Desirable and Undesirable Effects of Product Presentation Tools on Online and Offline Behavior

Dissertation

zur Erlangung des Doktorgrades

der Wirtschaftswissenschaftlichen Fakultät

der Georg-August-Universität Göttingen

(Dr. rer. pol.)

vorgelegt von

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Göttingen, Januar 2019

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Acknowledgements

This doctoral thesis would not exist without the help and support of many people during my doctorate, of whom I would like to make special mention here.

First, I want to express my particular gratitude to my examiners. Above all, I thank my supervisor, Professor Waldemar Toporowski. He gave me the freedom to pursue the research projects I was interested in and gave me his advice at crucial points. A very special thanks must go to my second examiner, Professor Maik Hammerschmidt, for his constant and invaluable support and faith in my skills and ideas, as well as all the feedback and countless productive discussions that continuously sharpened my thinking and improved my abilities as a researcher. I am also thankful to Professor Till Dannewald for taking the time to be my third examiner and for his advice and comments during presentations of my research projects in doctoral colloquia. Furthermore, I also want to thank my "quasi" examiner and very inspiring co-author Professor Welf Weiger for his never-ending methodological and professional counsel throughout all the years of doctorate. I learned so much from you.

Second, I want to thank my former and current colleagues at the Chair of Marketing and Retail Management: Dr. Anne Wiese, Dr. Julian Kellner, Dr. Tim Nierobisch, Dr. Sebastian Ludorf, Dr. Victoria Osburg, Dr. Ines Beeck, Laura Henkel, Vüsal Hasanzade and our secretaries, Margret Magerkorth, Petra Hempe, and Nadja Blaszkowski, for their support in administrative issues. I also thank the many student assistants that helped me during data collection, research and teaching preparations. My special thanks go to Helene Tausch, Fabian Reinkemeier, Sophia Albrecht, David Finken, and Judith Derenthal. Furthermore, thank you to all my other (former) colleagues from the Marketing Department for making my time here so special. All the best for your doctoral projects!

Finally, I want to thank everybody who supported me in my private life. First of all, my partner, Welf, has to be mentioned: thanks for all your support and understanding and the

distraction you gave me. My deepest gratitude goes to my parents, Claudia and Lothar, for their unconditional and comforting love and support not only during my doctorate but also at all other stages of my life. Special thanks also go out to my brother, Markus, for his creative ideas. Further, I would also like to show my appreciation for my closest friends, especially Marina Noll and Markus Gerken. Thank you all for your understanding in busy times and the support you gave me throughout the doctoral years.

Nadine Ahrend

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e.g.	for example
i.e.	that is
PPTs	Product presentation tools
SUR	Seemingly unrelated regression

"Internet (…) would seem to be a poor substitute for traditional transaction channels, where the good is available for inspection."

– Peterson, Balasubramanian, and Bronnenberg 1997 –

1 General Introduction

1.1 Relevance of the Topic

The physical barrier between consumers and tangible products is a significant challenge in online retailing. Since it is impossible to touch and try out products prior to purchase, key characteristics (e.g., material, function, and fit) cannot be fully evaluated in virtual settings (Dunn 2015; Flavián, Gurrea, and Orús 2016). This lack of direct product experience enhances customers' uncertainty regarding product performance (Kim and Lennon 2008). As a consequence, many customers refrain from online shopping, which means a significant loss in sales for online retailers, or they overbuy the same product (e.g., ordering a garment in different sizes or colors) and make the final choice after testing at home (Dishman 2014; Jing 2018). If the product characteristics do not meet customers´ expectations after trying at home, some or eventually all of the ordered products will be returned. However, product returns are highly critical for retailers since they ultimately undermine profitability through additional costs (e.g., for processing and logistics; Janakiraman, Syrdal, and Freling 2016).

In an effort to compensate for the lack of direct product experience, online retailers have introduced *product presentation tools* (PPTs). Such tools provide detailed information about tangible product characteristics (Hilken et al. 2017; Maity and Arnold 2013). For instance, apparel retailers use fit advisors as tools that provide customers with individual size recommendations based on their body measurements. Similarly, a product configurator enables consumers to compare products by specifying product characteristics and to visualize products from different angles. Thus, PPTs have the potential to create realistic shopping

experiences by making a product virtually present in customer's personal environment and able to be "tried out" while at the same time offering a sense of physical control over information provision (Yim, Chu, and Sauer 2017).

However, whether those tools are able to resemble touch-and-feel experiences of the physical world depends on their functional design characteristics. Therefore, in order to understand the impact of PPTs, retailers need to consider the generic characteristics of such tools and their specific effects instead of examining tools as a whole. Vividness and interactivity have been identified as key design characteristics of PPTs as both influence the relative effectiveness of tools and are highly configurable by managers. While vividness captures the richness of product information presentation to the senses, interactivity refers to the multiple opportunities to influence the display of product-related information (Lurie and Mason 2007; Suh and Lee 2005). Presentation tools offered by retailers in their online shops differ with respect to the extent and combination of both characteristics (Jiang and Benbasat 2007; Yim, Chu, and Sauer 2017).

Based on the assumption that such tools help consumers make informed purchase decisions online, which should reduce product returns, retailers have been increasingly investing in highly vivid and interactive PPTs in their online shops. However, it seems that in many instances PPTs did not fully deliver on their promises. For example, several retailers (e.g., Tesco and Lands' End) have withdrawn such tools from their online shops due to a dramatic increase in product returns after their introduction (POQ Commerce 2013; Randall 2015). Thus, instead of decreasing product return rates through facilitating purchase decisions, product returns in fact increased causing significant extra costs for processing, depreciation and logistics and ultimately undermining retailers' profitability (Janakiraman, Syrdal, and Freling 2016). Apparently, highly vivid and interactive tools complicated purchase decisions in the online channel. Despite this anecdotal evidence, no research on product return increasing effects of PPTs exists so far.

Anecdotal evidence from retail practice also shows that a particularly critical PPT characteristic responsible for increasing product return rates is interactivity. Interactivity demands high efforts from customers when using a tool to gather desired product information. Such intense participation effort might pay off only if a certain level of interactivity is surpassed so that the benefits of tool usage (e.g., information value) outweigh customers' perceived efforts. Otherwise interactivity only entails high cognitive demands (i.e., high costs) without true informational benefits which might result in poor purchase decisions and thus enhanced product returns (Randall 2015; Suh and Lee 2005). In other words, it may well be that undesirable outcomes of interactivity only occur for lower levels of interactivity, where the tools may not convey convincing product information for the decision process. Thus, the beneficial effects of interactive tools may not play out until a certain threshold of interactivity is exceeded. However, it is certainly unclear, from which level of interactivity high efforts in tool usage pay off for customers. Therefore, examining the impact of interactivity at different levels of the interactivity spectrum seems reasonable. Specifically, the reasoning above suggests that the (undesirable) effects of interactivity are not constant across the entire range of interactivity as currently assumed in literature but increases or decreases with increasing levels of interactivity (Lang 2000). Thus, interactivity is a characteristic that is prone for exhibiting nonlinear effects on behavioral outcomes.

However, increasing product returns after making purchases in the online channel is definitely not the only unintended outcome for retailers associated with the introduction of PPTs. While this outcome solely focusses on repercussions occurring in the online sphere, the impact of presentation tools might not be limited to the online channel, but may also transcend to customer decisions related to the offline channel as many customers use both formats for shopping. If inappropriately designed PPTs complicate the purchase process online, they are likely to inadvertently drive customers to physical stores as the more attractive alternative for making a purchase after having searched for product information

online (so called webrooming behavior; Jing 2018). While this outcome is critical for all retailers operating online shops, it is existence-threatening for online pure players for which each customer lost to the offline channel is a customer lost to competitors (Ailawadi and Farris 2017; Verhoef, Neslin, and Vroomen 2007). Although it is vital to get insights on how to prevent consumers from turning to physical stores after examining products by using PPTs, there is no research on the (undesirable) effects of presentation tools beyond the online channel.

