Gameful Urban Mobility:
Exploring the Potential for Gamification
in Various Modes of Transport

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Exploring the Potential for Gamification in Various Modes of Transport

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis/project is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Dominik Stampfl

22 August 2016
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Abstract

Urban mobility poses many challenges, such as congestion and pollution, which can make moving through cities less enjoyable. Many of these issues not only affect the mobile experience of individuals, but also the liveability in an urban environment for whole communities. Creating gameful experiences, known as gamification, holds great potential for addressing these problems and helps create a more enjoyable mobile experience for urban inhabitants. Game thinking can also serve as a design approach towards conceptualising and implementing gameful applications, for example by treating the city as a game space.

The core objective of this research is therefore to explore the potential of gamification when applied to urban mobility both from a bottom-up and a top-down perspective following interaction design research methodology, including design studies and design practice and guided by the research question: "How can gamification be applied to the context of urban mobility and what is a design approach to this, considering different modes (cities, types of transportation...), against the backdrop of enjoyability and liveability?"

Like putting a puzzle together, the research starts with investigating literature and practice in related fields and their overlaps, such as game design, mobility, urban environments and liveability. An evaluation of liveability indices showed that very few mobility-related indicators were included in these indices, which is why I developed a set of criteria. Based on the findings and using people-centred, participative methods as well as research-through-design, a design approach for developing mobile applications towards increasing urban liveability is suggested and reviewed in three different cities and mobility contexts.

During this practical part, specific mobility challenges were identified in each city and the design approach applied in order to develop concepts for addressing them. In Beijing, a one-week workshop with students from Peking University was conducted around automotive mobility. In Karlsruhe, a concept for bicycle mobility was developed together with local authorities. And in Melbourne, a workshop was held during
Melbourne Knowledge Week looking at local characteristics of the city’s mobility mix. One concept, developed during the workshop in Beijing, has already been iteratively turned into a fully functional prototype application for smartphones together with Stuttgart Media University.

With these projects, I was able to explore the potential of gamification in the context of urban mobility. Evaluation has confirmed it but also showed that it is in some cases not able to fully counter-balance negative issues, e.g. congestion. Nevertheless, the idea of applying game design in this context offers manifold opportunities to contribute to the better of urban liveability.
# Table of Contents

1. Introduction ........................................................................................................... 1
2. Research Approach .................................................................................................. 3
   2.1 Research Gap: Gameful Urban Mobility ......................................................... 3
   2.2 Hypothesis and Research Questions ............................................................... 5
   2.3 Definitions and Main Sources ......................................................................... 6
   2.4 Methodologies and Methods .......................................................................... 8
   2.5 Conclusion ....................................................................................................... 12
3. Topics and Literature Review ............................................................................... 14
   3.1 Urban Environments ....................................................................................... 15
      3.1.1 Urban Design Principles ...................................................................... 16
      3.1.2 Structures, Spaces and Mobility ......................................................... 18
      3.1.3 The Digital City ................................................................................... 21
   3.2 Mobility ......................................................................................................... 24
      3.2.1 Mobility System .................................................................................. 25
      3.2.2 Interaction in Mobility ...................................................................... 27
      3.2.3 Identity in Mobility ............................................................................ 29
   3.3 Games ............................................................................................................ 32
      3.3.1 Games and Play .................................................................................. 32
      3.3.2 Game Design ........................................................................................ 34
      3.3.3 Gamification ........................................................................................ 47
   3.4 Liveability ....................................................................................................... 49
      3.4.1 Two Dimensions .................................................................................. 50
      3.4.2 Enjoyment ............................................................................................. 52
      3.4.3 Evaluating Liveability ......................................................................... 54
      3.4.4 Liveability and Mobility ..................................................................... 59
   3.5 Conclusion ....................................................................................................... 66
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4.1 Related Work</td>
<td>116</td>
</tr>
<tr>
<td>6.4.2 Detailed Concept Description</td>
<td>118</td>
</tr>
<tr>
<td>6.4.3 Specifications and Core Functions</td>
<td>119</td>
</tr>
<tr>
<td>6.4.4 Outcome</td>
<td>120</td>
</tr>
<tr>
<td>6.4.5 Evaluation</td>
<td>121</td>
</tr>
<tr>
<td>6.4.6 Discussion</td>
<td>125</td>
</tr>
<tr>
<td>6.5 Conclusion</td>
<td>126</td>
</tr>
<tr>
<td>7 Discussion</td>
<td>128</td>
</tr>
<tr>
<td>7.1 Project Outcomes</td>
<td>129</td>
</tr>
<tr>
<td>7.1.1 Challenges in Mobility</td>
<td>129</td>
</tr>
<tr>
<td>7.1.2 Enjoyment</td>
<td>132</td>
</tr>
<tr>
<td>7.1.3 Concepts</td>
<td>135</td>
</tr>
<tr>
<td>7.2 Contributions</td>
<td>136</td>
</tr>
<tr>
<td>7.2.1 Contributions to Urban Design</td>
<td>136</td>
</tr>
<tr>
<td>7.2.2 Contributions to Mobility</td>
<td>137</td>
</tr>
<tr>
<td>7.2.3 Contributions to Gamification and Game Design</td>
<td>139</td>
</tr>
<tr>
<td>7.2.4 Contributions to Liveability</td>
<td>140</td>
</tr>
<tr>
<td>7.3 Suitability of Gamification</td>
<td>141</td>
</tr>
<tr>
<td>7.3.1 Ethical Issues</td>
<td>143</td>
</tr>
<tr>
<td>7.3.2 Considerations on Digital Data</td>
<td>145</td>
</tr>
<tr>
<td>7.3.3 Gamified Applications</td>
<td>146</td>
</tr>
<tr>
<td>7.4 Research Challenges</td>
<td>147</td>
</tr>
<tr>
<td>7.5 Future Research</td>
<td>147</td>
</tr>
<tr>
<td>8 Conclusion</td>
<td>149</td>
</tr>
<tr>
<td>9 Appendix</td>
<td>153</td>
</tr>
<tr>
<td>9.1 Bibliography</td>
<td>153</td>
</tr>
<tr>
<td>9.1.1 Literature</td>
<td>153</td>
</tr>
</tbody>
</table>
9.1.2 Applications ............................................................... 161

9.2 Figures and Tables .......................................................... 163

9.2.1 Figures ................................................................. 163

9.2.2 Tables ................................................................. 166

9.3 Publications and Attachments .......................................... 167
**Glossary**

Application – mostly digital applications, typically for smartphones

Gameful – containing elements of game

Gameful Urban Mobility – design space resulting from the overlap of the disciplines Game Design, Urban Environments and Mobility

Gamification – applying game design elements and mechanics to create gameful experiences

Identity – belonging or being related to a group, a place, a city etc.

Interaction – in this dissertation generally social interaction and interaction between humans and the city space

Liveability – functional and social aspects that make a city worth living in

Mobility – physical movement executed with the purpose of changing a person’s location

Mobility devices – vehicles for various modes of transport

Points of application – mobility challenges to address or goals to achieve, delivering the need or problem for designing gameful applications

Urban – a way of life in built environments with a certain minimum density (usually cities)
Preface

This dissertation is about exploring the potential of gamification in the context of urban mobility from different perspectives towards the goal of enhanced urban liveability and enjoyment. My interest is a very personal one, because I am a mobile person. In 2013, for example, I have covered approximately:

- 50,000 km by plane
- 15,000 km by car
- 15,000 km by train
- 1,500 km by bike and
- 150 km on local public transport

I have travelled extensively, lived in different countries on different continents and enjoy driving. Mobility enables me to discover new places and cultures, to stay in touch with family and friends and to take new job opportunities. It is a way of life that significantly enhances my individual quality of life. This is not merely due to the simple value of being transported from one point to another, but also to the supplementary pleasurable elements of mobility – the pure fun of driving at high speeds, the feeling of freedom when traversing an alpine pass, the intense smells and temperature changes I experience when cruising through forests in my convertible or the powerful physical experience of a tour on my road bike.

But mobility also has its downsides – it can harm people (e.g. traffic accidents) or cause health problems (e.g. through emissions) – and urbanisation is advancing at a rapid pace with more and more people living in increasingly large cities. Mobility thus poses major challenges, particularly in ever-growing urban areas, and also affects urban liveability both from an individual and citywide perspective (see section 3.4.4).

So how can we improve this situation? What new approaches can be developed?
As a designer, my primary research aim is to enhance the state of urban mobility. My vision is a sustainable, enjoyable urban mobility that not only serves its purpose for urban inhabitants in the best possible way, but also enhances their quality of life without harming them or the environment. I have always been convinced of the value generated by bringing together different disciplines. In that spirit, my perspective on the future of urban mobility is a broad one: I believe that understanding the mobile city and its liveability as a system will provide a solid basis for conceptualising and implementing different applications.

As a trained architect and urban planner, my goal is to bring together the top-down and bottom-up perspectives. Designing a house or an urban quarter must involve not only the human (bottom-up) perspective vis-à-vis questions of quality of life and individual experience in space, it must also take a broader, sometimes even global (top-down) perspective into account. This can range from considering the urban structure in which a building is placed to engaging with current discussions in the field of Sociology or within technical disciplines relevant to the construction and operation of the building.

My research interest has developed against this backdrop and I believe a practice-driven Ph.D. is best suited for my proposition because it allows me to both describe an approach that supports designers in conceptualising solutions to urban mobility challenges and to enhance this intention through conceptualisation and evaluation of practical projects.

This dissertation initially targets two groups of researchers and professionals: the first group are urban planners, urban designers and to some extent traffic planners, who create and design urban spaces and infrastructures. I suggest that outcomes like a design approach will support them in dealing with challenges and in achieving goals or visions they have developed beyond their traditional knowledge. Exploring connections between mobility and liveability might also help sharpen their goals. 

*They know what to achieve but may be looking for new ways to put this into practice.*
The second group are people with technical knowledge in developing digital applications, since my focus is on digital solutions to practical projects as opposed to physical urban alterations, for example. I suggest that systematic approaches for how to identify and deal with challenges in urban mobility enrich the context of developers when conceptualising applications.

They have the technical know-how but may be looking for a broader perspective on meaningful goals to achieve.

There is a third group, however: The citizens in a given city. I believe that only a profound knowledge of what is happening in their environment and what possibilities are out there to improve a situation can involve citizens in an active role, allowing them to become shapers of their own city rather than mere consumers. This is why I chose participatory formats like workshops and presented my research ideas and outcomes in public speeches and radio interviews to reach an audience beyond the academic world.
1 INTRODUCTION

Congestion again – just like every other morning at this traffic light. Exhaust fumes from the car in front of me spill into the cold air, obscuring my view. The only interpersonal communication is the sound of a solitary horn somewhere behind me; the first car hasn’t moved fast enough on green. I consider calling into work to let them know I’ll be late. Finally, things start to move, and I make it through the intersection. Now I just have to find a parking space. That ends up taking 20 minutes, and I resolve to give the tram another try tomorrow. For a change, it comes on time. I look around and gaze into empty faces. The monotony of the street, it seems, has followed me here...

How can we enjoy urban mobility – once more?

In recent years numerous examples of applications, incorporating game design elements in the context of mobility, have come into being. Creating gameful experiences, which will be discussed in a later chapter under the term ‘gamification’, seems to have great potential to address challenges occurring in urban mobility.

Chromaroma, for instance, turns London’s public transport into a digital game by using players’ travel data, which is retrieved from the Oystercard ticketing system. It contains typical game design elements such as competition, achievements or records as well as forms of interaction. By offering additional achievements for travelling off-peak, Chromaroma could potentially decrease congestion in peak hours (Mudlark 2011). Kars Alfrink (2014;540), a designer of games for social change, characterised this example as the ‘physical form of a city’ (in terms of the public transport system) being the ‘subject of play’, a notion I will explore later. Looking at other mobility devices (in terms of vehicles for various modes of transport), cars in particular cause many problems in cities like congestion or pollution. Applications such as car2go’s EcoScore or Honda Anti-Congestion Tech intend to address these problems by influencing motorists’ individual driving style. EcoScore integrates an eco-training application into cars, which are used in the urban car-sharing concept
car2go. The core idea is to illustrate and give feedback to the individual driving style (Montag 2012).

Many more examples have been studied, see section 4.2. They have increased my interest in the question of how game design elements, or gamification, are already used in the context of urban mobility and what design approach would allow their systematic application in this context – towards the greater goal of enhancing urban liveability, where I believe mobility plays a significant role.

To make the best possible use of existing research, I start by structuring and describing relevant knowledge in the fragmented areas that found my research. I then explore various forms of urban mobility and interconnections with liveability on a theoretical level as well as through three projects, which I conduct to different stages, gradually narrowing the scope down to detailed prototypes. For this reason I chose an exploration as appropriate methodology, further broken down into design practice, design studies, and design exploration. To capture the variety of options and notions, I preceded with bottom-up methods, such as workshops, incorporating local the knowledge of city dwellers and experts alike.

The following chapter delivers an outline of my research proposition and a full description of methods applied.
2 Research Approach

This research is about structuring and exploring the potential of gamification in the context of urban mobility towards drawing a comprehensive picture – though future developments will probably contribute to its expansion.

In the following sections I organise my research and describe, how I undertake it: The research gap leads to my hypothesis and corresponding research questions. The methodology describes how I proceed with this endeavour along with the areas of relevance, deriving conceptual frameworks and methods used in these different disciplines towards a design approach for Gameful Urban Mobility, to be advanced in alternation by developing concepts and applications.

The simplest description to frame my research is:

What? – Mobility.

Where? – In urban environments.

Why? – For enjoyable experiences in the context of liveability.


With what result? – A design approach, concepts, applications.

2.1 Research Gap: Gameful Urban Mobility

My research explores the potential of applying game design to different forms of urban mobility as a means of establishing what I call Gameful Urban Mobility, understood as the overlap of the disciplines Game Design, Urban Environments and Mobility; see Figure 1 and refer to chapter 4 for further elaborations.

Many existing applications can be included under the rubric Gameful Urban Mobility; see section 4.2 for an evaluation. However, there is no comprehensive research mapping this field and elaborating its relevance to other areas such as urban liveability. Similarly, there is very little academic research and literature available on Gameful Urban Mobility as an inclusive approach. Some researchers active in the overlap of game
and urban design, like Kars Alfrink (2014), already include mobility in their considerations of cities, though only some modes of transport. I give further consideration to the established knowledge in related disciplines in chapter 3.

Figure 1: Gameful Urban Mobility is where urban mobility and game design overlap.

Since this research area is currently evolving and, as I discuss later with relation to gamification in general, cannot yet be framed or comprehensively described, I have undertaken an exploration of this field along with the main related topics of mobility, urban design, game design and liveability. The wide scope of this exploration will be narrowed down during the course of this dissertation as the representation of these topics increases.

The research gap is therefore at first in a comprehensive consideration mapping this field and resulting in a design approach (‘from points of application to gameful solutions’), see chapter 4, as well as concepts and applications. Secondly, there is also a gap in connecting the relevance of mobility to enjoyment and urban liveability, which is preliminarily addressed in section 3.4.
Alongside the broader exploration of this field are specific questions relating for instance, to a specific mobility device in a defined city, which I indicate in the subsequent section. They serve as guidelines in the respective sections throughout my research.

2.2 Hypothesis and Research Questions

Remembering the examples of Gameful Urban Mobility given in the introduction, my core question is derived from an assumed potential of applying gamification to urban mobility towards enjoyability and liveability:

— How can gamification be applied to the context of urban mobility and what is a design approach to this, considering different modes (cities, types of transportation...), against the backdrop of enjoyability and liveability?

More detailed research questions have been developed in order to better understand the broader research topic:

— What are the fundamental aspects when combining urban mobility, gamification and liveability?
  ▪ How is enjoyment in mobility perceived in different cultures and cities?
  ▪ What is the interconnection between mobility and liveability?
— What design approach can be employed to make urban mobility more enjoyable in different modes of transport?
  ▪ What are specific mobility challenges and goals in different cities?
  ▪ Which game design elements and gameful experiences are suitable for application?

These questions are addressed throughout the dissertation, starting in chapter 3, and will feed into the design approach in chapter 4 as well as into the projects, described in chapters 5 and 6 and conducted according to these additional questions:

— As one of Germany’s foremost cities for cycling:
- How can the attractiveness of bicycle mobility in Karlsruhe be enhanced through gamification?
- What are forms of social identity in mobility and how can they be adapted to the group of cyclists?
- As a city with high traffic jam occurrences:
  - How can challenges resulting from automotive mobility in Beijing be addressed by gamification?
  - How can a smartphone be used to determine mobility patterns?
- As one of the world’s most liveable cities:
  - How is Melbourne’s liveability represented in mobility options and patterns?
  - How can the digital layer in cities contribute to a better mobile experience?

In the following sections I explicate the main sources referred to throughout this research as well as suitable methods I have identified.

### 2.3 Definitions and Main Sources

Applying elements of game design and game mechanisms to non-game contexts is called *gamification* (Deterding, Dixon, Khaled, & Nacke 2011). Since I embarked upon my research, this common definition has been revised and refined over the past few years and I reflect upon and discuss these developments against the background of my own projects later in the dissertation.

Gamification holds great potential for addressing challenges in urban mobility, such as congestion and pollution. This is primarily because gamification seeks to “make other non-game products and services more enjoyable and engaging” (ibid). My research explores the potential of applying game design to different forms of urban mobility as a means of establishing what I call Gameful Urban Mobility. I presume that mobility has an influence on the quality of life in a given city (see section 3.4.4) and thus that improving the state of mobility in that city through gameful applications will increase urban liveability. Accordingly, the core objective of this research is to explore the potential of gamification when applied to
urban mobility using people-centred, participative design methods and to suggest a design approach for increasing urban liveability through mobility. My research focuses on different kinds of mobility within urban environments, e.g. bikes and cars, but not on forms of long-distance mobility, e.g. aeroplanes or trains.

Extensive source material exists for the three key terms relevant to this research – urban environments, mobility and game design – much of which is included in the literature review in chapter 3. I have explored the literature from initially selected references (mentioned below), based on my personal knowledge and experience, current academic discussions and conversations with experts. My focus in this research, when applying gamification in the context of mobility, is on digital technologies with corresponding human-computer interaction methods; however, since social effects are integral to my research topic, my work builds on scholars who discuss these topics from a human-centred perspective. For each key term I have identified a few particularly important sources, taking the work of other scholars into account. These key sources are as follows:

— For urban environments, Jan Gehl (2010), who has extensive academic and practical experience looking at cities from both the human and mobility perspective
— For mobility, John Urry (2007), a sociologist who combines the social and physical perspectives on mobility, critically reflecting on the possibilities of technology
— For game design and gamification, Roger Caillois (2001) and Aaron Dignan (2011), whose research has further developed Johan Huizinga’s fundamental work on games published in the 1938 book Homo Ludens
— For the link between digital technologies and (automotive) mobility
  Oskar Juhlin (2010), who has undertaken extensive research on forms of human interaction and the potential of digitalisation in the context of motorised traffic

Upon identifying key sources, the next challenge was to develop appropriate methodology and procedure to structure and describe the fragmented areas, which my research is built on.
2.4 Methodologies and Methods

Since the framework for Gameful Urban Mobility is still indistinct, my research approach is undertaking an exploration rather than empirical studies, starting with a wide scope and narrowing it down to detailed prototypes.

I have therefore chosen exploratory research as appropriate methodology and use interaction design methods such as those of Daniel Fallman (2008), who describes a model he has frequently applied and refined during his design and research work. It consists of three extremes: design practice, design studies, and design exploration in the form of a triangle, see Figure 2.

![Figure 2: The model of interaction design research (Fallman 2008)](image)

Whereas design exploration “provides an interface towards society at large” (ibid), the other two dimensions are considered interfaces with industry and academia. This model is ideally situated to the different angles of my research endeavour, since my primary basis is in design exploration and studies but I am practice-led in my aim to influence design practice through my concepts and applications.

This model also reflects my strong intention to contribute to the better of urban mobility and liveability, involving locals for instance with participatory formats (see later in this section) in order to identify points
of application – understood as challenges to address or goals to achieve in the context of urban mobility and in their specific city. Identifying such points of application is similar to what Fallman (2008) considers as “problem-setting” and a core quality of design exploration. The other core quality is making use of the design and artefacts towards enhancing the design process itself, similar to the research-through-design method I apply for that purpose and describe later in this section.

In order to situate my research endeavour within broader methodologies, I refer to Ken Beatty (2010). As a rough structure, he suggests eight possible research paradigms based on consideration of the following three questions: Is it experimental or non-experimental? Is it qualitative or quantitative? Statistical or interpretive? Since the exploration I am undertaking has both theoretical and practical components, my research is experimental because it involves the conceptualisation, implementation and evaluation of applications. I use mainly qualitative methods and produce mostly interpretive results.

Based on their comprehensive overview of research methods typically applied in human-computer interaction, Lazar, Feng, and Hochheiser (2010;283) propose situating research outcomes in the context of existing experience and knowledge. Smith and Dean (2009) suggest this is also a solid basis for practice-led research. To develop such a foundation, I begin with a literature review discussing relevant topics (see chapter 3). Since this area of research is still being shaped, I take many different disciplines into consideration, including Urban Planning and Sociology as well as Mobility, Digital Technologies, Interaction and Game Design, and later discuss my research in relation to those fields; refer to Figure 5 in the following chapter.

Complementing the literature review, I structure and qualitatively evaluate examples of Gameful Urban Mobility applications as part of a case study in section 4.2; see for instance Lazar et al. (2010;147). Additionally, an examination of liveability indices helps identify mobility-related criteria for urban liveability from different perspectives, refer to section 3.4. This is also conducted in the form of a case study including commonly relevant indices such as the Economist Intelligence Unit’s Most
Liveable Cities or Mercer’s Quality of Living. An evaluation of the criteria and methods used in the indices may provide an additional guideline for how best to consider liveability in relation to mobility and reveal gaps in criteria for a comprehensive consideration of mobility options.

In order to apply the findings towards design practice, I develop a design approach (see section 4.1) and execute a series of practical projects in different cities to examine the variety of options and notions. I incorporate bottom-up methods, such as workshops, for leveraging local knowledge of city dwellers and experts alike. The projects are conducted with industry and/or city partners and include some or all of the following elements: field research (i.e. observations and surveys), participative formats and dialogical workshops, concepts/designs, implementation and evaluation. Qualitative methods as described by Creswell (2009;145ff) have been applied to develop and interpret the findings. I provide a detailed project plan and description of the projects in chapter 5.

These methods are situated within a broader research-through-design methodology, evolving with the 1960’s Design Methods Movement and commonly applied precisely in disciplines like human-computer interface design and architecture (Frankel & Racine 2010). Research-through-design further provides a “systematic procedure for arriving at a design solution” (ibid). Godin and Zahedi (2014) define its goal as gaining knowledge and understanding by adding the research layer to design, rather than designing objects. They draw this perception from a comprehensive review on research-through-design, including for instance Creswell (2009) and Frayling (1993).

In order to achieve that goal of gaining knowledge, Zimmerman, Stolterman, and Forlizzi (2010;312) describe research-through-design as a “process of iteratively designing artefacts as a creative way of investigating what a potential future might be”. So the desired outcome is not the artefact itself, i.e. an application in my research, but to enable me as a designer to improve my design process through the knowledge gained while creating applications; refer also to Martin and Hanington (2012;146f).
In other words: the realisation of applications based on my initial design approach for Gameful Urban Mobility informs the design process, similar to the core quality of design exploration described earlier by Fallman (2008), thereby helping me further enhance this design approach. To best accomplish this intention, I apply methods such as iterative creation, documentation of the design process and evaluation of the outcomes. Iterative creation (i.e. designing, testing, redesigning) is a method also commonly applied in human-computer interaction research; see for instance Lazar et al. (2010;251ff) elaborating on usability testing.

Since both this research and my background are interdisciplinary in nature, the practical part of this experimental research is best-supported using participatory design as the second major method. This method is similar to what Alfrink (2014;535) perceives as ‘soft’ or ‘second kind of urbanism’: “a less formal process, with more opportunities for direct engagement by people with a space”. Participatory design has gained widespread acceptance in exactly the fields in which my research is conducted – i.e. Urban Design, Interaction Design and Communication Design (see, e.g. Schuler and Namioka (1993), Sanoff (2008), Simonsen and Robertson (2012)). It involves interdisciplinary research and encourages both user and stakeholder engagement throughout different phases of the research and design process (Martin & Hanington 2012;128), which I do, for instance, by conducting workshops with local citizens and students. Input gained in such workshops is combined with the researcher’s own design and conceptualisation expertise towards creating a prototype (Martin & Hanington 2012;128).

Finally, I use my own publications, such as papers, talks or workshop discussions (see section 9.3) as a way to collect feedback both from a broad audience as well as from focus groups such as mobility experts and test the applicability of this research.
2.5 Conclusion

Figure 3 summarises the exploration of Gameful Urban Mobility towards answering my research question. The first step is to develop a preliminary design approach based on a literature review on the topics of my research. Game design inspires my research both on a conceptual design level (perceiving a city as a game space and mobility challenges as game conflicts; see the following chapter) and as applied on a practical level when developing projects.

Figure 3: My Ph.D. structure

This second step involves developing three applications, each of which is based on the potentials of digitalisation with the smartphone as an interface. Finally, one application is iteratively implemented as proof-of-concept and evaluated using experts’ knowledge in order to feed back into my original design approach.

The methods I have chosen can be structured as a combination of top-down and bottom-up approaches towards the intended outcomes (see Figure 4). To close the circle: Approaching an issue from different angles and scales is not only the core idea of the design exploration.
methodology, but also a typical approach in urbanism when designing city structures, public squares or facades.

I now start top-down with a literature review of the topics Game Design, Urban Environments and Mobility among others in the following chapter. A vocabulary is described along with a structure of urban mobility in section 3.2.1, and case studies of existing applications can be found later in section 4.2.
3 Topics and Literature Review

In this chapter I describe the context and frame the ‘big picture’ of my research from a top-down perspective, dismantling Gameful Urban Mobility. I will outline relevant topics and interconnections in the context of my research questions. The core terms that map the field of Gameful Urban Mobility are mobility, urban environments and game design in addition to liveability, which is the desired outcome; see Figure 5.

![Figure 5: Key terms (dark grey) and further fields of research (light grey).](image)

As a starting point I identify pertinent sources for each key term as described in section 2.3. I then explore the literature and discuss further aspects around these key terms, where they contribute to a better understanding of Gameful Urban Mobility. Beginning with broad concepts in order to identify relevant overlaps between disciplines, I progressively narrow down my focus with the goal of developing a design approach in the following chapter. Methods include a literature review on the topics and a qualitative evaluation regarding liveability and case studies on existing applications. The types of resources I consider include books, magazines, web-based sources, journal articles and studies.

Please note that parts of the following sections have been published in Stampfl and Walz (2013).
3.1 Urban Environments

Urban mobility is the context of my research. It is therefore necessary to explore what constitutes both urban environments and mobility, how they develop and interrelate in different types, and what further aspects in this context are relevant for my research.

