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Fig. 1. In a repertory grid study, we identified major factors of a convenient car ride: Our results show the importance of physical space, shared controls, the ability to view the landscape, communication, and personalization (from left to right).

Abstract. The driving experience has become one of the central decision factors when buying a car. In current manually driven cars, this experience is to a large extent influenced by driver-based infotainment functionalities. With the advent of rear-seat infotainment systems, manufacturers started to not only look at the driver's perspective but also focus on passenger experiences. But passenger experiences can go beyond traditional aspects of user experience as they also include aspects of coziness and comfort in the context of riding, which we describe as passenger convenience. While insights about the design space and passenger's needs are central when designing for an advanced level of passenger convenience, the body of knowledge in this area is limited. Therefore, we present the results from a repertory grid study (n=32) where we investigated what makes a passenger ride in a manually driven car convenient. Based on three predefined and three participant-selected riding situations we accounted for common patterns and individual differences. The results confirm the importance of well-being, physical comfort, and safety. The interviews unveil that passengers strive for access to in-vehicle systems, the possibility to act as a co-driver, and the support for the integration of external technology, connectivity, and personalization. Based on our findings, we extracted a set of design recommendations to consider when designing automotive systems with passenger convenience and experience in mind.

Keywords: Automotive User Interfaces, In-Car Experience, Riding Experience, Passenger Convenience

1 Introduction

Beyond arriving safely at a destination, the unique selling point of a car is more and more defined around the in-car experience [3]. Due to the technical innovations during the past century, a modern car provides a high-tech interactive space [37]. Thus, the design of automotive user interfaces plays an important role when it comes to in-car experiences [3]. Looking at research in industry and academia, we see a focus on driver-based systems and functionality innovation, as driving safely has a top priority [7, 41]. However, with an average occupation of 1.67 people per ride in the United States [42], we see that 56% of all car rides are with at least one additional passenger [12], e.g., a family member, colleague, or friend. We investigate what exemplifies a "good experience" in riding in a manual car, and how we can enhance passenger experience to be more convenient. In this context, understanding manual car rides from a passenger perspective are essential. Looking at the literature, only little is known about passenger's needs. Inbar & Tractinsky [30] report the necessity of having access to trip-related data, while a few articles show the importance of observing the surroundings [37, 46] and having the opportunity to assist the driver [26, 45]. However, it is important to get deeper insights into the design space and the passengers' values to be able to design for a better convenient in-car passenger experience.

Therefore, we broadly explore the design space of passenger-based in-car applications by answering the open research question: "Which factors do account for a convenient passenger experience in a manual car"? Convenience is defined as a feeling of coziness, contentedness, comfort, and relaxation within a specific situation as this reflects the overall setting, surroundings, and contextual factors in a more detailed manner [51]. Hence, it helps us to get deeper insights into passenger's needs beyond traditional user experience (UX) dimensions. To answer our research question and to identify the important aspects that make a ride convenient, we conducted a repertory grid study (n=32). Based on this interviewing technique, we elicited factors that contribute positively to a convenient passenger experience by focusing on participant's personal constructs about different (predefined and participant-specific) riding situations.

With our study, we first contribute to the general understanding of what makes the passenger experience in a manually driven car convenient, and second, we provide design recommendations with a focus on short-term product or service innovations that enable their incorporation into current (market-ready) cars. More precisely, we outline factors and their relationships that constitute to passenger convenience. Besides conforming common-sense assumptions like the importance of well-being, physical comfort, and safety, we discovered novel factors such as the need for shared functionalities between drivers and passengers and dedicated passenger applications. Figure 1 outlines such situations and scenarios that influence a convenient passenger experience. We translated our insights and findings into a set of design recommendations that focus especially on the design of technology-driven features and products that can easily be brought into current cars or enable to be applied on top of existing in-car services. Besides that, these recommendations systematically outline important aspects that should be considered during the design phase of the next generation of manually driven cars.

2 Related Work

In this chapter, we give an overview of prior work in the domain of passenger experiences and provide insights related to repertory grid studies.

2.1 Passenger Convenience

The ISO standard 9241-210 on human-centered design defines the user experience (UX) as "user's perceptions and responses that result from the use and/or anticipated use of a system, product, or service" [31] where the user's perceptions and responses comprise of user emotions, beliefs, preferences, perceptions, comfort, behaviors, and accomplishments. Thus, in the context of the car, the factors of driving comfort and more broadly well-being play an important role.

The Oxford dictionary describes comfort as a "state of physical and material well-being, with freedom from pain and trouble, and satisfaction of bodily needs" [44]. Depending on the mode of transportation and over time, different definitions for comfort have evolved. According to Looze et al. [36], a common denominator of these definitions is that comfort is a personal and subjective construct; it is the passenger's reaction to the environment, and it is affected by different (e.g., physical, physiological, psychological) factors. However, subjective well-being goes beyond traditional comfort aspects such as reaction to the environment as it also includes evaluations of oneself [17]. With this regard, well-being and comfort have been investigated generically for vehicles (e.g., [16]) and in specific domains, including airplanes [1, 49, 54] and trains [29, 48]. However, given that the latter are modes of public transportation, we expect them to only be applicable to some extent to the more private space of manually driven cars. In the automotive domain, the investigation of well-being refers mainly to automated driving. Elbanhawi et al. [19] therefore propose a theoretical framework to estimate comfort regarding path planning for automated vehicles. Sauer et al. collected qualitative and quantitative feedback on passenger well-being in automated cars using the MDBF questionnaire [50]. Regarding that, our study fills the gap by not only understanding the effects of well-being and comfort but also by identifying additional factors that contribute to a positive riding experience.

One additional factor that can influence passenger's experience is the feeling described with the Danish word "hygge" or with the German word "Gemütlichkeit". These words do not unambiguously translate into the English language. We use the term convenience to describe this feeling. In general, the perceived level of convenience refers to a feeling of coziness, contentedness, comfort, and relaxation within a specific situation. As an example, a single soft chair in a restaurant might be considered as cozy and improving UX. But the overall scene, sitting on that chair for dinner, surrounded by close friends with favorite music in the background is described as convenient (DE: "gemütlich"). Regarding product design, Shove defines convenience as the opportunity to create quality time [51]. More precisely, it refers to a product or service that helps users to finish a task more efficiently compared to traditional ways (e.g., the invention of the washing machine makes washing more convenient compared to manual washing) [51]. So, a convenient product is easily accessible, easy to use, and provides a high level of usability, by helping users within a specific context by finishing tasks efficiently and with satisfaction [20, 51].

