that the survey respondents attributed to the time saving factor. Another commuter, who walks to the train station, takes a local train and walks to work, also explained that he preferred to walk mainly because taking the bike would not save him time as he would have to circumnavigate the pedestrian zone. Additionally, he noted that there is no extra cycling path and even the smaller roads get cramped with cars during peak hours – underlining the need of direct routeing to facilitate the time saving factor and the need for separated infrastructure to reduce stress, one of the main weaknesses of the bike.

Other commuters that I interviewed, have additional reasons for not using the bike. One commuter that combines the car, long-distance PT and the bike explained that he uses the car for the 10 km distance between his home in a rural area and the train station in a big city, because a) 10 km is too long of a way to bike, b) he would lose too much time that he could spend with his family, c) he would be exposed to wet and cold weather for too long. While this commuter, in accordance with the survey results, emphasises the time factor and lack of weather shelter as the main obstacles, he also touches on the limited route length that people are physically able or willing to cover by bike.

5.2.2 Experiences with PT

Similar to the bike, PT has a road ahead to attract more people. Different commuters that I interviewed mentioned that a) PT does not offer them a direct route – it would require them to change busses or trains, which is prone to delays and therefore unreliable, b) when travelling by PT, they would have to deal with "annoying people that are loud and leave behind rubbish", c) PT is

unpractical when wanting to go grocery shopping on the way home, since one would have to drag the shopping bags around between different stops. One commuter said:

> *"I'd have to pay extra, it'd take much longer, I'd have to change trams, I'd have to walk part of the distance and the whole thing would be vulnerable to delays. […] Instead of relying on the unreliable punctuality, I go by car." (M13)*

While these weak points of PT might be favourable arguments for the bike regarding short distances, they become obstructive regarding longer distances, where commuters' main alternative to the car is to combine the bike with PT. Yet, offering another perspective, one PT commuter explained that he is discouraged from even owning a car when he sees that his neighbours often cannot find parking spots in the entire street where they live. Since the city where he lives and the town where he works are situated along a well-connected main route, PT saves him time, that he would otherwise spend in traffic jams and looking for parking lots. Again, the time factor constitutes a decisive element.

Another commuter, who combines the car with long-distance PT and the bike, added that living in proximity to an express train line allows him to reach work within the same amount of time, as driving the whole route by car would take him, due to expected traffic jams. He also said that he associates the idea of driving to work for 1.5 hours with so much stress, that he rather uses the train – less stress by equal travel time balances out the lack of independence and flexibility for him. This is an important point, considering that stress was a factor in the survey that is currently not a strength for the car. Nevertheless, this commuter's experience was not shared by many in the survey, as long-distance PT was largely perceived as stressful and time-consuming.

5.2.3 Commuter Experiences in the Context of Public Traffic Planning

Since the afore-presented quantitative and qualitative findings can have potential implications on the cycling strategy and other BW's traffic policies, commentaries from several selected political stakeholders are indispensable. This section sets the research findings into the context of the perspectives from the cycling interest group ADFC (Zühlke), BW's traffic agency NVBW (Hussinger) and BW's Ministry of Transport (VM).

Firstly, my interview contact at the VM pointed out the advantage of the bike as a "approachable" transport mode – one that a large majority has access to and already has experience in operating (personal interview, 03.04.2019). This evaluation also corresponds with the survey results obtained in this research.

Obstacles arise from how the bike and cycling are perceived: as stressful, unfree, unsafe, prone to accidents and time consuming. Zühlke attributes these points to the lack of a "safe, continuous and self-explanatory bike infrastructure" and to a low level of information among car drivers about traffic rules that concern cyclers (personal interview, 01.04.2019). However, Hussinger outlined that building cycling lanes which are physically separated from car lanes is oftentimes unrealistic, as streets are already fully built up, therefore lacking space for building such separate cycling paths (personal interview, 02.04.2019). Yet, both Zühlke and Hussinger pointed out the difficulty of enhancing cycling infrastructure when 80 % is under building authority of one of 1,101 different municipal councils, who according to Zühlke "all assume that the majority of their voters are car drivers" (personal interview, 01. & 02.04.2019). For this reason, all that NVBW can currently do is try to communicate, that statistically driving on the car road is safer than driving on the footway (see appendix 8) (Hussinger, personal interview, 02.04.2019).

However, the ADFC's view on this is that even when sticking to the current practices, much deficits are generated due to non-compliance with set regulations: Zühlke explains that protection strips are often wrongly marked and generally ignored by car drivers – frquently due to misleading marking or signposting and ignorance among car drivers (personal interview, 01.04.2019). In this regard, my contact at the VM pointed out that RadKULTUR currently does not target car drivers in their campaign to raise awareness about cycling safety (personal interview, 03.04.2019). Nevertheless, Zühlke concluded that "one can cycle well in cities, if one knows the area and can identify small side-streets to avoid traffic and, if one is prepared to put up with resultant detours" (personal interview, 01.04.2019).

The above adds to the already mentioned obstacles of cycling being perceived as time consuming and unfree. Hussinger pointed out that the time disadvantage of the bike can be somewhat levelled out through a higher share of e-bikes, as well as through infrastructural advancements (personal interview, 02.04.2019). Zühlke, however, asserted that time is also relative to how we choose to measure it, since cycling does save time that commuters would otherwise have to spend additionally for their physical well-being: for example, someone who commutes to work by car in 15 minutes and back, has to spend an hour in the evening to get the same physical well-being as someone who bikes the same distance to work in half an hour and back– thereby losing half an hour of time compared to the cyclist (personal interview, 01.04.2019). She criticises that this way of measuring commuting time is currently not communicated in such a way (personal interview, 01.04.2019).

Nevertheless, Zühlke concedes that car drivers have an inherently different perspective about cycling, since they ride along the main roads, which cyclers tend to avoid (personal interview,

01.04.2019). She explains that only if cyclists are faster on those roads where car drivers can see them (generally the main roads), only then some car drivers might be induced to rethink (Zühlke, personal interview, 01.04.2019). She, however, also points out that the car industry is a "powerful opponent", which diverts the focus from objective infrastructural matters or from the car's own safety as a mode of transport, and rather markets the car as a symbol of freedom and as an experience in itself (personal interview, 01.04.2019).