The word *urbanism* has its origin in the Latin word *urbs* – the city. But urbanism means more than just an agglomeration of people in space. It appears in Geography, Sociology and, of course, Architecture, where it is defined as the link between the built city and the city’s social structures. Accordingly, the term implies qualities like openness, tolerance and changeableness (Eisinger 2004;93-95). It can thus be understood as a way of life in environments with a certain minimum density.

This density generates explicit potentials, which have constituted the attractiveness of cities for centuries. These include trading, development of ideas and other forms of social interaction (Gehl 2010;IX). But it is precisely this density that has also always created explicit challenges, such as sewage or waste in the past before the development of appropriate infrastructures for fending off hygiene problems (Mumford 1961), or air quality and mobility issues today. These challenges are as specific to urban environments as qualities mentioned above, appearing in much more concentrated form than they do in rural environments.

![Figure 6: More and more people are living in cities; retrieved from Feige (2012).](image-url)
Today, for the first time in human history, more than 50% of the world’s population lives in cities (see Figure 6). This share is likely to increase to more than 70% in 2050 with a forecasted urban population of around six billion people (Feige 2012).

Since more and more people are living in cities, dealing with challenges in urban environments has become increasingly important. A focus on urban mobility can thus be hugely beneficial, and I concentrate my research accordingly.

But how have urban environments developed over the years and what are design ideas?

### 3.1.1 Urban Design Principles

In this section I look at how urban design principles have evolved and with what effect on mobility.

Historically considered, the guiding principles of urban design have changed over time. The compact city of the Middle Ages, often surrounded by city walls, evolved mainly for defence reasons (Sitte 2007). Indeed, the desire for visible demonstrations of power has produced many different design patterns over the centuries.

![Figure 7: The city shape of Karlsruhe (left) and Beijing (right); adapted from http://maps.google.com.](image)

In Karlsruhe, for example, the city I currently inhabit, the streets were arranged radially, all leading towards the palace. In Beijing, on the other
hand, ring roads were built in circles around the palace (see Figure 7). These early structures are still relevant today. They give every city an individual pattern and still exist as shaping elements today, not least for mobility infrastructure.

Many European capital cities like Paris and Berlin feature broad avenues and boulevards ideally suited to the splendid parades of the sovereigns. American cities, by contrast, were often organised pragmatically with grids of streets like those in New York (Koolhaas 1997).

The onset of industrialisation and subsequent separation of work and living space gave rise to the idea of suburban areas. At the beginning of the 20th century, for example, LeCorbusier (1927) designed huge, vertical "machines for living in" at the edges of cities. In the United States, the so-called American Dream – consisting, in part, of low-density family housing units – spawned vast, horizontal housing agglomerations like those in Los Angeles. These developments were made possible by the simultaneous increase of individual motorised mobility, which allowed people to overcome the distances produced by the spatial separation of daily functions.

One could even argue that these developments were triggered by the evolving automotive industry, as Russo and Fleming (2013) propose with the example of the Futurama exhibition during the 1939-40 New York World’s Trade Fair: “Futurama was a large-scale interactive exhibition sponsored by General Motors and housed in that company’s pavilion at the World’s Trade Fair. It imagined a future with the car at its centre and, in doing so, inspired America, and in turn Australia, to implement an untested urban growth model based on the car.” The end result was an “auto-sprawl syndrome” (Urry 2007;126), with automotive mobility as the driving force behind the design of cities for decades thereafter, entwining culture and urban development (Russo & Fleming 2013). I further elaborate on this notion in section 3.2.3, (“Identity in Mobility”).

Today, social elements have come to the fore in sustainable urban planning. Gehl (2010), for example, titled his book Cities for People, immediately establishing humans as the guiding principle for designing a
city and its functions. Along the same lines, the recent practice of measuring urban liveability suggests a clear interest in and emphasis on the human well-being, which I explore in greater detail in section 3.4. The human perspective is particularly relevant to my research since I seek to increase urban liveability through enjoyable mobility.

New and different ways to assess and structure cities are currently evolving and help improve the way we understand and work in urban space. It is common knowledge among urban designers that there is no one-size-fits-all city typology; instead, cities are appraised and grouped according to the evaluation purpose and corresponding criteria. Measuring a city’s liveability is just one way to evaluate it. But even this clear form of evaluation can be based on different criteria, as I discuss in section 3.4.3.

Prior to that assessment, it is beneficial to understand the relationship between mobility and the structure of a city, depending, for example, on the type of transportation and including aspects like enjoyment when moving through city space.

### 3.1.2 Structures, Spaces and Mobility

The close relationship between mobility and the character of a city can be perceived not only by a city’s overall shape or layout, but also by its infrastructures or modes of transport, it has been designed for. Compact, typically medieval, cities are ideal for pedestrian mobility, whereas the cities which evolved in the last century with the “rising tide of car traffic” favour motorised access (Gehl 2010;9).

Pedestrian mobility is highly relevant to both social interaction and liveability, as I discuss in section 3.4. Urry (2007;68-70) describes a “new urban type” of pedestrian, related to the discussion of enjoyment in mobility: the strolling flaneur. A product of 19th century Paris and Vienna and an archetype of the urban explorer, Walter Benjamin (2006) drew this picture of a poetic figure based on his analysis of Baudelaire’s poems. The flaneur is fascinated by the beauty and dynamism of the city, taking joy in the simple act of walking through it (see also Juhlin 2010;113).
Automotive mobility, on the other hand, has made various contributions to the progress of society. Urry (2007;110) considers the car system “more a way of life than a mobility system” and sees auto mobility as a “source of freedom”. Indeed, the car has enabled new forms of social life that are not dependent on rail tracks or timetables. However, as discussed, the downsides of automotive mobility in present-day urban environments are manifold.

Today, different cities around the globe produce different mobility patterns, depending in part on their urban structures. The interdependence between city space, mobility infrastructures and options is high. Feige (2012) suggests classifying cities according to six mobility categories. She distinguishes between car-centred and public-transport-centred (“transit”) mobility options, including hybrid forms. In Figure 8, she positions the mobility categories in relation to density and gross domestic product (GDP).

![Diagram categorising cities by mobility focus](image)

**Figure 8:** Categorising cities according to their mobility focus; retrieved from Feige (2012).

The figure shows, for example, that automotive mobility could be the primary mode of transport even in high-density urban environments (e.g. Beijing); however, as a city’s wealth increases, some sort of mass transit
system is likely to be implemented to ease traffic saturation. Although Feige does not take pedestrian and bicycle mobility into account, her approach helps me identify cities with different mobility options that are well-suited to my future projects (see chapter 5).

Just like mobility infrastructures, mobility devices exist in spatial relation to a city, depending significantly on their velocity. If a car is at a standstill the space it occupies is little more than its own size, around 8 square metres; whereas in motion, that space expands in relation to the car’s velocity and can easily reach a size many times larger than the car itself. For a car travelling at a speed of 50km/h that area increases to around 140 square metres (Knoflacher 1996;40). The higher the speeds, the larger the scale of the infrastructure required (see Figure 9).

These infrastructures underpinning a city originate, “what we call urban morphology - in other words, the form of the city, the kinds of buildings ... we have” (Fleming 2013). “If the urban mobility platform is walking you will get a very fine, dense, low-rise, high site coverage kind of city.... If the mobility platform is driving, you will get something like Los Angeles ...” (ibid), as visible in the Figure above. In addition to these two distinct, mobility-related urban morphologies, Fleming (2013) suggests a third one resulting from a combination of walking, transit and cycling infrastructures.

Since the city is a restricted environment, the velocity of mobility devices plays a decisive role in determining the space needed for any given mode
of transport; an aspect raised again later in the context of liveability. But mobility devices do not just occupy city space as means of transport; sometimes, they take possession of public space without any actual mobility purpose. Borden (2001) explores one example of this phenomenon, namely, the way skateboarding culture can take over city space and make enjoyable use of a city’s typology. The experience of moving through a city in this context is not so much an experience of mobility but of urban space; since there is no need for any particular infrastructure, skateboarders can take possession of existing urban elements, such as stairs and handrails. In essence, they treat the city as though it was a ‘gamespace’, which is exactly the way first Borden, then Walz (2010;291) suggested we treat it, lending credence to the notion of applying game design elements to mobility in an urban context.

Site-specific games are another way to experience a city. As described by Alfrink (2014) and Invisible Playground (2015), these games trigger engagement with urban space but most of them take a physical form in the way they are played. Digitalisation and the rise of digital devices, such as smartphones, offer potential for many more forms of interaction with city space, as examples of existing Gameful Urban Mobility applications demonstrate (see section 4.2 for an evaluation). In the following, I explore how digitalisation can change our cities and the way we interact with them.

3.1.3 The Digital City

The digitalisation of daily life has enabled new networks of communication with manifold impacts on mobility. Many recent developments, such as the smartphone and the mobile Internet, have lead to new forms of interaction in urban space, both by transforming the way we interrelate with the city – now no longer just a physical space, but also a digital one – and by enriching our experience of urban space, see for instance Urry (2007;5), Alfrink (2014;535) and Juhlin (2010). Schipfer (2013) describes this enriched experience as “integrated urban reality” and points to the example of augmented glasses, which project local information or communication options directly into a person’s field of vision. Location-
based services like Foursquare (www.foursquare.com) may also change mobility patterns by offering benefits for certain behaviours, either in the form of status within a social network or advantages at local outlets.

Another important work on this topic is McCullough’s (2004) *Digital Grounds*, which examines digital solutions within an urban environment from an architect’s perspective. This work is particularly relevant to my research because it frees the solution space of Gameful Urban Mobility from the physical city as stated in the previous section. Juhlin (2010;13-17) expands this idea: He introduces several fundamental reflections on social life in traffic and urban forms of interaction by looking at them from both analogue and digital perspectives. Similarly, McCall, Kracheel, and Koenig (2012;2f) bring together ‘the real and digital life’ with their mobile application ‘I-Gear’. They apply the idea of a ‘gamespace’ introduced in the previous section to automotive mobility by considering “moving in traffic” as a game. To achieve their goal of reducing traffic congestion by changing traffic-related behaviours, they incorporate incentives and encourage community building with interaction features.

Increasing digitalisation leads to a wide range of data occurring in a variety of sources. Sensors recording this data can be found for instance in the city infrastructure (e.g. road side or traffic light sensors), in vehicles (e.g. cars or buses), and personal devices that we carry with us (e.g. smartphones or fitness trackers). This data is, at least partially, available to the public, for instance via http://www.city-data.com or at http://www.citydatafuture.eu, and is now being employed by many researchers: Carlo Ratti, for instance, director of MIT’s *Senseable City Laboratory*, is mapping and visualising this data in order to understand city patterns and to design experiences based on a range of sensors using different interfaces, such as augmented glasses and smartphones (MIT 2015). The independent research group *The Mobile City* investigates the relationship between digital media technologies and urban life and the implications for urban design. Their work includes playful interventions and projects like *The Hackable City*, which "investigates how citizens, design professionals and institutions can take into account the role of digital technologies in society and redefine their roles in a democratic ‘city
making’ process” (Waal & Lange 2015). This approach is similar to Alfrink’s (2014;535) concept of ‘soft urbanism’ described earlier and points in the direction of participatory formats that I apply later in this research by including local citizens in the research and design process.

The notion of complementing digital technologies with design expertise in order to add a ‘quality’ to technology is also shared by Hovestadt (2013), an academic investigating in the overlap of information technology and architectural design at the ETH Zurich. I will accordingly discuss ethical issues in the context of gamified applications in section 7.3.1.

Advancing the idea of digitalisation, Hovestadt and Buehlmann (2009) propose to apply the rationality of digital networks, which allow communicating or exchanging data without delay over distance, to a “digital energy future”: an energy grid like a digital information grid would result in abundant energy available everywhere, and mobility devices could, in an utopian view, exchange energy just like information is exchanged today for example by smartphones.

The digital layer in a city therefore enables manifold links between digitised mobility objects or their users, with the smartphone to be highlighted as a device that can be interface and sensor at the same time as well as location-independent and location-specific at the same time.

Applications for smartphones are similarly not limited to one specific location in the way that local, physical applications tend to be (a characteristic not well-suited to the requirements of mobility); they can be made easily accessible to the large number smartphones users and implemented much faster than physical infrastructure.

I utilise these opportunities when developing the practical projects, explained in chapter 5, and further describe the potential of digitalisation in section 3.2.2 with relation to mobility. I focus on the potential of using mobility devices to interact with the city (including other humans, mobility infrastructure elements etc.) in order to overcome limits in interaction due to a location or time mismatch (for example if two persons are at the same place at different times). The collection of data and digitalisation per se may have downsides such as data security and misuse, though, which I reflect upon in section 7.3.2.
3.2 Mobility

In the following section, I explicate mobility, defining the context of investigation for applying gamification, by providing a definition and outlining its scope. I also consider sociological facets of mobility, i.e. how we interact while being mobile.

The term mobility is used in diverse contexts. According to Knoflacher (1996;23) and Urry (2007;8), these contexts can be summarised as follows:

— Physical-geographical mobility: a positional change in space
— Mental-anthropological mobility: i.e. migration of societies due to cultural desideratum
— Social mobility: social changes of individuals or groups

Independent of the context, the term “mobility” always suggests a specific relationship to time and a change in status quo, be it a change in location, shape or condition. Taking a closer look at physical mobility, we see that certain forms of movement are not driven by the aim of changing location, but rather characterise motion as an end in itself. Take skateboarding (see above) or rollercoaster rides, both of which suggest a strong link to games and play. Their emphasis on acceleration and velocity, for example, strongly connects them to game design elements like “vertigo,” as defined by Caillois (2001;36); see Figure 11 on page 33. Vertigo results when a body in motion reacts to physical movement. It stands in contrast to the reduction of physical movement of the human body caused by the increased motorisation of motion. Since machines like cars and trains now often do the moving for us, hardly any physical activity is required for us to be in motion.

My research, however, focuses on mobility as physical movement executed with the purpose of changing a person’s location. In this form, mobility is “fundamental to our economy and society” (European Commission 2011;4) and, as such, highly connected to social relations (Urry 2007;7-10). Indeed, it has enabled the development of today’s society, characterised by economic growth and prosperity as well as
access to jobs, goods and services (Mitchell, Borroni-Bird, & Burns 2010;2).

Mobility is thus a significant part of our daily life and also strongly connected to our quality of life (European Commission 2011;4). We are mobile on average approximately one hour per day, using different transportation devices (Urry 2007;4). Almost two thirds of this daily “mobile hour” is spent in a car, with about 11 minutes on foot. An average trip made by bicycle or car takes around 20 minutes (Juhlin 2010;3). In the development of my design approach, I first structure these different mobility options and then discuss two core aspects of mobility, that I have identified to be relevant in my research context, in the following sections: interaction and identity. Interaction is a fundamental characteristic appearing in games, mobility and urban liveability. A strong identity contributes to the ‘relatedness dimension’ in urban liveability (see section 3.4.1) and is also dependent on the mode of mobility.

3.2.1 Mobility System
In this section, I propose to introduce a design vocabulary specific to the field of urban mobility, which, in turn, allows categorising for a systematic discussion, since my research question involves the consideration of different types of mobility. This vocabulary is derived from components occurring in case studies (see section 4.2), from the literature review in this chapter as well as from observations, and includes ‘infrastructure elements’, ‘mobility devices’, ‘mobility systems’ and ‘incidents’. In order to structure urban mobility using this vocabulary, I’ve created Figure 10, which is part of my design approach (see section 4.1).

Other than walking, most forms of mobility involve a vehicle, such as a bike, car or train. I call these vehicles ‘devices’. ‘Infrastructure elements’ are parts of mobility systems that are not a device – e.g. intersections, traffic lights and steps. A ‘mobility system’ can be related to a device, such as a train network, or include manifold urban mobility options such as a pedestrian-friendly city structure, which I regard as a quasi-mobility system, as introduced in section 3.1.2.
Finally, ‘incidents’, like weather or occurrences, describe – mostly temporary – circumstances in which mobility takes place. This is an overlying aspect as I assume that incidents usually happen in conjunction with or affect the capability of a mobility device, infrastructure element or a mobility system. In my design approach, incidents are defined as ‘points of application’, i.e. where gamification is applied. Such points of application may constitute or cause some kind of inconvenience for mobile people, depending on the mode of transport being used. Rain, for example, is less of a concern for automobile users than for bicycle users. I define such challenges as hindrances to mobility, which are generally perceived as negative. If these are addressed or overcome, both enjoyment in mobility and urban liveability are likely to increase accordingly. I discuss the concept of challenges in greater depth in section 4.1.1. Apart from challenges, here defined as causing inconvenience, points of application can also be positive mobility aspects that should be enhanced, respectively goals that should be achieved, again in order to increase enjoyment and liveability.

![Figure 10: Categorising urban mobility](image)

I suggest that these sorts of points of application are interconnected with the relatedness dimension of the two-dimensional city model (see section 3.4.1) and could for instance be increasing interaction among mobile people or between them and the city, and identity through mobility types or devices; two aspects, I will now discuss below.
3.2.2 Interaction in Mobility

The term interaction has been defined in diverse ways across many different disciplines and is an important component of my own research both being a core game design element (refer to section 3.3.2) and a characteristic of urban liveability (see section 3.4). In this practice-driven dissertation, I follow the lead of Juhlin (2010;13), who describes two forms of interaction in the context of mobility: social interaction (between humans) and interaction between humans and mobile devices and networks. In addition to that, I propose to differentiate between physical and digital forms of interaction since digital technologies enable interaction independent of the physical environment as described in the previous section.

In mobility, the quality of physical interaction depends significantly on the mobility device in question. Public transportation, for example, brings together strangers in a restricted amount of space. Based on my discussion of city space in section 3.1.2, this scenario seems potentially ideal for interaction. But in reality, the opposite is often true, with people interacting very little on public transportation (Toprak, Platt, & Mueller 2012).

In motorised individual transport, by contrast, separation produced by "the speed of the vehicles and the enclosed position of the driver" makes interaction between drivers very short-lived, reduced to simple gestures and lacking the possibility of verbal interaction (Juhlin 2010;5). Social interaction can, however, still take place in the form of behavioural communication e.g. the way one positions one's car on the road or the speed one chooses to drive (Juhlin 2010;8). Also, from a communication technologies perspective, the separation of people in cars from their direct environment enables much more focused and less distracted forms of social interaction, e.g. via a mobile phone conversation with someone who is physically located elsewhere. Or the solitary driver may enjoy the remoteness and prefer not to seek out any form of interaction at all.

Juhlin (2010;127-128) has conducted extensive research on interaction in the mobility context, for example on forms of social interaction among motorcyclists. The two primary factors that account for the high level of
interaction in that group are shared identity and membership in a community (see the following section for a discussion about identity). Due to traffic conditions and the speed of motorcycle mobility, the time available for physical interaction is rather short, and interactions tend to be brief and random. Thus the most common form of interaction among motorcyclists is, unsurprisingly, a simple greeting when one biker encounters another on the road.

Today, in particular digitalisation as described in section 3.1.3 presents great potential for interaction, both social and between humans and the city. The ever-increasing availability of communication technologies has taken urban interaction to a whole new level. The result is two-fold. On the one hand, digital forms of communication free urban inhabitants from any specific spatial environment (though physical infrastructures are often somehow involved). On the other hand, mobile communication devices like smartphones allow people to connect to their physical environments anywhere, e.g. by using location-based services like Foursquare. I therefore consider the smartphone as a wildcard for all sorts of interactive applications in urban environments with the already mentioned advantages.

Due to their technical capacity to be used as a sensing device and the short innovation cycles compared to mobility infrastructures and devices, smartphones increasingly complement or even replace in-car infotainment and sensor technology (see section 6.4 for some of its numerous sensors). A “Bring your own device” (e.g. a smartphone) culture is currently developing (Blumtritt 2015) with the main advantage that a smartphone is typically with the owner at all times, whereas vehicles are left behind at some point. Tracking functions and communications features or the exchange of information between different forms of mobility are no longer tied to the specific mobility device, a person is using, but can ‘follow’ the user.

The smartphone is a very personal device and can be used anywhere, even without communication networks; simultaneously location-independent and very location-specific for access to real-time services wherever we are. One can, for example, receive personalised offers from
local shopping outlets or use SmileDrive to see which of our friends are nearby (www.smiledrive.vw.com).

Digitalisation, however, is not only an enabler for interaction as discussed in this section, but also has the potential to increase a city’s identity, for instance, through correspondent networks and applications, which is an aspect I look at in the following.

3.2.3 Identity in Mobility
Mobility devices are essentially objects in an urban environment. As such, they contribute to or even shape the identity of an entire city as for example gondolas in Venice or ‘tuk tuks’ (auto rickshaws) in Bangkok. But mobility devices can also shape their drivers’ identities or those of a whole society: Over the past few decades, the car has probably been the most discussed mobility device and the one that has produced the most closely examined love-hate relationships (see, for example, Gehl (2010:3-5)).
The car can be a symbol of individual freedom for a whole nation – as it is, for example, in the United States – or object of heavy criticism, e.g. due to the space it takes up in urban environments (see section 3.1.2). Dennis and Urry (2009), for their part, don not criticise the car per se, but the way it has developed. In order for the car to be sustainable in the future, they argue, it must better adapt to the system in which it is embedded.

Why is it that individual motorised vehicles like cars or motorcycles are considered a stronger identity marker than, for example, public transportation? In general, we like to communicate identity through objects and visible identification markers (Maase 2008), whether badges or brands, clothing styles or our choice of mobility device. As an object, then, a car is a sign of identification in its own right, not only in combination with a brand; and since the car-as-object plays such an important role in recent history, we often refer to a “car culture” rather than a more general “mobility culture” (Urry 2007:115-117). The cultural relevance of the car was well illustrated during the 2011 celebration of 125 Years of the Automobile. Several art museums in south-western
Germany, where the car was invented, staged exhibitions on the role of the car in society and its relation to identity, bearing names like *Car Culture* (ZKM 2011) and *Car Fetish* (Tinguely 2011).

Only relatively recently has the bike followed suit and begun to re-develop its own identity beyond a specific mobility use. A whole lifestyle, for example, has evolved around a specific type of bike, the so-called ‘fixie’, a bike with one fixed gear (Fixed Gear Lifestyle 2013). The encouragement of bicycle mobility in cities like Copenhagen supports the emergence of such an identity (Fleming 2012; 58-61), which, in fact, has a long-lasting cultural heritage in some countries, as Russo and Fleming (2013) describe referring to the “L’eroica” bicycle event: “L’eroica has successfully latched onto the curiosity that already existed regarding the history of Italian cycling. ... The vintage bikes and fashions hark back to a stylish “dolce vita” captured so evocatively on film. It has created a contemporary cultural imaginary that champions both environmental heritage and a sustainable lifestyle.”

In my review of the literature and existing projects, I have not yet encountered a similar phenomenon of identification through public transport. The closest is perhaps Chromaroma, a location-based game-like service for use on London’s public transport system described in section 4.2. It not only shapes an identity for the players themselves, as they are part of one of four teams, but also reflects the characteristics of London’s public transport turning its subway system into a playground for the purpose of that application – thus enhancing how a player identifies with the city.

Why is identity such an important issue? In his essay *Acceleration and Alienation*, German sociologist Hartmut Rosa traces alienation back to the accelerating pace of daily life, itself the result of mechanical acceleration over the past centuries. Acceleration in the digital sector, he explains, shortens the time it takes to complete tasks. In theory, this should increase the available time for an individual, but in fact, Rosa argues, it produces a constant time shortage because of the “infinite palette of possibilities that life presents us” and the resulting urge to actualise as many opportunities as possible (Hammelehle 2013). At the same time,
increasing social competition (over status, privilege, friendship, etc.) adds to the accelerating pace of daily life; everyone has to do just a little more than everyone else to succeed (Rosa 2012:3).

As a solution to this dilemma, Rosa (2012:5) proposes increasing “resonance experiences” in order to reduce alienation. Though he has not yet produced a full definition for resonance experience, he considers the following elements to be highly relevant:

— Acknowledgement, i.e. the opposite of disregard, which leads to alienation (this idea can be seen as a form of feedback and is therefore closely related to gameful elements as I discuss in section 3.3.3)
— Being in a state of “flow”, wherein your skill set is appropriate to the given challenge (the notion of flow is also relevant in the game context, as described in section 3.4.2);
— Experiences which shape identity (the current discussion in gamification is to move away from game design elements towards ‘gameful’ experiences, see section 3.3.3)

Connecting this general concept of resonance experience to the discussion on identity, it can be assumed that gameful applications in mobility may have great potential for increasing above-mentioned identity markers, for example through interactive elements creating acknowledgements with a positive overall effect on a person’s well-being. When looking at the initial characterisation of identity in mobility at the beginning of this section, two forms can be recapped: Firstly, a type of mobility or mobility device can be typical for a city and hence create identity for the city itself and its inhabitants. Secondly, belonging to a group of people with the same type of mobility device can create identity. I suggest that both forms enhance relatedness – a notion that will be further discussed in section 3.4.1 in the context of liveability. I apply the idea of identity in two of the three projects, described in chapter 5.

Having already touched upon game design, it is now time to look at games and gamification and discuss relevant facets, such as player types as well as game design elements and mechanisms.
3.3 Games

Having reviewed mobility both in itself and in relation to urban environments, I will now turn my attention to games, which are the third fundamental component forming this research and, according to Fullerton (2008;XIX), “an integral part of all known human cultures”.

Early games, which may not even have been called games, could take the form, for example, of competitions with everyday objects (Fullerton 2008;1). Almost every one of us plays games. Even if a person is not actually willing to play a game, he or she might still be activated by game mechanics. All games do not necessarily share the same structure but they usually have common elements. A card game, for example, seems, on first sight, totally different to a puzzle. In fact, they share many similarities, that define them both as games (Fullerton 2008;26). In his well-known 1958 book Man, Play and Games, Roger Caillois (2001) classified different characteristics of games (see the following section). His understanding of various types of play and games within society was inspired by the work of Johan Huizinga, whose seminal Homo Ludens was published in 1938.

When beginning my research on games, one interesting aspect for me as a native German speaker was to become aware of the difference between game and play for the first time. This is because both words are translated with the same German word “Spiel”, not distinguishing between the different meanings. It seems fitting to start the discussion on games with an elaboration on that difference. The most relevant aspects herein are that games are a form of organised playing which usually “result in a quantifiable outcome” (Dignan 2011;35) and the idea of “artificial conflicts” (ibid) as one core element of games that I interpret in the context of urban mobility in chapter 4.

3.3.1 Games and Play

According to Caillois (2001;11-36), a game, or ludus, is a form of structured playing based on clear rules and goals, a marked contrast to paidia, or free-form play. Caillois developed a matrix combining these two
concepts with four play categories into which different sorts of games can be divided (see Figure 11).