2.2 Supporting Passenger Experience

Regarding in-car passenger experience, Inbar & Tractinsky [30] reported, that entertainment, as well as infotainment-oriented services, play an important role. Mentioned key factors are the access to trip-related information and the possibility to interact with the in-car system [30]. Based on that, Berger et al. [4] and Matsumura & Kirk [37] evaluated these factors based on an interactive car window that supports the in-car experience due to contextual information adaptation [37]. Another work from Berger et al. [5] shows, based on a passenger-oriented in-vehicle infotainment system (IVIS), that watching movies and looking for points of interests are equally important in terms of user experience (UX). A cultural probing study by Oswald et al. unveiled that front-seat passengers want to have entertainment services (TV and movies), communication platforms, and support for work-related tasks in future cars [42]. In addition to individual entertainment and information content, passengers enjoy collaborating during a ride, by playing different multi-player games [40] or sharing information with other occupants [42]. Pfleging et al. report watching out of the window as the most frequently performed task by passengers [46]. However, passenger experience is also about co-experience and goes beyond the need for entertainment services. While co-experience is defined by Forlizzi & Battarbee [21] as creating UX during social interaction with a product or service, in the specific context of driving this refers to the act of being a co-driver. Co-driver activities are mainly about assisting the driver in a specific form like setting up the navigation or helping to keep the focus on the traffic situation [26, 45]. Research shows that such collaborations can reduce the driver's workload and minimizes the level of driver distraction [14, 35]. However, the traffic situation, as well as the relationship between the driver and passenger, influence the passenger's likelihood of being a co-driver [26, 37]. In addition, passengers often need to prevent themselves from getting motion sick which limits their ability to assist the driver as well [11].

Through current literature, we see that research rather focused on individual factors than on investigating the overall factors that constitute a positive passenger experience. With our repertory grid study, we fill this gap and identify the essential factors that relate to a convenient passenger ride through user elicitation.

2.3 Repertory Grid Methodology

The repertory grid methodology is an interviewing method for eliciting people's ideas or opinions about a specific topic, expressed by their own terminology [6]. This allows getting a detailed and personal overview of user's opinions, in our case related to a convenient passenger experience. The strength of this method lies in uncovering customers' hidden needs as the method bases on Kelly's Personal Construct Theory [33]. This theory assumes that the way people act is defined by the meaning they attach to situations or objects, so-called elements. During repertory grid interviews participants rate those elements based on a set of constructs (opposing word pairs), either supplied by the participants themselves or pre-determined by the interviewer. Those constructs can then be analyzed to see how people think about elements and how the elements are related to each other [6]. Pre-defined elements and constructs result in a matrix that demonstrates the connection between a specific element and constructs

[2]. In the case of non-fixed elements and constructs, the repertory grid method allows exploring a broader topic by investigating constructs (e.g., users, design space) based on people's opinions [18]. Within the HCI community, the repertory grid methodology has been applied in various domains. The most common ones are to get feedback on design ideas [28], or to understand people (e.g., [15, 32, 53]), and to explore the design space of a specific context (e.g., [23, 27, 34]). For instance, Gkouskos et al. conducted repertory grid interviews based on future vehicle concepts to identify driver needs for future transportation design [23]. Kawak et al. [34] and Hassenzahl et al. [27] used such interviews to create design spaces based on physical products the participants interacted with. In addition to the exploration of design spaces, repertory grids have also been applied across national backgrounds [53] and age groups [15].

3 Method Choice and Study

Previous literature about convenient riding experiences is scarce. Besides that, there is no systematic or structured framework for an interview that encompasses the breadth of this topic and at the same time achieves the necessary depth. Therefore, we applied the repertory grid interviewing technique because it is a structured approach to explore a design space from a user's perspective by collecting both qualitative and quantitative data [2, 25]. As it considers user's perceptions, needs, beliefs, and attitudes [27] it enabled us to get detailed insights into the aspects of a convenient passenger experience. More precisely, the repertory grid aims to provide insights into the important factors of a convenient car ride by people's personal constructs which they associate with their individual experiences. In the following subsection, we explain the research setup and the experimental procedure.

3.1 Elements & Constructs

The important dimensions for repertory grids are the elements that need to be judged, in our case the situations the participants remembered being a passenger (see also **Table 1**). During the interview, those elements/situations are used to elicit participants' personal constructs [2] – contrasting word pairs that describe participant's individual riding experiences based on the elements (e.g., long-distance trip vs. short distance trip).

Elements. The proposed numbers of different elements/situations for a repertory grid are typically between 6 and 10 elements [2]. Those elements can either be provided (pre-defined) by the researchers to compare elements/situations or defined by the participant during the interview to deeply discover the design space [2]. We followed the full repertory grid approach with a combination of pre-defined and participant-defined elements as described by Edwards et al. [18]. Therefore, we predefined three most frequent situations of being a passenger (see elements 4–6 in **Table 1**), while three additional elements (elements 1–3) had to be defined by each participant at the beginning of the interview. We asked the participants to come up with situations in which they could remember being a passenger. The description of an element/situation had to cover the reason for the trip, the distance, and with whom they were driving.

Constructs. Constructs are typically word pairs describing opposites (e.g., easy to use - difficult to use). These word pairs are in our experiment elicited through the participants during the interview by comparing elements/situations [2, 18]. This enabled us to explore participant's individual passenger experiences based on their own words and phrases. After the investigation of the constructs, the participants rated each construct on a 7-point Likert scale how important they consider each construct regarding a convenient passenger ride (1 = not important at all; 7 = highly important).

3.2 Participants

We conducted 32 interviews in German or English with participants living in Austria (22), Germany (5), the Netherlands (4), and France (1). The participants' ages ranged from 22 years to 77 years (M = 42.37 years, SD = 15.42 years, 17 males, 15 female). Our participants reported a variety of experiences in traveling as a passenger, ranging from several times a day (2) to several times a week, at least once a week (10), several times a month (9), once a month (4), and less than once a month (5). In addition, we asked the participants whom they travel with most frequently: 16 participants indicated that they travel with their partner, while other categories named were either family related: parents (5), kids (3), cousin (1), sibling (1); or with people close: friends (3), colleagues (2) or roommates (1). None of the participants was referring to ride-sharing or paid rides (e.g., taxi or Uber).

