HHL LEIPZIG GRADUATE SCHOOL OF MANAGEMENT

Dissertation

Essays on the Effect of Retail Innovation on Consumer Behavior

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As a result of the convergence of online and offline retailers, and due to the notoriously low margins in the retail environment, innovation and technology have become more and more competitive differentiators. The purpose of this cumulative dissertation is to explore consumers' behavioral reactions towards those technological innovations in brick and mortar retailing. As it is not feasible to consider every available technology in its own right, the focus of this dissertation is limited to the following three recent technologies: mobile payment, electronic shelf labels, and electric vehicle charging stations. By conducting experiments (Paper 1 and Paper 3) and leveraging real transaction data from a retailer (Paper 2), the author was able to formulate and investigate various research hypotheses, including a positive influence of new technology on the willingness to pay (Paper 1), mere revenue effect (Paper 2), and shopping intentions (Paper 3).

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Publication-based dissertation submitted in partial fulfillment of the requirements for the degree

Doctor of Economics
(Dr. rer. oec.)

at

HHL Leipzig Graduate School of Management

submitted by

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Leipzig, 11.10.2019

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“You can’t connect the dots looking forward;
you can only connect them looking backwards.
So you have to trust that the dots will somehow connect in your future.”

Steve Jobs (2005)

To Elisa, my wife, Cato and Leto, my children,

Gritt and André, my parents, and

Christa, Inge, Wilfried, and Erwin, my grandparents.

Acknowledgments

It would not be easy. This was clear from the beginning when I embarked on the journey of pursuing a PhD in economics. Not only because of the intellectual challenges that would lie ahead but also because of the tremendous amount of discipline that would be required to conclude such a great endeavor. Notwithstanding, I am extremely delighted to have finished my thesis and it is my great pleasure and privilege to highlight three main sources of support without which I could have not been successful.

First, I am tremendously thankful to HHL and in particular to my advisor Jun.-Prof. Dr. Erik Maier who gave me the unique opportunity to conduct research in an interesting field of economics and showed sympathy to my special requirements starting off as a student only holding a Bachelor of Science degree. Our collaboration was characterized by a mix of independent work with a lot of freedom and close-knit and inspiring problem-solving sessions. In addition, I would like to thank my co-authors Prof. Dr. Robert Wilken and Prof. Dr. Florian Dost, as well as my fellow Master/PhD students Jonas Gerhard, Sven Joosten, Cornelius Maas, and Lennard Schmidt.

Second, I would like to express my gratitude to my family and friends who supported me in all the good and bad times of the dissertation. They never doubted that I would succeed. Their believe helped me tackle many challenges.

Third, I want to thank my employer McKinsey & Company Inc. for giving me the opportunity to broaden my horizons and to grow as a person and intellectually without too much worry about financial constraints.

Table of content

List of abbreviations

ANOVA	Analysis of variance
eCommerce	Electronic commerce
e.g.	for example
ESL	Electronic shelf labels
EV	Electric vehicle
Fig.	Figure
IoT	Internet of things
n.d.	no date
NFC	Near Field communication
p.	page
POS	Point-of-sale
QR code	Quick Response code
SOR	Stimulus-Organism-Response
TAM	Technology Acceptance Model
US	United States of America
WTP	Willingness-to-pay

1 Introduction

The present cumulative dissertation explores examples of consumers' behavioral reactions towards technological innovations in brick and mortar retailing.

By leveraging experimental settings (Paper 1 and Paper 3) and real transaction data from a retailer (Paper 2), I was able to formulate and investigate various research hypotheses, such as a positive influence of new technology on willingness to pay (Paper 1), mere revenue effect (Paper 2), and shopping intention (Paper 3).

This dissertation is divided into four chapters (see Figure 1). The first chapter provides a general overview of retail innovation and relevant consumer behavior research. In addition, it provides concise summaries of my three research papers, overall contributions, managerial implications, research limitations, and an outlook. The research papers are presented as Appendix I, II, and III respectively.

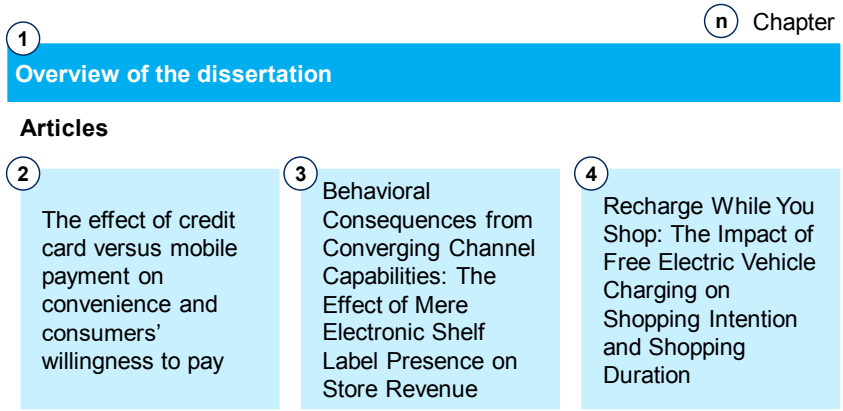

Figure 1: Dissertation structure (own illustration)

2 Theoretical foundations

Relevance: Machines do not shop for us, yet

Even though algorithms define more and more aspects of our daily life, technologies are still in its infancy when it comes to making purchase decisions for consumers (Grewal, Roggeveen, & Nordfält, 2017), despite the fact that consumers use new channels when communicating their shopping intentions (e.g., conversational commerce via chatbots or voice). It is for example still a vision of the future, that Apple's Siri automatically (re-)orders grocery based on historic consumption patterns or calendar entries. As of writing in 2019, our fridge is simply not smart (i.e., connected) enough to order groceries and prepare food for us. In most cases, shopping is still a human activity – may it be offline in physical stores or online in web shops. Therefore, the study of *consumer behavior* to fulfil their purchase decisions is still highly relevant.

From behavioral economics to consumer behavior research

Dismantling the term *consumer behavior* requires two definitions. First, behavior can be defined as a function that connects some organisms and their environments using personal characteristics and contexts (Stern, 2000). Second, a consumer is an economic subjects that uses (purchased) products or services (Parasuraman & Grewal, 2000).

In general, the economic research field dealing with the question how economic subjects behave is called *behavioral economics*: it builds on the findings that people make rational as well as irrational decisions. The scientific discipline of behavioral economics rose to fame with two recent Nobel Prizes for Danial Kahneman in 2002 and Richard H. Thaler in 2017. Kahneman and Tversky (1992) are famous for discovering and proving that people's behavior is often contrary to the known economic theories (e.g., their prospect theory describes opposing consumer reactions for potential gains and losses). Plus, they offer the concept, that humans have a fast thinking (partially irrational) and a slow thinking (making conscious decisions) brain (Kahneman, 2012). Additionally, Sunstein and Thaler (2009) established the concept of nudging, which

means changing consumer behavior stepwise instead of one big behavioral shift without formal restraining.

Following the research stream of behavioral economics, we as humans often make irrational decisions when it comes to shopping as consumers (e.g., good mood triggers shopping intention for hedonic products: López López & Ruiz de Maya, 2012). Hence, the need to study consumer behavior, because consumers show behavior by making economic decisions in all the different shopping situations and channels: where, what, when, and how many to buy and how much to pay. The field of consumer behavior research links economic theories from behavioral economics with consumer psychology and with the marketing sciences to understand how people purchase and use goods and services (Foxall, 2017). The current dissertation combines all three fields and as such should be considered a work on consumer behavior.

The purpose of this thesis is to aid a better understanding of how innovation (i.e., specific technologies) in the brick and mortar business as an environmental stimulus influences consumers' purchase decision process. To investigate such innovative and novel technologies in the field of consumer behavior, the classical stimulus-organism-response (SOR) model (Woodworth, 1918) was adopted in conjunction with different technologies encompassing stimulus, changes to a consumers' psychology as organism, and consumers' behavior as the response.

Purchase decision process

In simplified terms, today's purchase decision process follows five steps: problem recognition (also awareness), information search, evaluation of product options, purchase decision, and post-purchase support (Gupta, Su, & Walter, 2004; Kotler, 2000). In the first phase, consumers realize a need for a product or service. This could be triggered externally (e.g., through online or offline advertisement) or internally (e.g., by subconscious wishes).

In the next phase of the purchase decision process consumers seek information about the product or service (e.g., price, availability, options) they are interested in. This holds true for offline, where customers stroll through the aisles, as well as online, where customers use search engines, purchase intentions.

During the product evaluation phase shoppers compare their alternatives using multiple characteristics like quality and brand. This stage is especially influenced through internal (e.g., mood: Gorn, Goldberg, & Basu, 1993) and external (e.g., product information: Hong & Wyer Jr., 1989) situational influences.

To fulfil the actual purchase decisions in the fourth step, consumers rely on either an online or an offline retailer, even though prior and later steps could have included multiple channels (e.g., online, offline, social, conversional) with effects on consumer behavior (e.g., searching online and buying offline: Pauwels, Leeflang, Teerling, & Huizingh, 2011).

After the fourth step, post-purchase support affects consumer behavior through building customer loyalty, ensuring the physical delivery (e.g., to a home when a sofa is bought online or in store), and handling returns (Van Vaerenbergh, Orsingher, Vermeir, & Larivière, 2014).

Evolution of retailing

At first retailing started very early in mankind's history with professional merchants around 500 years ago (Ravid, 1976). Later, physical outlets in different formats were established for a more convenient and centralized shopping experience attracting a rich variety of customers (McArthur, Weaven, & Dant, 2015). With the emergence of the internet, electronic commerce (eCommerce) began its successful rise. Ecommerce is without doubt considered the most disruptive innovation for retail in the last decades (Grewal, Iyer, & Levy, 2004) with profound consequences for consumer behavior (e.g., changing preferences: Keen, Wetzels, de Ruyter, & Feinberg, 2004). Currently, depending on the category, either a fraction (e.g., only 1.2% of grocery in Germany:

ECommerceNews, 2018) or a large part (e.g., 42% of physical books in the United States are sold by amazon online: Day & Gu, 2019) of a shopping category volume is spent online. At first brick and mortar retailers responded to the competitive thread of online shopping outlets through opening their own eCommerce stores (Verhoef, Neslin, & Vroomen, 2007). Following, offline retailers started to innovate and integrate different channels (i.e., online and offline store) with the help of technology (Verhoef, Kannan, & Inman, 2015). As online retailing expanded to categories with in need of explanation, the former pure online players started opening physical stores (Avery, Steenburgh, Deighton, & Caravella, 2012; e.g., through showrooming: Gensler, Neslin, & Verhoef, 2017). As a result of the convergence of former online and offline retailers, and due to the notoriously low margins in the retail environment (Kahn & McAlister, 1997), innovation and technology are a key driver.

Innovation as technological trigger for consumer behavior changes

Broadly speaking, innovation is defined as "the doing of new things or the doing of things that are already done, in a new way" (Schumpeter, 1947, p. 151). To remain competitive, especially with the emergence of the eCommerce space (Grewal et al., 2017), retailers need to innovate (Acs & Audretsch, 1988) to stay in business, to tap into new markets, or to increase their profitability (Christensen, 1997). For the purpose of this thesis it is important to distinguish innovation from invention. Even though both are related to being something "new", an innovation is best described by being a practical application of an invention (Trott, 2017). In this cumulative dissertation, the introduction or availability of an innovation in a retail setting is used as a trigger to alter consumer behavior similar to the effect novel product features have on consumer behavior (e.g., on product evalution: Mukherjee & Hoyer, 2001).

A fast body of literature investigated the influence of retail technologies on consumer behavior in the past along *seven main themes* (Piotrowicz & Cuthbertson, 2014). First, the *integration of a new channel* is a technological change, e.g., adding a standard eCommerce (Avery et al., 2012; Gensler, Verhoef, & Böhm, 2012) or a mobile

shopping channel to an established retailer (Herhausen, Binder, Schoegel, & Herrmann, 2015; Huang, Lu, & Ba, 2016).

Second, researchers were interested in the influence of *mobile solutions*. Extant research found payment instruments (See-To & Ngai, 2018) like credit cards (Feinberg, 1986; Hirschman, 1982; Shah, Eisenkraft, Bettman, & Chartrand, 2015), debit cards (Moore & Taylor, 2011; Runnemark, Hedman, & Xiao, 2015), and mobile payment (Falk, Kunz, Schepers, & Mrozek, 2016; Trütsch, 2016) to change consumer behavior.

Third, the *role of social media* extends the direct one-to-one relationship between shopper and retailer to include a wider social network. On the one hand, customers gain access to reviews and ratings from trusted personal sources that influence purchase decisions (Grewal, Motyka, & Levy, 2018; Jumin, Park, & Han, 2011). On the other hand, consumers become cost-efficient brand ambassadors via worth-of-mouth communication if they have a pleasurable shopping experience (Blut, Teller, & Floh, 2018). This positive influences result in a significant improvement of multiple retail performance measures (Rapp, Beitelspacher, Grewal, & Hughes, 2013).

The fourth emerging theme of technology in retail is the *changing role of the store*. With increasing channel integration and shifts to direct online purchases, stores either become mere showrooms (Gensler et al., 2017) or retail hubs where consumers use services like click-and-collect and return online orders next to the ordinary shopping (Herhausen et al., 2015). Additionally, technology enhances the interior of stores with digital shelf labels (Soutjis, Cochoy, & Hagberg, 2017) or interactive displays (Burke, 2002).

The fifth topic takes account of the fact that different consumers have *diverse expectations* for the store. Whereby digital natives will not accept missing store Wi-Fi, less technology savvy customers would not mind. As those technology require high up-front costs, researchers need to investigate the potentially beneficial effects like increased sales.

Connected to the differentiating demands is the sixth theme: *privacy versus personalization*. Using every available technology possible might have an intimidating effect on consumers. Retailers can design individual offers exploiting a maximum willingness-to-pay based on multiple available information like previous purchases, search patterns, and contextual information (Garbarino & Lee, 2003).

The last theme of *supply chain redesign* connects to the changing role of the store. To enable various delivery options to and from the store more technology (investment) is needed. Retailers manage the different retail channels separately but require a smooth flow of information (e.g., stocks in retail outlets or warehouses) to fulfil demand via shopping assistance or self-service technology.

3 Purpose and focus of the dissertation

The previous sub-chapter explained the connected research fields and the relevance of technology effects on consumer behavior in retailing because of its ubiquitous appearance and theoretical implications. The main purpose of this dissertation is to investigate antecedents and behavioral consequences of retail innovation (technological advancements). Nevertheless, it is not possible to consider every available technology as a research subject. Hence, the focus of this dissertation is limited to the three technologies *mobile payment, electronic shelf labels,* and *electric vehicle charging.* Those collectively cover all stages of innovation diffusion. Based on the theory of innovation diffusion subsequent groups of individuals (i.e., innovators, early adopters, early majority, late majority, laggards) adopt new technologies successively and thereby drive market share penetration (Rogers, 2003). The dissertation applies the concept of innovation diffusion to retailers, whereby *innovators* are always the first retailers to integrate any innovation in their online or offline stores (e.g., pay with crypto currency like bitcoin). Similarly, for *laggards* established technology finds widespread integration among nearly every retailer (e.g., pay with debit cards). In parallel, shoppers usually expect this technology when visiting a store. The three different retail

innovations (technologies) were selected based on their respected market penetration among retailers to elucidate their impact on consumer behavior. Figure 2 depicts an overview of the innovation diffusion process and provides the linkage between technology diffusion stage, the investigated technology, and the respective research paper. The first paper relies on *mobile payment* as a technology that has a medium to high adoption rate depending on the specific market (statista, 2018). The second paper looks into *electronic shelf labels (ESL)* that are already quite common and found in most of the large retail chains (TechnavioResearch, 2017). The third and last paper investigates the (service) innovation of providing free *electronic vehicle (EV) recharging* at retail outlets. With only one percent of newly registered cars in Germany in 2018, electronic vehicles fall into the innovators or early adopters phase (Kraftfahrt-Bundesamt, 2019). In contrast to most of the available research on retail technology, this dissertation does not cover operational or purely technical aspects (Fisher & Raman, 2001; Stamatopoulos, Bassamboo, & Moreno, 2017; Tsai, Lee, & Wu, 2010).

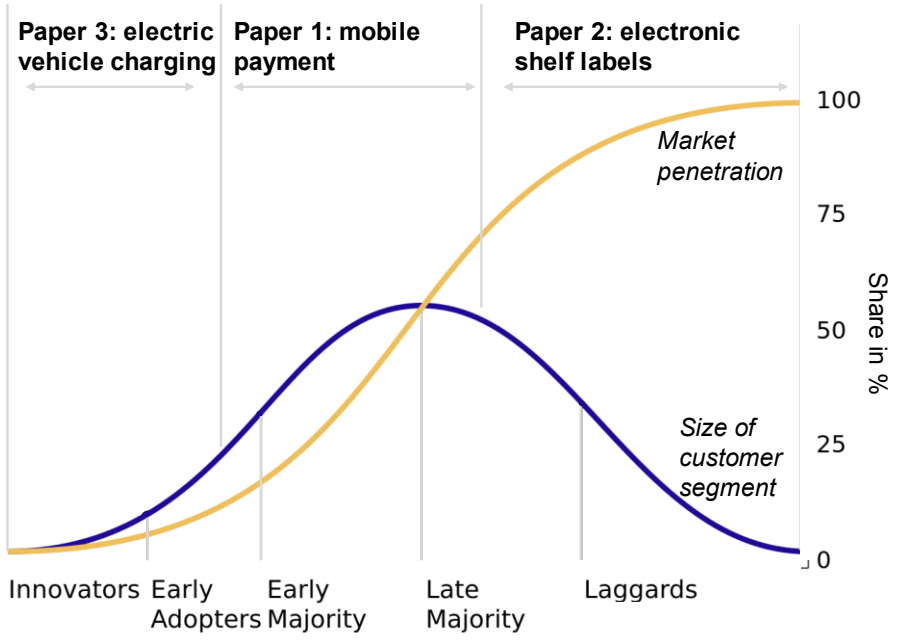

Figure 2: Paper covering different technologies along the innovation diffusion cycle (own illustration adapted from Rogers, 2003)

4 Article summary

4.1 Overview of dissertation articles

The dissertation consists of three research articles. Table 1 provides the title, authorship, contribution, and respective publication status of the three articles.

#	Title	Authorship	Contribution	Publication status
1	The effect of credit card versus mobile payment on convenience and consumers' willingness to pay	Joe Boden Erik Maier Robert Wilken	Main authorship with responsibility for data collection and analysis, and literature review Research design and writing of paper were a joint effort	Published in: Journal of Retailing and Consumer Services
2	Behavioral Consequences from Converging Channel Capabilities: The Effect of Mere Electronic Shelf Label Presence on Store Revenue	Joe Boden Erik Maier Florian Dost	Main authorship with responsibility for data collection and analysis, and literature review Research design and writing of paper were collaborative	Submitted to: Journal of Interactive Marketing
3	Recharge While You Shop: The Impact of Free Electric Vehicle Charging on Shopping Intention and Shopping Duration	Joe Boden	Single author Author's independent research	Submitted to: International Journal of Retail & Distribution Management

Table 1: Overview of dissertation articles

4.2 Summary first article: The effect of credit card versus mobile payment on convenience and consumers' willingness to pay

Introduction and research gap

Mobile payment is, depending on the respective market, an established or a new technology to pay at brick and mortar retailers. Prior research on payment instruments focused on comparing the incumbents payment methods: cash and credit/debit cards (Feinberg, 1986; Prelec & Simester, 2001; Runnemark et al., 2015). Data suggest that

there exists a higher level of willingness to pay (WTP) for customers that use cards. This card premium (Feinberg, 1986) was explained through less pain of paying ("...direct and immediate displeasure or pain from the act of making a payment..." Zellermayer 1996, p. 2) and less transparency of payment instrument compared to cash (Soman, 2003). Even though first research into the effect of mobile payment is published, no significant premium for mobile payment over credit cards was found (Falk et al., 2016). The first paper proposes that this is most likely due to a missing mediator because the pain of paying should be similarly low for both mobile and credit card payments. Recent literature found convenience to be a significant driver of mobile payment usage (Dahlberg, Guo, & Ondrus, 2015; Mallat, 2007). In addition, convenience is known to increase consumers' WTP (Carow & Staten, 1999; Carrigan & Attalla, 2001). Thus, if perceived, convenience is proposed to be an additional factor in contributing to the WTP effect. The first paper of the thesis proposes that the influence of mobile payment only is effective when the technology is ubiquitously adopted and thereby perceived as convenient.