Nevertheless, for longer distances and especially in rural areas, the bike must be well-connected to PT service, for the bike+PT combination to be an attractive alternative to the car. Zühlke sees little necessity in investing in rural cycling lanes due to an "excellent network of paved agricultural roads in the countryside", which offers a high standard of rural infrastructure suitable for cyclists. Additionally, Hussinger and Zühlke both saw the expansion of parking space with enhanced security standards as crucial for increasing the share of commuters who opt for this alternative (personal interview, 01. & 02.04.2019). There is, however, a rentability issue in rural areas concerning bike infrastructure and parking, which is why the ADFC advocates for an on-demand-scheme for parking boxes (Zühlke, personal interview, 01.04.2019). Nevertheless, Hussinger underlined the low costs of bike infrastructure relative to car infrastructural as an economic asset for public expenditure (personal interview, 02.04.2019).

Overall, my contact at the VM asserted that although the VM currently only invests a small fraction of the car infrastructure budget in the bike, cycling has a highly significant value for the VM (personal interview, 03.04.2019). This is in line with Hussinger's observation of a rapid transition in terms of an increasing awareness amongst public decision-makers regarding the bike's potential of tackling various societal problems (personal interview, 02.04.2019). These include climate change, air pollution, public health, already hinted-on economic calculation and an increasing openness to cycling as a means of transport within BW's population (Hussinger, personal interview, 02.04.2019).

6 Discussion

This chapter provides an analysis of the results presented in the previous chapter. It aims at a) deducing opportunities and challenges for the bike and the combination of bike+PT and b) discussing the implications that these opportunities and challenges have on BW's cycling strategy. For this, I relate the systemic context outlined in chapter 2 to the individual commuter perspective that informs the results.

Overall, the results show that a significant obstacle for bike commuting comes from the low relevance that commuters attribute to factors that it performs strongly in. Another obstacle derives from the fact that the car's performance outdid the bike's and PT's performance in categories regarded as relevant by commuters. At the same time, those factors that are crucial to achieve, due to their high relevance for commuters, were particularly weak points for the bike and PT.

6.1 RQ2: Windows of Opportunity and Remaining Challenges

Looking at quantitative findings related to individual attitudes, social norms and PBC, as well as considering qualitative findings related to commuting experience, it is possible to deduce certain windows of opportunity for the bike and PT, in terms of their (potential) advantages towards the car. I also deduced the main challenges that the bike and bike+PT need to overcome, in order to 'win over' current car drivers or local PT commuters with cyclable journeys. Table 5 below depicts an overview of the identified opportunities for the bike and bike+PT (based on high bike / PT performance and low car performance), as well as remaining challenges (based on weak performances in crucial categories and low relevance of the bike's strengths).

Table 5: Opportunities and Challenges of Bike and Bike+PT (own illustration, 2019). This table summarises the main windows of opportunities that bike/ bike+PT can use to divert commuters away from the car. It also presents a list of challenges that policymakers need to overcome, in order to make the bike/ bike+PT a sufficiently attractive alternative. The points on the list are largely informed by a comparative analysis of each transport mode's strengths and weaknesses. They are also informed by both expert & commuter interviews.

Opportunities			Challenges	
High bike performance	High PT performance	Low car performance	Crucial PT weaknesses	Crucial bike weaknesses
Cost reduction	Low accident risk	Stress reduction	Independence factor	Safety factor
Health/ fitness benefit	Nearby access (local)	Accident minimisation	Time disadvantage	Independence factor
Environmental factor	Full Network	Cost reduction	Lack of connecting infrastructure	Stress factor
High ability & access rates	Sufficient money	Environmental & health factor	Insufficient frequency	Time disadvantage
				Luggage space factor
				Weather shelter factor
				Infrastructural inequality

Firstly, what can be seen as a fundamental basis for bike commuting commercialisation is the high rates of commuters who have access to a bike and consider themselves able to operate it. Considering, however, that the share of bike commuters among people below 25 years was substantially higher in this survey, shows, that a switch in transport mode choices oftentimes occurs (presumably when commuters have saved up enough to buy their own car and take a driver's license test). Therefore, the focus has to be on creating the PBC conditions that motivate individuals to choose the bike instead of the car, as well as to change social norms and individual attitudes surrounding the perception of the different transport mode options.

One of the issues of the bike is that the factors where it was rated to be superior to the car (environmental and health/fitness, cost reduction factors) are of little relevance to commuters in BW. This is underlined by the fact that the share of bike+PT commuters does not rise when commuters are entitled to PT benefits from their employer. Therefore, for the bike to use its natural assets, RadKULTUR (and other public initiatives) should consider to design a communication mechanism through which these attributes can gain significance among commuters.

Furthermore, one can make use of the perceived deficiencies of the car that commuters experience today, namely: perceived stress in traffic, a perceived high risk of accidents, high costs. The bike being an affordable transport mode is an advantage already present today, in spite of cost reduction not being rated as a relevant factor in the survey. Yet, the share of commuters who think that cycling

is stressful and prone to accidents is higher than for the car. Therefore, to compete against the car, one promising approach would be to focus on ensuring that bike commuting becomes less prone to accidents and less stressful than the car.

In addition to surpassing the car in those categories that are currently the car's weak points, the bike also needs to live up to car standards concerning the car's current strengths. These mainly concern: insufficient luggage space, lack of weather shelter, perceived time advantage and feeling of independence. The first point underlines the necessity to incorporate user-friendly cargo bike infrastructure into the RadNETZ programme. However, this issue might also need to be addressed through an approach targeting social norms and individual attitudes, due to the limited knowledge regarding the acceptability of cargo bikes among BW commuters. Such an approach might also be needed regarding the weather shelter issue, as this is not something that can be solved through infrastructural measures.