<table>
<thead>
<tr>
<th>PAIDIA</th>
<th>AGÔN (Competition)</th>
<th>ALEA (Chance)</th>
<th>MIMICRY (Simulation)</th>
<th>ILINX (Vertigo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnult</td>
<td>Racing, Wrestling, Athletics</td>
<td>Counting-out rhymes, Heads or tails</td>
<td>Children’s initiations, Games of illusion, Top, Arms, Masks, Disguises</td>
<td>Children “whirling”, Horseback riding,Swinging, Wolfning</td>
</tr>
<tr>
<td>Agitation</td>
<td>Boxing, Billiards, Fencing, Checkers, Football, Chess</td>
<td>Betting, Roulette</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate laughter</td>
<td>Contests, Sports in general</td>
<td>Simple, complex, and continuing lotteries*</td>
<td>Theater, Spectacles in general</td>
<td></td>
</tr>
<tr>
<td>LUDUS</td>
<td></td>
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</tbody>
</table>

Figure 11: Classification of games; retrieved from Caillois (2001;36).

The four categories can overlap and are defined as follows (Ferro & Walz 2013):

— Agôn (competition) is a game that inspires competition and requires confrontation or conflict.
— Alea (chance) is used to characterise games of chance that include an element of uncertainty, such as rolling a die or flipping a coin.
— Mimicry (role playing) requires players to portray the identity of someone or something else.
— Ilinx (vertigo) is a category of games that seek to alter the perception of their players.

Paidia and ludus are interwoven, as there are games with elements of play and vice versa. The aspect most pertinent to this research is derived from the notion of games being a structured form of play that “in addition to creativity and curiosity [found in play], also requires hard work – thereby building the strengths of perseverance, love of learning, and optimism” (McGonigal 2014;654). Games can therefore be perceived as designed systems triggering motivation patterns.
Before embarking on an exploration of which elements are relevant to this
game system and on how these link to motivation patterns, I return to the
previously mentioned language difference for another clarification. Despite
the difference between the two nouns *game* and *play*, there is only one
respective adjective in standard English: *playful*. Considering its meaning
‘full of play’ or ‘containing aspects of play’, I follow Walz’s and Deterding’s
(2014;6-7) elaboration on an according adjective for game, as ‘containing
elements of game’: gameful. Their view goes along with what (McGonigal
2014;654) describes: “My original intention in using the word gameful
was simply to draw attention to the positive qualities of gamers. I wanted
to shine a light on the character strengths that games help us develop.”
In this spirit I now look at what games are about, which elements they
contain and how they are designed.

3.3.2 Game Design

In order to work with game design elements, i.e. apply them to the
context of urban mobility; it is first of all necessary to get a fundamental
understanding of how games are designed, as well as why they are
played, i.e. motivation patterns.

After studying different models both describing game design and its
ingredients (such as Bartle’s player types, discussed later in this section),
and suggesting a framework with relevant parts of a game, such as Aaron
Dignan’s (2011) *Game Frame*, I decided to work with Dignan for following
reasons: Based on his elaboration on the structure of games, he has
developed a systematic process to create a comprehensive game
experience, including all relevant elements, that is therefore also suitable
to serve as a design guideline for creating a gameful experience.

Compared to game design processes suggested by others, as for instance
by Kim (2010) or by Zichermann and Cunningham (2011), Dignan
suggests starting from the *core user activity*. Developing his behavioural
game scheme from this point, Dignan (2011;87-96) identifies game
design elements that can be used in gamification (see Figure 12).
Before relating them to my design approach at the end of this section, I take a closer look at how these elements are described:

— *Activity* as what players perform (area of focus, verbs); in the context of urban mobility for instance: biking, walking

— *Player profile* will be described in detail in the following section

— *Objectives* as short & long term goals; for instance in the context of urban mobility: enjoying mobility, increasing efficiency or knowledge of the city, changing mobility behaviours

— *Skills* as (specialised) abilities we learn; in the context of urban mobility for instance:
  - Physical: walking, riding a bike,…
  - Mental: improving memory, spatial logic, organisation,…
  - Social: meeting new people, helping other people,…

— *Resistance* (conflict) = "the force of opposition, that creates tension"; two common forms are competition and chance

— *Resources*: spaces and supplies
  - Each of these objects has specific attributes (what it can do and what can be done with it) and states (i.e., active/ inactive)
  - For instance the city, bike lanes, time, weather, temperature,…
— Actions are the moves available in the game, decisions and choices: “This includes what they are allowed to do as well as the when, where, and how of those moves.”

— Feedback as a system response to players’ actions; comes in many different forms, e.g. data and information (speedometer); representing every mechanism that can react to a player; main method of evaluating our performance; the feedback loop is a fundamental element in learning

— Black Box (= rules) contains all the information about the interplay between actions and feedback

— Outcomes as positive (e.g. rewards) or negative (e.g. start over) results that occur while in pursuit of the ultimate objective

I will now utilise these gamification core elements, derived from Dignan’s game scheme, on different levels:

Firstly, on the conceptual level, I apply gamification to develop a design approach based on the notion of ‘conflicting goals’ as a core conceptual element in games in diverse definitions of games (see section 4.1); despite the different meaning of the two words ‘goal’ and ‘conflict’ on first sight, they are both related to each other in the game context: “The notion of conflict entails (conflicting) goals; the notion of goals seems to entail the possibility of not reaching the goal, and thereby also a conflict.” (Juul 2003) If the city is considered as a game space in its own right (Walz 2010;291) and not just as a socio-technical system, then challenges in urban mobility can be perceived as game conflicts. They can, in fact, be treated as artificial conflicts, which are incorporated into games to encourage players to take action (Salen & Zimmermann 2004). See section 4.1 for how the idea of conflicts is applied to my design approach.

Secondly, on the functional level, I apply gamification as a toolbox with various game elements when developing applications both for addressing challenges in urban mobility as well as increasing interaction and creating enjoyable experiences. As a designer, my intention is to effect a positive transformation of an unpleasant situation into an enjoyable one for a mobile audience in the context of liveability – for example, by using digital media to make waiting in a traffic jam more enjoyable and sociable.
I will now take a closer look at some of these game design elements, starting with player types, since they are strongly related to the reason why people play games, i.e. their motivation.

**Player Types and Motivation Patterns**

To understand the motivation of people operating in a game context, it is necessary to discuss player and user types. The classification of users according to different personality types, why and how they interact with each other and their environments is a useful tool to assess the potential of a proposed game design element in gamification. I will now look at different approaches to the question of player types and motivation and their interrelation.

Richard Bartle (1996) is a frequently cited scholar who has been researching this field for some decades (Ferro & Walz 2013). Based on observed social patterns, Bartle distinguishes between four player types in a game environment, which he situates on an interest graph (Figure 13).

![Interest graph with four player types; adapted from Bartle (1996).](image)

**Figure 13:** Interest graph with four player types; adapted from Bartle (1996).
Ferro and Walz (2013) provide these definitions for the four types:

- **Achievers** act *on* the world and typically play to win.
- **Killers** act *on* players and find it enjoyable to dominate others.
- **Explorers** interact *with* the world and derive great pleasure from discovering something new.
- **Socialisers** interact *with* others and find this to be the greatest reward.

Bartle's 'player types' refer explicitly to games but have much in common with the five main 'user types' proposed by Marczewski (2013), which are potentially more appropriate to the context of gamification because of their strong link to motivation theories:

- **'Players'** like to collect achievements and see their name on the leaderboards. They simply enjoy playing the game and are happy with *extrinsic rewards*.
- **'Socialisers'** prefer to interact with others. The social connection aspect of *relatedness* is their primary motivation.
- **'Free Spirits'** like to have agency. They don’t want to be restricted in how they go through their personal journeys. They seek self-expression and *autonomy*.
- **'Achievers'** want to be the best, or at least achieve a certain level of success within the system. They do this for themselves, but may also be motivated by status as a representation of their personal achievement. They need a system that enriches them and leads them towards *mastery*.
- **'Philanthropists'** want to feel that they are part of something bigger. They want a system that allows them to enrich others and feel a sense of *purpose*.

Whereas in games, it is assumed that players want to play, the users of gamified systems are not necessarily interested in games – thus the distinction between ‘user types’ and ‘player types’. Indeed, Marczewski (2013) begins his classification with a simple two-fold separation: “Those willing to play and those not willing to play.” (see Figure 14) Only after that distinction is made does he consider motivation, identifying five different motivations, intrinsic or extrinsic, for five different user types.
It is noteworthy that particularly the intrinsic motivators Marczewski mentions (relatedness, autonomy, mastery and purpose) are similar to the ones found in the self-determination theory, one of the most well-established general theories of human motivation (Deci & Ryan 2000). Rigby (2014;120) describes correspondingly "three basic psychological needs that consistently emerge as powerful, universal sources of energy for motivation: competence, autonomy and relatedness." According to (Rigby 2014;115), who has taken into account Csikszentmihalyi (1975) and Deci and Ryan (2000), such motivation patterns have great potential for sustaining long-term engagement towards increasing enjoyment (see section 3.4.2). Figure 15 visualises basic motivational patterns – in this case, from a business perspective.

The distinction here between intrinsic and extrinsic motivation builds similarly on the discussion of player types in this section. But whereas Kjerulf (2006) claims that extrinsic motivation doesn’t work, other scholars argue that it could – when linked to and supporting an intrinsic goal at the end. Rigby (2014;128), for instance, describes an "internalization [sic] continuum", where a higher-quality motivation is achieved through extrinsic motivation by acting towards an intrinsic goal.
Extrinsic rewards should therefore have intrinsic relevance – e.g. in the form of a visible status within a community, which could be assumed to be a form of acknowledgment.

Back to Marczewski (2013), who then differentiates more precisely between intrinsic and extrinsic motivation, splitting the extrinsic player category into the following four types:

- **Self-Seekers** act *on* users for extrinsic reward.
- **Consumers** act *on* the system for extrinsic reward.
- **Networkers** interact *with* users for extrinsic reward.
- **Exploiters** interact *with* the system for extrinsic reward.

The result is a model with not four, but eight user types, all of which are plotted in Bartle’s structure in Figure 16. It is notable for the further discussion that the intrinsically motivated user types (left figure) match Bartle’s player types very closely.
Like Marczewski, Amy Jo Kim (2012) has also developed a model based on Bartle’s, though hers focuses on social engagement. Her model captures the motivational patterns in modern social gaming and social media and distinguishes between four categories, which she calls “social engagement verbs” (see Figure 17):

— Compete (similar to Bartle’s Killer): Competition drives social gameplay and self-improvement.
— Collaborate (similar to Bartle’s Socialiser): Collaboration and collective action are a purposeful way of socialising.
— Explore (identical to Bartle’s Explorer): Exploring content, people, tools and worlds is a rich and rewarding activity.
— Express (a replacement for Bartle’s Achiever): Self-expression is a key driver in modern social gaming and social media and a major motivator for engagement.

Kim’s designation of user types is particularly relevant to my research since social interaction is a key element of urban liveability and, in many cases, urban mobility (see section 3.4). Since different people prefer different types of enjoyment, gamification needs to be designed to engage as many user types as possible.
Nicole Lazzaro (2013) comes to a similar conclusion. She suggests that players (even during a single play session) alternate between four ways to enjoy a game, what she calls ‘4 keys 2 fun’, see Figure 18. She also observes that successful games seem to offer at least three of these keys.

Her model is described by Fullerton (2008; 290) as follows: “People play games in four ways. They enjoy the opportunity to master a challenge and to fire their imaginations. Games also offer a ticket to relaxation and an excuse to hang out with friends. ... We call these playstyles the “4 Fun Keys” (Hard Fun, Easy Fun, Serious Fun, and People Fun) because each is a collection of game mechanics that unlocks a different set of player emotions.”

Looking at the characteristics of each ‘key 2 fun’, it is noteworthy that Lazzaro’s model also has many crossovers with Bartle’s four player types:

— Serious Fun => Achiever
— Hard Fun => Killer
— Easy Fun => Explorer
— People Fun => Socialiser
To close the circle, the last model I discuss on the question of player types and motivational patterns is Dignan’s. Dignan (2011:88-89) also suggests a model distinguishing player profiles derived from the question of motivation:

- “Achievement versus enjoyment gets at the heart of how players evaluate an experience. Is it the outcome or the process that matters to them?
- Structure (= guidance) versus freedom tells us something about their learning style. Do they want to master skills through instruction, or to figure things out for themselves?
— *Control versus acceptance* indicates their relationship to power. Do they get it from dominion over others, or from their connection to community?

— *Self-interest versus social interest* gives us clues about their idea of success. Is it about their own progression, or overall progress?”

Breaking down his structure of player profiles once again results in elements similar to those found in Bartle’s model: I propose, for instance, that Dignan’s *self-interest versus social interest* is similar to Bartle’s two axis *player and world* and Dignan’s *control versus acceptance* is similar to Bartle’s player types *killers* (acting on players) versus *socialisers* (interacting with players).

After analysing different models of player types, I chose to work with Bartle’s model, because it delivers a high-level and equally precise enough classification, even though Bartle’s approach has weaknesses itself, as for instance that his player types were devised on the basis of gamers and are therefore not fully transferrable to users in different contexts.

However, similar to Lazzaro’s earlier cited notion that players alternate between different ways to enjoy a game, I don’t see Bartle’s player types as ‘either-or’ when it comes to player motivation; I suggest that motivation is a mixture of different components, which lies on a continuum dependent on player personalities. My conclusion is similar to Yee’s (2005) upon studying game motivation empirically, namely identifying three core components, related to Bartle’s model: “The achievement component measured the desire to gain power, compete against others, and master the mechanics of the game. The social component assessed desires to be part of a group effort and form relationships. The immersion component tapped the desire to escape real life, role-play, and become involved with the game’s narrative.”

To conclude, for my research it is important to keep in mind that basic human needs and intrinsic motivation can be addressed with player or user types as introduced here.
**Interaction patterns**

As mentioned earlier when looking at Kim’s refinement of Bartle’s model, interaction is a key element of urban liveability and contributes to well-being in the form of “positive relations with others” (Montgomery 2013;36). It is therefore worth taking a closer look at interaction patterns in the game context. Fullerton (2008;52) describes basic interaction patterns in games and demonstrates that they differ depending on the number of players involved and the type of game in question (see Figure 19). Such basic patterns could for instance be a player’s choice on how to proceed in a game, based on information received from the game.

![Interaction patterns diagram](image)

Figure 19: Player interaction patterns; retrieved from Fullerton (2008), derived from Avedon and Sutton-Smith (1971).

Bartle (1996) elaborates on these patterns on the basis of his four player types, Achiever, Explorer, Socialiser and Killer as described above by pairing two different types together and occasionally two of the same type. In each case, he describes the relationship between the two from both their perspectives – that is, he describes the dynamic that results
from their interaction. Pairing two killers, for example, could potentially lead to social avoidance: “Killers try not to cross the paths of other killers.” Depending on the type of player a given game is meant to attract, Bartle thus advises an increase or decrease of other player types within that game in order to best meet the needs of the target type.

Having introduced the idea of the city as a game space earlier, interaction between “a player and a game” could for instance be interaction between a citizen and the city or between two citizens courtesy the city context. Interaction can be on a structural or conceptual level in the game context, according to Dignan’s model, and thus serves as a design element for conceptualising applications. I now look at more game design elements.

**Game Design Elements**

Game design elements are defined as elements *characteristic for* games in contrast to *specific for or present in* games (Deterding et al. 2011) and are found on multiple levels such as game interface design patterns, principles and heuristics (e.g. game styles and player drivers), models (e.g. challenge or fantasy) and game mechanics. Bunchball (2010;9) suggests common game mechanics in relation to human desires, see Figure 20.

![Figure 20: Common game mechanics and their effect on human desires; adapted from Bunchball (2010;9).](image-url)
However, with the earlier discussion on Bartle’s player types and Dignan’s game frame in mind, Bunchball’s description appears uncategorised and incomplete: What Bartle defines as player types are found here as human desires. Elements like ‘reward’ or ‘status’ do not fit in that category of player types, though; a ‘status’, for instance, could be seen as one form of an ‘achievement’ and would therefore belong to a subcategory. Yet, according to the discussion in the previous section, it can be assumed that human desires lead to intrinsic motivation, which is why addressing player types when applying gamification seems essential for success. Compared to Dignan’s comprehensive elaboration on how to design a successful game experience with challenges and feedback as core elements (Dignan 2011;8), Bunchball reduces the idea of feedback to points, levels and leader boards.

After looking at Bunchball and other sources, such as (Gamification Wiki 2013), it can be concluded that many tend to decrease design options by limiting game design elements for the use in gamification to some specific features (such as commonly applied points and leader boards) rather than staying at the structural level of games which would offer a much greater design space. Ferro, Walz, and Greuter (2013) likewise come to the conclusion that game design elements and mechanics are manifold and should be implemented for instance with relation to player types.

3.3.3 Gamification

In the past several years, the term gamification has gained traction with a number of authors; each uses a slightly different definition, but the general idea is the application of “game design techniques to non-game experiences to drive user behaviour” (Gamification Wiki 2013). This broad definition encompasses the different positions of many researchers who have been working in this still young field, including for example Deterding et al. (2011) and Zichermann and Cunningham (2011). Deterding et al. (2011) provided an early definition for gamification (which is: applying elements of game design and game mechanisms to non-game contexts) and its relation to associated terms such as gamefulness and playfulness based on Caillois’ (2001;11-36) distinction between play and
game (paidia and ludus; see section 3.3.1). Since starting my research in 2012, Deterding (2014) has revised and completed his original definition of gamification based on further research and gamification practices towards a more comprehensive user experience rather than fragmented game design techniques or elements. I reflect and discuss this advancement in the context of my own projects in chapter 7.

Conclusion
Now with Dignan’s game structure as a reference for a comprehensive game experience in mind and reflecting on the discussion in this section, I use the following game design elements and mechanics as core elements for my design approach and ‘gamification toolbox’ towards creating an enjoyable experience with gameful applications:

(1) **Objectives**: later named as points of application, i.e. challenges to address or goals to achieve in urban mobility

(2) **Action – feedback – loop**: feedback as core of a gameful experience

(3) Four *player types*: ‘achiever’, ‘killer’ (renamed to ‘competitor’ for the use in this dissertation), ‘explorer’ and ‘socialiser’ (derived from Bartle, aiming to trigger intrinsic motivation)

(4) **Resources**: depend on the application; for instance context-related resources, such as ‘location’ or ‘time spent in traffic’ might be incorporated (for an example see the concepts described in chapter 6)

(5) **Skills** are met by game challenges that can either be related to mobility itself or to a substitute activity

These core elements can not only be found in what McGonigel (2014:655) describes as “key structural and aesthetic elements of a game”, namely goals, feedback and obstacles; the last of which I have described earlier as ‘conflicts’. Juho Hamari (2014) also comes to the conclusion, that certain dimensions of gamification (challenge-skill-balance, clear goals, and feedback among others) are most effective for creating a flow experience, thus increasing enjoyment; see section 3.4.2 for a comprehensive consideration. Beyond these core elements, I consider
other game elements of Dignan’s game scheme potentially suitable for use in gamification as they are, of course, part of the game experience.

Since most of the game design elements used in gamification build on or even exploit people’s natural desires and behaviours (Ferro et al. 2013), a critical discussion on the use of gamification in general can be found in section 7.3. However, the clear goal in this research is to increase positive aspects like enjoyment and liveability, which is why I am actually interested in the potential of gamification. So let’s look at what these two aspects are about in the next section.

3.4 Liveability

In the future, more and more people will live in cities (refer to the forecast in Figure 6 on page 15) and it seems safe to assume that they will want to enjoy their lives there. It is thus necessary, in my opinion, to look at urban liveability comprehensively in order to be able to develop the best measures to enhance it. Liveability is hence the “reason why” in this research since I am proposing that applying gamification can enhance urban liveability in the context of mobility.

The term liveability dates to the 1980s and is used to describe those characteristics of cities that make them liveable. Today, the term is often used to describe ‘standard of living’ rather than ‘quality of life’ (Liveablecities 2013). This means that the focus is more on a city’s functional rather than social aspects. Liveability, after all, depends on more than just effective infrastructures, but also on the extent to which a city is an enjoyable place. I elaborate on this notion of two dimensions in a city in the following section and I also look at how and with what methods liveability is evaluated, what indicators are used and at its relation to mobility.

Later in this section I discuss the definition of “enjoyment” and propose an interdependency of enjoyment, liveability and mobility in an urban environment. Since very little research has been previously conducted on this interdependency, I now discuss liveability and its relation to mobility.
Later, in chapter 5, I incorporate the topic of enjoyment in mobility into my research plan.

It is important to note that the urban mobility challenges mentioned earlier (i.e. congestion) not only affect mobile people, but can potentially influence every citizen in an urban environment. These challenges can have a negative impact on a city’s liveability, given that most cities are dependent on the way mobility options are organised, executed and adopted. Mobility thus affects the mobile experience of both individuals and entire communities (Gehl 2010;7).

3.4.1 Two Dimensions
Having already discussed urban design and its correlation to mobility, I now offer a more systemic view of the city: the idea of two dimensions for a liveable city, ‘function’ and ‘relatedness’. Initially, I summarise them in ‘standard of living’ versus ‘quality of life’ and discuss them in greater detail below.

Treating the city as a “socio-technical system” (Hillier 2009) made up of subsystems (e.g. spatial, temporal, societal, infrastructural, managerial, planning-related or data-driven), I propose a two-dimensional view of the city. Many previous researchers have also considered cities on the basis of two separate but interrelated dimensions. Charles Leadbeater (2011), for example, identifies the dimensions “system” and “empathy,” while Bill Hillier (2009) describes a “physical” and a “human” subsystem, and McCullough (2004) talks about “spatial literacy” and “social configuration” within an environment. Kars Alfrink (2014;533) adds another perception of this two dimensionality by mentioning a hard and a soft urbanism: “An example of hard urbanism is the effort to plan and build a new city neighbourhood [sic]. This urbanist practice is concerned with the physical form and its construction.” Alfrink’s notion is therefore not primarily about understanding an existing city but about the way a city is being developed – similar to a top-down approach as a planned, defined city versus a bottom-up approach with participating citizens, described for instance by
Gehl (2010) and applied in this research by choosing corresponding participatory methods.

Summing up with the concept of liveability in my research in mind, I will consider cities based on the following two dimensions similar to the above described models: function (i.e. systems, rules and infrastructure) and relatedness (i.e. interaction, community, culture; see Figure 21). By relatedness, I mean the ‘human’ dimension, which results, for example, from interaction encouraged through the design of public spaces, the amount of cultural offerings or the number of café chairs available (Gehl 2010). Fundamentally social and less readily apparent than the functional dimension, this dimension makes us feel comfortable in a city and allows us to enjoy it (Gehl 2010). Relatedness plays a decisive role in urban quality of life and, incidentally, in both happiness research and Sociology as well (see Bormans (2011), Urry (2007) and Gehl (2010)). The former assumes that social relations are a key criterion for a happy life; the latter sees relatedness – in the sense of interplay between people – as the very basis of society and organisation. Not least, relatedness is one of the core aspects in the self-determination theory as described in an earlier section and strongly interconnected with intrinsic motivation and enjoyment, as well as identity: “Belonging” to a community makes people happier in the end (Montgomery 2013;134).

![Figure 21: Model of a two-dimensional city.](image-url)
The most liveable cities, after all, provide a harmonious balance of function and relatedness. They combine, in other words, effective infrastructures with a humane environment (Scerri & Holden 2011), or as Alfrink (2014;527) puts it: "...a city, in short, that is livable [sic] in the full sense of the word—beyond good public transport, ample green space, and cultural activities.” A disproportionate development of either dimension, by contrast, creates an imbalance, as Leadbeater (2011) demonstrates.

On the one hand, too little function leads to chaos, a phenomenon particularly evident in developing countries, where the growth of infrastructure hasn’t always kept up with explosive urban expansion. Too little relatedness, on the other hand, can lead to a lack of identity and thus alienation (see section 3.2.3), as is the case in some American cities, where massive roadways and developments are as uninviting as the heavily regulated semi-public spaces of shopping malls.

To conclude, there is a strong link between game design and these two dimensions in a city towards liveability, as Alfrink (2014;536) describes. He identifies three potentials for designers in the context of a gameful city: the physical form (i.e. urban interventions), the digital networks as elaborated on in section 3.1.3, and the social practices going back to the idea of a bottom-up approach towards the relatedness dimension. One core aspect in this dimension is enjoyment, which I will discuss in the next section, also in the context of the interrelation between enjoyment (as user experience) and liveability (as impact on cities).

### 3.4.2 Enjoyment

Words like pleasure, enjoyment and fun tend to be used almost synonymously and interchangeably. Blythe and Hassenzahl (2004;91) see pleasure and fun as distinct forms of enjoyment: “Pleasure is closely related to degrees of absorption while fun can be usually thought [sic] in terms of distraction.” To illustrate what they mean by absorption, Blythe and Hassenzahl (2004;92) refer to Mihaly Csikszentmihalyi (1975), who has conducted research on something he calls “flow,” a physiological interpretation of pleasure.
He describes flow as a “peak experience of total absorption in an activity”. In a game for example, a state of flow is achieved when a player arrives at the optimal balance of ‘overload’ and ‘underload’ (Lazzaro 2013) resulting in "a state of mind classified by enjoyment, loss of time perception, and a suspension of self” (Dignan 2011;7).

Pleasure and fun as two forms of enjoyment can be further distinguished. Aristotle (2002) describes pleasure as “sense stimulation through action”, a description that constitutes the basis for Csikszentmihalyi (1975)’s notion of pleasure as “self-actualisation”. As to fun, Blythe and Hassenzahl (2004;93-94) argue that today’s meaning of the word has its origin in the Industrial-Age separation of work and leisure and the rise of cultural industries: “Fun is something we buy, something we consume, something that ultimately reproduces the situations of alienated labour that we are seeking to escape.” In relation to pleasure, then, fun is distinct in terms of its intensity, its relation to action and other factors (see Table 1).

<table>
<thead>
<tr>
<th>Fun (Distraction)</th>
<th>Pleasure (Absorption)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triviality</td>
<td>Relevance</td>
</tr>
<tr>
<td>Repetition</td>
<td>Progression</td>
</tr>
<tr>
<td>Spectacle</td>
<td>Aesthetics</td>
</tr>
<tr>
<td>Transgression</td>
<td>Commitment</td>
</tr>
</tbody>
</table>

Table 1: Characteristics of fun and pleasure; adapted from Blythe and Hassenzahl (2004;95).

On the one hand fun can be relatively spontaneous, informal and even purposeless, distracting the mind from any serious task (Fullerton 2008). On the other hand Rigby (2014;116) argues, referring to theories of intrinsic motivation (Csikszentmihalyi 1975; Deci and Ryan 2000), that fun can be defined as a positive emotional state of playful enjoyment “in which one is intrinsically engaged – meaning that the value of the experience is the experience itself, rather than the experience being instrumental in achieving something else”. This sort of enjoyment can therefore create intrinsic engagement, as Dignan (2011;74) puts it: “Fun is the easiest way to change peoples behavior [sic] for the better.”

Creating an enjoyable experience has consequently great potential to trigger intrinsic motivation patterns as described in section 3.3.2 and vice
versa: it can be assumed that if something is done with intrinsic motivation, the experience is more likely to be enjoyable.