Methodology

The moderated mediation hypothesis (higher mobile payment WTP only for customers who adopted it) is quantitively tested in a set of three studies across Germany, India, and the United States where a meaningful variation of personal adoption is expected.

Main findings

The research paper demonstrates that mobile payment is superior to credit card payments because of higher mobile payment convenience despite similar pain of paying. In addition, the paper introduces means of payment adoption as a moderator of the relationship between the payment instrument and shoppers' WTP. The models were empirically controlled for demographic influences and country level effects.

Contributions and implications

The first paper of the cumulative dissertation adds mobile payment to the literature on payment methods following multiple calls for research (Dahlberg et al., 2015; Shankar et al., 2016). It contributes by extending the existing pain of paying mediator with the new convenience of paying mediator as a mechanism to explain shopping behavior for mobile versus incumbent forms of payment, especially credit cards. For managers, the research further investigates the effect of payment instruments in new markets. The research could even be generalized and applied to new payment forms. Specifically, country managers should consider average payment technology adoption when considering which payment method to offer. Public policy makers could leverage those findings to make paying for public services more convenient and to realize a WTP premium.

4.3 Summary second article: Behavioral Consequences from Converging Channel Capabilities: The Effect of Mere Electronic Shelf Label Presence on Store Revenue

Introduction and research gap

Omni-channel strategies as a strategic imperative (Verhoef et al., 2015) lead retailers to increasingly integrate their sales channels (Herhausen et al., 2015) through innovative technologies. One prominent technical addition to the retail store are electronic shelve labels (ESL). These liquid crystal or electronic paper technology devices display up-to-date product information (e.g., product specification, price) to consumers (Soutjis et al., 2017).

Their integration leads to operational cost reductions (Stamatopoulos et al., 2017), revenue increase through price discrimination (Gedenk, Neslin, & Ailawadi, 2010; Zhou, Tu, & Piramuthu, 2009), and increased alignment of their channel-specific marketing mix (Varadarajan et al., 2010). In addition, the information gap between channels is bridged (Bell, Gallino, & Moreno, 2013).

The second paper of the cumulative dissertation poses the question whether an additional revenue – called the mere ESL effect – exists under constant pricing schemes

due to consumer behavior changes. The direction of the mere ESL effect is non-trivial. On the one hand, ESL conveys the impression of price unfairness simply because of the possibility to easily apply price discrimination thereby hampering shopping intentions (Burke, 2002; Campbell, 1999; Garbarino & Lee, 2003). On the other hand, ESL might improve store revenue because of two main reasons. First, consumer might value the signaling of price alignment between channels (Zhang et al., 2010) and second, consumers are likely to appreciate the improved service of having easily accessible and sumptuous product information at their disposal (Dickson & Sawyer, 1990; Grewal et al., 2011).

Methodology

Fortunately, we were able to secure a real sales and visitor data set from a large European home furnishing retailer who introduced ESL. The experimental setup of a treated and a control store allowed for a difference-in-difference analysis. Both stores are similar in key metrics (e.g., product range, catchment area) and in the treated store ESL was introduced for half of the categories. Thus, within and between stores perspectives were used for subsequent analyses.

Main findings

The difference-in-difference analysis of a category panel revealed that introducing ESL leads to positive revenue effects. However, this effect was mainly driven by the categories that received ESL at the cost of the non-treaded categories. Additionally, we find no change in store patronage. These results are empirically robust as the respective model has been rigorously tested with non-linear effect, different effect point specifications, and endogeneity controls.

Contributions

The paper is the first investigation into the revenue effect of the vastly adopted ESL technology. It also contributes to the question of how consumers might react to innovative pricing approaches (Blut et al., 2018; Grewal et al., 2017). Additionally, it

provides support for research that promotes a positive effect of channel integration (Cao & Li, 2015; e.g., Herhausen et al., 2015). As such, the paper has managerial implications for retail and store managers by baselining the revenue effect of ESL (+5-6% revenue increase in treated categories) for future investigations and advancements in channel integration. Furthermore, retailers do not need to be afraid of an adverse revenue effect due to retailers fear of fluctuating prices or perceived price unfairness. Thus, retailers can use ESL to stimulate shopping behavior by providing more product information and further bridging the channel specific weaknesses compared to online shopping.

4.4 Summary third article: Recharge While You Shop: The Impact of Free Electric Vehicle Charging on Shopping Intention and Shopping Duration

Introduction and research gap

With the emergence and slowly progressing adoption of electronic vehicles (EV) retailers started to offer free recharging during a shopping trip (e.g., Tesco, IKEA, Bauhaus, Kaufland). The third paper of the cumulative dissertations broadly investigates how this service offering influences consumer behavior and more specifically shines a light on shopping intention and shopping duration. Recent research found that architectural cues (e.g., appealing outlet design: Zielke & Toporowski, 2009) and technology (e.g., mobile payment at the point-of-sale: Falk et al., 2016) influence the overall store price image (OSPI) and thereby shopping intention and patronage. In contrast to the increasing OSPI, the provided technology (i.e., recharging a personal EV) is similar to known retail services like free parking (Hasliza, 2013) and should increase perceived service quality and thereby have a positive effect on shopping intent (Martensen, Grønholdt, & Kristensen, 2000; Rust & Zahorik, 1993).

Finally, the act of offering free recharging triggers a shift of time from the charging budget to the shopping budget as both can happen simultaneously (Bhat, 2001; Schwanen, 2004). Shoppers would even allow for a little detour to allow more time for recharging / to exploit free of charge recharging.

Methodology

The third paper uses a data set that was collected using a simulated shopping experiment with 103 German EV drivers. The data was empirically analyzed using repeated regression models and standard p-tests.

Main findings

The analyzed data suggests a favorable effect of providing free EV recharging on shopping duration and shopping intention. Shopping intention, however, is negatively impacted by overall store price image but overcompensated for by a positively perceived increase in service quality.

Contributions

The third paper contributes to the growing body of literature that dissects technology on the OSPI (e.g., Falk et al., 2016) and links it to changes in consumer behavior (i.e., shopping intention and duration). Moreover, it is the first paper that studies the new charging station technology and offers recommendations for retail managers and public policy makers.

5 General contributions and implications of this dissertation

The direct contributions of each paper are in the manuscripts as well as in Chapter 1.4 that contains the paper summaries. The combined research contribution of this cumulative dissertation is the finding, that technological retail innovations generally influence consumer behavior along the whole innovation diffusion cycle. Although the dissertation only includes three specific technologies (i.e., mobile payment, electronic shelf labels, electric vehicle charging), generalizing contributions in three main areas are notable: effects along systematic coverage of the innovation diffusion cycle, extension of main themes of technology in retail, and substantiation on the research question of the rational consumer. First, the cumulative dissertation covers the whole

process of innovation diffusion through three distinct technologies. This puts the focus on the complete life cycle of an innovation and not only on the singular application of a technology (Rogers, 2003). In the near future technological changes will lead to an increased convergence of retail channels (Grewal et al., 2017). Our research conceptually contributes to this change by highlighting the importance of adoption of a new technology (Paper 1), the potential to selectively increase revenue with a favorable in-store experience (Paper 2), and a way to lure more consumers to a physical outlet and increase their shopping intent and prolong their shopping duration through offering value-adding services. Summarizing, all three papers point to a positive effect of technology on consumer behavior.

Second, the three papers further extend the seven emerging main themes of technology in retail (Piotrowicz & Cuthbertson, 2014). The first paper contributes to the topics of *mobile solution* and *diverse customer experience*. The research positions mobile payment as an alternative means of payments to cater the needs of customers for more paying convenience. Thereby the role of mobile solutions is even further extended: from searching (Verhoef et al., 2015), being a purchasing channel itself (Han, Ghose, & Xu, 2013), to replacing established forms of payments like cash and credit cards (Mallat, 2007). The second paper contributes to the three themes *channel integration*, *personalization versus privacy,* and *role of social media*. It could show empirically, that the introduction of electronic shelf labels influences consumer behavior that results in a positive mere categorical revenue effect. Thereby the technology allows deep channel integration through aligned prices, social media interactions through directly displaying reviews and ratings, and dealing with consumers fear of individual price exploitations. The third paper contributes to the *changing role of the physical retail store*. It demonstrated the effects on consumer behavior when retail outlets provide services such as EV recharging.

Third, the dissertation substantiates the research body on the evolving nature of the utility maximizing rational homo economicus (Levitt & List, 2008). Although no

unifying theory is provided across all three papers the mixture of lab-experiments (Paper 1 and 3) and research with real transaction data (Paper 2) allows support for the general notion that technology in retail positively affects consumer behavior. A purely rational consumer following classical economic model would not increase his or her willingness to pay simply because the payment instrument or product information display changes.

All dependent variables in the three papers have high managerial relevance (Paper 1: WTP, Paper 2: revenue, Paper 3: shopping intent and duration). This allows us to draw two summarizing managerial implications that go beyond the arguments of the three individual manuscripts. First, the positive notion across all three manuscripts implies that retail managers should not hesitate too long when considering the introduction of new technologies, also to foster integration of their sales channels. Despite the fact that early adopters benefit from the behavioral changes longer, the initial investment costs need to be weighed against the fact that technology is generally more expensive in the beginning and late adopters might even out a potential competitive disadvantage at a much lower cost. Results from Paper 1 also recommend to cautiously reconsider the required adoption for any favorable consumer behavior change. Second, marketers should include technologies in their marketing and directly promote usage of a technology to elicit the favorable behavioral change, e.g., by promoting free charging on displays, offering discounts for the usage of mobile payment, or shifting advertising to product categories or stores with electronic shelf labels. As some technologies are rather subtle in their nature and hence unconsciously affect consumer behavior, retail managers need to make sure that consumers do not show adverse behavior when they realize the manipulation.

6 Limitations and future research

There are generally applicable and article-specific limitations whereby the latter are comprehensively addressed in the respective papers. The former limitations are

manifold. First, all three papers strongly rely on quantitative data that is reflected upon on / viewed and discussed in context to existing literature. Nonetheless, more qualitative research would enrich the presented results as well as the field.

Second, the types of shoppers and retailers are diverse and only some were covered in the individual papers (Grewal et al., 2017). Even though the results are highly applicable to other retail format and special shopper types, future research should substantiate and extend the current findings (e.g., deal-prone customers in a mall environment). Additionally, the results are always applicable for the average consumer as individual behavior, naturally, deviates from the average norm and people's characteristics differ.

Third, the limitation of three specific technologies is another obvious limitation of this dissertation for two reasons. On the one hand, new technologies will be introduced in the future and they will influence consumer behavior as well. On the other hand, mobile payment, electronic shelf labels, and electric vehicle charging stations were separately investigated. Future research should also consider a specifically defined mix of different technologies and their impact on consumer behavior.

7 Outlook

Due to increasing competition brick and mortar retailers are more than ever likely to adopt an ever-increasing array of innovative technologies to stay ahead of the competition and refining their unique selling point continuously prompting novel research questions.

In the future the three technology trends blockchain, internet of thing (IoT), and big data will profoundly change retailing. First, despite its popularity as a technological basis for cryptocurrency that could be used as a new form of payment, the blockchain has further potential use cases for retailers. The technology of a distributed ledger network could for example be used to provide unseen transparency into the supply chain and thereby providing rich product information (e.g., using IBM Food Trust technology for very

precise information on the origins of ingredients in a grocery, IBM, 2019). Another use case are customer data management and loyalty schemes as those systems would benefit from the distributed character of the blockchain and more security (Bryanov, 2019).

Second, the connection of different devices and sensors through the internet known as IoT (Gubbi, Buyya, Marusic, & Palaniswami, 2013), will enable more efficient store operations through better predictive inventory and directly following the flow of shoppers through the store (Grewal et al., 2018).

Third, despite an increasing risk of data lose due to security breaches, big data offers a lot of potential for retailers in the future. With more structured and unstructured data, cheaper storage, and increasing processing power, big data analytics can provide optimization for various retail processes like pricing, promotion management, and inventory replenishment (Grewal et al., 2018).

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Appendix I: The effect of credit card versus mobile payment on convenience and consumers' willingness to pay

Published in the Journal of Retailing and Consumer Services. 52 (2020).

Following is the published manuscript.

DOI: https://doi.org/10.1016/j.jretconser.2019.101910

The effect of credit card versus mobile payment on convenience and consumers' willingness to pay

Abstract

Extant literature on payment methods has focused on comparing cash and credit cards and emphasized the lower pain of paying (i.e., fewer negative consequences) for the latter. This finding, in turn, explains why consumers express higher willingness to pay (WTP) when paying with credit cards. The current study introduces mobile technology as a new payment method to this literature. Specifically, it highlights convenience as a positive driver of increased WTP for mobile payment. However, for consumers to perceive mobile payment as convenient, a personal adoption (enabled through an existing system in the respective country market) is necessary. A set of three studies across several country markets tests these assumptions empirically. Convenience emerges as a new mediator between mobile payment and increased WTP, contingent on personal adoption. These findings thus extend extant literature on the mechanisms consumers use with different payment methods, and they offer differentiated recommendations regarding payment channels for country managers.

Keywords willingness to pay, convenience, mobile payment, pain of paying, adoption

1 Introduction

A recently introduced payment alternative is mobile payment. Optimistic commentators have described it as the "death of cash" (Pickford 2015); even the Anglican church uses it for in-church donations (Bowsher 2017). In some countries, mobile payment has become an established payment mechanism similar to credit or debit cards. For instance, the volume of mobile payment transaction is expected to exceed credit card transaction volume by 30% in China (Wang 2018).

Extant literature on payment methods has focused on comparing cash and credit or debit cards and shows increased levels of consumers' willingness to pay (WTP) when using cards (Prelec and Simester 2001; Runnemark et al. 2015). This credit card premium (Feinberg 1986) can be explained by lower pain of paying ("...direct and immediate displeasure or pain from the act of making a payment..." Zellermayer 1996, p. 2) through, for instance, less transparency or decoupling payment and transaction (Gafeeva et al. 2018, Soman 2003, Prelec and Loewenstein 1998). Falk and colleagues (2016) are the first to also include mobile payment in the investigated means of payment, although only as side aspect in the investigation, but they do not find a significant premium of mobile pay over credit cards, only versus cash. We suggest pain of paying alone might be insufficient to explain differences in consumers' WTP for different payment means. For instance, other mediators might influence the results.

Convenience might be a second mediator that influences consumers' WTP. Extant research on mobile solutions in general establishes convenience as key advantage relative to non-mobile alternatives (see mobile travel and banking applications research, e.g., Dahlberg et al. 2015; Mallat 2007). Also research on payment means has suggested that convenience might explain why a payment method increases consumers' WTP (Dahlberg et al. 2015;

Hirschman 1979). Indeed, previous research shows that greater convenience in general can increase consumers' WTP (Carow and Staten 1999; Carrigan and Attalla 2001). Thus, if mobile payment is more convenient, it should also increase consumers' WTP, and retailers could boost revenues by incentivizing usage of convenient payment methods (e.g., by granting bonus points in a loyalty program). Pain of paying, in contrast, might not be a relevant driver for two reasons. First, mobile payment often charges established payment means (e.g., credit cards, direct debit), which implies that the pain of paying should be the same as for these payment means. Second, mobile phones might detract customers' focus from pain of paying, as mobile phones offer many non-payment functionalities (e.g., social media, gaming, photography).

Convenience of mobile phones, however, might not always be in operation. Specifically, before a technology (e.g., mobile payment) can be considered convenient, it must be adopted: The more consumers are used to a technology, the more convenient its use feels (Huh and Kim 2008; Zhou 2011). Word processing software is a well-known example: only adoption and use of such software make its use convenient (Davis et al. 1989) ; similarly, adoption to mobile technology requires an initial investment, after which the products can be conveniently used (Kim et al. 2007). In line with the diffusion and adoption literature (Lai and Chuah 2010; Yang et al. 2007), we connect convenience perceptions of an innovation with its adoption. We argue that an adoption of a technology reflects acceptance and experience with it and thus enhances convenience perceptions.

We thus propose that convenience perceptions regarding mobile payment will vary with personal adoption level. Specifically, and as a consequence, higher WTP for mobile payment will emerge only for customers who already adopted mobile payment. We test this moderated mediation in a set of three studies across countries in which we expect meaningful

variation of personal adoption (Germany, India, and the United States). Thereby, we contribute by extending the existing pain of paying theory with convenience as a mechanism to explain consumer behavior for mobile versus more traditional means of payment, especially credit cards. Additionally, we introduce adoption of a means of payment as a moderator of the relationship between the payment means and consumers' WTP. While the adoption of mobile payment has been investigated by extant research (Park et al. 2019) to the best of our knowledge, this is the first investigation where adoption moderates the relationship between the means of payment and WTP. Managerially, we extend the investigation of the effect of payment means to multiple markets.

2 Theoretical Background

2.1 Pain of paying and WTP

Researchers have extensively investigated the relationship between payment methods and consumer behavior (see Table 1). Early studies (Feinberg 1986; Hirschman 1979) show that consumers pay more when they are asked to use a credit card than when asked to use cash. To explain this credit card premium, Zellermayer (1996) coined the term "pain of paying" to describe the feeling consumers encounter when paying, which suggests a negative relation between pain of paying and WTP. Prelec and Loewenstein (1998) suggest mental coupling as explanation for the differences in pain of paying: the more mentally decoupled the actual payment is from the purchase (e.g., because the transaction happens in the future, such as for credit cards), the lower the pain of paying. Subsequent studies empirically establish the credit card premium on consumers' WTP (Prelec and Simester 2001). Analogous results have emerged for stored-value cards (Soman 2003), debit cards (Runnemark et al. 2015), and multifunctional bank cards (Gafeeva et al. 2018). Other studies identify the transparency with which consumers part from money (Raghubir and Srivastava

2008; Runnemark et al. 2015; Soman 2003) as a driver of perceived "monetary sacrifice" (Bornemann and Homburg 2011, p. 490). These studies show that credit cards are the least painful and transparent, followed by debit cards, and that cash is the most painful and transparent payment method.

In summary, extant research focuses on pain of paying as mediator of the relationship between means of payment and consumers' WTP, despite the fact that other explanations were discussed (e.g., convenience: Dahlberg et al. 2015). Adding additional mediators might complement this theory if they better describe the mechanism between different forms of payment, potentially also rendering the relationship susceptible to new moderators. Further, most studies and experiments were conducted in the U.S., where use of the investigated payment means is very homogenous and potential differences from different convenience perceptions might, thus, simply not have been occurred.

	—Payment means—				**-Mediators-**				
Article:	Cash	Credit	Debit/ value	Mobile	Pain of paying	Conve- nience	**Moderator(s)**	**Dependent variable(s)**	**Location**
Hirschman (1979)	✓	✓						Basket size	US
Falk (2016)	✓	✓		✓	✓			Store price image, WTP	Europe
Feinberg (1986)	✓	✓						WTP	US
Zellermayer (1996)	✓	✓			✓			WTP	US
Prelec and Loewenstein (1998)	✓	✓			✓		(Credit) debt, credit line	WTP	US
Prelec and Simester (2001)	✓	✓						WTP	US
Soman (2003)	✓	✓	✓					Basket size	US
Inman et al. (2009)	✓	✓						Basket size	US
Raghubir and Srivastava (2008)	✓	✓						WTP	US
Moore and Taylor (2011)	✓	✓	✓					WTP	US
Runnemark et al. (2015)	✓		✓					WTP	DK
Gafeeva et al. (2018)	✓		✓		✓			Recall error on spending	GER
Our research	✓	✓		✓	✓	✓	*Technology adoption*	*WTP, WTB*	*US, GER, IN*

Table 1: Extant research on payment forms and WTP and related constructs

We suggest that pain of paying using mobile payment is equal to that of using a credit card for two reasons: First, all mobile payments are charged through existing credit or debit cards and, therefore, are financially equivalent to them (e.g., in terms of settlement time). Second, compared to cash, both means provide far less restricted financial resources (e.g., cash restriction for ordering additional fries or a soda if only a 5 USD bill is available, but no restriction with credit card or mobile phone: Thomas et al.2011). Third, distraction and monitoring effects offset each other for mobile relative to credit card payment. On the one hand, one might argue that mobile payments have lower transparency than credit card payments, because a smartphone has many distracting functions other than paying (Bouwman et al. 2009; Minh 2011), which reduce the latter's transparency (Gafeeva et al. 2018). On the other hand, this effect is likely offset by the ability to constantly monitor spending with smartphone apps (e.g., account balance, purchase notifications; Soman 2003).

Incidental findings in extant research support this suggestion: Falk and colleagues (2016) assess the effect of payment means on the price image of stores, but also find that credit cards and mobile payment induce higher WTP than cash, but that credit cards and mobile pay do not significantly differ from each other. We suggest this is due to the similar low pain of paying for credit card and mobile payment compared to the pain of paying for cash. As we will explain in Section 2.3, however, a second mediation path (here: convenience) might exist, which – conditional on potential moderators (here: adoption) – will influence consumers' WTP.