Table 1. The defined elements (=situations) for the repertory grid study

Nr.	Element
1	*Self-defined by the participant*
2	*Self-defined by the participant*
3	*Self-defined by the participant*
4	Short distance ride (<30km) with your mother/father
5	Long-distance ride (>30km) with your best friend
6	Your most convenient passenger experience imaginable

3.3 Procedure

We conducted the interviews either in person or online via Microsoft Teams[1] (the interviews were conducted in June 2020, after the end of the first European Covid-19 lock-down). At the beginning of the experiment, the experimenter introduced the participants to the purpose of the study and explained the repertory grid method. This especially concerned the definition and usage of elements and the procedure of generating constructs. Once the consent form was signed, the experimenter shared the repertory grid document. After an initial trial of adding and judging an example on the repertory grid, the study started following the steps listed in **Table 2**.

[1] Microsoft Teams: https://www.microsoft.com/en-us/microsoft-365/microsoft-teams/group-chat-software, last accessed: 2020/09/12

Table 2. Description of the four steps followed to elicit participants' personal constructs.

	1	2		3	4
		2.1	2.2		
Step	Definition of the remaining three elements/situations	Selecting three out of six elements from the elements list	Generation of constructs (contrasting word pairs) based on the three selected elements	Defining the pole of each construct (word pairs) which contributed positively to passenger convenience.	Assessing the importance of how each construct contributes to convenience.
Description	The participant needs to think of three additional situations (elements) where he/she can remember being a passenger.	The experimenter selects three out of six elements from Table 1. These elements are used in step 2.2 to elicit the participant's personal constructs.	The participant needs to produce as many constructs as possible which describe two of the three selected elements (situations) from step 2.1. This means the statements define how two of the elements are alike but different from the third (triading).	The participant had to state for every construct generated in step 2.2, which pole contributes positively to his/her convenient passenger experience	The participant had to rate the constructs on a 7-point Likert scale from 1 (negative pole) to 7 (positive pole)
Output example	Three additional elements for the elements list: • Riding with my best friend from Germany to Italy for vacation (see also Table 1) • Visiting my grandma (40km) with my brother and my family • Going shopping with my boyfriend (20km)	Possible, random selection: • Riding with my best friend from Germany to Italy for vacation (see also Table 1) • Visiting my grandma (40km) with my brother and my family • short distance ride (<30km) with your mother/father	Example constructs out of the comparison of the three, selected elements in 2.1: *Used a navigation system vs. no navigation system was used* The part "used a navigation system" refers to the vacation ride while "no vacation system refers to the family rides.	Example construct from step 2.2: *Used a navigation system vs. no navigation system was used* ➔ Positive pole: used a navigation system ➔ Negative pole: no navigation system was used	Positive pole vs. negative pole from step 2: Used a navigation system vs. no navigation system used → rated with 7 means, that it is perceived highly convenient if a navigation system is used.
Responsibility	Participant	Experimenter	Participant	Participant	Experimenter

As a first step, participants had to produce the three remaining elements - the situations in which they remembered being a passenger. The second step was the elicitation of the word pairs – so-called constructs. This step is based on triadic comparisons of elements [18] which means, the experimenter chooses three elements out of the defined six elements from **Table 1** (step 2.1). The participant was asked to think about personal constructs that differentiate two of the elements from the third. This means, the participant had to come up with contrasting word pairs (constructs) which describe how two elements are alike but different from the third (e.g., using a navigation system vs. no navigation system was used, step 2.2.). Step 2.2 of defining constructs based on three elements was repeated until the participant could not think of any new ones. In case a construct was unclear for the researcher, the laddering technique was applied [6]: It allows to get more detailed information about the context and meaning of a construct by asking follow-up questions. To avoid leading the participant in any specific direction the laddering questions were limited to ask the participant about the exact meaning or a more detailed explanation of the construct.

After eliciting the constructs, the participant had to state which pole of the construct contributes positively to convenience (step 3) (e.g., either the pole of "using a navigation system" or the pole of "no navigation system was used"). To get quantitative insights into how strong each construct contributes to participants' most convenient passenger experience, we asked the participant to rate each construct on a 7-point Likert scale (1 = not important at all; 7 = highly important) (step 4) [47].

For each participant, we conducted three rounds of comparing elements/situations which incorporates steps 2, 3, and 4. In the first round, the experimenter randomly[2] chose 3 out of the elements 1–5 mentioned in **Table 1**. In the second round, the experimenter picked the two so far unused elements (from elements 1–5) and a random element from the first round. To understand what makes the most convenient passenger ride, element 6 (most convenient passenger experience) was chosen in the last round, it was complemented by two other randomly selected elements from **Table 1**.

Once the rating process was completed, participants answered demographic questions related to their age, gender, the frequency of being a passenger, and with whom they ride most often. At the end of each interview, the researcher checked if all constructs were rated. On average, sessions lasted one hour. The overall study was audio-recorded and was approved by the local ethics board.

3.4 Analysis of the Interview Results

We analyzed the interview results which incorporate the constructs and their ratings qualitatively and quantitatively.

Qualitative Analysis. We conducted a qualitative content analysis [38] based on inductive, thematic free coding to categorize the collected word-pairs (constructs). First, two researchers speaking the local dialect of the participants translated the word-pairs from German to English. As a next step, both construct poles have been assigned to one or multiple codes. This was done iteratively by combining similar codes to an overarching category which resulted in a hierarchical code structure with 3 levels (main, sub & sub-sub categories). The researchers performed these steps on a common agreement basis. We chose this approach to enable discussion of the meaning of the word pairs that were in the local regional dialect and how to categorize them accordingly. The same approach was used for the seven participants answering in English. Overall, the coding, with a series of iterations, resulted in 9 categories with subcategories (min: 3, max: 11) and sub-subcategories (min: 3, max: 11). **Table 3** provides an overview of all categories including sub-categories.

Quantitative Analysis. For the quantitative data analysis, we made use of the constructs rating and the mentioned frequency of categories. Therefore, we first analyzed the frequency of the sub-(sub) categories that have been mentioned by at least 50% of the participants (see **Table 4**). In addition, we also analyzed the rating of the constructs per category. We especially investigated the extreme rated (highest/lowest rated) constructs (see **Table 5**) to spot important but possibly rarely mentioned convenience aspects, as suggested by Fransella et al. [22]. This gave us the possibility to clearly define the aspects that make a passenger experience convenient.Besides that, we were interested in the relationship between the convenient categories/sub-

[2] Google random number generator: https://bit.ly/32lNUIP, last accessed: 2020/09/12

categories and their strength of its connection. Therefore, we correlated the frequencies of the categories by calculating the 2-sided Spearman's rank order.

4 Results

In our study the research question "Which factors account for a convenient passenger experience in a manual car?" was central. To explain our findings, we first give an overview of the overall elicited constructs and their categories, and second, we capture the key factors per category that relate to a convenient passenger experience both qualitatively and quantitatively. Whenever specific constructs (i.e., contrasting word pairs) are mentioned in the subsequent text, the first item always refers to the participant's positive, convenient pole, i.e., the aspect that positively contributes to a convenient ride.