The relevance of the potentially problematic consequences of PPTs is underscored by the fact that in the meantime the trend of introducing PPTs has reversed and retailers increasingly doubt whether high-end presentation tools are always a helpful thing. Against this background, it is surprising that little is known about the desirable and especially undesirable effects of PPT characteristics on customer behavior. In addition, potential mediating mechanisms that can explain these effects and moderating mechanisms that leverage or attenuate these effects have not been considered. Given these gaps in the literature, this dissertation seeks to answer three important research questions: *whether*, *how* and *when* the implementation of PPTs is advisable in terms of creating desirable effects and reducing undesirable effects. To address the first research question ("*whether*"), this work elaborates on the specific behavioral responses to different levels of vividness and interactivity of PPTs. The second research question ("*how*") relates to potential mediating mechanism that explain why PPT characteristics cause the desirable and undesirable behavioral responses. With the third research question ("*when*") the work examines which contingency factors influence these relationships. Specifically, the dissertation considers consumer- and retailer-related factors (e.g., consumer characteristics and online shop characteristics) that shape customers' responses to PPTs. Across three papers, this dissertation provides comprehensive answers to the three research questions and delivers valuable contributions for research and practice.

By primarily drawing on the visual representation framework, the dissertation considers the entire chain of effects from the design characteristics of PPTs controllable by retailers to their ultimate behavioral outcomes. This consideration of the entire chain of effects comes with several specific insights for retail researchers. First, the dissertation creates for the first time a holistic perspective on the effects of presentation tools by considering undesirable behavior in addition to desirable behavior not only regarding the online channel (i.e., the channel in which PPTs are implemented) but also with respect to alternative channels (i.e., offline channel). Second, the undesirable outcomes are clarified by examining the direction of the behavioral effects of interactivity (as a particularly harmful design characteristic) across varying levels of interactivity through analyzing potential nonlinearities in the functional relationships between interactivity and customer responses. Third, by considering mediating mechanisms the dissertation opens the black box between PPT characteristics and outcomes. Specifically, the dissertation shows that simulating touch-and-feel experiences in virtual settings unfolds cognitive and affective processes. Depending on whether these psychological processes are perceived as uncomfortable (e.g., in terms of cognitive effort) or pleasant (e.g., in terms of enjoyment) the behavioral effects for retailers are desirable or undesirable. Finally, the investigation of the influence of consumer characteristics on the desirable and undesirable effects facilitates a comprehensive understanding about the boundary conditions that determine the strength and shape of these effects.

For technology designers and e-commerce managers, understanding the effects of PPTs is essential for their design and effective implementation. Taken together, the results provide precise managerial guidelines by showing online retailers different ways to increase desirable behavior and mitigate undesirable behavior. First, the design characteristics (especially interactivity) have to be used with caution. Second, the synergistic or dissynergistic effects due to separated and combined use of design characteristics for the

online and offline channel should be considered in order to increase online sales and prevent the loss of profit through a defection to competing channels. Third, knowing the mediating mechanisms helps practitioners to regulate the impact of the PPT characteristics on behavior. Finally, insights on the leveraging impact of consumer- and retailer-related factors helps for an optimal targeting of PPTs.

The next chapter gives an overview of the relevant literature on PPTs responding consumer behavior.

1.2 Literature Review and Assessment

This section summarizes the results of previous studies that analyzed the effects of specific PPTs or their design characteristics (i.e., functional mechanism) on consumer behavior. Studies examining the effects of websites or online shops (e.g., layout and design) have been excluded because they deal with different settings. Table 1 provides an overview of the latest state of research on PPTs and shows how the three papers of this dissertation fill the resulting research gaps. In the following, the criteria for assessing extant studies are discussed individually.

Design characteristics: Previous research predominantly examines presentation tools as a whole in terms of treatment dummies or through simply considering a high or low level of one tool characteristic (e.g., Fiore, Kim, and Lee 2005; Park, Lennon, and Stoel 2005). However, such analyzes at the tool level have several disadvantages. First, it cannot map and analyze the variance of the key characteristics that are implemented in PPTs and which constitute the differential impact of such tools. According to the visual representation framework, the vividness of product information presentation and the ways in which customers can interact with a tool for extracting relevant product information are the two key characteristics in the design of presentation formats (Jiang and Benbasat 2007; Lurie and Mason 2007). Specifically, without differentiating between characteristics in terms of vividness and interactivity it is neglected that the characteristics can bear different behavioral implications (and maybe their effects even cancel out each other) and hence tools can have heterogeneous behavior impact depending on the mix of both characteristics. Second, no concrete implications for tool design can be derived in terms of which levels of vividness and interactivity should be implemented. Therefore, vividness and interactivity are the starting points (i.e., independent variables) in the conceptual frameworks of all three papers. By using this fine-grained approach of considering the specific design characteristics, the three papers

of the dissertation expand previous research by deriving generalizable insights on how the functional mechanisms underlying these presentation formats influence behavior.

Undesirable behavior: So far, the focus of research has been on desirable behavioral outcomes of PPTs (e.g., purchase intention and intention to revisit an online shop, attitude towards an online retailer or an online shop; e.g., Fiore, Jin, and Kim 2005; Kim and Forsythe 2008). All three papers of the dissertation expand previous research by analyzing undesirable consequences of PPTs (increasing product returns and driving defection to competing channels). These consequences are examined for each individual design characteristic instead of entire tools. The consideration of undesirable in addition to desirable behavior provides a holistic perspective on the effects of vividness and interactivity. Based on this, guidelines can be derived for online retailers on how to reduce such undesirable effects.

Nonlinear relationships of design characteristics: Technology designers and retail managers generally assumed that making tools as vivid and interactive as possible encourages favorable customer behavior. Therefore, for the relationship between specific PPTs or design characteristics and customer responses only linear effects have been examined so far (e.g., Jiang and Benbasat 2007; Park, Lennon, and Stoel 2005). Perhaps, a "more is better" decision rule is not fully warranted. By analyzing nonlinear effects between design characteristics and consumer responses in Paper 2, the possibility is taken into account that undesirable effects do not occur monotonically and might disappear once a certain level of a PPT characteristic has been exceeded. The inclusion of nonlinear effects extends prior research as it permits more realistic insights into the form of the functional relationships between PPT characteristics and consumer responses which is not possible with the (unrealistic) assumption of linear effects

Mediators: Some studies that analyze the effects of virtual product experience and PPTs treat mediating processes as a black box (e.g., Jin 2011; Suh and Lee 2005). Without the knowledge about the mediating mechanisms, the relationships between PPT characteristics and behavioral responses cannot be meaningfully explained. This gap is closed in Paper 1 and

Paper 2 by considering mediating mechanisms (cognitive effort and enjoyment). They represent a critical link between PPTs and behavioral outcomes, in that their effects can be competing but also complementary. So, they can explain the occurrence of so far unknown undesirable effects of PPT characteristics.