2.2 Convenience of paying

Besides subconscious influences (e.g., pain of paying) and direct utility from the service (e.g., through bonus points), consumers derive utility from the actual payment *process* (e.g., through a faster paying process; Feinberg 1986). They may perceive the act of paying

as simply more or less convenient, that is, feeling a high or low effort to perform a transaction (Teo et al. 2015). For instance, a consumer might not want to carry cash (Hirschman 1979), and it is easier to swipe a credit card than search for coins (Carow and Staten 1999). Consequently, research on means of payment has called for, but not conducted, an empirical investigation of the mediating effect of convenience (Feinberg 1986, Dahlberg et al. 2015).

Convenience has not been investigated as a driver of consumers' WTP for different means of payment. However, the adoption literature offers first evidence why convenience might be particularly high for mobile phones (e.g., Kim et al. 2007; Kleijnen et al. 2007). First, because most consumers always carry a mobile phone, mobile payment makes them independent of their wallet (containing cash *and* credit cards). Second, mobile payment solutions usually do not require consumers to sign a receipt or memorize a PIN code, which is more convenient than using a credit card. Third, many consumers use their mobile phone while queuing (e.g., for checking social media, reading news), which makes the payment means directly available at checkout (i.e., no need to search for a wallet). Finally, mobile payment has the fastest processing at the point of sale (Polasik et al. 2013). That said, we are cautious about positing the unconditional convenience superiority of mobile technology. Instead, we argue that not all consumers find mobile payment more convenient; rather, a personal adoption (in the respective country market) is a prerequisite.

2.3 Technology adoption and convenience of paying

Our key assertion is that convenience perception of paying depends on the adoption of the payment method. Adoption is individual but driven by market conditions. Individually, extant adoption research has established convenience and speed as key drivers for mobile payment (Lai and Chuah 2010; Park et al. 2019) and credit card usage (Yang et al. 2007).

Similar to mobile payment, internet banking (Lichtenstein and Williamson 2006), sustainable smartcard payment (Liao et al. 2014) and convenience food (Sheely 2008) needed frequent usage of its users to induce more and more convenience. Also company examples suggest that adoption drives convenience perceptions (Chang et al. 2009), as the case of WeChat Pay in China shows (Yap 2017). Because the adoption of the related messenger app (WeChat) is ubiquitous, it is convenient to also use the mobile payment solution (WeChat Pay), resulting in a surge of its market share over the former incumbent (AliPay). In summary, convenience of paying should be higher for those who have already adopted the instrument for conducting the payment.

In this light, the non-effect between credit card and mobile in Falk and colleagues (2016) might be due to not accounting for adoption as a moderator of the mediation through transparency. In summary, we suggest that individual adoption matters for the convenience perception of mobile payment. Formally:

> *H1: The effect of a payment method (credit card; mobile payment) on convenience of paying is moderated by its adoption, such that existing adoption (i.e., usage) increases convenience of paying.*

2.4 Convenience of paying and WTP

As soon as a payment method is perceived as more convenient, consumers should prefer paying through it, which ultimately should also increase WTP compared with less convenient payment methods. Consumers in retail are susceptible to situational characteristics of a purchase (Turley and Milliman 2000), in that retail solutions that fit consumers' situational needs increase WTP (e.g., fitting shopping trip type and retail environment: Hunneman 2017; ascertaining consumers with reviews: Maier et al. 2015; offering a pleasant shopping environment: Bruner 1990). Previous research on mobile

payment adoption has proposed, but not tested, convenience as a mediator of mobile technology's effect on WTP (de Kerviler et al. 2016; Teo et al. 2015).

Also studies unrelated to payment methods suggest that convenience increases consumers' WTP. For instance, ethical consumption research shows that convenience is a key driver for purchase decision (and often supersedes other motivations; Carrigan and Attalla 2001). Similarly, convenience is the key determinant for many credit card users (Carow and Staten 1999). We hypothesize that such positive effects of convenience also apply to payment methods and thus translate to convenience of paying. Formally:

H2: Higher convenience of paying (resulting from using a specific payment method: credit card; mobile payment) increases consumers' WTP.

Combining H1 and H2 leads to the following moderated mediation hypothesis:

H3: The effect of payment method (credit card; mobile payment) on consumers' WTP is mediated by convenience of paying, whereby a specific payment method increases convenience of paying in cases when it is adopted.

Fig. 1 offers an overview of our research model and the corresponding hypotheses.

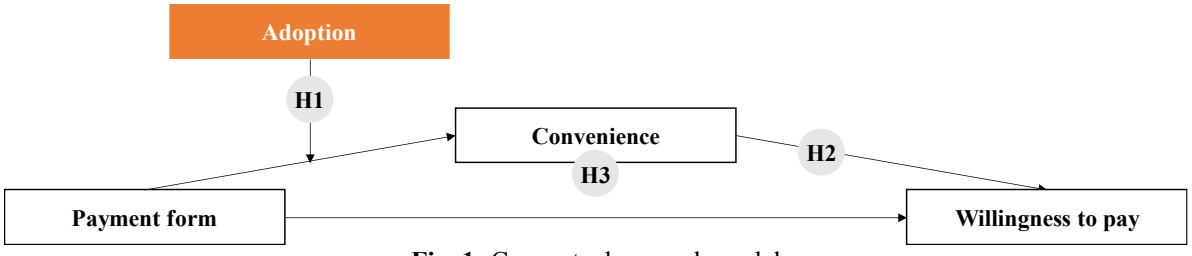

Fig. 1: Conceptual research model

3 Empirical Studies

Table 2 provides an overview of the studies, all of which use online surveys addressed to consumers. We conducted the studies in country markets characterized by different average degrees of adoption of the focal payment methods (mobile payment; credit card), to ensure variance among consumers' adoption rates. This is because individual adoption should

be conditional on market conditions, especially the availability of a payment technology in a given country. Adoption measured on the country level has a long tradition in diffusion research (Chandrasekaran and Tellis 2008). Some developing countries (e.g., India, China) have a political agenda to make mobile payment ubiquitously available as a replacement for cash, enabling a high mobile pay adoption (Beyes and Bhattacharya 2017; Digital India 2015). In contrast, in countries without such regulation, traditional payment instruments are replaced by new ones much more slowly (e.g., cash in Germany, credit cards in the United States). These market conditions also extend to credit cards: because the government aims to leapfrog from cash to mobile payment, many emerging economies have low credit card adoption, because they proceeded directly to mobile payment (PYMNTS 2017). In contrast, the credit card payment infrastructure is excellent in most Western economies (particularly the United States, where almost the entire body of research on the "credit card effect" was conducted; see Table 1), leading to a high individual adoption of credit cards. Consistent with this perspective, average payment system adoption rates vary strongly between countries (eMarketer 2018).

Individual adoption should, at least on average, therefore, depend on the country market, because mobile payment and credit card technology is widely supported in some markets, while it is uncommon in others. Using countries to manipulate variables aligns with extant research (e.g., Comin and Hobijn 2004). Specifically, Studies 1 and 2 compare general low mobile payment adoption countries (United States, Germany) with a general high adoption counterpart (India). To replicate the known credit card effect, both studies measure consumers' WTP when paying with cash. Study 3 generalizes the investigation by including varied price levels.

Study	1	2	3
Design	3 (payment means, between)	3 (payment means, within)	3 (payment means, between) × 2 (price level, within)
Location	India, United States	India, Germany	United States
H1	✓	✓	✓
H2	✓	✓	✓
H3	✓	(✓)	✓

Table 2: Overview of studies

3.1 Study 1

Design: We designed a hypothetical shopping experience as a survey that randomly assigned participants to either a credit card or mobile payment condition; an additional group was asked to consider cash. The scenarios (Americano coffee in a café, ice cream at the beach, and smartphone charger at a vending machine) are comparable to those used in extant research (Runnemark et al. 2015; Zellermayer 1996). We explained that only one payment method was available. In all purchase scenarios, we assessed consumers' WTP ("How much would you be willing to pay…"), convenience ("How convenient would it be to pay with…"; five-point Likert scale from "very inconvenient" to "very convenient"; Belk 1975), and pain of paying ("How painful would it feel to pay…"; five-point Likert scale from "very painful" to "very pleasurable"; Zellermayer 1996). We elicited the adoption levels of credit cards and mobile payment methods ("How often do you use mobile payment for offline payments (e.g., restaurants, stores)?"; five-point Likert: "never" to "always"). This study, as well as all subsequent studies, was approved by the Institutional Review Board of the university of the corresponding author.

The setup thus resulted in a 3 (payment method, between-subjects) × 3 (purchase scenario, within-subject) design, with individual adoption as a moderator. In line with the hypotheses, we focus on the comparison between mobile and credit card payments.

We chose India and the United States as study locations, because they strongly vary in the adoption of mobile phones. India has a high mobile payment adoption rate of 29% of overall smartphone users, pushed through governmental legislation (GlobalData Financial Services 2018). Adoption in the United States is far lower: only Apple Pay's adoption rate has exceeded 10%, while Samsung's (5%) and Android Pay's (7%) rates are much lower (PYMNTS 2017). Credit card adoption is reversed: In India, it is below 2% (30 million cards for 1 billion Indians: Government of India 2017), whereas U.S. adoption is numerically above 500% (1.8 billion cards on 325 million Americans: SmartMetric 2018).

Results: Two hundred fifty U.S. (n = 149; mean age = 36.08 years; 36% female) and Indian (n = 101; mean age = 32.18 years; 19% female) participants completed the experiment on Amazon MTurk. Despite a discussion about the validity of findings from MTurk, research notes the diverse demographics of the sample (Berinsky et al. 2012) and finds reliability and validity at least on par with other potential samples (such as students; Hauser and Schwarz 2016). The experiment was separately posted to the American and Indian portal of MTurk and a small amount was paid to each participant (~ 0.10$ per minute of participation: Peer et al. 2014). To ensure the validity of the responses, we set a minimum task approval rate of 95% and a minimum number of 500 completed tasks (Schmidt 2015, Peer et al. 2014). We excluded 5 participants who answered excessively fast (below 75s, or 1.5 SDs below the sample mean of 220s). Due to the different local currencies, we z-standardized WTP values (for descriptive statistics of all studies, see the Appendix, Table A.1).

To test H1, we ran a repeated-measure regression (because of the within-subject factor "purchase scenario") of convenience on the two focal payment methods (0 = credit card, 1 = mobile payment), adoption (0 = not adopted, 1 = adopted), the interaction of payment method and adoption and a control variable for the country. Table 3 summarizes all results for Studies

1, 2, and 3. To facilitate an easier interpretation, we coded the adoption dummy with 0 for all participants who never used mobile payment and 1 for those who did. Fig. 2 shows that the average convenience of paying (with credit card vs. mobile) is much higher (lower) when mobile payment is adopted (not adopted), resulting in an insignificant main effect of payment method (model 1: $\beta = .01$, $p > .1$). Consequently, and in line with H1, the interaction term (model 1: $\beta = .20$, $p < .05$) is significant, implying that the more strongly participants adopted the payment means, the more convenient its usage felt. We see a lower convenience perception in India (model 1: $\beta = -.24$, $p < .001$). Please not that this negative effect captures overall country differences in the perception of convenience of mobile payment beyond the effect of individual adoption.

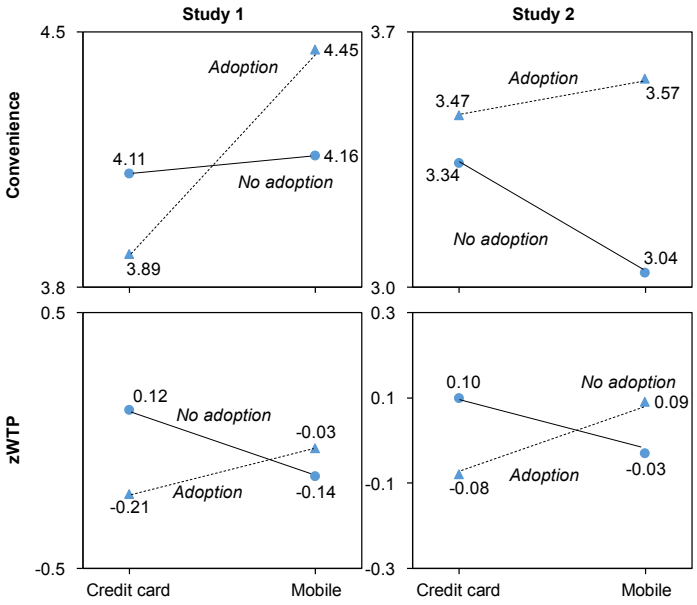

Fig. 2: zWTP and convenience means in Studies 1 and 2

To test H2, we regressed zWTP on the previous independent factors plus the potential mediator (convenience of paying) and pain of paying as control variable (model 2). In line with H2, convenience positively affects zWTP (model 2: $\beta = .15$, $p < .01$), while pain of paying does not ($\beta = .03$, $p > .1$), which reinforces the importance of convenience of paying as the key underlying mechanism between mobile and credit card payment. While mobile

payment on average lowers zWTP (β = –.15, $p < .01$), it increases zWTP for customers who adopted mobile payment (β = .19, $p < .05$). A bootstrapping analysis of moderated (through adoption) mediation (through convenience) confirms H3 (model 2 in Preacher et al. 2007, and model 8 in the SPSS PROCESS templates): The confidence interval for the index of the moderated mediation excludes zero (n = 5,000, bias corrected; CI95%: .68; 1.74). The same bootstrapping analysis confirms mediation for those who adopted mobile payment as the confidence interval excludes zero (n = 5,000, bias corrected; CI95%: .02; .12), whereas for non-adopters, it does not (CI95%: –.03; .04). In line with our expectation, pain of paying did not differ between mobile and credit card payment, and pain of paying did not influence WTP (neither directly: β = –.05, $p > .10$, nor in model 2, together with convenience: β = .03, $p > .10$). These effects remain consistent when adoption is used as input factor with a metric scale.

	Study 1		Study 2		Study 3	
Dependent variable:	**Convenience**	**zWTP**	**Convenience**	**zWTP**	**Convenience**	**WTP**
Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Payment method	.01	–.15 *	–.11 *	–.05	–.26 *	–.10
(0=credit card 1=mobile payment)	(.15)	(.12)	(.12)	(.09)	(.25)	(.16)
Country	–.24 ***	.07	.04	–.02	—	—
(0=US, Germany 1=India)	(.11)	(.09)	(.24)	(.19)		
Adoption	–.02	–.19 **	.02	–.08	–.06	.09
(0=not adopted 1=in use)	(.15)	(.11)	(.21)	(.16)	(.22)	(.14)
Adoption × mobile	.20 *	.19 *	.11 †	.09 †	.27 *	.06
(Interaction: adoption and mobile payment)	(.21)	(.16)	(.20)	(.15)	(.35)	(.22)
Price	—	—	—	—	.00	.21 ***
(0=low, 1=high)					(.10)	(.09)
Price × mobile	—	—	—	—	.05	–.10
(Interaction: high price and mobile payment)					(.20)	(.16)
Price × adoption × mobile	—	—	—	—	–.13 †	–.02
(Interaction: high price, mobile payment, and mobile adoption)					(.23)	(.19)
Convenience	—	.15 **	—	.05 *	—	.43 ***
		(.04)		(.04)		(.03)
Pain	—	.03	—	–.10	—	–.23 ***
		(.04)		(.04)		(.04)

Table 3: Studies 1,2, and 3: Model specifications and results
Notes: standardized β; † $p < .10$; * $p < 05$; ** $p < .01$; *** $p < .001$
[1] Study 1: 0=US, 1=India; Study 2: 0=Germany, 1=India; Study 3: no country control, as only conducted in US.

Because we expected the adoption of mobile payment to differ between countries, we investigated whether also consumers' country of residence would influence the effect of mobile payment. We, therefore, conducted a repeated measure regression without adoption but included country (as a new proxy for adoption) and its interaction with mobile payment. The results are in line with H1, H2, and H3: only Indian participants, where the average adoption of mobile payment ($M_{US} = 1.61$; $M_{India} = 2.47$; paired sample t-test = 10.60, $p < .001$) is higher than of credit cards ($M_{US} = 2.98$; $M_{India} = 2.79$; paired sample t-test = 1.92, $p < .10$), perceived mobile payment as more convenient, and were, in turn, willing to pay more

(see Appendix, Table A.2). Additionally, we calculated model 1 and 2 with the demographic control variables age, gender, and income (see Appendix, Table A.3). All results remain consistents, while we see a marginally positive effect of income (model 1 in Appendix Table A.3: $\beta = .09$, $p < .10$) and age ($\beta = .08$, $p < .10$).

To complement our hypothesis testing, we built a model for a cash vs credit analysis (similar to model 1 but on pain instead of convenience, with adoption of credit cards instead of mobile payment [0 = no users, 1 = users]). We note that in line with extant research, credit cards decreased pain of paying, but only for the customer that adopted credit card payment ($\beta = -.24$, $p < .01$). These results indicate that adoption has also a moderating effect for credit cards. We find no main effect of credit card payment on zWTP ($\beta = -05$, $p > .10$), but in line with extant literature see a negative effect of pain on zWTP ($\beta = -.10$, $p < .05$).

3.2 Study 2

Design: Study 2 replicates Study 1 in a different geographical context to ensure that the results are not idiosyncratic to the country of analysis, switching from the United States to Germany. At the time of the experiment (mid-2017), large mobile payment providers (Apple Pay, Android Pay) had not yet offered their service in the German market but loyalty card providers (e.g., Payback) and startups provided services to pay with a mobile phone; consequently, average adoption was low (4%; statista 2018). Each participant stated his/her WTP for all payment means in the scenarios. Apart from this variation, the procedure (e.g., purchase scenarios), measures (e.g., zWTP) and design (3 [payment method] × 3 [scenarios], individual adoption levels) were the same as in Study 1. An Institutional Review Board approved the study design.

Results: Two hundred ninety-four German (n = 231; mean age = 26.58 years) and Indian (n = 63; mean age = 27.19) students were recruited and completed the experiment. We used mailing lists of different university institutions and courses. A lower than expected participation rate at the Indian universities resulted in our unbalanced dataset.

Similar to study 1 we divided participants into groups who did and did not adopt mobile payment. Fig. 2 shows that the average convenience of paying is higher for participants who adopted mobile payment, irrespective of the means of payment. Therefore, a repeated measure regression with adoption, means of payment, their interactions, and country shows a significant main effect of payment method (model 3: $\beta = -.11$, $p < .05$). However, convenience increased (declined) for mobile versus credit card payment for participants who adopted (did not adopt) mobile payment. Consequently, and in line with H1, the interaction term (model 3: $\beta = .11$, $p < .10$) is (marginally) significant, (weakly) supporting the moderating role of adoption.

We then regressed zWTP on the previous independent factors, convenience of paying and pain of paying (model 4). In line with H2, convenience positively affects zWTP (model 4: $\beta = .05$, $p < .05$), while pain of paying does not ($\beta = -.10$, $p > .10$), which replicates our findings from Study 1. The same regression of zWTP without convenience and pain shows that participants who adopted mobile payment have a significant higher zWTP (model not shown: $\beta = .11$, $p < .05$).

Again, bootstrapping analysis overall confirms moderated mediation (H3, model 2 in Preacher et al. 2007): The confidence interval for the index of the moderated mediation excludes zero (n = 5,000, bias corrected; CI95%: .00; .10). In contrast to Study 1, the confidence interval for the mediating effect of convenience for those who did not adopt mobile payment is fully negative (CI95%: −.07; −.00), while the mediation was not significant

for the adopters (CI95%: –.02; .05). This partially supports H3, as mobile payment negatively effects WTP through less convenience for participants who did not adopt mobile payment, although the positive effect for participants who adopted mobile payment does not arise.

Because the adoption rate for mobile payment is high in India (29% of smartphone users) and very low in Germany (4%), we conducted a robustness test with country as a proxy for adoption, instead of individual levels. We aggregated all participants depending on their home country (low adoption level for all Germans; high adoption level for all Indians). A repeated measure regression without adoption but including country (as a new proxy for adoption) and its interaction with mobile payment supported H1, H2, and partially H3 (see Appendix, Table A.2). Additionally, we included age in our models and see no change to our results (see Appendix, Table A.3).