Moreover, the points of reducing the time discrepancy between the car and the bike and increasing the feeling of independence that both cyclists and non-cyclists attribute to the bike, need to be addressed. One advantage in that regard is that cyclists are currently untouched by traffic jams, which makes cycling more predictable. Another advantage is that bike commuting saves time that would otherwise have to be spent on fitness-related activities after work. Yet, a challenge is the low importance attributed to the fitness & health factor by survey respondents.

For longer distances, however, the bike needs to succeed in combination with PT and therefore partly relies on a sufficient attractiveness of the PT net to commuters. To achieve this, we must turn to those PT weaknesses that commuters attached high relevance to, namely: insufficient frequency, lack of connecting infrastructure, as well as the time disadvantage and lack of independence. My qualitative findings suggest that the latter two points can largely be attributed to the former two points, as well as to a perceived unreliability of the PT service. Hence, it is imperative that the PT network invests in a more frequent, better-connected and more reliable service, since these are PBC factors that multiplicate into negative PT attitudes and social norms.

At the same time, there are certain expansion limits of PT infrastructure, in terms of the number of trains that can pass a given station per hour or in terms of the current lack of train conductors/bus drivers, as well as rentability issues for connections into the hinterland, away from the main travel routes. These are challenges that can partly be addressed by an increased attractiveness of the bike, which can help to cover distances that are economically unprofitable for the PT net and to make space in local PT for those, whose commuting distances are too long to bike.

Here, qualitative findings suggested several advantages of the bike compared to local PT: cycling is more predictable and simpler, since it does not require transfers and waiting times. Therefore, cycling commuters are also more independent from PT service issues – provided that the infrastructure allows them to perceive their bike trip as independent (see above). Lastly, the bikes inherent strengths (cost reduction, health/ fitness factor) need to gain importance also in this regard.

Moreover, the combination of bike+PT needs to function well concerning longer routes. Opportunities that speak for PT are a high feeling of accident minimisation compared to the car – with the challenge that this is currently not the case for the bike (see above). Furthermore, a considerable share of survey respondents has access to a full PT network, which is a baseline from where remaining challenges can be tackled. However, qualitative data suggested that bike+PT needs to be better connected to become a viable option for commuters.

6.2 RQ3: Policy Implications for the Cycling Strategy

The opportunities and challenges identified above require measures to support the bike and PT. In Table 6, I present prioritised ideas of intervention that can tackle some of the most important challenges and enable some of the most important opportunities. I then discuss how the required interventions are currently addressed in the cycling strategy. The analysis in this section is informed both by survey participant interviews, as well as by expert interviews.

Table 6: Required actions and interventions (own illustration, 2019). This table depicts the recommended actions to exploit the opportunities and tackle the challenges presented in the previous section of this chapter.

Challenges	Required Actions/ Interventions
Position bike as safe & stress-free alternative. Stressing the feeling of independence	a) safe, direct, well-developed infrastructure b) information campaigns addressing car drivers
Reduce perceived time discrepancy	a) (connecting) infrastructure b) information campaigns on time calculation
Increase attractiveness of PT network	a) PT strategy
Address lack of luggage space	a) Infrastructure for cargo bikes b) Support acceptance of cargo bikes
Address lack of weather shelter	a) communication efforts directed at social norms/ individual attitudes
Increase social significance of health/fitness + environment factor in the context of commuting	a) communication efforts directed at social norms/ individual attitudes

Overall, one of the most central challenges for diverting commuting from the car to the bike, is to position the bike as a safe and stress-free alternative to the car. For this, infrastructure that commuters perceive as safe and stress-free by commuters is needed. Nevertheless, there is a distinct discrepancy between qualitative data suggesting a separate cycling path and the goals of the cycling

strategy. In contrast to what commuters argue for, the cycling strategy advocates for cycling strips within the sight of car drivers, pointing out its cost-efficiency and relative safety compared to cycling on pedestrian walks. Hussingers' argument regarding streets already being fully built up and lacking space for separated cycling paths only lands, if one considers the space currently given to cars as inalterable. This should, hence, be reconsidered especially since the cycling strategy has a defined goal to enhance safety and to reduce the number of casualties among cyclists.

This current deficiency is especially salient, considering the cycling strategy's objective of not only increasing objective, but also subjective safety. Qualitative findings suggest that unsafe infrastructure contributes to a low feeling of independence and high stress. Further it unfolds, that this issue also contributes to the bike's time disadvantage since commuters need to take detours to find proper cycling infrastructure. Therefore, the potential of separated cycling paths for increasing the bike's attractiveness is enormous. This, however, is not only a matter of separated cycling paths, but of sensitising car drivers towards cyclists' safety, which has not been taken up by RadKULTUR.

Another central challenge is to make bike+PT more time-efficient, than the car currently is. A well-connected infrastructure system could address this challenge, as well as the issue of the lack of independence. For this, a mechanism to resolve rentability issues is needed, since these prevent advancement especially in rural areas., e.g. concerning bike parking, which is crucial for facilitating bike+PT commuting. One option could be the on demand-scheme advocated for by the ADFC.

Furthermore, bike+PT heavily depends on a higher attractiveness of the PT network for wider application by commuters. Although BW does have a region-wide PT strategy similar to the cycling strategy, PT continues to face several challenges, as outlined in the section above. How these challenges can be addressed, is a matter that needs to be taken up in a separate research study directed at the PT strategy. Nevertheless, time is also relative to how commuters perceive it. Although RadKULTUR communicates slogans such as „cycle past traffic jams" (see appendix 1), it currently fails to apply a communication strategy aimed at transporting the message of the bike saving time that would otherwise have to be spent additionally on fitness-related activities.

Another frequently occurring concern among survey participants is the bike's limited storage capacity. Although cargo bikes can, to a certain degree, make up for this perceived deficiency, a wider use of cargo bikes among cyclists would pose additional infrastructural requirements, regarding the width of cycling paths, especially when such paths are painted on the car road. A feasibility study on cargo bikes in commuter traffic could be a valuable addition in this research field.

