Desire for (Control of) Smart Technology

Investigating Consumers' Perception, Motives and Needs regarding Autonomous and Proactive Agents

DISSERTATION

of the University of St. Gallen,

School of Management,

Economics, Law, Social Sciences

and International Affairs,

to obtain the title of

Doctor of Philosophy in Management

submitted by

Nicola Schweitzer

from

Germany

Approved on the application of

Prof. Dr. Andreas Herrmann

and

Prof. Dr. Torsten Tomczak

Dissertation no. 4802

Difo-Druck GmbH, Bamberg 2018

The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, May 22, 2018

The President:

Prof. Dr. Thomas Bieger

To my parents for their unconditional love and support.

To Daniel and Nina for encouraging me to take this route.

To my supervisors and project partners for offering me this opportunity.

To Johanna and Emanuel for giving it a serious shot.

To Matteo for never being tired to discuss.

Table of Contents

Summary

The combination of recent breakthroughs in artificial intelligence and ever-increasing computational power is enabling the creation of autonomous and proactive technologies that act on behalf of consumers. Use cases range from the next generation of virtual assistants that will proactively make decisions for the consumer, to Level 5 self-driving cars, which autonomously take over the task of driving. Due to the novelty of many of these technologies, little is known in theory and practice about the perception of consumers and emerging customer needs in the context of such innovations. Since relinquishing control to technology can cause consumer reactance, it is central to the development of autonomous and proactive products and services to identify, understand, and address perceived disadvantages. In addition, specific customer desires regarding such technologies can arise and should be addressed by manufacturers in order to increase consumers' willingness to use and purchase. However, conducting a meaningful investigation into consumer perceptions and needs regarding a technology that has not been introduced to the market yet is a challenging undertaking. Building further methodological knowledge can support the development of successful research designs in foresight research. The following research questions examine the above challenges in the context of different smart technologies:

1. How do consumers perceive proactive digital agents that autonomously and proactively make decisions for them?
2. Which new customer needs and use cases arise in the context of semi-autonomous vehicles?
3. How can visualizations support foresight research?

Article I demonstrates with the help of exploratory qualitative research that consumers perceive proactive agents to prompt trade-offs between functional and psychological consumption motives. Based on in-depth interviews, focus groups, and a quantitative survey, article II identifies innovative use cases for semi-autonomous vehicles and examines their relevance to automotive customers. By means of a case study, Article III describes how visualizations can make a valuable contribution to foresight research.

Zusammenfassung

Die jüngsten Erfolge in der Erforschung künstlicher Intelligenz und eine ständig steigende Rechenleistung ermöglichen die Entwicklung autonomer und proaktiver Technologien, die im Namen von Verbrauchern agieren. Anwendungsfälle reichen von der nächsten Generation von virtuellen Assistenten, die proaktiv Entscheidungen für den Verbraucher treffen werden, bis hin zu selbstfahrenden Autos der Stufe 5, welche vollumfänglich die Fahraufgabe übernehmen. Aufgrund der Neuheit vieler dieser Technologien ist in Theorie und Praxis wenig über die Wahrnehmung von Verbrauchern und die sich abzeichnenden Kundenbedürfnisse im Zusammenhang mit solchen Innovationen bekannt. Da jedoch die Delegation von Kontrolle an Technologie Reaktanz bei Verbrauchern auslösen kann, ist es für die Entwicklung autonomer und proaktiver Produkte und Dienste von zentraler Bedeutung, von Verbrauchern empfundene Nachteile zu erkennen, zu verstehen und zu beheben. Darüber hinaus können konkrete Kundenwünsche bezüglich derartiger Technologien entstehen und sollten von Herstellern adressiert werden, um Nutzungs- und Kaufbereitschaft von Verbrauchern zu erhöhen. Die Untersuchung von Verbraucherbedürfnissen in Bezug auf neue Technologien, die noch nicht auf dem Markt eingeführt wurden, ist jedoch ein herausforderndes Unterfangen. Der Aufbau weiteren methodischen Wissens kann die Entwicklung erfolgreicher Forschungsdesigns in der Foresight-Forschung unterstützen. Die folgenden Forschungsfragen untersuchen die oben ausgeführten Herausforderungen im Zusammenhang mit verschiedenen intelligenten Technologien:

1. Wie nehmen Verbraucher proaktive digitale Agenten wahr, die autonom und proaktiv Entscheidungen für Verbraucher treffen?
2. Welche neuen Kundenbedürfnisse und Anwendungsfälle ergeben sich im Zusammenhang mit teilautonomen Fahrzeugen?
3. Wie können Visualisierungen Foresight-Forschung unterstützen?

Artikel I zeigt mittels explorativer qualitativer Forschung, dass proaktive Agenten Kompromisse auslösen zwischen funktionalen und psychologischen Konsummotiven. Basierend auf Tiefeninterviews, Fokusgruppen und einer quantitativen Umfrage werden in Artikel II innovative Anwendungsfälle für semiautonome Fahrzeuge ermittelt und ihre Relevanz für Automobilkunden untersucht. In Artikel III wird anhand einer Fallstudie beschrieben, wie Visualisierungen einen wertvollen Beitrag zur Foresight-Forschung leisten können.

Article I

Schweitzer, N., Gollnhofer, J. F., and de Bellis, E. (submitted to the Journal of Product Innovation Management): Exploring the Potential of Proactive AI-enabled Technology for Social Innovations.

Exploring the Potential of Proactive AI-enabled Technology for Social Innovations.

Nicola Schweitzer[(1)]

Johanna Franziska Gollnhofer[(2)]

Emanuel de Bellis[(3)]

(1) Nicola Schweitzer is a Doctoral Candidate at the Institute for Customer Insight, University of St. Gallen, Switzerland (nicola.schweitzer@unisg.ch).

(2) Johanna Franziska Gollnhofer is an Assistant Professor at the Department for Marketing and Management, University of Southern Denmark, Denmark (johannafranziska.gollnhofer@unisg.ch).

(3) Emanuel de Bellis is an Assistant Professor at the Institute for Customer Insight, University of St. Gallen, Switzerland (emanuel.debellis@unisg.ch).

Abstract

Groundbreaking advances in artificial intelligence permit today's virtual assistants (e.g., Amazon Alexa or Google Assistant) to develop from reactive to proactive agents, able to initiate their own behavior and to make decisions autonomously on behalf of consumers. Overlaying these developments upon the rising interest in social innovation, this paper proposes the concept of proactive social innovation (PSI) to refer to innovations that have a social impact, and are based on proactive AI-enabled technology. Potential applications of PSIs offer manifold benefits on both an individual level (e.g., heightened consumer welfare) and for society as a whole (e.g., healthier population). Drawing on research into consumer behavior, information systems, and innovation management, the authors argue that PSIs challenge well-established human-machine interactions due to the delegation of decisions to technology. A scenario-inspired qualitative study across emerging and developed markets explores consumers' perceptions of one specific PSI, namely a nutrition agent that proactively manages different steps in food consumption, thereby nudging consumers toward healthier diets.

The findings demonstrate that delegating decisions to PSIs prompts trade-offs between functional (e.g., convenience, time efficiency) and psychological consumption motives—such as personal control, social connectedness, experiential rewards, and individuality. The authors argue that these trade-offs depend on the prevalent consumption motive (functional vs. psychological) and the need for assistance (low vs. high), which in turn determines whether the technology is perceived as enabler, disabler, ideative facilitator, or practical supporter.

The contribution of the paper is threefold: It conceptualizes PSI as a novel and promising form of social innovation, identifies trade-offs between conflicting consumption motives caused by PSIs, and introduces a future research agenda along with implications for practitioners to further explore and promote PSIs.

Introduction

Consider the following two innovations: Fridge A autonomously orders milk on the basis of pre-defined consumer preferences (e.g., 2 liters per week from a specific brand). By contrast, Fridge B proactively assembles and orders personalized diets for the consumer, based on real-time data (e.g., a consumer's insulin level), without interacting with the consumer. These two innovations illustrate the vast opportunities offered by artificial intelligence (AI) and point to a fundamental paradigm shift in the near future: the evolution from reactive (Fridge A) to proactive technology (Fridge B). The latter technology proactively and autonomously initiates anticipatory behavior and decisions on behalf of the consumer to act in advance of future occurrences (Huffmann and Chandra, 2017; Kolbjørnsrud, Amico, and Thomas, 2016; Zinn, 2017). Proactive technology does so by applying AI and analyzing implicit information (e.g., user data) instead of reacting to commands. The notion of proactivity is captured best by a proactive agent that evaluates options and makes decisions by "sensing the environment and acting on it, over time, […] so as to effect what it senses in the future" (Franklin and Graesser, 1996, p. 25).

We argue that proactive agents are optimally suited for enhancing social innovations. By merging the recent interest and advances in proactive AI-enabled technologies with those in social innovations, we introduce the concept of proactive social innovation (PSI). We envision this technological innovation as delivering novel solutions that can more effectively and efficiently solve social problems thanks to the digitalization and automation of complex processes, the technology's ability to learn and its proactive behavior in response to the recognition of patterns in large volumes of data (Christensen, Baumann, Ruggles, and Sadtler, 2006; Clarke et al., 2006; Jennings, 2000; Soderland, 2017, Zinn, 2017). Early examples of PSIs—though with only low levels of proactivity—improve individual health management with the help of proactive, personalized medical care (e.g., goforward.com; MacIntosh et al., 2016) and increase consumer welfare through pre-emptive interventions based on anticipated consumer needs (Schneider, 2017).

To realize the large potential of PSIs and to increase their adoption likelihood, we explore consumers' perception of PSIs using the example of a nutrition agent that proactively manages food consumption processes. We expect such proactive nutrition agents to yield multiple social benefits given the dramatic increase in obesity and diabetes mellitus type II as well as other nutritional challenges in both emerging and developed countries (Baier and Hanson, 2004; Jayawardena et al., 2012). Specifically,

the proactive nutrition agent promotes healthy nutrition by optimizing nutritional intake while exhibiting additional benefits such as time savings, resource management, convenience, and individual health management.

Despite these functional and social benefits at community level (e.g., improved population health), we argue that consumers' delegation of decisions to PSIs challenges well-established human-machine interactions (Belk, 2017; Lee and Choi, 2017). A scenario-inspired qualitative study in emerging and developed markets explores consumers' perception of PSIs and finds that delegating decisions to PSIs provokes trade-offs for consumers. Specifically, we observe trade-offs between functional consumption motives, which are a direct outcome of the consumption process and are often quantifiable, and psychological consumption motives, which are an indirect outcome of the consumption process and are thus more difficult to anticipate. Several theoretical and practical contributions follow from these findings: First, we develop the concept of PSI as promising technology in the field of social innovation. Second, we identify four trade-offs between conflicting consumption motives that are caused by the proactivity of the technology. Third, we offer implications for researchers and practitioners that work in the realm of social innovations and proactive AI-enabled technologies.

The remainder of the paper is organized as follows: We introduce the concept of PSI and outline its prospects for social innovations. Based on a cross-disciplinary literature review on human-machine interaction and consumption motives, we hypothesize that PSIs provoke trade-offs between functional and psychological consumption motives. We then report our empirical results and conclude by discussing the results against prior literature and suggesting practical implications as well as future research.

Theoretical Background

Prospects of Proactive AI-enabled Technology for Social Innovations

Social innovations "improve either the quality or the quantity of life" (Pol and Ville, 2009, p. 881) as they aim to address social issues surrounding health care, the environment, economy, education, or consumer welfare (Barczak, 2012). Prior studies have stressed the positive influence of social innovations in different contexts, focusing largely on improving social issues of Bottom-of-Pyramid communities (e.g., Alvord, Brown, and Letts, 2004; Nakata and Weidner, 2012; Prahalad, 2012; Ramani, Sadreghazi, and Gupta, 2017). Due to major advancements in AI, which are expected

to infiltrate many areas of everyday life and to have a strong impact on different consumer groups as well as industries such as health care, retail, electric utility, and manufacturing (Bughin et al., 2017), the next generation of social innovations is likely to be empowered by AI-enabled technologies. Better resource management, improved decision-making, and standardization are just some functional advantages of AI-enabled technologies (Nadimpalli, 2017). For example, autonomous agents in retail are expected to automate evaluation, product filtering, and product choice on the basis of personal and aggregated consumer data (Bughin et al., 2017; Wang, Tan, and Ren, 2004). We argue that, in particular, proactive AI-enabled technologies offer promising new solutions and widespread positive influence to social needs due to their reliance on intelligent algorithms and large volumes of data and their ability to recognize patterns in complex information (Soderland, 2017; Zinn, 2017), thereby reaping the benefits of digitalization and automation (Chandy, Hassan, and Mukherji, 2017; Jennings, 2000). Consequently, we suggest the concept of proactive social innovation (PSI) defined as a technology that makes use of proactive AI while having a positive social impact on individuals and society as a whole. Besides the functional benefits granted through proactive AI-enabled technology, we argue that PSIs will offer manifold social benefits especially in the health sector, as apparent in recent as well as expected developments in the field (MacIntosh et al., 2016) that yield more proactive health management, diagnostics, and democratic access to medical assistance (Soderland, 2017). A current example from the health care sector - however with low levels of proactivity - is Weka Smart Fridge, which provides better inventory, budget, and resource management of vaccines. Weka Smart Fridge manages the inventory of vaccines in clinics and employs proactive AI to deliver alerts to medical staff when vaccines are about to expire or run low, thereby preventing human error due to unrecorded vaccines and enabling better resource management of life-saving vaccines.

Another promising way to yield social benefits is by employing nudge theory, defined as “any aspect of the choice architecture that alters people’s behavior in a predictable way without forbidding any options or significantly changing their economic incentives” (Thaler and Sunstein, 1999, p. 6). Instead of banning unhealthy foods, for instance, supermarkets can designate a section of trolleys for fruit and vegetables while restaurants can make salad rather than fries the default side order. These nudges have the potential to improve population health (Marteau et al., 2011). A sophisticated and potentially ubiquitous technology like PSIs is likely to take nudging to the next level. This applies for general health issues such as smoking, alcohol, and physical

activity, and is particularly promising for diet-related health issues such as obesity and diabetes mellitus type II (Kozup, Creyer, and Burton, 2003; Roberto, Pomeranz, and Fisher, 2014). Specifically, nutrition agents (as one form of PSIs) can tailor food choices according to specific dietary restrictions, past nutrition intake, and physical activity—and are resistant to specific consumer biases such as the unhealthy-equals-tasty intuition or the influence of environmental cues on food choices (Biswas et al., 2017; Raghunathan, Naylor, and Hoyer, 2006). Thus, nutrition agents can foster a healthier diet to prevent as well as treat health-related issues. Taken together, PSIs offer consumers various functional benefits and thus seem to be a promising social innovation. However, prior research indicates that consumers perceive intelligent technology in ambivalent ways. We will review this literature next.

Changes in Human-Machine Interaction Through Proactive AI-enabled Technology

Besides their manifold functional benefits at the individual level and social benefits at the societal level, PSIs are likely to fundamentally change the interaction between humans and machines. We argue that the shift of decision power to proactive technology has a substantial impact on how consumers perceive the technology.

Research on consumers' perception of proactive AI-enabled technology is scant. Preliminary evidence exists on consumer acceptance of different precursors of proactive agents, showing that consumer reactions vary substantially depending on the technology's attributes, the level of proactivity and the context. Several studies in the domains of marketing and innovation research found that consumers perceive reactive recommender systems as generally positive. For instance, avatar sales agents (i.e., virtual company representatives that provide recommendations) increase consumer satisfaction (Holzwarth et al., 2006) and are preferred by consumers in online shopping processes (Keeling et al., 2010). Moreover, recommender systems can lead to higher quality of decision-making and higher efficiency of purchase decisions (Häubl and Trifts, 2000; Xiao and Benbasat, 2007) as well as a reduction in search costs for price and product quality information, which ultimately improves consumer welfare (Lynch and Ariely, 2000). However, follow-up studies on these technological agents found that technology-mediated relationships, such as with avatar sales people or helper robots, were perceived as less friendly by consumers in comparison to human-human interactions (Keeling, Keeling, and McGoldrick, 2013) and that digital

assistants with humanlike features undermined the enjoyment of computer games (Kim, Chen, and Zhang, 2016).

Several studies looked at technologies that are equipped with a higher degree of intelligence and – depending on the technology – some level of proactivity and autonomy, i.e. the ability to function independently and in a goal-directed way without user interference (Rijsdijk and Hultink, 2009). Again, they found positive as well as negative perceptions of the technology. For instance, research on smart products which are "able to collect, process, and produce information and can be described as 'thinking' for themselves" revealed that consumers perceive autonomy of consumer household appliances, such as apparent in autonomous lawn mowers or washing machines, as beneficial yet risky (Rijsdijk and Hultink, 2003; 2009, p. 35). The authors demonstrated that product autonomy partly decreases the complexity associated with a product and at the same time increases performance risks associated with the technology. Adaptability of a product, that is, the ability of a technology to respond to its environment and to adapt to it, increased perceived complexity and risk of a product. Other studies on smart products with higher degrees of autonomy and low levels of proactivity found that consumers fear an impairment in their freedom to choose or act and to lose certain hedonic and social aspects of consumption (Heiskanen et al., 2007; Schweitzer and Van den Hende, 2016). For instance, Schweitzer and Van den Hende (2016) revealed that a health monitor which collects personal health and dietary data and makes dietary suggestions elicited feelings of technology dependence in consumers, resulting in reduced intention to adopt such technologies. Related research showed that consumers embrace connected, intelligent, yet non-proactive objects enabled through the internet-of-things (e.g., smart fridges or smart phones) for their functional (i.e., usefulness), hedonic (i.e., the pleasure and emotional benefit of using and sharing) and communal value (i.e., need for conformity, for belonging, or adhering to a community), while worrying about data privacy issues and addiction to technology (Touzani et al., 2017).

Summarizing, prior studies have yielded ambivalent results regarding the perception of autonomous technologies and proactive agents in their very early development stages. To the best of our knowledge, there are no studies that investigate consumers' perception of highly proactive technologies from a social innovation perspective. Next, we will argue that the ambiguous perception of proactive agents is partly due to trade-offs between functional and psychological consumption motives.

Relevant Consumption Motives for Proactive AI-enabled Technologies

We argue that the perception of PSIs depends on consumers' predominant consumption motives. Consumption is partly rooted in the fulfillment of functional motives: Goods are consumed for their functional aspects such as quality, ease of use, and convenience, which are expressed in the notion of utility maximization (Thaler, 1985). However, a number of studies in consumer and innovation research have highlighted that consumption and innovation adoption are not only motivated by functional aspects but are, instead, also motivated by socializing, experiential, and fun aspects (Holt, 1995; Okada, 2005; Stock, Oliveira, and von Hippel, 2015). For example, consumption can alleviate the feeling of being socially excluded by strengthening communal bonds (Lee and Shrum, 2012), offers experiential rewards (Csikszentmihalyi, 2000; Holbrook and Hirschmann, 1982), and allows for distinction from other individuals (Snyder and Fromkin, 1977). In addition, the desire for control has been shown to be an important driver in consumption. For instance, when personal control over outcomes in life is limited, consumers seek control in consumption, by choosing products and environments which feel structured due to inherent boundaries (Cutright, 2012) or through "lucky" products to have at least the illusion of control (Hamerman and Johar, 2017).

Given our interest in consumer perceptions of PSIs, we summarize prior research by distinguishing between functional and psychological consumption motives. Functional consumption motives refer to motives that are a direct outcome of the consumption process and are often quantifiable (e.g., efficiency or health outcomes). Psychological consumption motives refer to motives that are an indirect outcome of the consumption process and are thus more difficult to anticipate (e.g., experiential rewards or uniqueness through consumption processes).

Methodology

Our Scenario: A Nutrition Agent

Based on thorough desk research and forecasts of AI-enabled developments in retail and the health care industry (Bughin et al., 2017; Huffmann and Chandra, 2017; Soderland, 2017; Zinn, 2017), we developed a scenario of a PSI in the form of a nutrition agent. We had our scenario validated by an AI expert from a large IT company and a health expert in the field of diabetology for realistic fit. The nutrition agent developed for this study was described as being able to proactively and

autonomously initiate its own actions and decisions on behalf of consumers. More specifically, the agent automates product evaluation and filtering in consumption processes and proactively manages personalized purchases on the basis of personal (e.g., individual health data) and aggregated data (e.g., preferences of similar consumers in terms of demographics and context) with the help of personalization techniques (Gao, Liu, and Wu, 2010). Because the sketched technology relies on proactive AI, it was described as learning a user's preferences and needs over time by accessing different data sources, such as demographic information (e.g., age, gender, and salary), real-time health data (e.g., blood pressure and insulin level), and previous consumption history. In this way, the nutrition agent yields higher well-being due to personalized nutrition plans, enhanced consumer welfare due to higher utility maximization, significant time savings, better budgeting, and optimized resource management. We described this scenario to our informants verbatim as follows: "Imagine a technology that proactively and automatically orders food for you on the basis of your needs and preferences. It detects when you need food and understands what kind of food you want and that is healthy for you. The technology does so by applying artificial intelligence to your data, that is, previous consumption behavior, current health status, personal nutrition plan and salary, as well as aggregated consumer data. It is also able to connect with a technology that automatically prepares food for you."

Data Collection

In light of the explorative nature of our investigation and following prior research on future innovations (Rijsdijk and Hultink, 2009), we take a scenario-inspired approach based on qualitative methods. Thus, our empirical basis encompasses extensive qualitative data in the form of in-depth interviews and focus groups based on a purposeful sampling strategy for innovative, trend receiving consumers (Hofmann, 2015; Schweitzer et al., 2015). A total of 45 informants were suggested by our network and screened through an initial phone interview (lasting approx. 45 min) by ensuring (1) perceived technological reflectiveness, (2) curiosity and open-mindedness, (3) the ability to observe and recognize patterns in technological advancements, and (4) diverse background (e.g., in terms of family and education) of informants in the same national sample. Eventually, 30 semi-structured interviews (average age: 24; gender: 57% female; average length: 58 minutes) were conducted with informants in China (n = 10), Switzerland (n = 9), and the USA (n = 11) as we

were interested in consumers' perceptions of PSIs across developed (i.e., Switzerland and USA) and developing (i.e., China) markets. Further, we conducted four focus groups (average number of participants: 4; average length: 175 minutes) with previously interviewed informants and after the one-on-one interviews. All interviews and focus groups were conducted by the first author, recorded and transcribed verbatim. Following a semi-structured interview protocol, we started with grand-tour questions to explore our informants' personal background (McCracken, 1988). Next, informants were introduced to a poster demonstrating mega trends of the future that we developed based on extensive desk research in order to prime them with a futuristic mindset. Then, aligned with prior research (Rijsdijk and Hultink, 2003; 2009; Vriens et al., 1998), consumers were confronted with a verbal description of the nutrition agent. Informants were asked questions investigating their feelings, perceived advantages, and possible objections towards this technology. The interviewers guided the informants step-by-step through an automated shopping and cooking process. Those parts yielded insights into how PSIs are perceived by consumers. During the focus groups, participants were confronted with the insights generated within the interviews to further elaborate on and discuss the findings from the one-on-one interviews. We identified consumption processes that consumers are willing to delegate to the nutrition agent, under which circumstances they hesitate to relinquish control, and how the nutrition agent relates to psychological consumption motives. Interviews and workshops finished when saturation was reached and no new insights were gained through additional data (Morse, 1995).

Data Analysis

Data analysis followed an iterative approach, as we circled between data and theory (Lincoln and Guba, 1985; Spiggle, 1994) in order to develop theoretical and practical insights. Data analysis unfolded through the following steps: We coded for benefits and pitfalls of the nutrition agent. Through several rounds of structured coding (i.e. open, selective and axial coding, Glaser and Strauss, 1967) we aggregated those benefits and pitfalls into trade-offs between psychological and functional consumption motives. For triangulation purposes (Denzin, 1970), we validated our results by comparing the insights with a sample of 24 professionals in the same three markets. Further, the comprehensive literature review from the fields of social innovation, innovation management, consumer behavior, and information systems provides a multidisciplinary lens and improves the validity of our results.

Findings

Our findings show that when employing PSIs consumers perceive trade-offs between the fulfillment of functional and of psychological consumption motives. We identified four such trade-offs, namely between functional consumption motives and (1) personal control, (2) social connectedness, (3) experiential rewards, and (4) individuality. We demonstrate how these trade-offs are perceived differently depending on consumers' prevalent consumption motive and their need for support in the consumption process.

Functional Benefits of the Nutrition Agent

We find that consumers perceive various functional benefits of PSIs, such as healthier diets, time efficiency, convenience, and more informed decision-making. In particular, informants with a weak emotional link to food and low expertise in the field embrace the nutrition agent, such as Thomas: "I would be the first and best customer […] If something like that existed, which designs a menu on the basis of my body functions, that helps me to lose weight or stay fit, then I would use it immediately." Thomas is specifically fascinated by a personalized diet suggested by the agent and Nina, too, an informant with a functional perspective on food and low expertise, anticipates:

> *I wouldn't have to take care of anything and wouldn't have to look up the information on what is healthy or low in calories, but at the same time, I would have increased benefits. Because I wouldn't always eat the same foods but would have different foods while making less effort than I currently do, when I'm always eating the same food. That would be a great benefit, especially considering my health. (Nina, Switzerland)*

Due to her functional perspective on food and low level of expertise, Nina would almost completely outsource the food acquisition and preparation process to the technology in order to maximize her "cost-benefit ratio." The same goes for Frederik who does not care much about food: "This is one of the things that I want to be automated […] I want breakfast to be organized and lunch as well. I want a minimal amount of thinking." Similarly, Candice would use the nutrition agent to spice up her diet with more variety: "I eat the same thing for one week […] It [the technology] would bring color to my life". Yuliang, Lisha, and Candice believe that the technology would be very helpful for planning and time-saving in the food consumption process and would value the time efficiency gained through the technology. Jenny points out that she would invest the gained time in other, more meaningful ways: "It would give

you more free time that you can then use in other ways", for instance "to volunteer for a park clean initiative."