To replicate extant research and test, whether adoption also influenced other means of payment, we built a model for a cash vs credit analysis, including individual adoption as a moderating variable (similar to model 3 but on pain instead of convenience, and with mobile payment adoption changed to credit card adoption). We note that in line with extant research, credit cards decreased pain of paying, but only for the customer that adopted credit card payment ($\beta = –.42$, $p < .001$). These results indicate that individual adoption has a moderating effect for credit cards. Confirming extant literature, we find a main effect of credit card payment on zWTP; however, this effect only appears for participants who adopted credit cards ($\beta = .15$, $p < .05$). As expected, we find a negative direct effect of pain on zWTP ($\beta = –.08$, $p < .05$).

3.3 Study 3

Design: To increase the robustness of our findings, Study 3 compares the effect of means of payment across different price levels (Zellermeyer (1996). Each participant

encountered two low-price scenarios (choice to buy an Americano in a café, ice cream at the beach) and two high-price scenarios (choice to refill gas for a truck, order of a dishwasher repair). Further, Study 3 tests if individual WTP adoption differences are sufficiently large within one country to moderate the effect of the means of payment.

We randomly allocated participants to a cash, credit, or mobile payment condition, in which they learned they only had one means of payment available. For example, the gas refill scenario for the cash condition read: "Imagine you are looking for a gas station to fill up your half-full RAM with 20 gal. You can only pay with cash. The cost is 40$." These scenarios are comparable to those used in extant research (Runnemark et al. 2015; Zellermayer 1996). As the variation of price levels requires set prices, we assessed WTP as willingness to buy ("How likely would you buy…" in percentages from 0 to 100, similar to Beerli and Santana 1999). We assessed pain of paying, convenience and mobile payment adoption as previously, which resulted in a 3 (payment method, between-subjects) × 2 (price level, within-subject) design. We based Study 3 in the United States because we aim to replicate extant research findings in the current market environment, and previous work has almost exclusively been conducted there (see Table 1). An Institutional Review Board approved the study design.

Results: We recruited 204 participants from MTurk (mean age = 35.45 years; 41% women) in exchange for a small monetary compensation, to prevent a bias from the use of student samples (e.g., in Study 2; Peterson, 2001). To assess H1, we ran a repeated-measure regression of convenience on the two means of payment (dummy variables), price level (0 = low; 1 = high), adoption (0 = no use; 1 = user), and their interaction. The findings replicate the previous ones, in that it shows a negative main effect of mobile payment (vs. credit card) on convenience ($M_{\text{convenience, credit}} = 4.11$, $M_{\text{convenience, mobile}} = 3.85$: $\beta = -.26$, $p < .05$). In support of H1, we see a significant positive interaction between adoption and mobile payment (model

5: β = .27, $p < .05$). In addition, we find a negative marginally significant three-way interaction of adoption, mobile payment, and price level (β = –.13, $p < .10$). This result indicates that mobile payment users find paying more convenient, but only for low-cost items, potentially due to security concerns (de Kerviler et al. 2016; Shaw 2014). In line with H2, convenience positively affects WTP (model 6: β = .43, $p < .001$), although pain of paying also has a significant effect (β = –.22, $p < .001$). In addition, we see a higher spending preference in high price scenarios (β = .21, $p < .001$).

Bootstrapping analysis confirms H3 (model 2 in Preacher et al. 2007): The confidence interval for the index of the moderated mediation excludes zero (n = 5,000, bias corrected; CI95%: .28; .57). The same bootstrapping analysis confirms mediation for those who adopted mobile payment as the confidence interval excludes zero (n = 5,000, bias corrected; CI95%: .38; .63) as well as those who did not adopt it (n = 5,000, bias corrected; CI95%: .00; .17). The results confirm convenience as a mediator and imply a higher effect of mobile payment through convenience on WTP when consumers adopted to mobile payment.

Additionally, we calculated model 5 and 6 with the demographic control variables age, gender, and income (see Appendix, Table A.3). All effects remain consistent. Additionally, we see a significant positive effect of income (model 5 in Appendix Table A.3: β = .16, p < .001) and age (β = .17, p < .001) and a significant negative effect of gender (β = –.13, p < .01) on convenience. Only gender effects WTP (β = –.11, p < .01).

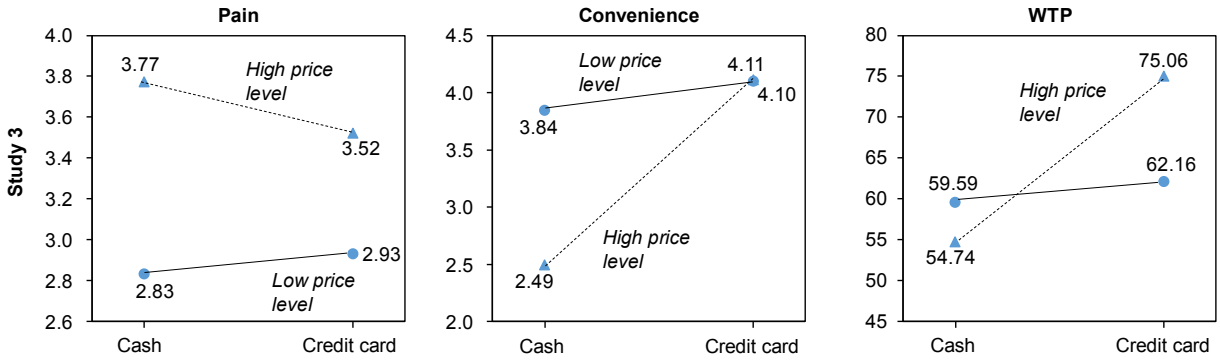

Fig. 3: WTP and pain means in Study 3

The study also replicates the credit card effect from extant literature: Relative to cash, pain of paying is lower for credit cards ($M_{\text{pain, credit}} = 3.22$, $M_{\text{pain, cash}} = 3.30$: $F(1, 589) = 8.32$, $p < .01$, $\eta = .12$), which is exacerbated for high-priced items ($M_{\text{pain, credit high}} = 3.52$, $M_{\text{pain, cash high}} = 3.77$: $F(1, 589) = 14.99$, $p < .001$, $\eta = .16$). Consequently, although the main effect of credit cards on WTP is insignificant (vs. cash: $M_{\text{WTP, credit}} = 68.61$, $M_{\text{WTP, cash}} = 57.17$: $F(1, 589) = 2.44$, $p = .11$, $\eta = .06$), we observed a positive interaction with high-priced items ($M_{\text{WTP, credit high}} = 75.06$, $M_{\text{WTP, cash high}} = 54.74$: $F(1, 589) = 11.52$, $p < .001$, $\eta = .14$). In summary, Study 3 matches our previous findings and replicates the credit card premium from extant literature.

4 Conclusion

4.1 Research contributions

We added mobile technology to the literature on payment methods, following calls for research (Shankar et al. 2016) to analyze "real-world payment scenarios [in a setting with] competition between mobile and other payments" (Dahlberg et al. 2015, p. 274). We establish convenience as novel mediator of the relationship between the means of payment and WTP, finding that mobile payment, if adopted by the individual consumer, can be superior (increased consumers' WTP) to other payment methods (herein, credit cards) through greater convenience of paying, although the pain of paying does not differ between

the methods. However, that superiority depends on adoption, as novel moderator of the effect of means of payment: convenience perceptions of a payment means can only be high when consumers have used the technology. Including convenience and adoption in an assessment of the effects of mobile versus other means of payment is conceptually necessary, because it would lead to different predictions. The pain of paying does not differ between the different payment means in the investigated countries. Consequently, retailer would expect a similar WTP effect for mobile payment as for credit cards. However, because convenience matters and adoption varies, mobile payment can either lead to a higher WTP (for customers who adopted the technology) or lower WTP (for customers who did not adopt the technology). We thus explain the absence of a significant difference between credit cards and mobile pay in extant research (Falk et al. 2016) with a similarity of pain of paying. Because extant research used single-country settings to assess the effect of means of payments, adoption as a moderator could not have surfaced. Therefore, our research aligns with previous works that stresses the moderating role of country-level variables (Angulo-Ruiz et al. 2016). Through individual adoption, the findings of this research should be applicable to new payment forms that emerge in the future (e.g., paying with a smart jewelry or in further future even contact lens, Gemalto 2017).

Our contribution also builds a bridge to the diffusion and international marketing literatures (Chandrasekaran and Tellis 2008; Mallat 2007). Within the payment method literature, it emphasizes the role of positive effects (i.e., convenience of paying), in contrast to extant findings (e.g., the “credit card effect”), which focus on negative aspects (i.e., pain of paying).

4.2 Managerial implications

Although our research shows that a convenience-driven effect of mobile payment on WTP depends on adoption, retailers might be happy about this conditionality: as everybody who wants to pay by mobile phone has already adopted to the technology, retailers might use the means of paying to price discriminate. For all those customers that have not yet adopted to mobile payment, we recommend that retailers promote first time mobile payments in stores (e.g., through special discounts) to increase adoption. Thereby, retailers capitalize on the reciprocal relationship of adoption between customers and retailers that was highlighted by recent literature (Lee et al. 2019). As our findings hold not only on the individual but also on the country level, we recommend country managers to consider average adoption rates of payment technology and their adoption forecasts, when deciding which payment technology to focus on. Traditional payment service providers (e.g., Visa, MasterCard, American Express) should develop mobile payment formats (i.e., apps), as adoption of this technology will likely increase in most countries, with some emerging economies potentially showing a leapfrog development from cash to mobile pay (similar to India and China). Policy makers can foster the development through regulation and can realize the WTP benefit when they make paying for public services easy (e.g., public transportation, official enquiries). In general, but particularly in countries with low adoption, retailers and payment solution providers should emphasize convenience gains of mobile payment in their communication activities

4.3 Limitations and future research

First, future research should replicate our findings beyond India, the United States, and Germany; African countries, where mobile payment is ubiquitous and cash usage is limited, would be a particularly interesting setting to see how a missing adoption of cash

affects consumer behavior. Second, although all studies support the positive effect of convenience on WTP, the magnitude varies. This might be due to the sample characteristics (e.g., students and Amazon Turk), chosen scenarios (based on established literature but subject to cultural influence), and single-item scales. The differences should be systematically researched in the future. Third, to better understand the psychological processes behind the acceptance of payment technologies, micro-level studies with more individual characteristics (e.g., individual-level consumer innovativeness; Goldsmith and Hofacker 1991) or economic restrictions, like income, which have been shown to influence the use of payment means, (Greenacre and Akbar 2019) would complement our research. In such an investigation, it would also be interesting to explore drivers or boundary conditions for the applicability of both potential mediation routes (through convenience and pain of paying).

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Appendix:

	Study 1						Study 2						Study 3		
Country	US			India			Germany			India			Condition		
Condition	**Cash**	**Credit card**	**Mobile payment**	**Cash**	**Credit card**	**Mobile payment**	**Cash**	**Credit card**	**Mobile payment**	**Cash**	**Credit card**	**Mobile payment**	**Cash**	**Credit card**	**Mobile payment**
n	149			101			231			63			81	67	56
WTP_{Cafe}	2.78 (1.02)	2.65 (0.83)	2.34 (0.83)	1.95 (1.53)	1.58 (0.97)	2.14 (1.26)	2.89 (1.42)	3.17 (1.40)	3.06 (1.48)	2.23 (0.80)	2.02 (1.06)	2.43 (0.70)	63.16 (32.91)	67.69 (30.28)	63.63 (33.94)
WTP_{Beach}	2.97 (1.01)	2.95 (1.00)	2.57 (1.01)	1.98 (1.37)	1.66 (0.74)	2.00 (1.03)	4.11 (1.68)	4.28 (1.61)	4.11 (1.71)	1.74 (1.11)	1.60 (1.10)	1.92 (1.06)	56.02 (30.35)	56.63 (33.35)	50.09 (31.51)
$WTP_{Vending}$	16.57 (8.38)	15.58 (8.07)	14.62 (7.37)	12.3 (13.88)	8.15 (5.47)	11.12 (8.63)	17.00 (9.68)	19.17 (9.07)	18.28 (9.34)	12.06 (8.77)	13.07 (10.78)	14.07 (10.17)	-	-	-
WTP_{Gas}	-	-	-	-	-	-	-	-	-	-	-	-	62.59 (30.00)	79.37 (27.14)	68.20 (29.71)
$WTP_{Dishwasher}$	-	-	-	-	-	-	-	-	-	-	-	-	46.89 (31.97)	70.75 (28.31)	53.55 (30.95)
$Pain_{Cafe}$	3.18 (1.19)	2.44 (1.07)	3.09 (1.16)	2.61 (1.13)	3.12 (1.37)	2.06 (1.21)	2.72 (1.38)	3.39 (1.31)	2.61 (1.39)	2.95 (1.22)	3.05 (1.54)	3.62 (1.34)	2.93 (1.19)	2.93 (1.05)	2.70 (1.08)
$Pain_{Beach}$	2.89 (1.13)	2.44 (1.37)	2.87 (1.21)	2.03 (1.22)	3.32 (1.20)	1.94 (1.15)	2.50 (1.40)	3.17 (1.36)	2.50 (1.31)	3.00 (1.12)	2.95 (1.54)	3.48 (1.27)	2.74 (1.34)	2.93 (1.25)	3.13 (1.08)
$Pain_{Vending}$	3.36 (1.12)	2.63 (1.20)	2.87 (1.15)	2.78 (1.29)	2.47 (1.31)	2.00 (1.26)	2.11 (1.16)	3.39 (1.27)	2.44 (1.18)	3.10 (1.20)	3.33 (1.44)	3.57 (1.27)	-	-	-
$Pain_{Gas}$	-	-	-	-	-	-	-	-	-	-	-	-	3.35 (1.25)	3.12 (1.17)	3.09 (1.03)
$Pain_{Dishwasher}$	-	-	-	-	-	-	-	-	-	-	-	-	4.19 (1.05)	3.93 (1.11)	3.71 (1.25)
Convenience Cafe	3.93 (1.11)	4.48 (0.82)	4.4 (0.80)	4.03 (1.16)	3.38 (1.56)	4.48 (0.85)	2.50 (1.51)	3.61 (1.43)	3.28 (1.535)	3.19 (1.31)	3.38 (1.63)	3.62 (1.10)	3.94 (1.22)	4.22 (0.93)	4.02 (1.09)
Convenience Beach	3.7 (1.21)	4.19 (1.07)	4.47 (0.80)	4.17 (1.00)	2.76 (1.62)	4.29 (0.94)	2.61 (1.43)	3.56 (1.22)	3.11 (1.54)	3.14 (1.13)	3.33 (1.57)	3.62 (1.14)	3.74 (1.28)	3.99 (1.17)	3.79 (1.33)
Convenience Vending	3 (1.32)	4.63 (0.82)	3.96 (1.28)	3.56 (1.32)	3.97 (1.24)	4.39 (0.84)	2.17 (1.27)	3.78 (1.09)	3.00 (1.47)	3.05 (1.10)	3.52 (1.49)	3.76 (0.98)	-	-	-
Convenience Gas	-	-	-	-	-	-	-	-	-	-	-	-	2.59 (1.39)	4.36 (1.00)	3.93 (1.14)
Convenience Dishwasher	-	-	-	-	-	-	-	-	-	-	-	-	2.40 (1.39)	3.87 (1.22)	3.68 (1.25)
Age	35.87 (9.61)			32.18 (7.07)			26.58 (5.46)			27.19 (2.64)			35.25 (10.81)	36.03 (11.09)	35.04 (11.32)
$Gender_{Female}$	-	-	-	-	-	-	-	-	-	-	-	-	0.4125	0.4179	0.4107

Table A.1: Means and standard deviations in all conditions

	Study 1		Study 2	
Dependent variable:	**Convenience**	**zWTP**	**Convenience**	**zWTP**
Model:	**(1)**	**(2)**	**(3)**	**(4)**
Payment method	–.07	–.16**	–.10*	–.04
(0=credit card 1=mobile payment)	(.13)	(.11)	(.13)	(.09)
Country	–.44***	–.11	.01	–.09
(0=US/Germany 1=India)	(.14)	(.16)	(.19)	(.14)
India × mobile	.40***	.25**	.12*	.10†
(Interaction: high adoption and mobile payment)	(.20)	(.17)	(.27)	(.20)
Convenience	—	.14*	—	.05*
		(.04)		(.04)
Pain	—	.06	—	–.09
		(.04)		(.04)

Table A.2: Studies 1 and 2: Model specifications and results
Notes: standardized β; † $p < .10$; * $p < 05$; ** $p < .01$; *** $p < .001$

	Study 1				Study 2				Study 3			
Dependent variable:	**Convenience**		**zWTP**		**Convenience**		**zWTP**		**Convenience**		**zWTP**	
Model:	**(1)**		**(2)**		**(3)**		**(4)**		**(5)**		**(6)**	
Payment method	.01		–.15	*	–.11	*	–.05		–.24	**	–.12	
(0=credit card 1=mobile payment)	(.15)		(.12)		(.14)		(.09)		(.20)		(.14)	
Country	–.18	**	.15	**	.04		–.02		—		—	
(0=US, Germany 1=India)	(.11)		(.10)		(.16)		(.12)					
Adoption	–.00		–.18	**	.02		–.08		–.05		.07	
(0=not adopted 1=in use)	(.15)		(.12)		(.18)		(.13)		(.14)		(.10)	
Adoption × mobile	.19	*	.19	*	.11	†	.09		.22	*	.08	
(Interaction: adoption and mobile payment)	(.17)		(.17)		(.23)		(.18)		(.26)		(.19)	
Price	—		—		—		—		.02		.21	***
(0=low, 1=high)									(.14)		(.10)	
Price × mobile	—		—		—		—		.04		–.11	
(Interaction: high price and mobile payment)									(.27)		(.19)	
Price × adoption × mobile	—		—		—		—		–.11	+	–.02	
(Interaction: high price, mobile payment, and mobile adoption)									(.31)		(.19)	
Convenience	—		.13	*	—		.05	*	—		.40	***
			(.04)				(.04)				(.04)	
Pain	—		.0		—		–.10		—		–.23	***
			(.04)				(.04)				(.03)	
Income	.09	†	.15	**	—		—		.16	***	.06	
	(.02)		(.02)						(.02)		(.02)	
Age	.08	†	.03		.02		.01		.17	***	–.06	
	(.01)		(.00)		(.01)		(.01)		(.00)		(.00)	
Gender	–.03		–.05		—		—		–.13	**	–.11	**
	(.11)		(.09)						(.11)		(.08)	

Table A.3: Studies 1,2, and 3: Model specifications and results with demographic control variables
Notes: standardized β; † $p < .10$; * $p < 05$; ** $p < .01$; *** $p < .001$

Appendix II: Behavioral Consequences from Converging Channel Capabilities: The Effect of Mere Electronic Shelf Label Presence on Store Revenue

Submitted to Interactive Marketing.

Following is the submitted manuscript.

Behavioral Consequences from Converging Channel Capabilities: The Effect of Mere Electronic Shelf Label Presence on Store Revenue

Abstract:

As a strategic imperative, today's retailers increase the integration of their channels. Electronic shelf labels (ESL) currently replace paper tags to technologically enable the omni-channel transformation, by aligning price and product information presentation between on- and offline channels. Consumer reactions to ESL are yet unexplored: the fear of frequent price changes, known from online channels, could spread to offline channels and reduce consumer purchase intent and overall revenue. In contrast, ESL could prevent showrooming from signalling price consistency and offering consistent information (e.g., reviews) between the on- and offline channels. We explore a retailer data set that allows us to isolate the "mere ESL effect", as the retailer's pricing strategy was constant over the introduction of ESL (e.g., no dynamic pricing). A difference-in-difference analysis establishes that overall revenue and visitor numbers are not affected by an ESL introduction (keeping prices constant), but those categories that receive ESL gain revenue, while the remaining categories lose. This finding supports further channel integration as it might help to prevent consumer behavior that is targeted at exploiting channel differences (i.e., showrooming for price or more information).

Keywords:

Retail channel integration; price presentation; electronic shelf label; retail innovation

1. Introduction

Following the omni-channel paradigm (Verhoef, Kannan, and Inman 2015), retailers are increasingly integrating their sales channels (Herhausen et al. 2015), for instance along the customer journey (e.g., click and collect: Gao and Su 2016). Additionally, retailers develop the technical capabilities of brick and mortar stores, aiming to copy the capabilities of the online channel (Betancourt et al. 2016; e.g., through WLAN customer tracking with: Fung 2013; in-store tablet computers: Blázquez 2014). One of these technical developments, and the focus of this analysis, are electronic shelf labels (ESL, Varadarajan et al. 2010). ESL are digital and connected price displays for stores. As such, ESL copy online stores in two aspects: first, ESL offer a digital way to present more comprehensive and up-to-date price and product information (e.g., user reviews); second, they allow the retailer to quickly change the price (e.g., in reaction to competition) or align it between channels (e.g., with the online store). This research investigates customer reactions to the introduction of ESL.