However, enjoyment is context related (Blythe & Hassenzahl 2004;94) and/or dependent on the duration (Montgomery 2013;211). Activities generally associated with enjoyment, such as dancing, playing a game, listening to music and conversation, can be enjoyable or not depending on the situation in which they are embedded and on the individual participants’ backgrounds. If someone has just had lunch, for example, a rollercoaster ride may not be enjoyable at all – or it is for three minutes, but not for three hours. Likewise, if someone has just had heart surgery, he or she will likely find a steep hill less enjoyable than someone in training for the Tour de France. These examples further illustrate the loop to intrinsic motivation from another perspective: There would probably be no intrinsic motivation without the right context.

I can not summarise better than Rigby (2014;115-116,129) who concludes, that according to diverse research over the past two decades, increasing the motivational quality leads to more enjoyment, greater satisfaction and well-being.

But what does he mean with well-being and how does it fit into the idea of liveability?

3.4.3 Evaluating Liveability

In this section I discuss liveability indices to better understand the indicators used and to identify criteria relevant to the context of mobility.

Various indices are devoted to identifying the most liveable cities – among them, the Economist Intelligence Unit’s Most Livable Cities Index and Mercer’s Quality of Living Index. Liveablecities (2013) and BetterCitiesNow (2012) have compared the most important indices. Based on their work and on the official information provided by the index developers, I have created Table 2 to give an overview of the indicators on which the indices are based, including subcategories. This evaluation was conducted in the early stages of my research using the latest available indices in February 2013.
<table>
<thead>
<tr>
<th>Index</th>
<th>Indicators</th>
</tr>
</thead>
</table>
| A.T. Kearney: Global Cities Index 2012 | Business activity  
Human capital  
Information exchange  
Cultural experience  
Political engagement |
| Economist Intelligence Unit: Most Livable Cities 2012 | Stability  
Healthcare  
Culture & Environment  
Education  
Infrastructure |
| Institute for Urban Strategies: Global Power City Index 2011 | Economy  
Research & Development  
Cultural interaction  
Liveability  
Environment  
Accessibility |
| Knight Frank: World City Survey 2011 | Economic Activity  
Political Power  
Knowledge and influence  
Quality of life |
| Mercer: Quality of Living 2012 | Political and social environment  
Economic environment  
Socio-cultural environment  
Health and sanitation  
Schools and education  
Public services and transportation  
Recreation  
Consumer goods  
Housing  
Natural environment |
| Monocle: Quality of Life 2012 | Social and economic circumstances for residents  
Public health  
Infrastructure  
Ease and availability of local transport |
| OECD: Better Life Index 2012 | Housing  
Income  
Jobs  
Community  
Education  
Environment  
Civic engagement  
Health  
Life satisfaction  
Safety  
Work-life balance |
| PricewaterhouseCoopers: Cities of Opportunity 2012 | Intellectual capital and innovation  
Technology readiness  
Transportation and infrastructures  
Health, safety and security  
Sustainability and the natural environment  
Economic clout  
Ease of doing business  
Cost |
<table>
<thead>
<tr>
<th>PricewaterhouseCoopers: Cities of Opportunity 2012</th>
<th>Demographics and livability [sic]</th>
</tr>
</thead>
<tbody>
<tr>
<td>City gateway</td>
<td>City gateway</td>
</tr>
<tr>
<td></td>
<td>Infrastructure Development</td>
</tr>
<tr>
<td></td>
<td>Quality of life</td>
</tr>
<tr>
<td></td>
<td>Equity and social inclusion</td>
</tr>
<tr>
<td></td>
<td>Environmental sustainability</td>
</tr>
</tbody>
</table>

Table 2: Indices ranking liveability.

Some of these indices focus on general standards of living; others have an economical emphasis or aim to evaluate the competitiveness of cities in a global context. Subcategories in each index usually include education, economic power, political environment and stability, infrastructure and housing, culture and community and healthcare. In Figure 22, I have developed a chart that consolidates the most relevant indices and the respective indicators on which they are based.

Most of these indicators refer primarily to a city’s standard of living, i.e. its function dimension, as determined by data such as crime rates, health statistics and sanitation standards (Liveablecities 2013). They do not, in other words, take my second dimension, relatedness, into account. The only indicators that do include some of these elements are those I’ve categorised in Figure 22 as ‘quality of life’, ‘culture’ and ‘environment’. Scerri and Holden (2011) likewise criticise this one-dimensional focus and take issue with the chief intention of some of the indices, particularly those produced by consultancies – e.g. to provide companies with information on which to base “hardship allowances as part of expatriate relocation packages.”

Also, mobility-related aspects, such as the quality and accessibility of transportation infrastructure (see Table 3 on page 59 for more examples), can rarely be found on the list of indicators considered by these indices. If they are included at all, then certainly not in the form of a holistic definition that incorporates various options of urban mobility as described in section 3.2.1 and the many ways that mobility is connected to liveability (see the following sections).
The A.T. Kearney Global Cities Index and OECD Better Life Index contain no mobility indicators whatsoever, a big gap considering the strong link between mobility and liveability. At least some mobility indicators are included in the Economist Intelligence Unit’s Most Liveable Cities Index, such as “quality of road network”, “quality of public transport” and “quality of international links”. Even this, however, seems minimal when one considers the many options of urban mobility; the index makes no mention, for example, of bicycle infrastructure or car share offers becoming popular in many cities around the globe. The Institute for Urban Strategies Global Power City Index does slightly better, including “infrastructure of international transportation” and “infrastructure of inner-city transportation” indicators in its “accessibility” category. Likewise, the Mercer Quality of Living Index features “public transport” and “traffic congestion” as indicators in its “public services and transportation” category as well as “[access to] cars” in its “consumer goods” category, though it also ignores today’s mobility alternatives like bikes or car sharing models.
Only the PwC Cities of Opportunities Index delivers a broader, though still not comprehensive consideration of mobility. It lists the indicators “public transport system”, “mass transit coverage”, “cost of public transport” and “licensed taxis” under the category “transportation and infrastructure” as well as the criterion “traffic congestion” under the category “demographics and liveability”. The UN Prosperity of Cities Report includes an “infrastructure development” criterion but uses very generic wording to describe it: ”...provides adequate infrastructure in order to improve urban living and enhance productivity, mobility and connectivity.” “Air pollution”, by contrast, can be found as a criterion in many of the indices, including PwC, Mercer, OECD and Institute for Urban Strategies.

In Table 3, I provide an overview of the mobility-related indicators included in the indices mentioned here.

The methods applied to create each index are as different as the ways in which the indicators are assessed; some indices provide no information at all on those methods. This makes it difficult to compare outcomes, much less evaluate the informative value of each individual index.

<table>
<thead>
<tr>
<th>Index</th>
<th>Mobility-related Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.T. Kearney: Global Cities Index 2012</td>
<td>No identifiable indicator</td>
</tr>
<tr>
<td>Economist Intelligence Unit: Most Livable Cities 2012</td>
<td>Infrastructure</td>
</tr>
<tr>
<td></td>
<td>Quality of road network</td>
</tr>
<tr>
<td></td>
<td>Quality of public transport</td>
</tr>
<tr>
<td></td>
<td>Quality of international links</td>
</tr>
<tr>
<td>Institute for Urban Strategies: Global Power City Index 2011</td>
<td>Environment</td>
</tr>
<tr>
<td></td>
<td>Pollution</td>
</tr>
<tr>
<td></td>
<td>Accessibility</td>
</tr>
<tr>
<td></td>
<td>Infrastructure of international transportation</td>
</tr>
<tr>
<td></td>
<td>Infrastructure of inner-city transportation</td>
</tr>
<tr>
<td>Knight Frank: World City Survey 2011</td>
<td>No identifiable indicator</td>
</tr>
<tr>
<td>Mercer: Quality of Living 2012</td>
<td>Health and sanitation</td>
</tr>
<tr>
<td></td>
<td>Air pollution</td>
</tr>
<tr>
<td></td>
<td>Public services and transportation</td>
</tr>
<tr>
<td></td>
<td>Public transport</td>
</tr>
<tr>
<td></td>
<td>Traffic Congestion</td>
</tr>
<tr>
<td></td>
<td>Consumer goods</td>
</tr>
<tr>
<td></td>
<td>Cars</td>
</tr>
<tr>
<td>Monocle: Quality of Life 2012</td>
<td>Infrastructure</td>
</tr>
<tr>
<td></td>
<td>No further information available in public sources</td>
</tr>
</tbody>
</table>
Having described liveability as a combination of standard of living and quality of life earlier, it can be noted that hardly any of the so-called liveability indices comply with this notion due to a lack of quality of life indicators. Also, mobility aspects are barely considered in most indices and if so, then only to a minor degree. Since the connection between liveability and mobility is significant, I propose the inclusion of more relevant indicators in such indices. I will lead a discussion on the connections between mobility and liveability both from an individual and a city perspective in the following section with the goal of distinguishing appropriate indicators.

### 3.4.4 Liveability and Mobility

As described in section 3.1.2, mobility plays a significant role in influencing the structure of a city. Mobility behaviour, in turn, is often the
result of a certain city shape. In the United States, for example, many households have moved to the edges of cities, where housing is more affordable. This generally produces suburban housing patterns, i.e. widespread areas with limited access to public transportation (Transportation for America 2012). This affects quality of life as seen from the individual perspective: since mobility options are limited, suburban inhabitants are often restricted to automotive mobility, which, due to cost, health or other considerations, might not be their first choice.

We must also consider the correlation between liveability and mobility from a city perspective. From the point of view of the elderly, for example, “the livability [sic] of a community is greatly affected by the community’s transportation system”, contends the American Association of Retired Persons. “Transportation networks provide the framework for how a community lives and connects, as well as how the economy grows within the community” (AARP 2012). The AARP (2012) goes on to argue that many transportation projects aim to create a “socially, environmentally, and economically sustainable livable [sic] community”. It suggests that liveability factors should be incorporated into transportation design, pointing to “complete streets” as an example of successful mobility infrastructure. Complete streets are “safe and convenient for travel by car, foot, bicycle and transit for everyone in the community regardless of age or ability.” Design that focuses only on motorised traffic, by contrast, may contribute to the disintegration of city life, as posited by Juhlin (2010;6).

Parking spaces are a good example of the interrelation between mobility and liveability, but also of the sometimes opposing interests of an individual and the city, see Figure 23. From an individual perspective, automotive mobility may be preferable to public transport mobility in terms of comfort and privacy. The ability to quickly, easily and affordably find a parking space would, from that perspective, increase individual liveability. From a city perspective, however, a multiplicity of individual drivers may take up valuable urban space; from that point of view, parking should be expensive to discourage individual drivers and spatially
restricted to leave room for the construction of public spaces like parks, which also play a role in urban liveability.

Indeed, my project in Beijing (see chapter 6) identified parking as a major challenge in big cities (and inconvenience from an individual perspective) and generated several ideas for addressing the issue ‘gamefully’.

So what are the possible mobility indicators for liveability, how can they be structured from an individual and a city perspective and what are interrelations?

**Individual Perspective**

On an individual level, the availability, variety and affordability of mobility all have an impact on a person’s standard of living. According to Füssl, Oberlader, Risser, Seisser, and Risser (2012), the correlation is based on many factors, some economic, some social and some related to health. Transportation for America (2012) argue that “opportunities to be physically active have been engineered out of daily life”. To reintegrate physical activity back into daily mobility would likely have a positive effect on health. This would not only improve individual liveability, but also communal liveability since it would presumably lower the costs associated with unhealthy lifestyles (e.g. obesity), which are carried by the entire community and which can be enormous (Transportation for America 2012). Table 4 provides an overview of the correlation between liveability...
and mobility from an individual perspective. I retrieved aspects from European Commission (2011), Fleming (2012), Gehl (2010) and Transportation for America (2012), and grouped them into four areas: social, individual, cost and health. Interrelations between these aspects and mobility devices, as introduced in Figure 10 in section 3.2.1, were then qualitatively evaluated, based on my own assessment. The impact on liveability aspects ranges from very positive (+ +) to very negative (- -).

<table>
<thead>
<tr>
<th>Mobility device</th>
<th>Social aspects</th>
<th>Individual aspects</th>
<th>Cost</th>
<th>Health aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stay connected</td>
<td>Flexibility (i.e. schedules, routes)</td>
<td>Weather dependence</td>
<td>Privacy</td>
</tr>
<tr>
<td>foot</td>
<td>++</td>
<td>0</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>skateboard</td>
<td>+</td>
<td>0</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>rollerskates</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>scooter</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>bike</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>--</td>
</tr>
<tr>
<td>scooter</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>--</td>
</tr>
<tr>
<td>motorbike</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>--</td>
</tr>
<tr>
<td>quad</td>
<td>+</td>
<td>0</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>car</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>taxi</td>
<td>++</td>
<td>0</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>city bus</td>
<td>+</td>
<td>0</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>bus</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>gondola</td>
<td>--</td>
<td>+</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>tram</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>subway</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 4: Correlations between liveability and mobility from an individual perspective.

In light of my concept of the two-dimensional city, the most interesting question for me towards the relatedness dimension is: What makes mobility enjoyable? Before investigating on this question with my projects in chapters 5 and 6, here are some considerations from other sources:

In the 04/2012 edition of Abgefahren (page 59), a German vintage car magazine, one writer shares his experience of driving an old convertible. In his perception, the drive is reduced to the basics of mobility: movement through an environment in a way that allows direct connection with that environment be it through the warmth of the sun or the smell of the corn. Without the “filters” and “softeners” of modern cars, the driver becomes more aware and the drive itself more intense. Urry (2007;125) describes a similar experience of being intensely connected to the environment with “no separation from the sights, smells and sounds of the road”. A sense of connection to the environment seems important
when we’re talking about enjoyment in mobility. On the other hand, privacy and comfort can also produce enjoyment in mobility; sometimes, after all, we don’t want to be connected in such an intense way, but would prefer to enjoy calm and quietness in an enclosed space.

Juhlin (2010;113-114) describes enjoyment as something between physical relatedness and separation. He identifies a contemporary figure, the “automobile flaneur”, who, much like the pedestrian flaneur discussed in an earlier section, enjoys the act of travelling by car as an end in itself. But while driving a car is a solitary experience, part of the pleasure for the automobile flaneur consists, according to Juhlin, of the driver’s curiosity about other drivers and vehicles that he encounters on the road: “The driver engages in the same kind of enjoyment as the flaneur. He takes an interest in the visual appearance of the social interaction in the vicinity.”

Physical or visual connection to environment also plays a role in the consideration of other forms of mobility like, for example, the subway. In my view, the subway offers neither privacy nor enjoyment and furthermore cuts travellers off from city space because of running underground. By contrast, a positive example of visual connection is JCDecaux’s (2013) low tech game Man-eater, which makes use of the location-relatedness during tram rides: “The game’s rule is simple: a cartoon sticker representing a “man-eater” monster is added to the tramway’s window. As the tram is moving, passengers are invited to look through the window, close an eye and make the man-eater “eat” as many pedestrians’ heads as possible.” For me personally, enjoyment in mobility is directly related to the surrounding space as also introduced with the idea of site-specific games in urban environments in section 3.1.2.

Having discussed different perspectives of the car in particular with the example of parking in the introduction of this section and bearing in mind the huge congestion problems cars are causing in more and more cities (see chapter 6), it is obvious that the solution is not likely to be having everyone drive in a city to experience the enjoyment described here. The question is rather, how these aspects of individual liveability can be considered from the city perspective since the city perspective will most likely be the relevant one taking into account higher goals of liveability.
City Perspective

A city is a restricted environment; it has only a finite amount of available space. This reality often produces competition for such as parking spaces. The use of space directly correlates to the quality of life within a city; public parks, for example, improve urban liveability for a whole community, whereas parking spaces do so only for certain individuals. Models for allocating space differ in the criteria used: some place a premium on space shared equally by the entire community, while others focus on pay-per-use space. Even space designated for a specific use can be prone to permanent negotiation. Juhlin (2010;8) cites roads as an example: though the allocation of road space usually follows specific rules, it is also governed by a form of automotive body language.

Gehl (2010;9-17) emphasises the importance of motivating people to walk or cycle in order to increase activity in public space and create livelier cities. Fleming (2012;19-21) agrees, though as a cyclist, he emphasises the benefits of cycling over “ tiresome and boring” walking. Both believe that populating urban space increases the likelihood of social interaction and thus enhances liveability. More pedestrian and bicycle traffic means more time spent in the city space and, accordingly, more opportunities for interaction in that space. By contrast, Juhlin (2010) argues that motorised traffic “…contribute[s] to the disintegration of city life”. He sees the car as “something between a private box and a public stage” that leads to “an erosion of community life”.

<table>
<thead>
<tr>
<th>Mobility device</th>
<th>Environmental aspects</th>
<th>Social aspects</th>
<th>Cost</th>
<th>Public health aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use of city space in standstill</td>
<td>Use of city space while moving</td>
<td>Emissions: gas</td>
<td>Emissions: noise</td>
</tr>
<tr>
<td>foot</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>skateboard</td>
<td>++</td>
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<td>rollerskates</td>
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<td>scooter</td>
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<tr>
<td>motorbike</td>
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<td>city bus</td>
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<td>bus</td>
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<td>gondola</td>
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<td>tram</td>
<td>0</td>
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<td>++</td>
<td>++</td>
</tr>
<tr>
<td>subway</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

Table 5: Liveability and mobility from a city perspective.
Table 5 summarises the various correlations between mobility and liveability from a city perspective. I retrieved categories and aspects from European Commission (2011), Fleming (2012), Gehl (2010) and Transportation for America (2012), and qualitatively evaluated again the impact on liveability as described in the previous section.

**Sub-Conclusion**

The correlations between liveability and mobility are manifold and must be considered from different perspectives. Many indicators for both perspectives (individual and city) interrelate as demonstrated in Table 6 and agreed e.g. by Montgomery (2013;19).

![Image](image_url)

*Figure 1: The interrelation between the individual and the city perspective.*
This is no surprise as a city consists of individual inhabitants. Safety, for example, as a city indicator contributes to individual liveability in terms of increasing well-being, whereas activity (e.g. through cycling or walking), as an individual indicator, influences the community for instance by avoiding health costs.

My research will contribute to both perspectives as I develop concepts targeting individual liveability by increasing enjoyment (see chapter 6) and urban liveability by working with urban mobility challenges (see sections 5.2 and 5.3).

3.5 Conclusion

In this chapter I have discussed four major topics, fundamental to my research, and their interrelations: Urban Environments, Mobility, Game Design and the notion of liveability.

Since more and more people live in cities, it is of utmost importance that we address challenges in urban environments and increase liveability. In this age, urban transformations no longer take place only on the physical level as urban design traditionally does; on the contrary, the growing importance of digital networks has opened up extensive new ‘space’ for urban designers within urban environments, and this space contains many opportunities for addressing challenges in innovative ways. As in urban design, the two aspects of interaction and identity can be found in mobility and are again interrelated with urban design aspects in a city.

The same applies to liveability. An evaluation of relevant indices shows, however, that not many mobility-related indicators can be found in these indices, which is why I suggest criteria from an individual and city perspective. In order to structure aspects of liveability, I propose to work with the model of a two-dimensional city with ‘function’ being as important for liveability as ‘relatedness’.

Game design elements seem to have an especially large amount of potential for addressing or even overcoming challenges in urban mobility since game mechanics are based on human desires and motivational
patterns. When it comes to gamification, I differentiate between player types and work with Dignan’s game structure including mechanics and elements. Looking at the mobile city through the lens of games can inspire new ways of improving urban mobility. From this perspective, time spent waiting at a bus stop or sitting in a traffic jam becomes suddenly full of potential. Considering the city as a game space and perceiving challenges as game conflicts is the basis for my design approach allowing me to develop a structure of challenges and concomitant applications in the following chapter that will further feed into defining practical projects as described in chapters 5 and 6.

To conclude, the most important finding for the further research is the interrelation between game design elements (e.g. player types), (intrinsic) motivation, enjoyment and well-being that have been developed throughout this chapter towards enhancing the relatedness dimension and liveability.
4 GAMEFUL URBAN MOBILITY

Shifting from the broader theoretical outlook of the previous chapter to practical projects, in this chapter, I connect urban mobility with game design and develop my design approach as a guideline for conceptualising gameful applications for urban mobility. This pivotal part of my dissertation brings the top-down perspective, captured in the previous chapter, together with the bottom-up perspective taken in the following part.

Before developing my design approach, I apply the idea of a design space, understood as a contextual framework for designing. My design space results from the overlap of disciplines discussed in chapter 3: urban environments, mobility and game design. Accordingly, this design space is what I call Gameful Urban Mobility, see Figure 24.

Figure 24: My design space is where urban mobility and game design overlap.

My design space delivers the broader contextual framework for Gameful Urban Mobility applications, conceptualised along my design approach.
4.1 My Design Approach

Framed by the design space just outlined, in the following I propose a design approach and suggest a process with guidelines, starting from the notion of city as game space and conflicts as points of application. I take into account the findings from chapter 3, for instance considering outcomes of the liveability indices evaluation and referring back to digitalisation as an enabler for conceptualising solutions.

Looking at diverse definitions of games, one common element is described as ‘goal’ or ‘conflict’. Despite the apparent difference in meaning of the two words at first sight, they are both related to each other in the game context: “The notion of conflict entails (conflicting) goals; the notion of goals seems to entail the possibility of not reaching the goal, and thereby also a conflict.” (Juul 2003) A similar game element is Dignan’s (2011) idea of resistance, as elaborated in section 3.3.2, namely “the force of opposition, that creates tension”. This tension triggers the creativity to solve the respective game conflict and proceed in the game.

Considering the city not just as a socio-technical system as introduced in section 3.4.1, but as a game space in its own right (Walz 2010) permits us to perceive challenges in urban mobility as game conflicts, just as artificial conflicts are incorporated into games to encourage players to take actions (Salen & Zimmermann 2004). Viewing the city through this gameful lens, artificial conflicts in urban mobility that prevent us going from A to B most efficiently, can be small scale like a red traffic light for a motorist or a steep hill for a cyclist; but can also be found on larger scale like the congestion of streets or the pollution caused by individual motorised traffic. Other examples include isolation or a lack of enjoyment.

Drawing a game challenge from the activity itself (herein: a mobility challenge from being mobile, e.g. riding a bike) so that it is “inherent in the activities the user engages in” is, according to Deterding (2015;16), a promising approach to gameful design because it supports users by persuading their intrinsic goals and needs.

This notion of perceiving mobility challenges as game conflicts is therefore one core element in my design approach, see Figure 25. The points of
applications deliver the mobility context from which to draw these mobility challenges and will be discussed in the following section.

The other two are the mobility and city context, which I expand on in the following section, and game design elements as introduced in section 3.3.3 and elaborated upon in the city context.

Figure 25: My final design approach

Like one of its core aspect, namely the cycle of testing and redesigning, the design approach itself has been developed iteratively. Figure 26 shows an initial stage of the design approach, already containing the major elements but lacking this cycle.

Figure 26: One initial design approach

Through testing this initial design approach by developing concepts and by considering them with relation to knowledge gained during my Ph.D. journey, the design approach has been revised several times in order to achieve the goal of an appropriate description of the design process. Designing the projects and developing the design approach was therefore a parallel activity during my research, not consecutively as it appears in this dissertation.

The preliminary model lacked exactly what is typical for game design processes and according to Fullerton (2008;248) even the “most
important activity, a designer engages in”, explicitly playtesting: iterative cycles consisting of build-test-redesign with constant user testing. On the way to playtesting a design, Fullerton (2008) defines the other core elements of a game design process as the conceptualisation and prototyping phases. Playtesting or the design iteration (to generalise the wording in regards to other design disciplines) can involve many cycles in different phases, see Figure 27, in addition to different evaluation methods, i.e. self-testing or group testing with discussion and feedback formats.

Designing iteratively is also a core element of the research-through-design method as described in section 2.4
4.1.1  **Context: Points of Application**

Points of application, as introduced in section 3.2.1, can be elements of mobility, such as devices (i.e. bike, car), infrastructure elements (i.e. traffic light, pedestrian crossing) and whole mobility systems. I also include temporary instances, like traffic jams, weather conditions or accidents. Any point within the mobility system is a potential point of application; Figure 28 delivers a structure of such points of application.

![Figure 28: Elements of mobility as points of application. The highlighted examples are rain, traffic congestion and a pedestrian crossing.](image)

These points of application deliver the context and starting point for designing Gameful Urban Mobility applications, i.e. by addressing an identified mobility challenge (see the following section for a range of examples). I therefore propose perceiving elements in the mobility system as design opportunities towards the conceptualisation of applications that enhance enjoyment and liveability. This approach is, as described above, in the context of games where game conflicts are not perceived as problems but as chances for creativity.

4.1.2  **Conflict: Urban Mobility challenges and goals**

Derived from my analysis of the interrelation of mobility and liveability, I describe common mobility challenges in this section and explore further
mobility issues as well as possible goals. These challenges or goals are the starting point for developing gameful solutions, for instance applying participatory methods such as workshops. Local perceptions of challenges, which might differ according to cultural background for example, are specifically addressed during the course of the projects, in which local city dwellers or students have a chance to contribute their distinct points of view (see chapter 5).

Technology has greatly enhanced the way we are mobile today; with increased speed and comfort, we can choose from a variety of mobility options to cover large distances. But technology-enabled mobility also has unintended consequences that often outweigh its benefits, particularly in urban environments. Examples include congestion, overcrowding, environmental pollution, noise pollution and long travel times (Mitchell et al. 2010;2).

Three problems in particular come up again and again in the literature (see e.g. European Commission (2011;8)): congestion, poor air quality and noise exposure. Congestion is not only a problem for the individual motorist, but rather a general mobility problem given the imbalance between enormous demand and limited spatial capacity in a city. Consider, for example, bicycle traffic in Copenhagen with congested bike lanes (Fleming 2012) or air traffic around the world with congested air space (European Commission 2011;5). Indeed, the contested negotiation of mobility space can be traced back over 100 years. In his article, Holzer (2013) explores the phenomenon of mass motorisation in cities and the consequent friction with other road users, such as pedestrians and horse riders, who had inhabited road space for centuries.

Apart from issues related to restricted space, there are further challenges: Juhlin (2010;3), for instance, contends that while mobile technologies expand forms of social interaction in numerous ways, they also come with their own set of restrictions, such as, for example, “the driver being enclosed in the shell of a vehicle and the often very high speed, which limits the time available for interaction during each encounter”. Isolation is indeed an issue that has also been identified during fieldwork in the Beijing project, see chapter 6.
In Table 7, I’ve grouped challenges into various categories such as Environmental Impacts or Social Impacts. The importance of each challenge depends on various factors, including the type of mobility device in question, the specific mobility situation and the geographical shape of the city. In cities where the airflow is restricted due to topography or climate, for example, local emissions of motorised traffic have a much higher impact than they do in coastal cities, where fresh air quickly rarefies them.