Moreover, the issue of the bike's lack of weather shelter is another obstacle, as long as this factor is rated as highly as in this study. Since this matter cannot be solved through infrastructural advancements, this is something that has to be taken up from a social norms and individual attitudes perspective. Further research could address the question of how such a transformation of the relevance put on the weather shelter factor can be introduced and facilitated.

Such a transformation is also necessary concerning the fitness/health and environmental factor, which are currently not attributed with sufficient relevance by commuters. Hence, the limited importance poses an obstacle in making use of the bike's inherent strengths. Thus, further studies should also address the question of how to increase the significance of these factors within the commuting context, especially concerning the fitness/health field which is less prone to controversies between two frontlines.

6.3 Suggestions for Further Research

This research provides an understanding of how commuters value different attitudes, social norms and PBC factors regarding their transport mode choice. From these insights I have deduced different windows of opportunity for the bike, as well as remaining challenges. Yet, to quote Hussinger from NVBW "mobility behaviour is a complex construct with many influences […] and one's mobility biography already starts in one's childhood". Therefore, before going further into research limitations, I would like to point out the diversity of the 2.5 million commuters in BW which also became apparent in the individual interviews. Therefore, there are no flat-rate solutions, as the complexity of mobility behaviour and the diversity of individuals obstructs the idea of a "one size fits it all"-approach. For example, this research did not incorporate commuters working in the service sector, who commute from one costumer to the next, instead of from home to work and back.

Instead, the discussed interventions constitute a mere catalogue of measures to address the bike's deficiencies concerning those factors that commuters found most relevant for their mobility choices. However, additional studies would have to conduct more precise impact assessments on the interventions deduced from survey and interview data in this study. For example, survey data showed that cycling has a perce ived safety issue and interview data implied that the lack of physical separation of cycling paths from car roads is a main driver of this feeling. Yet, such conclusions would have to be re-examined on a larger scale than was possible within the scope of this thesis and their impact would have to be assessed in pilot programs, to see if there is an actual causation between the two.

Furthermore, due to the complexity of the topic, additional research is required to investigate deeper into the meanings behind the attitude, social norms and PBC factors for different groups of individuals. For example, one might have enough luggage space for one's work requisites, in order to commute by bike, but if one has to drop off or pick up one's child at day-care on the way, then factors are at play that go beyond this research.

At the same time, this research lacks the scope to investigate qualitatively on a broader scale, in what way different factors investigated in this study interrelate with each other. Therefore, further research on the extent to which certain attitude factors are a product of social norms or infrastructural PBC factors, or, in turn, to what extent the way we perceive control factors are a product of individual attitudes or social norms, could be helpful to put a clearer focus for solution strategies.

Moreover, further research could address the question of what kind of communication strategies would be most effective in achieving a transformation of social norms and individual attitudes connected to transport – how can we transform society's definition of independence? How can we create a higher social significance of environmental/ health factors connected to commuting?

Lastly, since the VM also has a parallel strategy for PT, it could be of relevance to cross-analyse the two campaigns in a further research project, in order to understand how they interrelate and to identify and make use of fields where two-fold gains are possible.

7 Conclusion

Throughout this thesis I aimed to understand how the cycling strategy can become more attractive for commuters. How can the cycling strategy incentivise a higher share of bike commuting and thereby encourage each commuter to make work the place where their bike is?

Recognising the singularity of each individual case, I established tendencies regarding the relevance of different factors, their attribution to different transport modes and their interrelation with one another. My findings identified several attitudes and PBC factors at the core of the perceived negative experience with bike commuting. There was evidence that the negative perception of attitude factors towards the bike might, at least to a degree, be grounded in the absence of PBC factors, due to infrastructural constraints. It became apparent that several measures of the cycling strategy are not radical enough to dispel control factors perceived as insufficient.

This research has proven the potential of incorporating qualitative data into TPB. I related the classic survey-based TPB analysis to concrete qualitative experiences in the field. Due to this qualitative addition, I could unfold how different factors interrelate and form one (perceived) experience among commuters. This allowed for a holistic comparison between the political goals of the cycling strategy and TPB factors that should ideally facilitate a positive bike-commuting experience.

Based on this comparison, I highlighted different courses of action, in order to achieve a more favourable evaluation of the bike by commuters. These findings can motivate the regional government to incorporate a commuter-focus into the cycling strategy, enabling a precise tailoring of measures around their needs. The added knowledge generated in this thesis can support an ongoing change towards more sustainable commuting behaviour. For this, further research that substantiates emerging follow-up questions highlighted in the previous chapter is needed.

Utilising this knowledge not only supports a possible sustainability transition in BW's transport sector. This thesis also contributes to improving air pollution in BW's cities, reducing noise exposure of residents along large roads, counteracting public health issues and diminishing the public costs for facilitating infrastructure.

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Appendix 1: RadKULTUR - Promotion Examples

"I want to see the world through your eyes!"

Backside reads:

"Do it out of love: change your perspective and put yourself into others' position from time to time.

"One just has to turn to look at you!"

Backside reads:

"Do it out of love: establish eye-contact and smile. This does not only work when flirting, but also helps

"I need space, honey!"

Backside reads:

"Do it out of love: hold distance when overtaking. Car drivers often get too close to cyclists when

"Cycle past the traffic jam."

Cycling is farmer's market… easy to the shop.

Cycling is city park… easy to the favourite location.

Cycling is mobility… easy for everybody.

Cycling is morning dew… easy to work.

Appendix 2: Survey Questions & Results

Transport Mode Choices in Commuter Traffic

(Translated from its German original)

Hello!

First, I would like to thank you for taking part in this survey and supporting me in my Master thesis. My name is Sandra Seethaler, I'm currently in my last semester of Environmental Studies and Sustainability Science at Lund University (Sweden). As part of my thesis, I analyse the mobility behaviour of commuters in Baden-Württemberg. I apply a social psychology method, in order to understand which factors lead to commuters choosing a certain mode of transport (eg. car, public transport, bike). This research focus is also relevant for you as a commuter, who relies on an efficiently planned and directed commuter transport system.