Design characteristics-behavior moderators: So far, many previous studies assume homogenous effects of PPTs or their characteristics on behavioral outcomes across individuals (e.g., Fiore, Kim, and Lee 2005; Park, Lennon, and Stoel 2005). However, the same characteristic may be experienced differently by different customers. Based on the current state of research, it is hardly possible to reveal target group-specific effects of the functional mechanisms of various tools. Paper 1 and Paper 2 close this gap by showing which combinations of vividness and interactivity levels are most effective for specific target groups and product categories in terms of reinforcing desirable and mitigating undesirable behavior. These give retailers precise recommendations for effective tool design. However, not only target group characteristics are important moderating factors, but also the design of the online shop offers retailers a powerful lever to strengthen the bright-side and reducing the dark-side effects of PPTs. Therefore, Paper 3 considers an easy-to-implement online shop characteristic (i.e., product reviews) as a moderator of the relationships.

Offline channel: Inadequately designed PPTs can complicate the purchase process online which is likely to inadvertently drive customers into physical stores after having searched for product information online. Such cross-channel effects of tools go unmentioned in previous PPT research. So far, the focus was exclusively on the online channel (e.g., Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007). Paper 3 closes this gap by analyzing the effects of the design characteristics on both the online and offline channel. The paper provides a more complete picture of the effects of presentation tools. Additionally, it offers retailers guidelines for an appropriate design of PPTs, allowing them to control online and offline behavior concurrently.

Table 1: Summary of Previous Research

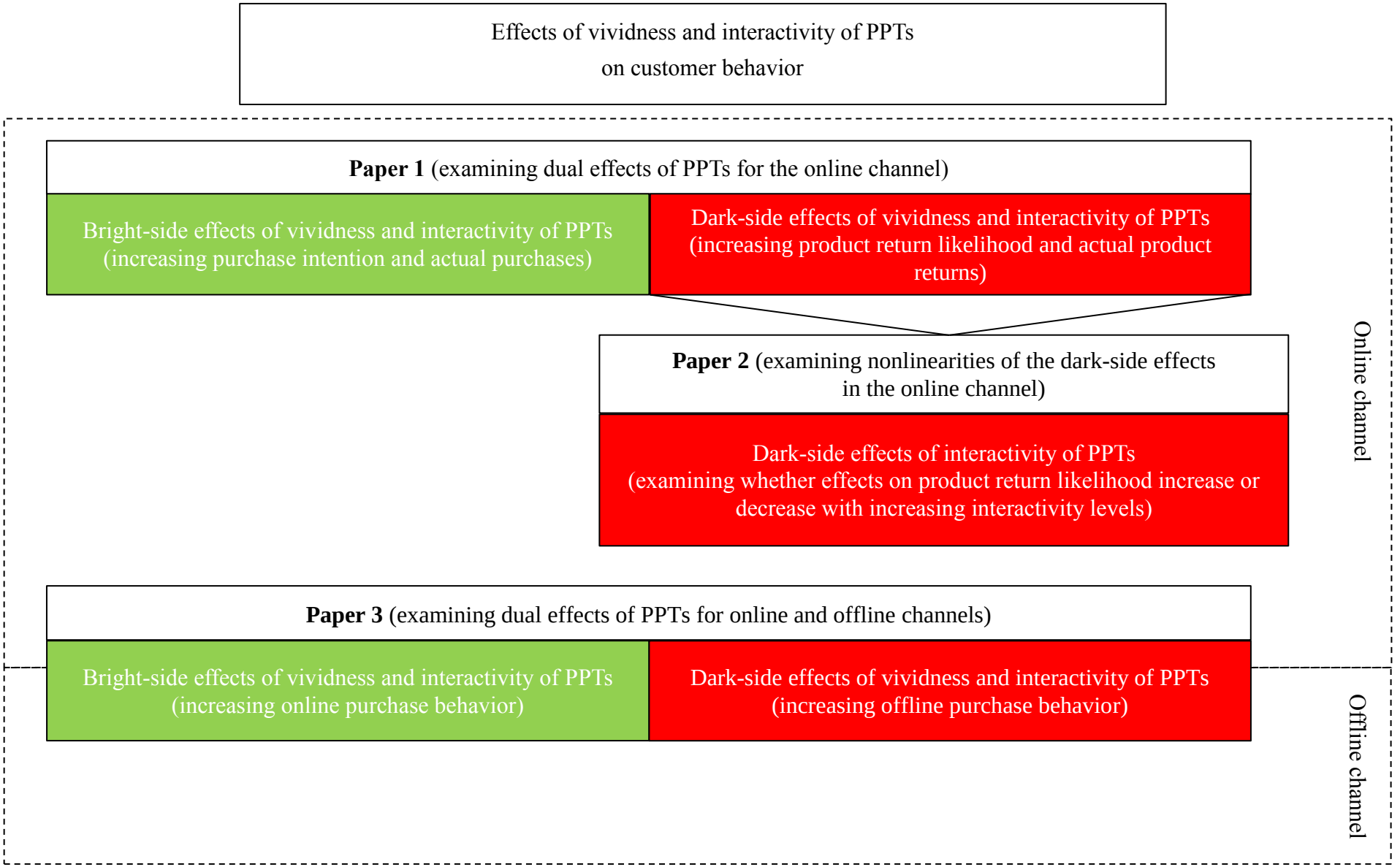
Authors	Design characteristics	Undesirable behavior	Nonlinear relationships of design characteristics	Mediators	Design characteristics-behavior moderators	Offline channel
Fiore, Jin, and Kim (2005)	×	×	×	✓	×	×
Fiore, Kim, and Lee (2005)	×	×	×	✓	×	×
Park, Lennon, and Stoel (2005)	×	×	×	✓	×	×
Suh and Lee (2005)	✓	×	×	×	×	×
Holzwarth, Janiszewski, and Neumann (2006)	×	×	×	✓	✓	×
Jiang and Benbasat (2007)	✓	×	×	✓	×	×
Lurie and Mason (2007)	✓	×	×	✓	✓	×
Kim and Forsythe (2008)	×	×	×	✓	✓	×
Jin (2011)	×	×	×	×	✓	×
Merle, Senecal, and St-Onge (2012)	×	×	×	✓	×	×
De, Hu, and Rahman (2013)	×	✓	×	×	×	×
Choi and Taylor (2014)	×	×	×	✓	✓	×
Müller-Stewens et al. (2017)	×	×	×	✓	×	×

Paper #1	✓	✓	×	✓	✓	×
Paper #2	✓	✓	✓	✓	✓	×
Paper #3	✓	✓	×	×	✓	✓

1.3 Research Outline

The dissertation comprises three papers which examine the effects of vividness and interactivity of presentation tools on desirable and undesirable behavior relating to the online channel (Paper 1 and Paper 2) as well as those relating to online and offline channels (Paper 3). Figure 1 gives an overview of the dissertation's framework. First, this framework provides a holistic perspective on the dual effects of PPTs, which extends current research by revealing dark-side effects (e.g., increasing product returns) in addition to the already analyzed desirable effects (e.g., increasing online purchases). Second, it "zooms in" on the undesirable effects (i.e., product returns) of a particularly critical characteristic – interactivity – to concretize the direction of the effects across the entire spectrum of interactivity, which deepens the understanding of the formation of dark-side effects. Third, the framework contributes to a holistic perspective by investigating the desirable (i.e., increasing channel loyalty) and undesirable effects (i.e., driving defection to competitors' channel) of PPTs with respect to the offline channel, in addition to their effects in the online channel.

Figure 1: Dissertation Framework Comprising Three Papers



Common to all three papers is the goal to identify means to strengthen the bright-side behavioral effects and to reduce the dark-side ones. Consequently, all papers examine whether, how and when different levels of vividness and interactivity increase the desirable outcomes for retailers (online purchases) and reduce undesirable consequences (product returns and defection to competitors' channel).