<table>
<thead>
<tr>
<th>Challenges in Urban Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessibility and Availability</strong></td>
</tr>
<tr>
<td>Distance to public transport stations</td>
</tr>
<tr>
<td>Reliability of transport systems</td>
</tr>
<tr>
<td>Variety of transportation options</td>
</tr>
<tr>
<td>Restricted areas (e.g. pedestrian zones)</td>
</tr>
<tr>
<td><strong>Conditions</strong></td>
</tr>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>Topography (e.g. steep hill)</td>
</tr>
<tr>
<td>Climate (e.g. hot and humid)</td>
</tr>
<tr>
<td><strong>Temporary</strong></td>
</tr>
<tr>
<td>Weather (e.g. rainy, hot)</td>
</tr>
<tr>
<td>Congestion</td>
</tr>
<tr>
<td>Blocked street due to road work or accident</td>
</tr>
<tr>
<td><strong>Environmental Impacts</strong></td>
</tr>
<tr>
<td>Emissions (air quality, smell)</td>
</tr>
<tr>
<td>Emissions (noise)</td>
</tr>
<tr>
<td>Ozone depletion</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
</tr>
<tr>
<td>Energy consumption</td>
</tr>
<tr>
<td>(Political dependence on specific energy forms)</td>
</tr>
<tr>
<td><strong>Health</strong></td>
</tr>
<tr>
<td>Accidents (e.g. deaths and injuries)</td>
</tr>
<tr>
<td>Asthma</td>
</tr>
<tr>
<td>Obesity</td>
</tr>
<tr>
<td><strong>Safety/Security</strong></td>
</tr>
<tr>
<td>Road safety (of infrastructure and device)</td>
</tr>
<tr>
<td>Security (e.g. public spaces and public transport)</td>
</tr>
<tr>
<td><strong>Other aspects</strong></td>
</tr>
<tr>
<td><strong>Societal</strong></td>
</tr>
<tr>
<td>Cost (i.e. infrastructure, environmental, health)</td>
</tr>
<tr>
<td>Social fragmentation</td>
</tr>
<tr>
<td>Visual intrusion</td>
</tr>
<tr>
<td><strong>Individual</strong></td>
</tr>
<tr>
<td>Travel time</td>
</tr>
<tr>
<td>Waiting time</td>
</tr>
<tr>
<td>Lack of enjoyment</td>
</tr>
<tr>
<td>Cost (i.e. tickets, taxes, energy)</td>
</tr>
<tr>
<td>Comfort</td>
</tr>
<tr>
<td>Physical exercise</td>
</tr>
<tr>
<td>Privacy</td>
</tr>
<tr>
<td>Isolation</td>
</tr>
<tr>
<td>View</td>
</tr>
</tbody>
</table>

Table 7: Challenges in urban mobility.
The challenges included in Table 7 were culled from a variety of sources (e.g. European Commission (2011), Juhlin (2010), Mitchell et al. (2010), Transportation for America (2012), Urry (2007), and Gehl (2010)) and describe common observations and general assumptions as well as individual perspectives.

Goals can often be perceived as elements corresponding to mobility challenges; however, they are found in different dimensions according to the two-dimensional city described in section 3.4.1. When the challenge, for instance, is enduringly congested roads, then the goals could be to build more roads to ease traffic, which would be in the functional dimension. In the relatedness dimension, goals could be manifold, for instance:

— Stimulating behaviour change in order to make people use the cars less and attract them to other modes of transport or to make people pair up and use the space in cars more efficiently; an approach that can be based on extrinsic motivation (i.e. congestion charges or car-pool lanes) or intrinsic (i.e. the Melbourne based initiative ‘unlock the grid’, where feedback on the individual contribution to congestion was supplied along with suggestions to reduce one’s personal score)

— Making such situations more enjoyable for drivers, i.e. by taking traffic congestion as a given fact with no quick solution (an approach also used in the traffic companion application, section 6.4) and providing gameful activities incorporating ‘resources’ resulting from that situation.

In addition to the table above, I have explored possible points of application and goals in the mobility context in Figure 29, based on an analysis of the exploration of my literature review, previous models, the analysis of indices and case studies etc. Goals to achieve can for instance be derived from mobility-related liveability aspects as explicated in section 3.4.4. The goals described as examples in this section have been carefully compiled to the best of my knowledge, since applied gamification can be manipulative, an issue discussed in section 7.3.1.
4.1.3 Design: Game Design Elements

According to the conclusions in section 3.3.3, there is a wide range of game characteristics suitable for gamification. Instead of limiting and excluding game design elements for the purpose of gamification, I have highlighted the ones that I believe are most important below. I rely herein on Dignan’s Game Frame as it comprehensively describes a process to create a gameful experience, which, I propose, is the key to achieving enjoyment (enjoyment is usually the main reason why we play games, see section 3.3.2):

(1) Objectives: later named as points of application, i.e. challenges to address or goals to achieve in urban mobility

(2) Action – feedback – loop: feedback as core of a gameful experience

(3) Four player types: ‘achiever’, ‘competitor’, ‘explorer’ and ‘socialiser’ (derived from Bartle)
(4) **Resources**: depend on the application; for instance context-related resources, such as ‘location’ or ‘time spent in traffic’ might be incorporated

(5) **Skills** are met by game challenges that can either be related to mobility itself or to a substitute activity

These game design elements should be seen as design tools rather than as a one-size-fits-all approach and should always pay into the main function and thus goal. Therefore, game design elements need be applied carefully, bearing in mind the whole experience to be designed. Examples can be found in the following section.

### 4.2 Case Studies: Applications

What are the potential contributions of gamification to mobility? In this section I look at what practical applications have already been developed, with what aim and which game design elements. I have assembled a number of relevant applications, which sit in the design space defined above and include aspects of urban environments, mobility and game design. I will now describe the selected applications to give an overview of the existing field.

The addition of a digital layer in urban infrastructures (see section 3.1.3) allows data to be generated progressively and to be used in different ways and applications. Chromaroma, for example, uses the travel data of players retrieved from the Oyster card ticketing system in London’s public transportation (Mudlark 2011). The point of application in this instance is the public transport system and the goals could be increasing enjoyment for riders by increasing interaction and addressing the player types, as well as decreasing congestion at peak hours.

*SBB.Connect*, the recently launched application of the Swiss Federal Railways, combines features of Chromaroma with those of a social network like Facebook and takes them beyond the city limits. Frequent travel on any SBB route can ‘conquer’ it but since the system only recognises travel in the previous 60 days, a conquered route must be
continually defended. A chat function enables players to make contact with friends or strangers on the same train.

In addition to games that enable human-human interaction via digital networks, there are also those that forgo the digital detour. The *Cart-Load-O-Fun* project at the RMIT University in Melbourne, for example, explores the question of how social interaction can be encouraged in public transportation – that is, in spaces where very little interaction tends to occur despite the fact that many people are tightly crowded together. A temporary installation on Melbourne’s trams encouraged passengers to press sensors on hand grips in order to drive up a scale that was visible to everyone; more people participated and the harder those people pressed, the higher the value registered on the scale (Toprak et al. 2012).

Like *Cart-Load-O-Fun*, *Street Pong* is also based on an existing infrastructure – namely, the traffic lights at pedestrian crossings. Here, two participants on opposite sides of the street can play digital ping pong while the light is red. Once the light turns green and the game ends, the two strangers will encounter one another while crossing the street and perhaps get into a conversation – initiation of social interaction par excellence. The prototype developed by two students at the University of Applied Sciences and Arts in Hildesheim has just been implemented in 2015 (Urban Invention 2015).

What about other forms of mobility like the car? Influencing motorists’ individual driving styles could reduce many of the urban problems mentioned above such as congestion and emissions. *EcoScore*, for example, integrates an eco-training application into cars used in the car-sharing program *car2go*. Rewards and rankings increase interaction among users. According to the application’s creator, “We developed the EcoScore in order to help car2go members to better understand how predictively and environmentally friendly their driving is. It is comprised of three categories: acceleration, cruising and deceleration. We have illustrated the driving quality in each category with a tree. When your driving is particularly good, these trees may even host a number of animals” (Montag 2012).
The Honda *Anti-Congestion Tech* application monitors individual driving, detecting acceleration and braking patterns that might cause congestion. The system encourages motorists to drive more smoothly, resulting in higher average speeds and fuel efficiency improvements (Ingram 2012).

Another application, Volkswagen’s *SmileDrive*, claims to “maximize [sic] fun on every drive” by linking personal routes to a social network and providing several possibilities for interaction with either friends or other *SmileDrive* users (Volkswagen 2013).

These applications serve as good examples of how game design elements can be applied to urban mobility and consequently the potential such applications can offer. Table 8 summarises a range of different applications in relation to the aspects incorporated in my design approach. Smartphone based applications are in bold text.

<table>
<thead>
<tr>
<th>Goals</th>
<th>Gameful Urban Mobility Applications</th>
<th>Game Design Elements</th>
<th>Player types</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Clear Goal</td>
<td>Feedback</td>
</tr>
<tr>
<td>Track mobility</td>
<td><strong>Fitocrazy</strong> tracks fitness activities as in a game with points/levels</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Moves</strong> covers many daily activities like walking, cycling, and running</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Nike+ fuel band</strong> measures activities (distance, speed etc.); set goals</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Runtastic</strong> records running routes and offers analysis on parameters</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Strava</strong> tracks bike tours; offers comparison with friends</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>car2go Ecoscore</strong> feedbacks on efficient driving skills</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Honda Anti-Congestion Tech</strong> encourages motorists to drive more smoothly to avoid traffic jams</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Mini Minimalism Analyser</strong> feedbacks on efficient driving skills</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Mini Driving Excitement Analyser</strong>: points and levels for driving skills</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td><strong>Zendrive</strong>: app measuring and analysing a driver’s behaviour</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Trigger social interaction</td>
<td>Cart-Load-O-Fun: social interaction through physical exercise on a tram</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>CURBTXT: register with mobile and licence plate and text other drivers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Piano Stairs encourages people to use stairs instead of escalators</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Street Pong is a pong game at a pedestrian traffic light</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SBB.Connect is an app to connect with friends on the same train</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>VW Smiledrive is a social app to interact with other drivers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Enhance mobility experience context-related</td>
<td>Blankways suggests alternative routes for pedestrians</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chromaroma is a game based on personal travel data in subways</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Komoot is a social bike net with qualitative input (i.e. ‘nice route’)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Man—eater: a cartoon sticker on the tram’s window “eating” pedestrians’ heads as the tram is moving</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Porsche GTS Routes a social app, with qualitative input (‘nice route’)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>REXplorer is a location-based mobile game for tourists</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Walkonomics: app which indicates the greenest route from A to B</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>BMW snippy delivers short stories into the car</td>
<td>X</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Brightdriver makes driving fun through interactive audio games</td>
<td>X</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 8: Core game design elements of selected Gameful Urban Mobility applications

The applications are outlined alongside the game design elements I have defined as most appropriate for use in gamification in my research. I further structure the concepts according to what I consider to be their main function and thus goal, distinguishing between ‘track mobility’, ‘trigger behaviour change’, ‘trigger social interaction’ and ‘enhance mobility’, the later both context-related and not. Many applications could fit in to more than one category and accordingly have several goals; in this case I have chosen what I deem to be the primary one from a user’s perspective. For example, many of the activity tracking apps also trigger behaviour change towards an healthier lifestyle, i.e. by giving feedback on
one’s performance, and enhance social interaction, i.e. by incorporating competition features. Also, many of the bicycle apps, for instance, allow interaction by sharing pleasant routes with others as well as encouraging the exploration of a city by following qualitatively rated routes shared by others but their primary function is to track certain indicators and make them available to the user.

The variety of goals and corresponding complexity is discussed and considered with relation to an ethical background in section 7.3.1.

Looking at the table, it can be concluded that all applications incorporate fundamental game elements, such as clear goals, feedback and resources. These resources can have various characteristics. I presume that the resources are usually linked to the core activity. If the activity, for instance, is running and the application’s purpose is to track that activity, then resources could be any parameters resulting from that activity, i.e. the distance or the speed which are then displayed and further processed within that application. If the activity is cycling and the application’s purpose is to share the route with others, then the tracked route is the resource necessary to participate in that “game”.

The table also shows that different player types are being addressed, in some cases clearly linked to the goal, in others less obviously so. For instance applications tracking activities, i.e. running, typically address the player type ‘achiever’, as the information is usually used to either compare against one’s earlier parameters or, if also interactive, against someone else’s parameters. Applications that enhance mobility in a context-related manner usually address the player type ‘explorer’.

It is more difficult to clearly identify certain player types in applications that enhance the mobility experience without relation to a mobility or city context, i.e. by offering stories or games (refer to the two last examples in the table). The goal of those applications is to offer an enjoyable experience whilst on the move, but the enjoyability is drawn from substitute activities offered by that application. Although the overall goal can be identified as providing enjoyment, it is not possible to clearly link it to game design elements, such as feedback and resources – aspects
found in all of the other evaluated applications. These aspects may exist within the substitute activity as may player types, but they are not specifically linked to the mobility experience. In such cases mobility is merely a random environment for playing these games.

The two applications *BMW Snippy* and *Brightdriver* have been evaluated nonetheless, since they are smartphone apps offering games or enjoyability in the context of mobility. Anticipating the evaluation of one of my own prototyped applications (see section 6.4.5), I propose that incorporating mobility aspects in applications, such as driving or location data, can enhance the overall experience by making it specific to mobility.

But before anticipating the projects, the following section examines how they have been identified and defined.

### 4.3 Gameful Urban Mobility

In order to prepare the projects and better understand, what manifold possibilities can be considered for Gameful Urban Mobility applications, I have explored interconnections between urban mobility and urban design on the one side and game design on the other in Figure 30. The ultimate enabler for all sorts of applications between these facets is digitalisation, the ultimate (mobile) device the smartphone. Both allow accessing the full potential of these manifold connections by linking city and mobility aspects with game design elements in gameful applications.

Starting from the left, I build on findings from earlier sections, such as points of application in mobility and the case study to identify ‘game resources’ in mobility in the previous section. Further reading the figure form the left, I propose that urban design and urban mobility aspects can add *relatedness* to game design by delivering the context; relatedness being one of the two dimensions in a city relevant in the context of liveability (see section 3.4.1). And, reading the figure from the right, game design adds *gamefulness* to urban design and mobility; gamefulness being a quality towards increasing enjoyment and triggering intrinsic motivation. The manifold interconnections between game design...
and urban design or urban mobility are explored from these two perspectives.

Examples for interconnections from a mobility perspective are city data or mobility patterns which could serve as input for gameful applications. Examples from a game design perspective are game elements previously discussed, such as different forms of interaction, which could be applied to and enhance urban mobility.

In addition to points of application as initially defined in section 3.2.1, I have explored what I call ‘moments of mobility’ which describe not only a device or mode of transport like riding a bike, but add a temporary condition or circumstance for example “uphill in the rain” (see also the
previous section). The purpose is to extend the variety of points of application in urban mobility by giving what I introduced earlier as ‘incidents’, a dynamic or temporary notion, dependent, for instance, on time or weather.

Some of the Gameful Urban Mobility examples given in the section above already incorporate this notion: Street pong, a pong game played at a pedestrian traffic light, is only active when the traffic light is red. The point of application in this case is thus not the traffic light itself, but the temporary situation of the traffic light being red and therefore obliging pedestrians to wait.

I have further explored aspects in urban mobility and urban design that could have an impact on the game experience, i.e. by serving as input, chance or bonus, and could consequently be considered as game resources. Examples are the typography of a city or the distance covered.

This exploration is far from complete and I reflect on further potential in the discussion in section 7.1.3.

After exploring opportunities within the Gameful Urban Mobility design space in this chapter, I conclude with some basic considerations towards identifying situations for practical projects in the following section before describing the projects in detail in the next chapter.

### 4.4 Conclusion

In this chapter I have developed and elaborated my design approach with the three elements context, conflict and (iterative) design based on my top-down perspective in the previous chapter. I believe that this approach is suitable as a general structure for systematically conceptualising, designing, developing and implementing solutions addressing urban mobility challenges. In order to both achieve a better understanding of the practicability of my design approach and to deliver a proof-of-hypothesis with concepts and applications, I will conduct a series of practical projects that are described in the following chapters.
I have therefore chosen three different cities on three different continents and three different forms of mobility. The criteria for the selection of the projects not only involved ideal scenarios for how to achieve a wide variety of projects towards verifying my hypothesis, but also facets making the projects feasible, such as contacts to city authorities or academics for practicable implementation as well as funding opportunities. These contacts also helped in realising participatory methods as introduced in section 2.4, i.e. getting access to local students or citizens for workshops.

My broader research questions, as introduced in section 2.2, serve as guidelines for the projects:

— What design approach can be employed to make urban mobility more enjoyable in different modes of transport?
  - How is enjoyment in mobility perceived in different cultures and cities?
  - What are specific mobility challenges and goals in different cities?
  - Which game design elements and gameful experiences are suitable for application?

Additionally, the projects have been conducted along more specific questions:

— As one of Germany’s foremost cities for cycling:
  - How can the attractiveness of bicycle mobility in Karlsruhe be enhanced through gamification?
  - What are forms of social identity in mobility and how can they be adapted to the group of cyclists?

— As a city with high traffic jam occurrences:
  - How can challenges resulting from automotive mobility in Beijing be addressed by gamification?
  - How can a smartphone be used to determine mobility patterns?

— As one of the world’s most liveable cities:
  - How is Melbourne’s liveability represented in mobility options and patterns?
• How can the digital layer in cities contribute to a better mobile experience?

In terms of technically implementing a concept, I focus on the smartphone across all projects as a device with manifold advantages described above, and aim to make optimal use of its functions and sensors in the way fitness apps already do. Let’s dive into the projects in the following chapter.
5 Projects

In order to test my design approach, and in accordance with my research questions, i.e. considering different cities and modes of transportation, I have undertaken a series of practical projects that use participatory design and research-through-design methods to generate ideas and concepts for addressing points of application in urban mobility. Referring to Figure 4 on page 13, this part of the dissertation is the bottom-up perspective, which, in combination with the top-down perspective covered in chapter 3 and 4, will result in Gameful Urban Mobility concepts and applications.

In this chapter, I describe how I have selected the three projects, which are explorative journeys in three cities resulting in conceptual applications towards answering the core question of this research – namely, how the implementation of game design elements in mobility can create enjoyable mobile experiences against the backdrop of liveability.

The projects combine various participatory elements, including collaborative design workshops, studios and seminars open to students and urban citizens, along with my own independent work. In addition, I have applied the research-through-design method with its elements: iterative creation, documentation of the design process and evaluation to achieve and refine outcomes such as concepts and fully functional prototype applications. Figure 31 shows some aspects of the three projects, such as the cities, the forms of mobility focused on and the steps that have been taken.

In participatory formats, workshop participants collaborate on the conception of ideas and development of concepts by applying game design elements and methods to points of application in urban mobility. The projects also include data collection of mobility challenges in selected cities, which is another aspect I intend to investigate. The data was compiled using qualitative methods like site visits, structured observations or interviews, then analysed and utilised in concepts and designs. This approach is a common one in design research disciplines as well as Architecture and Urban Planning, which I have studied.
The goals of the projects are according to my broader research questions as follows:

— To individually and collaboratively investigate points of application and challenges in urban mobility, such as, congestion and pollution due to motorised traffic;
— To brainstorm, conceptually design and prototype gamified solutions to those challenges, towards enhancing enjoyability and liveability, in a variety of forms, e.g. concept presentations and early-stage (mobile) software applications;
— To gain a preliminary understanding of the design possibilities and limitations of applying game design elements to urban mobility and to thereby contribute to the existing literature on urban mobility, urban design and game design (see discussion in chapter 7)

My participation in the projects is informed by my academic, practical and design experiences. It was my responsibility:

— To design, manage and lead each project;
— To provide knowledge for participants on relevant topics such as mobility, urban environments and game design;
— To inform participants about appropriate methods;
To apply my design approach independently and to use it as a base for conceptualising and designing solutions to the identified points of application.

With these projects I thus intended to both interpret and enrich the theoretical findings (refer to chapter 3) and validate and refine my proposed design approach (see chapter 4).

5.1 Project Outline and Goals

The three cities Beijing (CN), Melbourne (AUS) and Karlsruhe (DE) have been chosen for projects. My intention with the practical projects was to look at three different modes of mobility in three different cities on three different continents to better understand both varieties in challenges and forms of enjoyment in mobility, in addition to other questions to be answered in the respective cities. Since the projects are intended to address a wide variety of situations, a wide variety of factors were taken into account in their design, including national environment, size, climate and shape of the city and its respective mode of transport (see Table 9), comprising for instance the findings on mobility foci explained in section 3.1.2 and on liveability in section 3.4. Melbourne has been ranked the Most Liveable City of the World many times.

<table>
<thead>
<tr>
<th></th>
<th>Beijing (CN)</th>
<th>Melbourne (AUS)</th>
<th>Karlsruhe (DE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continent</strong></td>
<td>Asia</td>
<td>Australia</td>
<td>Europe</td>
</tr>
<tr>
<td><strong>Inhabitants</strong></td>
<td>&gt; 20 million</td>
<td>&gt; 4 million</td>
<td>~ 300,000</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td>5,200 inh./sq km</td>
<td>1,500 inh./sq km</td>
<td>2,900 inh./sq km</td>
</tr>
<tr>
<td><strong>Mode of Transport</strong></td>
<td>Automotive</td>
<td>Mobility system, different modes</td>
<td>Bicycle</td>
</tr>
</tbody>
</table>

Table 9: Comparison of relevant factors in Melbourne, Beijing and Karlsruhe.

As such, the projects cover diverse cultural backgrounds (e.g. Western/European and Australasian) and diverse urban populations, ranging from the approximately 300,000 inhabitants in Karlsruhe to more
than 20 million in Beijing. The selected cities also vary in their densities from relatively high in Beijing with 5,200 inhabitants per square kilometre to fairly low in Melbourne with only around 1,500 on average (Demographia 2013); please note: the demographic data from this source can only indicate a tendency, since it is based on different years.

Density, as one facet, obviously has an effect on mobility options and offers as well as GDP (refer to Figure 8 on page 19). Accordingly, the mobility focus in each project is different; in Beijing on individual automotive mobility, in Karlsruhe on bike mobility, and in Melbourne, on a mix of different forms of mobility. Locals have been invited to participate in the respective workshops/seminars not least in order to provide insight into the specific cultural and practical conditions of mobility in their city.

I have a personal connection to all three cities by either living or visiting and working in them for a period of time. Being a trained architect and urban planner I can, generally speaking, easily comprehend cities in terms of its structure and mobility system. I am currently living in one of the cities, Karlsruhe, which I therefore know very well. In the other two cities I have applied participatory design (i.e. collaborative workshops and design) as a method to involve local citizens both in the research and the design process as a way of enhancing my own knowledge. This also included local fieldwork and interviews.

A workshop organised with Peking University and sponsored by industry partner Audi China was conducted in Beijing from 12-17 August 2013. It was offered to Peking University master’s degree students supervised by Professor Zhao Chen Ding, Deputy Director of PKU’s Games & Interactive Media Research Lab (see the following section for further details). Another workshop took place as a Melbourne Knowledge Week offering on 29 October 2013, promoted and open to all Melbourne citizens. The project in Karlsruhe was conducted in collaboration with local authorities in 2013 as part of a competition to conceptualise an application for bicycle mobility. It will be prototyped and made available for the public in the context of the 200 years celebration of the ‘draisine’, the predecessor of the bike invented in Karlsruhe, in 2017. Table 10 summarises the different approaches.
Aside from a deeper knowledge about mobility challenges and forms of enjoyment, the project outcomes were initially various concept ideas for each city, some of which have been further detailed. One of these design concepts, the idea of a virtual traffic companion in Beijing, has then been refined by research-through-design methods such as creation and documentation, resulting in the first prototype application as a proof-of-concept. This was again evaluated and reflected, hence iteratively refined, resulting in the second prototype with a different technical focus.

Since the project in Beijing has been developed the furthest, I start with describing the other two projects within this chapter and devote the following chapter 6 to explain the Beijing project.

### 5.2 Project in Karlsruhe: RADiate

The project in Karlsruhe was conducted as part of a competition with the following task, derived from Karlsruhe’s strategic goals: “How can the attractiveness of bicycle mobility in Karlsruhe be advanced through gamification?” This is likewise my research question for this project. In order to re-confirm and situate resulting points of application and
challenges according to my design approach, I chose the method of structured observations as defined by anthropologist Geertz (1973), over participatory formats used in Beijing and Melbourne with the intention of including local insights.

This method incorporates the researcher’s background and view when interpreting observations and making assumptions. It therefore corresponds with the methodology of this research, which I have situated in section 2.4. To observe and consider the observations with relation to one’s own experience is also the way I have been trained as an architect: When starting the design process, in addition to technical aspects or a site analysis, social and anthropological facets are also taken into consideration since buildings are usually inhabited by humans.

I am currently living in Karlsruhe and personally experience the city with a variety of forms of mobility, such as walking, cycling, driving or taking the tram. Based on my knowledge of the city, I use pictures and explanations in the following section in order to convey the local perspective.

5.2.1 Point of Application and Challenges
Situating the pre-defined goals with regards to my design approach, the point of application for this project is bicycle mobility on a systemic level and the challenges are described in the following paragraph.

In comparison to the other two cities, Karlsruhe is very small with 300,000 inhabitants. Typical mobility challenges, which have been identified in Beijing and are more likely to be found in larger and denser cities, such as traffic congestion, are only present to a much lesser degree in Karlsruhe. However, due to an extensive reconstruction of the local train and tram network resulting in street closures and detours, see Figure 32, Karlsruhe has made it into the top three German cities in 2015 when it comes to traffic jams (Beeger 2015).
Nevertheless, in general today’s mobility mix contributes to a low congestion rate: About half of Karlsruhe’s trips are made with non-motorised individual mobility alternatives (24% pedestrian and 25% bicycle share), 34% by motorised individual transport and 17% by public transport (omniphon 2012). This high share of bicycle mobility is visible throughout the city in the form of an extensive bike network; two examples are shown in Figure 33.
Karlsruhe’s strategic goal for 2025 is to further increase the share of sustainable transport, specifically pedestrian and bicycle mobility (Karlsruhe 2013). This can be considered as the broader goal to achieve in this project. As part of a Karlsruhe city marketing competition to achieve this goal, the concept ‘RADiate’ has been developed in the context of this research and successfully submitted with realisation intended for 2017.

The strategic goal for the concept is to enhance bicycle mobility by strengthening the relatedness dimension as introduced in section 3.4.1. and according to the core hypothesis of my research. As a solution for short-term implementation, a digital (gameful) application is conceptualised.

The functional dimension, for example more bike lanes or a better bike network, can also contribute to achieve Karlsruhe’s strategic goal, but with an expected longer implementation timeframe and not as part of this dissertation’s scope. Interaction and identity features have been identified as key elements for enhancing the overall attractiveness of a type of mobility (refer to the discussion of identity in mobility in sections 3.2.3 and 3.4.1).

The design process of RADiate is illustrated in the following sections beginning by defining the application’s core functions derived from the overall goals. Knowledge gained from similar applications has been incorporated and potential hindrances were thereby anticipated in discussions with both stakeholders and developers of applications.