The purpose of this survey is to collect the statistical data necessary to achieve the outlined research aim. Please remember to only fill it in if you really are a commuter, meaning that you work in a different municipality than you live in.

Your data will be analysed anonymously, so that your responses cannot be related back to you personally. Furthermore, I will use this data exclusively for the purpose of the above-mentioned research project. At no time I will pass your data on to third parties.

Lastly, I want to make you aware of the exact meaning of the following abbreviations:

PT = public transport

Local PT = city busses, local rural busses, trams, s-trains

Long-distance PT = regional and long-distance trains, overland busses

Section 1: personal and mobility-specific details

This section collects personal data relevant for this research, eg. your gender and age. Moreover, this section collects information regarding specific aspects of your commuting journey.

What is your gender?

o	Male	56 %
o	Female	44 %
o	Diverse	0 %

What is your age?

o	Under 25	14 %
o	25-40	43 %
o	41-55	32 %
o	Over 55	11 %

How big is the population size at your place of residence?

- o Under 5,000 22 %
- o 5,000 to 10,000 23 %
- o 10,000 to 20,000 12 %
- o 20,000 to 50,000 12 %
- o 50,000 to 100,000 11 %
- o Over 100,000 20 %

What type of work do you do?

- o Physical indoor work 11 %
- o Non-physical indoor work 80 %
- o Physical outdoor work 8 %
- o Non-physical outdoor work 1 %

How long is the distance between your home and your work?

- o Under 10 km 17 %
- o 10 to 20 km 14 %
- o 20 to 30 km 29 %
- o 30 to 50 km 22 %
- o Over 50 km 19 %

Do you receive any kind of transport benefits from your employer? If so, which kind?

- o None 56 %
- o PT benefits 32 %
- o Company car / financial compensation for the use of your own car 11 %
- o Company bike 1 %
- o Carsharing membership 0 %

Section 2: your mobility behaviour

This section collects information on your daily commuting behaviour concerning different transport options.

How often do you use the following modes of transport for commuting?

> *The option "car + PT" and "bike + PT" apply when both transport modes are being combined, eg. when you drive to the nearest train station by car / bike.*

	Daily	Several times per week	Several times per month	Sporadically	Never
Car	58 %	9 %	7 %	3 %	23 %
PT	15 %	8 %	2 %	19 %	56 %
Bike	5 %	3 %	2 %	8 %	81 %
Car + PT	7 %	3 %	1 %	5 %	84 %
Bike + PT	3 %	0 %	2 %	9 %	87 %

How motivated are you to use the following modes of transport for commuting?

This question does not concern the degree of frequency with which you use a certain transport mode, but seeks to understand whether you re-evaluate your transport options anew from time to time or if you decided once and have from then on rather automatically repeated the same commuting behaviour.

	Very low	Low	High	Very high
Car	16 %	14 %	15 %	54 %
Long-distance PT	62 %	19 %	9 %	11 %
Local PT	53 %	22 %	11 %	14 %
Bike	58 %	22 %	11 %	9 %

How would you rate the degree of habit when it comes to your commuting-related transport mode choices?

1	2	3	4	5
27 %	11 %	24 %	13 %	24 %

Section 3: your attitude towards different transport modes

Please indicate what statements you find applicable to the following transport modes:

If I commute by car/PT/bike, I can…

	Car	Long-distance PT	Local PT	Bike
save time	81 %	12 %	16 %	11 %
minimise my accident risk	20 %	43 %	60 %	2 %
shelter myself from the weather	86 %	25 %	35 %	0 %
feel safe	78 %	34 %	40 %	12 %
support the environment	5 %	37 %	48 %	67 %
reduce my transport costs	30 %	15 %	23 %	62 %
feel less stressed	50 %	16 %	30 %	23 %
feel more independent	87 %	4 %	5 %	24 %
support my health / fitness	2 %	8 %	10 %	81 %

Please indicate how important you find the above-mentioned factors for your personal mobility choice:

	Unimportant	Rather unimportant	Rather important	Important
Time factor	3 %	4 %	15 %	77 %
Accident risk factor	20 %	30 %	32 %	19 %
Weather shelter factor	5 %	12 %	27 %	55 %
Personal safety factor	9 %	16 %	40 %	35 %
Environmental factor	23 %	34 %	20 %	23 %
Cost factor	11 %	16 %	36 %	36 %
Stress reduction factor	4 %	10 %	45 %	41 %
Independence factor	4 %	8 %	25 %	63 %
Health / fitness factor	26 %	36 %	26 &	11 %

Section 4: social acceptance of different transport modes

The feedback of the following social groups towards the car is…

	Mainly negative	More negative than positive	More positive than negative	Mainly positive
Family	1 %	3 %	26 %	70 %
Friends	1 %	10 %	24 %	65 %
Colleagues	0 %	9 %	26 %	65 %
Advertisement	9 %	21 %	42 %	29 %
Media	14 %	33 %	32 %	21 %

The feedback of the following social groups towards PT is…

	Mainly negative	More negative than positive	More positive than negative	Mainly positive
Family	29 %	34 %	21 %	16 %
Friends	19 %	44 %	25 %	12 %
Colleagues	24 %	38 %	22 %	15 %
Advertisement	11 %	29 %	37 %	23 %
Media	11 %	27 %	33 %	29 %

The feedback of the following social groups towards the bike is…

	Mainly negative	More negative than positive	More positive than negative	Mainly positive
Family	24 %	23 %	26 %	26 %
Friends	23 %	22 %	26 %	29 %
Colleagues	26 %	21 %	25 %	27 %
Advertisement	21 %	22 %	37 %	20 %
Media	20 %	23 %	30 %	28 %

How important is the feedback of the following social groups for you in general?