Paper 1, first, examines the effects of each PPT characteristic on behavioral outcomes. Because it is unclear whether and how tools trigger undesirable behavioral outcomes – despite ample practical evidence on dark-side effects of PPTs – the paper not only focuses on desirable outcomes of PPT characteristics (increased purchases), but particularly on undesirable behavioral consequences (increased product returns). Thus, the paper analyzes at first dual effects of such tools. Second, the paper examines mediating mechanisms (cognitive effort and enjoyment) through which PPT characteristics operate in parallel and which may counterbalance in producing the desirable and undesirable effects. In doing so, it is expected that responses to presentation tools vary across customer groups. Thus, finally, the paper investigates when consumer characteristics (consumers with low and high need for touch and advice seeking) have a strengthening or weakening influence on the relationships between PPT characteristics and mediator variables. Such insights are crucial for retailers to calibrate the degree of vividness and interactivity, and to decide whether these degrees should vary between different target groups and product categories to promote desirable behavior and reduce undesirable outcomes.

After providing empirical evidence on the existence of undesirable effects of interactivity (Paper 1), knowledge is needed on how to design PPTs in a way that mitigates these undesirable outcomes. Therefore, *Paper 2,* first, picks up the results by "zooms in" to an especially undesirable outcome of highly interactive tools (product returns). In doing so, it is important to investigate whether increasing levels of interactivity are associated with continuously increasing dark-side effects. For this, nonlinear effects have to be taken into

account when the linear terms of the interactivity effects prove to be significant. Examining nonlinear effects in a second step allows to make realistic evaluations of the direction of the effects of interactivity across the entire range of interactivity. Second, as Paper 1 confirmed the existence of mediating mechanisms, it is also important to analyze how they operate in the presence of nonlinear effects. Only if the more realistic (nonlinear) effects between interactivity and mediating variables are taken into account after having tested for linear effects, a full understanding of interactivity's implications for customer behavior can be obtained. Finally, especially because Paper 1 has also confirmed the moderating influence of consumer characteristics, their influence must also be considered in a nonlinear effects setting. It could happen that the shape of the effects of interactivity strongly differs across customer segments (customers with low and high advice seeking and tool experience). This facilitates a target group-specific design of interactive tools, reducing undesirable behavior. The exclusive investigation of an undesirable consequence of PPTs contributes to the current research and creates more concrete guidelines for technology designers and retailers to limit the dark-side effects of this particularly critical design characteristic.

Paper 3, first, analyzes the potential of vivid and interactive presentation tools to not only enhance online purchases (increasing channel loyalty) but also prevent customer migration to the offline channel (decreasing defection to competing channels) and hence counter the so-called webrooming dilemma. Second, it is crucial for all retailers and especially for online pure players to be aware of the effects that a combination of high vividness and interactivity levels has on purchase decisions regarding the online as well as the offline channel. This provides insights on whether vividness and interactivity operate in a synergistic or dissynergistic manner. Finally, the paper examines how an easy-to-use online shop characteristic (product reviews as an additional source of information beyond PPTs) influences the separate as well as combined impact of vividness and interactivity. This knowledge is vital for online pure players and for all retailers operating online to get insights

on how to keep customers in the online channel and finally make the cost-intensive opening of physical stores obsolete.

Table 2 summarizes the research questions, key findings, and key contributions of the papers.

Table 2: Overview of the Papers

Paper	Key interest	Research questions	Key findings	Key contributions
#1 Designed to Fail? The Impact of Design Characteristics of Product Presentation Tools in Online Shopping	Analyze the effects of vividness and interactivity on desirable and undesirable behavior.	(1) Do vividness and interactivity of PPTs trigger desirable and undesirable outcomes for retailers? (2) What are the mediating mechanisms in these relationships? (3) Do outcomes of vividness and interactivity vary across customer groups?	(1) Dark-side effects of PPT characteristics (particularly interactivity) exist beyond bright-side effects. (2) Undesirable effects of high interactivity levels prevail especially for customers with high need for touch in hedonic settings and customers with low advice seeking in utilitarian settings. (3) PPT design should be aligned to target groups and product category in which a retailer operates.	(1) Provides for the first time a holistic picture on consumers' responses to PPTs. (2) Explains why PPT characteristics differ in their bright- and dark-side effects. (3) Shows that customer characteristics regulate behavioral responses to PPTs.
#2 Interactivity – Boon or Bane? The Nonlinear Relationship between the Interactivity of Product Presentation Tools and Product Returns	Investigate the direction of the effects of interactivity on undesirable behavior.	(1) Does interactivity trigger product returns? (2) What are the mediating mechanisms between interactivity and product returns?	(1) Undesirable outcomes (i.e., high cognitive effort and low enjoyment) are strongest for medium levels of interactivity.	(1) Deepens PPT research by revealing changing strengths and directions of the effects of interactivity across the range of interactivity.

		(3) How does the influence of interactivity on product returns change depending on consumer characteristics?	(2) High levels of advice seeking and low levels of tool experience accentuate the non-linear effects of interactivity on cognitive effort and enjoyment. (3) Optimal interactivity levels should be set regarding to target groups.	(2) Clarifies that bright- and dark-side effects of interactivity strongly differ depending on the level of interactivity. (3) Shows that the shape of the relationships between interactivity and mediators depends on customer characteristics.
#3 Stand by Me: How Online Retailers Can Survive Against the High Street	Analyze the effects of vividness and interactivity on desirable and undesirable behavior on two shopping channels.	(1) Do vividness and interactivity trigger online purchase behavior while reducing purchases at offline stores? (2) How does combining both design characteristics impact online and offline purchase behavior? (3) When should high levels of the design characteristics be pursued?	(1) PPT characteristics cause bright- and dark-side effects regarding the online and offline channel. (2) Combining high vividness and interactivity triggers undesirable effects. (3) Product reviews support the understanding of products and create shopping experiences without the need for visiting physical stores.	(1) Extends insights on the effects of PPT characteristics beyond the online channel. (2) Explains that the bundling of both PPT characteristics can have synergistic or dissynergistic effects. (3) Demonstrates that the negative impact of combining both PPT characteristics can be counterbalanced by complementing them with product reviews.

Each paper faces different methodological challenges. A detailed description is provided in the data and methodology sections of the respective papers. In addition, Table 3 gives an overview of the data, sample, research context, and methodology of the papers.

In all three papers, a scenario-based experimental approach was chosen for the purpose of testing the conceptual frameworks in order to achieve sufficient variation of the design characteristics based on real-life PPTs in existing online shops. Doing this, Paper 1 used survey data with purchase intention and product return likelihood measures matched with actual purchase and product return data obtained from a follow-up field survey. Paper 2 used survey data with product return likelihood measures and Paper 3 used survey data with intention and actual field purchase data for online and offline channels. This approach is common for measuring the effects of tools or their design characteristics on behavioral outcomes in PPT research (e.g., Jiang and Benbasat 2007; Park, Lennon, and Stoel 2005). Although there are very few studies that analyzed actual behavior in the form of objective (long-term) server log data, website click data and/ or purchase and product return data by cooperating with a retailer (e.g., De, Hu, and Rahman 2013), they only provide insights about the effects of tools as a whole and not the effects of the single tool characteristics as the papers of this dissertation do.