The proactivity of the agent is valued by some participants, as the agent might nudge them into healthier nutrition (Kozup, Creyer, and Burton, 2003; Thaler and Sunstein, 1999). Jenny thinks that "having someone else, or something, that was proactively messaging me about these things [i.e., healthy nutrition] would be really helpful." She describes the agent as enabling because it might steer people into healthier, yet enjoyable nutrition choices, which people "wouldn't normally expect to enjoy based on the healthy criteria that they are trying to hit." Using Jenny's mother as an example, the technology would "make sure she was making the right choices because her health is bad enough as it is." Finally, Nina perceives that a proactive technology might have additional benefits: "I regard a certain degree of proactivity as positive, also because you learn about yourself and your habits."

Even foodies (i.e., consumers with a high expertise and involvement in the domain of food) like Roberto and Chun embrace the convenience aspect of delegating routine tasks (e.g., ordering and carrying beverages or salt) to the technology, especially those that do not provide a sensory experience or are not relevant to their identity. This, in turn, would allow them to take care of the "more relevant" tasks themselves.

Also when food consumption has an emotional component, for instance, in social settings with friends, some informants (i.e., those with a low level of expertise) would embrace the technology as it inspires the planning and food acquisition process: "I am not super creative. Everything I cook is the same stuff I have made for years […] Something like that would mix my options, say when friends come over" (Jenny). Similarly, Nina would use the technology as a support to plan meals for friends on the basis of "health limitations, allergies, and taste preferences."

Consumers who view the nutrition agent as enabling often have a functional perspective on food while at the same time expressing a high need for support (because of their low level of expertise) in the different food consumption steps. Those with a more emotional link to food and a high level of expertise in food acquisition and preparation view the agent as a support for routine tasks, or perceive it as disabling. As we will show next, this scepticism is rooted in the impaired fulfillment of psychological consumption motives.

Impairment of Personal Control through the Nutrition Agent

Our findings highlight that delegating decisions to nutrition agents might reduce individuals' feelings of personal control over the consumption process and thereby fail to address consumers' desire for control, which has been referred to as "an essential component of what it means to be human" (Leotti, Iyengar, and Ochsner, 2010, p. 6). Personal control is the belief that events depend on one's own behavior and not on destiny, circumstances, other people or external forces (Rotter, 1966) and is also important in food consumption, for instance, when controlling one's food intake. Reflecting on delegating food choices to the nutrition agent, Fatima takes the notion of personal control on a meta-level: "I think that's like a fundamentally human thing to have at least the illusion of control or some ability to manipulate or chart the course of events that you experience or engage." In her view, the perception of being able to exert personal control over one's environment and to produce desired results (Kelly, 1955) facilitates a fulfilling life. Stephan mirrors this opinion by describing self-determination "as a very important matter for humans" and Jerrie, referring to her desire for personal control over the described nutrition agent, adds that she is "a firm believer that technology should be in the backend support to enhance human lives. And what that means is, the decision point and the ownership of that decision comes from humans". Fatima explains that it is important for her to have personal control over food consumption, for instance, over the selection process: "I select what I consume and what source of nourishment I take in", also to make sure that certain criteria are met, such as "it being ethically sourced and organic" or as Jenny puts it, "it is playing into the fact that a bell pepper isn't good if it has a dent."

Our findings suggest that nutrition agents that actively drive consumption decisions compromise personal control and self-determination (Ryan and Deci, 2000) in consumption processes. Previous research demonstrated that consumers show lower acceptance of products that threaten personal control (e.g., Schweitzer and Van den Hende, 2016). Extending this research, our informants reacted hesitantly to the idea of relinquishing personal control over nutrition decisions to proactive technology. At the thought of delegating consumption decisions to the nutrition agent, Chun envisions an undesirable dependence on technology:

> *Once the decisions that I should make are made by them [i.e., the nutrition agent], what should I do? They can almost do everything for me. They can also decide whether I need to eat this or not. If they said "No," then what? I cannot eat this anymore? No. I still want to eat it if I want to. […] I want to be self-*

> *determined. I want to be independent. I mean, once the machine breaks down, then what? (Chun, China)*

Chun describes a loss of personal control and self-determination through proactive agents. Some informants go as far as referring to an existential fear of being replaced by the technology. For example, Melissa is afraid of being vulnerable to proactive agents: "I don't want it to be replacing an actual human […]. I don't want to be vulnerable to it." In a similar vein, Yuchun fears losing her purpose as a mother if outperformed by the nutrition agent: "I don't want my children to think I am nothing compared to the machine. If this machine could really do a lot of things better than me, then I would just be afraid to be a mum." The findings illustrate that the described nutrition agent might hamper a feeling of personal control which seems essential for consumers' well-being in the interaction with proactive agents.

A critical condition for the acceptance of the nutrition agent is clearly the possibility for making choices. The removal of choice has been shown to lead to feelings of helplessness as well as to poor health (Mineka and Hendersen, 1985; Rotter, 1966; Taylor and Brown, 1988) due to a suppression of perceived personal control (Leotti, Iyengar, and Ochsner, 2010). When asked about the agent's preferred levels of proactivity and autonomy, Yuliang highlights his need to exert personal control by making decisions and choices and describes the agent as a choice assistant rather than a driver of his decisions:

> *It's your life, so, you need to control your life. Yes. You need to make some decisions. Sometimes you hesitate to make decisions because you don't know what you can choose from, like restaurants or that sort of thing. So, the agent can help you by listing several options that you may prefer, so it's much easier for you to choose. So, it helps you to make the decision but does not make the decision for you. (Yuliang, China)*

Yuliang acknowledges the difficulty of decision-making in certain situations and embraces a technology that supports the consumer in this task. If a possibility for choice is granted, Craig explains he does not mind the nutrition agent "choosing the brands for me. I don't mind it ordering the things for me." However, when deprived of choice and the possibility of exerting personal control over preferences and outcomes, the findings reflect informants' fear of being disabled through proactive agents.

This critical perception of the nutrition agent is also reflected in a fear of being manipulated into less beneficial products due to consumers' reduced personal control

over the consumption process. Research on recommender systems shows that product choices might be biased due to inherent limitations of the input data or predictive modeling technique, resulting in over- or underpredictions for certain items (Adomavicius et al., 2013), an issue that is likely to be even more prominent for proactive agents.

When asked about the prediction accuracy of nutrition agents, several informants mention human unpredictability, such as Yuliang who recognizes the "uncertainty of the real person" or Lisha who says that, "sometimes even I don't know what I want so I don't think a machine would know exactly what I want", indicating a lack of trust in the agent's prediction accuracy. Moreover, the participants clearly fear strategic behaviors by companies that might leverage proactive agents for their competitive advantage. They are concerned that the purchases undertaken by the technology could be biased toward corporate rather than consumer interests. When asked about which entity might develop the nutrition agent, Craig assumes it to be private organizations and explains:

> *If it's a private organization and it is in partnership with x amount of brands, it's only really motivated to recommend those brands to me because it's in partnership with those companies. Now, when I find out that there is a whole world of other brands that might have been better for me, but this isn't going to recommend it to me, because they're not its partners, now I don't like it. Because now I feel like it has limited my choices, not to the things that are based on my preferences, but based on the things that are its preferences that fall within what are my behaviors. (Craig, USA)*

If implemented by a private organization, Craig expects the nutrition agent to prioritize the company's interests, tricking consumers into suboptimal choices and products. He fears that the agent would hamper his ability to make the best decisions for himself by pushing products he might not necessarily want or need; this would eventually prevent him from adopting the technology. Cem adds that nutrition agents, when cooperating with brands and advertisers, "might be used as a really strong marketing tool", manipulating consumers to optimize monetization for the company whereas Stephan is afraid of manipulation in terms of price adjustments according to different user groups. Research in information systems shows that such agents might indeed manipulate consumer preferences in a way beneficial to the service provider instead of the consumer. For example, the service Netflix has previously been identified as providing suggestions based on inventory management to increase sales, not purely on consumer

preferences (Pathak et al., 2010). Due to a lack of trust in the benevolence of private organizations, many informants would require the agent to prove "that it is unbiased" (Craig) or developed by "an entrepreneur that […] operated within the non-profit sphere" (Fatima). Overall, our informants see their personal control compromised by the nutrition agent with downstream consequences for their sovereignty and protection from manipulation.

Impairment of Social Connectedness through the Nutrition Agent

Prior research has shown that consumption caters to the need to belong, that is, the desire for interpersonal attachments, and that consumption processes create social connectedness (Baumeister and Leary, 1995; Loveland, Smeesters, and Mandel, 2010; Troisi and Gabriel, 2011). The different steps in food consumption also typically offer ample opportunities for social interaction. Some participants fear that the nutrition agent would hamper possibilities to socially connect with others through consumption. Says Trevor when asked why he prefers going to a farmers' market over an automated shopping process:

> *I think it's the disconnection with the producers; so part of going to the farmers' market, or a butcher or any of that, is interacting with the people whose craft is to cut up the meat. (Trevor, USA)*

For him, shopping at the farmers' market includes a form of social connection; it is about interacting and connecting with other people. He defies the notion that grocery shopping is just a rationalistic, functional buying process. This perspective is also reflected in cooking processes that facilitate bonding across consumers (Wallendorf and Arnould, 1991). As Christian put it when asked about the significance to him of cooking and related consumption processes:

> *I think that preparing food in a group requires interaction – which is a nice thing – because it needs focus and cooperation. You have to coordinate your conceptions of the meal. It is complex, but not too complex, so it still fosters interaction. You can talk (...) and in the end you can enjoy the outcome together. (Christian, Switzerland)*

Christian emphasizes the role of consumption processes in bringing people together through fostering social interaction (Lee and Shrum, 2012). According to Christian, food experiences bind people together through "rituals" and provide "pleasurable sensations." Consumption processes for him are not just functional endeavors targeted

towards utilitarian goals, but unfold through embodied practices resulting in social interactions—and those interactions are meaningful to consumers. In our given scenario, Trevor similarly emphasizes the importance of having people over and preparing food for them, resulting in social bonding. The idea of consumers as social beings is especially reflected in the "care and love" that our informant Nina wants to convey to her close circle by choosing appropriate products and preparing dinner for them. As Yudi states, preparing dinner is about "using my heart to do something. It means that I really care about you, I want to make you happy." Yudi here emphasizes the interpersonal and communal aspect of consumption.

These common experiences create a form of affect that orients groups - and therefore social connectedness - and provides meaning to consumers (Kuruoğlu and Ger, 2015). By handing some tasks to a nutrition agent, Roberto fears that he would lose his "relationship with food". Probed for his reaction to the nutrition agent, Stephan states, "We are social beings and we will always stay social beings. And just because you could make this task efficient and less-time consuming – you do not have to do it". Social connectedness not only refers to friend circles but also connects the consumer back to a whole supply chain system, thereby creating transparency and building trust. Says Jenny:

> *If you go to the grocery store, like the wholefood places around my apartment, I have gone in and asked them questions about different kinds of apples or fruits and they are kind of like "hmm". But if you could talk to a farmer they know exactly, they know if they are good that week, if you come back next week they will be better, that sort of thing. They know their stuff in a way that I definitely feel comfort in. I feel like I can trust what they are saying. (Jenny, USA)*

Relying on nutrition agents would mean that mundane possibilities for interaction, such as in grocery stores, are replaced by "rationalistic and functional machines" (Leo) overriding the emotional, affective and human touch in consumption that results in integration, bonding and social connectedness. Maria worries about individuals "who live alone, do not have families and for sure experience the desire to interact with other humans" underscoring that "real communication is important". By recalling the example of her mom, Melissa illustrates how technological advances already threaten social interactions today: "She goes to the self-checkout at the grocery store and when dialing a company there is just an automated voice on. She is just craving for human interaction." This resonates with prior research emphasizing that frequent, recurring situations are needed in order to maintain social relationships and the feeling of

belonging (Baumeister and Leary, 1995). Summarizing, the nutrition agent is perceived as hampering social connections with others.

Impairment of Experiential Rewards through the Nutrition Agent

Whenever our informants judge a step in the consumption process as relevant for experiential rewards (Rohm and Swaminathan, 2004), they often caution against relying on the nutrition agent. Experiences refer to sensory perceptions, aesthetic considerations, and emotional feelings in consumption processes (Carù and Cova, 2003) and result in experiential rewards (Csikszentmihalyi, 2000) referring to temporary improvements in mood. Asked about his shopping habits and their importance to him, Roberto responds:

> *I go to a market to buy fresh ingredients, I buy peas, mint, lemons, olives, to make it more pleasant… I might buy other stuff. I like to be creative. Maybe I find something in the market that goes with the peas and mint soup. There might be other things that I buy. Then I go to my favorite butcher in town and buy the meat. I order the beverages and they are delivered to my place. I don't want to be bothered with touching bottles. But I want to see the food. (Roberto, Switzerland)*

Roberto, a self-proclaimed foodie, describes the supermarket almost as a sensory arena, where like Stephan, he can "smell, touch and feel" (Stephan) the food (e.g., Rohm and Swaminathan, 2004). Those sensory experiences allow for creativity and a playful form of discovery – a type of browsing - where our informants "discover items that they did not know before" (Stephan) and are not deprived of their creativity (Trevor). Trevor continues explaining that for him cooking is almost a holistic, encompassing experience:

> *I guess the other aspect of that is, it's a craft that is also being pushed for technologically pretty much constantly. So it's an interesting thing to continue to incorporate new techniques or new ingredients or new technologies into the process. (Trevor, USA)*

For Trevor, cooking is a craft, simultaneously a way of entertaining and incorporating new techniques, or an almost exciting experience.

Nutrition agents might create alienation between the consumers and the purchase process by compromising the experiential dimension. As Fatima puts it when being asked about her concerns regarding the nutrition agent:

> *I feel like technology dehumanizes the process of consumption and our interaction with food to some capacity in various settings. Food often needs a coordinated effort, so the lack of that might completely negate the entire notion of eating with other individuals, especially if it is so customized. (Fatima, USA)*

Fatima voices her fears of being "dehumanized" when technology takes over consumption steps that basically require a coordinated effort, i.e. resulting in a common experience.

This experience dimension seems to be especially important for informants who seek "to learn and grow" (Candice) or consider "planning, making choices and seeking what the options are" as part of the fun (Marie). For them the experiential rewards come in form of skill development. As described by Sandra:

> *I wake up in the morning. I make fresh chai tea. And then I go and pick my mint from the garden, put it in there. If I wanted something Turkish, I don't know what I want. And coming home would be an experience in that either the entire family, my kids and myself, and my husband, we would go and look at the garden and assess what is growing, and what looks good. We would take what we needed for that meal, pick it off the vine, and prepare it together. (Sandra, USA)*

For Sandra nutrition is not reducible to functional means but delivers some form of experiential rewards that can be achieved through playing an active role in consumption processes. Overall, shopping and cooking experiences are not always just burdensome tasks, but play a special role in consumer lifeworlds and also deliver experiential rewards (Csikszentmihalyi, 2000): Interacting with objects is a form of counter-rumination by focusing the mind on a material object, task or goal. This view was also expressed by Yudi who sees purchasing food and cooking as a way to escape heavy thoughts, such as uncomfortable emotional topics.

These findings show that nutrition agents pose a potential threat to the fulfillment of experience-oriented consumption motives (e.g., Csikszentmihalyi, 2001; Holbrook and Hirschmann, 1982).

Impairment of Individuality through the Nutrition Agent

Our findings suggest that the inherent human motive of perceiving and portraying oneself as a unique individual (Snyder and Fromkin, 2012), a need that is frequently expressed through individual food preferences and cooking, is not addressed by the nutrition agent due to the delegation of decisions to the technology. Consumers fear that their individuality would be constrained, which might in turn lead to equal, uniform consumers who think and behave in a similar way. We define individuality as the quality or character of a particular person that distinguishes him or her from others of the same kind (Snyder and Fromkin, 1977; Tian et al., 2001). An expressed risk is that consumers would adjust toward each other due to the use of aggregated consumer data that rules out the peculiarities of individuals. In response, consumers might not accept specific decisions made by the nutrition agent and eventually abandon (or not even adopt) the technology to regain (or keep) their power in decision-making processes.

An essential concern voiced by our informants is the reduced individuality that nutrition agents might trigger (Snyder and Fromkin, 1977). According to Fatima, the widespread use of nutrition agents will "create this homogenous population." Stephan fears that dependency on algorithms would make him "monotonous" as he would always tend to eat the same. Nina states that "the preparation [of a meal] is a very important step for me because that is where the creativity and individuality goes in." Besides these general concerns, our informants also fear reduced diversity when delegating decisions to nutrition agents. Describing the technology, Fatima is afraid that "we are completely losing our diversity in terms of our decision-making." The threat of reduced diversity is echoed by several informants as summed up by Chun:

> *I think they will make everyone become the same, because we are using the same technology, and maybe it will make the same food, the food will taste alike. There is not a lot of diversity here. […] I want diversity, I want to be special. If the technology can offer us diversity, I can accept it. But if it just makes the same things, I think it will lose its appeal. (Chun, China)*

Whereas the majority of informants sees their individuality and diversity in jeopardy, we observe differences not only with regard to individuals and contexts (see paragraph on functional benefits of PSIs), but also with regard to the predominant culture. Specifically, informants with predominantly collectivistic worldviews (China; Hofstede, 2001) express the individuality threat more than informants with predominantly individualistic worldviews (Germany and the USA; Hofstede, 2001),

despite the former's interdependent (vs. independent) social environments that focus on the group instead of the individual (Nisbett and Masuda, 2003). Yuliang argues that in China "people are more eager to stand out, to have their unique things" because there are "so, so many people in China." Further, Nina differentiates between specific consumption contexts, for instance, when eating on her own as opposed to eating with others:

> *For me food is very functional, but if I invite people over I want to show them something about my personality, I want the night to be more special and more about us and what we really like. […] It needs to represent us or my tastes or ideas or skills. So it must be more about individuality of myself as a host. That means for me, I would usually order my food in restaurants on normal nights, but if I invite people to my house there is no external catering. Because if I invite them to my house it needs to be individual. (Nina, Switzerland)*

Whereas this quote highlights the importance of stressing one's individuality through consumption, there are also more specific indications with regard to reduced diversity. Yuliang and Jerrie mention that small, individual, and particular businesses such as "the little mom and pop shop" may not be considered by the nutrition agent and are therefore likely to disappear. Similarly, Jerrie questions how candid the agents' decisions are and whether they will only consider restaurants that pay.

In addition to individuality and diversity concerns, informants fear that delegating decisions to PSIs might also lead to reduced creativity (Bharadwaj and Menon, 2000), with potential downstream consequences for the innovativeness of society as a whole. As Fatima puts it in the context of data sharing, "that might prevent individuals from promoting the creativity, the innovation to drive society in a positive and progressive direction in whatever capacity that may be." The desire to maintain (and potentially even extend) creativity in the face of decision delegation is also expressed by Frederik and summed up by Jerrie:

> *Making decisions and building a smart intelligent algorithm based on historical data limits the possibility for human discovery and innovation in a way. Because you're only feeding data that you know already. And that's why I think, as clichéd as it sounds, human innovation or design thinking cannot be replaced by machines, because that's the unexpected part, that there is no data to fit into it just yet. (Jerrie, USA)*

This points to the general finding that our informants do not expect technologies to replace humans due to humans' unique standing. Overall, they consider that decision delegation hampers consumers' individuality, their desired level of diversity, and their creativity.

In sum, despite its various functional benefits, our informants expected that the nutrition agent would impair the fulfillment of four important psychological consumption motives (i.e., personal control, social connectedness, experiential rewards, and individuality). We interpret these results as four conflicting trade-offs that consumers are likely to face when using PSIs.

Discussion

We introduced the concept of proactive social innovation (PSI) and found that consumers' delegation of decisions prompts trade-offs between functional and psychological consumption motives. We add to research on social innovations by drawing on the potential of proactive AI-enabled technologies and outlining the social and functional benefits of PSIs. Further, we contribute to the literature on consumer and innovation research by pinpointing how consumers perceive such a technological innovation. Finally, we develop practical implications and a research agenda for further investigation of PSIs.

Consumers' Multifaceted Perception of PSIs

Innovation research has shed light on the potential of "big data" for addressing social problems (Chandy, Hassan, and Mukherji, 2017). Similarly, research on AI has introduced innovative ways to tackle social needs. For example, preliminary results showed that AI can help to prevent HIV spread in homeless populations (Yadav et al., 2015), or optimize defense of fisheries from illegal fishing (Haskell et al., 2014). To the best of our knowledge, no academic work has yet combined the prospect of proactive AI-enabled technologies with that of social innovations in order to augment the latter's positive social impact.

This paper explored consumers' perception of PSIs to potentially increase the adoption likelihood of this promising technology. Prior research has mainly examined consumer perceptions of reactive technologies (e.g., Holzwarth, Janiszewski, and Neumann, 2006; Keeling, Keeling, and McGoldrick, 2013). Studies on technologies with a high

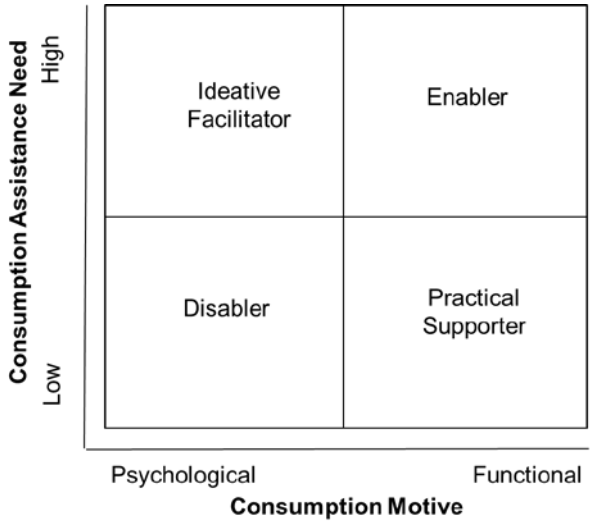
degree of autonomy and, occasionally, with low levels of proactivity (also referred to as "smart products") yielded ambivalent results on how consumers perceive such technologies. For instance, autonomous consumer appliances with no proactivity were perceived as beneficial (Rijskdijk and Hultink, 2003; 2009), whereas smart products with some level of proactivity elicited feelings of disempowerment (Schweitzer and Van den Hende, 2016). Rijsdijk and Hultink (2003) concluded that "consumers may also consider these products complex and the use and purchase of such products risky. In addition, people often show a desire for control and may be reluctant to hand over control" (p. 204).

We add to research on smart products by mapping out consumers' perceptions of a social technology that entails a high degree of proactivity. Specifically, we unpack under which circumstances consumers perceive such technology as enabling, and when and why they perceive it as risky or disabling. The findings reflect that PSIs are perceived as prompting trade-offs between functional and psychological consumption motives. We summarize our findings by developing two dimensions that explain the multifaceted perception of PSIs by consumers: the consumption motive (functional vs. psychological: referring to the prevalent, situational-dependent consumption motive of the consumer) and the need for consumption assistance (low vs. high; referring to the perception of the technology as offering additional expertise in consumption processes; see Figure 1).

Based on those two dimensions, consumers perceive the technology as enabler, ideative facilitator, practical supporter, or disabler. The PSI is an enabler when consumers perceive it as catering to functional motives as well as offering valuable consumption assistance (e.g., non-experts who show little interest in a consumption category and have no expertise, thus having a high need for consumption assistance). In situations when a need for inspiration outweighs functional consumption motives, yet a high need for assistance prevails, the technology functions as ideative facilitator (e.g., food non-experts who invite friends over for dinner and need the technology to manage the creative consumption process). The PSI is a practical supporter when a low need for consumption assistance prevails yet the consumption motive is functional (e.g., food experts that use the technology for functional tasks, such as proactively ordering low-involvement products). The PSI is as a disabler when it is perceived as compromising psychological motives while not adding any valuable consumption assistance (e.g., food experts who enjoy all steps of the consumption experience and do not want to delegate decisions to a PSI). Our framework suggests that the

perception of PSIs is situational and multifaceted, and can vary among and within different consumption categories. In other words, consumers perceive and consequently embrace a PSI differently according to the situation (e.g., dinner with friends vs. lunch on a working day) and the product categories (e.g., shopping for convenience products vs. shopping for organic vegetables).

Figure 1. Consumers' perception of PSIs as a multi-facetted concept.



We expected to also find differences in the perception of PSIs across markets in the light of well-established cross-cultural differences between so-called individualistic and collectivistic countries (Hofstede, 2001; Nisbett et al., 2001; Nisbett and Masuda, 2003). Interestingly, we find that the three markets we sampled our informants from (i.e., China, Switzerland, and USA) had similar views on the potential benefits and pitfalls of the technology—with the exception of the issue of a constrained individuality, which, contrary to traditional views but in line with more recent research (Hamamura, 2012), was most prominent and widespread in China. This finding suggests that PSIs need to put additional emphasis on providing distinctiveness in China (and potentially also in other East Asian markets) to be adopted by consumers and to eventually elicit their positive social impact.