	Not important	Rather unimportant	Rather important	Important
Family	45 %	25 %	16 %	13 %
Friends	53 %	29 %	14 %	4 %
Colleagues	60 %	23 %	8 %	9 %
Advertisement	78 %	14%	4 %	3 %
Media	77 %	14 %	7 %	2 %

Section 5: Enabling conditions for commuting with different transport modes

In this section you evaluate to what degree you find yourself capable to use different transport modes for your commuting. Do you see any obstacles or facilitating conditions which influence your transport mode choice?

Please indicate which of the following conditions you see fulfilled in relation to the car / bike:

	Car	Bike
You have access to the vehicle	90 %	76 %
You are able to operate the vehicle	95 %	77 %
There is a complete road network	95 %	35 %
The road network is well-developed	86 %	30 %
The road network is well-signposted	88 %	31 %
There is sufficient parking space	63 %	55 %
You feel well-informed about the possibilities of using the vehicle	80 %	54 %
You have enough time to use the vehicle	82 %	22 %
You have enough money to use the vehicle	81 %	65 %
There is sufficient space for your luggage	93 %	18 %

Please indicate how important you find each of the above-evaluated factors:

	Unimportant	Rather unimportant	Rather important	Important
Access to the vehicle	7 %	4 %	23 %	66 %
Ability to operate	4 %	9 %	27 %	59 %
Complete road network	4 %	7 %	26 %	63 %
Well-developed road network	4 %	9 %	27 %	59 %
Well-signposted road network	12 %	22 %	26 %	40 %
Sufficient parking space	5 %	7 %	18 %	70 %
Information on possibilities of using the vehicle	16 %	29 %	29 %	26 %
Sufficient time	4 %	7 %	13 %	76 %
Sufficient money	4 %	15 %	30 %	51 %
Sufficient luggage space	8 %	13 %	33 %	46 %

Please indicate which of the following conditions you see fulfilled in relation to local / long-distance PT:

	Local PT	Long-distance PT
You have nearby access to the network	73 %	38 %
There is a full transport network	57 %	40 %
Departure, transfer and arrival points are well-connected	40 %	26 %
You feel well-informed about the possibilities of usage	50 %	31 %
The service is frequent enough for your needs	29 %	16 %
You have enough time to use the service	29 %	20 %
You have enough money to use the service	66 %	53 %
There is sufficient space for your luggage	40 %	33 %

Please indicate how important you find each of the above-evaluated factors:

	Unimportant	Rather unimportant	Rather important	Important
Nearby access to the network	3 %	1 %	14 %	81 %
Full transport network	3 %	1 %	19 %	77 %
Well-connected departure, transfer & arrival points	3 %	3 %	10 %	84 %
Information on the possibilities of usage	4 %	25 %	26 %	44 %
Frequency of service	3 %	1 %	16 %	79 %
Sufficient time	3 %	2 %	13 %	81 %
Sufficient money	3 %	15 %	27 %	54 %
Sufficient luggage space	11 %	20 %	35 %	34 %

Section 6: one last question

This survey is the first research step in my Master thesis. In the following step, I would like to gain a deeper understanding of the survey results by inviting a number of participants to individual interviews. In these interviews, I would like to discuss your personal view towards the different available transport modes further. In this way I can understand the mobility behaviour of commuters in Baden-Württemberg more in-depth, than possible through this survey.

Email address & place of work: _____

Appendix 3: Short Profiles of Commuter Interviewees

The below-depicted table lists the conducted 2nd stage interviews. All interview partners were acquired through their participation in the survey. The table lists basic information regarding the code used in this publication to refer to the different interview partners, the associated city where the interview took place (either place of work or place of residents of the interview partners), as well as the date, time and location of the interview. The interview code was generated from the first letter of the interviewees' first names and their participant number, deriving from the order of participants in the survey.

Interviewee code	Associated City	Date and Time of Interview	Interview Location	Duration	Sampling method	Transport Mode
J65 + wife	Freudenstadt	24. March 18.00	Cafe	28:28	Consecutive	Car
C6	Radolfzell	25. March 17.00	Cafe	30:45	Consecutive	PT
M13	Mannheim	26. March 11.30	Cafe	47:38	Consecutive	combines
E12	Heilbronn	26. March 18.00	Interviewee's home	58:05	Snowball	Bike

Below there are short profiles of each of the five interview partners. Each profile compiles information on the interviewee's survey responses, as well as the perspectives expressed during the interview. In this way, the profiles constitute an overview to retrace the insights gathered from the interview, since the transcripts – being in German – are not directly added as an appendix. At the same time, the profiles help to gather a holistic understanding of the perceived realities of those personas that a substantial part of content in this thesis is based on.

J65

An older middle-aged village man who works a factory job around 20 to 30 km from his home. He goes daily by car (habit) and is not motivated to use any other mode of transport. For him, the car is the only transport mode that allows him to save time and be independent. However, he also cares about the environment and reducing his costs, which he ascribes to PT/bike. He feels safe in the car, but thinks that his accident risk would be lower with PT/bike. He only cares little about what his direct peers think, however, they perceive the car positively, the bike somewhat positively and PT largely negatively. He has access to both car and bike and considers himself able to operate them, however, there is no full and well-developed bike infrastructure net, he feels uninformed about possibilities to use the bike and he doesn't have time for it. Regarding PT he doesn't see any enabling conditions fulfilled other than that he has enough money to use it and enough space for luggage.

E12

An older big city man who works an office job, less than 10 km from his home. He mostly commutes by bike and sometimes by car (habit). He's motivated to go by bike, less so by car and not at all by PT. Although he feels more independent, safe and weather-protected in the car, he feels that biking reduces his commuting costs, makes him more relaxed, is good for both the environment and his health and is equally fast as the car. He feels like the opinion of his direct peers is very relevant and there he sees much approval for both car and bike, and rather negative perceptions towards PT. He sees deficiencies for the bike concerning signposting, parking space and luggage space, but thinks that he doesn't have enough time to use the car instead. He gives the PT quite good reviews in terms of the provided enabling conditions, although he thinks he does not have enough space for his luggage.