4.1 Overview about the Elicited Constructs

Overall, we elicited 1520 constructs, with an average of M=47.5 (SD=15.8) constructs per participant (min: 9, max: 83). Based on common agreement coding, two researchers grouped these constructs into *nine overarching convenient categories* with subcategories and sub-subcategories (see Table 3). In this section, we provide a general overview of the main categories, while the next subsection will focus on the convenience aspects of the passenger experience.

Most of the constructs refer to *Technology & Equipment* (510 constructs) which incorporates the importance of accessible and controllable functions – mainly provided by the car itself. This is also about devices and goods passengers bring into the car (e.g., smartphone, food & drinks, clothes). The second most frequently mentioned category defines the passengers' *Physical Comfort* (451 constructs). It addresses the value of the sitting position, seat comfort, temperature regulation, and the condition of the car itself (e.g., serviced car). Another 211 constructs relate to passengers' *Well-being*, more precisely to positive emotions, feelings, moods, and outlines the importance of avoiding motion sickness. 181 constructs align to the *Trip* itself. Especially to the type of trip (e.g., leisure trip, shopping trip), the overall trip characteristics (e.g., a fun ride, an exciting trip), and its time and duration. Mentioned responses describing the communication of the occupants, the perceived togetherness as well as the relationship between people in the car relate to the *Social* category (154 constructs). The remaining constructs refer to the *Outside Environment* (128 constructs), *Safety* (78 constructs, driving safety and personal safety), *Driving Behavior* (74 constructs), and being a *Co-Driver* (35). Some of these categories strongly relate to each other. For instance, there is a significant positive correlation between *Well-being* and *Physical Comfort* (r_s = .630, p = .0001). Besides, there are significant positive correlations between *Technology & Equipment* and *Physical Comfort* (r_s = .715, p = .0000) as well as between *Safety* and *Driving Behavior* (r_s = .637, p = .0001). *Well-being* also shows a strong positive relationship with the *Social* Situation in the car (r_s = .481, p = .0053), the *Outside Environment* (r_s = .475, p = .0060) and Safety (r_s = .449, p = .0099). Between all other categories, there could no relationships be observed.

Table 3. The nine overall identified categories including sub-categories and example construct that participants associate with a convenient passenger experience – derived through the qualitative content analysis.

Category	#	Description	Sub-Categories	Example constructs (positive pole / negative pole)
Availability of Technology & Equipment	510	This category refers to the technology and equipment that is available in the car, either provided by the car itself or brought in by the passenger.	Infotainment, Entertainment, External Items (e.g., mobile phone, food & drinks), In-car technology-based Equipment, non-technology-based Equipment, Personalization & Recommendation	• Access to movies, Netflix, and Prime / No access to movies. • To have your own climate control / Not having an own climate control.
Physical Comfort	451	This category concerns the overall physical comfort provided by the car	Sitting position, Seat, Air & Climate, Space & Storage, Car Condition, Noise Scenery, Sound, Light Condition, Cleanness	• Sitting in the front / Sitting in the back. • Can stretch out the feet / Cannot stretch the feet out. • No smoking while driving / Smoking while driving. • Do not detect possible non-functioning of the car / To detect possible non-functioning of the car.
Well-being	211	This category refers to the passenger personally. It specifically concerns the feelings, and the perception passengers encounter during a ride.	Mood, Feelings, Emotions, Personal focus, Trust, Motion Sickness	• To be relaxed / Uncertainty • Trust in driver / No trust in the driver. • To be lost in thoughts / To be concentrated on the route. • No motion sickness / Motion sickness.
Trip	181	This category specifically concerns how the procedure of the trip looks like. It refers mainly to the type of the trip, the characteristics, and the travel time and distance	Trip Type, Stops & Places, Destination, Navigation, Trip Distance, Time, Trip-Planning, Schedule, Frequency of Travels, Trip Costs, Trip Characteristics	• Take spontaneous breaks / Mandatory breaks. • A leisure trip / A business trip. • Adventure ride / Shopping trip. • It is enjoyable / It is unpleasant.
Social	154	This category refers to the social situation inside the car. This often describes the communication between people in the car and the perceived togetherness.	Driver feelings, Relationship to the driver, Conversations in the Car, Relationship to other Passengers, Togetherness, Amount of People in the Car, Respect & Tradition, Social Connection with the outside world, Atmosphere in the Car	• Chat with the driver / Be quiet. • Play video games together / Everyone on specific screen playing different games. • Driving with people I love (friends, family) / Driving with people I hate.
Outside Environment	128	This category concerns everything that goes on outside the car. It specifically refers to the observation of traffic and landscape.	Road & Traffic, Situational Awareness & Overview, Landscape View, Seasons & Weather	• Avoid traffic jams / Standing in a traffic jam. • More overview of traffic / No overview of the traffic. • Nice location and view / Ugly city.
Safety	78	This category concerns what passengers associate with safety and what they need to feel safe.	Feeling safe, Driver focus, Safety in general, Accidents / Breakdowns, Actions in case of Emergencies, Injuries	• A safe feeling / To feel unsafe. • Car is safe and functional / The car is not so safe and functional. • To not have breakdowns / To have a breakdown.
Driving Behavior	74	This category refers to the perceived driving style and speed level.	Driving Style, Speed Level, Perception of the ride	• Comfortable driving style / Terrible driving style. • Lower speed level / Higher speed level
Co-Driver	34	This category concerns how passengers assist and alert the driver.	To (not) take over driving tasks, Alert the driver, Assist the driver	• To look for a parking space / No search for a parking space • Support the driver by navigating / Not supporting the driver by navigating

4.2 Passengers' Most Convenient Ride

To identify the important aspects that make a ride as a passenger convenient, we looked first at the preferred construct poles of the most frequently occurred sub-categories/sub-subcategories which are at least mentioned by 50% of our 32 participants. These 18 categories are listed in **Table 4**. Secondly, we analyzed the overall extreme ratings of constructs per main category (highest rating = 7; lowest rating = 1) to identify their importance, as suggested by Fransella et al. [22] (see **Table 5**).