A New Era of Human-Machine Interaction and Decreasing Consumer Power

Prior research has shown that consumers experience trade-offs between conflicting consumption motives, such as functional versus sustainable or utilitarian versus

hedonic motives (Luchs, Brower, and Chitturi, 2012; Raghunathan et al., 2012). We add to this research by showing that a fundamental shift in the decision power from human to machine leads to a conflict between functional and psychological consumption motives. Our findings demonstrate that the high degree of proactivity blurs the boundaries between consumers and technology, thereby leading to a redefinition of traditional human-machine interaction.

These findings are intriguing when discussed in the context of how the digital economy empowers market actors. Prior research has highlighted the positive features of digitalization, such as enhanced opportunities for organization and communication (Hollenbeck and Zinkhan, 2006), relatively low costs (Castells, 2000; Juris, 2005), democratization of power relationships between consumers and other market actors (e.g., blogging; McQuarrie, Miller, and Phillips, 2013), and empowerment of marginalized communities (Leong et al., 2016). Our research shows that increasing digitalization (with increasing levels of automation and proactivity) is perceived by consumers in ambivalent ways. The de-humanziation of consumption entailing an increasingly digitalized and automated consumption experience challenges psychological needs as well as consumer sovereignty—that is, the influence of consumers on production, offers and quality of goods and services. Specifically, we find that the delegation of decision power to technology is perceived as limiting consumer sovereignty in consumption processes.

The predicted change in human-machine interaction further bears the risk of consumer manipulation. Previous research on recommender systems found a potential bias of such systems and potential sabotage (Lam, Frankowski, and Riedl, 2006; Mobasher et al., 2007, Pathak et al., 2010). We find that consumers perceive proactive (vs. reactive) technology as even more undermining of consumers' personal control, increasing the threat of potential manipulation by service providers. The latter has an influence on power relationships between consumers and technology as well as those between consumers and other market players.

Implications for Future Research and Practitioners

Prior research has shown that a detailed understanding of consumer needs and perceptions is essential for the success of innovations (Von Hippel, 2001) and technologies addressing social needs (Schweitzer et al., 2015). By exploring consumers' perception of PSIs, our insights support developers in aligning consumer

perceptions with the actual product at the so-called fuzzy front end (i.e., the starting point of opportunity recognition and conceptual development of new products; Van Den Ende, Frederiksen, and Prencipe, 2015).

A major implication that follows from our findings is that developers of PSIs should provide unique, individual solutions that meet the specific preferences of their customers, and should highlight this effort to consumers. While personalized solutions are one way to achieve this goal, providing consumers the opportunity to proactively customize a part of their consumption is likely to enhance their feeling of control (Smets, Langerak, and Rijsdijk, 2013). For instance, in order to tackle the perceived impairment of personal control, PSIs should allow consumers to customize the agent's level of proactivity and autonomy according to personal preferences, or the criteria according to which a PSI decides for the consumer. Further, it is important to distinguish consumption processes that might be replaced by robotic interactions or shifted to the virtual space from those that are pertinent for peer-to-peer interactions. Moreover, firms should differentiate between consumption processes that yield experiential rewards and those that do not. Through customization and personalization options, PSIs could be developed that are adjustable to individual needs and the perception of social connectedness and experiential rewards. In order to both protect consumers from bias and sabotage and increase consumer trust (Waytz, Heafner, and Epley, 2014), the implementation of attack-detection mechanisms, such as suggested for today's recommender systems (Lam, Frankowski, and Riedl, 2006), could be a feasible approach to tackle the risk of external manipulation.

Our findings provide first insights into how consumers perceive PSIs. As our findings come with contextual and methodological constraints and yield initial exploratory insights, we call for further research pursuing the fruitful avenue of PSIs. For instance, health-care start-ups (e.g., forward.com) and initiatives of large companies in the education sector (e.g., teacheradvisor.org provided by IBM) foreshadow the importance of PSIs in a wide range of industries, and might serve as interesting application cases for studying PSIs. Despite our global perspective of interviewing consumers on three different continents, our sample consisted of a rather homogenous group in terms of demographic and educational background. This prompts us to call for research investigating the feasibility and perception of PSIs from the perspective of different actors such as a more heterogeneous consumer sample, innovation managers or regulators. Furthermore, experimental studies could further test the role of psychological consumption motives that are likely to drive PSI adoption.

More specifically, future research should investigate different ways to increase consumers' feeling of personal control over the consumption process (Cutright, 2012), despite decision delegation to PSIs, for instance by investigating different technology-based measures (e.g., sequential choice designs, customization options, different forms of human-machine communication). Research should also aim at clarifying the relationship between different task and product attributes (e.g., utilitarian vs. hedonic products; Botti and Mcgill, 2011) and the accepted level of proactivity of the PSI. It would also be important to better understand which factors have a positive influence on consumers' trust in PSIs (Komiak and Benbasat, 2006; Waytz, Heafner, and Epley, 2014).

In order to ensure positive social impact, studies should investigate the critical relationship between technological possibilities and consumer protection and ways in which PSIs can be perceived as enabling rather than disabling (e.g., personalization options, more market transparency). The creation of a more communal consumption process should also be in the focus of future research, to determine both how PSIs can foster instead of reducing social interactions, and the role of experiences in PSIs. Future studies should also clarify how PSIs can ensure that data aggregation supports detection and forecasting of general preferences while not leading to uniform patterns. Lastly, which unique, individual solutions exist that allow PSIs to meet very specific preferences of their users?

Conclusion

We introduced the concept of PSI with the overarching goal of enhancing the positive social impact of innovations. Our findings suggest that consumers perceive conflicting trade-offs between functional and psychological consumption motives resulting in diverse perceptions of PSIs spanning from disabling to enabling. Taking a consumer perspective on innovations allows the development of customer-centric innovations that have a positive social impact, therefore reaping the potential of proactive social innovations.

Acknowledgements

We would like to thank Martin Faltl for his outstanding support in the collection of data in the USA.

References

Adomavicius, G., J. C. Bockstedt, S. P. Curley, and J. Zhang. 2013. Do recommender systems manipulate consumer preferences? A study of anchoring effects. *Information Systems Research* 24 (4): 956–75.

Alvord, S. H., L. D. Brown, and C. W. Letts. 2004. Social entrepreneurship and societal transformation. *The Journal of Applied Behavioral Science* 40 (3): 260–82.

Baier, L. J., and R. Hanson. 2004. Perspectives in diabetes. *Diabetes* 53 (5): 1181–6.

Barczak, G. 2012. The future of NPD/ innovation research. *Journal of Product Innovation Management* 29 (3): 355–57.

Baumeister, R. F., and M. R. Leary. 1995. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117 (3): 497–529.

Belk, R. 2017. Consumers in an age of autonomous and semi-autonomous machines. In *Contemporary Consumer Culture Theory*, eds. E. M. F. John F. Sherry and E. Fischer, 5-32. London: Routledge.

Bharadwaj, S., and A. Menon. 2000. Making innovation happen in organizations: Individual creativity mechanisms, organizational creativity mechanisms or both? *Journal of Product Innovation Management* 17 (6): 424–34.

Biswas, D., C. Szocs, R. Chacko, and B. Wanisink. 2017. Shining light on atmospherics: How ambient light influences food choices. *Journal of Marketing Research* 54 (1): 111–23.

Botti, S., and A. L. McGill. 2011. The locus of choice: Personal causality and satisfaction with hedonic and utilitarian decisions. *Journal of Consumer Research* 37 (6): 1065–78.

Bughin, J., E. Hazen, S. Ramaswamy, M. Chui, T. Allas, P. Dahlström, N. Henke, and M. Trench. 2017. *Artificial intelligence – the next digital frontier?* Available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Advanced%20Electronics/Our%20Insights/How%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/MGI-Artificial-Intelligence-Discussion-paper.ashx

Carù, A., and B. Cova. 2003. Revisiting consumption experience: A more humble but complete view of the concept. *Marketing Theory* 3 (2): 267–86.

Castells, M. 2000. *The rise of the network society.* Oxford, UK: Blackwell.

Chandy, R., M. Hassan, and P. Mukherji. 2017. Big data for good: Insights from emerging markets. *Journal of Product Innovation Management* 34 (5): 703–13.

Christensen, C. M., H. Baumann, R. Ruggles, and T. M. Sadtler. 2006. Disruptive innovation for social change. *Harvard Business Review* 84 (12): 94-101.

Clarke, J., C. J. Dede, D. J. Ketelhut, and B. C. Nelson. 2006. A design-based research strategy to promote scalability for educational innovations. *Educational Technology* 46 (3): 27–36.

Csikszentmihalyi, M. 2000. The costs and benefits of consuming. *Journal of Consumer Research* 27 (2): 267–72.

Cutright, K. M. 2012. The beauty of boundaries: When and why we seek structure in consumption. *Journal of Consumer Research* 38 (5): 775–90.

Denzin, N. 1970. *The research act in sociology: A theoretical introduction to sociological method.* London: Butterworths.

Franklin, S., and A. Graesser. 1996. Is it an agent, or just a program? A taxonomy for autonomous agents. *In International Workshop on Agent Theories, Architectures, and Languages*. Berlin, Heidelberg: Springer.

Gao, M., K. Liu, and Z. Wu. 2010. Personalisation in web computing and informatics: Theories, techniques, applications, and future research. *Information Systems Frontiers* 12 (5): 607–29.

Glaser, B., and A. Strauss. 1967. Grounded theory: The discovery of grounded theory. *Sociology The Journal of the British Sociological Association* 12: 27–49.

Hamamura, T. 2012. Are cultures becoming individualistic? A cross-temporal comparison of individualism-collectivism in the United States and Japan. *Personality and Social Psychology Review* 16 (1): 3–24.

Hamerman, E. J., and G. V. Johar. 2017. Conditioned superstition: Desire for control and consumer brand preferences. *Journal of Consumer Research* 40 (3): 428–43.

Haskell, W. B., D. Kar, F. Fang, M. Tambe, S. Cheung, and L. E. Denicola. 2014. Robust protection of fisheries with COmPASS. In *Proceedings of the Twenty-Sixth Annual Conference on Innovative Applications of Artificial Intelligence Robust*: 2978–83.

Häubl, G., and V. Trifts. 2000. Consumer decision-making in online shopping environments: The effects of interactive decision aids. *Marketing Science* 19 (1): 4–21.

Heiskanen, E., K. Hyvönen, M. Niva, M. Pantzar, P. Timonen, and J. Varjonen. 2007. User involvement in radical innovation: Are consumers conservative? *European Journal of Innovation Management* 10 (4): 489–509.

Hofmann, R. 2015. Visionary competence for long-term development of brands, products, and services: The trend receiver concept and its first applications at Audi. *Technological Forecasting and Social Change* 101: 83–98.

Hofstede, G. 2001. *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations.* Thousand Oaks: Sage Publications.

Holbrook, M. B., and E. C. Hirschman. 1982. The experiential aspects of consumption: Consumer fantasies, feelings, and fun. *Journal of Consumer Research* 9 (2): 132–40.

Hollenbeck, C. R., and G. M. Zinkhan. 2006. Consumer activism on the internet: The role of anti-brand communities. In *NA - Advances in Consumer Research*, ed. C. Pechmann and L. Price, 479–85. Association for Consumer Research.

Holt, D. B. 1995. How consumers consume: A typology of consumption practices. *Journal of Consumer Research* 22 (1): 1–16.

Holzwarth, M., C. Janiszewski, and M. M. Neumann. 2006. The influence of avatars on online consumer shopping behavior. *Journal of Marketing* 70 (4): 19–36.

Huffmann, S., and R. Chandra. 2017. Your Google Assistant is getting better across devices, from Google Home to your phone. Available at: https://www.blog.google/products/assistant/your-assistant-getting-better-on-google-home-and-your-phone/

Jayawardena, R., P. Ranasinghe, N. M. Byrne, M. J. Soares, P. Katulanda, and A. P. Hills. 2012. Prevalence and trends of the diabetes epidemic in South Asia: A systematic review and meta-analysis. *BMC Public Health* 12 (1): 380.

Jennings, N. R. 2000. On agent-based software engineering 6. *Artificial Intelligence* 117 (2): 277–96.

Juris, J. S. 2005. The new digital media and activist networking within anti-corporate globalisation movements. *The Annals of the American Academy of Political and Social Science* 597 (1): 189–208.

Keeling, K., D. Keeling, and P. McGoldrick. 2013. Retail relationships in a digital age. *Journal of Business Research* 66 (7): 847–55.

Keeling, K., P. McGoldrick, and S. Beatty. 2010. Avatars as salespeople: Communication style, trust, and intentions. *Journal of Business Research* 63 (8): 793–800.

Kelly, G. A. 1955. *The psychology of personal constructs: A theory of personality.* New York: Norton.

Kim, S., R. P. Chen, and K. Zhang. 2016. Anthropomorphized helpers undermine autonomy and enjoyment in computer games. *Journal of Consumer Research* 43 (2): 282–302.

Kolbjørnsrud, V., R. Amico, and R. J. Thomas. 2016. *The Promise of artificial intelligence*. Available at: https://www.accenture.com/t20170411T174532Z__w__/us-en/_acnmedia/PDF-32/AI_in_Management_Report.pdf#zoom=50

Komiak, S. Y., and I. Benbasat. 2006. The effects of personalization and familiarity on trust and adoption of recommendation agents. *MIS Quarterly* 30 (4): 941–60.

Kozup, J. C., E. H. Creyer, and S. Burton. 2003. Making healthful food choices: The influence of health claims and nutrition information on consumers' evaluations of packaged food products and restaurant menu items. *Journal of Marketing* 67 (2): 19–34.

Kuruoğlu, A.P., and G. Ger. 2015. An emotional economy of mundane objects. *Consumption Markets and Culture* 18 (3): 209–38.

Lam, S. K., D. Frankowski, and J. Riedl. 2006. Do you trust your recommendations? An exploration of security and privacy issues in recommender systems. In *Proceedings of the 2006 International Conference on Emerging Trends in Information and Communication Security (ETRICS)*, 14–29.

Lee, S. Y., and J. Choi. 2017. Enhancing user experience with conversational agent for movie recommendation: Effects of self-disclosure and reciprocity. *International Journal of Human Computer Studies* 103: 95–105.

Lee, J., and L. J. Shrum. 2012. Conspicuous consumption versus charitable behavior in response to social exclusion: A differential needs explanation. *Journal of Consumer Research* 39 (3): 530–44.

Leong, C. M. L., S.-L. Pan, S. Newell, and L. Cui. 2016. The emergence of self-organizing e-commerce ecosystems in remote villages of china: A tale of digital empowerment for rural development. *MIS Quarterly* 40 (2): 475–84.

Leotti, L. A., S. S. Iyengar, and K. N. Ochsner. 2010. Born to choose: The origins and value of the need for control. *Trends in Cognitive Sciences* 14 (10): 457–63.

Lincoln, Y. S., and E. G. Guba. 1985. *Naturalistic inquiry*. Newbury Park: Sage.

Loveland, K. E., D. Smeesters, and N. Mandel. 2010. Still preoccupied with 1995: The need to belong and preference for nostalgic products. *Journal of Consumer Research* 37 (3): 393–408.

Luchs, M. G., J. Brower, and R. Chitturi. 2012. Product choice and the importance of aesthetic design given the emotion-laden trade-off between sustainability and functional performance. *Journal of Product Innovation Management* 29 (6): 903–16.

Lynch, J. G., and D. Ariely. 2000. Wine online: Search costs affect competition on price, quality, and distribution. *Marketing Science* 19 (1): 83–103.

MacIntosh, E., N. Rajakulendran, Z. Khayat, and A. Wise. 2016. Transforming health: Shifting from reactive to proactive and predictive care. Available at: https://www.marsdd.com/news-and-insights/transforming-health-shifting-from-reactive-to-proactive-and-predictive-care/

Marteau, T. M., D. Ogilvie, M. Roland, M. Suhrcke, and M. P. Kelly. 2011. Judging nudging: Can nudging improve population health? *British Medical Journal* 342: 263–5.

McCracken, J. 1988. *The long interview.* Beverly Hills: Sage Publications.

McQuarrie, E. F., J. Miller, and B. J. Phillips. 2013. The megaphone effect: Taste and audience in fashion blogging. *Journal of Consumer Research* 40 (1): 136–58.

Mineka, S., and R. W. Hendersen. 1985. Controllability and predictability in acquired motivation. *Annual Review in Psychology* 36 (1) 495–529.

Mobasher, B., R. Burke, R. Bhaumik, and C. Williams. 2007. Toward trustworthy recommender systems. *ACM Transactions on Internet Technology* 7 (4): 1–38.

Morse, J. M. 1995. The significance of saturation. *Qualitative Health Research* 5 (2): 147–9.

Nadimpalli, M. 2017. Artificial intelligence risks and benefits. *International Journal of Innovative Research in Science, Engineering and Technology* 6 (6).

Nakata, C., and K. Weidner. 2012. Enhancing new product adoption at the base of the pyramid: A contextualized model. *Journal of Product Innovation Management* 29 (1): 21–32.

Nisbett, R. E., and T. Masuda. 2003. Culture and point of view. *Proceedings of the National Academy of Sciences* 100 (19): 11163–70.

Nisbett, R. E., K. Peng, I. Choi, and A. Norenzayan. 2001. Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review* 108 (2): 291–310.

Okada, E. M. 2005. Justification effects on consumer choice of hedonic and utilitarian goods. *Journal of Marketing Research* 42 (1): 43–53.

Pathak, B., R. Garfinkel, R. D. Gopal, R. Venkatesan, and F. Yin. 2010. Empirical analysis of the impact of recommender systems on sales. *Journal of Management Information Systems* 27 (2): 159–88.

Pol, E., and S. Ville. 2009. Social innovation: Buzz word or enduring term? *Journal of Socio-Economics* 38 (6): 878–85.

Prahalad, C. K. 2012. Bottom of the pyramid as a source of breakthrough innovations. *Journal of Product Innovation Management* 29 (1): 6–12.

Raghunathan, R., R. W. Naylor, and W. D. Hoyer. 2006. The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing* 70 (4): 170–84.

Ramani, S., S. Sadreghazi, and S. Gupta. 2017. Catalysing innovation for social impact: The role of social enterprises in the Indian sanitation sector. *Technological Forecasting and Social Change* 121: 216–27.

Rijsdijk, S. A., and E. J. Hultink. 2003. "Honey, have you seen our hamster?" Consumer evaluations of autonomous domestic products. *Journal of Product Innovation Management* 20 (3): 204–16.

Rijsdijk, S. A., and E. J. Hultink. 2009. How today's consumers perceive tomorrow's smart products. *Journal of Product Innovation Management* 26 (1): 24–42.

Roberto, C. A., J. L. Pomeranz, and J. O. Fisher. 2014. The need for public policies to promote healthier food consumption: A comment on Wansink and Chandon (2014). *Journal of Consumer Psychology* 24 (3): 438–45.

Rohm, A. J., and V. Swaminathan. 2004. A typology of online shoppers based on shopping motivations. *Journal of Business Research* 57 (7): 748–57.

Rotter, J. B. 1966. Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied* 80 (1): 1–28.

Ryan, R. M., and E. L. Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 55 (1): 68–78.

Schneider, C. 2017. 10 reasons why AI-powered, automated customer service is the future. Available at :https://www.ibm.com/blogs/watson/2017/10/10-reasons-ai-powered automated-customer-service-future/

Schweitzer, F., and E. A. Van den Hende. 2016. To be or not to be in thrall to the march of smart products. *Psychology and Marketing* 33 (10): 830–42.

Schweitzer, F., C. Rau, O. Gassmann, and E. Van Den Hende. 2015. Technologically reflective individuals as enablers of social innovation. *Journal of Product Innovation Management* 32 (6): 847–60.

Smets, L. P. M., F. Langerak, and S. A. Rijsdijk. 2013. Shouldn't customers control customized product development? *Journal of Product Innovation Management* 30 (6): 1242–53.

Snyder, C. R., and H. L. Fromkin. 1977. Abnormality as a positive characteristic: The development and validation of a scale measuring need for uniqueness. *Journal of Abnormal Psychology* 86 (5): 518–27.

Snyder, C. R., and H. L. Fromkin. 2012. *Uniqueness: The human pursuit of difference.* New York: Springer Science and Business Media.

Soderland, S. 2017. The inevitability of artificial intelligence. Available at: http://health.oliverwyman.com/drive-innovation/2017/10/the_inevitabilityof.html

Spiggle, S. 1994. Analysis and interpretation of qualitative data in consumer research. *Journal of Consumer Research* 21 (3): 491–504.

Stock, R. M., P. Oliveira, E. Hippel. 2015. Impacts of hedonic and utilitarian user motives on the innovativeness of user-developed solutions. *Journal of Product Innovation Management* 32 (3): 389–403.

Taylor, S. E., and J. D. Brown. 1988. Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin* 103 (2): 193–210.

Thaler, R. 1985. Mental accounting and consumer choice. *Marketing Science* 4 (3): 199–214.

Thaler, R. H., and C. R. Sunstein. 1999. *Nudge: improving decisions about health, wealth, and happiness*. New Haven: Yale University Press.

Tian, K. T., W. O. Bearden, and G. L. Hunter. 2001. Consumers' need for uniqueness: Scale development and validation. *Journal of Consumer Research* 28 (1): 50–66.

Touzani, M., A. A. Charfi, P. Boistel, and M.-C. Niort. 2017. Connecto ergo sum! An exploratory study of the motivations behind the usage of connected objects. *Information and Management*, forthcoming.

Troisi, J. D., and S. Gabriel. 2011. Chicken soup really is good for the soul. *Psychological Science* 22 (6): 747–53.

Van Den Ende, J., L. Frederiksen, and A. Prencipe. 2015. The front end of innovation: Organizing search for ideas. *Journal of Product Innovation Management* 32 (4): 482–7.

Von Hippel, E. 2001. Innovation by user communities: Learning from open-source software. *MIT Sloan Management Review* 42 (4): 82–6.

Vriens, M., G. H. Loosschilder, E. Rosbergen, and D. R. Wittink. 1998. Verbal versus realistic pictorial representations in conjoint analysis with design attributes. *Journal of Product Innovation Management* 15 (5): 455–67.

Wallendorf, M., and E. J. Arnould. 1991. “We gather together”: Consumption rituals of Thanksgiving Day. *Journal of Consumer Research* 18 (1): 13–31.

Wang, Y., K. L. Tan, and J. Ren. 2004. PumaMart: A parallel and autonomous agents based internet marketplace. *Electronic Commerce Research and Applications* 3 (3): 294–310.

Waytz, A., J. Heafner, and N. Epley. 2014. The mind in the machine: Anthropomorphism increases trust in an autonomous vehicle. *Journal of Experimental Social Psychology* 52: 113–7.

Xiao, B., and I. Benbasat. 2007. E-commerce product recommendation agents: Use, characteristics, and impact. *MIS Quarterly* 31 (1): 137–209.

Yadav, A., L. Marcolino, E. Rice, R. Petering, H. Winetrobe, H. Rhoades, M. Tambe, and H. Carmichael. 2015. Preventing HIV spread in homeless populations using PSINET. In *Proceedings of the 27th Conference on Innovative Applications of Artificial Intelligence* (AAAI 2015): 4006-11.

Zinn, R. 2017. Proactive AI. *Forbes*. Available at: https://www.forbes.com/sites/forbestechcouncil/2017/11/08/proactive-ai/#42c6ba26619a

Article II

Schweitzer, N., Hofmann, R., and Meinheit, A. (submitted to Technological Forecasting and Social Change): New Use Cases for Autonomous Vehicles: Consumer-Centric Corporate Foresight Research with Innovative Consumers.

New Use Cases for Autonomous Vehicles: Consumer-Centric Corporate Foresight Research with Innovative Consumers

Nicola Schweitzer(1)

Rupert Hofmann(2)

Andreas Meinheit(3)

(1) Nicola Schweitzer is a Doctoral Candidate at the Institute for Customer Insight, University of St. Gallen, Switzerland (nicola.schweitzer@unisg.ch).

(2) Rupert Hofmann is the Project Lead Trend Research Audi Mobility Innovations at Audi Business Innovation GmbH, Germany (rupert.hofmann@audi.de).

(3) Andreas Meinheit, I/VZ, AUDI AG, Germany andreas.meinheit@audi.de).

Abstract

When control is delegated to an automated car, people will be able to invest time in non-driving related tasks, resulting in more enjoyable and productive time spent in the vehicle. Understanding customer needs in the context of vehicle autonomy is crucial for organizations in the automotive industry and forms the basis for strategic decision-making. The consumer-centric, corporate foresight research described in this paper aims to explore how customers of premium cars want to spend time in semi-autonomous vehicles (SAVs).

A qualitative pilot study with 29 visionary, trend-receiving consumers from Germany, the USA and China identified three innovative use cases for premium SAVs. A subsequent quantitative online survey with 733 participants from the same three markets confirms the relevance of the use cases for mainstream and innovative consumers and discloses individual preferences for specific secondary activities. The findings underline that SAVs are a game changer, transforming future cars from pure mobility providers into extended living and office spaces, with implications for the transport system and practitioners.

The contribution of the paper is three-fold: It introduces a consumer-centric corporate foresight study, discloses future consumer needs in the context of premium SAVs and outlines implications for practitioners along with a future research agenda.

Introduction

"Traffic congestion has become one of the plagues of modern life in a big city. Time spent ensnarled in traffic is not simply time wasted; for most of us, it is time miserably wasted." (Arnott and Small, 1994, p. 446). According to the INRIX 2017 Global Traffic Scorecard, commuters living in Los Angeles spent on average over 100 hours in traffic jams in 2017 alone. This number equals to 2.5 work weeks per year of poorly invested time.