C6

An older man from a sizeable city who works an office job, around 20 to 30 km from his home. He commutes entirely by PT, with no motivation to go by car and little motivation to go by bike. The most important factors for him are that he commutes in an environmentally friendly way and that the commuting takes as little time as possible. While he would ascribe neither of these two factors to the car, he feels like the bike would be environmentally friendly, but not time-efficient and also not a safe and weather-protected travel mode. He feels that only PT accommodates for all his important factors, except that it is not a cheap transport mode. He doesn't feel like social norms are very relevant, although only the car generally receives positive feedback from his peers, while the bike and PT receive mixed to negative feedback. He does not own a car, nor does he have a driver's license, which also has financial reasons. However, he does own a bike, knows how to operate it and feels informed about possible ways of using it. However, while he feels that car infrastructure is very well-developed and signposted, this cannot be said about bike infrastructure. Possibly this is one of the reasons why he feels like he doesn't have enough time to commute by bike. In contrast, PT accommodates for all his needs.

M13

A middle-aged man from a sizeable city who works an office job, more than 50 km from his home. He either goes by car only or combines the car/ bike with long-distance PT. He feels very motivated to use either of these three modes of transports, while not motivated to use local PT. Most important for him is to save time, travel costs and to be independent and protected from the weather. While PT helps him to save costs, the car accommodates for the other three factors. For him only his family's opinion is relevant and they are very positive towards the car, while rather negative towards PT & bike. He has access to both car and bike and considers himself able to operate them. He also thinks that both car and bike have adequate infrastructure. However, there are not enough parking spaces for the bike and not enough space to take his work luggage along. Long-distance PT meets all his needs, while local PT doesn't at all.

Appendix 4: Interview Guide for Commuters

Explain consent form:

Introduce myself & research project
Publication of thesis → anonymity
Permission to record
Confidentiality of personal data & recording

Part 1: Political Expectations

Do you feel like a certain mobility behaviour is expected of you from the political domain? If so, what behaviour is expected?

Do you feel like the enabling conditions are provided in order to conduct the expected mobility behaviour?

Would you generally be willing to adapt to an expected mobility behaviour (for instance when looking at environmental concerns), provided that the enabling conditions are put in place?

Part 2: Commuting Experiences in the current System

Task: Please sketch out your most frequent commuting trip

How would you generally describe your experiences as a commuter along this route?
What kinds of feelings appear? What are these feelings connected to?

Task: Please mark those points within the sketch, where you experience your commuting trip positively (green colour) and negatively (red colour)

What concrete experiences are connected to the marked points?

What factors provoke these experiences in your opinion?
What characteristics of the route in terms of traffic planning issues etc.?

What do you consider to be at the root of these positive / negative experiences?

How strongly is your transport mode choice shaped by these experiences?

Do you think these experiences would be different if you would use another kind of transport?
More positive or negative? Why?

Part 3: Own Expectations

In what direction do you think the mobility system will develop in the future?
Electrification / PT & bike / more efficient FF engines?

What do you think should be done in order to achieve a more environmentally friendly transport system?
Taxes / financial support / more consistent policies / infrastructure etc.

What do you wish for regarding the future direction of our mobility
From politics/ traffic planners/ your employer?

Appendix 5: Interview Guide for Policy Stakeholders

Explain consent form:

Introduce myself & research project
Publication of thesis → cite by name or anonymously?
Permission to record the interview?

Part 1: The Potential of the Bike

What kind of role do you see for the bike in a future sustainable mobility system?

How do you evaluate the potential of the bike for mobility and commuter mobility specifically, especially when you consider the sentiments prevailing in society as part of the contemporary mobility debate?

What do you consider to be the main challenges / obstacles, that you notice concerning the development of the cycling sector?

Part 2: Challenges - Perception of the Bike

The cycling strategy stands on the two pillars RadNETZ and RadKULTUR.

In what way do you observe correlations between people's attitudes and the provided surrounding conditions?

Concretely: To what extent do prevailing attitudes and social norms shape the surrounding conditions and to what extent can surrounding conditions influence the attitudes and social norms?

In my survey, the three most important and determining factors for transport mode choices were a) the assumption that one could save time with a specific mode of transport, b) the feeling of greater independence, c) the expectation to have a less stressful experience.

In what way were these factors considered and incorporated into the conceptualisation of RadKULTUR?

Part 3: Challenges - Infrastructure Development

In my survey, one of the most detrimental factors for the bike was the lack of perceived security: only 2 % indicated that cycling would reduce their accident risk. Since perceived security also turned out to be one of the most important factors in the survey and considering that the feeling of security also relates to the above-mentioned factor of stress, this can be a determining factor for non-cyclers. An important factor would be to physically separate the cycling infrastructure from car lanes.

Why is there so little happening in this regard, considering that such a motive is also absent in the cycling strategy standards?

In what way does the potential of the bike also rely on gaining more space?

To what extent does gaining more space for the bike depend on taking space away from the car?

Does the cycling strategy do too little at the expense of car-drivers?

The cycling strategy's main goal is to connect overland routes reaching each of the 1,001 municipalities in the state. In this way, the cycling strategy needs to physically bridge rural, peri-urban and urban areas.

In what way does the cycling strategy need different approaches to satisfy the different needs of these very different areas?

Especially for distances that are too long to bike, which is often the case in rural areas, the opportunity to combine the bike with PT becomes necessary, if car usage is to be reduced. Among survey participants that have access to PT benefits, the share of PT usage and PT combination with the car rose significantly but remained equally low concerning the combination of bike & PT, as among survey participants without such benefits.

How do you characterise the main challenges that remain for this combination alternative?

In what way does the bike's potential also depend on the limitations of the PT system?

To what extent are PT and cycling policies coordinated syntonised?

Part 3: Policy Considerations

In a recently published Forsa Survey, respondents were on the one hand strongly in favour of a more sustainable transport sector, but on the other hand evaluated exactly those specific policy interventions positively, that would tread car-drivers the least on the feet.