Technology & Equipment: Overall, most constructs refer to the category of *Technology & Equipment.* When it comes to the passenger's most convenient ride, the level of entertainment, especially provided by personalized *Audio Content* (30/32 participants) (e.g., "Good music with a beat vs. Bad choice of music", P33) plays an important role. Currently, this is mainly achieved by connecting Bluetooth music devices (e.g., smartphone) to the infotainment system (e.g., "Own Bluetooth music vs. Radio", P14). In addition, passengers want to have access to the in-car infotainment system to manually *Control* it (e.g., "Controlling the music vs. Not being able to change the music", P13). This refers to manually adjusting the music or to change the temperature as shown by significant positive correlations between *Control & Audio Content* (r_s = .732, p = .0000) and *Control & Air Conditioning* (r_s = .639, p = .0001). In addition, the infotainment system is perceived as convenient to retrieve information, especially through the integrated *Navigation System* (strong positive relationship between *Information Access* & *Navigation System*; r_s = .488, p = .0047). In general, *Information Access* is appreciated by 20/32 participants as they value staying informed about the outside world, the car, and the trip progress.

Table 4. The most frequently mentioned categories which make a convenient passenger experience including the description of the preferred pole and the non-preferred pole of the construct. The categories highlighted in green are mentioned by over 90% of the participants, the blue ones by over 70 %, the yellow ones by 60%, and the orange ones by at least 50 %.

Code	Description of the preferred construct pole	Description of the non-preferred construct pole	Participants	Number of Constructs	Main Category
Sitting Position	Sitting in the front	Sitting in the back	96,87%	183	Physical Comfort
Audio Content	Listening to personalized audio content, while having the possibility to select or skip a specific song.	Listening to commercial, non-preferred audio content while selecting or skipping a song is not possible.	93,75%	103	Technology & Equipment
Conversations in the Car	Having conversations about fun and non-private topics with others in the car, preferable with the driver.	Having less conversations or no conversations at all. In case of conversations – talking about private, personal topics.	93,75%	94	Social
Feelings	Overall positive feelings a passenger perceives during the ride (e.g., comfortable, relaxed, safe)	Overall negative feelings a passenger perceives during a ride (e.g., stress, discomfort, unsafe)	90,62%	151	Well-being
Landscape View	To have a good and enjoyable landscape view	To have a non-enjoyable or restricted landscape view	81,24%	53	Outside Environment
Seat	An adjustable, comfortable seat	A non-adjustable, dis-comfortable seat	78,13%	64	Physical Comfort
Controllability	To have the ability to control (in-car) functions	To have restricted or limited ability to control (in-car) functions	75%	79	Technology & Equipment
Physical Space	Availability of physical space	Lack of physical space	75%	55	Physical Comfort
Air Conditioning	To have automatic air conditioning with climate zones	To have no air conditioning or manual air conditioning (without climate zones)	68,75%	36	Physical Comfort / Technology & Equipment
Driving Style	The driver drives with a reasonable driving style	The driver drives with an inappropriate driving style	68,75%	46	Driving Behavior
Trip Characteristics	The trip is joyful & exited	The trip is not enjoyable and stressful	68,75%	45	Trip
Information Access	Access to trip-related information and news	No / limited access to trip related information and news	62,5%	62	Technology & Equipment
Navigation System	The availability and usage of a navigation System	No navigation system is available or used	62,5%	37	Technology & Equipment
Situational Awareness & Overview	To have a good overview of the outside environment to stay situationally aware	To have a limited or restricted overview of the outside environment. Situational awareness is not given	62,5%	39	Outside Environment
Trip Type	To be on a private, voluntary, leisure Trip	To be on a mandatory, business trip	56,25%	35	Trip
Being a Co-Driver	To be able to alert or assist the driver	Limited ability or no ability at all to alert or assist the driver	56,25%	36	Co-Driver
Stops & Places	Make additional stops and breaks	Do not make additional stops and breaks	53,13%	24	Trip
Togetherness	Having a higher feeling of togetherness (with people in the car)	Having a lower feeling of togetherness (with people in the car)	50%	22	Social

Physical Comfort: Passengers also strive for a high level of physical comfort to experience the most convenient ride. This incorporates having as much *Physical Space* as possible, especially more legroom to avoid being cramped in the car ("Can stretch legs vs. Cannot stretch legs", P17). In addition, convenience in terms of *Physical Comfort* refers to individual temperature regulations ("Individual climate zones (per seat) vs. single climate zone", P10) and to an adjustable, ergonomic *Seat*. These factors reflected the preference of 31/32 participants to sit at the front. Additional reasons for this are a better view out of the windows towards the landscape (mentioned by 11 participants), a better overview of the traffic & driving situation (mentioned by 17 participants), the possibility to interact with in-car systems (mentioned by 16 participants) and the availability of more physical space (mentioned by 17 participants). Quantitative results in addition unveil, that there is a strong positive relationship between the *Sitting Position* and the possibility to *Control* an in-car system (r_s = .408, p = .0206) as well as between the *Sitting Position* and the *Air Conditioning*. This reflects, that some functions are better or only usable from the front passenger's seat.

Table 5. Overview of the extreme-rated (most important/least important) constructs per main category. Among the 1520 elicited constructs, 30 (1,97%) constructs were rated as least important and 475 constructs (31,25%) were rated as most important. The two highest average score ratings and the two highest proportion of most important constructs are highlighted in green.

Category	Number of constructs rated with highest value = 7	Proportion of constructs rated with 7	Number of constructs rated with lowest value = 1	Proportion of constructs rated with 1	Average rating	Number of different constructs
Technology & Equipment	118	23.14%	20	3.92%	5.48	510
Physical Comfort	147	32.59%	4	0.89%	5.69	451
Well-being	124	58.76%	1	0.47%	6.25	211
Trip	57	31.50%	2	1.10%	5.56	181
Social	29	18.83%	7	4.54%	5.01	154
Outside Environment	35	27.34%	1	0.78%	5.43	128
Safety	45	57.69%	0	0%	6.23	78
Driving Behaviour	36	48.65%	0	0%	6.00	74
Co-Driver	7	20.59%	3	8.82%	5.00	34

Well-being: The *Well-being* of passengers has the highest priority as this category received the highest proportion of most important rated constructs (58.76%) and the highest average rating score (6.25, see also **Table 5**). The main aspects that refer to a high level of convenience are the possibility to relax (44 constructs by 19 participants), to feel comfortable (23 constructs by 15 participants), and the need to feel safe (34 constructs by 16 participants). Besides, *Well-being* shows a strong positive relationship with the categories *Trip Characteristics* (r_s = .494, p = .0041), the *Landscape View* (r_s = .503, p = .0033) and the *Physical Comfort* (r_s = .481, p = .0053). This means, that these factors have an impact on passengers' perceived *Well-being*.