ESL are increasingly common in retail: the technology has a global market of USD 400 million that is expected to annually grow 15% until 2022 (TechnavioResearch 2017). 72% of US retailers were investing into this technology in 2018 (Bhutani and Bhardwaj 2018). Three reasons are driving the adoption of electronic shelf labels: (1) operational cost savings and (2) the potential to increase revenue through better pricing strategies, potentially to counter growing pressure from online retailers (e.g., through more dynamic pricing). The (3) revenue effect of consumer reactions to the mere presence (i.e., without enacting dynamic pricing) of ESL, which we refer to as "mere ESL effect" – is yet unexplored. The latter is the focus of this research.

We suggest that a revenue effect of ESL can arise even in the absence of changes in the pricing strategy, as consumer react to the mere presence of ESL. However, the direction

of this “mere ESL effect” is not clear a priori. On the one hand, ESL aligning store and online capabilities in terms of pricing might create a negative reaction: it might impose the fear of price unfairness to store visitors (e.g., through threatening dynamic or personalized pricing, commonly discussed in an online context: Garbarino and Lee 2003). Consumer rights organizations often highlight ESL as a phenomenon that unsettles consumers because the latter fear “the era of supermarket flutter prices” (Gassmann 2017) and lose trust into the price fairness of a retailer (Campbell 1999). Trust into fair pricing and changes in the retail environment have been shown to influence consumer behavior (Burke 2002). Similarly, online customers are often more price sensitive and less loyal, potentially causing them to more quickly change stores (Ansari, Mela, and Neslin 2008). This could reduce purchase intention or even consumers’ willingness to visit stores with ESL in the first place. On the other hand, extant research showed that retailers profit from channel integration (Herhausen et al. 2015) as it diminishes consumers’ reasons for showrooming behavior, such as searching for a better price or more information (Gensler, Neslin, and Verhoef 2017). For instance, ESL might signal that on- and offline prices are aligned in a consistent pricing strategy (Zhang et al. 2010). Additionally, ESL can display more extensive information usually only available in online stores, such as average ratings from other users’ reviews. Additionally, ESL might positively influence the store image, as, consumers value innovative technology in the retail context (Dickson and Sawyer 1990; Grewal et al. 2011) and ESL may offer consumers just that (e.g., Garaus et at 2016).

To answer the research question of whether the mere ESL effect positively or negatively impacts revenue, we investigate sales data from a large European home furnishing retailer that introduced ESL. We conduct a difference-in-difference analysis for two similar stores: a treated and a control store. In the Treated Store, ESL was introduced for a third of

the categories, without changing the pricing strategy, enabling us to investigate the mere ESL effect both between stores and with a within-store perspective that controls for potential unobserved external effect. Although we find no overall revenue effect of an introduction of ESL, our research establishes a positive revenue effect in those categories which received the ESL at the cost of the non-ESL categories. Furthermore, we demonstrate that customers do not abandon a store after ESL is introduced. This supports extant research which highlights the positive consumer behavior effects of channel integration (e.g., Herhausen et al. 2015; Cao and Li 2015).

Our research contributes in three dimensions. First, we offer, to the best of our knowledge, the first investigation into the revenue impact of ESL, through isolating consumer reactions to the mere presence of ESL. Thus, we answer calls for research on consumer reactions to innovative retailing technologies (Blut, Teller, and Floh 2018; Grewal, Roggeveen, and Nordfält 2017) and detail consumer reactions to a specific means of omni-channel integration (Saghiri et al. 2017) with a quasi-experiment longitudinal design (Herhausen et al. 2015; Li et al. 2018). Our findings are also substantively relevant for retail managers who are looking for means of integrating their channels (Cao and Li 2018) or store managers who already operate a store with ESL. Second, by quantifying the mere ESL effect, we offer a baseline for future investigations of changes in the pricing strategy (e.g., flexible pricing). Finally, we extend our understanding to the applications of ESL beyond grocery, thus answering explicit calls for research (Garaus, Wolfsteiner, and Wagner 2016; Grewal et al. 2011).

2. Theoretical Foundations

2.1 Retailer motivation

Retailers have been using multiple means to align their sales channels' capabilities. For instance, online shops offer video live chats (e.g., IKEA Sweden offering shopping support and customer service: Ecommerce Guide 2019) in an attempt to offer the same consulting as in the store. In offline stores, many technological advances aim at replicating the capabilities of the online shop, such as tablet computers which provide an overview of the whole assortment (Graham 2019) or the offer to have the purchased product conveniently delivered to one's home (Piotrowicz and Cuthbertson 2014). One such integration technology are ESL: small devices, that provide consumers with price (e.g., unit price, or discount price) and product information (e.g., review rating, country of origin) on a liquid crystal display (LCD) or electronic paper technology (e-ink) (Soutjis, Cochoy, and Hagberg 2017). ESL were first introduced in the United States in 1985 but they required further technological advancements to become a more widespread phenomenon (Solomon and Deeter-Schmelz 1993). Data integration, for instance, constituted a key obstacle to integrating retail channels (Zhang et al. 2010). ESL overcome this with regards to price information: Each price tag is connected to a central database and the cash register system through infrared technology or radio frequency (Garaus, Wolfsteiner, and Wagner 2016), which can either be used for a store-by-store adjustment, or an alignment between stores and the online channel.

Three motivations for retailers to introduce a new technology to their stores (e.g., ESL, mobile payment, in-store wireless internet) have been discussed in the literature: (1) reduced costs, (2) enhanced performance by improving the pricing strategy (e.g., through price discrimination), or (3) integrating channels by bringing the online shopping experience offline.

As first motivation, shrinking margins require cost reductions and ESL can lead to reduced *operational costs* for providing price information. ESL reduce the so-called menu costs of pricing (Stamatopoulos, Bassamboo, and Moreno 2017), by automating the error-prone and costly (up to 0.70% of store revenue: Levy et al. 1997) process of attaching paper price labels to shelfs for every single stock unit. In this, integrating the pricing displays between on- and offline can serve as route to cost efficiency (Tagashira and Minami 2019). Second, ESL might enable a *revenue increase* through *price flexibilization and discrimination*. Specifically, retailers can use new pricing strategies like targeted pricing (e.g., based on time of day), zone pricing based on distance to a store (Cebollada, Chu, and Jiang 2019), adopt dynamic pricing, or apply other new short-term promotion strategies (Gedenk, Neslin, and Ailawadi 2010) to increase revenue and profitability per transaction. Third, and the focus of this research, retailers might use ESL as means of integrating their channels (Cao and Li 2018) in an attempt to *perceivably align their channel specific marketing mix* (Varadarajan et al. 2010). Specifically, ESL provide established online store functionality in a brick and mortar store (Grewal, Roggeveen, and Nordfält 2017): For instance, retailers can use the electronic display to show user generated content, such as consumer reviews to increase purchase intention (Jumin, Park, and Han 2011). Additionally, retailers might present up-to-date stock level information, recommend similar products (e.g., to influence consumers' product choice: Senecal and Nantel 2004), or even highlight price advantages (e.g., to lower search intention for lower prices: Ahmetoglu, Furnham, and Fagan 2014).

2.2 Extant literature on ESL

Extant research has so far focused on the general perception, potential operational cost savings, and the implementation of ESL, disregarding both consumer reactions to retailer

attempts to increase revenue through price flexibilization (motivation 2) or ESL as means of channel integration (without explicit price changes; motivation 3). Table 1 provides an overview. Multiple research contributions (e.g., Garaus, Wolfsteiner, and Wagner 2016; McKenzie and Taylor 2016; Soutjis, Cochoy, and Hagberg 2017) suggest, but do not empirically investigate, that ESL can theoretically have a positive revenue effect through more flexible pricing. However, how consumers might react to such practices – or their threat – is not investigated. Therefore, we hope to close a research gap through researching the revenue impact of the mere presence of ESL for non-groceries.

Research dimension	Article	Findings	Revenue effect suggested	Revenue effect tested
General perception	Garaus et al. 2016	Consumers accept ESL and perceive them as easy to use, regard ESL labeled products as higher quality, and see stores that use ESL with a better image, but are unsure of the main ESL benefits	✓	✗
	McKenzie and Taylor 2016	Seeing ESL, consumers think about accuracy, errors and technical breakdowns as both, potential advantages and disadvantages	✓	✗
	Goodstein and Escalas 1995	Consumers trust increases due to higher price accuracy as reduced discrepancy between shelf price and checkout price	✗	✗
	Solomon and Deeter-Schmelz 1993	Consumers have a positive attitude towards ESL, wish for other stores to implement the technology, assume more accurate pricing but no price increase, and ask for more information about ESL	✓	✗
Operational efficiency	Soutjis et al. 2017	In stores, ESL do not replace paper prices, instead they are combined with paper labels, because they have better feature representation, but enable retailers to adjust prices quickly	✓	✗
	Stamatopoulos et al. 2017	ESL improve retail performance because they increase gross margins and sell more quantity through more frequent and smaller downward price changes	✓	✗
	Grewal et al. 2011	ESL enable better possibilities for pricing (e.g., dynamic pricing), promotion offers, and targeting and create higher effectiveness	✓	✗
	Zhou et al. 2009	Framework that helps stationary retailers to compete with online offerings through dynamic pricing strategies based on a membership card	✓	✗
Technical implementation	Yin-ping and Wen-rui, 2017	ESL functions like real-time data receiving, sending, displaying can be enabled through simple technology	✗	✗
	Zhou et al. 2013	Introduction of ultra-low-power ESL with wireless communication base station modules and MAC and router protocols based on Wireless Sensor Network (WSN)	✗	✗
Revenue effect	This manuscript	ESL increase revenue in ESL-treated vs. non-ESL-treated categories	✓	✓

Table 1: Overview of extant literature on ESL and our contribution

2.3 The mere ESL effect on revenue

Potential negative effects of ESL: Pricing research, while not studying ESL directly, suggests that ESL might be negatively perceived because of the mere *possibility* of frequent price changes (in contrast to paper-based shelf labels). The overall price image of a store influences consumers purchase intent (Ho, Ganesan, and Oppewal 2011). Integrating on- and offline pricing capabilities might, hence, spread consumers' fear of price discrimination from

the online (Garbarino and Lee 2003) to the offline stores. Further, ESL could enable a pricing frequency similar to what is currently already common at many gas stations (i.e., changes by the minute). The majority of shoppers, however, dislike the concept of frequently changing prices (Burke 2002), resulting in lower intention to purchase (reducing revenue) with the respective retailer (Campbell 1999). This perception is mainly driven through consumers aiming to prevent or reduce (price) uncertainty, potentially delaying their purchases (Mazumdar and Jun 1992; Shiu et al. 2011).

Furthermore, fairness perceptions might alter consumers' willingness to purchase at a given retailer. Whether consumers perceive a price as fair or unfair depends largely on their trust towards the retailer and the purchase circumstances. Customers understand the necessity for different prices due to higher transaction cost (Thaler 1983). Some examples include seasonality for booking a hotel, perishability for buying grocery, and changing crude oil prices. Consumers even accept price increases to sustain a reasonable profit margin but consider price increases due to higher demand unfair (Kahneman et al. 1986). Regularly returning customer of a retail store must have trust because they show "the willingness […] to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action […]" (Mayer, Davis, and Schoorman 1995, p. 712). In a retail environment, where product choice is complex, trust is vital to ease the decision making (Eberhardt, Wobker, and Kenning 2015). Despite the fact that consumers know about frequently changing prices (e.g., in grocery retail due to perishable goods), they would be suspicious about other price changes from a dynamic pricing strategy, as the consumers fear overpaying (Ahmetoglu, Furnham, and Fagan 2014). Additionally, research on the price image of a retailer suggests that the mere possibility of dynamic pricing could negatively

affect a store's price image thereby reducing consumer spending (Hamilton and Chernev 2013).

Summing up, extant research suggests that consumers anticipate dynamic pricing efforts and react negatively to them, even in absence of an actual change in pricing strategy. We refer to it as the *negative mere ESL effect*.

Potential positive effects of ESL: On the other hand, introducing ESL may lead to a *positive mere ESL effect*: We find reasons for positive consumer reactions from an improved consistency between the on- and offline store: (1) ESL might serve as signal of price consistency between channels, and they enable (2) consistent presentation of price and product information (e.g., reviews). Additionally, two factors might influence the overal store image: (3) perceptions of store innovativeness through ESL as novel technology and (4) an improved perception of the shelves as a whole.

First, ESL could signal price consistency between the on- and offline channels. The explanation would run exactly contrary to the above-describe negative trust-based effects of ESL. Specifically, ESL might serve as a positive signal of attractive prices. Many consumers believe that online prices are on average lower than offline (Gensler, Neslin, and Verhoef 2017). For instance, the offline channel is incapable of offering special discounts common online. An example would be a flash sale online (e.g., two-hour 20% of all electronics) that without ESL could only be integrated in a brick and mortar environment with substantial effort (e.g., extra displays for information, temporary exchange of many shelf labels for a short time) or an extensive time period (e.g., start the sale earlier or have it all day which would potentially result in lost revenue). Further, the market environment forces retailers to counter competitive price changes (Zhou, Tu, and Piramuthu 2009) especially online (Wolk and Skiera 2009), but the high effort of product repricing prevents these changes from being

applied offline. This, in turn, might create uncertainty over the offline prices and, in turn, lead to channel migration (e.g., mobile price check in store: Grewal et al. 2018). ESL, therefore, might help to reduce perceived price inconsistencies between the channels.

Consumers generally appreciate integration between sales channels (Herhausen et al. 2015). Omni-channeling implies consistency across the whole marketing mix (e.g., available products across channels, Verhoef, Kannan, and Inman 2015) and distribution-related services (Betancourt et al. 2016). Using a way of price presentation similar to the online shop might, further, imply price consistency, which would reduce price uncertainty and increase willingness to accept (Okada 2010). Indeed, many retailers already offer price guarantees, which essentially offer consumers the same price compared to the cheapest online store (Nalca 2017). ESL, thus, can help to overcome the information differences (Bell, Gallino, and Moreno 2013) and ascertain consumers that prices are consistent between a retailer's channels (Li et al. 2018). This should positively affect purchase intention and revenue, as perceived price differences are a core motivation for showrooming (Gensler, Neslin, and Verhoef 2017).

Second, consistency in the presentation of product information might positively affect purchase intention. Empirical findings show that changes in how prices are displayed affect consumer behavior and purchase intention (Zeithaml 1982). Many attributes of a price label influence consumer perceptions (e.g., coloring price labels red: Puccinelli et al. 2013). This should also be true when retailers adopt their offline price presentation to mimic the presentation in online stores. Digital channels offer greater information efficiency (Pauwels et al. 2011), but lack the option to try and test the product (Avery et al. 2012). Therefore, online shops often present more detailed information compared to offline stores (Betancourt et al. 2016, e.g., product characteristics specifications, reviews), in an attempt to ameliorate

product uncertainty (Weathers, Sharma, and Wood 2007). ESL enable retailers to present similar information offline (Bhargave, Mantonakis, and White 2016). Figure 1 shows the consistency between online and offline product information presentation of a German electronics retailer using ESL: both presentations show similar price, product information and provide product ratings. This information integration might prevent showrooming, as consumers do not have to search for the additional information online (Gensler, Neslin, and Verhoef 2017).

Figure 1: Example of ESL presenting information consistently with the online store (images taken on October 05, 2019)

Prior to purchase, consumers appreciate such additional product information (Bell, Gallino, and Moreno 2013), especially product reviews (Jumin, Park, and Han 2011). Retailers using modern ESL, increasingly present such reviews and information offline (e.g., in the Amazon book stores). Consequently, ESL enable stores to systematically provide price and additional information in a structured manner, similar to their online stores where users intuitively know where to expect price and product information. This would not be possible with paper labels, as the latter hold less information and are infeasible to update (e.g., when the average product rating changes). ESL might, thus, offer the best of both (channel) worlds to the consumer, by integrating the information capabilities of the online channel with the experience capabilities of brick and mortar stores (Avery et al. 2012).

Two additional advantages of ESL relate to the overall perception of the store. Third, innovation in a retail store may constitute a competitive advantage. Younger shoppers demand technological innovation in a retail channel (McKenzie and Taylor 2016). Electronic shelf labels are such an innovative technology (Solomon & Deeter-Schmelz 1993) as they allow more detailed information, such as nutrition information for grocery shopping or detailed specifications for electronics.

Figure 2: ESL introduction increased easier readability and price processing for consumers

Finally, ESL might have a positive effect on the overall tidiness perception of the shelves. As ESL are rarely ripped of shelves (in contrast to pulled or unreadable paper price tags) consumers are less irritated due to missing prices (D'Astous 2000). Additionally, the similar structure of all ESL in a retail store and the superior readability of e-ink compared to paper based price displays (Siegenthaler et al. 2011) facilitate price information processing (Bettman 1975). For some visual examples, see Figure 2, which highlights that ESL may improve the overall perception of the shelf: in contrast to disposable and cheap paper labels,

they signal an investment into quality and usability. Research highlighted that well organized shelves (e.g., a clear link between actual product and price tag) increase revenue and foster a better customer satisfaction (Drèze, Hoch, and Purk 1994; Fancher 1991).

2.4 Hypotheses

In summary, drawing on non-ESL research, we could argue for both, a negative mere ESL effect, driven by anticipations of potential price changes, and a positive mere ESL effect, driven on a category level by higher price and information consistency, and at a store level by improved innovativeness perception and product presentation. We suggest that the positive mere ESL effect should outweigh the negative mere ESL effect for two reasons, especially for categories where ESL is introduced. First, anticipations of the unintended dynamic pricing likely require actual experiences to develop. Only after frequent price changes are personally experienced (e.g., when the price changes at the gas station upon approach), consumers are likely to adjust their behavior. This should not be the case for situations of a mere ESL effect (i.e., without changes to the pricing policy). In contrast, benefits of ESL become effective immediately and should, thus, improve the product and store perceptions from the start.

Second, integration of the information from the online store into the offline product presentation is likely to increase consumer utility directly at the product (vs. at the store level), potentially having a more direct effect on purchase intention. Also adoption literature found that consumers value available information on the ESL, perceive ESL as easy-to-use with a positive influence on product quality, but no effect on price fairness perception (Garaus, Wolfsteiner, and Wagner 2016; Solomon and Deeter-Schmelz 1993). Additionally, the comparison of ESL and paper shelf label hardware also showed no difference for price fairness in general (Garaus, Wolfsteiner, and Wagner 2016). Thus, we expect the positive

mere exposure effects to outweigh the negative in general and specifically when categories with ESL are compared with categories without ESL (H2). As the overall effects (improved innovativeness perception, improved shelf perception) are less directly related to a purchase, we expect a weaker effect. Nevertheless, we hypothesize to test for an overall effect:

H1: Introducing ESL has a positive effect on revenue.

However, the overall positive effect might only strongly apply to those categories, which receive ESL and where prices and information are consistent on- and offline, while others are not affected. Therefore, we specify the more general hypothesis to:

H2: Introducing ESL has a positive effect on revenue in those categories for which ESL is introduced.

3. Empirical Research

3.1 Data description and methodology

To assess the mere ESL effect on retailer revenue, we obtained data from a large home furnishing retailer that operates over 100 brick and mortar stores in a major European market, as well as a smaller online shop. The retailer's largest categories are beds, sofas, and kitchen, which generate 45% of the total revenue. But products are also available in thirteen other categories (e.g., carpets, floor materials, curtains; see the Appendix for a full list of the categories and descriptive statistics and a correlation matrix). The data set consists of daily categorical revenue and visitor numbers from two comparable retail stores between March 01, 2016 and March 31, 2017 (13 months). The retailer applied a multiplier to all visitor and sales data, in order to sanitize the actual sales data; therefore, we report all financial figures in monetary units (MU). The retailer introduced ESL in the treatment store in the middle of our dataset period (September 23, 2016). We treat the introduction as "event", whose effect we will model.

We chose the difference-in-difference (DID) approach, as this quasi-experimental setup allows to control for unobserved variables (Meyer 1995). This approach is frequently used for analyzing technical changes in retailing (e.g., studying shopping behavior after mobile channel introduction: Han et al. 2013; Huang et al. 2016) and marketing research (e.g., analysing purchasing behavior after offline movie rental closure: Zentner, Smith, and Kaya 2013), because many potentially relevant variables in this context are difficult to observe (Avery et al. 2012). We compare a "treated" store, in which ESL was introduced, with a "control" store, which did not receive ESL. This comparison, therefore, controls for unobserved *across-store effects* (e.g., overall demand reduction for home furnishing, product seasonality).