Autonomous vehicles will allow drivers a more productive and pleasant way of spending time in the car (Becker and Axhausen, 2017; Gruel and Stanford, 2016). Even semi-autonomous vehicles (SAVs) with high automation will already be able to take over the complete driving task for a specific period of time (Gasser et al., 2012), for example, on the highway, thereby enabling drivers to engage in non-driving related activities. Looking at new secondary activities, preliminary results indicate a higher value of riding in semi- and fully autonomous vehicles compared to vehicles without automation or other modes of transport (Steck et al., 2017; Wadud and Huda, 2018).

Understanding consumer needs with the advent of autonomous vehicles is fundamental to the survival of established car manufacturers. In particular, the anticipated changes in market structure stemming from the disruptive nature of autonomous vehicles (Schuelke-Leech, 2017), with competent new players like Google's Waymo or Chinese start-ups such as NIO entering the industry, leave the future of the automotive market highly uncertain (Zmud, Sener, and Wagner, 2016). Traditional players need to identify signals of change in the industry ecosystem as well as in consumer behavior, in order to answer strategic questions concerning the future of autonomous driving and to manifest their role in it (Bernhart and Winterhoff, 2016).

Corporate foresight, "an emerging field with a rich tradition" (Rohrbeck, Battistella, and Huizingh, 2015, p. 1) can support organizations in anticipating what might drive the industry and consumers in the next decades. It does so by helping companies to maintain strategic agility, that is, to identify trends and dangers and to respond to them appropriately (Vecchiato, 2015). Corporate foresight also allows organizations to develop new business models, products, and service innovations that are likely to be relevant to consumers (Heger and Rohrbeck, 2012; Hofmann, 2015; Rohrbeck and Gemünden, 2011; Ruff, 2015), as in the case of this paper.

While previous research exists on general consumer preferences regarding (semi-) autonomous vehicles (Kyriakidis, Happee, and De Winter, 2015; Schoettle and

Sivak, 2014a, 2014b; Wadud and Huda 2018), a detailed elaboration of changing consumer needs as well as of relevant use cases in such cars is still lacking. Moreover, surprisingly few foresight studies integrate consumers for predicting changes in consumption behavior (for exceptions see: Hoffman, Kopalle, and Novak, 2010; Hofmann, 2015; Ruff, 2015). In particular, qualitative studies within foresight activities, such as interviews and focus groups, oftentimes rely on expert rather than consumer opinions (e.g., Bloem da Silveira Junior et al., 2018), despite the goal of identifying consumer needs, motives and attitudes (Hengstler, Enkel, and Duelli, 2016).

The present study therefore aimed at providing a consumer-centric lens on arising consumer needs in developed and developing markets as well as exploring attractive use cases for autonomous vehicles with the help of future potential customers of the technology. Since consumers might be overwhelmed with evaluating a groundbreaking technology they are not familiar with, individuals high in visionary competence and innovativeness were invited to take part in the research. Further, a general preference of drivers for an override function in automated cars (e.g., König and Neumayr, 2017), and an anticipated hypothetical bias in evaluating more radical innovations (i.e., fully automated vehicles), led to a research focus on SAVs. Lastly, manufacturers of premium cars are likely to be among the first to offer more sophisticated use cases in SAVs and show a strong interest in identifying meaningful secondary activities in cars as demonstrated by different pilot studies published by premium manufacturers (e.g., Audi MediaCenter, 2015; Mercedes-Benz, 2015). This explains the cooperation with the company partner AUDI as well as the study context, which is premium vehicles.

This paper contributes to research on automated vehicles and answers a call to investigate new mobility options made possible by this technology (Kun, Boll, and Schmidt, 2016). Further, the paper contributes to the corporate foresight literature as it describes a consumer-centric approach in foresight research, including visionary future customers. Lastly, the paper makes a practical contribution by outlining implications for practitioners along with a future research agenda.

The remainder of the paper is organized as follows: We discuss the potential of corporate foresight in answering questions related to the anticipated automotive disruption caused by autonomous vehicles. Based on interviews and focus groups with an international sample of visionary consumers we introduce new use cases in the context of premium SAVs. We then verify the use cases' relevance for common and innovative customers of premium vehicles with a quantitative online survey. We

conclude by discussing the results against prior literature, suggesting practical implications and future research.

Theoretical Background

Applying Corporate Foresight to Predict Disruption Caused by Autonomous Vehicles

Corporate Foresight. According to Rohrbeck, Battistella, and Huizingh (2015, p. 1), corporate foresight is defined as "a practice that permits an organization to lay the foundation for a future competitive advantage" and helps managers to identify, observe and interpret trends and signals of change, in order to decide on organization-specific implications and actions. Essentially, corporate foresight enables organizations to anticipate what may happen in the future, to gather necessary resources on time, to challenge conventional ideas in order to adapt the company culture to changes, and, in line with the latter, to successfully maneuver an organization through change (Rohrbeck, Battistella, and Huizingh, 2015; Wright, Bradfield, and Cairns, 2013). Especially in times of high uncertainty, such as when an entire industry is disrupted by a new technology, corporate foresight can fundamentally contribute to an organization's survival (Rohrbeck, Battistella, and Huizingh, 2015; Tapinos, 2012; Vecchiato and Roveda, 2010). Many enterprises have therefore established corporate foresight units to tackle different strategic issues, such as trend research for innovative products, anticipating the value of projected innovations, or the identification of new business models (Coates, Durance, and Godet, 2010; Daheim and Uerz, 2008; Hofmann, 2015; Rohrbeck and Gemünden, 2011; Ruff, 2015).

Several studies have been published on the positive influence achieved by companies' strategic foresight activities on specific corporate outcomes (Coates, Durance, and Godet, 2010; Heger and Rohrbeck, 2012; Rhisiart, Miller, and Brooks, 2015). For example, previous research has highlighted the value of corporate foresight in vision finding, long-term decision-making and brand, product and service development in the automotive sector (Hofmann, 2015) as well as in improving product innovation in consultancies (Andriopoulos and Gotsi, 2006).

Over 30 different foresight methods have been developed, ranging from quantitative to qualitative and semi-quantitative methods, which are often triangulated (Popper et al., 2008). Amongst the more popular forecasting methods are scenario planning (e.g.,

Schoemaker, 1995), the Delphi method (e.g., Linstone and Turoff, 1975), technology roadmapping (Petrick and Echols, 2004; Phaal, Farrukh, and Probert, 2004), patent analysis (e.g., Daim et al., 2006), or a combination of different methods (e.g., Hussain, Tapinos, and Knight, 2017). In many cases, expert opinions formulate the basis for the derived results. Documented cases of consumer integration into the forecasting activity aside from surveys are harder to find. Even for research questions targeted at the end consumer, expert panels are often preferred over interviewing the customer base (Hengstler, Enkel, and Duelli, 2016). For this study, a consumer-centric multiple methods approach was chosen that combined qualitative data generation (i.e., literature review, in-depth interviews and focus groups) with a quantitative online survey. We argue below why the integration of consumers into foresight research is valuable when exploring future customer needs in the context of autonomous vehicles (Hofmann, 2015; Ruff, 2015).

Disruption through Autonomous Vehicles. Six levels of driving automation have been defined by the SAE international's J3016, ranging from manual to fully autonomous driving. The major change in terms of human-car interaction occurs at SAE level 3, conditional automation. Conditional automation implies that, in certain situations, the automated driving system is able to perform the entire dynamic driving task autonomously without human interference (SAE International, 2014). With the advent of Level 3 automation, the role of the human operator changes from an active controller, that is, someone who manually controls machines, to a supervisory controller, that is, someone who supervises the functioning of automated technological processes (Lee and Moray, 1994).

Vehicles with conditional or high automation (i.e., vehicles with Level 3 and 4, respectively), and especially fully autonomous vehicles (i.e., FAVs, Level 5) can be considered a radical innovation (Chandy and Tellis, 1998, 2000) as they challenge the entire transport ecosystem, fundamentally reorder well-established patterns (Schuelke-Leech, 2017; Sprei, 2018; Van de Ven et al. 1999, p. 171) and will likely induce massive paradigm changes (Tushman and Anderson, 1986). Discontinuities on a macro and micro level through SAVs and FAVs are foreseeable (Garcia and Calantone, 2002). Research shows that this new technology will heavily impact cities (Zakharenko, 2016), consumer behavior (Gruel and Stanford, 2016; Harper et al., 2016), safety (Fagnant and Kockelman, 2015) as well as travel and energy demand and resulting greenhouse gas emissions (Wadud, MacKenzie, and Leiby, 2016). As typical

for radical innovations, SAVs and FAVs are anticipated to create new markets surrounding hard- and software and to initiate fundamentally new product applications (Herbig, 1994; Meyer, Brooks, and Goes, 1990; VDA, 2015). Further, automation in cars is an innovation driver, with car manufacturers, automotive suppliers and new IT-players investing billions in research and development of autonomous and connected vehicles.

However, many innovations are being rejected by consumers despite compelling features (Garcia, Rummel, and Hauser, 2006; Molesworth and Suortti, 2002). Aside from a perceived relative advantage of an innovation, multiple characteristics influence consumers' acceptance of radical innovations, such as compatibility, complexity, trialability, observability (Rogers, 2010), as well as uncertainty or risk (Hoeffler, 2003; Ostlund, 1974). Importantly, previous research points out that even the best technical innovations fail if they do not adapt adequately to the customer (Kleijnen, Lee, and Wetzels, 2009). Consumer-centricity and a balance between technology push and market pull are thus important factors for understanding future customer needs and for developing brand and product portfolios that are attractive to consumers, especially in the resource-intense automotive sector (Ruff, 2015).

Consumer-centric corporate foresight can support enterprises to understand adoption and consumer lifestyle changes for technology development, planning, and decision-making (Coates, 1985; Hofmann, 2015; Kleijnen, Lee, and Wetzels, 2009; Linstone, 2011; Nieuwenhuijsen et al., 2018; Ruff, 2015; Slaughter and Slaughter, 1999). Particularly in the context of the uncertainties surrounding future mobility, inviting consumers to partake in corporate foresight research can increase the validity of predicting consumers' mobility lifestyle changes. Next, we will discuss previous research investigating consumer acceptance of autonomous vehicles and consumer mobility needs arising in the context of vehicle automation.

Consumer Research on AVs

Acceptance of AV. Previous academic and market research on consumers' acceptance of autonomous vehicles points out ambivalent public opinions (e.g., Kyriakidis, Happee, and De Winter, 2015; Payre, Cestac, and Delhomme, 2014; Power, 2012; Zmud, Sener, and Wagner, 2016). Early global surveys carried out by Schoettle and Sivak (2014a, 2014b) showed that the majority of respondents expressed positive opinions, yet high levels of concern about riding in an autonomous car. Participants

were especially skeptical about safety issues related to the equipment or system failures and did not expect the technology to perform as well as humans. A global survey by Kyriakidis et al. (2015) confirmed drivers' concerns and reported fear of software hacking/misuse, legal issues, and, again, the cars' safety. An online survey with a sample from Austin, Texas followed by qualitative interviews also reported that half of participants were likely and half were unlikely to use autonomous vehicles (Zmud, Sener, and Wagner, 2016). More recent research by Haboucha, Ishaq, and Shiftan (2017) conducted in Israel and North America points out that early AV adopters as likely to "be young, students, more educated, and spend more time in vehicles", and in line with this, also Owens et al. (2015) demonstrated that younger generations are more open to the technology than older generations. Payre, Cestac, and Delhomme (2014), on the other hand, studying FAV with the help of a qualitative and quantitative pilot study in France and a subsequent survey, revealed a 68% a priori acceptance of the technology, especially for highways, traffic congestion and automatic parking, yet also higher acceptance rates for men.

Studies investigating perceived consequences of automation for driving behavior show that the public regards the loss of driving fun as a major downside associated with autonomous cars (EY, 2013), and that drivers express a strong desire for the possibility to regain control of driving at any time (König and Neumayr, 2017). Moreover, while many consumers demonstrate a willingness to pay for automation (Bansal, Kockelman, and Singh, 2016; Daziano, Sarrias, and Leard, 2017), autonomous vehicles seem not to be regarded as status symbol (Böhm et al., 2006). Thus, research reveals that consumer opinions about vehicle automation are still torn between positive and negative attitudes, highlighting that car manufacturers need to find solutions for convincing consumers of the benefits of automation and purchase.

Studies on In-Vehicle Time Usage. Through participation in a wide array of new tasks while the vehicle takes over the driving task, drivers might find new pleasure in "driving" (Le Vine, Zolfaghari, and Polak, 2015). Early results indicated that participants are open for new activities and services once the car takes over driving, such as reading or watching movies (Schoettle and Sivak, 2014b). Also more recent studies find that drivers seem open to engaging in secondary tasks such as sleeping, watching movies/TV, using virtual reality (VR) and driving while intoxicated/using drugs (Noblet et al., 2018), watching the roadway or working (Wadud and Huda, 2018). Further, Kyriakidis et al. (2015) reported that the higher the level of

automation, the more secondary tasks people are inclined to engage in, such as resting, watching movies or reading. Studies in the driving simulator (Jamson et al., 2013) as well as a field study confirm these results: in particular, drivers who are familiar with driving assistance systems seem inclined to participate in secondary tasks when the vehicle takes over the driving task (Naujoks, Purucker, and Neukum, 2016). So far, however, detailed use cases and descriptions of how exactly consumers want to spend their time in automated vehicles are lacking.

Previous research on the influence of secondary activities on vehicle attractiveness applying causal loop diagrams could demonstrate with different scenarios how automation might influence the value of time in cars, mode choice, and the broader transportation system (Gruel and Stanford, 2016). Depending on the scenario, drivers might explore new uses that will positively influence vehicle attractiveness, travel time and travel distance. However, other results show a lower perceived value of time spent in autonomous as compared to conventional vehicles, indicating that drivers do not yet perceive an advantage in engaging in secondary tasks in AVs (Yap, Correia, and van Arem, 2016).

Summarizing, the consumer research undertaken in the context of autonomous vehicles underpins that consumer needs might be complex and should be further and more thoroughly investigated to ensure drivers' acceptance and usage of this new technology. Ultimately, the possibility of engaging in in-vehicle secondary tasks will redefine consumption patterns. This study aims to shed more light on the consumer's idea of and expectations concerning premium SAVs and how to spend time in such a vehicle.

Overview of Studies

In order to manage possible weaknesses of different methods in identifying future consumer needs, an iterative, multiple methods approach was implemented. The triangulation of qualitative methods with a quantitative survey design helped to increase the results' validity (Bloem da Silveira Junior et al., 2018; Campbell and Fiske, 1959; Flick, 2017), by capturing a more holistic picture of the research question and by ruling out biases inherent in the different methods (Creswell, 2003).

Based on an exploratory qualitative pilot study, new use cases for and secondary activities within SAVs were developed with the help of visionary customers of premium vehicles. Subsequently, the main use cases and activities were introduced to

a broader sample of innovative and common consumers within a quantitative online survey so as to estimate their relevance for a broader consumer group. The studies are outlined in detail below.

Qualitative Pilot Study

The qualitative pilot study aimed to better comprehend consumers' perception, needs, and motives concerning SAVs and builds the qualitative foundation for the iterative development of new use cases in the context of premium SAVs. Based on this, purposeful measures for a subsequent quantitative survey could be created. The empirical basis encompasses secondary qualitative data in the form of an extensive literature review to inform the interview guide, as well as primary qualitative data in the form of in-depth interviews and focus groups. A literature review followed by qualitative data generation is an established way of generating primary data in foresight research (Magruk, 2011; Porter et al., 2004), and has previously been applied for different research questions in corporate foresight studies (Hofmann, 2015; Moradi and Vagnoni, 2018; Spiess et al., 2015).

Method

Sample. The sample was selected based on a purposive sampling strategy for innovative, trend receiving customers of premium vehicles (Hofmann, 2015; Schweitzer et al., 2015; Spiggle, 1994). Trend receivers (TRs) are consumers who perceive changes and potentials of the new in a specific domain in a highly sensitive and differentiated way. They have discerning views of what drives them and other consumers and what aspects are undergoing change. Hence, TRs were recruited for this study due to their visionary competence in anticipating future consumer needs, as demonstrated in previous foresight research (Hofmann, 2015).

In total, 29 TRs from Germany (GER; n = 14), the USA, and China (CHN) were suggested by our network (n_{GER} = 14, n_{USA} = 7, n_{China} = 8; see Appendix A for an overview of the TR sample). All TRs had rich experience with or were owners of premium vehicles at the time of the interviews. This selection criterion ensured expertise with premium automobiles as a basis for envisioning future concepts of premium SAVs. Further, as indicated by prior studies, higher-income groups living in urban areas show the greatest interest in autonomous vehicles (Bansal, Kockelman,

and Singh, 2016) and benefit most from the technology due to their higher driving distances and higher in-vehicle productivity enabled by automation which leads to a higher perceived value of time (Wadud, 2017). Therefore, all TRs were of higher income groups. Lastly, Germany, the USA and China were selected as markets for the study since they are among the four biggest automotive markets worldwide (Statista, 2016) and represent the most important customer segments for the automotive industry. Furthermore, prior studies have indicated differences in preferences between drivers from developed and developing countries (Kyriakidis, Happee, and De Winter, 2015; Schoettle and Sivak, 2014b), highlighting the need for comparisons between different markets.

Interviews. Based on extensive desk research, a semi-structured interview guide was developed including open questions to explore how intentions, motives, and behavior regarding semi-autonomous vehicles might change up to 2025. The interviewer started by asking grand-tour questions about the interviewees' current mobility behavior and continued with the interviewees' perception and idea of semi-autonomous driving as well as preferred in-vehicle time usage. The interviewer probed when it was thought relevant. All interviews were conducted by two interviewers in winter 2014/15, were verbatim recorded and lasted on average 110 minutes each. Content and structure of the interview guide were continuously and iteratively adapted between interviews (Spiggle, 1994). This procedure enabled the integration of insights from previous interviews into subsequent ones. In this way, the iterative process helped with induction, that is, with developing concepts from the data, as well as with deduction, thus with refining these concepts and inferring theoretical and practical implications. The interview phase was ended when saturation was reached and no new insights were gained through additional data (Morse, 1995).

All interviews were transcribed, coded, and analyzed via qualitative content analysis, an empirically grounded methodology that helps to draw replicable and valid inferences from the participants' interviews (Krippendorff, 2012; Lincoln and Guba, 1985; Spiggle, 1994). The interview data was coded for benefits of SAVs and preferred in-vehicle time usage. Through structured coding (i.e. open, selective and axial coding, Glaser and Strauss, 1967) the results obtained were aggregated into use cases which emerged from the data, e.g. the car as entertainment space, as well as general secondary activities, e.g. watching television, and use case-specific secondary activities. The use cases were then visualized by professional graphic designers.

Visualizations are an essential component of many foresight studies as they trigger an authentic experience of future scenarios and facilitate insight generation, new perspectives and the integration of implicit knowledge (Eppler and Platts, 2009; Müller and Shwarz, 2016; Schweitzer, 2017).

Focus groups. Following the interviews, two consecutive focus groups allowed for an open discussion of the use cases and further knowledge creation (Dufva and Ahlqvist, 2015; Spiess et al., 2015). The focus groups were held with German TRs who had participated in the previous interviews (n_1= 6 and n_2 = 8, see Appendix A for sample description). During the focus groups, the visualized use cases were systematically structured, discussed, discarded, extended and fine-tuned by means of individual and group work as well as plenum discussions.

Results

The interviews and workshops revealed that TRs imagine innovative use cases for premium SAVs. Three main use cases as well as attractive secondary activities were identified on the basis of the qualitative interviews and focus groups. The most relevant activities described by the participants are those which can still be undertaken in the classical driving position and which can be interrupted, if attention for traffic is required again. The visualizations and descriptions of the final three use cases for SAVs served as stimuli in the subsequent quantitative online survey (see Figure 1 for visualizations).

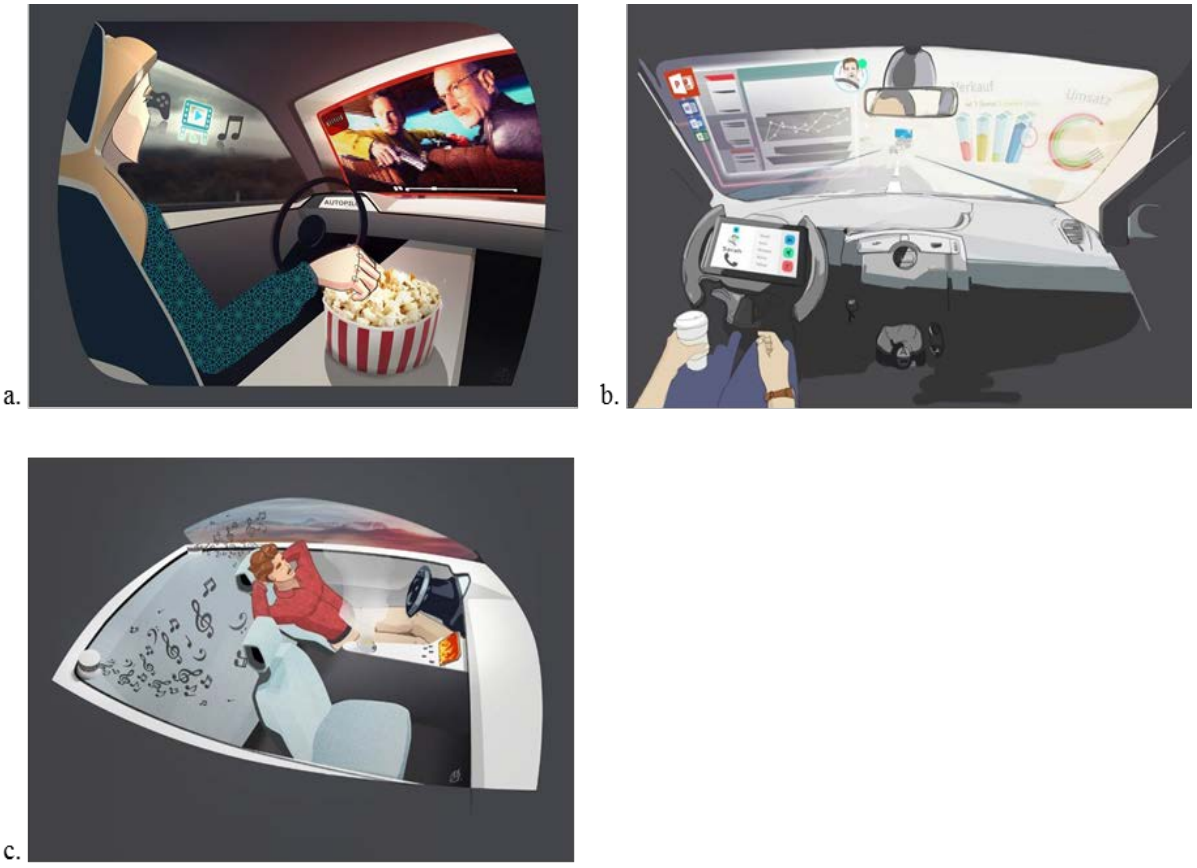
Entertainment. TRs envisioned SAVs that offer entertainment in form of a cinema-like experience. While the vehicle is in control of driving, TRs imagined watching movies or TV, playing games (analog or digital) or listening to and/ or exploring music and audio books in an easy-going yet private atmosphere. Furthermore, TRs could imagine using the car for entertaining family time, for example, watching a movie together with their kids.

Work. The second use case is linked to professional life. TRs described SAVs as typical office spaces in which they can work on new concepts and ideas, write reports, create presentations, talk to colleagues or business partners via (video) telephone,

write emails or network. TRs appreciate a private and silent atmosphere, unlike in a train or plane, and the facilitation of working tasks by adaptation of the cars' interior design to their needs. In line with this idea, TRs imagined having a table to work at, an integrated video phone or the option to have meetings with colleagues inside the car.

Communication and relaxation. The third use case is again connected to private life and results from TRs envisioning the car as a relaxation retreat in which to calm down, relax and escape from everyday life. This use case also includes the possibility for communication with friends or family, either personally or via (video) phone, as well as the pursuit of personal interests, like browsing the internet as well as enjoying the ride with some snacks and drinks.

Figure 1. *Visualizations of the final three use cases in the context of SAVs (a. entertainment, b. work, c. communication and relaxation). The use cases were established on basis of a qualitative pilot study with 29 trend receivers from Germany, the USA, and China.*



Source: *AUDI Trend Research, use cases and illustrations developed in cooperation with Hyve AG.*

Quantitative Online Survey

Qualitative data collection was followed by a quantitative online survey, which consisted of closed and open questions and was also implemented in Germany, the USA, and China. The survey allowed us to evaluate consumers' acceptance and relevance of the visualized use cases and secondary activities in premium SAVs as identified in the qualitative pilot study.

Method

Sample. Participants were recruited from a participant pool provided by an external agency. In total, 733 participants aged from 25 to 65 took part in the online survey (n_{GER} = 284, n_{USA} = 230, n_{China} = 219, M_{age} = 42.5 years, 46% females, see Appendix B for country-specific demographics). Participants all held a university degree, household net income was EUR 3,000 per month or higher and respondents were owners of a new premium car in order to represent the premium car segment and thereby maximize external validity in identifying attractive use cases for premium SAVs (Singleton and Straits, 2005). Due to their higher interest in autonomous vehicles and their predicted early adoption pattern (Haboucha, Ishaq, and Shiftan, 2017; Owens et al., 2015), around one fourth of participants (27.8%) were screened to be digital natives, who are individuals born later than 1979. As previously mentioned, certain personality traits have been identified as beneficial in new product development (Gurtner and Soyez, 2016; Hofmann, 2015; Schweitzer et al., 2015). In particular, ideas from emergent nature consumers (ENC) have been shown to be highly innovative, yet they result in a high "reality fit" and appreciation from the "common" consumer. Moreover, emergent nature characteristics mirror those of trend receivers recruited for qualitative research and have been translated into a scale for quantitative surveys (Hoffman, Kopalle, and Novak, 2010). In order to allow for more innovative ideas concerning secondary activities in SAVs in response to the open questions (see description below), a third of participants were screened to be ENCs (i.e., to obtain a mean score of 6.0 or higher on the 7-point ENC Likert scale).