How do you handle this paradox?

To what extent do you feel like there is a consistent overall sustainability strategy in BW's mobility sector?

In what way do you consider the duality of protecting the car industry on the one side and cycling and PT strategies on the other side as problematic?

Appendix 6: Consent Form Commuters

Consent Form for Research Project Participation

[Translated from the original German]

Researcher: Sandra Seethaler
Project name: Future visions for commuters‘ mobility behaviour

This interview is part of a Master level research project by the above-named researcher in the field of Environmental Studies and Sustainability Science. The research analyses the mobility behaviour of commuters in Baden-Württemberg. On the basis of this analysis, the research discusses future visions for solving current mobility debates and relates them back to current political traffic planning strategies.

This research will be published. The identity of all participants remains anonymous. Participants' personal data will not be passed on to third parties and will exclusively be used for the purpose of the above-described project. Furthermore, this research pursues no commercial interests and serves a purely scientific purpose.

The interview is recorded. The recording serves to retain the content for later access during the research project and will be deleted upon completion.

With my signature I declare that I am informed about and consent to the above-outlined terms of participation.

_____ _____

Place, Date Signature

[The consent form was signed by all interviewees prior to the start of the interview, with the opportunity to ask questions for clarification about the above-discussed points or the research project in general, if needed. All interviewees were provided with the email phone contact of the researcher, in case of unclarities in the aftermath. Furthermore, all interviewees received an abstract of the thesis with the opportunity of requesting the link to the full publication.]

Appendix 7: Consent Form Policy Stakeholders

Consent Form for Research Project Participation

[Translated from the original German]

Researcher: Sandra Seethaler
Project name: Future visions for commuters‘ mobility behaviour

This interview is part of a Master level research project by the above-named researcher in the field of Environmental Studies and Sustainability Science. The research analyses the mobility behaviour of commuters in Baden-Württemberg. On the basis of this analysis, the research discusses future visions for solving current mobility debates and relates them back to current political traffic planning strategies.

This research will be published.

Please indicate below, whether you agree on me directly referencing this interview (provided that you get to review them for approval prior to the hand-in date) or whether you prefer to stay anonymous.

The identity of all participants remains anonymous. Participants’ personal data will not be passed on to third parties and will exclusively be used for the purpose of the above-described project.

( ) Yes

( ) No

Furthermore, this research pursues no commercial interests and serves a purely scientific purpose.

The interview is recorded. The recording serves to retain the content for later access during the research project and will be deleted upon completion.

With my signature I declare that I am informed about and consent to the above-outlined terms of participation.

_____ _____

Place, Date Signature

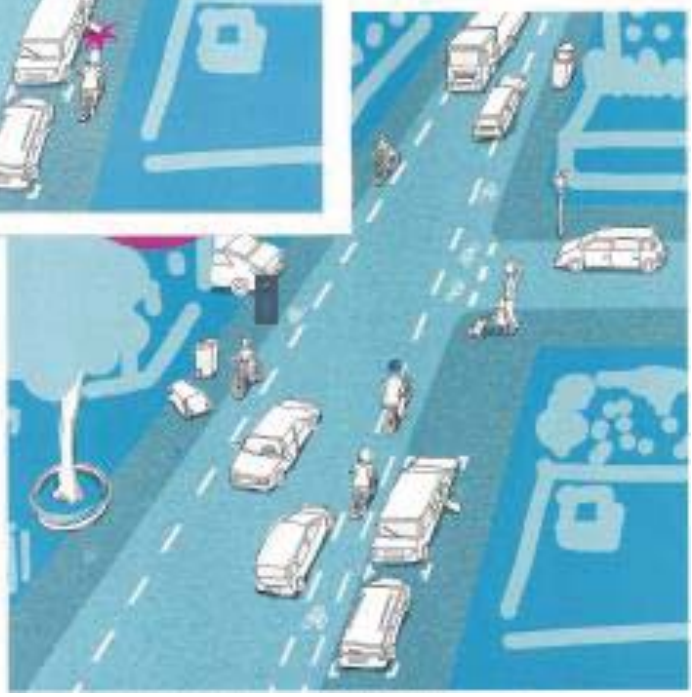
[The consent form was signed by all interviewees prior to the start of the interview, with the opportunity to ask questions for clarification about the above-discussed points or the research project in general, if needed. All interviewees were provided with the email contact of the researcher, in case of unclarities in the aftermath. Furthermore, all interviewees received an abstract of the thesis with the opportunity of requesting the link to the full publication.]

Appendix 8: RadKULTUR Communication Material – Cycling Safety

"Protection strips make cyclists visible – seeing and being seen"

"Without protection strips – route with obstacles"

"With protection strip – free ride."



We are a cycling road now

-Here you are allowed to drive next to each other

-We are entitled to especial concern here

-Here, the priority-to-the-right-rule applies, unless otherwise indicated

-Cycling children under 8 years of age ride on the footway

... andere Verkehrsteilnehmer?

- Zusätzliche Schilder, wie zum Beispiel „Anlieger frei" oder „Pkw frei", erlauben, die Straße zu befahren und die Parkplätze zu nutzen. Aber Radfahrer haben Priorität.
- Autos und Motorräder dürfen Radfahrer überholen, wenn ein seitlicher Sicherheitsabstand von 1,50 Metern eingehalten werden kann.
- Für den motorisierten Verkehr gilt: Höchstgeschwindigkeit 30.
- Inlineskater dürfen die Fahrradstraße nur nutzen, wenn es ein Zusatzschild erlaubt. Ansonsten müssen sie auf den Gehwegen fahren.

Rights & duties of cyclists

You can cycle next to each other.
Max. speed is 30 km/h.
Footways belong to pedestrians.
The priority-to-the-right-rule applies.

Rights & duties of other traffic participants

Additional signs like "residents free" allow you to use the road, while giving priority to cyclists.
Overtaking cyclists only with 1.5 m safety distance.
Max. speed is 30 km/h.
Skaters are only allowed to drive on the road if explicitly indicated.