Trip: The feeling of convenience is also influenced by the characteristics of the trip itself. Participants mentioned that a convenient passenger experience is about a joyful and exciting trip rather than a stressful trip (e.g., "Relaxed trip vs. Stressful trip", P8). It is also rather a private, voluntary leisure ride without time pressure (e.g., "No time pressure vs. Time pressure", P1; "Leisure, private trip vs. Professional trip", P33) than a business trip. Therefore, adding additional *Stops & Breaks* to discover new places or taking time to go to a restaurant on a journey contribute to a positive experience, (e.g., "Spontaneous breaks vs. Mandatory breaks", P28). This is in line with the quantitative observation which shows a strong positive relationship between the *Landscape View* and the *Trip Type* (r_s = .488, p = .0047).

Social: Constructs that relate to the social aspects in the car highlight the importance of having *Conversations* and staying connected with others. 19 of 32 participants mentioned that having general conversations contribute to their most convenient passenger ride. Another 15 participants appreciate to especially talk about fun and non-private topics (e.g., "Fun talk vs. Serious talk", P1). Besides, the factor *Togetherness*, more precisely the contact with others by having group conversations or playing games together is a convenience factor (e.g., "Communicate with others in the car vs. Silence", P9; "To play verbal games vs. Don't play verbal games", P3). In terms of the social situation in the car, results show a strong negative relationship between *Conversations* and the *Number of People* in the car (r_s = -.490, p = .0044) which can be described by the difficulty to talk with people in the front when sitting in the back (e.g., "Can hear what people in the front tell when sitting in the front vs. Cannot hear what people in the front tell when sitting in the back", P1).

Outside Environment: Our data unveil the importance of the *Outside Environment* to experience a convenient ride as 127 out of the 128 constructs received high ratings. The convenience of the outside environment mainly refers to have a scenic view to enjoy the landscape (26 of 32 participants). This means, that passengers prefer to drive along panoramic roads to be able to explore new areas (e.g., "Explore new places vs. Drive along known places", P20; "[take a] panoramic road vs. [take the] shortest route", P26). This is again qualitative measurable by a strong relationship between the *Landscape View* & the *Trip Type* (r_s = .488, p = .0047). Besides watching the beautiful scenery, participants mentioned the need to observe both the traffic and driving situation to stay situationally aware (e.g., "Better overview of the driving situation/Less overview of the driving situation", P2).

Safety: Only 78 constructs relate to the overreaching category of passenger's *Safety (*personal safety and driving safety), as safety might be considered a prerequisite. It is likely that participants thought there is no need to explicitly mention such aspects. However, over 50% of the mentioned constructs related to *Safety* were rated as most important which results in the second-highest average rating score of 6.23. This means that *Safety*, can have a strong impact on the perceived level of convenience. Especially the condition of the car itself (e.g., "A serviced car vs. A non-serviced car", P17) to avoid breakdowns and the available driving assistant functions are mentioned aspects that constitute to a convenient experience (e.g., "Driver assistance systems for relaxation as a passenger vs. No driver assistance system", P29). Also, our data shows the dependencies that other categories have on *Safety:* For instance, the overall *Safety* situation has a statistically strong relationship to the level of *Trust towards the driver* (r_s = .455, p = .0089) and how *safe a passenger feels* (r_s = .509, p = .0029).

Driving Behavior: With a high mean rating of 6 (see Table 5), *Driving Behavior* constitutes as well to a convenient passenger experience. 22 of our 32 participants mainly refer to a reasonable *Driving Style* which incorporates anticipatory driving (e.g., "anticipatory driving style vs. quick braking and tailgating", P14) and proactive braking (e.g., "Proactive baking vs. abrupt braking", P28). The analysis of the relations unveils that there is a significant positive correlation between *Driving Style* and *Driver's Focus* (the driver focusing on the driving task – category Safety) (r_s = .638,

p = .0001). In addition, over 50% (17/32) of the participants mentioned that they prefer a reasonable speed level relative to the road condition and traffic situation.

Co-Driver: *Being a Co-driver* and having the possibility to assist or alert the driver makes the ride more convenient for 18 participants. However, the level of importance of this category compared to the other ones is rather low as demonstrated in Table 5 by the average rating (5.0) and the proportion of least important rated constructs (8.82%). Nevertheless, over 50% of participants referred to co-driver tasks when talking about convenience. Such tasks are mainly about supporting the navigation and being responsible for music (e.g., “Support with navigation vs. Do not support with navigation”, P8). This can also be observed by the strong positive correlations that *Being a Co-Driver* has with *Control* (r_s = .488, p = .0047), *Audio Content* (r_s = .488, p = .0047) and the *Navigation System* (r_s = .503, p = .0033). Another reported convenience aspect is the possibility to stay aware of the situation to be able to alert the driver in case dangerous situations occur (e.g., “To warn the driver about situations vs. No control over what the driver is doing”, P13).

To summarize our results, the passenger’s most convenient ride is a combination of nine overreaching factors that do relate to and influence each other. The overall relationships between those are visualized in **Fig. 2**.

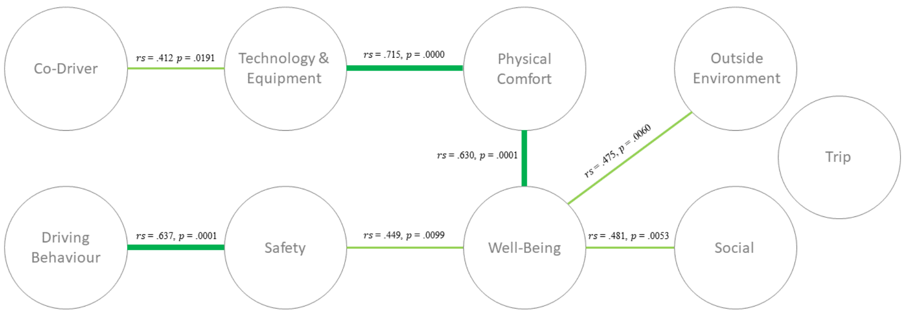

Fig. 2. The relationships between the nine overarching categories: Significant, positive correlations are highlighted in dark green while strong, positive relations are demonstrated in light green.

5 Discussion & Design Recommendations for a Convenient In-Car Passenger Experience

For users of cars common-sense proffers several attributes of in-car experiences that contribute to a pleasant and convenient passenger experience. However, in the lack of a systematic study to evaluate whether these assumptions hold, our repertory grid study attempted to both generate novel insights on passenger convenience but also to validate the common-sense driven observations. The insights from our study confirm several of these assumptions but also reveal novel insights on other aspects of passenger experiences in cars that lead to a feeling of convenience.