The papers follow previous PPT research which has mainly focused on the apparel industry (e.g., Merle, Senecal, and St-Onge 2012) and the consumer electronics industry (e.g., Suh and Lee 2005) and chose these industries as their empirical context. Other reasons for the choice of these contexts are the high product return rates (apparel industry 75% and consumer electronics industry 33%; Optoro 2017) and the prevalence of webrooming behavior (consumer electronics 54%, apparel 49%, and furniture 19%; eMarketer 2016) which both is necessary for obtaining a sufficient variation in the dependent variables. The three papers employ a broad portfolio of state-of-the-art analytical methods such as simultaneous equations

estimation, bootstrapped mediation (moderation) analysis, nonlinear relationship estimation, and methods for addressing selection, heterogeneity and endogeneity issues.

The next chapter provides the abstracts of the papers.

Table 3: Data, Sample, Research Context, and Methodology of the Papers

Paper	Data	Sample size	Research context	Methodological considerations

#1 Designed to Fail? The Impact of Design Characteristics of Product Presentation Tools in Online Shopping	Treatment conditions with different levels of vividness and interactivity; survey data on purchase intention and product return likelihood matched with actual purchase and product return data	#1: n = 902
		#2: n = 679
			#1: Apparel
			#2: Consumer electronics
				• Scenario-based online experiment
				• Simultaneous model estimation
				• Bootstrapped indirect effects estimation
				• Alternative measures for
				  ○ vividness and interactivity – expert coding
				  ○ PPTs – dummy treatment
				  ○ purchase intention and product return likelihood – actual purchases and actual product returns

#2 Interactivity – Boon or Bane? The Nonlinear Relationship between the Interactivity of Product Presentation Tools and Product Returns	Treatment conditions with different levels of interactivity; survey data on product return likelihood	n = 990	Apparel	• Scenario-based online experiment • Simultaneous model estimation • Nonlinear relationship estimation • Bootstrapped indirect effects estimation

				• Alternative measure for interactivity – expert coding

#3 Stand by Me: How Online Retailers Can Survive Against the High Street	Treatment conditions with different levels of vividness and interactivity; survey data on intentions and actual online and offline purchase data	#1: n = 1,104
		#2: n = 512
			#1: Furniture and consumer electronics
			#2: Apparel and consumer electronics
				• Scenario-based online experiment
				• Simultaneous model estimation
				• Alternative measures for
				  ○ vividness and interactivity – expert coding
				  ○ online and offline purchase intention – actual online and offline purchases
				  ○ product reviews – dummy and product review usefulness

1.4 Abstracts

1.4.1 Paper 1

Many retailers offer product presentation tools (PPTs), such as animated 3D images or product configurators, in their online shops to assist customers in finding the right products and thereby reduce product returns. However, practical evidence suggests that PPTs may instead increase product returns, causing significant costs for retailers. To examine whether the desirable or undesirable outcome prevails, this research focuses on real-life presentation tools to evaluate the effects of two major design characteristics: vividness and interactivity. Robust evidence across two studies set in hedonic and utilitarian product domains shows that while vividness fosters the inclination to purchase and mitigates the likelihood of product returns, interactivity represents a double-edged sword. Although interactive tools trigger enjoyment, they drive cognitive effort by demanding intensive customer participation, which reduces purchases and fosters product returns. To avoid the harmful effects of interactivity and fully capitalize on PPTs, retailers in hedonic settings should target online customers with low need for touch, while retailers of utilitarian products should focus on advice seekers.

1.4.2 Paper 2

Many retailers introduce product presentation tools (PPTs, e.g., videos and fit advisors) to their online shops to help consumers choose the right product (i.e., fit), in hopes that this will decrease product returns. However, practical evidence suggests that PPTs increase product returns through complex participation requirements instead of reducing them. This development is highly undesirable as it ultimately undermines retailers´ profitability through due to additional processing and logistics costs. To examine whether and how these undesirable outcomes prevail, this research focuses on real-life tools to evaluate undesirable effects. Interactivity seems to be a potentially harmful design characteristic of PPTs as it

complicates instead of simplify the purchase decision process. A study dealing with the product category of apparel, characterized by high product returns, provides robust evidence that interactivity is a double-edged sword. Nonlinear relationships describe these counterbalancing effects. To avoid the harmful impact of interactivity, retailers should design the level wisely. Retailers with a high advice seeking target group should offer tools with high interactivity to mitigate undesirable consequences. Customers with low tool experience should get tools with high interactivity to cause desirable effects.

1.4.3 Paper 3

Searching product information online but then migrating to stationary stores for purchasing has increased dramatically. This webrooming behavior is a major threat for online pure players. They have no offline stores which could compensate for lost online revenues. To increase purchases in their online shops and to make switching to offline competitors obsolete, online pure players heavily invest in product presentation tools (PPTs) like videos or product configurators in order to simulate physical touch-and-feel experiences in their virtual stores. However, so far there is no evidence whether PPTs can indeed reduce online-to-physical store switching. To examine whether and when PPTs promote online purchases and reduce offline purchases, this research employs two studies with real-life PPTs. Robust evidence for both digital and nondigital product categories shows that vividness of PPTs fosters online purchases and reduces the purchase attractiveness of the offline channel. Interactivity of PPTs, on the other hand, intensifies the webrooming dilemma and pushes customers into physical stores. Combining high levels of vividness and interactivity exacerbates the defection to offline competitors. To avoid the harmful effects and strengthen the beneficial effects of PPTs, online retailers should complement their PPTs with product reviews by other customers to provide a “social proof” of the information provided by PPTs.

Following the introduction, this work is divided into five parts. Chapter 2 through 4 are structured as three independent papers which address the three research questions that were presented in the previous section. Chapter 5 draws upon the entire thesis, tying up the various contributions to research and practical implications provided by the three papers. The comparative discussion also indicates avenues for future research that might help to broaden the understanding of consumer responses to PPTs.

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2 Designed to Fail? The Impact of Design Characteristics of Product Presentation Tools in Online Shopping (Paper 1)

(with Maik Hammerschmidt, Welf H. Weiger, and Waldemar Toporowski)[1]

This version of the paper was invited for second round review in the *Journal of Retailing*, 2018.

A prior version of this paper was invited for first round review in a Special Issue of the *Journal of the Academy of Marketing Science*, 2016.

An earlier version of this paper has been presented at the conference *Forschungstagung Marketing* 2015, Trier, Germany.

Keywords: vividness, interactivity, cognitive effort, product returns, product presentation tools

[1] This paper was created in cooperation with the listed co-authors. I was responsible for the literature research, the theoretical framework, the hypotheses development, the data management, the methodology, and the empirical analysis. My co-responsibilities comprised the positioning, the contribution statement, the conceptual framework, and the implication section.

2.1 Introduction

The absence of "touch-and-feel" experiences in online retailing is a fundamental barrier to purchase and is the main reason for product returns (Grohmann, Spangenberg, and Sprott 2007; Shulman, Coughlan, and Savaskan 2011). To convey detailed information about tangible product characteristics and to visualize how products match customers' specific needs, online retailers increasingly offer product presentation tools (PPTs; Hilken et al. 2017; Maity and Arnold 2013). For instance, through fit advisors, apparel retailers provide customers with individual size recommendations upon entering their body measurements, while by offering product configurators they enable customers to visually compare products by specifying product characteristics (De, Hu, and Rahman 2013; Lurie and Mason 2007). These tools provide vivid product information and allow customers to interact in many ways regarding the presentation of product-related content.

For online retailers, vividness and interactivity have been identified as the key design characteristics of PPTs because they are highly configurable by managers and are expected to evoke touch-and-feel experiences among online shoppers. While vividness captures the richness of product information and supports imagination of actual product use, interactivity reflects the multiple opportunities to display product-related information (Lemon and Verhoef 2016; Lurie and Mason 2007). On the premise that PPTs help customers make better purchase decisions, prior research has evaluated how enhancing vividness and interactivity leads to desirable effects such as increased purchase intentions or intention to revisit the online shop (e.g., Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007).