The challenge in DID approaches lies in ensuring comparability between the stores (Avery et al. 2012). For instance, the selection of the ESL store might have been endogenous, for instance because the latter was best suited for a new technological innovation (e.g., due to higher income in the catchment area). Absolute differences between the stores are not critical for a DID analysis, but control and treatment store should not follow different trends (Lechner 2011). We, therefore, matched the ESL store with the non-ESL store in any characteristic which might generate a different trend in customer behavior (characteristics selected in discussion with the management of the retailer): we selected two stores which were comparable in terms of a broad set of influence variables (e.g., product range, average purchasing power of visitors in the specific area, urban vs. rural location, store size, and average daily revenue and visitors). Further, senior management of the retailer stated that the selection of the ESL store was not strategic in terms of revenue potential, but rather driven by hopes to reduce menu costs. In summary, the DID comparison should control for unobserved

across-store effects and the store matching ensures a like-for-like and non-endogenous comparison.

Still, unobserved *between-store effects* might bias the comparison. For instance, a competitor might have opened a shop in the proximity of one of the stores. Further, one of the stores might have received additional advertisement to attract customers, which might increase overall store sales – an endogenous behavior which is common in retail after changes in the retail channels (Ansari, Mela, and Neslin 2008) or store openings (Pauwels and Neslin 2015). In the present case, such differences seem unlikely: managers of the retailer stated that no specific actions were taken to support the introduction of ESL (e.g., additional marketing) or other distortions were observed (e.g., competitive action). Additionally, we could control for potential between-store effects through exploiting the panel structure of the sales data: as the retailer did not introduce ESL in all of the categories, but only in ten of sixteen (e.g., carpets, wallpaper, curtains), we can compare the performance of the ESL categories with those that did not receive ESL. We, therefore, compute category-specific differences between the stores, which enable us to investigate the effect of ESL introduction in a panel model of the different categories over time. This categorical DID should control for all remaining, potentially unobserved between-store effects.

Importantly, as the introduction of ESL was not accompanied by changes in the pricing strategy (e.g., more variable pricing), because the ESL introduction was integrated to reduce menu costs and offer additional price information, consumer reactions should not be affected by potential price changes. Specifically, store management did not use the ESL to more frequently adjust prices or price-discriminate in any form, but rather used the same company-wide prices as before. The ESL store, therefore, offers an ideal testbed for the mere ESL effect on revenue, as a primary revenue effect from changes in the pricing strategy (e.g.,

revenue increase from temporal price discrimination) and consumer reactions to a pricing strategy change are excluded. We, thus, can assess a baseline effect for the introduction of ESL. In summary, our unique data set enables us to control for across- as well as between-store effects and to isolate the mere ESL effect.

3.2 Model specification

For each day *t* we first computed ratios (relative differences) for all revenues in category *i* (see equation [1]) and overall visitor numbers (see equation [2]) in our matched sample. Please note that an increase in the ratio indicates that the Treated Store improves versus the Control Store.

$$[1] \qquad RevenueRatio_{i,t} = \frac{Revenue_{Treated-Store,i,t}}{Revenue_{Ccontrol-Store,i,t}}$$

$$[2] \qquad VisitorRatio_{t} = \frac{Visitors_{Treated-Store,t}}{Visitors_{Ccontrol-Store,t}}$$

Two categories exhibited unusually large variance in the ratios of their revenue: While the revenue ratio varied within one standard deviation for all except two categories, two categories showed a large variance in the revenue ratio (whole kitchens: $\sigma_{\text{Ratio Treated Store/Control Store}} = 2.23$; living room wall units: $\sigma_{\text{Ratio Treated Store/Control Store}} = 4.14$). The reason for this large variance is their infrequent sales (e.g., daily sales vary by factor 10), combined with high prices. We, therefore, exclude these categories from the analysis, in line with prior research with categorical panels (Bang et al. 2013). We also excluded a limited number of sales days (4% of total sales days) with false (e.g., internal accounting adjustments, flagged by the retailer) and missing data entries (e.g., public holidays).

We model the "event" of introducing ESL with step, point, and count dummies, in line with extant research (Deleersnyder et al. 2002). First, the dummy "Time Step" is zero prior to the implementation and one after the implementation (Huang, Lu, and Ba 2016).

Second, “Time Point” is a dummy to capture the average effect that could occur around the implementation (e.g., due to reduced visitors while changing the labels). This effect is sometimes also called pulse dummy (Cleeren et al. 2016). We used a period of three days prior and subsequent to the ESL introduction. Please note that we explore alternative period lengths for the Time Point dummy later as robustness checks. Third, “Time Count” increased by one each week after the introduction of ESL, and captures any effect that would just evolve over time, either strengthen or weaken an existing effect (Avery et al. 2012). We also added a dummy variable “ESL Category” for those categories that receive ESL, which we also integrated in interaction with the three event dummies. We also include the effect of daily visitors in the model. To control for specific effects for any potential overall demand changes, we included daily search request for our retailer’s name from Google Trends as “Demand Control”. Finally, we control for time-specific effects (dummies for week day and month) as covariates, which we do not report in the model result tables. The cross-sectional time series model controlled for category-specific fixed effects. Therefore, we specify the panel model for categories *i* at time *t* as follows:

$$[3] \qquad RevenueRatio_{i,t} = \beta_0 + \sum \beta \begin{bmatrix} TimeStep_{i,t} \\ TimePoint_{i,t} \\ TimeCount_{i,t} \\ ESLCategory_{i,t} \\ ESLCategory_{i,t} \times TimeStep_{i,t} \\ ESLCategory_{i,t} \times TimePoint_{i,t} \\ ESLCategory_{i,t} \times TimeCount_{i,t} \\ Visitors_t \\ DemandControl_t \end{bmatrix} + \varepsilon_{i,t}$$

3.3 Model free evidence

To descriptively assess the overall effect of a mere ESL introduction, we first investigate the overall revenue development over time (see Figure 3). Overall revenue in the

ESL store lies slightly below the non-ESL store. We see that prior to the ESL introduction, the differences between both stores is rather constant over time (between a ratio of .8 and 1.1). Directly after the introduction, revenue in the ESL store increases less strongly than in the non-ESL store but closes the gap over the subsequent months and finally drops again. This leads to an overall increase in the gap between the ESL and the non-ESL store ($RevenueRation_{pre}$ = .97 vs. $RevenueRation_{post}$ = .94). This would indicate a small negative revenue effect of introducing ESL, contradicting H1.

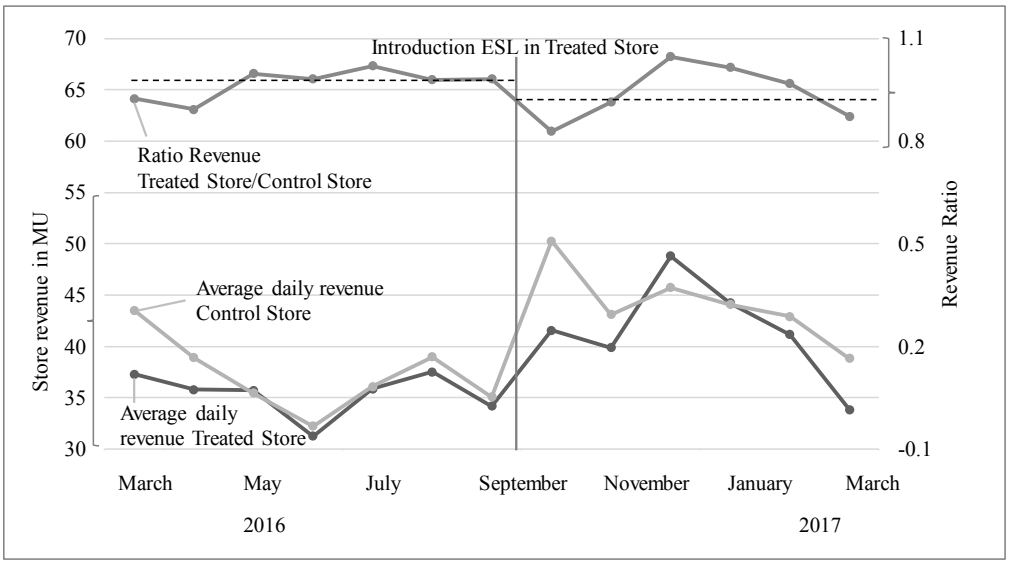

Figure 3: Revenue and revenue ratio development pre and post ESL introduction

This development over time is also visible when comparing the data prior and after the ESL introduction (see Figure 4). Overall, we see that the Control Store has a slightly stronger revenue growth than the Treated Store (difference increases from +5 to +6 percent). However, while the Control Store performs better for product categories that did not receive ESL (difference increased from –4 to –2 percent; please note that the ESL store generates more revenue here), the ESL categories developed more positively in the Treated Store (difference declined from +17 to +16 percent). These results offer a first support for H2 and

an interaction of ESL introduction and product category. Visitor differences did not substantially change.

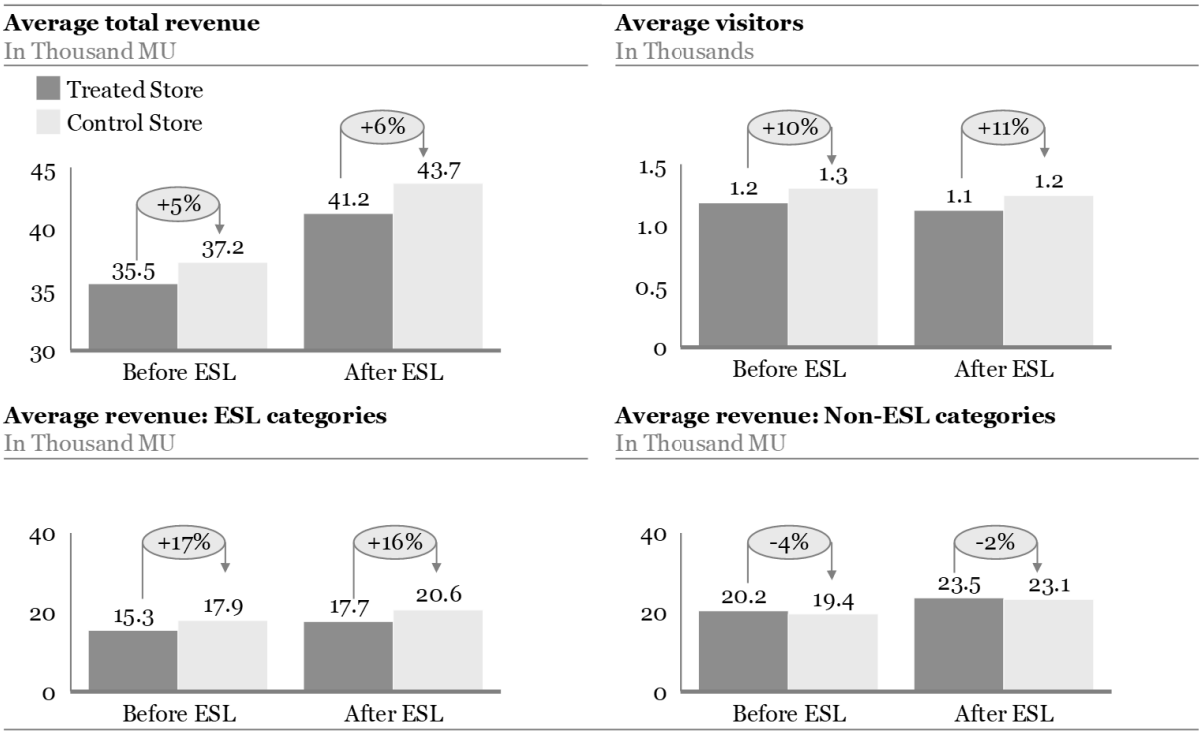

Figure 4: Model free evidence for an effect of ESL introduction on revenue

3.4 Results

Table 2 reports multiple different specifications of the panel models. We first investigate a baseline model, without time dummies or interactions (Model 1). We see that the categories which receive ESL have larger differences than non-ESL categories over the total timespan (model 1: $\beta = -.16$, $p < .001$). Not surprisingly we find, that revenue is directly affected by visitors ($\beta = .28$, $p < .001$). The revenue differences were not affected by the ESL introduction ($\beta = .03$, $p > .10$). Please note that this result is not significantly affected by demand changes ($\beta = .01$, $p > .10$), as none of the subsequent model is. This would indicate that ESL have no effect on sales, in line with our descriptive results and in contrast to H1.

If we, however, include the interaction of the Time Step dummy with the ESL Category (Model 2), we find – in line with H2 and our model free evidence – that ESL

categories outperform non-ESL categories: while the revenue decline overall in the ESL relative to the non-ESL store after the introduction (β = –.09, p < .05), the ESL treated categories in the Treated Store developed positively after ESL introduction (β = .09, p < .01). In fact, they offset the negative effect in the non-ESL categories. This is early evidence for a potential in-store revenue shift from non-ESL to ESL categories.

Dependent variable:	**Revenue**			**Visitor**	
Model:	(1)	(2)	(3)	(4)	(5)
ESL Category	–.16 ***	–.20 ***	–.20 ***	–.00	–.00
(0=no-ESL, 1=ESL in treated)	(.04)	(.04)	(.04)	(.01)	(.01)
Time Step	–.03	–.09 *	–.15	–.04	.04
(0=before, 1=after ESL intro)	(.04)	(.04)	(.13)	(.01)	(.04)
Time Point	—	—	–.02	—	–.00
(1=during ESL intro + 6 days)			(.16)		(.04)
Time Count	—	—	.04	—	–.06
(0=before, +1 each week after ESL)			(.00)		(.00)
ESL Category × Time Step	—	.09 **	.09 †	—	—
		(.03)	(.06)		
ESL Category × Time Point	—	—	.04	—	—
			(.13)		
ESL Category × Time Count	—	—	–.01	—	—
			(.00)		
Visitors	.28 ***	.28 ***	.27	—	—
	.07	(.07)	(.06)		
Demand Control	.01	.01	–.01	.04 **	.05 **
	(.00)	(.00)	(.00)	(.00)	(.00)
Observations	3,553	3,553	3,553	3,553	3,553
Adjusted R^2	.20	.20	.19	.56	.43
AIC	4,530.79	4,523.14	4,539.39	–5,735.88	–4,851.82

Note: standardized β with † p < .1; * p < .05; ** p < .01; *** p < .001

Table 2: Model specifications and results

We then compute the full revenue model with all event dummies, to test whether any effect occurred during the implementation of ESL or whether the positive effect for ESL categories intensifies, diminishes or increases over time (Model 3). Our main finding of a positive step effect for ESL categories is consistent with the previous model (β = .09, *p* < .1), but the other event dummies are not significant. This indicates that the positive effects of an

ESL introduction to the ESL categories are stable over time – at least in the time horizon which we investigated (7 months). Model 3 also fit the data worse than Model 2 (i.e., higher AIC). We, therefore, use Model 2 for our interpretation, concluding – in support of H2 – that ESL has a positive effect on the categories where it is introduced, but not on the store overall (not supporting H1).

We also investigate the effect of the ESL introduction on visitor numbers, and do not find a significant effect. This indicates that visitors did not evade the store due to the ESL introduction (e.g., based on a loss in trust), but rather shifted from non-ESL to ESL categories.

Additionally, the Demand Control positively influences visitors – a finding with high face validity.

3.4 Robustness checks

We employed three robustness checks to test the validity of our model: (1) non-linear effects, (2) different Time Point specifications, and (3) endogeneity controls. We report the full models in the Appendix Table A3. We first model non-linear effects. Fig. 1 shows a post-introduction difference pattern which could point to an (inverse) quadratic function. We, therefore, included polynomials of the Time Count variable up the third degree, both as main effects and in interaction with the ESL categories. None of these coefficients reaches significance (see Appendix Table A3 Model A.1 for quadratic Time Count). Further, the model selection criteria always favor our Model 2 over the robustness models. We, thus, conclude that there is no evidence for non-linear effects and the reported results are robust to alternative polynomial model specification.

Second, the specification of the Time Point variable is susceptible to considerable variation in extant research (e.g., Deleersnyder et al. 2002; Stremersch and Tellis 2004). To

show that the non-effect of the Time Point variable is not solely due to its specification, we investigated two alternative models with more extensive periods around the introduction: one where the Time Point dummy took the value of 1 already three weeks prior to the introduction (Appendix Table A3 Model A.2), and one where it took the value of 1 three weeks after the introduction (Appendix Table A3 Model A.3). Both models were consistent with Model 3 (Model 2 did not include the dummy), whereby Time Point remained insignificant, although with slightly better fit ($AIC_{Early\ Time\ Point}$ = 4,525.75; $AIC_{Late\ Time\ Point}$ = 4,528.50). Model specifications with shorter time periods (3 instead of 6 days) were also consistent with Model 3. We, thus, conclude, that our findings are robust to the specification of the Time Point dummy.

Third, although the DID approach controls for unobserved across-store and between-store effects, endogenous independent variables remain a core concern and prevalent area of discussion in research that relies on non-experimental data (as, e.g., in Germann, Ebbes, and Grewal 2015). The theoretical rationale for the presence of a remaining potential endogeneity bias that eludes the DID might be a strategic selection of the ESL categories, although senior management of the retailer denied such motivation. To test whether the results are robust when controlling for endogeneity with an alternative approach, we include Gaussian copulas of the ESL category as control function variable (Park and Gupta 2012) to Model 2 (Appendix Table A3 Model A.4). The copula term in the extended model is not significant ($\beta = .05$, $p > .1$), and the interaction effect of the Time Step variable with the ESL category remains consistent ($\beta = .09$, $p < .01$). In summary, we conclude that our results are robust when accounting for alternative functional forms, different Time Points, and when controlling for a remaining potential endogeneity bias.

4. Discussion

4.1 Key findings

"The litmus test for any interactive technology […] is its potential impact on the financial performance of the retailer" (Varadarajan et al. 2010, p 107). The result of our litmus test is cautiously positive: retailers' sales channel integration through ESL creates a positive effect in those categories where it is implemented (+5-6%). However, there is no overall (total revenue, total visitors), but only a positive category effect of ESL. A technical explanation is that the retailer implemented the technology only for a third of its product categories and the category effect, is thus, insufficiently large to generate a positive overall effect. Conceptually, consumers perceive price and information consistency between channels only for those categories for which ESL is introduced and revenue should, therefore, only be affected for those.

In line with this suggestion, we find a positive effect of an ESL introduction for those categories which received the ESL. In contrast, the non-ESL categories in the ESL Treated Store lost revenue relative to the ESL categories. This might be an indication of an internal customer migration: because the product offering is perceived as consistent with the online store (i.e., ESL as price consistency signal, with consistent information, such as reviews), customers have less incentive to research shop (Gensler, Neslin, and Verhoef 2017) and purchase more frequently. This might lead to a substitution between categories and an internal migration, as budgetary constraints force customers to make trade-offs (Kim and Park 1997). Please recall that this revenue effect constitutes a "mere ESL effect", that is the consumer reactions to the mere presence of ESL without any price discrimination.

4.2 Managerial implications

These findings have multiple managerial implications: First, management hoping to increase sales channel integration and reduce menu costs through the use of ESL does not

need to be afraid an of adverse revenue effect of an ESL introduction. Our data shows that customers are neither avoiding the shop where ESL was introduced, nor are they spending less. This is good news for the many shops that are currently digitalizing their shelf labels in an attempt to integrate their sales channels but fear alienating trusting customers. Thus, retail managers have the chance to easily provide more product information to customers. In this, retailers can hope to overcome the weaknesses of brick and mortar stores through integrating the strengths of the online channel (Betancourt et al. 2016) in the presentation of price and product information. As price comparisons are an important driver for consumer research shopping (Gensler, Neslin, and Verhoef 2017), aligning prices across channels might prevent customer channel migration. Second, our data shows that retail managers cannot hope for a strong positive revenue or visitor effect (e.g., from greater innovativeness). In our example, where ten of sixteen product categories (35% of total revenue) received ESL, the store revenue was not affected overall. Rather, revenues shifted from non-ESL categories. This allows for a more cautious and a more aggressive recommendation: cautious retailers might start integrating channels by introducing ESL to some categories, without having to fear an overall revenue loss. Ideally, these categories benefit the retailer with higher margins than the non-ESL categories. To mitigate a loss in the non-ESL categories, those could receive extra promotion support (e.g., more coverage in flyers). More aggressive retailers might opt for full integration by equipping all products with ESL. Although we could not test that properly with our data, the absence of a negative mere ESL effect, and an indication of consumer preference for ESL suggest that a store might benefit from ESL introduction compared to its competitors. We leave an empirical test to further research.