Overall, our results confirm the assumption that well-being, physical comfort, and safety are the main factors for a convenient in-car passenger experience. To ensure that passengers perceive a ride as safe and convenient, the relationship to all occupants and the trust towards the driver is important. Regarding technological equipment, we give insights into the importance of information seeking, personalization, recommendations, and connectivity for passengers' external devices. In the following, we discuss our findings and summarize them in the form of design recommendations. These design recommendations result from in-depth discussion and brainstorming of the authors, based on the identified categories. The focus lies especially on short-term product or service innovations that enable integration into current cars. In addition, they outline important aspects for the next generation of manually driven cars which should be considered by future in-vehicle interface designers.

Enable (Shared) Control of Functions. Our results show that controlling in-car systems evidently is a basic need that does not refer to the driver only. For a convenient experience, 75% of our participants think that controlling a device and having access to settings and functions is essential. Overall, passengers want to be able to change things by themselves, instead of relying on others. An established example of this fact is the invention of air conditioning with separate climate zones that enable individual access and controllability [55]. Besides that, we see the trend of dedicated rear-seat infotainment systems that give backseat passengers access to the internet and media-based services [9]. Other researchers investigated infotainment systems that provide especially passengers with information about points of interests [5, 37]. In addition, the positive correlation between the categories *Control & Navigation System* and *Control & Air Conditioning* unveils that driver-based functionalities are frequently used by and important for passengers, too. However, current infotainment systems still neglect passengers since the design focuses mainly on the driver [39, 41]. Thus, we see a clear need for future designers and developers to better integrate the passenger's role and needs when investigating in-car control functions.

> To enable a convenient passenger experience, future cars should be equipped with more passenger-dedicated services that align with passengers' need for controllability and access to functions. A key factor for a more convenient passenger experience is the ability to share control of functions between driver and passenger.

Allow for Connectivity and Technology and Support Personalization. Our results provide deep insights into the convenience aspects of the interactive in-car space. Regarding technological services, our data unveil the necessity of entertainment features as most constructs refer to this category. This is in line with previous suggestions by Meschtscherjakov et al. [41] and it confirms the importance of the investigations related to video and gaming services (e.g., [5, 40]). It also shows that entertainment services that are currently provided in mainly luxury cars are appreciated (e.g., [9]). Besides that, 30 of 32 participants report the importance of services that personalize and recommend content based on their preferences (e.g., audio content). Personalization in this case is not limited to entertainment. It also refers to route choices (e.g., panoramic road, route along sights) and physical aspects like individual temperatures.

Looking at current cars we see already different ways of personalization like the seat that automatically adjusts to the driver or the pre-selection of the favorite radio channel when starting the car [7]. However, these features rather focus on the driver than on passengers. In addition, passenger convenience refers to the possibility to connect personal devices with the in-car environment. This was especially expressed by connecting the smartphone via Bluetooth to the in-car radio system ("Own Bluetooth music vs. Radio", P14). While current cars offer a basic integration of external devices (especially smartphone ↔ infotainment system), this integration is mostly limited to one device (owned by the driver) [8, 41]. However, passengers also bring their personal devices into the car and want to use them during a ride on a regular basis [37].

> To enhance passenger convenience, designers need to focus on improving and extending entertainment features and support the connectivity to personal devices beyond the driver's phone. Besides that, a higher level of personalization for both entertainment and physical aspects is needed to enhance passengers' convenience.

Design for Co-Driving Experiences in the Car. Over 56% of the participants reported that being involved in the driving situation by acting as a co-driver contributes to a convenient riding experience. Reported co-driver episodes relate mainly to support activities like programming the navigation system or alerting the driver in case of dangerous situations, rather than on direct driving-related tasks (e.g., steering the car). Therefore, passengers prefer to sit in the front to be able to best contribute to the ride. This is to some extent in line with previous findings of co-driver activities by Meschtscherjakov et al. [41] and Gridling et al. [26]. Besides that, research shows that co-driving activities help the driver to minimize workload and to reduce distraction [14, 35]. With this regard, we see the need to design for a higher level of co-driving experience to relieve the driver and to enhance passengers riding experience.

> As co-driver activities reduce driver distraction and enhance passenger convenience, it is essential to design with the co-driving experience in mind. Therefore, future driving supportive services should be usable by front seat as well as by back seat passengers to best support convenient riding experiences.

Design for Engagement with the Surrounding & Creation of Memories. The outside environment has a major impact on passengers' perceived convenience as this was reported by 81% of our participants. This especially refers to the landscape view and the possibility to observe sites through the window**.** Thus, our data confirm the need for contextual interfaces to support riding experience [30] and demonstrate the importance of past investigations that show information about the surrounding attractions (e.g., [5, 37]). Besides that, the creation of memories is important to experience a highly convenient ride. Therefore, it is advised to guide users through new areas and to recommend unusual routes or panoramic roads. Another aspect lies in the possibility to engage with the surroundings. Thus, we see an enormous potential for new innovations and technological developments that should be extended to the use by passengers (e.g., augmented reality or virtual reality interfaces and systems [39]).

To design for the most convenient ride, the integration of contextual information is key. Thus, we see the potential of creating positive memories through the engagement with the outside world and by recommending panoramic roads or routes with a high density of sites.

Design for Well-Being & Comfort. Overall, we confirm the assumption that well-being is a main factor of passenger's perceived convenience. Overall, the results are in line with Wilfinger et al. [56] who report that well-being combines the perception of feeling comfortable and relaxed, especially during long trips. Designing for a high level of comfort and well-being relates mainly to our assumptions about comfort qualities of the car like avoiding motion-sickness, supporting safety, providing an ergonomic seat, and guarantee enough physical space. Besides that, our data unveil that passenger's comfort and well-being are highly influenced by the level of trust towards the driver, the overall physical comfort, the outside environment, and the social situation in the car. Thus, it correlates highly with other design recommendations. However, the possibility to relax and feel comfortable depends on physical comforts such as an ergonomic and adjustable seat, a perfect temperature, and the right perception of space. Looking at current cars, an adjustable seat for front-seat passengers is standard, while also additional comfort functions like an integrated seat massage are already established in luxury lines (e.g., BMW 7 series[3]). Nevertheless, we still see a huge design potential for in-car experiences that can contribute to passenger's well-being and comfort, especially when it comes to the integration of external devices like body-posture support systems or wearables.

Well-being and comfort are essential requirements when it comes to passengers' most convenient rides. While the design for these factors is already established, a huge potential still lies in integrating external devices that improve well-being in order to increase the riding experience.