Although originally expecting to reduce product returns with the help of PPTs, several retailers (e.g., Tesco and Land's End) withdrew these tools from their online shops because PPTs complicated the purchase process through complex participation requirements which dramatically increased product return rates due to sub-optimal product selections (POQ

Commerce 2013; Randall 2015). While this response is highly undesirable as it ultimately undermines profitability through enhanced processing and logistics costs (Terry 2014), it is surprising that research has not investigated whether high vividness and interactivity levels of presentation tools trigger product returns, and if so, how. By overlooking these negative consequences, extant studies' predictions regarding the effectiveness of PPTs for retailers' performance might be overly optimistic (Bonifield, Cole, and Schultz 2010). Moreover, research lacks insight on whether the effects of vividness and interactivity vary across customer groups with respect to important online shopping habits. Such insight is critical for retail managers to fine-tune PPTs and to decide whether their vividness and interactivity levels should be adjusted across target groups.

Given these knowledge gaps, our study seeks to answer the following research questions: (1) Do vividness and interactivity of PPTs trigger desirable and undesirable outcomes for retailers? (2) What are the mediating mechanisms in these relationships? (3) Do outcomes of vividness and interactivity vary across customer groups? To answer these questions, we present a framework that relates vividness and interactivity to the desirable and undesirable behavioral outcomes, namely purchase intention (Suh and Lee 2005) and product return likelihood (Janakiraman and Ordóñez 2012). Our framework explains the impact of design characteristics on these outcomes through their influence on cognitive effort and enjoyment (Herrmann et al. 2013; Maity and Arnold 2013). Both are critical intervening variables because individuals strive to assimilate useful information with low cognitive effort while enjoying the use of information tools as much as possible. The framework also considers need for touch and advice seeking as moderators because they strongly relate to retailers' targeting decisions.

Through two experimental studies using real-life tools of existing online shops, we contribute to online retailing literature in several ways. First, we advance existing research on the beneficial outcomes of PPTs (Fiore, Jin, and Kim 2005; Park, Lennon, and Stoel 2005) by

contrasting the "bright-side" effects of PPTs' design characteristics with their so-far neglected dark-side effects to provide a more complete understanding of customer responses to PPTs. In so doing, we consider both the beneficial responses that are associated with higher sales (i.e., enhanced purchase intentions) and the potential detrimental behaviors associated with higher costs (i.e., enhanced product return likelihood).

Second, we explain why the design characteristics of PPTs differ in their bright versus dark-side effects. To this end, we consider cognitive effort and enjoyment as competing, potentially offsetting mediating mechanisms that link PPT characteristics and behavioral outcomes (Babin, Darden, and Griffin 1994; Childers et al. 2001). Doing so allows for generalizable implications for retailers to calibrate PPTs' degree of vividness and interactivity.

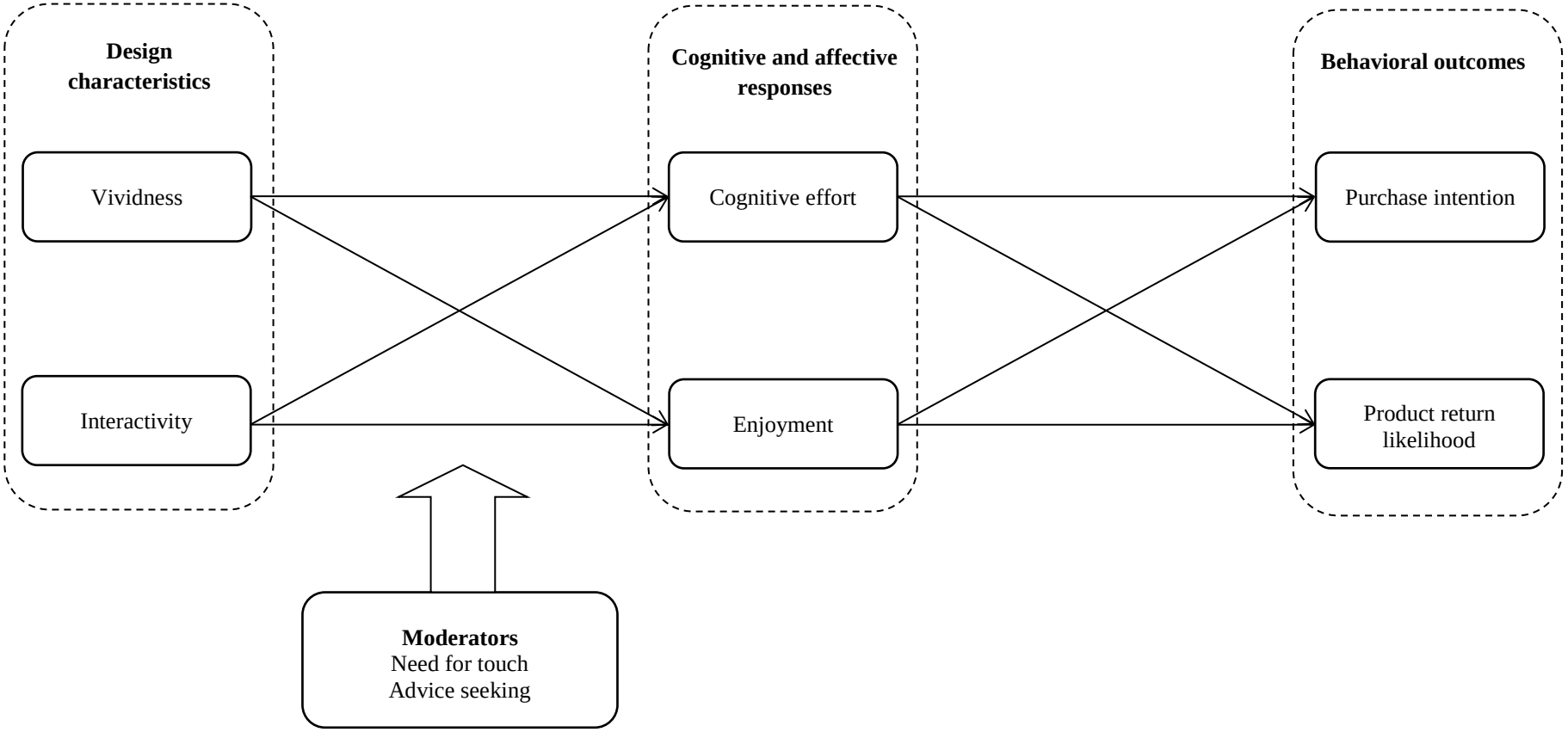
Third, our model also helps to discern which levels of vividness and interactivity are most effective for particular customer segments in terms of accentuating advantageous purchase consequences while minimizing detrimental product return effects. Thus, we guide retailers in deciding how to design effective presentation tools for each segment.

After presenting our conceptual framework and developing our hypotheses, we describe two experimental studies combined with field surveys to test our framework in hedonic and utilitarian product domains, which previous research has identified as prototypical online shopping contexts (Poncin and Mimoun 2014; Wang et al. 2007). By integrating the results from both contexts, we offer broad empirical insights into the repercussions of vivid and interactive tools across varied forms of online shopping. Additionally, we provide managerial recommendations for online retailers adjusted to their specific product settings and targeted customer groups.