Measures and survey. After being informed of the expected time for completion, respondents were screened according to the predefined criteria listed under "sample". The survey was structured hierarchically, moving from abstract to more specific usage situations and features in the context of SAVs. At first, subjects read a description of

SAVs in order to align the subjects' concept of the technology (see Appendix C; Hohenberger, Spörrle, and Welpe, 2017). Then, subjects were asked to imagine a fictional 120-minute drive on a highway in a SAV. Within the scenario, the car was described as taking over driving for 120 minutes and subjects were told that time could be invested in secondary activities outside the driving task. While imagining this situation, participants had to choose their preferred use case during the ride. Use cases were represented by visualizations obtained in the qualitative study (Figure 1) and were additionally described in written form to facilitate participants' imagination of the use case. The three use cases were listed in random order.

Afterwards, participants were asked to allocate 120 minutes in a SAV to a list of secondary activities according to individual preference. The secondary activities were also derived from the qualitative data and formulated in detail in three discussion rounds with three consumer behavior researchers and two automotive experts (see Appendix D for the list of secondary activities). Subsequently, the sample was randomly distributed amongst the three main use cases and aimed to dive deeper into one specific use case with the help of open questions such as "What is good entertainment/ work/ relaxation for you? How do you imagine entertainment/ work/ relaxation in a semi-autonomous car? Think of activities, atmosphere, interior, technology, software and interfaces". In order to prevent fatigue, subjects were asked to imagine and describe only one use case at this stage of the survey. In a last step, participants rated the perceived relevance of use case-specific secondary activities which also emerged from the qualitative data and expert discussion rounds on a 7-point Likert scale.

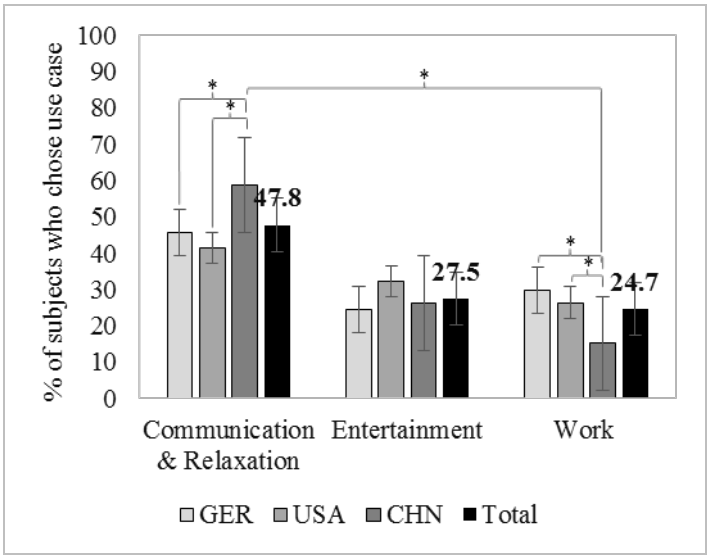
Data analysis. The authors performed descriptive analyses and significance tests to quantify and estimate the relevance of the three main use cases and secondary activities. Due to research pointing at country- and gender-specific differences (Hohenberger, Spörrle, and Welpe, 2017; Kyriakidis, Happee, and De Winter, 2015; Schoettle and Sivak, 2014a, 2014b), different customer segments defined by sociodemographic variables (i.e., country and gender) were compared to assess the use cases' and activities' relevance for specific customer segments. Similar to the qualitative pilot study, the open questions were coded and analyzed via qualitative content analysis (Krippendorff, 2012; Lincoln and Guba, 1985; Spiggle, 1994).

Results

Choice of preferred use case.

A chi-square test examining differences in consumer preference for the three use cases was found to be significant ($\chi^2(2, N = 661^2) = 63.13$, $p = 0.001$). Results indicate that participants' top preference was for the use case "communication and relaxation" in a SAV, with almost half of the sample (47.8%) voting for this option. The difference between the use cases for entertainment (27.5%) and work (24.7%) was small. The overall high frequencies of votes for all use cases point towards their general relevance for participants[1].

Figure 2. *Choice of preferred use case for the overall sample and according to country in percentage, n = 661[2]. In this and subsequent figures, error bars indicate the standard error and *: Asymp. Sig. (2-sided), p-value <= 0.05, **: Asymp. Sig. (2-sided), p-value <= 0.01. GER = Germany, CHN = China.*



Country-specific differences. A chi-square test investigating the relationship between use cases and countries points out significant differences between Germany, the USA and China ($\chi^2(4, N = 661^2) = 19.05$, $p = 0.001$). A comparison of column properties with Bonferroni-adjusted p-values revealed that the Chinese sample selected the use

[1] No significant differences were found in choice of use case between consumers high and low in emergent nature (Hoffman, Kopalle, and Novak, 2010).

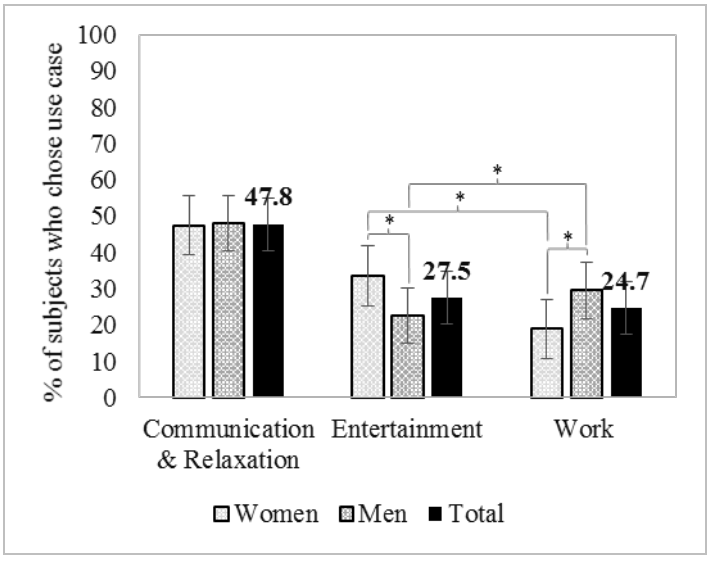
[2] Participants who chose more than one use case were excluded from the analysis.

case “work” significantly less often and the use case “communication and relaxation” significantly more often than German and US-American subjects. Within-country comparisons show that also the difference between the use cases “work” and “communication and relaxation” were significant for the Chinese sample.

Gender-specific differences. The observed results for gender also differed significantly from what would be expected if female and male participants were drawn from the same distribution (χ^2 (2, N = 661[2]) = 14.63 p = 0.001). A comparison of column properties indicated that women expressed a significantly stronger preference for the use case “entertainment” in comparison to men. Men, on the other hand, chose significantly more often to work in the car. The observed counts for “entertainment” and “work” also differed significantly within both groups.

Please see Figures 2 and 3 for the results of the overall sample and group comparisons. Appendix E and F show detailed cross tabulations for use case*country and use case*gender.

Figure 3. *Choice of preferred use case for the overall sample and according to gender in percentage, n = 661[2].*



Time investment in secondary activities.

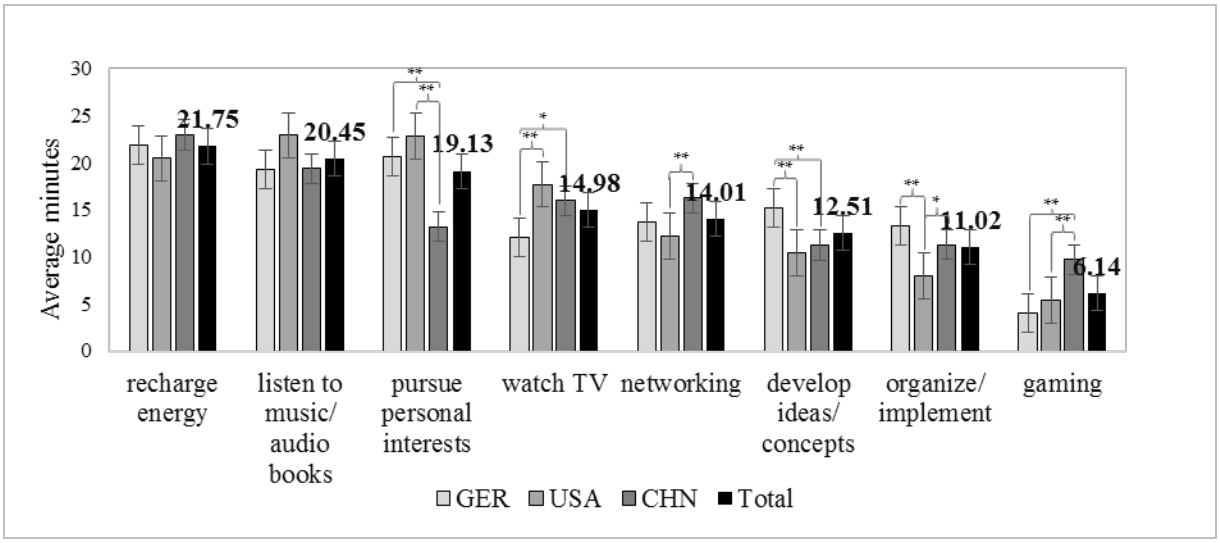
The distribution of minutes onto secondary activities is in line with the dominance of the use case “communication and relaxation”. Participants would like to invest most of

their time in recharging energy (i.e., snoozing, relaxing, enjoying the landscape, eating, drinking, M= 21.75) and listening to music or audio books (M = 20.45). Participants also allocated more than 10 minutes per activity to the other tasks, pointing to their general relevance, with the exception of gaming.

Country-specific differences. A significant result of a Levene's tests for homogeneity of variances indicated that variances of the secondary activities were not equal for the three countries. In order to account for the inhomogeneity of variances, Welch ANOVAs were conducted to compare the effect of country on the allocation of minutes. Significant effects of country were found for most of the activities presented (i.e., for "watching TV" ($F(2, 730) = 6.32$, $p = 0.002$), "gaming" ($F(2, 730) = 18.64$, $p < 0.001$), "developing ideas and concepts" ($F(2, 730) = 6.37$, $p = 0.002$), "organizing and implementing projects" ($F(2, 730) = 7.62$, $p = 0.001$), "networking" ($F(2, 730) = 6.09$, $p = 0.002$), and "pursuing personal interests" ($F(2, 730) = 28.00$, $p < 0.001$). Post-hoc comparisons applying Games-Howell tests revealed that the Chinese sample distributed significantly more minutes onto the activity "gaming" ($M_{GER} = 3.97$, $SD_{GER} = 7.88$, $M_{USA} = 5.43$, $SD_{USA} = 10.25$, $M_{CHN} = 9.70$, $SD_{CHN} = 12.04$), and significantly less minutes onto "pursuing personal interests" ($M_{GER} = 20.68$, $SD_{GER} = 19.08$, $M_{USA} = 22.86$, $SD_{USA} = 20.52$, $M_{CHN} = 13.21$, $SD_{CHN} = 10.75$) in comparison to the other two countries. German subjects, on the other hand, preferred to distribute more time to work-related activities than the other two country samples (e.g. "developing ideas and concepts": $M_{GER} = 15.20$, $SD_{GER} = 17.53$, $M_{USA} = 10.42$, $SD_{USA} = 15.46$, $M_{CHN} = 11.23$, $SD_{CHN} = 11.97$) and were significantly less interested in watching television in the car ($M_{GER} = 12.02$, $SD_{GER} = 17.03$, $M_{USA} = 17.70$, $SD_{USA} = 22.40$, $M_{CHN} = 15.97$, $SD_{CHN} = 15.15$). Please see Figure 4 for a depiction of mean minutes allocated for the overall sample and country comparisons.

Gender-specific differences. In line with their pronounced interest in the use case "entertainment", women allocated more time to hedonistic activities like listening to music and audio books ($t(731) = 2.68$, $p = 0.007$), and pursuing personal interests ($t(637.33) = 2.49$, $p = 0.013$). Male subjects distributed significantly more minutes to organizing and implementing projects ($t(730.92) = -3.172$, $p = 0.002$) as well as networking with business partners ($t(731) = -2.754$, $p = 0.006$), underlining their interest in the use case "work".

Figure 4. *Distribution of minutes to secondary activities for the overall sample and by country, n=733. Displayed means reflect the overall sample.*



Use case-specific secondary activities

Entertainment. A descriptive analysis of the relevance of specific secondary activities within the use case "entertainment" revealed that new entertainment possibilities, like watching TV and movies, were perceived as relevant for SAVs (please see Figure 5). The analysis of the open questions showed that the German and Chinese samples more often mentioned an entertainment experience in solitude, while American subjects could rather imagine sharing the experience with friends or family. In general, the atmosphere was described as relaxed, quiet, comfortable and cheerful. German and American subjects listed (HD) TV screens and a Dolby surround sound system as desirable features to support a perfect in-vehicle entertainment experience. The Chinese sample expressed a desire for stable Wi-Fi and, in less concrete terms, a first-class, intelligent entertainment system for an optimal entertainment experience.

Work. In the context of work in a SAV, typical office activities such as doing online or offline research for projects, planning to-do lists, having contact with colleagues and coordinating tasks, were perceived as particularly relevant (please see Figure 6). The open questions revealed that, across countries, participants preferred to work alone and undisturbed in an SAV. The atmosphere was described as private and tranquil. German and American subjects in particular envisioned the SAV as an extended office in order to work effectively, including a classical office setup with stable and fast internet, a

telephone and monitor as well as storage areas. Chinese participants mentioned a comfortable, soundproof interior, with Wi-Fi connection and intelligent technologies to establish an optimal work atmosphere.

Communication and relaxation. All activities within the context of communication and relaxation were rated rather high in perceived relevance, which underlines the strong preference for this use case (please see Figure 7). According to the open questions analysis, the subjects could envisage a communication and relaxation experience either alone or with others. The atmosphere within this use case was described as calm and easy-going. Across countries, participants desired a stable Wi-Fi access and high comfort. German and American respondents in particular addressed specific features, such as a good sound system, high resolution displays and comfortable seats. The Chinese sample expressed interest in in-vehicle game consoles.

Figure 5. *Depiction of mean perceived relevance of eight specific activities in the context of entertainment in a SAV, for the overall sample within this use case (n = 261) and between countries. For this and the subsequent figures, depicted means reflect the overall sample within this use case. Items were rated on basis of a Likert scale from 1 (not relevant at all) to 7 (highly relevant).*

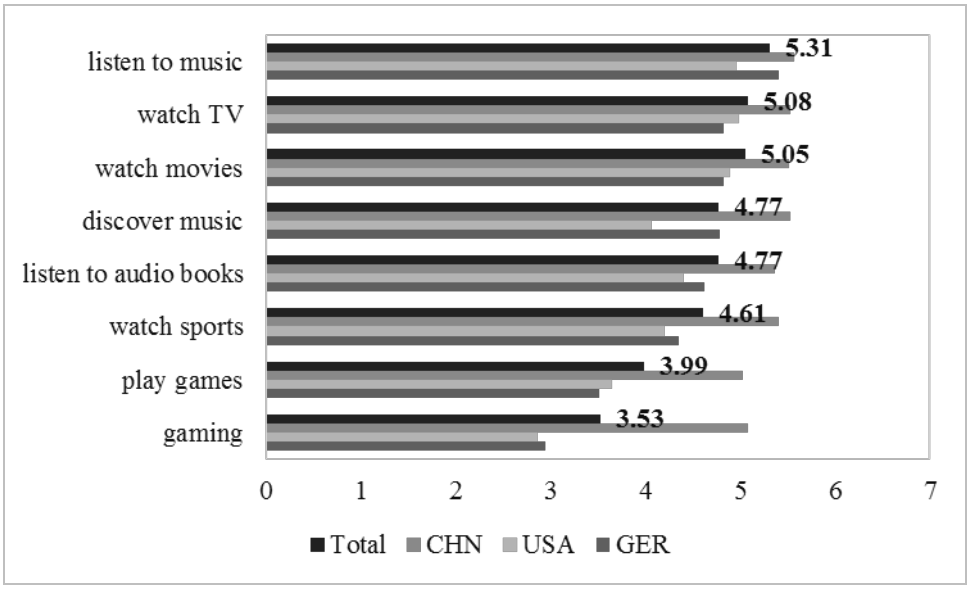


Figure 6. *Depiction of mean perceived relevance of seven specific activities in the context of work in a SAV, for the overall sample within this use case (n = 218) and between countries.*

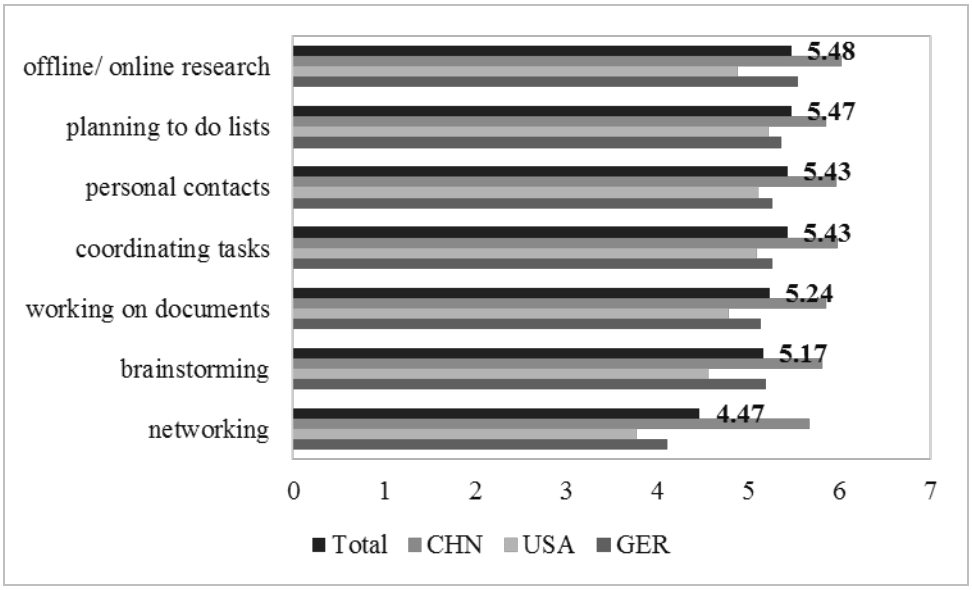
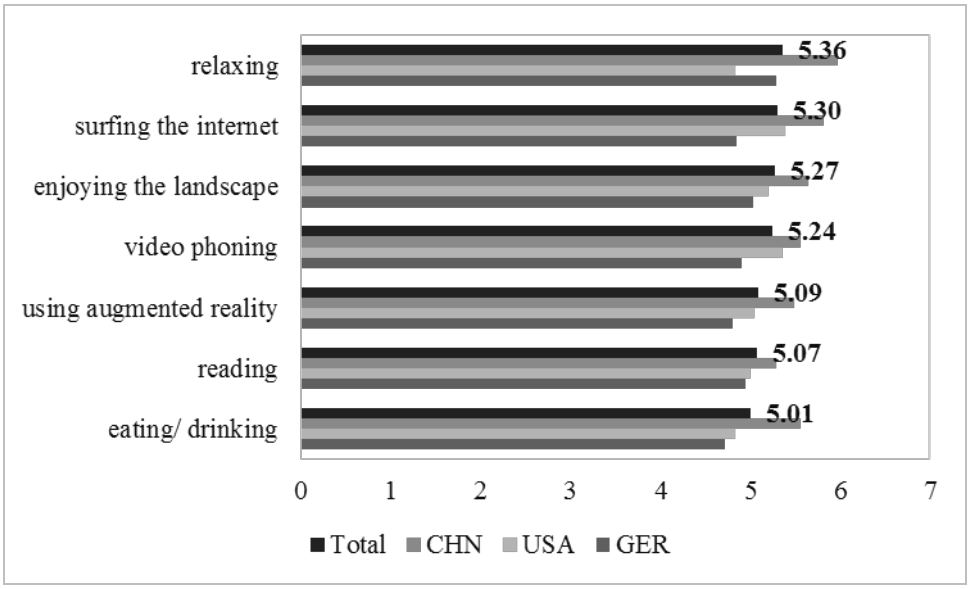


Figure 7. *Depiction of mean perceived relevance of seven specific activities in the context of communication and relaxation in a semi-autonomous car for the overall sample within this use case (n = 254) and between countries.*



The moderate to high relevance ratings and answers to the open questions demonstrate that participants likely imagine and accept new secondary activities in the context of

all three main use cases for semi-autonomous driving. Country and gender comparisons revealed differences in preferences. Whereas the Chinese and female participants indicated higher interest in hedonic activities inside the car, German and male respondents showed higher preference for work-related tasks (see Appendix G for more detailed statistical analyses of the use case-specific secondary activities).

Discussion

This consumer-centric corporate foresight research conducted in three developing and developed markets explored changing consumer needs and the relevance of new use cases in the context of premium SAVs. Corporate foresight is crucial for organizations to anticipate trends in technology, markets and consumption behavior and to react appropriately to such signals by strategically planning ahead, freeing resources, and preparing the company for change (Rohrbeck, Battistella, and Huizingh, 2015; Wright, Bradfield, and Cairns, 2013). The present research investigated future consumption behavior in the highly uncertain automotive market, which is being disrupted by autonomous vehicles, in order to help organizations within the industry to maneuver these times of change. Understanding changes in consumer attitudes and needs is important to enable automotive manufacturers and suppliers to forecast the decision-making processes behind consumers' acceptance of and their willingness to use and purchase (semi-) autonomous vehicles.

The results of this multiple methods research highlight the benefits of integrating visionary consumers into corporate foresight activities (Hofmann, 2015) as well as of triangulating different approaches (Bloem da Silveira Junior et al., 2018; Campbell and Fiske, 1959; Flick, 2017). Interviews and focus groups exploring future consumption behavior were held with trend receiving customers of premium cars (Hofmann, 2015) and resulted in the three main use cases, "entertainment", "work", and "communication and relaxation", as well as specific secondary activities in the context of premium SAVs. By means of a quantitative online survey with a sample of common and innovative emergent nature consumers (Hoffman, Kopalle, and Novak, 2010), the use cases were reviewed and fine-tuned and their relevance for future consumers, and thus their market potential, were estimated. Further, the survey helped to identify differences between customer groups.

A new purpose for the automobile. Previously, several surveys have indicated a lower acceptance of unfamiliar in-vehicle activities (e.g., resting or watching a movie), as compared to classical non-driving related activities (Kyriakidis, Happee, and De Winter, 2015; Schoettle and Sivak, 2014b), as well as a lower valuation of time in autonomous compared to manually driven cars (Yap, Correia, and van Arem, 2016). More in line with Noblet et al. (2018) and Wadud and Huda (2018), the results of the qualitative and quantitative studies presented here indicate an open-mindedness of customers towards new secondary activities in SAVs. For example, the analogy to specific rooms, such as a cinema-like experience for entertainment, a space for relaxation, or a moving office, is well accepted by and of relevance to both innovative and more common customers of premium vehicles. “Communication and relaxation” was by far the most preferred use case. Group comparisons indicate individual preferences of subgroups with respect to the other use cases and specific secondary activities. For example, the Chinese sample voiced a higher interest in investing time in communication with friends and family or relaxing, as previously documented by Schoettle and Sivak (2014b).

The results denote that consumers expect premium SAVs to transform from pure mobility providers into extended living and working spaces with new functionalities in order to guarantee a good in-vehicle experience. While not the focus of the study, attractive secondary activities might function as a compensation for a perceived lack of fun due to the delegation of the driving task (EY, 2013). As such, the use cases described here might pave the way to creating a more enjoyable consumption experience in premium SAVs. Moreover, prior research has documented fear and skepticism in consumers towards autonomous vehicles, especially in women (Hohenberger, Spörrle, and Welpe, 2016; Kyriakidis, Happee, and De Winter, 2015). The use cases described have the potential to induce hedonic enjoyment in consumers while eliciting a feeling of control due to the remaining possibility of taking over the driving task (König and Neumayr, 2017). In this way, anxiety-related responses towards automated cars might be reduced as suggested by Hohenberger, Spörrle, and Welpe (2016).

In comparison to current mobility services which already allow for different activities, such as trains or planes, privately-owned SAVs in particular offer the benefit of allowing people to engage in meaningful activities in a more individual, private setting. For example, the option to use the vehicle for leisure and relaxation is reminiscent of a living room in which to enjoy personal activities and might fuel an

ongoing interest in the purchase of private vehicles (Steck et al., 2017). As indicated by preliminary studies, privately owned SAVs might indeed be valued higher than shared experiences with other customers.