Support Social Connectedness within the Car. When designing with passengers in mind it is important to consider the social situation within the car to allow passengers to experience a convenient ride. As our data shows, 93.75% of the participants like to have conversations when riding. This seems obvious and has already been discussed in the literature [41, 56]. However, recent technological considerations like in-car virtual reality applications focus more on the individual passenger than on the group interaction [39]. Besides that, we found that a convenient ride is rather a leisure or vacation ride with friends or family members than a business trip with colleagues or less known people. This confirms mentioned riding situations in literature that passengers prefer [30]. During rides with loved ones, our results unveil that passengers strive for a feeling of togetherness. This is to some extent in line with the need for relatedness to people inside/outside the car and by using the time to catch up with family-related things as reported by Gkouskos et al. [24]. Thus, the aspect of social connectedness is essential for perceived passenger convenience. This also incorporates the ability to allow for better communication between the front and the back as previously

[3] BMW 7: http://content.bmwusa.com/microsite/7series_2013/com/en/newvehicles/7series/sedan/2012/showroom/convenience/driving_comfort.html#t=l, last accessed: 2021/01/26

investigated with the integration of several microphones and speakers [52]. But activities that contribute to social connectedness can go beyond traditional conversations. Desired features, therefore, range from in-car games [40] to sharing information with other occupants [5, 42] or to support group decisions (e.g., shared music playlist). Thus, we see a clear need to explore the design space to support the feeling of togetherness through future in-vehicle systems in more detail.

When riding with familiar people, there is a clear need to enhance the feeling of togetherness by allowing group decisions and information sharing. Thus, the development of future in-vehicle systems that support social connectedness is essential to establish a convenient passenger experience.

Information Access is Important for Convenient User Experiences. Passengers want to stay connected with the outside world, but they also want to explicitly connect with the activity or ride they are currently undertaking. Overall, trip-related information to enhance passenger experience was already proposed by Inbar & Tractinsky [30]. However, 20 of 32 participants unveil the need to receive information beyond the time of arrival, speed level, or traffic jams. This especially refers to information about the direct surroundings and having access to both local and global news. First attempts have already been made by showing reduced information about attractions [5]. While current rear-seat infotainment systems with access to the Internet are already established [9], we still see the need to investigate the integration of information access based on passenger's needs and preferences. This means to better embed information-based service to the in-car infrastructure and to selectively deciding what information to display when and how, to best support passenger's convenience.

Information about the ride and the outside world is important to the support riding experience. Therefore, future in-car applications should selectively provide access to information, based on passenger preferences and needs.

Consider Passenger Safety Perception. While safety received fewer constructs compared to other categories, over 57.7% of the mentioned ones were rated with the highest possible importance value of 7. Thus, our results confirm the assumptions of the need to arrive safely without any major troubles like breakdowns or accidents and outline the importance of safety perception. However, the subjective feeling of being safe does not only refer to the driving situation but also depends on the relationship with the driver, as already reported by Inbar & Tractinsky [30]. Also, our data unveil that this feeling gets influenced by passenger's level of trust towards the driver as they wish for a responsible driving style and a speed level that aligns well with the road and traffic situation. In addition, the use of driving assistance systems (ADAS) does not only impact drivers' experiences [24] as our data shows. The use of an ADAS, like (adaptive) cruise control, is highly appreciated by passengers as it improves their convenience level positively. Therefore, we envision to better inform passengers about the status of such assistive systems to enhance their safety feeling as well as their level of trust towards the driver.

The overall feeling of safety has highest priority for passengers and impacts their convenient riding experience centrally. Therefore, to improve the passengers' safety perception future vehicle concepts should a) aim for a higher level of trust between the passenger and the driver and b) better inform the passenger about the use and status of ADAS features.

Our design recommendations outline important factors when it comes to the design of technology-driven features and products that can easily be brought into current cars or that can be applied on top of existing in-car services. All recommendations were derived from the nine investigated convenience factors that we combined with findings from prior work in this field. Our results are possibly limited by the choice of our method: As the repertory grid method allows to explore a topic in depth, both qualitatively and quantitatively, it does not allow to identify hierarchical relationships of constructs mentioned after each other. Given the explorative nature, where each participant may produce different constructs which contribute to convenience, the frequencies do not provide a ground truth across all participants but indicate the importance of certain topics. In addition, we are aware that the employed convenience sampling to find our participants might influence our findings. Nevertheless, the sample represents participants from diverse age groups and is nearly gender-balanced. As our results are indicative for Europe, they may not fully generalize beyond Europe. Besides that, another limitation of any method involving users (and no domain experts) is that participants rather think about their daily lives, and we therefore might miss visionary aspects for future concepts. However, we do not see this as a true limitation, as our goal was to explore the design space from a user's perspective, and in addition, the automotive industry typically designs for evolution rather than using disruptive approaches leading to a revolution.

6 Conclusion

By means of a repertory grid study we investigated aspects that constitute to passengers' convenient riding experience in a human-driven car. Our interviews extend prior work,verify common-sense assumptions, and we unveil what aspects designers should focus on when designing in-car applications with the passenger in mind, especially when it comes to innovations that allow for easy integration into current cars. The interviews provided broad and deep insights into qualitative aspects that constitute a convenient riding experience. We condensed this information into a set of eight design recommendations that give an overview of the design space and provide future developers and designers with directions to best support passenger experiences. Beyond the assumptions of basic needs for well-being, physical comfort, and safety, passengers highly value access to in-vehicle systems. More precisely this relates to the possibility for shared control and an extensive integration of external devices, connectivity, and personalization. We, therefore, see the need for designing the co-driving experience, i.e., the creation of a shared experience when using in-vehicle systems during a joint ride with a passenger. Contradicting with concepts that advertise personal virtual reality experiences in cars [38], the interviews revealed that social connectedness is another essential aspect that constitutes to passenger's most convenient ride. Thus, the key for the next generation of in-car user interfaces will be the ability to make the whole journey for everyone in the car a shared experience. By enabling everyone to participate in this experience actively if they wish to or to enhance the journey with the ability to create shared memories seems promising. We conducted the interviews in central Europe, which is one of the core markets for automotive manufacturers. While future research should investigate whether cultural differences exist in other markets, we see our work as an essential starting point for the design of a shared user experience for manual car rides and in-car technology that takes driver and passengers into account. While revolutionary design and inventions are much desired, the industry is mostly bound to gradual improvements, for instance, to comply with safety and security requirements. Following the task-artifact cycle [11], which proposes continuous adaptations of existing systems to (changed) user needs, our findings match this approach of evolutionary design and suggest incremental improvements in future vehicles.

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