4.3 Theoretical implications

This research contributes to the growing literature that focuses on consumer perceptions of integrating retail channels through technology (e.g., Herhausen et al. 2015) in an attempt to build omni-channel systems (Verhoef, Kannan, and Inman 2015). In line with extant research, we find that the benefits of channel integration outweigh the potential downsides (e.g., Cao et al., 2015), possibly because the weakness of a channel in one aspect (here, e.g., presentation of product information) can be mitigated by technology (here ESL, Betancourt et al. 2016). Specifically, technological innovation might reduce consumers' perceived ability to exploit price and information inconsistencies between channels, which often results in research shopping (Gensler, Neslin, and Verhoef 2017).

Importantly, our research shows that not only a comprehensive integration, but already the use of integration in two areas of the marketing mix (here: pricing and presentation of product information) can have a positive effect on retail performance. In this, we show with actual sales data the benefits of on- to offline price integration, which might reduce the risk of showrooming (Gensler, Neslin, and Verhoef 2017). If more retailers would integrate their pricing across channels – either with or without ESL – a higher price dispersion of retailers with multiple channels (Pan, Ratchford, and Shankar 2004) might become a thing of the past (Sun and Flores 2014; Xing, Yang, and Tang 2006). On the other hand, an integrated omni-channel world opens up possibilities for a strategic differentiation of prices between channels (Xing, Yang, and Tang 2006). Additionally, consistent information presentation, such as technical specifications or other users' evaluation, between the on- and offline channel limit reasons for cross-channel information search (Gensler, Verhoef, and Böhm 2012).

Our results, therefore, are a first indication that despite consumers' fear of unfair prices the positive effects of ESL outweigh the negative and thereby increase revenue. We,

thus, help "to understand the consumer implications of […] ESLs." (Grewal et al. 2011, p 48). This research, thus, aligns with multiple recent works on positive effects following the adoption of new technology in retail (e.g., RFID chips: Müller-Seitz et al. 2009; innovative payment technology: See-To and Ngai 2018). As our effects are category-specific, we would be cautious, however, in suggesting ESL as a tool to improve store atmosphere (Donovan et al. 1994). It remains an interesting question whether providing more price and product information through ESL might be a means of better positioning utilitarian- or search products, or of presenting products to customers with a prevention focus (Ashraf and Thongpapanl 2015).

4.4 Conclusion, limitations, and future research

Retailers and research can use our findings as a baseline for potential changes in their pricing strategy (Grewal et al. 2011): we establish the effect of the mere presence of ESL on visits and revenue. Changes in the pricing strategy would, in addition to the mere ESL effect, have a direct impact on revenue (e.g., through more targeted pricing, better reaction to competition), but might also result in a negative consumer reaction. Our research helps to distinguish the "mere" effect of ESL from an actual change in the pricing strategy. Future research should, therefore, investigate the effect of a more dynamic pricing (Ahmetoglu, Furnham, and Fagan 2014). While dynamic pricing is well known to be employed in the online and offline tourism industry (e.g., early booking discounts, last minute deals) it is not clear whether the same would be true for brick and mortar retail (Abrate, Nicolau, and Viglia 2019).

As our results are managerially credible, in line with our theorizing and robust versus multiple alternative model specifications (e.g., including controlling for endogeneity), we have no indication to doubt the validity and reliability of our findings. However, we

acknowledge that our dataset is limited in three domains: first, we only compare two different stores. Although these are comparable and representative for the retailer, adding more stores to the analysis would be beneficial. Researchers would then need to address new validity concerns (e.g., using store introductions at different times [Avery et al. 2012] increasing the susceptibility to bias by unobserved variables). Second, our data is limited to a number of categories among home furnishing products. This already extends research on ESL beyond grocery retail (e.g., McKenzie and Taylor 2016), but future research should extend the number of investigated categories. Further, specific category characteristics have been shown to moderate pricing effects (Chang, Siddarth, and Weinberg 1999; Bell and Lattin 2000). Such a moderation is unlikely in our case, as the ESL categories were not strategically (by management) or theoretically (by us) selected. However, future research could assess whether theoretical category differences (e.g., transaction criticality: Bang et al. 2013) could moderate the mere ESL effect. Third, we relied on data from a European retailer, but different cultures show differing average consumer innovativeness (Goldsmith and Hofacker 1991) and might, thus, react differently to ESL.

As we employ company data, which covers consumer reactions (revenue, visits) in a period around the event of ESL introductions, it is difficult to identify the consumer-level mediator that enabled a revenue increase for ESL categories or reduce revenue in non-ESL categories. It is reasonable to assume that, given the constant overall revenue and visitor numbers, the mere presence of ESL do not lead to a loss in trust in the retailer (Garbarino and Lee 2003) or perceptions of price unfairness (Richards, Liaukonyte, and Streletskaya 2016). This might indicate that consumers are better informed and more rational than researchers sometimes fear, a phenomenon referred to as “marketplace metacognition” (Wright 2002):

consumers might simply be able to differentiate the mere presence of ESL from situations in which actual price discrimination happens.

Finally, electronic shelf labels are just one of many innovations (e.g., in-store wireless internet, check-in stations at the point-of-sale, robots as service staff) that are currently implement by retailers around the world to integrate their different sales channels. Beyond testing the effect of individual components, research should develop broader frameworks for consumer reactions to an increasing channel integration; such frameworks would enable future research to predict the indirect effects of new technologies. Such general frameworks are highly popular for assessing the acceptance of technology (e.g., the technology acceptance model: Davis, Bagozzi, and Warshaw 1989), but missing for consumer reactions after facing new technology as a mean to integrate a retailer's sales channels.

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Appendix

	Control Store				Treated Store			
	Mean	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**
Visitor	1245.4	538	2545	326.66	1143.90	567	3247	419.30
Flooring	3.51	1.10	10.90	1.46	3.26	.60	12.90	1.85
Carpet	2.17	.40	5.40	1.11	2.12	.40	6.90	1.09
Wallpaper	2.63	.80	6.70	.93	2.12	.60	6.10	.90
Electronic	2.88	.60	9.50	1.20	3.1	.80	10.70	1.40
Textile	2.11	.60	6.30	.84	1.59	.60	5.20	.75
Curtain	2.16	.70	4.80	.67	1.56	.40	4.70	.62
Hardware	3.83	.80	9.00	1.53	3	1.20	9.10	1.36
Sofa	6.41	.80	22.00	3.64	6.85	.30	27	4.44
Small furniture	4.00	1.20	13.30	1.77	4.11	1.10	15.80	2.06
Bed	7.9	1.40	29.80	4.36	8.16	1.50	32.70	4.92
Living wall	2.04	.10	7.90	1.26	2.05	0	7.40	1.41
Dining	3.16	.40	11.10	1.74	3.25	.10	24.40	2.30
Kitchen	6.55	00	25.80	4.80	6.67	0	28	5.26

Table A1: Category descriptive statistics

	Mean	**Min**	**Max**	**SD**	**V**	**Fl**	**Ca**	**Wa**	**El**	**Te**	**Cu**	**Ha**	**So**	**Sm**	**Be**	**Li**	**Di**	**Ki**
V	.90	.61	2.22	.16	1.00													
Fl	.95	.23	4.50	.45	.29***	1.00												
Ca	1.05	.33	4.00	.45	.35***	.12	1.00											
Wa	.83	.31	2.65	.27	.39***	.18**	.10	1.00										
El	1.11	.42	2.83	.35	.42***	.20***	.31***	.21***	1.00									
Te	.76	.35	1.78	.22	.52***	.25***	.31***	.28***	.37***	1.00								
Cu	.73	.21	1.72	.22	.42***	.15**	.21***	.31***	.24***	.26***	1.00							
Ha	.79	.40	2.37	.21	.55***	.18**	.24***	.36***	.50***	.43***	.24***	1.00						
So	1.26	.11	9.95	.96	.25***	.23***	.17**	.13*	.23***	.20***	.10	.18**	1.00					
Sm	1.06	.44	2.38	.33	.37***	.23***	.14*	.30***	.35***	.23***	.12*	.38***	.21***	1.00				
Be	1.13	.18	4.40	.56	.25***	.25***	.06	.25***	.23***	.23***	.13*	.23***	.31***	.24***	1.00			
Li	1.43	.00	30.00	2.23	.15**	.33***	.20***	.10	.25***	.06	.09	.10	.46***	.22***	.26***	1.00		
Di	1.12	.14	7.50	.66	.21***	.10	.11*	.07	.18**	.15**	.09	.13*	.32***	.11*	.19***	.25***	1.00	
Ki	2.05	.00	33.67	3.86	-.02	.06	.06	-.08	.07	-.02	.03	-.04	.06	.03	.00	.00	.03	1.00

Note: * p < .05; ** p < .01; *** p < .001; V: Visitors, Fl: Flooring, Ca: Carpet, Wa: Wallpaper, El: Electronics, Te: Textile, Cu: Curtain, Ha: Hardware, So: Sofa, Sm: Small furniture, Be: Bed, Li: Living walls, Di: Dining, Ki: Kitchen

Table A2: Category-differences descriptive statistics and correlation matrix

Dependent variable:	Revenue							
Model:	**(A.1)**		**(A.2)**		**(A.3)**		**(A.4)**	
ESL Category	–.20	***	–.19	***	–.20	***	–.20	***
(0=no-ESL 1=ESL in T-Store	(.04)		(.04)		(.04)		(.04)	
Time Step	–.13		–.26		–.27		–.09	*
(0=before ESL intro 1=after ESL intro)	(.12)		(.62)		(.62)		(.04)	
Time Point Early	—		–.00		—		—	
(0=before/after 3 weeks before ESL intro 1= 3 weeks before ESL intro)			(.47)					
Time Point Late	—		—		–.02		—	
(0=before/after 3 weeks after ESL intro 1= 3 weeks after ESL intro)					(.21)			
Time Point	–.02						–.02	
(0=before/after ESL intro 1= during ESL intro)	(.15)						(.16)	
Time Count	—		.14		.14		.04	
(0=before ESL intro 1..24=weeks after ESL intro)			(.02)		(.02)		(.00)	
(Time Count)²	.02							
(0=before ESL intro 1..1444=quadratic weeks after ESL intro)	(.00)							
ESL Category × Time Step	.08	*	.11	*	.12	*	.09	**
(Interaction: treated category in T-Store)	(.04)		(.05)		(.05)		(.03)	
ESL Category × Time Point Early	—		–.26	†	—		—	
(Interaction: treated category in T-Store)			(.12)					
ESL Category × Time Point Late	—		—		–.03		—	
(Interaction: treated category in T-Store)					(.12)			
ESL Category × Time Point	.04							
(Interaction: treated category in T-Store)	(.12)							
ESL Category × Time Count	—		–.03		–.03		—	
(Interaction: treated category in T-Store)			(.00)		(.00)			
ESL Category × Time Count non-linear	–.00							
(Interaction: treated category in T-Store)	(.00)							
Copula(Category)	—		—		—		.05	
							(.03)	
Visitors	.27	***	.28	***	.28	***	.28	***
			.07		(.07)		(.07)	
Demand Control	.01		.01		.01		.01	
			(.00)		(.00)		(.00)	
Observations	3,553		3,553		3,553		3,553	
Adjusted R2	.20		.20		.20		.17	
AIC	4,539.47		4,525.75		4,528.50		4,668.10	

Note: standardized β with † p < .1; * p < .05; ** p < .01; *** p < .001

Table A3: Core model specifications

Appendix III: Recharge While You Shop: The Impact of Free Electric Vehicle Charging on Shopping Intention and Shopping Duration

Submitted to International Journal of Retail & Distribution Management.

Following is the submitted manuscript.

Recharge While You Shop: The Impact of Free Electric Vehicle Charging on Shopping Intention and Shopping Duration

Abstract

Purpose The purpose of this paper is to investigate the effect of offering free electric vehicle (EV) recharging to customers at retail stores.

The Design/methodology/approach Data was collected through a simulated shopping experiment in which German EV drivers served as study participants.

Findings Quantitative data analysis from 103 study participants demonstrates a favorable effect of offering free EV charging on shopping intention (mediated through overall store price image and perceived service quality) and on shopping duration.

Research limitations/implications This research was conducted in Germany, nonetheless the chosen constructs should apply to consumers worldwide, and therefore, similar studies should be conducted in other markets.

Practical implications This paper encourages retail managers to install free EV charging points as they can have a positive effect on purchase intention and shopping duration. In addition, early adaption of free EV charging could result in a competitive advantage.

Originality/value This paper adds technology as an influencing factor on overall store price image and perceived service quality and offers a first explanation of understanding consumers response to free EV recharging.

Keywords OSPI, service quality, shopping duration, shopping intention

Paper type Research paper

Recharge While You Shop: The Impact of Free Electric Vehicle Charging on Shopping Intention and Shopping Duration

Introduction

Retailers historically act in a low-margin competitive environment. Hence, they have always been keen to expand their customer base to economically react to demographical, technological, and behavioral changes (Kahn and McAlister, 1997). To potentially attract more customers to their stores, an increasing number of retailers install charging stations for electric vehicle (EV) drivers (e.g., in Germany: IKEA, Bauhaus, Kaufland; in the UK: Tesco, Leggett, 2018). At such EV stations, consumers can recharge their EVs. A very ambitious goal was recently announced by Lidl. This German discounter wants to build a charging network so that the maximum driving distance between two Lidl charging points is 50 kilometers (Lidl, 2019). Naturally, retailers proclaim that they want to support the German "Energiewende" – a massive transition from fossil to renewable energy sources – or generally commit to the 1.5-degree goal of the Paris Climate Accord (e.g., Tesco in the UK, Walmart in the United States). However, one should also take business reasons into account when judging the investments into electric charging infrastructure. Especially considering that the retailers provide or plan to provide the charging at no costs to their customers and thereby introduce a new service much like shopping malls that offer free parking spaces.

The present paper investigates the effect of offering free recharging on (1) shopping intention and (2) shopping duration of electric vehicle drivers in German retailing. When a retailer decides to offer free recharging for electric vehicles,

consumer's store image perception changes in two ways. First, by providing the free charging possibility retailers change their overall store price image in a way that the store outlet is perceived as being more expensive. Prior research showed that architectural cues like glass fronts and nice entrees (Zielke and Toporowski, 2009) and technology such as mobile payment at the point-of-sale (Falk et al., 2016) influence the overall store price image (OSPI) and therefore affect shopping intention and patronage (Arnold et al., 1983; Cristina, 2014). That is what prompt us to formulate the hypothesis that free EV recharging may increases the OSPI.

In addition, customers might perceive a higher service quality of the retailer because they save themselves a trip to a charging station (i.e., time for the trip and money for the provided electricity). We consider free EV charging as a technology that provides a customer-specific service, similar to offering in-store wireless internet access. Service quality research established the positive effect of high quality on shopping intent in the past (Martensen et al., 2000; Rust and Zahorik, 1993). Similar to providing free parking for shoppers, we expect higher perceived service quality when a retailer offers free EV charging (Hasliza, 2013). From a theoretical standpoint it is not clear whether the combined effects of an increase in OSPI and an increase in perceived service quality have a net positive or net negative effect on shopping intention. Second, charging while shopping replaces a charging trip and extends the time budget for shopping (Bhat, 2001; Schwanen, 2004). Customers could even accept a little detour to receive the benefits of free charging further prolonging their shopping trip. In addition, every minute spent longer in a store while the car is charging for free lessens the pressure to end a shopping trip.

We collected a unique dataset with actual German EV drivers that participated in a simulated shopping trip to study their shopping behavior and answer the research question how consumers react to the technological service offering of free EV charging.

Our investigation finds a positive effect of free charging on shopping intention and shopping trip duration even though free EV charging increases the overall store price image. Higher perceived service quality mediates the effect of increased shopping intention. In general, our results strongly support a positive business case for providing free EV charging to customers and extent the knowledge of technology effects on the overall store price image.

The unveiled relationship between free charging and retail store performance has direct business model implications for retail managers, public policy makers, and consumers. Thereby, we contribute to the ongoing discussions of how retailers increase their competitiveness and create experiences for customers (Grewal et al., 2017).

Theory and hypothesis development

Free charging, OSPI formation, service quality, and shopping intention

Free recharging at retailers changes the store image along the dimensions overall store price image and perceived service quality, thereby changing the retailer's performance (Hildebrandt, 1988). First, multiple research streams, from pricing research (e.g., the effect of pricing strategies: Ellickson and Misra, 2008) to branding research (e.g., influence of a retail environment on store brand: Baker et al., 1994) used different concepts of price-images. This paper relies on the definition of "…price image as the general belief about the overall level of prices that consumers associate with a

particular retailer." (Hamilton and Chernev, 2013, p. 2) in contrast to the earlier proposed consumer price expectation on an assortment level (Nyström, 1970). For a comprehensive literature review and an overview of price-images' different conceptualizations and operationalizations refer to Hamilton and Chernev (2013).

The formation of a beneficial price-image is instrumental for retail managers to steer the retailing operations as consumers use low price signals to find stores with low prices (Dutta and Bhowmick, 2009). The perceived beneficial price level directly influences retailing performance (Hildebrandt, 1988) and helps to form a strong brand with increased purchase intention (Cristina, 2014; Woodside and Walser, 2007). Low unit prices (Desai and Talukdar, 2003) and frequent price advantages over the competition (Alba et al., 1994) are established measures to form a favorable OSPI. However, also store attributes not related to prices like store size, tidiness, assortment size, and appealing interior influence the store price image (Buyukkurt and Buyukkurt, 1986). Additionally, the choice of the store format is crucial, as retail formats (Koschmann and Isaac, 2018) elicit specific price-image perception that directly affects shopping intention (Zielke, 2010). For example, it is unlikely to find someone who checks prices for a EUR 10 bottle of wine in a discount store (low OSPI: e.g., Aldi, Trader Joe's) whereas the same shopper could be quite likely to check prices for the same bottle while shopping at a convenience store or supermarket (high OSPI: Whole Foods, EDEKA) due to the different price images (Hamilton and Chernev, 2013).

This paper discusses two reasons to consider free EV charging influencing price-image perception as (1) the formation of a price-image is rather a process than a

simple one-time estimation and (2) even smaller changes to a retailer's operation facility are likely to change the price-image.

First, OSPI is built in three phases according to extant literature: the store scanning, the product browsing, and the checkout phase (Falk et al., 2016). Free EV charging adds an additional dimension to the store-scanning phase next to commercial and word-of-mouth information (Büyükkurt, 1986) by including free EV charging as a service that is considered in the formation of a price image prior to entering a store. Since recency has a strong effect on evaluation, the supply of free EV charging would influence the OSPI (Gürhan-Canli, 2003). In addition, literature substantiates that along the whole process, consumers rely on compensatory inferences to form their prices image (Chernev and Carpenter, 2001). In the case of free EV charging, the prospect of great service is likely to attenuate price image related attributes that would promote a rather low OSPI (Hamilton and Chernev, 2013).

Second, architectural cues (attaining architecture increases price-image: Zielke and Toporowski, 2009), cleanliness (untidy stores decrease price-image: Baker et al., 2002), and point-of-sale technology (mobile payment decreases price-image: Falk et al., 2016) have been shown to alter price-images. We argue that the very visible charging stations itself and the signs promoting the service can be considered an architectural cue that most likely influences the OSPI (see Figure 1).

Figure 1: Prominently placed EV charging station at a German retailer store (Kaufland, Berlin)

Even though free EV charging is likely to influence the OSPI, the direction of the effect is not easy to specify as extant literature suggests that irrational consumer reactions prevail after the introduction of a new technology (Falk et al., 2016) or architectural enhancements (Zielke and Toporowski, 2009). Generally, offering free charging to retail customers costs around EUR .40 per kWh including the investment of the charging facility (we assume EUR .30 per kWh and a EUR 7,400 investment depreciated over 5 years). Customers could perceive the offering as a luxury and could assume prices to be higher at the respective retailer's store resulting in a rather unfavorable OSPI. In contrast, prior research showed an "irrational process – payment transparency bias" (Falk et al., 2016, p. 2422) of the rather new technology mobile payment on OSPI in a way that intransparent payments (the mental distance of a payment instrument from cash: Soman, 2003) trigger more positive OSPI

judgements: cash-only retailers are perceived more expensive than retailers offering mobile payments. Nevertheless, taking the high investment costs and general perception of an expensive e-mobility drawn from the media (e.g., Clemente, 2019) into account, the paper argues that consumers perceive the free offering as costly service that increase the overall store price image:

H1: Free recharging affects the overall store price-image negatively (increases OSPI).