5.2.2 Concept goals

The overall goal for RADiate is to enhance bicycle mobility by making cycling more enjoyable as well as strengthening the identity of the cycling community in Karlsruhe. The application should therefore address many different types of cyclists, for instance those who commute by bicycle or those cycling for leisure or exercise purposes in and around Karlsruhe. Certain game elements including challenges and feedback have been chosen in order to increase interaction among cyclists and enhance the
experience of cycling as a whole. The intention is to address all four player types in order to reach a broad community: challenges for the competitors, location-related content for the explorers or interaction functions for the socialisers.

In addition to this conceptual framework, two further goals for the application were defined in discussions with the stakeholder:

— It should allow the incorporation of location-specific or temporary disruptions, such as the traffic restrictions due to Karlsruhe’s current major infrastructure overhaul (refer to the idea of incidents in my categorisation of urban mobility in section 3.2.1)

— It should contribute to building a cycling community in Karlsruhe including features with the possibility for users to communicate, to set tasks and challenges for other users as well as to create their own content (refer to the idea of identity, strengthening the relatedness dimension and hence liveability)

Related Work

When developing the RADiate concept with its core functions (see next section), related work initially involves fitness trackers, which include bicycle activity. In addition to the overview of such applications in section 4.2, I describe concepts directly related to RADiate in the following.

The Nike+ fuel band was one of the first of its kind. It measures distance, speed, time and calories burned while running. It can be linked to a computer where runs can be tracked, goals set and competitions with other runners initiated.

Fitocrazy uses a similar approach, namely to track fitness activity, however, it is able to distinguish between different forms of activities so is not limited to running like the Nike+ fuel band. The application works in a similar way to a computer game with points to be gained to reach the next level. Some levels also have particular challenges like running an extra circuit. An activity-specific group can be joined for competition with fellow athletes.
REXplorer is a location-based mobile computer game for tourists in the German city Regensburg. It involves a digital network of information to be experienced while moving through the physical city, based on google maps with location-based tasks, links and rewards. Some of the reviewed applications are illustrated in Figure 34.

![Figure 34: Related work: Fitocrazy, Nike+, Komoot and Strava](image)

Aside from fitness trackers, there are social activity networks for cycling available as well as location-based games with corresponding tasks, all of which contain aspects that are used in the RADiate concept. Komoot and Strava are both social bike networks including a route planner that allows users to submit qualitative evaluations like “nice route” or “steep section”. Komoot tracks routes and focuses more on the social component, for instance with a function to share good photo locations, whereas Strava’s emphasis is on the activity of cycling itself and the competition aspect using features similar to fitness trackers.
Core Functions

The following core functions have been incorporated into the RADiate application, derived from the concept goals described earlier and with the aim of addressing both different types of cyclists (i.e. those who cycling to work or for leisure or exercise) and reflecting all player types:

— A digital bike network with the possibility for users to add (and retrieve) qualitative information on routes and places, in order to increase the connection of local cyclists with their city/environment

— Social network functions, including for example coming to the aid of a nearby fellow cyclist with a pump when they have a flat tyre (see Figure 35), a sharing function to loan bikes and exchange views with authorities

— Challenges, as for example finding the quickest route between two points, using the bike in all weather conditions and delivery of shopping for elderly people

The possible appearance of such an application is illustrated in early stage visualisations, shown in Figure 35 and Figure 36.

Figure 35: Core functions of RADiate include social interaction
To increase the overall attractiveness and location specificity of this application, the intention is to work with local, bike-related businesses and the local public transport system to offer benefits for community members, for instance based on their contribution to the social network or if meeting a challenge.

5.2.3 Outcomes, Current Status and Evaluation
To date, the main outcome of this project is a detailed concept description, which has been presented as part of the competition. It is attached in the appendix; all essential content is illustrated in the sections above, though. The city of Karlsruhe’s marketing board decided to implement this concept by 2017, after funding has been confirmed.

Since the application has not yet been realised, user evaluation has not been possible. However, when anticipating possible drawbacks in discussions with potential development partners and the city of Karlsruhe’s marketing board, one key parameter for an effective
implementation was assumed to be a sufficient number of users and relevant partners right from the start; because of the application’s many interactive, collaborative, and community-based features, a substantial number of users seems necessary to make the application relevant to the target group. Therefore, the idea was to distribute the application to students of local universities, many of whom are regular cyclists, and grow the network from there. In order to address legal issues related to the use of smartphones while riding a bike, a smartphone holder will be provided with the application.

Look out for Karlsruhe’s 200 years celebration of the draisine in 2017!

5.3 Project in Melbourne: trace.MEL

An urban renewal project, initiated in 1985, was probably the origin of the high standard of liveability, with which Melbourne has now been associated for many years (Gehl 2010;15). To incorporate local knowledge, a one-day workshop as a participatory format was offered during Melbourne Knowledge Week on 29 October 2013 at RMIT’s Design Hub, promoted and open to all Melbourne citizens.

Fifteen participants joined the workshop, aged from mid 20s to mid 50s. They were mainly academics in one of the fields of this research (e.g. game design or urban planning) and generally interested in and knowledgeable about mobility issues in Melbourne. Due to time restrictions, no empirical studies were undertaken such as the random interviewing of passers-by. Instead, the workshop participants were answered questions. The limitations of this method are discussed in section 7.1.2 in contrast to the method applied during the workshop in Beijing, where passers-by, not experts, were interviewed.

The outcomes are described in the following sections.

5.3.1 Workshop Outcomes

A core aspect of this research is investigating challenges and forms of enjoyment in mobility in different cities. I therefore first collected
participants’ feedback on the two questions below. Compared to the workshop in Beijing where interviewees were chosen randomly (described in the following chapter), I could assume that participating citizens in Melbourne were generally interested in and familiar with mobility issues. I reflect on that difference between the workshop participants in the two cities in the discussion in chapter 7.

The collected answers to the first question “What are challenges in mobility?” were then grouped as follows, based on my own assessment:

- Barriers for access to mobility
  - Language barrier
  - Payment systems (i.e. myki, Melbourne’s prepaid travel card)
  - Digitalisation (i.e. access to travel information and tickets for citizens without smartphones)
  - Socio economic issues
  - Lack of local knowledge
  - Access to transport modes (in terms of distance)
  - Access for wheelchair users and the elderly
- In the context of disability: isolation, a lack of information or independence, access to community
- Congestion during events (when walking)
- Technical breakdown of mobility devices
- National disasters (bush fires) that cause road closures

To conclude, the majority of answers relate to the general aspect of access to mobility, rather than on challenges that might be perceived as ‘typical’ for today’s urban mobility which were introduced in the very beginning and further detailed in section 4.1.2, for example, congestion or pollution.

The second question “What is enjoyment in mobility for you?” led to these answers:

- Having mobility options
- Not being reliant on the car
- The flexibility of trams:
  - The ease of getting on and off trams
- Large tram network
  - Walking, because one is ‘in control’ and gets a good sense of the city
  - Walking through a park
  - Cycling along the water
  - Coming by places
  - Discovering ‘laneways’ (narrow alleys, typical for Melbourne) and back streets in the city
  - Enjoying the view while driving on Westgate Bridge
  - Experiencing the wind while walking or riding a bike
  - Being able to track mobility

To conclude, I propose grouping the answers around two topics: firstly, enjoyment is derived from the way in which one is mobile (first three list points), and secondly from the enjoyment of the city while being mobile. The last answer (namely, that enjoyment is derived from tracking mobility) confirms the potential of examples given in the previous chapter where bicycle applications track physical activity. I compare these outcomes in section 6.2 with the Beijing workshop outcomes.

The participants were then introduced to the topic and presented with relevant knowledge about the research area, including Mobility, Urban Environments, and Game Design. Based on this knowledge and the answers to the afore-mentioned questions, workshop participants were asked to brainstorm and develop ideas addressing one (or more) chosen challenge towards more enjoyment in urban mobility along the following guidelines:

- What is the mobility challenge?
- What goal should be achieved?
- How would Melbourne look in 2025 with this challenge addressed?
- How would this increase enjoyment?

First, envisioning a future scenario (third bullet point) often serves as an anchor towards ideating solutions for an identified mobility challenge in the present day; refer to the scenario planning process, described in section 6.1. The following figures show a sample outcome of a group
working along the design approach towards conceptualising a bicycle application.

Figure 37: Sample group answering guiding questions

At first, general guiding questions were answered, see Figure 37, and then game design elements, drawn from Dignan’s (2011) behavioural game scheme, were applied to develop a concept addressing the chosen mobility challenge, see Figure 38.

Figure 38: Sample group incorporating typical game design elements into their concept
5.3.2 Concept Description
Reflecting on the workshop outcomes, i.e. forms of enjoyment in mobility, which characterise Melbourne; rather than starting with mobility challenges I chose to focus on the broader idea of liveability as one of Melbourne’s core elements, which corresponds to the overall goal. Melbourne’s liveability is embodied, for instance, by its variety of places and people, or by characteristic elements contributing to Melbourne’s unique identity in the urban mobility context. Such elements include laneways, water (i.e. the bay and the Yarra river), parks and mobility options in general, and add to an enjoyable experience in the city, as identified by workshop participants.

The concept trace.MEL targets visitors and aims to build a connection between them and the city they are discovering. The core element of this concept is thus not to address a mobility challenge, but to increase relatedness and identity between the visitors and the city. Mobility is still the means to achieve this. Corresponding to the research question “How can the digital layer in cities contribute to a better mobile experience?”, the concept is designed as a smartphone application, leveraging the potential of the digital city as elaborated on in section 3.1.3.

Concept Goals
The core service of trace.MEL is
— To trace and visualise routes of visitors while discovering the city
— To allow them to highlight their favourite spots en route
— To incorporate Federation Square as an urban intersection where visitors (and locals) meet

Based on the notion “the city as game resource”, the point of application is mobility on a systemic level and the goal is to enhance Melbourne’s identity as a multi-cultural city, incorporating the variety of places, people, ethnicities and suburbs, as well as increase the relatedness dimension of visitors. Game design elements include feedback and the player types focused on are explorer and achiever. Users most suited to this application are visitors who enjoy exploring the city and sharing their
experiences as well as getting feedback on their movements through the city (i.e. in the form of a digital track record as a souvenir).

**Related Work**

There are several applications available that deliver an additional information layer to visitors or allow tracing their mobility behaviour and contributing to the community. Examples can be found in section 4.2 and include REXplorer, a location-based game for tourists enhancing their experience in the city of Regensburg, and bicycle apps like Strava that allow tracking routes and comparing them with friends.

**Core Functions**

Based on the use of smartphones and their sensors, traceMEL has the following core functionalities:

— Visitors download the application and register using the free WiFi at the visitor information on Federations Square

— They are assigned a colour according to their home country

— During their stay in Melbourne all their mobility activity is anonymously tracked, i.e. where they go and what mobility devices they use, using the GPS sensor or their smartphone (see the next section for a detailed description of the technical functionality of smartphone sensors)

— They have the possibility to mark their favourite places with a simple one-push function, when they are at the particular location

— Their mobility behaviour will be visible on a display at Federation Square’s visitor information, showing all recorded routes anonymously in real time (with 1 hour delay for safety reasons), overlapping and fading out after 24 hours; the top 5 visitor colours will be shown, the rest displayed in grey

— A heat map of the favourite places will also be displayed

— Their individual route is available for download from their personal account
This application is attractive both for visitors and the City of Melbourne. Benefits for visitors are for instance:

— To earn about one’s personal mobility behaviour
— To take the visualisation of their personal route home as a souvenir
— To remember their favourite places

Benefits for the City of Melbourne could be:

— To know about where visitors come from, how long they stay, where they go and what mobility devices they use
— To know about their favourite places

5.3.3 Outcomes, Current Status and Evaluation

The concept has been suggested to City of Melbourne authorities and the implementation potential discussed with the City of Melbourne’s innovation department. Due to organisational restructuring, it is currently on hold.
6 PROJECT IN BEIJING: TRAFFIC COMPANION

This project took place in the dense Asian city Beijing with typical congestion problems (Oelrich 2015), as corroborated by the fieldwork (see section 6.2.1). It involved three stages:

— An initial workshop was held in August 2013 designed to feed into my main research questions (see section 2.2) as well as the more specific one for Beijing: “How can challenges resulting from automotive mobility in Beijing be addressed by gamification?” Outcomes included fieldwork and research on challenges and enjoyment in Beijing and the conceptualising of Gameful Urban Mobility applications, based on my design approach.

— Derived from these ideas, one concept was implemented in collaboration with the Mobile Applications Research Group at Stuttgart Media University, supervised by Prof Dr Ansgar Gerlicher, Assoc Prof Dr Steffen P Walz and myself.

— Based on the evaluation of this first implementation, a second revised prototype has been developed as part of a Bachelor thesis along the research question: “How can a smartphone be used to determine mobility patterns?”, again in collaboration with the Mobile Applications Research Group at Stuttgart Media University and under supervision of Prof Dr Ansgar Gerlicher, Assoc Prof Dr Steffen P Walz and myself.

6.1 Workshop

The workshop was held in Peking University’s Creation Park in Yizhuang (Beijing) over six full days. Participants were local (i.e. Chinese, inhabiting Beijing) master’s students, two out of three female and with the following backgrounds:

— Interaction Design: 9 students (Peking University)
— New Media Design: 2 students (Beijing Institute of Fashion Technology)
— Visual Communication: 1 student (Beijing Institute of Fashion Technology)
The workshop in Beijing was designed around five phases in order to reflect current knowledge in the various relevant fields as detailed in chapter 3 and address the research questions outlined in section 2.2. It was designed with the focus on automotive mobility but also included other forms of mobility during research and fieldwork (see phase 1 to 3).

In Phase 1, the students were introduced to the topic and presented with relevant knowledge about the research area, including Mobility, Urban Environments, Game Design and Liveability as well as to the design approach as an overall guideline to follow. This phase also involved a presentation of the Audi brand and target customers in light of the partnership with Audi China.

In Phase 2, students were asked to present an object, photo or drawing illustrating enjoyment in mobility from their individual perspective, according to their cultural background and own mobility experiences.

In Phase 3, they were introduced to my early stage design approach and asked to identify current challenges in urban mobility; see section 4.1.1. The goal was to identify examples of challenges as a fundamental part of the design process rather than conducting an empirical study. Methods included a questionnaire for structured observation developed by Diekmann (2002; 474-480) and filled out by the students along with a second questionnaire to help them conduct interviews with mobile citizens of Beijing (see Figure 39). The questionnaires were developed and supplied by myself. The students were also asked to additionally gather images and/or videos during their field research in order to visualise and document their findings. To increase the variety of those findings, the students were split into groups of three to four and sent to different areas, where the relevant target groups of car-drivers were expected, according to the project focus on automotive mobility; for example shopping malls with parking facilities.
In Phase 4, the students, again working in groups of three to four, were asked to develop an urban mobility vision for 2025 based on the scenario planning process (Martin & Hanington 2012;152), before designing a concept for short-term implementation. Developing a vision at first serves as an anchor in the future towards ideating solutions for one identified mobility challenge of today (ibid). The students were asked to incorporate their idea of enjoyment into their vision as an overall goal, focus on automotive mobility and consider the Audi brand values (as a sponsor).

In Phase 5, the students developed a detailed concept, following the design approach and their own vision, meeting these criteria; the concept should:

— Address an identified challenge in automotive mobility
— Increase enjoyment
— Be practicable and feasible for implementation in 2013/2014
— Reflect forms of enjoyment in Chinese culture

Figure 39: Questionnaire for field research.
As a core element of the design approach, students were asked to incorporate game design elements of their choice to create a gameful experience, based on Dignan’s (2011) behavioural game scheme introduced in section 3.3.2. For both the brainstorming session and the development of a detailed concept, students were divided into the same groups, in which they had conducted field research and analysis, and supervised by myself.
6.2 Workshop Outcomes

According to the workshop design, different formats of outcomes have been produced for each phase and presented to the group.

6.2.1 Fieldwork

In Phase 4, described above, 30 questionnaires were returned in total with multiple answers possible.

(1) Figure 52 shows the answers to the question: *How are you mobile?*

![Bar chart showing mobility forms of the interviewees](image)

As this research shows, automotive mobility (in red: car, taxi) is the primary mode of transport in Beijing for those interviewed, followed by public transport (in dark grey: subway, bus).

There was a very low incidence of mobility forms commonly perceived as sustainable and with a positive impact on liveability, such as walking or cycling (see chapter 3 and the earlier example of Karlsruhe); shown in light grey.
(2) Figure 43 displays the answers to the question: *What are challenges in mobility?*

![Figure 43: Mobility challenges for the interviewees](image)

Corresponding to the high share of automotive mobility, most challenges are car related (in red), such as traffic jams or being bored while driving. Congestion can also be found in public transport (in grey). This outcome is in line with current research, see for example Oelrich (2015).

(3) Figure 44 shows the answers to the question: *What is enjoyment in mobility for you?*

![Figure 44: Enjoyment in mobility for the interviewees](image)

It can be concluded, that not many people enjoy mobility due to the mobility experience itself, i.e. when walking or enjoying the scenery (shown in red). Due to boredom and a lack of pleasure derived from being mobile, people tend to do substitute activities like listening to music.
6.2.2 Concepts
Each of the four groups of students then developed one concept, applying gamification to a mobility challenge they had identified during fieldwork. The four concepts are summarised as follows:

(1) *Every Parking* is a concept targeting the difficulties finding a parking spot. The idea is to turn the time taken up searching for a spot into a currency for an auction for empty spots. So the longer you look for a parking spot, the more likely you will be directed to one.

(2) *Hello Car* aims to increase friendliness among drivers addressing the driving irritability syndrome with road rages. The core idea is to have a communication feature attached to the outside of a car, for example in form of a monitor that is able to display (friendly) messages to other drivers.

(3) *Audi City* is turning the time that is involuntarily spent in city traffic into a resource for a virtual city development game. Similar to the *Every Parking* concept, the amount of disposable resources increases with the time spent in traffic.

(4) *Diki* (later named *Traffic Companion*) is a virtual traffic companion addressing feelings of loneliness, restlessness and depression due to city traffic. Accompanying, socialising and assisting are the core functions to overcome those negative threats.

This last concept was chosen for further development and prototyping as described in the following section. The reasons were primarily its feasibility and potential, and secondly because it is based on a smartphone without the need to incorporate further elements, such as real parking spots, which decreases the complexity for implementation. According to the iterative design process described in section 4.1, the prototyping involved several stages that are elaborated in the following sections.
6.3 Traffic Companion: First Prototype

The development of the first prototype was offered as a semester project to all Stuttgart Media University students. A group of seven students got together to develop this application, based on the idea of a social traffic companion (see concept 4: Diki in the previous section).

As just illustrated, this initial concept idea was one outcome of the participatory design process with students in Beijing applying game design elements to urban mobility in order to achieve an enjoyable experience. Being asked to provide a picture for an enjoyable traffic situation in phase 2 of the workshop, one student showed a picture of a cat sitting in a bicycle basket as a metaphor for a social companion whilst en route (see Figure 45).

![Figure 45: The Idea of a Social Companion](image)

This image seemed perfectly suited as a starting point for the idea of the social companion Diki. The question now was, how this idea of a social companion could be transferred into a smartphone application and what functions were needed? To answer these questions, the concept was further detailed as the first evaluation of the iterative design process, which is described in the following section.

6.3.1 Detailed Concept Description

To achieve a solid basis for the development of the first prototype application, it was necessary to provide the students with comprehensive information. The original Diki concept was therefore revised and the following aspects, shown in Figure 46, were determined for the renamed
Traffic Companion application and presented to the students at the start of the project as a briefing.

**A gameful application on the smartphone for citizens of Beijing**

The TC app:
- addresses automotive lifestyle during Stop-and-Go phases and traffic jams and recognises if a driver stands or drives. It uses mainly non-disturbing types of input, e.g. voice, and large interface elements.
- offers very small ‘quests’ if the driver stands for more than 10sec (=active mode).
- cannot be interacted with when the driver accelerates and when the vehicle moves (=passive mode). However, the app can be configured to read news, entertainment, messages etc to the driver whilst in passive mode.
- entertains and connects the driver to make the traffic jam more enjoyable. Examples of active mode interactions include e.g. simple yes/no, hot/not, 1-to-10 quizzes, to keep the driver socially connected, e.g. by rewarding if the driver has - self-reportedly - called his family already. This earns the driver points.
- influences and trains drivers through quests, to act more 'swarm' compliant and thus cause less traffic jams, i.e. by avoiding lane and tempo changes, bottlenecks, heavy traffic and stop-and-go sections, road congestions etc.
- encourages vehicle users, through quests, to travel during less busy times.
- is a virtual companion

**Example quests:**
- Micro quizzes: “Today’s weather: better or worse than yesterday?”
- Time spent in traffic jam translates into currency that can be spent on virtual items to redress companion or add items
- Compete compete against other companion => status comparison
- “Drive one tempo for as long as you can!” (the longest driving driver will be measured and rewarded, and receive a “Flowstar of the Day” badge)
- “Stay in one lane for as long as you can!” (the most constant drive will be rewarded)
- User-generated quests

**Optional**
- Specific “cute” iPhone holder like ubooly.com

Figure 46: The refined concept for Traffic Companion as presented to the students

In addition, the original concept idea, including its derivation through different workshop phases, was presented to the students to provide the necessary context.
6.3.2 Outcome and Evaluation

With this image of a positive, enjoyable mobility experience in mind, the first prototype of Traffic Companion was designed. Conceptually, the user would have a choice of several characters with different appearances, one of which was implemented (see Figure 47).

![Figure 47: The First Prototype of the Traffic Companion](image)

This prototype reflects the ‘cutesy’ nature of the original workshop idea in its design and much effort has been put into ‘bringing it to life’ with facial animation and sounds – although it is automated and cannot interact like a ‘real’ companion. Additionally, some mini games and quizzes have been developed based on the requirements of the traffic situations and incorporated in the application. The user interface for these games is voice-controlled with only multiple-choice answers. However, not all of the conceptualised content (refer to Figure 46) could be implemented due to limitations in time and resources. And this prototype lacked core functionality for running automatically – primarily a solid detection feature; the games had to be started manually by waiving a hand. Appropriate testing was therefore not possible.

This is why a second iteration of the Traffic Companion prototype, described in the following section, was developed with the main focus on reliable automated detection.
6.4 Traffic Companion: Second Prototype

The core question for this iteration was how the mobility rhythm in a city can be detected and used with a smartphone as input for automatically offering gameful diversion. A mobility rhythm results, for example, from a driving-stopping pattern of a given mobility device and is thus context related, for instance in regards to congestion or traffic lights.

With the research-through-design method (creation, documentation, evaluation) a second proof-of-concept prototype application was developed to demonstrate that it is possible to recognise such traffic patterns using only the built-in sensors of a smartphone, and during these pattern phases, to automatically offer enjoyable diversion to the user. This pattern approach is similar to the way fitness apps utilise smartphone sensors to track distance or velocity (Runtastic 2015). Solutions monitoring traffic conditions as, for instance, applied by ITS (Intelligent Transport Systems) often use dedicated sensors attached to the vehicle or the infrastructure. For this purpose, however, the smartphone is the most promising alternative: Detection of the same quality is possible almost everywhere and the sensing device is likewise able to process the data and deliver outputs; in addition, the device is not only commonplace, but also always on the user’s person, giving it the advantage of user-centricity (see section 3.1.3).

This second prototype was again developed in cooperation with Stuttgart Media University; this time in form of a Bachelor thesis, offered to students by a public notice in the university.

6.4.1 Related Work

In addition to the overview given in section 4.2, applications directly related to this concept have been studied and are described here.

Traffic congestion detection can be considered as a subfield of activity recognition, whereas ‘driving on a congested road’ could be seen as an activity. Activity recognition, using smartphones as the sensing platform, is currently a widely studied field and research is conducted for example in recognising human activities like standing, sitting down, standing up,
falling, going up or down stairs (Brezmes, Gorricho, & Cotrina 2009). Fitness applications for smartphones are available for almost any form of physical activity. Some apps use external sensing devices like wristbands, others built-in smartphone sensors. Moves, for example, covers many daily activities like walking, cycling, and running. It offers analysis for different categories, such as distance, duration, steps, and calories burned for each activity and furthermore summarises all daily motion in the form of a storyline with places visited (Moves 2015).

Transportation mode detection is another related research area. To classify transportation modes, e.g. bus, train or car, some applications focus mainly on GPS (Global Positioning System) (Zheng, Chen, Li, Xie, & Ma 2010), others use a combination of accelerometer data and GPS (Reddy et al. 2010). The Microsoft Research Institute in India have implemented a system called Nericell10 which uses the accelerometer, microphone, GSM radio (Global System for Mobile Communications) and GPS sensors to detect road and traffic conditions, such as potholes, bumps, braking and honking. While not entirely relying on accelerometer data the concept of triggered sensing is applied, where high-energy consuming sensors (GPS, Microphone) are triggered by low energy consuming sensors (Accelerometer) in order to conserve energy (Mohan, Padmanabhan, & Ramjee 2008).

To the best of my knowledge, no systems were in use, which integrate accelerometer data to monitor traffic conditions, when this application was conceptualised in 2014. However, accelerometer data had already been used to monitor vehicle motion for instance to get insights into a driver’s on-road behaviour. Measuring driver behaviour using mobile phone sensors is arousing interest for all manner of usages even beyond the car itself. Falkson (2015) describes the application Driversiti (2015) with vehicle, driver and passenger identification, cloud based information like weather or traffic incidents, and tracking information on where the smartphone owner was before entering the car. Despite information being used to increase driver safety, it is pretty obvious that many more use cases with different goals can be thought of based on the generated data. I will elaborate on that in the discussion section 7.3.2.
6.4.2 Detailed Concept Description

The detailed concept description provided for the first prototype has been further refined and is displayed in Figure 48.

In addition to this concept description, a specification sheet and design concept was developed based on the original workshop idea as well as the findings in sections 4.1 and 4.3 and provided to the Bachelor student as part of the briefing. It is described in the following section.

Further Development: Gameful Auto-Motion

- **Core questions:**
  - How can the iPhone M7 processor information (used e.g. in fitness apps to measure motion activity) be translated into automotive traffic situations in order to increase driving enjoyment?
  - When is a good time for intervention (i.e. what sort of traffic situations) and how can the application recognise that?
  - What are suitable interactions and with what interface?
- **Conditions**
  - Notion of city as game space with obstacles (“conflicts”, i.e. red traffic light, ‘wasted’ time) as asset
  - City specific characteristics to serve as input:
    - Local content, such as topography
    - Location specific content, such as location of traffic lights
    - Mobility patterns
- **Work mode**
  - Iterative process to narrow down the concept for a gameful auto-motion application
  - Focus on general functioning, not on single games or quests
  - How can the content technically be designed/implemented most effectively?