A new model of smart mobility. The use cases for premium SAVs identified here highlight the role of these vehicles in a new smart model of mobility, with value in mobility being derived from how much the traveler spends on travel tickets, vehicle ownership, services and apps (Docherty, Marsden, and Anable, 2017; Fagnant and Kockelman, 2015). SAVs' increasingly user-centric nature, offering a spectrum of secondary activities outside the driving task as well as potentially innovative and personalized services (Heitanen, 2014), will allow this means of transport to better address individual customer needs, improve the quality of hours spent in traffic and commercialize such activities. Especially for commuters, these new possibilities seem to positively influence the attractiveness of travel-time in autonomous vehicles (Hensher, 2011; Steck et al., 2017), with high income commuters benefitting most from automation, due to a more productive use of time inside autonomous vehicles (Wadud, 2017). A higher appreciation of travel time in SAVs might not only result in new revenue streams for manufacturers and service providers, but might also have a profound impact on the amount of travel time spent and distance travelled in future automated cars (Gruel and Stanford, 2016). The latter might potentially lead to more vehicles on the road, including all the forecasted positive (e.g., higher safety, less congestion, greater efficiency) and negative (e.g., higher system costs, information asymmetries due to data misuse) externalities (Docherty, Marsden, and Anable, 2017; Fagnant and Kockelman, 2015; Gruel and Stanford, 2016). Further, the commoditization of individual journeys and in-vehicle travel time in SAVs might fuel the ongoing trend towards an increasingly neo-liberal transport system (Gössling and Cohen, 2014). At the same time, this development might undermine the role of state involvement in organizing and providing transport to reach different social policy goals (Ranci, 2011; Shaw et al., 2008).

Implications for manufacturer and suppliers. Major implications of vehicle automation for practitioners that follow from the results are the need for fundamentally new product applications (Herbig, 1994; Meyer, Brooks, and Goes, 1990; VDA, 2015) as well as the formation of new markets and partnerships surrounding hard- and software. For example, the use cases for premium SAVs described here suggest that

the cars' interior design, systems and services should enable flexible ways of using space and time, with the car's interior adapting to new secondary activities with movable chairs, displays, and table areas. Additionally, personalized digital services and their integration into premium SAVs might be necessary to attract premium customers and provide compensation in the form of the new degrees of freedom and usage of time. Pilot projects published by several manufacturers confirm that exterior and interior design and the functionality of autonomous vehicles will be much different from today's automobiles (e.g., Mercedes-Benz, 2015; Nissan, 2015; Pitzke, 2015; VDA, 2015).

The observed individual preferences for different use cases and activities highlight the necessity of taking cultural and gender preferences as well as their intersection into consideration in the design of interior concepts and services for autonomous vehicles. The findings suggest the possibility for customization of the car as a potential solution to better address individual consumer needs. Research on consumer co-production of products supports this conclusion as it reveals a positive influence of consumer's active engagement in product creation on subsequent product evaluations (Troye and Supphellen, 2012), especially if the process of designing was enjoyable (Franke and Schreier, 2010), as well as its influence on product performance (Smets, Langerak, and Rijsdijk, 2013). At the same time, cross-cultural research comparing Asian countries concludes that mass customization might succeed best in cultures that are low in uncertainty avoidance (de Bellis et al., 2015).

The new requirements and consumer needs following vehicle automation challenge existing functionalities and pave the way for alliances and strategic partnerships with other players (Docherty, Marsden, and Anable, 2017). For example, new partners specialized in the interior architecture of offices and private spaces might support the design of innovative interior concepts for SAVs, while large technology enterprises already help with establishing the IT infrastructure needed for autonomous driving and developing new digital services together with partners from the automotive industry (Cohan, 2017; Kröger, 2017). Moreover, for both autonomous driving and digital, internet-enabled services to function, infrastructure such as 5G networks will be necessary to enable seamless connectivity on all roads, calling for the government as an important partner in enabling the technology in general as well as new in-vehicle applications (Federal Ministry of Transport and Digital Infrastructure, 2017).

Limitations and future research. In a future of full automation, even more usage scenarios and customer groups are imaginable, especially considering mobility-impaired individuals, such as non-drivers, the elderly and people with travel-restrictive medical conditions. Allowing restricted user groups, for example older generations, to enhance their self-mobility with autonomous vehicles (Bellet, Paris, and Marin-Lamellet, 2018), might eventually cause a "14% increase in annual light-duty VMT (i.e., vehicle-miles-travelled) for the US population 19 and older" (Harper et al., 2016, p. 1). Again, such forecasts imply that many of the suggested benefits of autonomous vehicles, such as lower energy demand, less vehicles on the street and reduced congestion, might be undermined by a higher demand for this means of transport compared to public alternatives (Docherty, Marsden, and Anable, 2017).

Due to the radical nature of the technology and a hypothetical bias in discussing more radical use cases, that is, fully autonomous vehicles, the scope of the present study is limited to SAVs. Interviews with trend receivers on the topic of FAVs (not discussed in this paper), revealed more innovative use cases, such as moving hotel rooms in which to sleep over night. In future, a higher familiarity with the technology might allow for a thorough investigation of a more radical technology and business models for FAVs with the help of mainstream consumers and new customer groups (such as mobility-impaired individuals).

Further, the focus of the present study on customers of premium vehicles makes it difficult to transfer the results to other customer groups which might have different interests or preferences. Also, the use cases described might increase the price of SAVs, with more affordable vehicle segments not being able to offer all use cases or secondary activities described here. However, especially for individuals with a limited budget, more meaningful activities in SAVs might be an important factor influencing their decision on which means of transport to choose. Therefore, follow-up studies with different customers groups might reveal other important use cases or activities.

Moreover, while ownership was not the focus of the study, the identified use cases are more representative of privately owned vehicles. Other customer groups might be less interested in privately owned SAVs, highlighting the importance of research that investigates Mobility-as-a-Service approaches, such as shared autonomous vehicles (Heitanen, 2014; Kamargianni et al., 2016).

Lastly, secondary activities in SAVs and the control over the driving task by the vehicle will have a profound impact on the interaction between the driver and the vehicle. Previous studies have shed light on drivers' capabilities in take-over situations

(e.g., Körber et al., 2016), optimal in-vehicle recognition technology to evaluate take-over readiness (Braunagel et al., 2015), the consequences of secondary task involvement (Naujoks, Purucker, and Neukum, 2016) and influences of in-vehicle displays on drivers' distraction (Kraft et al., 2018). For example, in a recent field study, Naujoks, Purucker, and Neukum (2016) could show that quality of driving in an SAV was not impaired after engaging in secondary in-vehicle activities. Research in a high-fidelity driving simulator points out slower reaction times during take-over and drivers' difficulties in managing take-over situations during incidents on the road when engaged in non-driving related activities (Dogan et al., 2017; Merat et al., 2012; Radlmayr et al., 2014). On the other hand, training in an automated car has been demonstrated to improve human automation performance (Payre et al., 2017). Since the driver of an SAV changes from an active controller to a supervisor, communication between the two parties, man and machine, needs to be faultless before manufacturers can allow drivers to engage in secondary activities. The ambivalent results on the success of take-over situations underline that more research is needed in order to establish safe driving in SAVs. Moreover, the change in human machine interaction might require international guidelines for the transition period to high automation in order to ensure safety in SAVs across countries.

Conclusion

This paper contributes to research on SAVs by describing changes in consumption behavior, arising customer needs, and implications for practitioners in the face of this radical technology. Moreover, the paper discloses in detail the study design of a consumer-centric corporate research approach. The findings underline that the impact of vehicle automation on consumers, the transport system and industry might be fundamental. Offering many more degrees of freedom to passengers in terms of space and time usage will result in new consumption patterns, new priorities and strategic partnerships for car manufacturers and suppliers, as well as new business models, to name just a few major consequences. With the advent of SAVs, and later on, FAVs, the transport system might change from traditional to smart and neo-liberal, leading to a higher attractiveness of vehicles due to a higher value of time and door-to-door mobility as opposed to a less private, less flexible public transport system. This corporate foresight research has helped an automotive industry partner to be better prepared for the transition from manual to automated vehicles.

Acknowledgement

We would like to thank Boris Meiners and Mark Ebert from AUDI AG as well as Dr. Alexander Hahn, Volker Bilgram and Johanna Winding from Hyve AG for their outstanding support in the conduction of the qualitative pilot study and the generation of the qualitative data. The paper has been conducted by University of St. Gallen in cooperation with Audi AG.

References

Andriopoulos, C., and M. Gotsi. 2006. Probing the future: Mobilising foresight in multiple-product innovation firms. *Futures* 38 (1): 50–66.

Arnott, R., and K. A. Small. 1994. The economics of traffic congestion. *American Scientist* 82 (5): 446–55.

Audi MediaCenter. 2015. Long-distance test drive successfully completed: Audi A7 Sportback piloted driving concept arrives in Las Vegas following 560 mile drive [Press release]. Available at: https://www.audi-mediacenter.com/en/press-releases/long-distance-test-drive-successfully-completed-audi-a7-sportback-piloted-driving-concept-arrives-in-las-vegas-following-560-mile-drive-411

Bansal, P., K. M. Kockelman, and A. Singh. 2016. Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. *Transportation Research Part C: Emerging Technologies* 67: 1–14.

Becker, F., and K. W. Axhausen. 2017. Literature review on surveys investigating the acceptance of automated vehicles. *Transportation* 44 (6): 1293–306.

Bellet, T., J. C. Paris, and C. Marin-Lamellet. 2018. Difficulties experienced by older drivers during their regular driving and their expectations towards Advanced Driving Aid Systems and vehicle automation. *Transportation Research Part F: Traffic Psychology and Behaviour* 52: 138–63.

Bernhart, W., and M. Winterhoff. 2016. Autonomous driving: Disruptive innovation that promises to change the automotive industry as we know it. In *Energy Consumption and Autonomous Driving*. *Lecture Notes in Mobility*., ed. J. Langheim. Cham: Springer.

Bloem da Silveira Junior, L. A., E. Vasconcellos, L. Vasconcellos Guedes, L. F. A. Guedes, and R. M. Costa. 2018. Technology roadmapping: A methodological proposition to refine Delphi results. *Technological Forecasting and Social Change* 126: 194–206.

Böhm, S., C. Jones, C. Land, and M. Paterson. 2006. Part one conceptualizing automobility: Introduction: Impossibilities of automobility. *The Sociological Review* 54 (s1): 1–16.

Braunagel, C., E. Kasneci, W. Stolzmann, and W. Rosenstiel. 2015. Driver-activity recognition in the context of conditionally autonomous driving. In *2015 IEEE 18th International Conference on Intelligent Transportation Systems*, 1652–7.

Campbell, D. T., and D. W. Fiske. 1959. Convergent and discriminant validation by the multitrait multimethod matrix. *Psychological Bulletin* 56 (2), 81-105.

Chandy, R. K., and G. J. Tellis. 1998. Organizing for radical product innovation: The overlooked role of willingness to cannibalize. *Journal of Marketing Research* 35 (4): 474–87.

Chandy, R. K., and G. J. Tellis. 2000. The incumbent's curse? Incumbency, size, and radical product innovation. *Journal of Marketing* 64 (3): 1–17.

Coates, J., P. Durance, and M. Godet. 2010. Strategic foresight issue: Introduction. *Technological Forecasting and Social Change* 77 (9): 1423–5.

Coates, J. F. 1985. Foresight in federal government policymaking. *Futures Research Quarterly* 1 (2): 29–53.

Cohan, P. 2017. *This startup is helping daimler and bmw compete with google for $10 trillion market.* Forbes. Available at: https://www.forbes.com/sites/petercohan/2017/09/29/this-startup-is-helping-daimler-and-bmw-compete-with-google-for-10-trillion-market/#2dce29061342

Creswell, J. 2003. *Research design: Qualitative, quantitative, and mixed method approaches* (2nd ed.). Thousand Oaks: Sage Publications.

Daheim, C., and G. Uerz. 2008. Corporate foresight in Europe: From trend based logics to open foresight. *Technology Analysis and Strategic Management* 20 (3): 321–36.

Daim, T. U., G. Rueda, H. Martin, and P. Gerdsri. 2006. Forecasting emerging technologies: Use of bibliometrics and patent analysis. *Technological Forecasting and Social Change* 73 (8): 981–1012.

Daziano, R. A., M. Sarrias, and B. Leard. 2017. Are consumers willing to pay to let cars drive for them? Analyzing response to autonomous vehicles. *Transportation Research Part C: Emerging Technologies* 78: 150–64.

de Bellis, E., C. Hildebrand, K. Ito, and A. Herrmann. 2015. Cross-national differences in uncertainty avoidance predict the effectiveness of mass customization across East Asia: A large-scale field investigation. *Marketing Letters* 26 (3): 309–20.

Docherty, I., G. Marsden, and J. Anable. 2017. The governance of smart mobility. *Transportation Research Part A*: *Policy and Practice*: forthcoming.

Dogan, E., M. C. Rahal, R. Deborne, P. Delhomme, A. Kemeny, and J. Perrin. 2017. Transition of control in a partially automated vehicle: Effects of anticipation and non-driving-related task involvement. *Transportation Research Part F: Traffic Psychology and Behaviour* 46 (Part A): 205–15.

Dufva, M., and T. Ahlqvist. 2015. Knowledge creation dynamics in foresight: A knowledge typology and exploratory method to analyse foresight workshops. *Technological Forecasting and Social Change* 94: 251–68.

Eppler, M. J., and K. W. Platts. 2009. Visual strategizing the systematic use of visualization in the strategic-planning process. *Long Range Planning* 42 (1): 42–74.

EY. 2013. Autonomes Fahren – die Zukunft des Pkw-Marktes?

Fagnant, D. J., and K. Kockelman. 2015. Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations. *Transportation Research Part A: Policy and Practice* 77: 167–81.

Federal Ministry of Transport and Digital Infrastructure. 2017. *5G Strategy for Germany: A scheme to promote the development of Germany to become a lead market for 5G networks and applications*. Available at: https://www.bmvi.de/SharedDocs/EN/publications/5g-strategy-for-germany.pdf?__blob=publicationFile

Flick, U. 2017. Mantras and myths: The disenchantment of mixed-methods research and revisiting triangulation as a perspective. *Qualitative Inquiry* 23 (1): 46–57.

Franke, N., and M. Schreier. 2010. Why customers value self-designed products: The importance of process effort and enjoyment. *Journal of Product Innovation Management* 27 (7): 1020–31.

Garcia, R., and R. Calantone. 2002. A critical look at technological innovation typology and innovativeness terminology: A literature review. *Journal of Product Innovation Management* 19 (2): 110–32.

Garcia, R., P. W. Rummel, and J. Hauser. 2006. Co-opetition for the diffusion of resistant innovations: A case study in the global wine industry using an agent-based model. In *Agent-based models of market dynamics and consumer behavior. Institute of Advanced Studies*, 1–10. University of Surrey, Guildford.

Gasser, T. M., C. Arzt, M. Ayoubi, A. Bartels, L. Bürkle, J. Eier, F. Flemisch, D. Häcker, et al. 2012. *Rechtsfolgen zunehmender Fahrzeugautomatisierung* (Berichte der Bundesanstalt für Straßenwesen, Reihe F84). Bremerhaven: Wirtschaftsverlag NW.

Glaser, B., and A. Strauss. 1967. Grounded theory: The discovery of grounded theory. *Sociology The Journal of the British Sociological Association* 12: 27–49.

Gössling, S., and S. Cohen. 2014. Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. *Journal of Transport Geography* 39: 197–207.

Gruel, W., and J. M. Stanford. 2016. Assessing the long-term effects of autonomous vehicles: A speculative approach. *Transportation Research Procedia* 13: 18–29.

Gurtner, S., and K. Soyez. 2016. How to catch the generation Y: Identifying consumers of ecological innovations among youngsters. *Technological Forecasting and Social Change* 106: 101–7.

Haboucha, C. J., R. Ishaq, and Y. Shiftan. 2017. User preferences regarding autonomous vehicles. *Transportation Research Part C: Emerging Technologies* 78: 37–49.

Harper, C. D., C. T. Hendrickson, S. Mangones, and C. Samaras. 2016. Estimating potential increases in travel with autonomous vehicles for the non-driving, elderly and people with travel-restrictive medical conditions. *Transportation Research Part C: Emerging Technologies* 72: 1–9.

Heger, T., and R. Rohrbeck. 2012. Strategic foresight for collaborative exploration of new business fields. *Technological Forecasting and Social Change* 79 (5): 819–31.

Heitanen, S. 2014. Mobility as a Service - The new transport model? *EuroTransport* 12 (2): 2–4.

Hengstler, M., E. Enkel, and S. Duelli. 2016. Applied artificial intelligence and trust - The case of autonomous vehicles and medical assistance devices. *Technological Forecasting and Social Change* 105: 105–20.

Hensher, D. A. 2011. Valuation of travel time savings. In *A handbook of transport economics*, ed. A. de Palma, R. Lindsey, E. Quinet, and R. Vickerman, 135–59. Cheltenham, UK; Northampton, MA: Edward Elgar Publishing Limited.

Herbig, P. A. 1994. *The innovation matrix: Culture and structure prerequisites to innovation.* Westport, CT: Quorum Books.

Hoeffler, S. 2003. Measuring preferences for really new products. *Journal of Marketing Research* 40 (4): 406–20.

Hoffman, D. L., P. K. Kopalle, and T. P. Novak. 2010. The “right” consumers for better concepts: Identifying consumers high in emergent nature to develop new product concepts. *Journal of Marketing Research* 47 (5): 854–65.

Hofmann, R. 2015. Visionary competence for long-term development of brands, products, and services: The trend receiver concept and its first applications at Audi. *Technological Forecasting and Social Change* 101: 83–98.

Hohenberger, C., M. Spörrle, and I. M. Welpe. 2016. How and why do men and women differ in their willingness to use automated cars? The influence of emotions across different age groups. *Transportation Research Part A: Policy and Practice* 94: 374–85.

Hohenberger, C., M. Spörrle, and I. M. Welpe. 2017. Not fearless, but self-enhanced: The effects of anxiety on the willingness to use autonomous cars depend on individual levels of self-enhancement. *Technological Forecasting and Social Change* 116: 40–52.

Hussain, M., E. Tapinos, and L. Knight. 2017. Scenario-driven roadmapping for technology foresight. *Technological Forecasting and Social Change* 124: 160–77.

Jamson, A. H., N. Merat, O. M. J. Carsten, and F. C. H. Lai. 2013. Behavioural changes in drivers experiencing highly-automated vehicle control in varying traffic conditions. *Transportation Research Part C: Emerging Technologies* 30: 116–25.

Kamargianni, M., W. Li, M. Matyas, and A. Schäfer. 2016. A critical review of new mobility services for urban transport. *Transportation Research Procedia* 14: 3294–303.

Kleijnen, M., N. Lee, and M. Wetzels. 2009. An exploration of consumer resistance to innovation and its antecedents. *Journal of Economic Psychology* 30 (3): 344–57.

König, M., and L. Neumayr. 2017. Users' resistance towards radical innovations: The case of the self-driving car. *Transportation Research Part F: Traffic Psychology and Behaviour* 44: 42–52.

Körber, M., C. Gold, D. Lechner, and K. Bengler. 2016. The influence of age on the take-over of vehicle control in highly automated driving. *Transportation Research Part F: Traffic Psychology and Behaviour* 39: 19–32.

Kraft, A. K., F. Naujoks, J. Wörle, and A. Neukum. 2018. The impact of an in-vehicle display on glance distribution in partially automated driving in an on-road experiment. *Transportation Research Part F: Traffic Psychology and Behaviour* 52: 40–50.

Krippendorff, K. 2012. *Content analysis: An introduction to its methodology*. Thousand Oaks: Sage.

Kröger, M. 2017. *Karten-Allianz Here: Daimler und Co. rüsten zum Kampf gegen Google.* Spiegel Online. Available at: http://www.spiegel.de/wirtschaft/unternehmen/here-daimler-bmw-und-audi-blasen-zum-kampf-gegen-google-a-1128577.html

Kun, A. L., S. Boll, and A. Schmidt. 2016. Shifting gears: User interfaces in the age of autonomous driving. *IEEE Pervasive Computing* 15 (1): 32–8.

Kyriakidis, M., R. Happee, and J. C. F. De Winter. 2015. Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. *Transportation Research Part F: Traffic Psychology and Behaviour* 32: 127–40.

Lee, J. D., and N. Moray. 1994. Trust, self-confidence, and operators' adaptation to automation. *International Journal of Human-Computer Studies* 40 (1): 153–84.

Le Vine, S., A. Zolfaghari, and J. Polak. 2015. Autonomous cars: The tension between occupant experience and intersection capacity. *Transportation Research Part C: Emerging Technologies* 52: 1–14.

Lincoln, Y. S., and E. G. Guba. 1985. *Naturalistic inquiry*. Newbury Park: Sage.

Linstone, H., and M. Turoff. 1975. *The Delphi method: Techniques and applications.* Reading, MA: Addison-Wesley.

Linstone, H. A. 2011. Three eras of technology foresight. *Technovation* 31 (2–3): 69–76.

Magruk, A. 2011. Innovative classification of technology and foresight methods. *Technological and Economic Development of Economy* 17 (4): 700–15.

Merat, N., A. H. Jamson, F. C. H. Lai, and O. Carsten. 2012. Highly automated driving, secondary task performance, and driver state. *Human Factors* 54 (5): 762–71.

Mercedes-Benz. 2015. The Mercedes-Benz F 015 luxury in motion. Available at: https://www.mercedes-benz.com/de/mercedes-benz/innovation/forschungsfahrzeug-f-015-luxury-in-motion/

Meyer, A., G. Brooks, and J. Goes. 1990. Environmental jolts and industry revolution: Organizational responses to discontinuous change. *Strategic Management Journal* 11: 93–110.

Molesworth, M., and J.-P. Suortti. 2002. Buying cars online: The adoption of the web for high-involvement, high-cost purchases. *Journal of Consumer Behaviour* 2 (2): 154–69.

Moradi, A., and E. Vagnoni. 2018. A multi-level perspective analysis of urban mobility system dynamics: What are the future transition pathways? *Technological Forecasting and Social Change* 126: 231–43.

Morse, J. M. 1995. The significance of saturation. *Qualitative Health Research* 5 (2): 147–9.

Müller, A. W., and J. O. Shwarz. 2016. Assessing the functions and dimensions of visualizations in foresight. *Foresight* 18 (1): 76–90.

Naujoks, F., C. Purucker, and A. Neukum. 2016. Secondary task engagement and vehicle automation - Comparing the effects of different automation levels in an on-road experiment. *Transportation Research Part F: Traffic Psychology and Behaviour* 38: 67–82.

Nieuwenhuijsen, J., G. H. de A. Correia, D. Milakis, B. van Arem, and E. van Daalen. 2018. Towards a quantitative method to analyze the long-term innovation diffusion of automated vehicles technology using system dynamics. *Transportation Research Part C: Emerging Technologies* 86: 300–27.

Nissan. 2015. Nissan IDS concept: Nissan's vision for the future of EVs and autonomous driving. Available at: http://nissannews.com/en-US/nissan/usa/releases/nissan-ids-concept-nissan-s-vision-for-the-future-of-evs-and-autonomous-driving

Noblet, C. L., J. Rubin, A. Eslin, and R. Jennings. 2018. What's "driving"adoption of automated vehicles? In *Transportation Research Board 97th Annual Meeting*. Washington DC.

Ostlund, L. E. 1974. Perceived innovation attributes as predictors of innovativeness. *Journal of Consumer Research* 1 (2): 23–9.

Owens, J. M., J. F. Antin, Z. Doerzaph, and S. Willis. 2015. Cross-generational acceptance of and interest in advanced vehicle technologies: A nationwide survey. *Transportation Research Part F: Traffic Psychology and Behaviour* 35: 139–51.

Payre, W., J. Cestac, and P. Delhomme. 2014. Intention to use a fully automated car: Attitudes and a priori acceptability. *Transportation Research Part F: Traffic Psychology and Behaviour* 27: 252–63.

Payre, W., J. Cestac, N. T. Dang, F. Vienne, and P. Delhomme. 2017. Impact of training and in-vehicle task performance on manual control recovery in an automated car. *Transportation Research Part F: Traffic Psychology and Behaviour* 46: 216–27.

Petrick, I. J., and A. E. Echols. 2004. Technology roadmapping in review: A tool for making sustainable new product development decisions. *Technological Forecasting and Social Change* 71 (1–2): 81–100.

Phaal, R., J. P. Farrukh, and D. R. Probert. 2004. Technology roadmapping - A planning framework for evolution and revolution. *Technological Forecasting and Social Change* 71: 5–26.

Pitzke, M. 2015. Neue Dachfirma Alphabet: Google räumt auf. Retrieved. Available at: http://www.spiegel.de/wirtschaft/unternehmen/mit-alphabet-wird-google-zum-konglomerat-a-1047567.html

Popper, R., L. Georgiou, J. C. Harper, M. Keenan, and I. Miles. 2008. Foresight methodology. In *The handbook of technology foresight*, ed. R. Popper. Cheltenham, UK: Edward Elgar.

Porter, A. L., W. B. Ashton, G. Clar, J. F. Coates, K. Cuhls, S. W. Cunningham, K. Ducatel, P. van der Duin, et al. 2004. Technology futures analysis: Toward integration of the field and new methods. *Technological Forecasting and Social Change* 71 (3): 287–303.

Power, J. D. 2012. 2012 U.S. Automotive emerging technologies study results. [Press release]. Available at : http://autos.jdpower.com/press-releases/2012-us-automotive-emerging-technologies-study

Radlmayr, J., C. Gold, L. Lorenz, M. Farid, and K. Bengler. 2014. How traffic situations and non-driving related tasks affect the take-over quality in highly automated driving. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 58 (1): 2063–7. Los Angeles, CA: Sage Publications.

Ranci, C. 2011. Competitiveness and social cohesion in Western European cities. *Urban Studies* 48 (13): 2789–804.