2.2 Conceptual Framework

Our proposed framework is theoretically rooted in the visual representation framework (e.g., Jiang and Benbasat 2007; Lurie and Mason 2007). It elaborates on how different forms of product information visualization in virtual settings influence customer behavior. More precisely, it posits that the design characteristics are the sources of cognitive and affective responses to such tools, which in turn determine customers' behavioral responses. Drawing on this framework, our model relates the PPT characteristics (vividness and interactivity) to behavioral outcomes (purchase intention and product return likelihood) through two mediated pathways (cognitive effort and enjoyment). We further argue that two moderators (need for touch and advice seeking) determine when PPTs lead to more or less beneficial outcomes for retailers. Figure 2 depicts the framework. We next elaborate on the selection of model variables and precisely define all variables.

Figure 2: Research Model for Study 1 and Study 2



Design Characteristics of PPTs

The visual representation framework suggests vividness and interactivity as key functional characteristics of PPTs because they are highly configurable by managers and are expected to evoke quasi-sensory experiences among online shoppers. More precisely, by imitating the process of touching and feeling products in virtual settings, the two design characteristics have the potential to support product understanding and imagination of actual product use before purchase (Lemon and Verhoef 2016).

We define *vividness* as the richness of (product) information representation (Li, Daugherty, and Biocca 2003; Lurie and Mason 2007). Specifically, vividness refers to the number of different cues and modes offered by presentation tools and the degree to which the presentation is imagery-provoking (Choi and Taylor 2014; Darke et al. 2016). For instance, videos showing product use in real-life situations are considered highly vivid.

We define *interactivity* as the extent to which users can engage with presentation tools and modify virtual objects to extract relevant product information (Jiang and Benbasat 2007; Suh and Lee 2005). Thus, interactivity refers to the number of possible user actions, the speed of assimilating user input, and the ability of providing immediate feedback (Lurie and Mason 2007; Park, Lennon, and Stoel 2005). For example, a 3D model allowing the user to combine different garments and rotate and zoom in on the model is considered highly interactive.

Cognitive and Affective Responses to PPT Design Characteristics

The visual representation framework further emphasizes that cognitive and affective responses to PPT characteristics determine customers' behavioral outcomes. That is, when using such tools to gather information, individuals translate PPT characteristics into cognitive and affective evaluations. Drawing on these insights, we include cognitive effort and enjoyment as constructs in examining the mediating role of cognitive and affective evaluations. The two constructs operate in parallel and may reveal counterbalancing effect

paths in the relationship between PPTs and behavioral outcomes (Franke and Schreier 2010; Maity and Arnold 2013). We define *cognitive effort* as the extent of mental strain a consumer incurs during PPT use. More specifically, cognitive effort represents how demanding the consumer finds the activity necessary to fully use a PPT (Haumann et al. 2015). In contrast, we define *enjoyment* as the degree to which the consumer perceives using PPTs to be emotionally stimulating, pleasant, and fun (Babin, Darden, and Griffin 1994).

Behavioral Outcomes

We propose that cognitive effort and enjoyment in the context of PPT use manifests in desirable and undesirable behavioral outcomes that ultimately result in revenues or costs for the retailer (Janakiraman, Syrdal, and Freling 2016). As a proxy for the retailer's revenues we consider *purchase intention*, defined as the propensity to purchase from a retailer (Suh and Lee 2005). As a proxy for the retailer's costs we consider *product return likelihood*, defined as a customer's expected propensity of returning considered products to the retailer, for example because of anticipated problems regarding quality or fit (Bechwati and Siegal 2005; Maity and Arnold 2013).

Moderators

Online shopping is characterized by high degrees of intangibility (e.g., 25% of all online shops provide only one static image per product) and diversity (e.g., Amazon carries 723 types of women's running shoes; Bleier, Harmeling, and Palmatier 2017), resulting in potential uncertainty regarding the right product options to choose. How customers rely on haptic cues (e.g., feeling the quality of a fabric) and authentic information (e.g., reviews about the technical performance of consumer electronics) to facilitate purchase decisions determines whether customers respond favorably or unfavorably to PPTs (Dabholkar and Bagozzi 2002; Meuter et al. 2005). Thus, we consider these two aspects as moderating variables that regulate

the extent to which cognitive effort and enjoyment result from PPT characteristics. *Need for touch* is defined as the preference for haptic cues and sensory experiences (Peck and Childers 2003a; b) and *advice seeking* is defined as the preference for product recommendations (Brooks, Gino, and Schweitzer 2015).

2.3 Hypotheses Development

Effects of Vividness on Cognitive Effort and Enjoyment

Several studies suggest that vivid presentation tools (e.g., videos presenting the product) activate customers' imagination of tactile product attributes even in the absence of physical stimuli (Choi and Taylor 2014; Park, Lennon, and Stoel 2005). The activation of sensory experiences while shopping online enables customers to envision "trying" the product in a personally relevant context (Hilken et al. 2017). Such a sense of first-hand experiences facilitates the quick and easy understanding of product characteristics when using the PPT (Herrmann et al. 2013; Mosteller, Donthu, and Eroglu 2014). Through enhancing the ease of processing product information, high vividness lowers the perception of required time and mental energy for obtaining useful product information. Therefore:

H1a. Vividness has a negative effect on cognitive effort.

Vivid information presentation typically involves multisensory stimulation (Suh and Lee 2005). Compared to a static product presentation (e.g., still pictures), vivid PPTs expose customers to dynamic and visually appealing information presentation, such as animated graphics and moving pictures, which create spatial presence of products mimicking real-world shopping experiences and aiding the customer in neglecting the technology-mediated setting (Hilken et al. 2017). This allows customers to immerse themselves in the customer journey with undistracted imagination. The resulting affective stimulation creates feelings of fun and

enjoyment (Jiang and Benbasat 2007; Orús, Gurrea, and Flavián 2017). Therefore, we propose the following.

H1b. Vividness has a positive effect on enjoyment.

Effects of Interactivity on Cognitive Effort and Enjoyment

High interactivity that allows a multitude of possible actions demands substantial participation effort in terms of perceived time spent, learning, and potential hassle for gathering desired information, independent of the tool's intuitiveness (Etgar 2008; Köhler et al. 2011). The greater the participation required by highly interactive tools, the less likely the value of the obtained product information compensates for the associated cognitive wearout. Further, every additional interactive feature is one more source of potential misunderstanding and faulty performance (Thompson, Hamilton, and Rust 2005). Overcharging a tool with interactive features raises doubt as to whether consumers can use the tool to its full potential before they are tired and overwhelmed. Thus, we propose:

H2a. Interactivity has a positive effect on cognitive effort.

Although interactivity may lead to detrimental cognitive responses, it may also be beneficial in terms of positively valenced emotional responses (Babin, Darden, and Griffin 1994; Mishra, Mishra, and Nayakankuppam 2007). More precisely, customers may find engaging with interactive tools to produce a personally relevant outcome that isinherently arousing and entertaining (Franke and Schreier 2010). In fact, the mere opportunity to interact with PPTs can activate affective responses (Suh and Lee 2005).

H2b. Interactivity has a positive effect on enjoyment.

Effects of Cognitive Effort on Behavioral Outcomes

Complex and mental-energy-consuming co-creation processes related to using PPTs might result in the perception of a "painful" decision process which triggers counterfactual thinking where customers envision the consequences of their behavior before deciding to act (Gleicher et al. 1995). To avoid anticipated undesirable outcomes of their purchase decisions, customers are likely to abandon the purchase process (Etgar 2008; Franke and Schreier 2010). Increased cognitive effort could also deplete cognitive resources necessary for thoroughly assessing information on the pros and cons of a product and thus raise the expectation to purchase a non-fitting product. This would also result in a lowered intention to move forward in the customer journey.

H3a. Cognitive effort has a negative effect on purchase intention.