Further Development: Gameful Auto-Motion

- **Possible functions (Draft! To be developed along core questions)**
  - Recognises:
    - Stop and go and traffic jam (motion activity input)
    - Red traffic light
    - Location (what street with what usual speed, intersection, traffic lights, …)
  - Active Mode:
    - Switches on, when: standstill or stop-and-go (speed below t.b.d.)
    - Switches off, when: speed above t.b.d.
    - Offers to choose a game or quest and starts it
    - Suitable game or quest to be integrated (voice controlled, not developed; i.e. open-source game or flash game (sws), html5, well-games.com etc. from portal (only short games are suitable, e.g. 10 secs?)
    - Socializing with other TCs on route (**optional**)
    - Time spent in traffic jam translates into currency that can be spent on virtual items to redress companion or add items (**optional**)
  - Passive Mode: reoccurring facial animation

Figure 48: The Briefing for the second Traffic Companion prototype
6.4.3 Specifications and Core Functions

Traffic Companion was conceptualised as a smartphone application, turning an iPhone into a virtual traffic companion (TC). The target group is car drivers in urban environments. The focus during the prototyping process was on a reliable detection of the two traffic situations: ‘traffic jam’ and ‘waiting at a red traffic light’ as the trigger for the automated start of a mini-game, tailored to the specifics of the situation. Accordingly, the following core functions have been specified together with technical experts from Stuttgart Media University in order to achieve a solid technical basis for the required detection functions:

— Core functions:
  - Use of built-in sensors in an energy efficient way to detect the two traffic situations congestion and red traffic lights
  - Reacting to specified traffic situation: Starts mini game (single player only): depending on traffic situation (i.e.: traffic jam, red traffic light) and user preferences (see user functions)

— User functions:
  - Personalise TC with name and character
  - Set preferences regarding the types of mini games preferred

In terms of the appearance, the focus was on high quality graphic design as well as optimal usability and interface standards with minimum distraction, thus appropriate for the automotive environment.

According to that briefing, a detailed function flow concept has been developed as basis for designing the application. An early stage graphic design and functions are shown in Figure 49. It starts with a stand-by mode, until a relevant traffic situation is detected. Then, a mini game will be started out of a selection of games. Once the traffic flows again, the mini game will automatically be paused or ended, and the applications switches back to stand-by mode.
6.4.4 Outcome

The outcome is a fully functional prototype application for an iPhone. During the development of the application, much emphasis has been placed on a both reliable and energy efficient detection function. To develop the congestion detection algorithm, signals from smartphone sensors (such as the accelerometer, the gyroscope and the GPS module) were processed and enhanced with filter technologies.

Subsequently, congested conditions were simulated in test drives, both with the vehicle stopping and not coming to a complete standstill. Acceleration and braking characteristics were extracted from the gained data to achieve a ‘traffic jam’ classification.

The red light detection functionality follows a similar approach as the congestion detection with the additional prerequisite of knowing the traffic lights’ locations. A red light is detected if a traffic light stored in the database is located within a certain range of the vehicle’s location.

The limited number of test drives conducted to date can only provide an indication as to the reliability and efficiency of the developed algorithms. Additional research is therefore necessary to further evaluate the detection algorithms by providing a greater number of samples in more diverse traffic conditions. A video of the fully functional prototype can be retrieved from Schmidt (2014).

This efficient traffic situation detection functionality can now be used for all sorts of applications and target groups. As introduced earlier, the Traffic Companion application currently utilises the functionality as activator for the automated start of mini-games when an appropriate
traffic situation occurs. Each traffic situation requires different types of mini games. During traffic congestion and particularly in stop-and-go traffic, the driver needs to retain full concentration on the traffic. Accordingly, the mini games may only allow minimal distraction and should have no restriction in playing time. One example is shown in Figure 50; the player has to find a common word that applies to all four pictures.

![Figure 50: Home screen (left) and a mini-game for a traffic jam situation](image)

During waiting times at red traffic lights, however, full concentration can be given to playing a quick game. If either of the traffic situations is detected, one of a selection of games will be randomly started according to the specific situation.

### 6.4.5 Evaluation

As part of research-through-design the second prototype has been evaluated through expert interviews in the form of an ‘expert walkthrough’ as described by Lewis and Wharton (1997). This method is used in human-computer interaction design and particularly suitable for
an efficient evaluation of prototypes in different stages. The goal of the evaluation was to reflect on the current prototype and the potential of further advancements towards increasing enjoyment for the users.

Six experts have been approached based on their knowledge and practice. The experts differ in age, gender and experience of China, since the original concept idea was developed from the perspective of Chinese students. In one-to-one interviews, they were asked both about their individual experience in the two traffic situations, which TC targets, and about the general potential they anticipate for TC. The input for the interview was both the concept description detailed earlier and the video (Schmidt 2014) demonstrating the functionality of Traffic Companion in real time and from a driver’s perspective. The results of the experts’ interviews were analysed based on the transcriptions. A summary is given after each block of questions.

(1) Initially, the participants were asked about their driving patterns, their personal experience regarding the two traffic situations and how they would usually feel, as well as what they would do during traffic jams or when having to wait at a traffic light.

All six interviewees have a neutral/relaxed/pragmatic attitude towards traffic jams. Many are contented just to listen to music; only one pointed out that she feels stressed during traffic jams if there is a time pressure to reach the destination. A traffic jam is thus not necessarily annoying for everyone and the underlying assumption that a traffic jam is a mobility challenge cannot therefore be generalised.

(2) Afterwards, detailed questions on the overall potential of the current prototype were asked as follows:

— What do you think of the overall application functionality (detection and automated start of games)?
  If applicable, how could the detection functionality be improved?
— What do you think of the application’s appearance and design?
  If applicable, how could the design be improved?
— Do you assume that this kind of application increases driver distraction during these particular traffic situations? If yes, how could distraction be further minimised?
— Do you enjoy playing games like the ones offered at all?
— Would Traffic Companion make the two situations more enjoyable for you? If yes, why?
  If yes, would the increase of enjoyment continue to last, if there were to be variety of games available? If no, why not?
  If no, how could the application be improved in order to achieve a positive long-term impact?

All experts have rated the simplistic design and overall functionality positively as well as the anticipated detection function. However, driver distraction is seen to be an issue particularly as attention to the game could result in being unaware of the traffic lights changing to green. This could be solved for instance by linking the application to a car’s internal driver assistance features which could automatically stop the game when free-flow traffic is detected or the traffic light is green again. Some participants pointed out that for safety reasons they would not recommend mounting the phone on the windscreen, but rather it be placed in the centre console – which would not allow for visual interaction with the phone.

Ultimately, playing mini games is not enjoyable for everyone. Only one out of six experienced enjoyment from the current selection of mini games; another expert suggested offering an alternative of games assisting relaxation or showing pictures saved on the phone in a similar way to a screensaver. The conclusion would be to offer other forms of games and enjoyment instead (see the following section).

(3) Finally, further ideas were introduced that have not yet been implemented; refer also to the next section for developments. The following questions were asked to find out about future potential with comparison to the current status:
Would one or more of these features increase enjoyment for you?
If yes, which one(s)?
Would one or more of these features lead to ongoing enjoyment?
What other and/or additional features could make the application more enjoyable for you?

Offering a choice of games upon detection would increase enjoyment for some, as would games or functions that only need the driver to react via voice control, i.e. karaoke sing along. Great potential towards increasing enjoyment was seen in interacting with the city or driving environment, i.e. spotting certain cars in the traffic jam, as well as tracking one’s own mobility behaviour – similar to fitness apps - followed by forms of social interaction, even with the avatar.

Sub-Conclusion
Looking at the outcomes of the experts’ interviews, I draw the following conclusions, reflecting the knowledge gained during this dissertation:

Firstly, the second prototype offered only substitute activities in the form of mini games to be played during traffic jams, with no relation to the environment or to the mobility activity. This did not meet the intended goal of increasing enjoyment. Considering my later findings, which feature in the case study section (section 4.2), it is clear that specific player types were not addressed by this application.

Secondly, it was assumed by the experts that the application would not produce ongoing engagement. Rigby (2014;115) delivers a reasonable explanation for that aspect, corresponding also with the discussion in section 3.3.2 on motivation patterns: Addressing meaningful goals, such as education, health care, and personal growth, none of which are short-term endeavours, would be more likely to increase sustaining engagement.

Thirdly, driver distraction has been identified as a weak point, even though the application has been designed for minimal distraction. That means that the interaction with the smartphone should probably be limited to voice-only, as also defined in the initial concept for this
application. The application *Brightdriver* is one example for a conceptualised application that only offers audio-based games to avoid unintended driver distraction (Brightdriver 2012).

This has been the first evaluation involving experts and it is obvious that further concept iterations would be required based on redenr7des in order to achieve an optimal outcome – again evaluated and also user tested, as the design approach proposes.

6.4.6 Discussion

Due to the primary focus being on a technically reliable prototype, it was not possible to implement some conceptual aspects of the original Traffic Companion prototype, i.e. a strong social companion character, in this iteration. Additionally, the implemented mini-games may serve more as a short-term diversion than as an on-going amplification of enjoyment levels. To achieve that, and reflecting upon the evaluation, I propose enhancing the user experience in future stages of this application with functions such as the following:

(a) To react or to interact with the specific context of a given urban environment, e.g. the current location, other people nearby etc. Such aspects could serve as input into the game played, i.e. as a resource, a goal or an opponent, or even be the basis for a game in their own right. Functions could for instance include: City and mobility patterns, for example the rhythm of driving and standstill in traffic jams or turns taken, or location specifics such as the frequency of passing a particular traffic light at red or green.

(b) To increase the game experience, for example with statistics on games played, won, times and so on, or with options for interaction with other players using this application.

(c) Linking back to the original idea of a social companion, the application could serve as an instrument to interact with friends and family. Examples are communication and social interaction features, such as the latest information like emails, text or chat messages, news and social media content, and ‘intelligent’ links to other applications, e.g. triggering a
service that checks the calendar for appointments, which cannot be met because of the delay, and notifies anyone affected.

The general idea of a companion enabling social interaction, however, seems to have the expected potential towards more enjoyability. According to a news article by Christiane Oelrich (2015) on what people do in traffic jams in Asian cities, the first would be to use the smartphone for interacting with family and friends on social media.

The idea of a social companion can also be found targeting different goals: The recently launched app Companion targets situations in which pedestrians feel unsafe, occurring for instance when walking home alone late at night in an unknown neighbourhood. Users can request a companion in their contacts, who can then trace the route to the predefined destination on their smartphone. This app also uses motion detection: if there is a change in movement, for example running instead of walking, the walking buddy will be notified and can start an alarm on the user’s phone or even call the police (Velez 2015).

6.5 Conclusion
During the course of the three projects RADiate, trace.MEL and Traffic Companion, I was able to explore the potential of gamification in the context of urban mobility in different forms of mobility and situations, with different goals, and on different levels to a very close detail. The latest iteration of Traffic Companion focused on the technical realisation while some conceptual aspects were not implemented. Evaluation has shown the importance of realising those details when trying to achieve a successful implementation. Further iterations and redesigns would therefore be needed to optimise the final outcome.

Generally speaking, the final design approach that has been described in section 4.1 based on typical game design procedures, such as a constant loop of evaluation and redesign, is suitable for applying gamification towards achieving the intended outcomes. However, small changes can already thwart the goal. By contrast, the model developed initially (see Figure 26 on page 70) is not appropriate, as experienced with the
development of TC. This is mainly because a design process without iterations would need to be framed with very detailed guidelines and based on broad expertise to arrive at the intended goal. That does not seem practical, since in the discussion on gamification I concluded that it is not reasonable to significantly narrow down the use of game design elements, see section 4.1.3.

This could also be considered as a general problem with gamification: Despite the extensive and diverse discussion in this field (refer to section 3.3.3), it is not fully framed and completely described, or if so, at least not conclusively. Maybe precisely because of the diversity, discussions will continue: Deterding (2014), for instance, notes the need to reframe gamification and delivers a consolidated method for gameful design, based on a comparison of different approaches, in which iteration plays an essential role, in his just published article (Deterding 2015;38). I will expand on this view in section 7.2.3.

To conclude my research project, I discuss the generated outcomes in the following chapter and consider them in the light of the previously developed academic discussion and case studies.
7 Discussion

Despite the aforementioned diversity of gamification in general, this research has contributed to that discussion in three ways relating to my research question: “How can gamification be applied to the context of urban mobility and what is a design approach to this, considering different modes (cities, types of transportation...), against the backdrop of enjoyability and liveability?”

The first contribution was in exploring fundamental aspects around the core of Gameful Urban Mobility: mobility, urban environments and games as well as liveability; see Figure 51 as initially introduced in chapter 3 on page 14.

![Figure 51: Key terms and the fields of research.](image)

Secondly, by developing a generic approach for designing Gameful Urban Mobility applications based on this theoretical exploration, and thirdly, by testing and refining this approach with three projects.

Reflections on the sustainability of gamification, digital data and ethical issues are also included in this chapter and have not been discussed earlier, as this is based on knowledge gained with the projects.

I start the discussion along the project outcomes in the following section.
7.1 Project Outcomes

Chapters 5 and 6 describe the three projects in Beijing, Melbourne and Karlsruhe. The outcomes were a better understanding of local mobility characteristics and concepts at different levels, one of which has been turned into prototype applications (see sections 6.3 and 6.4). In Beijing and in Melbourne, workshops were conducted and local citizens were asked questions regarding their personal experiences of both challenges and enjoyment in mobility. Identifying these challenges is part of the design approach, based on the concept of game conflicts as developed in section 4.1.2.

7.1.1 Challenges in Mobility

Although the intention behind identifying mobility challenges through fieldwork was not to deliver empirical results, the outcomes both confirmed assumptions recognised in other sources (see section 4.1.2), as well as added further facets.

Beijing

Looking at the workshop outcomes, I conclude that mobility challenges in a given city significantly depend on the category respectively mobility focus of that city; see Figure 8 in section 3.1.2. In this figure, Beijing can be classified as a traffic saturated city with the capacity of infrastructure being a major issue (Feige 2012). This usually leads to congestion with corresponding problems for liveability, such as increases in journey time, noise and air pollution (Gehl 2010;219). It is typical for a developing city and no surprise that these issues have been confirmed by the students’ investigations during the workshop.

In detail: Most of the interviewees’ trips are undertaken by car (24 of 55), followed by public transport including bus (19 of 55). Perceived mobility challenges are therefore traffic jams and consequently waste of time (11 of 33) as well as crowded or delayed public transport (6 of 33).
It can be assumed that Beijing is currently developing into a hybrid city, strengthening other forms of mobility while retaining significant dependence on motorised transportation. For example the amount of subway lines has already increased significantly between my first visit in 2006 and my latest in 2013. However, the fieldwork outcomes with congestion as the primary challenge may lead to the conclusion that in such large and dense cities as Beijing the whole mobility system is generally over capacity. Even transport modes like subways, which are actually intended to ease motorised congestion, are crowded. Common and sustainable forms of mobility in earlier times like walking and cycling have been repressed by the increase of the road network and the growth of the city, leading to longer distances and even more need for mobility. All this might negatively impact the quality of life (Gehl 2010;219).

Three solutions for that dilemma could be thought from the perspective of my background as a trained architect and urban planner and reflecting the findings in this research:

First of all a substitute activity could increase one’s enjoyment whilst in such situations. This is both what Traffic Companion is proposing (i.e. playing a game or socially interacting) und what interviewees are most likely to do anyway (i.e. listening to music, reading a book; refer to the previous chapter).

Secondly, to steer or reduce mobility demand for instance with congestion pricing models. This actually would be extrinsic motivation, but could also involve gamification to turn it into a positive intrinsic one, as examples have shown.

Thirdly, a better though considerably longer-term solution might be to overcome the separation of work and housing, which has led to increasing mobility needs over the last decades (see section 3.1.1). The city structure would need to be adjusted to reduce daily mobility needs or allow more efficient and sustainable transport modes such as walking or cycling. That would mean to create more compact cities in terms of short distances, suitable for pedestrian and bicycle traffic. In case of a large city like Beijing, it could imply creating a network of decentralised, smaller city
formats, allowing shorter commutes, which would contribute to life satisfaction (Montgomery 2013:82).

Thus it is probably sometimes a better idea to solve the original problem, i.e. the reason for mobility needs, instead of gamifying the symptoms, i.e. a traffic jam. However, gamification can again contribute, not merely with applications as demonstrated with Traffic Companion but also as an instrument to involve citizens as described in an earlier chapter with the bottom-up approach by Alfrink (2014).

**Melbourne**

In Melbourne, challenges in mobility have been seen less in specific mobility situations, such as being stuck in a traffic jam, but more in general mobility issues. The main barriers for access to mobility mentioned by the interviewees were payment options, language and digitalisation with the need to use a computer or smartphone for information or ticketing and also one specific infrastructure example: access to mobility options for elderly or disabled persons.

Why can access to mobility be such a major challenge for Melbournians? I offer two propositions for answering that question: Firstly, from the background of personal experience in Melbourne, I assume that some of these challenges either reflect Melbourne’s characteristics or current issues. Problems with payment options referred to the recent introduction of Melbourne’s prepaid travel card *myki* and are shared by the local press, see for instance Clay (2015). Language barriers may reflect the multiple nationalities inhabiting Melbourne. Physical access to mobility, e.g. for elderly or disabled, may reflect the experience in urban planning, some of the participants have.

Secondly, on a meta-level, I have pointed out in section 3.2 that mobility enables us to access jobs, goods and services and is strongly connected to our quality of life. These benefits are founded, of course, on access to mobility itself. In his book *Social Media on the Road*, Juhlin (2010;20) discusses Kevin Lynch’s (1981) work on establishing “dimensions for architecture to support good urban quality of life”. One of these indicators
is access and Lynch comes to a similar conclusion, suggesting that access to mobility can be seen as access to city life with its benefits like people, services and education, thus enhancing relatedness in the end.

**Karlsruhe**
In Karlsruhe, the mobility situation is unusual at the time of writing because of a major reconstruction of tram and subway tracks. This affects not only public transport with detours and reduced capacity but also automotive traffic and to some extent bicycle or pedestrian traffic due to road and bicycle track closures.

However, the goal with the RADiate application was not merely to address current mobility challenges but to enhance the overall experience of cycling. This approach for applying gamification is shared by Deterding (2014;307), who suggests, as part of his invitation to rethink gamification, applying it to facilitate the good life rather than to avoid harm and compulsion. That again is similar to what I have proposed in section 4.1.2, namely that for every (negative) challenge there is a corresponding (positive) goal. The project in Melbourne also supports this notion, as the goal was to increase relatedness between visitors and the city, again towards increasing liveability.

### 7.1.2 Enjoyment
During fieldwork in Beijing and Melbourne, both workshop participants and passers-by were asked how they personally enjoy mobility. The results are shown in Figure 52. Since the context of my research is mobility in urban environments, I represent the outcomes with relation to these two dimensions to identify similarities or differences.

In Beijing, only two out of 20 enjoyed mobility through mobility-related aspects; here: walking and looking at the scenery. Only one out of 20 found chatting with others to be an enjoyable thing to do whilst being mobile.
The majority experience enjoyment through substitute activities: listening to music (13 of 20), reading (three of 20) and playing with the mobile phone (one of 20). However, despite these forms of enjoyment not being mobility-related at first sight, they offer potential to be linked to a specific mobility situation. Music, for instance, could be related to the mobility context and increase interaction as Juhlin (2010;114-115) describes with a concept called collaborative music listening. The idea is that car drivers share their music with fellow road users or tune in themselves to music shared by others. This would, according to Juhlin, also enhance another form of enjoyment whilst on the road: visually appreciating the environment (namely interacting with fellow road users), similar to the flaneur mentioned earlier.

The feedback in Melbourne looks very different: Most of the answers were directly related to mobility as for example having mobility options, such as cycling along the water and Melbourne’s extensive tram network. This enables casual and flexible mobility in the interviewees’ eyes (three of 14). The opportunity to experience city characteristics when mobile was also mentioned, i.e.: laneways, back streets, parks, and the vibrancy of
city space when for example coming by places. This form of enjoyment is again similar to the flaneur, discussed in sections 3.1.2 and 3.4.4, who appreciates attractive city environments. It could also be associated with Montgomery’s (2013;181) notion, that “people who travel at their own steam” (like walking or riding bicycles) are enjoying themselves more than with other forms of mobility; refer to the aspect of autonomy as part of the self-determination theory, discussed in section 3.3.2.

Reflecting this discussion against the aspect of motivation, the outcomes confirm Montgomery’s (2013;84) view, that “intrinsic motivators ... are about the journey [here: enjoying mobility itself] rather than the destination [here: getting from A to B]”. This again is similar to Deterding’s (2015;16) suggestion to draw a game challenge from the activity itself (i.e. mobility) for making the experience inherent (see section 4.1). In the context of liveability, it seems likely that these different perceptions relate to ratings measured by liveability indicators: Melbourne is among the world’s most liveable cities whereas Beijing suffers from fundamental problems such as bad air quality and a high congestion rate.

However, I can also draw the conclusion that the different way in which fieldwork has been conducted has impacted the outcomes: In Beijing, students were asking citizens randomly on streets whereas in Melbourne the questions were answered by the workshop participants who were mainly academics and experts in the fields of urban planning, architecture or mobility. I therefore surmise that not only more expert knowledge is included in the answers given in Melbourne, but the quality of answers could also be influenced by the way experts perceive current issues.

To conclude, the outcomes thus reflect not only cultural differences and diverse views of different groups of interviewees but might also be due to slight differences in the method applied.

In the context of games and enjoyment, Deterding (2014;309) proposes a further notion: enjoyment is not necessarily drawn from the activity of playing the game itself but rather from the choice whether to play a game or not. This goes back to the self-determination theory mentioned earlier,
where autonomy is a significant part (autonomy herein as the choice to play or not).

### 7.1.3 Concepts

The Traffic Companion prototype demonstrated that it is possible to use a smartphone to detect defined traffic situations in automotive mobility utilising various sensor data. In principle, the algorithms developed can be applied in many other mobility situations, since they follow an approach similar to physical activity detection in fitness apps. Applications already in existence distinguish not only between different forms of physical activities, i.e. walking, running, cycling, but also between different forms of mobility such as automotive, public transport or bicycle.

In addition, numerous databases are available, listing the locations of traffic lights or infrastructure elements like stairs and elevators for the benefit of handicapped citizens. This information, as well as various data gained through detection or supplied by city authorities, could be incorporated in many different ways into gameful applications. Figure 29 on page 76 shows some examples. Many more conceptual approaches could be devised and the following questions can serve as guidelines to further unlock the potential:

- What sort of connections could be made between a smartphone and urban mobility elements making use of the digital layer?
- What sort of challenges or points of application could be detected with a smartphone?
- What sort of features could be triggered upon detection of such situations?

All this feeds into possible future research opportunities based on this dissertation, see section 7.5. Before continuing this discussion, I sum up my contributions to the various fields in the following section.
7.2 Contributions

This research contributes to the related areas of research in many ways but particularly to the intersections between these fields. Gameful Urban Mobility as an entire concept is one example for these overlays; the link between game design elements like player types, motivation patterns and enjoyment introduced in section 3.3.2 is another.

Understanding the dimensions of a city as well as the importance of including mobility aspects in liveability indexes lays the foundation for working with my design approach along the three aspects (1) context / points of application (2) challenges to be addressed or goals to be achieved (3) game design elements to be applied. The procedure for applying my design approach in order to arrive at a certain goal is described in section 4.1 and related sub-sections.

I will discuss the contributions to related research areas in the following sections, beginning with urban design.

7.2.1 Contributions to Urban Design

The main contribution in this field is to uncouple urban design from space and time (for example the time it takes to implement built environments) by making use of the digital layer and the smartphone, amongst other digital touchpoints, in order to enhance urban design goals. Such goals could be many aspects of urban liveability such as enjoyment, safety, identity, vibrancy of space and many more. When it comes to mobility, urban design often intends to influence mobility behaviour and to trigger different forms of mobility, e.g. through the layout of streets, number and network of bike paths or vibrancy of space through a high level of attractiveness.

When considering the way urban design usually works, outcomes are typically master plans that are then turned into built environments (= space). This city space remains unchanged sometimes for decades (= time) until the next design proposal is agreed on. This usually happens when the focus changes over time or the purpose of the original master plan is not being fulfilled anymore. Also global or local issues with a
knock-on effect might arise, such as energy or air quality. The city of Stuttgart, for instance, was designed in the 1960s with an automotive focus. The resulting large streets running through the city led to the separation of city quarters and an attractive urban space. Parts of the city were consequently redesigned to give more space to sustainable forms of urban mobility like bicycles or pedestrians and thus increase urban well-being; refer for instance to Gehl (2010;234) or see Juhlin’s (2010;19-21) elaborations on ”Traffic and City Life”.

My proposition is that gamified applications are able to tackle such challenges short-term without the initial need to rebuild city infrastructure. Of course, I advocate adjusting city design accordingly, if need be (as elaborated on the example of Beijing in section 7.1.1), but the goal to get more people riding bikes instead of using cars could be advanced by such gamified (digital) applications without having to wait for impulses resulting from a rebuilt infrastructure.

In addition to structural initiatives, urban design goals can thus also be supported by digital technology. Although the space itself does not change through such applications or (digital) urban interventions, the intercourse with the space changes. With my work I am therefore offering an approach, which urban designers can add to their toolbox for addressing challenges or achieving goals in urban environments.

7.2.2 Contributions to Mobility

Gamified applications have great potential to not only tackle mobility challenges in the short-term, but also to steer mobility behaviour and to make mobility enjoyable where it no longer is. Liveability can thus be enhanced both on an individual and on a city level. In order to achieve this, my design approach offers conceptual guidelines for addressing such challenges.

With regards to points of application, i.e. mobility devices and context, the possibilities are manifold. I have reviewed and organised existing applications in section 4.2, explored the design space of Gameful Urban Mobility as a contextual framework in section 4.3 and demonstrated it by
conceptualising three applications in chapters 5 and 6. My categorisations both of the urban mobility system with devices, infrastructure, system and incidents (see section 3.2.1) and of mobility challenges and goals (refer to section 4.1.2) deliver a starting point to rethink any mobility issue towards deciphering it.

Gameful applications can offer alternative forms of enjoyment by tackling motivation patterns. One example is ‘Commutastic’, an application developed by Kracheel et al. (2015) to address traffic congestion during peak hours through mobility behaviour change. Instead of offering substitute activities for commuters stuck in traffic, their strategy is to incentivise commuting at a time when roads are less congested, by proposing alternative after work activities, such as going shopping or to the gym, with benefits including monetary incentives. Although these benefits trigger extrinsic motivation at first, “intrinsic rewards are as well triggered by the larger context of doing something good while reducing traffic and enhancing wellbeing” (ibid).

Another example is the idea of substituting today’s forms of enjoyment in mobility with other forms of enjoyment based on game design elements. I have shared this notion in a presentation which I gave in an early phase of this research at the conference Games for Change in Melbourne in October 2012; refer to Stampfl (2012) for the video. The core idea was to substitute aspects of driving enjoyment unlikely to be possible in dense cities (e.g. speedy driving in a sports car), with other forms of enjoyment based on gameful experiences. A main feature in this example is interaction with other mobile people.

Interaction is likewise a core game design element (see section 3.3.2) and often a principal element in Gameful Urban Mobility applications, be it interaction between motorists or in public transport. Examples have been given in section 4.2 and include REXplorer and VW Smiledrive. One of the main contributions of the idea of interaction, often enabled by digitalisation (see section 3.1.3), is that it allows for overcoming physical distance in different mobility devices, for instance between motorists in their separate vehicles. Juhlin (2010) has undertaken extensive research on forms of human interaction and the potential of digitalisation in the
context of motorised traffic, as I discussed in section 3.2.2. Interaction contributes to relatedness, thus liveability, and therefore plays an essential role in each of my concepts.