Rhisiart, M., R. Miller, and S. Brooks. 2015. Learning to use the future: Developing foresight capabilities through scenario processes. *Technological Forecasting and Social Change* 101: 124–33.

Rogers, E. M. 2010. *Diffusion of innovations*. 4th ed. New York: Simon and Schuster.

Rohrbeck, R., and H. G. Gemünden. 2011. Corporate foresight: Its three roles in enhancing the innovation capacity of a firm. *Technological Forecasting and Social Change* 78 (2): 231–43.

Rohrbeck, R., C. Battistella, and E. Huizingh. 2015. Corporate foresight: An emerging field with a rich tradition. *Technological Forecasting and Social Change* 101: 1–9.

Ruff, F. 2015. The advanced role of corporate foresight in innovation and strategic management - Reflections on practical experiences from the automotive industry. *Technological Forecasting and Social Change* 101: 37–48.

SAE International. 2014. Automated Driving Levels of Driving Automation are defined in New SAE International Standard J3016. Available at: http://www.sae.org/misc/pdfs/automated_driving.pdf

Schoemaker, P. J. H. 1995. Scenario planning: A tool for strategic thinking. *Sloan Management Review* 36 (2): 25–40.

Schoettle, B., and M. Sivak. 2014a. *A survey of public opinion about connected vehicles in the U.S., the U.K., and Australia.* Ann Arbor: The University of Michigan Transportation Research Institute.

Schoettle, B., and M. Sivak. 2014b. *Public opinion about self-driving vehicles in China, India, Japan, the US, the UK, and Australia.* Ann Arbor: The University of Michigan Transportation Research Institute.

Schuelke-Leech, B. A. 2017. A model for understanding the orders of magnitude of disruptive technologies. *Technological Forecasting and Social Change* 129: 261–74.

Schweitzer, F., C. Rau, O. Gassmann, and E. Van Den Hende. 2015. Technologically reflective individuals as enablers of social innovation. *Journal of Product Innovation Management* 32 (6): 847–60.

Schweitzer, N. 2017. Sketching the Future of Mobility with Visualizations. *Marketing Review St. Gallen* 3: 19–27.

Shaw, J., R. Knowles, and I. Docherty. 2008. Transport governance and ownership. In: *Transport geographies: Mobilities, flows and spaces.* eds. R. Knowles, J. Shaw, I. Docherty. Oxford: Blackwell. 62–80.

Singleton, R. A. J., and B. C. Straits. 2005. *Approaches to social research*. Oxford University Press.

Slaughter, R., and R. A. Slaughter. 1999. *Futures for the third millenium: Enabling the forward view.* Leonards, Australia: Prospect Media.

Smets, L. P. M., F. Langerak, and S. A. Rijsdijk. 2013. Shouldn't customers control customized product development? *Journal of Product Innovation Management* 30 (6): 1242–53.

Spiess, H., E. Lobsiger-Kägi, V. Carabias-Hütter, and A. Marcolla. 2015. Future acceptance of wind energy production: Exploring future local acceptance of wind energy production in a Swiss alpine region. *Technological Forecasting and Social Change* 101: 263–74.

Spiggle, S. 1994. Analysis and interpretation of qualitative data in consumer research. *Journal of Consumer Research* 21 (3): 491–504.

Sprei, F. 2018. Disrupting mobility. *Energy Research and Social Science* 37: 238–42.

Statista (2016): Größte Automärkte weltweit nach Pkw-Neuzulassungen von Januar bis Juni 2016 (in Millionen). Available at: http://de.statista.com/statistik/daten/studie/164769/umfrage/groesste-automaerkte-weltweit-nach-pkw-neuzulassungen/

Steck, F., V. Kolarova, F. J. Bahamonde Birke, S. Trommer, and B. Lenz. 2017. How autonomous driving may affect the value of travel time savings. In *Transportation Research Board (TRB) 97th Annual Meeting*, 1–18.

Tapinos, E. 2012. Perceived environmental uncertainty in scenario planning. *Futures* 44 (4): 338–45.

Troye, S. V., and M. Supphellen. 2012. Consumer participation in coproduction: "I made it myself" effects on consumers' sensory perceptions and evaluations of outcome and input product. *Journal of Marketing* 76 (2): 33–46.

Tushman, M. L., and P. Anderson. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly* 31 (3): 439–65.

Van de Ven, A. H., D. E. Polley, R. Garud, and S. Venkataraman. 1999. *The innovation journey.* New York: Oxford University Press.

VDA. 2015. VDA: Connected and automated driving to become industry megatrend and strengthen Germany as an industrial location. Available at: https://www.vda.de/en/press/press-releases/20151029-VDA-Connected-and-automated-driving-to-become-industry-megatrend-and-strengthen-Germany-as-an-industrial-location.html

Vecchiato, R. 2015. Creating value through foresight: First mover advantages and strategic agility. *Technological Forecasting and Social Change* 101: 25–36.

Vecchiato, R., and C. Roveda. 2010. Strategic foresight in corporate organizations: Handling the effect and response uncertainty of technology and social drivers of change. *Technological Forecasting and Social Change* 77 (9): 1527–39.

Wadud, Z. 2017. Fully automated vehicles: A cost of ownership analysis to inform early adoption. *Transportation Research Part A: Policy and Practice* 101: 163–76.

Wadud, Z., and F. Y. Huda. 2018. The potential use and usefulness of travel time in fully automated vehicles. In *Transportation Research Board 97th Annual Meeting*. Washington DC.

Wadud, Z., D. MacKenzie, and P. Leiby. 2016. Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles. *Transportation Research Part A: Policy and Practice* 86: 1–18.

Wright, G., R. Bradfield, and G. Cairns. 2013. Does the intuitive logics method – and its recent enhancements – produce "effective" scenarios? *Technological Forecasting and Social Change* 80 (4): 631–42.

Yap, M. D., G. Correia, and B. van Arem. 2016. Preferences of travellers for using automated vehicles as last mile public transport of multimodal train trips. *Transportation Research Part A: Policy and Practice* 94: 1–16.

Zakharenko, R. 2016. Self-driving cars will change cities. *Regional Science and Urban Economics* 61: 26–37.

Zmud, J., I. N. Sener, and J. Wagner. 2016. *Consumer acceptance and travel behavior impacts of automated vehicles.* Final Report PRC 15-49 F: Texas A&M Transportation Institute.

Appendix

Appendix A. *Overview of 29 trend receivers participating in qualitative pilot study. I = Interview, F = Focus Group.*

TR	Country	Profession	Participation
TR 1	GER	Chief Branding Officer of a large peer-to-peer property rental company	I & F
TR 2	GER	CEO of a medium-sized pharmaceutical company	I & F
TR 3	GER	Data Scientist, Blogger, CEO of a startup for mobile data technology	I & F
TR 4	GER	Managing Director of a sports marketing and communication agency	I & F
TR 5	GER	Professor of Illustration at a school of design/ university	I & F
TR 6	GER	Founder and owner of a coaching company and leadership trainer	I & F
TR 7	GER	Head of Innovation of the largest manufacturer of home appliances in Europe	I & F
TR 8	GER	Partner and Founder of an innovation group and university professor at a school of finance and management	I & F
TR 9	GER	Chief Technology and Innovation Officer of a worldwide leading TV-media investor	I & F
TR 10	GER	Senior Consultant Trend Scouting and Open Innovation of the largest engineering company in Europe	I & F
TR 11	GER	Consultant	I & F
TR 12	GER	Managing Director at an institute offering consultancy in the area of inclusive business innovations	I & F
TR 13	GER	Founder and Managing Director of a consultancy for branding and organizational development	I & F
TR 14	GER	Director Business Development of a provider for messaging services	I & F
TR 15	CHN	Director of a national energy institute	I
TR 16	CHN	CTO of a global supplier of electric motors, motor controllers, and auxiliary equipment for the industrial vehicle industry	I
TR 17	CHN	Professor of Industry Engineering at a university	I
TR 18	CHN	Director of a transportation research center	I
TR 19	CHN	CMO at a ski resort	I
TR 20	CHN	Co-Pilot of an airline	I
TR 21	CHN	Founder of a designer brand	I
TR 22	CHN	General Manager of a fashion company	I
TR 23	USA	Global Innovation Manager of a multinational and leading sports company	I
TR 24	USA	CEO of one of the largest crowd-investing platforms worldwide	I
TR 25	USA	Director of Research and Strategy of a provider of business intelligence for elite creative professionals	I
TR 26	USA	Associate of a large financial service provider	I
TR 27	USA	Director of Marketing of a leading supplier of specialty chemical products and industrial materials	I
TR 28	USA	Education Coordinator of a large US American library	I
TR 29	USA	Professor of Marketing at a university	I

Appendix B. *Country-specific demographics for sample of online survey.*

	n	Mean Age	% of Females
Germany	284	41	41.2
USA	230	42	50.4
China	219	38	47.5

Appendix C. *Description of SAVs in online survey.*

Semi-autonomous driving means that your car will take over driving for you in specific situations, for example on the highway. You will have to remain seated in the front seat during that time; however you will not have to control the steering wheel, the accelerator or the brakes. For several hours, your car will completely take over driving for you.

If the car needs your attention, for example when you approach the motorway exit, you will have approximately 10 seconds to regain control over the car. In case you do not take back control over the wheel within those 10 seconds, the car will park itself on the emergency lane.

While your car drives autonomously, you will have a lot of time for other activities. We would now like to know, how you want to make use of that time in your car.

Appendix D. *Secondary Activities in SAVs as part of quantitative online survey.*

- Television, e.g. watch movies, series, documentaries, news, society news or sports
- Listen to music and audio books, e.g. listen to own playlists, explore new music, listen to audio books
- Gaming, e.g. play video games with console or parlor and card games
- Develop ideas and concepts, e.g. do online research, read information offline, do brainstorming, develop ideas or new concepts
- Organizing and implementing, e.g. edit documents, write reports, coordinate with business partners or plan appointments and to-do's
- Networking, e.g. have conversations via video telephone or personally in the car, strengthen contacts via professional networking platforms like Xing/ LinkedIn
- Stock up on some energy, e.g. snooze, relax, enjoy the landscape or privacy, eat and drink
- Pursue personal interests, e.g. surf online on YouTube or Facebook, read a book, contact friends or family, explore the environment via travel advice from the car

Appendix E. *Use Case * country cross tabulation, n = 661[2]. Each subscript letter denotes a subset of country categories whose column proportions do not differ significantly from each other at the .05 level (Ent = Entertainment, CR = Communication and relaxation).*

			Country			Total
			GER	USA	CHN	
Use Case	ENT	Count	64_a	71_a	47_a	182
		% within Use Case	35.2%	39.0%	25.8%	100.0%
		% within country	24.4%	32.3%	26.3%	27.5%
		% of Total	9.7%	10.7%	7.1%	27.5%
		Standardized Residual	-1.0	1.3	-.3	
	Work	Count	78_a	58_a	27_b	163
		% within Use Case	47.9%	35.6%	16.6%	100.0%
		% within country	29.8%	26.4%	15.1%	24.7%
		% of Total	11.8%	8.8%	4.1%	24.7%
		Standardized Residual	1.7	.5	-2.6	
	CR	Count	120_a	91_a	105_b	316
		% within Use Case	38.0%	28.8%	33.2%	100.0%
		% within country	45.8%	41.4%	58.7%	47.8%
		% of Total	18.2%	13.8%	15.9%	47.8%
		Standardized Residual	-.5	-1.4	2.1	
Total		Count	262	220	179	661
		% within Use Case	39.6%	33.3%	27.1%	100.0%
		% within country	100.0%	100.0%	100.0%	100.0%
		% of Total	39.6%	33.3%	27.1%	100.0%

Appendix F. Use Case * gender cross tabulation, n = 661[2]. Each subscript letter denotes a subset of country categories whose column proportions do not differ significantly from each other at the .05 level (Ent = Entertainment, CR = Communication and relaxation).

			Gender		
			Female	Male	Total
Dimension	ENT	Count	101_a	81_b	182
		% within Use Case	55.5%	44.5%	100.0%
		% within Gender	33.6%	22.5%	27.5%
		% of Total	15.3%	12.3%	27.5%
		Standardized Residual	2.0	-1.8	
	Work	Count	57_a	106_b	163
		% within Use Case	35.0%	65.0%	100.0%
		% within Gender	18.9%	29.4%	24.7%
		% of Total	8.6%	16.0%	24.7%
		Standardized Residual	-2.0	1.8	
	CR	Count	143_a	173_a	316
		% within Use Case	45.3%	54.7%	100.0%
		% within Gender	47.5%	48.1%	47.8%
		% of Total	21.6%	26.2%	47.8%
		Standardized Residual	-.1	.1	
Total		Count	301	360	661
		% within Use Case	45.5%	54.5%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	45.5%	54.5%	100.0%

Appendix G. *Statistical analyses for specific secondary activities.*

Entertainment. Kruskal Wallis tests comparing the three country samples within the use case entertainment were significant for almost all attributes at $p \leq 0.05$, meaning that the mean ranks differ between countries (watching movies: $H(2) = 9.18$, $p = 0.010$; watching TV: $H(2) = 6.31$, $p = 0.043$; watching sports: $H(2) = 17.83$, $p < 0.001$; discovering music: $H(2) = 30.86$, $p < 0.001$; listening to audio books: $H(2) = 11.52$, $p = 0.003$; gaming: $H(2) = 64.44$, $p < 0.001$; playing parlor games: $H(2) = 36.74$, $p < 0.001$). Gender comparisons only revealed a higher preference of men to watch sports games in the car in comparison to women ($U = 6539.50$, $p = 0.001$).

Work. Kruskal Wallis tests comparing mean rank scores between countries for the use case work revealed significant differences for all specific attributes except planning to-do lists (offline/ online research: $H(2) = 15.24$, $p < 0.001$; brainstorming: $H(2) = 20.85$, $p < 0.001$; working of documents: $H(2) = 15.49$, $p < 0.001$; coordinating tasks: $H(2) = 10.36$, $p = 0.006$; networking: $H(2) = 46.43$, $p < 0.001$; contact with colleagues/ business partners: $H(2) = 10.16$, $p = 0.006$). Gender comparisons revealed no significant differences.

Communication and relaxation. Kruskal Wallis tests, examining likely differences between countries for the use case communication and relaxation, were significant for the attributes “relaxing” ($H(2) = 23.33$, $p < 0.001$), “eating/ drinking” ($H(2) = 10.57$, $p = 0.005$) and “surfing the internet” ($H(2) = 14.02$, $p = 0.001$). Again, differences on the attribute level between female and male respondents were not significant.

Article III

Schweitzer, N. (accepted at Marketing Review St. Gallen): Sketching the Future of Mobility with Visualizations.

Sketching the Future of Mobility with Visualizations

Nicola Schweitzer[1]

(1) Nicola Schweitzer is a Doctoral Candidate at the Institute for Customer Insight, University of St. Gallen, Switzerland (nicola.schweitzer@unisg.ch).

Abstract

When conducting foresight research on disruptive innovations, visualizations are a powerful tool to generate customer insights, communicate findings and buy-in internal stakeholders. This paper demonstrates the successful application of visualizations in a consumer-centric foresight study on the future of self-driving cars.

Introduction

In order to remain competitive, companies struggle with a continuous search for new opportunities (Eisenhardt and Martin, 2000; Teece, Pisano, and Shuen, 1997). Sometimes, firms are required to react rapidly to radical developments (Brown and Eisenhardt, 1997; Gersick, 1991; Levinthal, 1992). Firms that are unable to anticipate changes or to design countervailing strategies may end up in precarious situations (Christensen, 1997; Day and Schoemaker, 2004; Stubbart and Knight, 2006). Especially radical innovations challenge the entire industry ecosystem and fundamentally reorder well-established patterns (Tushman and Anderson, 1986; Tushman and O'Reilly, 1997; Van de Ven et al., 1999, p. 171). Such innovations often embody a new technology and result in discontinuities on a macro and micro level (Garcia and Calantone, 2002). However, many innovations are rejected regardless of compelling features (Garcia, and Atkin, 2002; Molesworth and Suortti, 2002), due to a missing link to consumers' needs (Kleijnen, Lee, and Wetzels, 2009). Understanding which adaptations have to be made to a company's strategy to face uncertainties and to comply with customer expectations and which opportunities arise in the face of new developments is of major importance for a company's survival (Paap and Katz, 2004). One way of doing this is to establish customer-oriented foresight research as a fundamental element of business strategy (Kleijnen et al., 2009; Rohrbeck and Gemünden, 2011; Roveda and Vecchiato, 2006).

This article introduces a case of innovative foresight implemented in the automotive industry, which aimed at anticipating the future of self-driving cars with the help of profound customer insights. Thereby, visualizations enhanced generation, interpretation, and communication of data. The article shall demonstrate with examples how visual communication drives the success of foresight research on disruptive innovations. After introducing the theoretical background and general study framework, the author outlines two empirical studies and explains different functions of visualizations in foresight. Implications will be drawn for practice.

Theoretical Background

Strategic Foresight

One of the most challenging tasks for managers is to understand what the future holds and to strategically plan ahead. The increasing complexity and interaction of economic, social and competitive factors tend to be cognitively, socially, and

emotionally demanding (Eppler and Burkhard, 2007). This is where systematic foresight research comes into play. According to Miles, Keenan, and Kaivo-Oja (2003), foresight describes research activities which provide inputs about an organization's long-term future. Strategic foresight deals with the future 10 or more years ahead. It enables the detection of weak signals in the immediate and extended environment, new trends, as well as opportunities (Coates, 2010) and thereby, helps to address problems early. Thorough strategic foresight has the power to enhance a firm's decision-making process as well as to motivate internal stakeholders with a bold, aspirational vision (Bezold, 2010).

One way of approaching upcoming changes with foresight is by developing scenarios of alternate futures and the world external to an organization (Ringland, 2010). Scenarios help to anticipate how changes in the expression and interaction of different factors, as well as the joint impact of multiple uncertainties, influence the future (Bezold, 2010; Schoemaker, 1995). The use of scenarios is valuable to contextualize different ideas. They simplify available data through sense-making processes such as consistent and inspiring storytelling (Brown, 2009) and can thereby inform and engage internal stakeholders (Ringland, 2010). Visualizations play an important role in the design of scenarios (Bezold, 2010).

Visualizations

Various formats of visualizations exist, such as graphs, diagrams, photographs, schemata, maps, cartoons, and videos. Research has shown that images are more easily processed, understood and memorized by the human brain than text (Clark and Paivio, 1991; Paivio, 1986; Park, Puglisi, and Sovacool, 1983). They are part of the thought process and help to tell stories by triggering imagination and by summarizing complex situations (Ottino, 2003). In the communication with others, visualizations support knowledge management, for example, by establishing mutual understanding of concepts (Müller and Shwarz, 2016). Furthermore, they are of value in different process stages of strategy making, by addressing diverse cognitive (e.g., information overload), social (e.g., coordinating multiple hierarchic levels) and emotional (e.g., creating involvement and engagement of the staff) challenges (Eppler and Platts, 2009).

Also in the context of foresight research visualizations have proven to be very helpful (Müller and Shwarz, 2016). Heinonen and Hiltunen (2012) demonstrated that the use

of visual images enhances creativity in the development of visionary ideas, arguing that there is "a reciprocal and reinforcing relationship between creativity and innovation" – one spurring the other. In combination with scenarios of possible futures, visualizations provide images to the narratives. Therewith, visualizations facilitate synthesis of information and ultimately comprehension of challenging content by reducing cognitive overload (Eppler and Platts, 2009). According to dual coding theory, images also improve learning and recall of such narratives. This results from information being processed in brain areas responsible for interpreting visual in addition to written input (Clark and Paivio, 1991; Paivio, 1986). Lastly, research has shown that visualizations, especially surprising or shocking images, make written reports more emotional (Heinonen and Hiltunen, 2012; Müller and Shwarz, 2016) and thereby increase engagement in a topic (Bezold, 2010). The main functions of visualizations in foresight research are described below.

Enhancing creativity. By making complex topics more tangible (Baerten, 2007), visual communication supports creative thinking. Inspiring visualizations boost imagery, allow for changes in perspective and enable innovation (Heinonen and Hiltunen, 2012).

Establishing Understanding. Visualizations function as a common denominator. By constructing and conveying insights for shared conversations and mutual understanding, they provide an important social benefit (Eppler and Platts, 2009).

Managing complexity. Images help to effectively manage complexity and cognitive overload (Eppler and Platts, 2009). By compressing and synthesizing information, they are valuable on a cognitive level.

Generating Insights. Visualizations combine multiple perspectives and can depict concepts and patterns. Therewith, visualizations lead to new and innovative insights (Heinonen and Hiltunen, 2012; Müller and Shwarz, 2016).

Transferring Knowledge. Visualizations allow for the transfer of knowledge at many levels (Müller and Shwarz, 2016). Complex information can be communicated more easily and successfully with visual communication than with text (Park et al., 1983).

Encouraging engagement. Visualizations increase involvement of stakeholders on an emotional level. The use of inspiring images in communication can motivate and buy-in recipients (Bezold, 2010; Eppler and Platts, 2009; Müller and Shwarz, 2016).

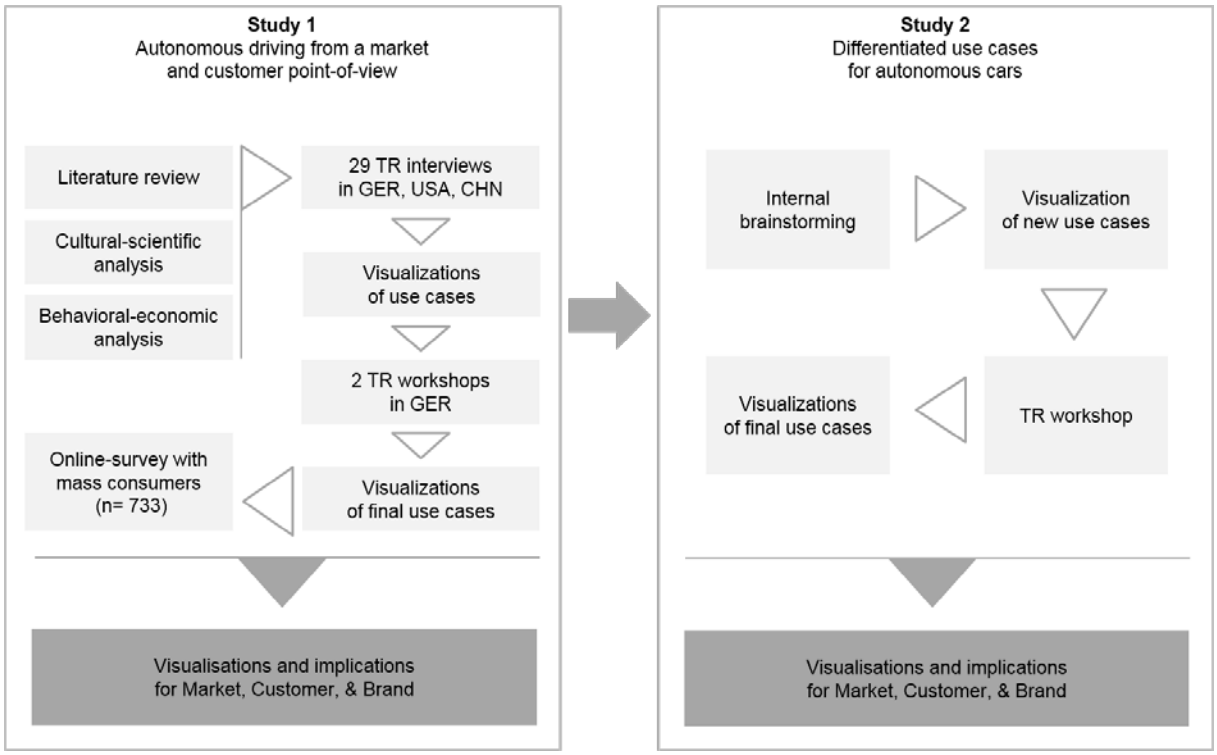
Within this consumer-centric foresight study, visual images were employed and developed in the context of the disruptive innovation of self-driving cars.

Visualizations helped to explore the automotive future, supported visual storytelling and the buy-in of the management board by condensing complex customer insights into single images. The following case study will provide details on the function and value of visualizations in this automotive industry project.

Case Study: Challenges of autonomous driving for the market and customer

The advent of self-driving vehicles and the radical nature of this development contribute to a rapidly evolving automotive industry, characterized by a high degree of complexity and uncertainty. In 2015 and 2016, two customer-centric foresight studies were implemented in cooperation with an established German car manufacturer. The aim of the studies was to systematically explore and sketch possible futures and business opportunities evolving in the face of autonomous driving. In order to account for multiple perspectives, the research team relied on a multi-methodological research design that combined qualitative and quantitative approaches (Figure 1).

Figure 1. *Depiction of research designs of study 1 and 2. TR = Trend Receivers.*



Ultimately, the generated insights resulted in visualized scenarios for semi-[3] and fully automated driving[4]. Visualizations were developed iteratively with the support of customers to provide consistent images of a possible automotive future.

Study 1:
Autonomous driving from a market and customer point-of-view

Research Design

An extensive literature review combined with a cultural-scientific and a behavioural-economic analysis provided the basis for a series of interviews with trend receivers in Germany, the USA, and China. Trend receivers (TR) are visionary customers who perceive changes and potentials in a specific domain in a highly sensitive and differentiated way (Hofmann, 2015). Qualitative insights from the interviews were sketched and transferred into visualized scenarios which were discussed and further developed in two consecutive workshops with German TR. Graphic designers professionally visualized three final scenarios for semi- and fully automated cars, respectively. Subsequently, a quantitative online survey with 733 customers from the same three countries validated the visualizations for semi-automated driving. Insights and visualizations resulted in a video on autonomous driving as well as a report for internal stakeholders.