Besides influencing the OSPI, free recharging also affects the second store image dimension: the perceived service quality of the retailer. It is a complex process to measure how customers perceive the service quality of a retailer. Early research established the SERVQUAL model consisting of the five dimensions tangibility, reliability, responsiveness, assurance, and empathy (Parasuraman et al., 1988). As SERVQUAL measures expectations, it is not suitable for many research questions (Brady et al., 2002) and consequently, a performance related scale called SERPERF was developed (Cronin and Taylor, 1992). Methodologically, SERVPERF performed better than SERQUAL in the past (Brady et al., 2002; Dabholkar et al., 2000). The positive effects of service quality on purchase intention (online: Lee and Lin, 2005; Martensen et al., 2000; e.g., online: Rust and Zahorik, 1993) also benefit the patronage of a retail store (Gagliano Bishop and Hathcote, 1994).

Prior research has shown that offering free parking spaces significantly influences perceived service quality because in many other cases some form of parking ticket needs to be paid for (e.g., hypermarkets distinguishing themselves from normal supermarktes: Hasliza, 2013). Allowing consumers to not only park for free but also

receive additional value through charging should result in a much higher perceived service quality of the retailer:

H2: Offering free EV recharging at retail stores positively affects perceived service quality.

It is unclear how the contradicting effects of increased price-image and increased perceived service quality affect consumers' overall shopping intention. On the one hand, established literature demonstrates that an unfavorable change in the OSPI significantly alters consumers' retail choice (e.g., choice of cost aware consumers for the lowest-price-image store: Burton et al., 1994; entrance of a low-price-image rival: Singh et al., 2006). On the other hand, increases in service quality led to substantially improve consumers' shopping intention (Zielke, 2010) and overall store performance (Borucki and Burke, 1999).

As consumers presumably prefer higher services independent of the retailer's price image, we expect the positive effect from higher perceived service quality to offset any negative effect from a higher OSPI. Following Baron and Kenny (1986) we pose the hypothesis that free charging as an antecedent influences shopping intention while OSPI and the perceived service quality mediate this effect:

H3a: Free recharging directly increases shopping intention.

H3b: OSPI mediates the effect of free charging on shopping intention.

H3c: Perceived service quality mediates the effect of free charging on shopping intention.

Free charging and shopping trip duration

Prior research concludes that environmental factors influence the duration of a shopping trip (e.g., manipulation through music: Yalch and Spangenberg, 2000), we argue that offering free charging to shoppers is likely to extend shopping trips owing to three reasons.

First, customers mentally set aside different time budgets for fixed and flexible activities (Schwanen, 2004). If a fixed budget – e.g., gas refilling or waiting at an EV charging station - is no longer required, time budget allocation shifts and goes up for shopping (Bhat, 2001). Therefore, average shopping time would increase. Interestingly, research found no effect of extended opening hours on shopping duration, thus, indicating no limiting factor for free charging (van den Broek and Breedveld, 2004), thus, the positive effect from free charging could not be substituted through longer shopping hours.

Second, the fact that not all retail outlets are equipped with charging facilities will nudge customers to do a little detour to a location further away than their usual store of choice. As the time to reach a shopping location directly correlates positively with the time spent shopping, this should result in overall longer shopping trips (Schwanen, 2004).

Third, customers will see a clear benefit of staying longer as they charge their EV for free during that time. The combination of medium charging power and free service may be two potential drivers for longer shopping trips as most charging stations that are located at retailers offer charging power between 7 and 22 kW, a 10-minute shopping trip would only offset the consumed energy for a return trip to the retailer. For any additional benefit from the shopping trip, the duration of such would

need to be prolonged. We argue that EV drivers will unconsciously spent more time in a store when they know that their car is being charged outside (for free). We formally conclude:

H4: Offering free charging at retail stores prolongs a customer's shopping trip.

The full research model is displayed in Figure 2.

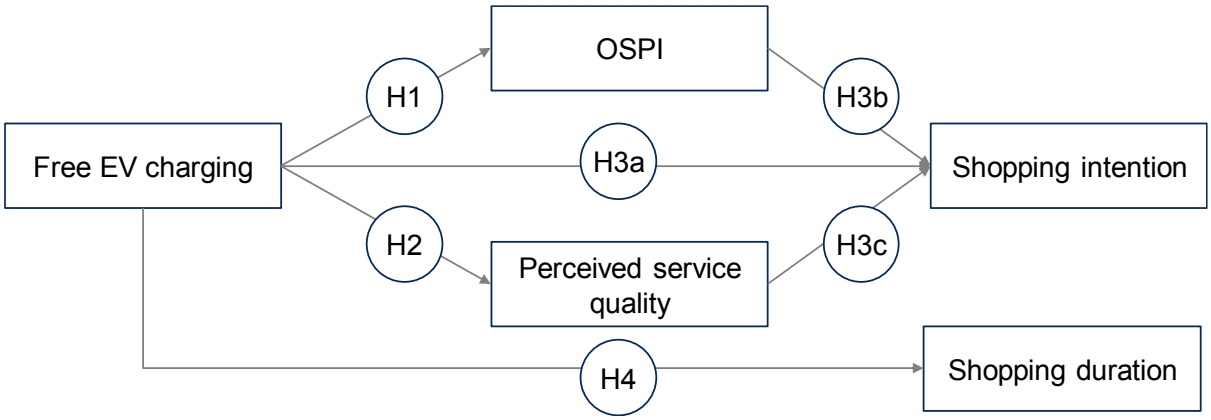

Figure 2: Theoretical research model

Empirical research

Method, measures, and data

Participants conducted a simulated shopping trip to a hypothetical grocery supermarket named "BestFood+". We consciously chose to avoid including a known grocery retail brand (e.g., Lidl, Aldi, Rewe, Kaufland) for two reasons. First, to create an authentic shopping situation without the bias from prior shopping trips to stores of any brand the participant may have earlier experience with (Zielke, 2010). Second, to confine any unwanted effect from the respective retail format (Koschmann and Isaac, 2018).

To isolate the effect of free charging we enrolled electric vehicle drivers to participate in our experiment. The more comprehensive sampling results in more validity compared to mere student samples or online panels. Participants come from three main sources. First, we reached out to specific private interest groups on social media and invited group members who own an EV. Second, we recruited participants from Germany's largest EV podcast's slack channel and one of the largest online EV forum communities. For the third recruiting strategy a direct outreach to potential participants at charging stations on two different workdays in two different weeks was perused. We kindly asked the EV owners to participate in our experiment.

We randomly assigned the participants either to a *free charging* or *free parking* condition. This was operationalized by telling the treated (free charging) group that they would plug-in the charging cable before the start of their shopping trip. The control group (free parking) was only told that they do not need any parking ticket and parking was free of charge while shopping. Both conditions were supported by visual stimuli using a photo of a parking space with a sign "free parking" respectively providing an image of a free parking lot with a charge station and a sign "free charging". Following prior research on the overall store price image (Falk et al., 2016) we asked participants to purchase nine products for a representable shopping basket (e.g., toothbrush, beer, coffee, chips) covering all four stock keeping unit categories (Desai and Talukdar, 2003: short span-high price, short span-low price, long span-high price, long span-low price). The products appeared in a random order to mitigate any unintended order effect.

After the shopping trip, participants received information about their total basket price of EUR 30.68 and they were again reminded that during the shopping trip parking (or charging respectively) was free of charge. Afterwards they rated the overall store price image and the perceived service quality, stated their shopping intention, and provided their estimated shopping duration. OPSI was rated on three items following prior research (Blair et al., 2002; Desai and Talukdar, 2003; Falk et al., 2016) on a seven-point Likert scale (1 = “much lower” to 7 = “much higher”): “How do prices at BestFood+ compare with prices at other stores?”, “How does the price of the basket you just purchased at BestFood+ (nine products for EUR 30.68) compare with expected prices at other stores?”, and “In general, prices at BestFood+ are…”. Perceived service quality was measured following with adoption of the SERVPERF scale (Cronin and Taylor, 1992) by measuring one item from each of the five dimensions on a seven-point Likert scale (1 = “fully agree” to 7 = “do not agree at all”): “BestFood+ offers me an attractive shopping experience.”, “BestFood+ fulfills its promises to me.”, “BestFood+ takes care of my problems as a customer.”, “I trust BestFood+.”, and “BestFood+ shows genuine effort to offer me advantages.”. Shopping intention was measured with four items on a seven-point Liker scale (1 = “fully agree” to 7 = “do not agree at all”) following Zielke (2010): ”I should shop at this store as often as possible.”, “I should shop at this store as seldom as possible.”, “I should consider this store for my shopping.”, and “I should disregard this store for my shopping.”.

Participants provided self-reported information on grocery shopping frequency and price awareness. After providing the demographic information gender, age, income, household size, and education, a quality check at the end of the experiment inquired about the type of car the participant currently drives.

Results

103 participants finished the experimental shopping trip. We had to exclude 22 participants as they self-reportedly do not drive a vehicle that would benefit from free charging (i.e., no car at all, car with internal combustion engine, or hybrid without plug-in functionality). Table 1 shows the descriptive statistics of the remaining 81 participants.

	Free parking	**Free charging**	**Total**
N	40	41	81
Mean age in years	40.31 (12.50)	45.08 (10.97)	42.67 (11.94)
% female	40%	32%	37%
Mean household size	2.78 (1.08)	2.68 (.89)	2.73 (.99)
Median income	More than EUR 3.000 and less than EUR 3.500	More than EUR 3.000 and less than EUR 3.500	More than EUR 3.000 and less than EUR 3.500
Median education	Master/ Diploma	Master/ Diploma	Master/ Diploma
Median shopping frequency	4-6 times	4-6 times	4-6 times

Table 1: Participants' statistics

As Cronbach's alpha indicated very good validity of our constructs we averaged the multiple items of OSPI ($\alpha = .89$), perceived service quality ($\alpha = .95$), and shopping intention ($\alpha = .94$) into a single measure, respectively. In addition, we reversed the coding for perceived service quality and shopping intention to be more intuitive (i.e., positive effects meaning an increase).

According to a Student's t-test customers in the free charging condition perceive BestFood+ slightly more expensive than in the free parking condition

supporting H1 ($M_{OSPI,\ free\ charge}$ = 4.88, $M_{OSPI,\ free\ park}$ = 4.45, t = 1.99, p < .05, η = .22). In support of H2 participants have a higher perceived service quality in the free charging than in the free parking condition ($M_{Service,\ free\ charge}$ = 4.19, $M_{Service,\ free\ park}$ = 3.05, t = 5.39, p < .001, η = .52). Similar to the previous analysis, a t-test found significant difference of shopping intention between the free charging and free parking groups supporting H3a ($M_{SI,\ free\ charge}$ = 5.00, $M_{SI,\ free\ park}$ = 2.86, t = 6.88, p < .001, η = .61). An analysis of the estimated shopping duration revealed a significant difference between the two conditions supporting our hypothesis (H4) that free charging extends the shopping duration of EV drivers ($M_{Duration,\ free\ charge}$ = 27.83, $M_{Duration,\ free\ park}$ = 12.55, t = 4.24, p < .001, η = .43).

To further test our hypotheses, we ran five linear regression models (see Table 2). First, a regression of OSPI on conditions and the control variables age, gender, income, education, price awareness, shopping frequency, and household size found no significant effect of free charging on OSPI (Table 2, model 1: β = .11, p > .1). Instead we see a significant positive effect of price awareness (β = –.28, p < .01), gender (β = .33, p < .01), and shopping frequency (β = .31, p < .01). In summary, model 1 does not support *H1* (negative effect of free charging on OSPI) as BestFood+ was rather perceived more expensive either by price conscious, very frequent, or male shoppers and not due to the free charging offering.

Second, like model 1 a regression of perceived service quality on condition and the same control variables finds support for *H2* (positive effect of free charging on perceived service quality) as participants in the free charging condition perceive service quality significantly higher (model 2: β = .51, p < .001). Counterintuitively, a

weak significant income control variable indicates that participants with higher income have a higher service quality perception of BestFood+ ($\beta = .21$, $p < .1$). A potential explanation would be that participants do not fully trust the free charge offering. The lower income EV drivers fear hidden or unknown costs, which are irrelevant for the higher income participants. A second explanation for the surprising effect would be that consumers feel unconsciously obliged to purchase more after receiving a free service similar as if they would have received a free product sample (Bruce, 1991). The indirect obligation would be no burden for the high-income participants but for the low-income participants.

The third model regressed shopping intention on condition and the control variables. We found a direct significant effect of condition (model 3: $\beta = .59$, $p < .001$) indicating support for H3a (free charging positively influences shopping intention).

The fourth model extends the prior model with the two mediators OSPI and perceived service quality. As before, however strongly reduced, we find a positive effect of condition on shopping intention (model 4: $\beta = .25$, $p < .001$). Both mediators OSPI ($\beta = -.21$, $p < .01$) and perceived service quality ($\beta = .72$, $p < .001$) show a significant effect on shopping intention. A bootstrapping analysis of mediation (Baron and Kenny, 1986) cannot confirm full mediation for OSPI (H3b) as the interval includes zero (n=5,000, bias corrected; CI95%: -.25; .07), but for perceived service quality (H3c) as the interval excludes zero (CI95%: .70; 2.00). The weak significant positive control variable shopping frequency ($\beta = .12$, $p < .10$) logically indicates that participants who shop more often show a higher shopping intention.

The fifth model regressed shopping duration on condition, OSPI, and service quality and all control variables. A positive main effect of condition (model 5: $\beta = .22$, $p < .05$) indicates support for H4 (free charging prolongs shopping duration). In addition, we see an indirect effect of perceived service quality ($\beta = .50$, $p < .001$) which means that participants who perceive higher service quality shop longer. Our significant gender control variable ($\beta = -.28$, $p < .01$) indicates that women in general expect longer shopping times. As found by other studies, this is most likely due to the fact that women still, even though things are changing, do more grocery shopping than men and therefore dedicate a larger time budget to the grocery shopping activity in general (Schwanen, 2004). Interestingly, higher education seems to significantly reduce shopping duration ($\beta = -.22$, $p < .05$).

Dependent variable:	**OSPI**	**Service quality**	**Shopping intention**		**Shopping duration**
Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Condition	.11	.51***	.59***	.25***	.22*
(0=free parking 1=free charging)	(.20)	(.23)	(.34)	(.25)	-3.6
OSPI				-.21**	-.07
(1=low prices 7=high prices)				(.12)	-1.8
Service quality				.72***	.50***
(1=great service 7=bad service)				(.11)	-1.62
Price awareness	-.28**	-.03	.06	.02	-.06
(1=very price conscious 7=not price conscious)	(.09)	(.1)	(.15)	(.1)	(1.45)
Gender	.33**	-.16	-.10	.09	-.28**
(1=female 2=male)	(.23)	(.26)	(.39)	(.26)	(3.82)
Age	-.08	-.02	-.07	-.08	.09
	(.01)	(.01)	(.01)	(.01)	(.14)
Income	.08	.21+	.18	.05	.11
(1=low 7= high)	(.06)	(.07)	(.10)	(.06)	(.92)
Education	.002	-.11	-.08	-.002	-.22*
(1=low 4=high)	(.13)	(.15)	(.22)	(.14)	(2.00)
Household	.09	.11	.09	.02	.12
	(.1)	(.11)	(.17)	(.11)	(1.56)
Shopping frequency	.31**	-.10	-.02	.12+	.01
(1=less often 2=very often)	(.10)	(.11)	(.17)	(.11)	(1.67)
Observations	81	81	81	81	81
Adjusted R2	.23	.26	.35	.74	.47
Hypotheses:	H1: *x*	H2: ✓	H3a: ✓	H3b: *x* H3c: ✓	H4: ✓

Table 2: Model specifications and results
Notes: standardized β with + p < .1; * p < .05; ** p < .01; *** p < .001

General discussion

Using the hypothetical shopping experiment and following our quantitative analysis, we found support for all but one hypotheses. Free EV charging clearly

increases perceived service quality and thereby positively affects consumers' shopping intention. On the contrary, free EV charging does not affect the OSPI in general. Replicating extant research, we find that higher OSPI reduces shopping intention. Our results also demonstrate that offering free EV charging extends shopping duration on average by 122%. With a slight deduction we argue that the longer shopping duration translates into a doubled average basket size for EV drivers. This would turn the investment and running costs (roughly EUR 7,400 for a charging station and EUR .30 per kWh) into a positive business case, if the shopping volume increases similarly (see Table 3).

Cost per charge cycle	
Charging station in EUR/Station	7,400
Electricity in EUR/kWh	0.30
Opening times h/Day	13
Sales days per year	300
Charging points per charging station	2
Maximum output in kW/Charging point	22.00
Average shopping time in h	0.50
Average utilization per charging station in percent	50.00
Charging cycles per day	26
Charging cycles for 5 years	39,000
Depreciations per charge cycle in EUR	0.19
Electricity cost per charge cycle in EUR	3.30
Total cost per charge cycle in EUR	3.49
Additional profit	
Average basket value EUR	20.00
Trade margin in percent	20.00
Contribution margin per shopping cart	4.00
Required additional shopping volume	87

Table 3: Rough business case estimation

Contribution, managerial implications, and further research

Theoretical contribution

At a conceptual level, the present paper enriches extant research in several ways, by extending OSPI research to the out-of-store experience of a shopping trip and including EV charging stations as an additional technology that influences OSPI. First, we include external store features and free service offering (EV charging) as antecedents to the formation of the OSPI. To the best of our knowledge prior research on dimensions effecting OSPI was limited to the in-store experience of a shopping trip (e.g., prominance of low priced items: Ofir et al., 2008; availability of low price guarantees: Shankar et al., 2016). In addition, we extend recent research that worked on technology's impact on OSPI (e.g., mobile payment: Falk et al., 2016) by including recharging stations. Additionally, the paper answers a call to "…investigate more mediators and moderators for the impact of price-image dimensions on shopping intentions." (Zielke, 2010, p. 765). We found strong support, that consumers prolong their shopping trip due to free recharging. Generalizing that finding, we recommend that retail managers shift consumers' time budget dedicated to shopping by offering additional services that have a high service quality and offer value to consumers (e.g., automated shopping lists based on chosen cooking recipes).

Managerial implications

The revealed interrelations provide practical recommendations for retail managers, public policy makers, and consumers. For retail managers the present research of measuring price images helps to check how technology can interfere with the effect of their chosen pricing strategies (Downs and Haynes, 1984). In addition, retail managers should evaluate how other technological services like robot sales reps

could increase service quality to positively affect consumers' shopping duration and intention.

Even though no strong evidence was found that free EV charging increases OSPI, retailers can mitigate the risk of any potential negative effect of an increased OSPI by providing explanations, even if they are trivial, as to why they can offer a superior service (Langer et al., 1978). For example, retailers could highlight that excess electricity from the photovoltaic installation on the roof of the retailer is used reducing running costs substantially. On the other hand, they could provide information on potential subsidies received to install the charging stations in the first place.

These findings are also noteworthy for public policy makers when considering subsidies for retailers that build charging stations, as retailers with free recharging benefit in their standard operations. Especially if the charging stations are only reachable during standard operating hours, subsidies are not necessary to further expand the charging network on retailer parking spaces.

Additionally, prior research has shown that consumers' service expectation differ across store formats and therefore retail managers of stores with a higher likelihood of attracting EV drivers, should consider offering free EV charging (Marlene, 2014).

Limitations and future research

The current research extends our understanding of out-of-store technology impact (here: free EV charging) on shopping intention and duration through perceived service quality and OPSI. However, the findings have several limitations and provide

opportunity for further research. Although the participants of our data set are actual EV drivers, the sampling did not follow any strict quota. Nevertheless, the empirical demographic information does not show any strange deviation from the sample we would expect for EV drivers.

The conducted experiment purposefully considered the reaction of EV drivers to EV charging to generalize our findings of consumers' response to a new retail innovation (here: service) they use. We acknowledge that non-EV drivers might react differently to the presence of a free service. However, recent research indicates that adoption (i.e., usage) is required to perceive a technologies' advantages (e.g., mobile payment: Boden et al., 2020). A similar limitation is the focus on Germany concerning the business case and participant recruitment. Nonetheless, our recommendations could be generalized, for countries like China and selected states in the United States of America that pursue political agendas comparable to Germany. This research presumes that retailers offer EV charging for free. This could change in the future and retailers could start invoicing the charged energy. One could assume this would further weaken the effect on OSPI and place charging as a paid service with different effects to consumer behavior. However, further research is needed to understand the effect.

Further, the construct price-image has two dimensions and only one can be controlled by the management, the other lies internally with the consumer and is hard to understand in a purely quantitative analysis. Further research could employ qualitative interview-based research or use a form of mixed format research to solidify the finding. Through our research we find the initial effects of free EV charging on OSPI and perceived service quality. As time continues and the offering establishes

itself in the market; satisfaction and customer loyalty are two important mediators, that could affect consumer behavior as well (Rust and Zahorik, 1993).

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