Gameful Urban Mobility applications, offering substitute activities and thus taking attention away from the original problem, do have potential to enhance the quality of mobility. However, applications relating to the mobility activity itself or contributing to solving the original mobility challenge are likely to be more effective and deliver a longer lasting gameful experience.

7.2.3 Contributions to Gamification and Game Design

This research mainly contributes by further translating the theoretical framework developed from the original definition of gamification into design practices and likewise feeds back from applied gamification into theory. This is twofold, by proposing a design approach for developing gameful applications, based on theory, and testing it with presentations and in workshops, as well as by learning from the evaluation of implemented applications.

Gamification is still a young discipline. When commencing my research in 2012, gamification was commonly defined as “...applying elements of game design and game mechanisms to non-game contexts...” (Deterding et al. 2011). In the meantime, Deterding (2014) has reviewed his original definition, reflecting recent discussions and practices. He now moves away from merely single components of games, namely design elements and game mechanics, to a more comprehensive notion of gamification and indicates particularly the importance of a well thought-out user experience. This corresponds with other, more complete views on what comprises games, such as Dignan’s (2011) Game Frame, and matches my findings when looking at gamified applications from a motivational perspective.

Regarding methods for gameful design, I have developed and refined my design approach with the core elements (1) context (i.e. points of application), (2) challenge to be addressed or goal to be achieved, (3)
game design elements to be applied, to result in iteratively designed concepts. Deterding (2015;19f) has recently evaluated (industry) gamification methods, taking into account authors such as Kim (2010) and Zichermann and Cunningham (2011). He narrowed them down to a generic design process similar to my own approach though more detailed in some aspects. He specifies in greater depths, for example, which game design elements should be used and distinguishes between end user goals and system-owner goals, i.e. goals of an industry using gamification to motivate their customers towards a certain behaviour. Deterding (2015;21) questions the focus on system-owner centric goals which use game design to manipulate users to their own ends, whereas standard interaction design methods are usually user-centric (i.e. beginning and ending with the end users’ goals). I discuss this notion in the context of ethical considerations; see in the later section 7.3.1.

In addition to exploring urban mobility as a context for applying gamification, my research also suggests settings, for which actual games (in contrast to gameful applications) can be designed. Traffic Companion, for example, describes very specific mobility situations where games could be played, namely during congestion and while waiting at red traffic lights. The following aspects are then relevant:

— Games must be designed for minimal driver distraction. This influences both the gameplay and the user interface.
— Such games are played whilst travelling in a mobile space (the car) through an urban environment. Games could thus take into account the specifics of this situation, for instance, by relating the gameplay to the current environment or the precise location in the city.

To conclude, it is important to keep in mind that lasting enjoyment is most likely achieved by designing experiences with meaningful goals.

7.2.4 Contributions to Liveability
Upon evaluating liveability indices, I have suggested that only very few mobility aspects are taken into account. Mobility, however, is not only a core benefit of today’s society but also significantly shapes a city through
its infrastructure, contributes to the city’s overall energy consumption and air quality and is directly relevant to a citizen’s well-being. I therefore propose taking many more aspects into account when evaluating a city’s liveability.

In contrast to most of the mobility aspects currently found in indices (if they are contained at all), such aspects should be generic in order to represent both individual and communal characteristics as well as their interdependency. I have collected and structured such aspects in section 3.4.4.

Furthermore, mobility aspects could embody goals towards urban liveability, which can be seen as the ultimate goal I intend my research to contribute to, similar to a system-owner goal as described above in the game context. According to Deterding’s (2015) argumentation in the previous section, such a goal might not be user-centric per se and may offer the user no inherent motivation. However, the two dimensions of function and relatedness in a city I have introduced, not only offer a systemic view on the city, but also help deducing user-related goals from this high-level goal. I further proposed that relatedness is strongly linked not only to certain game characteristics, such as interaction, but also to intrinsic motivation and enjoyment, which could ultimately be considered user-specific.

In summary, the main contribution to liveability is translating it into smaller aspects that can be set as goals both for enhancing the quality of evaluation in the indices mentioned and for conceptualising applications.

7.3 Suitability of Gamification

In this research, I have applied game design elements twofold: to structure and access my context, the city, and to make use of gamification as a design tool with my design approach. However, gamification is only one design approach among others and I came to the conclusion in the previous section that it is still complicated to frame and depict precisely. Why is this?
J. Hamari, Koivisto, and Pakkanen (2014) deliver an explanation by comparing gamification with the longer-established persuasive technology, since they have many similarities: “...the conceptual core of both veins of development incorporates 1) the use of technology that 2) is aimed at affecting people’s/users’ psychological attributes, such as attitudes or motivations, which are further presumed to 3) affect behavior [sic].” Despite the rapid increase of gamification-related studies (see Figure 53), they propose that “a relatively larger proportion of empirical studies exist” on persuasive technologies. This notion lets Rigby (2014;114) suggest that “...gamification currently has a hype problem”.

![Figure 53: Number of search hits, by year, for the main keywords associated with the relevant streams of research from paper titles, keywords, and abstracts in the Scopus database (J. Hamari, Koivisto, & Pakkanen 2014;119)](image)

Nevertheless, based on my experience I still see a lot of general potential because it is possible to trigger intrinsic motivation with gamification, i.e. towards increasing enjoyment as I have explored in section 3.3.2. With comparison to persuasive technology, J. Hamari, Koivisto, and Pakkanen (2014) similarly conclude that “gamification centers [sic] more around invoking users’ (intrinsic) motivations (through gameful experiences and affordances)".
Consequently, Deterding (2014;307) suggests moving to motivational affordances instead of game design elements and to the framing of contexts instead of structuring objects. In order to achieve that in the best possible way, Deterding (2015;22) proposes not to rely primarily on player types, but rather “on bottom-up, empirical, and thus inherently context-sensitive methods of eliciting the specific motivations of one’s specific target user group in its specific context”; examples are “data-driven personas or laddering interviews” (ibid). Alternatively, a more generic approach could be “well-validated models of universal human needs and motives” (ibid).

Gamification is thus about a comprehensive user experience which should therefore be the focus when applying gamification – not points and badges. Although these game design elements can contribute to the user experience, some of them build on or even exploit people’s natural desires and behaviours (Ferro et al. 2013), an issue further explored in the following section.

7.3.1 Ethical Issues
Gamification can trigger basic psychological patterns in humans. It is strongly related to motivational patterns and hence highly influential on human behaviour. So what should be the goal of applied gamification? Who decides what to achieve with/through an application?

The discussion about what goals are ‘ethically correct’ is not an easy one. Particularly if gamification is used in the context of corporates or marketing, goals might be addressed that are not obvious at first sight. Dignan (2011;63) questions this kind of “forced play”, when “corporate priorities [are] ahead of their own” as well, “…because play, at its core, is an activity that originates in freedom”.

Deterding (2015;21) likewise challenges the focus on what he calls system owner (i.e. corporate) goals in gamification that are, according to his evaluation, often accompanied either by an absence of end user (i.e. player) goals or by end user goals which ultimately support system owner
goals. However, he points out that “practically all standard interaction
design methods are user-centric” (ibid).

To illustrate such conflicting goals, one example is the spread of devices
and applications tracking activities as referred to in the case studies in
section 4.2. Although such features tend to have a relevant benefit for the
user (as otherwise they might not be used at all, see for example Dignan
(2011;78)), they could in fact pursue different goals from the provider’s
perspective. The following example illustrates goals from different
perspectives with the Nike+ fuel band:

— From a runner’s perspective to get feedback on performance and
  progress and increase enjoyment, e.g. with competition features

— From a general health care perspective to encourage more people to
  run by making it more enjoyable or relevant for them and thus lead to
  healthier lifestyles and lower health costs

— From Nike’s perspective, as a sports gear supplier, to encourage more
  people to run and therefore sell more equipment or presumably gain
  data that could be used or sold

The second example is the Traffic Companion application. Although it had
a clear goal, when it was conceptualised, there are multiple goals for
which it might be employed – sometimes even conflicting:

— The original goal, from a motorist’s perspective, to counterbalance
  negative impacts occurring in dense city traffic or during traffic jams,
  such as boredom and loneliness, with a social companion

— From a car manufacturer’s perspective to keep automotive mobility
  attractive even in challenging environments, and thus trigger car sales

— From a city’s perspective, the decrease of automotive traffic might be
  the ultimate goal, due to spatial or air quality issues. From this
  viewpoint, counterbalancing negative impacts of motorised traffic and
  thus increasing its attractiveness might not be a goal to follow at all.

Another example is the application Chromaroma introduced earlier.
Players not only participate in a game that enhances their travel
experience and makes it more enjoyable, they also provide a significant
amount of travel data to the London public transport system, who can use
that data to create mobility profiles; an issue brought up for instance by Alfrink (2014;541). The last aspect of data security in particular is one that seems most prevalent in the discussion about digitalisation and data collection, at least from my current perception in Germany. Let’s take a closer look at this issue in the next section.

7.3.2 Considerations on Digital Data

Parts of this work would not have been possible without digital data: One of the core outcomes, the Traffic Companion application, was designed to make use of data from the sensors incorporated in a mobile phone. Dignan (2011;55) refers to the ‘quantified self’ (“self-knowledge through numbers”) as an evolving example of a movement based on digital data that is made easily available with ever smaller sensors.

With the growing amount of personal data from various sources, increasingly collected and evaluated, the questions arise as to how it can potentially be used, because “regardless of what is being measured, someone can find a way to profit from every single data point” (Dignan 2011;56). Even very basic information, such as the number of steps taken per day, cannot only be used by many different parties but also lead to predictions on personal behaviour, when combined with other data. Andrews (2014;360) points out, that “increasingly intimate information they are sharing through gamification may be accessed by third parties or used against them”.

Despite these risks (which do need to be addressed), I conclude with a utopian view on the availability of digital data in cities, shared by Alfrink (2014;556): “Think of a gameful city as a counterpoint to a smart city. Where a smart city promises increased control and legibility to large organizations [sic], a gameful city promises increased autonomy and influence to individuals.” The basis for this is “the openness of the technology itself and the policies surrounding the use of the data generated by it” (Alfrink 2014;542). Such a utopia would allow for many gameful applications, as introduced and developed throughout this research, some of which will be further discussed in the following section.
7.3.3 Gamified Applications

During the course of this research I have studied many and designed some Gameful Urban Mobility applications – all with the intention of enhancing a mobility situation and contributing to the achievement of a meaningful goal. However, even such a reasonable goal could lead to unintended drawbacks: Dr Paul Barratt points to the downsides of applications like Strava (described in sections 4.2 and 5.2.2): His research came to the conclusion that applications with social link functions are decreasing face-to-face interaction because solo rides are becoming more popular instead of social group rides (Singletrack 2013). However, he also found out that such applications in general make cyclists ride faster, further and more frequently – they therefore seem to achieve their original goal at the end. This fact has been long known in the psychology of sport. Vanderbilt (2013), for instance, refers to a late 19th century psychologist: “Cyclists who raced against competitors or a pacemaker were faster than cyclists who rode alone.”

These findings on pros and cons of applied gamification are similar to the conclusion of J. Hamari, Koivisto, and H. (2014) who have evaluated empirical studies on gamification. They summarise that gamification, as in adding a gamified layer to a given context, generally works in the intended, usually motivational, way – however, some caveats exist in their view, most concerning the context, unanticipated effects or user qualities as just described with the example of Strava. The outcomes of my own research indicate that applications which try to enhance a negative situation by offering a substitute activity like a mini game may not be successful in the long-term since they lack a meaningful goal for those not interested in playing games. The critical issue for sustaining engagement and long-term success is thus the applications’ goals. These goals should be personally meaningful, i.e. in fields like “education, healthcare and personal growth” (Rigby 2014;115) and lead towards behaviour change through motivational models.

However, my research has also shown (refer to the evaluation of the second Traffic Companion prototype), that not only achieving goals but also other relevant experiences such as social interaction in the form of
sharing news or pictures with friends, can lead to a long-term enjoyable experience.

7.4 Research Challenges

Besides challenges with regards to content, the following challenges had to be overcome when organising this research.

The first and most important challenge was to identify an appropriate methodology and procedure to structure and describe as well as explore the fragmented areas that founded my research. Since the framework for Gameful Urban Mobility is still indistinct, my research approach was undertaking an exploration rather than empirical studies, starting with a wide scope and narrowing it down to detailed prototypes. I have therefore chosen exploratory research as appropriate methodology. In order to apply the findings towards design practice, I developed a design approach and executed a series of practical projects in different cities, incorporating bottom-up methods, such as workshops, for leveraging local knowledge of city dwellers and experts alike.

Finally, I used my own publications, such as papers, talks or workshop discussions as a way to collect feedback both from a broad audience as well as from focus groups such as mobility experts and test the applicability of this research.

Other challenges involved the time available for this practice-led Ph.D., which resulted in re-adjusting the research scope to a reasonable scale that delivers a basis for further research endeavours as indicated in the next section.

7.5 Future Research

Based on the outcomes and contribution of my research project, I outline in which directions my ideas could evolve. I also describe, what I could not answer with my research and why and whether there were other answers than expected.
Projects were conducted in three different cities on three continents with various modes of mobility to achieve cultural and structural variety. However, this is still just a fraction of possible urban environments and traffic situations and there are many more, which could be considered and addressed. Also, demographic differences were not considered, and cultural ones only to a small degree, which leaves space for further research.

The design approach was developed with the intention of delivering a generic method for conceptualising applications; its usability has been tested with three projects. However, since gamification is most reasonably applied by designing user experiences rather than by adding single game design elements, it might need more detailed application to achieve a constant quality of results. Research could develop this further.

More specifically and as introduced earlier in section 7.1.3 while discussing the Traffic Companion concept, future research could further incorporate and use information provided by cities, infrastructures or mobility devices in applications.

Options for future research can further be drawn from the many interconnections between liveability and mobility as indicated in sections 4.1.2 and 4.3.
8 Conclusion

Congestion again – but I don’t mind! There’s just enough time for a quick mini game against the driver in the red car in front of me. Although authorities have not yet completed the new master plan for my city, we have seen a variety of short-term measures being implemented lately that make commuting a whole new experience. I have ‘adopted’ the upcoming street section and will not only get a wild card for my mini games every time I pass, but also have a say in how authorities could improve the local mobility situation. I now feel related to this area and look forward to help enhancing the urban quality here.

Generally, the idea of applying game design in the mobility context seems to be on the rise: Ford, for instance, announced the Ford Smart Mobility Game Challenge in August 2015 as part of their Ford Smart Mobility plan with 25 projects across the world. The challenge is to design gameful solutions and innovative ideas for global mobility issues. Ford wanted to use the creativity of the gaming community and the potential of specific game characteristics like fun (CarIT 2015).

When applying gamification in the context of mobility, I have demonstrated that there are different strategies. At first, on a conceptual level, game design can be utilised as a broader design philosophy to access a design context (i.e. perceiving a city as a game space and mobility challenges as game conflicts). Then, it can be a design approach for addressing such challenges in urban mobility towards increasing liveability, by creating lasting enjoyable experiences through meaningful goals that trigger intrinsic motivation. Not least, it can be used as an instrument to involve citizens as described in an earlier chapter with the bottom-up approach.

Figure 54 summarises the exploration of Gameful Urban Mobility towards answering my research question: “How can gamification be applied to the context of urban mobility and what is a design approach to this, considering different modes (cities, types of transportation...), against the backdrop of enjoyability and liveability?”
I started my journey by exploring relevant top-down aspects and their interrelations around the core of Gameful Urban Mobility: mobility, urban environments and games as well as liveability. Based on that, I have developed a generic approach for designing Gameful Urban Mobility applications based on this theoretical exploration.

The next step involved conceptualising three applications, each of which is based on the potentials of digitalisation with the smartphone as an interface, because it frees the solution space of Gameful Urban Mobility from the physical city. Investigating top-down and bottom-up, for example through fieldwork, likewise is a typical approach for urbanism. Participatory formats, such as workshops, add local knowledge and hence complete the picture of topics like liveability and mobility. Finally, one application was selected and was iteratively implemented as proof-of-concept, then tested and evaluated with experts’ knowledge in order to feed back into my original design approach. Although I enclosed all aspects of this research question in my studies, the solution space is much bigger than I could cover with this dissertation.

The main methodology for this research was an exploration of game design, urban environments, and mobility, aiming to broadly mapping this field and elaborating its relevance to related areas, such as urban
liveability. Therefore, methods based in interaction design research were applied, consisting of three main components: design practice, design studies, and design exploration in a triangle shape, see Figure 55.

![Figure 55: The model of interaction design research (Fallman 2008)](image)

An evaluation of liveability indices showed, that very few mobility-related indicators were included in these indices, which is why I developed a set of criteria from an individual and city perspective. These could serve as goals for gameful applications. In order to structure aspects of liveability, I proposed working with the model of a two-dimensional city with ‘relatedness’ being as important for a liveable city as ‘function’. The growing importance of digital networks in urban environments brings up new opportunities for urban designers, which I utilised by designing applications for smartphones.

Game design elements seem to hold an especially great amount of potential for addressing or even overcoming challenges in urban mobility and contributing to the relatedness dimension, since game mechanics are based on human desires and motivational patterns. When it comes to gamification, I differentiated between player types, which are strongly linked to one’s intrinsic motivation, and work with Dignan’s game structure.
Looking at the mobile city through the lens of games can inspire new ways of improving urban mobility. Considering the city as a game space and perceiving challenges as game conflicts was later the basis for my initial design approach, allowing me to develop a structure of challenges and concomitant applications that fed into defining practical projects.

As part of this design approach, urban mobility has been structured in order to define points of application and goals to be achieved. Game design elements can then be applied iteratively. This cycle of testing and redesigning is typical for design-related practices — likewise for developing games and for urban design. The practice-led format of this Ph.D. similarly represents the iterative nature of such practices. I propose that this approach is suitable as a general structure for systematically conceptualising, designing, developing and implementing solutions for urban mobility challenges and goals and I have tested and enhanced it accordingly with three practical projects.

The projects have been designed using mainly participatory formats in three different cities to learn more about mobility and urban specifics, enjoyment in mobility in different cultures as well as city-specific mobility challenges. The goal was to explore how gamification could be applied to different types of mobility and I made use of the smartphone both as an interface and as a sensor device. The results confirmed the general potential but evaluation showed that it is in some cases not able to fully counter-balance negative issues, e.g. congestion. Nevertheless, this approach offers manifold opportunities to contribute to liveability both by supporting meaningful goals and with short-term fun.

Where to from here? Despite some imponderables and the fact that ideas like motivation, incentives or perception of liveability depend on cultural background and social context: gamification adds to the solution portfolio and hence is worth being added to the toolset for urban design, mobility and liveability with great potential in particular for interdisciplinary solutions to advance urban mobility.
9 APPENDIX

9.1 Bibliography

9.1.1 Literature


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9.1.2 Applications

*Blankways* suggests alternative routes for pedestrians  
(Grabar 2012)

*BMW snippy* delivers short stories into the car  
(BMW 2013)

*Brightdriver* makes driving fun through interactive audio games  
(Brightdriver 2012)

*car2go Ecoscore* feedbacks on efficient driving skills  
(Montag 2012)

*Cart-Load-O-Fun:* social interaction through physical exercise on a tram  
(Toprak et al. 2012)

*Chromaroma* is a game based on personal travel data in subways  
(Mudlark 2011)

*CURB TXT:* register with mobile and licence plate and text other drivers  
(Harley 2013)

*Driversiti:* app measuring and analysing a driver’s behaviour  
(Driversiti 2015)

*Fitocrazy* tracks fitness activities as in a game with points/levels  
(Fitocrazy 2013)

*Geotab9:* app measuring and analysing a driver’s behaviour  
(Geotab 2014)

*Honda Anti-Congestion Tech* encourages motorists to drive more smoothly to avoid traffic jams (Ingram 2012)

*Komoot* is a social bike net with qualitative input (i.e. ‘nice route’)  
(Komoot 2013)

*Man-eater:* a cartoon sticker on the tram’s window “eating” pedestrians’ heads as the tram is moving (JCDecaux 2013)

*Mini Minimalism Analyser* feedbacks on efficient driving skills  
(Lampka 2013)

*Mini Driving Excitement Analyser:* points and levels for driving skills  
(Apple 2013)

*Moves* covers many daily activities like walking, cycling, and running  
(Moves 2015)

*Nike+ fuel band* measures activities (distance, speed etc.); set goals  
(Nike 2012)

*Piano Stairs* encourages people to use stairs instead of escalators  
(The Fun Theory 2009)

*Porsche GTS Routes:* a social app, with qualitative input (‘nice route’)  
(Porsche 2014)

*REXplorer* is a location-based mobile game for tourists  
(Rexplorer 2007)
*Runtastic* records running routes and offers analysis on parameters (Runtastic 2015)

*SBB.Connect* is an app to connect with friends on the same train (Vogt 2012)

*Strava* tracks bike tours; offers comparison with friends (Strava 2015)

*Street Pong* is a pong game at a pedestrian traffic light (Urban Invention 2015)

*Walkonomics*: app which indicates the greenest route from A to B (Walkonomics 2013)

*VW Smiledrive* is a social app to interact with other drivers (Volkswagen 2013)

*Zendrive*: app measuring and analysing a driver’s behaviour (Meng, Mao, & Choudhury 2015)
9.2 Figures and Tables
If no other source is stated, the copyright belongs to the author.

9.2.1 Figures
Figure 1: Gameful Urban Mobility is where urban mobility and game
design overlap. ................................................................. 4
Figure 2: The model of interaction design research (Fallman 2008)....... 8
Figure 3: My Ph.D. structure.................................................. 12
Figure 4: Exploring the Design Space of Gameful Urban Mobility both top-
down and bottom-up approach........................................... 13
Figure 5: Key terms (dark grey) and further fields of research (light grey).
...................................................................................... 14
Figure 6: More and more people are living in cities; retrieved from Feige
(2012). .................................................................................. 15
Figure 7: The city shape of Karlsruhe (left) and Beijing (right); adapted
from http://maps.google.com. .............................................. 16
Figure 8: Categorising cities according to their mobility focus; retrieved
from Feige (2012). ................................................................. 19
Figure 9: Comparison of a traffic intersection in Los Angeles and the
pedestrian-friendly centre of my medieval hometown Freiburg at the
same scale; adapted from http://maps.google.com................. 20
Figure 10: Categorising urban mobility ....................................... 26
Figure 11: Classification of games; retrieved from Caillois (2001;36). ... 33
Figure 12: Structure of games; retrieved from Dignan (2011). .......... 35
Figure 13: Interest graph with four player types; adapted from Bartle
(1996). .................................................................................. 37
Figure 14: User type model; adapted from Marczewski (2013). ........... 39
Figure 15: Motivation patterns; adapted from Kjerulf (2006)............. 40
Figure 16: Four intrinsic (left) and four extrinsic user types; adapted from
Marczewski (2013). ............................................................... 41
Figure 17: Social engagement verbs and motivational patterns; adapted from Kim (2012) ........................................ 42
Figure 18: Lazzaro’s model of “4 Keys 2 Fun” (Lazzaro 2013) ............ 43
Figure 19: Player interaction patterns; retrieved from Fullerton (2008), derived from Avedon and Sutton-Smith (1971). ................. 45
Figure 20: Common game mechanics and their effect on human desires; adapted from Bunchball (2010;9). ................................. 46
Figure 21: Model of a two-dimensional city......................................... 51
Figure 22: Consolidation of liveability indices. ................................. 57
Figure 23: Individual versus city interests on the example of parking. ... 61
Figure 24: My design space is where urban mobility and game design overlap. ................................................................. 68
Figure 25: My final design approach .................................................. 70
Figure 26: One initial design approach .............................................. 70
Figure 27: The iteration of a game design (Fullerton 2008)................. 71
Figure 28: Elements of mobility as points of application. The highlighted examples are rain, traffic congestion and a pedestrian crossing. ..... 72
Figure 29: Exploration: From exemplary points of application (left) to exemplary goals (right)................................................. 76
Figure 30: Exploration: Interconnections between urban mobility, urban design and game design .............................................. 83
Figure 31: An overview on the three projects................................. 88
Figure 32: The reconstruction of the tram network in Karlsruhe causes street closures and hence congestion ................................. 93
Figure 33: Bike-only streets and clearly marked bicycle lanes are examples of Karlsruhe’s extensive cycle network ......................... 93
Figure 34: Related work: Fitocrazy, Nike+, Komoot and Strava .......... 96
Figure 35: Core functions of RADiate include social interaction ....... 97
Figure 36: Challenges support building a community ................. 98
Figure 37: Sample group answering guiding questions .......................... 102
Figure 38: Sample group incorporating typical game design elements into their concept .................................................................................. 102
Figure 39: Questionnaire for field research ........................................... 108
Figure 40: Students working on their vision ........................................... 109
Figure 41: Students presenting their concepts ........................................ 109
Figure 42: Mobility forms of the interviewees ....................................... 110
Figure 43: Mobility challenges for the interviewees ............................... 111
Figure 44: Enjoyment in mobility for the interviewees ........................... 111
Figure 45: The Idea of a Social Companion .......................................... 113
Figure 46: The refined concept for Traffic Companion as presented to the students .............................................................................. 114
Figure 47: The First Prototype of the Traffic Companion ...................... 115
Figure 48: The Briefing for the second Traffic Companion prototype .... 118
Figure 49: Early stage graphic design and function flow for Traffic Companion prototype ................................................................. 120
Figure 50: Home screen (left) and a mini-game for a traffic jam situation ................................................................................................. 121
Figure 51: Key terms and the fields of research .................................... 128
Figure 52: Answers to the question: "How do you enjoy mobility?" ..... 133
Figure 53: Number of search hits, by year, for the main keywords associated with the relevant streams of research from paper titles, keywords, and abstracts in the Scopus database (J. Hamari, Koivisto, & Pakkanen 2014;119) ................................................................. 142
Figure 54: My Ph.D. structure ............................................................... 150
Figure 55: The model of interaction design research (Fallman 2008) ... 151
9.2.2 Tables

Table 1: Characteristics of fun and pleasure; adapted from Blythe and Hassenzahl (2004;95). ................................................................. 53

Table 2: Indices ranking liveability. .................................................. 56

Table 3: Summary of mobility-related indicators in liveability indices. ... 59

Table 4: Correlations between liveability and mobility from an individual perspective ................................................................. 62

Table 5: Liveability and mobility from a city perspective. ................. 64

Table 6: The interrelation between the individual and the city perspective. ......................................................................................... 65

Table 7: Challenges in urban mobility. .............................................. 74

Table 8: Core game design elements of selected Gameful Urban Mobility applications ................................................................. 80

Table 9: Comparison of relevant factors in Melbourne, Beijing and Karlsruhe. ................................................................. 89

Table 10: Details of the three projects. .............................................. 91
9.3 Publications and Attachments

Publications


**Ethics Approval**

CHEAN_B_0000015505_07-13.pdf (Attachment 15)