Use and function of visualizations in Study 1

Enhancing creativity. TR interviews covered current mobility behavior, as well as visions of semi- and fully autonomous driving in 2020 and 2025, respectively. For the interviews, visual stimuli of the technology were chosen on basis of the literature review to facilitate understanding and imagination of this radical technology. Those images helped to inspire creative thought processes and enabled an open space for concretizing an aspirational future of mobility. Individual user journeys played a major role in creating this vision of future mobility and laid the groundwork for sketching specific scenarios.

[3] **Semi-automated cars:** Vehicles which can monitor the driving environment and are in control of the driving task only in specific traffic situations (SAE International, 2014).
[4] **Fully automated cars:** Cars which take over the entire driving task in all situations.

Managing complexity. Interviews were transcribed verbatim, then coded, and analyzed via qualitative content analysis (Krippendorff, 2004). The vast amount of qualitative data was condensed, translated and visualized in form of preliminary sketches for semi- and fully automated cars. In this research stage, visualizations supported the structure, synthesis and interpretation of the data, while avoiding information overload. Complex insights were integrated into comprehensible images of future cars. The research team identified relevant examples of product use (e.g. entertainment), advantages (e.g. productivity) and requirements for exterior and interior design.

Generating Insights. Systematic content analysis and the parallel development of visualizations led to the detection of patterns within the TRs' statements and greatly assisted the team in drawing inferences from the data. During the workshops, preliminary sketches (Figure 2) improved insight generation by allowing TRs to take new perspectives and by triggering an authentic experience of the future (Baerten, 2007; Müller and Shwarz, 2016). Workshop members iteratively adapted the drawings during discussions according to upcoming insights. Participants were able to take a deep-dive into the wide possibilities of the technology and to imagine completely new usage scenarios for automated cars.

Figure 2. *Left and right: Preliminary sketches of first thoughts on semi- and fully automated cars, respectively. Middle: Workshops, working with preliminary sketches. The sketches were further developed and used as discussion material during trend receiver workshops.*

Source: *AUDI Trend Research, illustrations developed in cooperation with Hyve AG.*

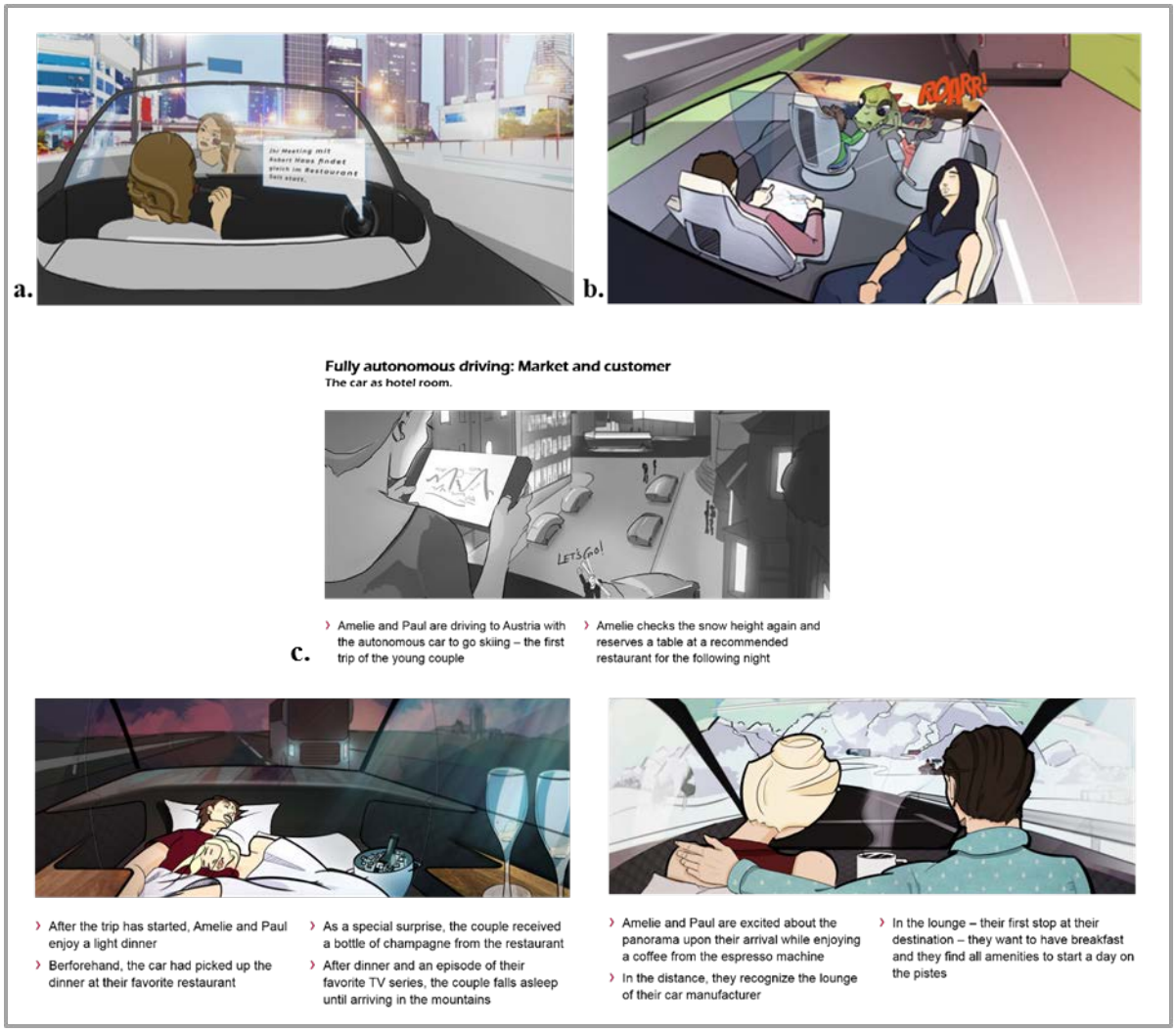
Establishing Understanding. The visualized scenarios aligned different perspectives within the research team and formed a consistent idea of the topic and findings. Visualizing the content assured mutual understanding with the TR sample during the workshops as well as inside the research team.

Validating Findings. The preliminary visualizations introduced to and developed during TR workshops also served the purpose of validating interpretations. They were systematically structured, discussed, discarded and fine-tuned by means of individual and group work as well as plenum discussions. This process ensured that the drawn inferences and visualizations captured the most salient customer expectations and needs. Moreover, the iterative process of constructing and deconstructing made the development of consistent images of the future easier. By means of an extensive quantitative online survey, the findings on semi-autonomous cars were further validated with mainstream consumers. Visualizations of the three most important use cases were shown to 733 consumers who then had to indicate their preference. Every use case was chosen by at least one fourth of the sample, indicating high approval of the visualized insights.

Transferring Knowledge. The drawn images ultimately helped to organize the data into final visualized scenarios which eased understanding of the content compared to great volumes of simultaneous insights. This also allowed for an effective communication of study results and thereby made their integration into the strategic planning of the firm more likely. As shown in Figure 3, the images reveal a plethora of innovative insights. For example, the scenarios suggest an adaptation of the car's interior to consumer needs, such that people can engage in new secondary activities in automated cars. The findings and images were summarized in a report and in a video on autonomous driving for the management board. Within the final study report, the developed visualizations underlined the innovation’s radical nature and mapped out emerging business opportunities.

Encouraging Engagement. The visualizations in the final report capture the richness and range of customer insights generated in the interviews and workshops. They stimulated decision makers to consider the suggested changes and challenged their prevailing mindset. Together with the report of the main findings, the carefully developed visualizations motivated the management board to support subsequent studies and to distribute the findings to a wider audience.

Figure 3. *Visualization of final scenarios for fully automated vehicles (a. Relaxing between meetings, b. More family time, c. Relaxed to a holiday destination including short narrative).*



Source: *AUDI Trend Research, illustrations developed in cooperation with Hyve AG.*

Study 2:
Differentiated use cases for autonomous cars

Research Design

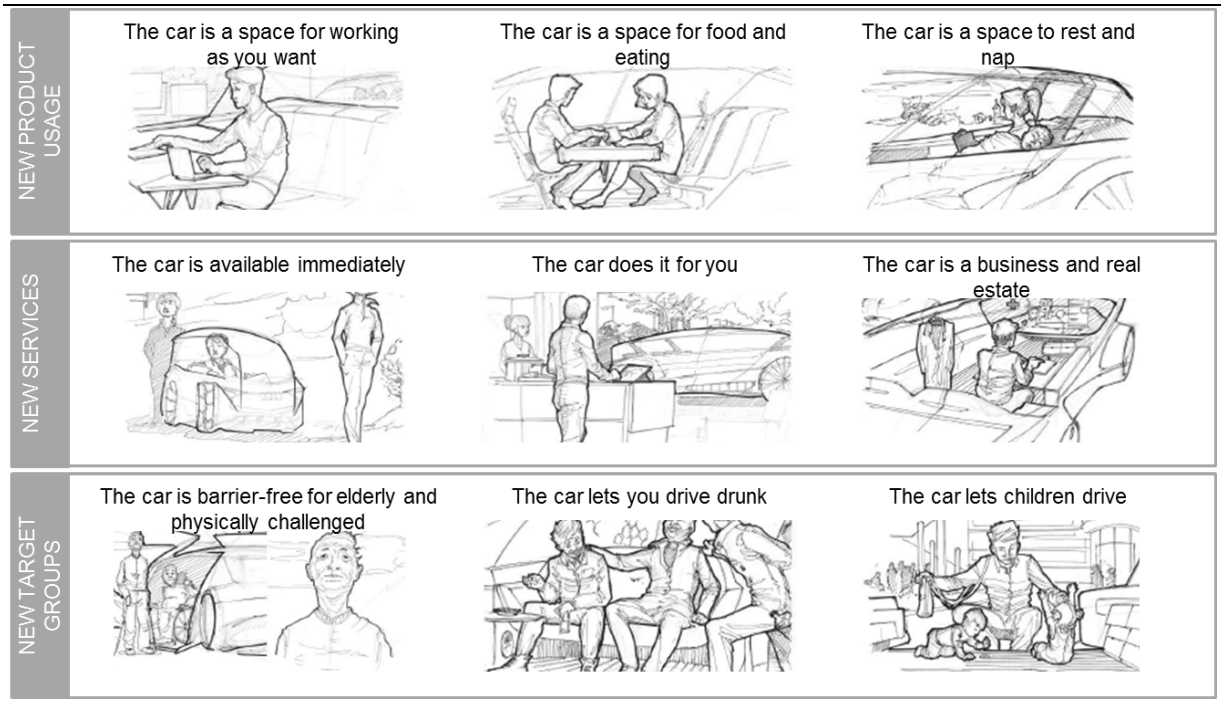
After an iterative analysis of the findings of study 1, the research team visualized more differentiated use cases for fully automated cars. These use cases were evaluated, rated and adjusted in a workshop with 6 TRs in Germany by means of group discussions and individual working tasks. On the basis of the workshop insights, the research team visualized final use cases. Study 2 allowed for further in-depth exploration of the

automotive future by identifying necessary changes to the exterior and interior design, customer-oriented services and business opportunities in the face of full automation.

Functions of visualizations in Study 2

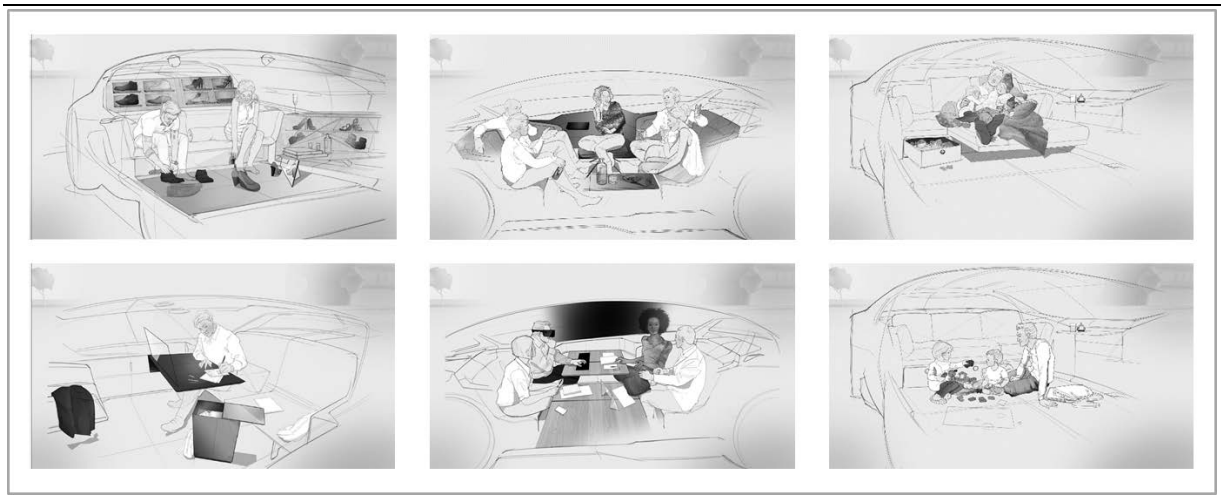
Again, visualizations helped to transfer the previously generated insights to the TR sample, to trigger creative thought processes within the group and thereby to successfully collect further customer insights during the workshops. They also ensured that the TR discussed the use cases on basis of a mutual understanding. Lastly, the images were valuable in convincing internal stakeholders of changing mobility concepts. For example, the board of management communicated the study insights to an external audience at symposiums and press conferences. Extracts of preliminary and final visualized usage scenarios are depicted in Figure 4 and 5, respectively. The images underline that the role and design of future cars are about to change dramatically. Figure 6 depicts how visualizations support the different phases of the foresight research process.

Figure 4. *Preliminary visualizations of new product usage for fully automated cars as input for the TR workshops in study 2.*



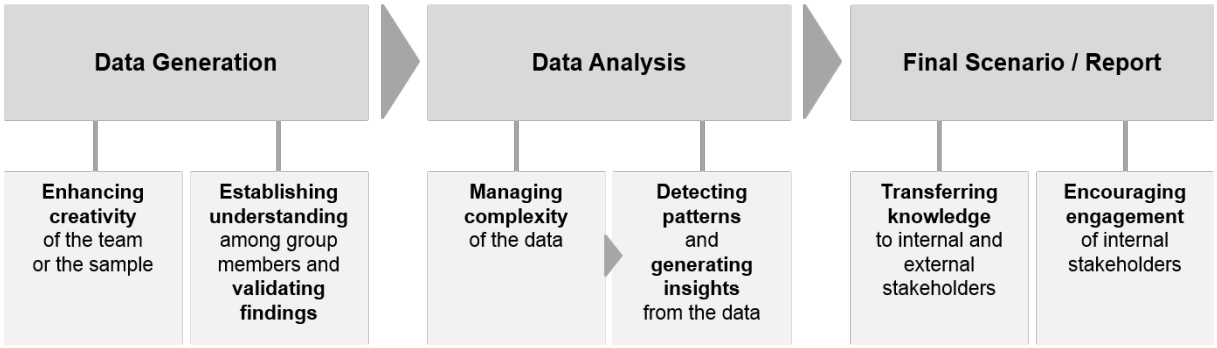
Source: *AUDI Trend Research, illustrations developed in cooperation with gravity GmbH.*

Figure 5. *Examples of final visualizations of new use cases for fully automated cars (study 2), e.g. top left: the car as retail space; lower left: the car as an office; lower right: the car as extended living room for family time.*



Source: *AUDI Trend Research, illustrations developed in cooperation with gravity GmbH.*

Figure 6. *Functions of visualizations throughout the foresight research process.*



Discussion

This article emphasizes the benefit of visualizations in consumer-centric foresight on disruptive innovations by describing how they were used in two case studies on autonomous driving. The presented case studies were embedded in a multi-methodological research project and conducted in cooperation with an established German car manufacturer. Visualizations served as a helpful tool throughout the entire foresight research process and supported the generation of profound, consumer-driven insights on the radical innovation of self-driving cars. The paper describes how visualizations can be employed and developed at different project stages to stimulate

creative thought processes of consumers, manage complexity, generate customer insights, enable mutual understanding of the topic, transfer knowledge, as well as to encourage engagement of the management board. Moreover, the author outlines how visualizations help to validate inferences that were drawn from the data.

The conducted case studies underline that an iterative development of visualizations makes them more powerful and ensures that the images are consistent with and representative of customer needs and expectations. In addition, a continuous dialogue with consumers and an interdisciplinary team guarantee that multiple facets and perspectives are taken into account in the design of visualizations. Also within this research project, visualizations of scenarios for semi- and fully automated cars were developed with the help of an iterative process and a continuous dialogue with future-oriented customers (i.e. trend receivers). Ultimately, visionary, customer-centric images were sketched with wide-ranging impact on strategic planning and engagement of internal stakeholders.

However, visualizations never represent every single insight. In this study, for example, the visualized scenarios depict an aspirational rather than a threatening future. While addressing advantages of the technology, potential downsides such as customer worries or overall industry threats, are not captured by the images. Research teams can account for this limitation by combining images with written narratives and a complete report on the results.

The two case studies confirm recent insights from Müller and Shwarz (2016) as well as from Heinonen and Hiltunen (2012) on the importance of visual communication in foresight research and extend the findings to the realm of highly disruptive innovations. The studies serve as an example of how the use and development of visualizations support managers in anticipating the future. This approach does not only stimulate the creativity of team members and samples, which is necessary for envisioning alternative and radical possibilities of disruptive innovations. Visualizations are also valuable in managing and communicating a complex plethora of socio-economic, social and competitive factors and in gaining support from relevant stakeholders.

Implications for Foresight in Practice

1. Develop images *iteratively* during customer workshops to stimulate creativity.

2. Employ visualizations as discussion material to ensure mutual understanding and to validate customer insights.
3. Sketch visualizations during insight generation to structure complex data and to detect patterns and trends.
4. Break complex narratives into single, comprehensible images and integrate them into the report of findings to improve communication.
5. Develop emotional and inspiring visualizations of possible futures to engage stakeholders.

Lessons Learned

In the context of foresight research on highly disruptive innovations, visualizations play a supportive role throughout the entire research process. They help to stimulate creative thoughts, manage complexity, generate customer insights, enable mutual understanding, transfer knowledge, encourage engagement of stakeholders and validate findings. Especially the iterative development of visualizations together with visionary customers is valuable in sketching alternate futures in a given field.

Management Summary

Visualizations are a valuable support in foresight research on disruptive innovations. This article introduces a consumer-oriented case study on the future of self-driving cars. It describes how an iterative development of visualizations supports the generation of profound and valid customer insights, interpretation of data and communication of findings to stakeholders.

Acknowledgement

This research was conducted in cooperation with Boris Meiners, Mark Ebert and Andreas Meinheit from AUDI AG as well as Dr. Rupert Hofmann from Audi Business Innovation GmbH. The author would like to thank these two companies for allowance to publish the study insights as well as Hyve AG, gravity GmbH, Prof. Dr. Wolfgang Ullrich and Annekathrin Kohout for outstanding visualizations.

References

Baerten, N. 2007. *Experiencing futures*. Paper presented at the *From Oracles to Dialogue; Exploring New Ways to Explore the Future, COST A22 Conference*, Athens, Greece.

Bezold, C. 2010. Lessons from using scenarios for strategic foresight. *Technological Forecasting and Social Change* 77 (9): 1513–18.

Brown, S. L., and K. M. Eisenhardt. 1997. The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly* 42 (1): 1–34.

Brown, T. 2009. *Change by design: How design thinking transforms organizations and inspires innovation*, New York: HarperCollins Publishers.

Christensen, C. M. 1997. The innovator's dilemma: When new technologies cause great firms to fail, Boston: Harvard Business Review Press.

Clark, J. M., and A. Paivio. 1991. Dual coding theory and education. *Educational Psychology Review* 3 (3): 149–210.

Coates, J. F. 2010. The future of foresight—A US perspective. *Technological Forecasting and Social Change* 77 (9). 1428–37.

Day, G. S., and P. J. H. Schoemaker. 2004. Driving through the fog: Managing at the edge. *Long Range Planning* 37 (2): 127–42.

Eisenhardt, K. M., and J. A. Martin. 2000. Dynamic capabilities: What are they? *Strategic Management Journal* 21 (10-11): 1105–21.

Eppler, M. J., and R. A. Burkhard. 2007. Visual representations in knowledge management: Framework and cases. *Journal of Knowledge Management* 11 (4): 112–22.

Eppler, M. J., and K. W. Platts. 2009. Visual strategizing: The systematic use of visualization in the strategic-planning process. *Long Range Planning* 42 (1): 42–74.

Garcia, R., and T. Atkin. 2002. Coo-petition for the diffusion of resistant innovations: A case study in the global wine industry. *Institute for Global Innovation Management Working Paper*, 05-002: 1–22.

Garcia, R., and R. Calantone. 2002. A critical look at technological innovation typology and innovativeness terminology: A literature review. *Journal of Product Innovation Management* 19 (2): 110–32.

Gersick, C. J. G. 1991. Revolutionary change theories—A multilevel exploration of the punctuated equilibrium paradigm. *Academy of Management Review* 16 (1): 10–36.

Heinonen, S., and E. Hiltunen. 2012. Creative foresight space and the futures window: Using visual weak signals to enhance anticipation and innovation. *Futures* 44 (3): 248–56.

Hofmann, R. 2015. Visionary competence for long-term development of brands, products, and services: The trend receiver concept and its first applications at Audi. *Technological Forecasting and Social Change* 101: 83–98.

Kleijnen, M., N. Lee, and M. Wetzels. 2009. An exploration of consumer resistance to innovation and its antecedents. *Journal of Economic Psychology* 30 (3): 344–57.

Krippendorf, K. 2004. *Content analysis: An introduction to its methodology*. Thousand Oaks, London, New Delhi: Sage Publications.

Levinthal, D. A. 1992. Surviving Schumpeterian environments: An evolutionary perspective. *Industrial and Corporate Change* 1 (3): 427–43.

Miles, I., M. Keenan, and J. Kaivo-Oja. 2003. Handbook of Knowledge Society Foresight. Dublin: European Foundation for the Improvement of Living and Working Conditions.

Molesworth, M., and J. P. Suortti. 2002. Buying cars online: The adoption of the web for high-involvement, high cost purchases. *Journal of Consumer Behaviour* 2 (2): 155–68.

Müller, A. W., and J. O. Shwarz. 2016. Assessing the functions and dimensions of visualizations in foresight. *Foresight* 18 (1): 76–90.

Ottino, J. M. 2003. Is a picture worth 1,000 words? *Nature* 421: 474–6.

Paap, J., and R. Katz. 2004. Anticipating disruptive innovation. *Research-Technology Management* 47 (5): 13–22.

Paivio, A. 1986. *Mental representations: A dual coding approach.* Oxford: Oxford University Press.

Park, D. C., J. T. Puglisi, and M. Sovacool. 1983. Memory for pictures, words, and spatial location in older adults: Evidence for pictorial superiority. *Journal of Gerontology* 38 (5): 582–8.

Ringland, G. 2010. The role of scenarios in strategic foresight. *Technological Forecasting and Social Change* 77 (9): 1493–8.

Rohrbeck, R., and H. G. Gemünden. 2011. Corporate foresight: Its three roles in enhancing the innovation capacity of a firm. *Technological Forecasting and Social Change* 78 (2): 231–43.

Roveda, C., and R. Vecchiato. 2006. Foresight in corporate organizations. In *Second International Seminar on Future Oriented Technology Analysis*, *Impact of FTA Approaches on Policy and Decision-Making*, Seville: 1–20.

Schoemaker, P. J. 1995. Scenario planning: A tool for strategic thinking. *Sloan Management Review* 36 (2): 25–40.

Stubbart, C. I., and M. B. Knight. 2006. The case of the disappearing firms: Empirical evidence and implications. *Journal of Organizational Behavior* 27 (1): 79–100.

Teece, D.J., G. Pisano, and A. Shuen. 1997. Dynamic capabilities and strategic management. *Journal of Strategic Management* 18 (7), 509–33.

Tushman, M. L., and P. Anderson. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly* 31 (3): 439–65.

Tushman, M. L., and C. O'Reilly. 1997. *Winning through innovation: A practical guide to leading organizational change and renewal*. Boston: Harvard Business School Press.

Van de Ven, A. H., D. E. Polley, R. Garud, and S. Venkataraman. 1999. *The innovation journey*. New York: Oxford University Press.

Curriculum Vitae

Name: Nicola Schweitzer

Date and place of birth: 15th of April 1985 in Düren, Germany

EDUCATION

2015-2018	University of St. Gallen, Switzerland
	Doctoral candidate of business administration
2018	Columbia Business School
2009-2011	Technical University Munich, Germany
	Master of Science in Consumer Affairs
2008-2010	Ludwig-Maximilians University, Germany
	Master of Science in Neuro-Cognitive Psychology
2005-2008	Maastricht University, Netherlands
	Bachelor of Science in Psychology
2008	Université de Montréal à Montréal, Canada
1995-2004	Gymnamisum am Wirteltor, Germany
	Abitur

PROFESSIONAL EXPERIENCE

	University of St. Gallen, Institute for Customer Insight, Switzerland
2015-2018	Research Associate and Project Leader
	Gruppe Nymphenburg Consult AG, Germany
2013-2014	Consultant
2011-2013	Junior Consultant
	Technical University Munich, Chair of Entrepreneurship, Germany
2010-2011	Research Assistant