However, counterfactual thinking might motivate customers to move forward in the customer journey albeit knowing that they are likely to make a wrong purchase and consequently intending to return the product in the first place. Impairing confidence in the decision-making process might also spark the feeling of overlooking important information (Etgar 2008). This feeling arouses suspicions of making erroneous assessments while choosing the products (Heitmann, Lehmann, and Herrmann 2007). The anticipation of making a poor choice coincides with the customer's expectation that a product may have to be returned. This uncertainty may in turn spur the inclination to overbuy a product in different variants (e.g., ordering the same product in different colors or different specifications), which increases the anticipated likelihood for returns.

H3b. Cognitive effort has a positive effect on product return likelihood.

Effects of Enjoyment on Behavioral Outcomes

Joyful customer experiences have been shown to increase the time spent in an online shop and raise customers' willingness to purchase (Babin, Darden, and Griffin 1994; Dabholkar and Bagozzi 2002). Likewise, pleasant and visually appealing experiences help to distract users from problems outside the virtual shopping environment and release resources for forming purchase decisions (Pham 2004; Wang et al. 2007).

H4a. Enjoyment has a positive effect on purchase intention.

Individuals who experience enjoyment while shopping are more satisfied with the shopping process and have a stronger belief that a product satisfies their needs. This conviction fosters the customer's decision to keep products, even if the product does not meet expectations after the purchase (Maity and Arnold 2013). As greater enjoyment also enhances attitudes and trusting beliefs toward the retailer (Schlosser, White, and Lloyd 2006), general willingness to "hurt" the firm (i.e., by returning products) is hampered.

H4b. Enjoyment has a negative effect on product return likelihood.

Moderating Effects of Need for Touch

Need for touch moderates the impact of vividness on cognitive effort and enjoyment. Customers with high need for touch tend to promote trust in their purchase decision by obtaining tactile information through physical examination of products (Peck and Childers 2003a; b). Vivid PPTs mimic a tactile shopping experience and effectively compensate for the lack of haptic cues. Thus, customers with a high need for touch should be more easily convinced of the benefits of using vivid PPTs to evaluate product quality and are likely to move through the purchase decision process with reduced cognitive effort (Park, Lennon, and Stoel 2005; Yazdanparast and Spears 2013).

H5a. The negative impact of vividness on cognitive effort (i.e., the cognitive effort reducing effect) is reinforced when need for touch is high.

A realistic and visually rich product presentation provided by vivid tools should particularly inspire enjoyment for customers who seek affective stimulation through touch sensations (Peck and Childers 2003a). Because these individuals are more likely to form richer mental product representations, they have greater ability to become engrossed in the virtual environment (Choi and Taylor 2014; Jin 2011). Vivid PPTs should therefore be more effective at creating an emotion-stimulating impact for touch-oriented customers. In sum, we posit:

H5b. The positive impact of vividness on enjoyment (i.e., the enjoyment-stimulating effect) is reinforced when need for touch is high.

Need for touch moderates the impact of interactivity on cognitive effort and enjoyment. Customers with high need for touch are less willing to invest resources in gathering product information (Babin, Darden, and Griffin 1994; Peck and Childers 2003a). Hence, for customers with high need for touch the perceived effort of intensive participation in the purchase decision process are particularly high (Peck and Childers 2003b). Moreover, for such customers the risk of being overwhelmed by complex interactive tools is greater (Choi and Taylor 2014). In sum, the more customers desire touch sensations the more strongly they will associate high levels of interactivity with greater cognitive effort.

H6a. The positive impact of interactivity on cognitive effort (i.e., the cognitive effort enhancing effect) is reinforced when need for touch is high.

As discussed, high need for touch is strongly associated with a strong preference for activities providing emotional stimulation. Thus, increased emotional benefits resulting from interactive PPTs are valued as particularly joyful and are particularly arousing for customers high in need for touch (Peck and Childers 2003a). Thus:

H6b. The positive impact of interactivity on enjoyment (i.e., the enjoyment-stimulating effect) is reinforced when need for touch is high.

Moderating Effects of Advice Seeking

Advice seeking moderates the impact of vividness on cognitive effort and enjoyment. Customers characterized by high advice seeking value the availability of comprehensive information to support purchase decisions. For these customers, the easy and immediate access to visually rich product information provided by vivid tools should be very appealing (Reinecke Flynn, Goldsmith, and Eastman 1996). Thus, the cognitive effort-reducing effect of vividness should be accentuated for advice-seeking customers.

H7a. The negative impact of vividness on cognitive effort (i.e., the cognitive effort reducing effect) is reinforced when advice seeking is high.

Advice seekers tend to rely on social influence in the customer journey (Berger 2014). Vivid product presentations provide virtual consultation through, for instance, explaining products in videos. Thus, for advice seekers such a simulated consultation should result in stronger emotions, higher social closeness (Darke et al. 2016) and generate more joyful shopping experiences (Van Doorn et al. 2017).

H7b. The positive impact of vividness on enjoyment (i.e., the enjoyment-stimulating effect) is reinforced when advice seeking is high.

Advice seeking moderates the impact of interactivity on cognitive effort and enjoyment. By relying on others, advice seekers strive to obtain information quickly and easily, reducing their search costs (Brooks, Gino, and Schweitzer 2015). However, retrieving information by using interactive tools drains a user's own cognitive resources owing to the active participation required. Thus, advice seekers are more likely to associate interactivity with

prohibitively high efforts, and cognitive effort is likely to outweigh the benefits of the additional information obtained through interactive tools.

H8a. The positive impact of interactivity on cognitive effort (i.e., the cognitive effort enhancing effect) is reinforced when advice seeking is high.

Interactive tools allow numerous interactions with another entity, enabling quasi social interactions in real time and reducing the feeling of social isolation in online shops (Van Doorn et al. 2017). As advice seekers find real-time interaction of particular relevance (Berger 2014), they may have more affective responses when they get product-related information by using highly interactive tools (Hoffman, Novak, and Kang 2017).

H8b. The positive impact of interactivity on enjoyment (i.e., the enjoyment-stimulating effect) is reinforced when advice seeking is high.

2.4 Study 1: Testing the Model in a Hedonic Shopping Context

2.4.1 Setting

Study 1 uses a large-scale experiment in a hedonic setting to test the hypotheses. We focus on online fashion retailers because the appeal of fashion depends on design and / or aesthetics representing typical hedonic attributes (Okada 2005; Voss, Spangenberg, and Grohmann 2003). Unlike most previous studies, we use PPTs embedded in real-life online shops instead of fictitious tools presented on mock web sites. In doing so, we ensure a realistic and natural shopping environment to establish external validity (De, Hu, and Rahman 2013; Wang et al. 2007).

2.4.2 Pre-Study

First, to test whether the focal product (a casual pullover) is categorized as hedonic, we asked 42 university students between 18 and 35 years to evaluate it using the item "I'm very excited about shopping for this apparel" (anchored by 1 = "strongly disagree" and 7 = "strongly agree"; Voss, Spangenberg, and Grohmann 2003). The average rating was above the scale midpoint (M = 4.57), confirming that consumers perceived the product as hedonic. Second, we selected potential PPTs by examining tools that are most frequently employed by established apparel online shops and by asking 196 apparel online shoppers in another pre-study. We identified five generic tools: multi-angle images (presenting products from different perspectives), video (presenting products in full-motion demonstrations), mix-and-match (presenting products in customized outfits), size guide (offering a static table to identify ideal fitting size), and fit advisor (generating automatic size recommendations based on user input). Table 4 gives full descriptions of these tools.

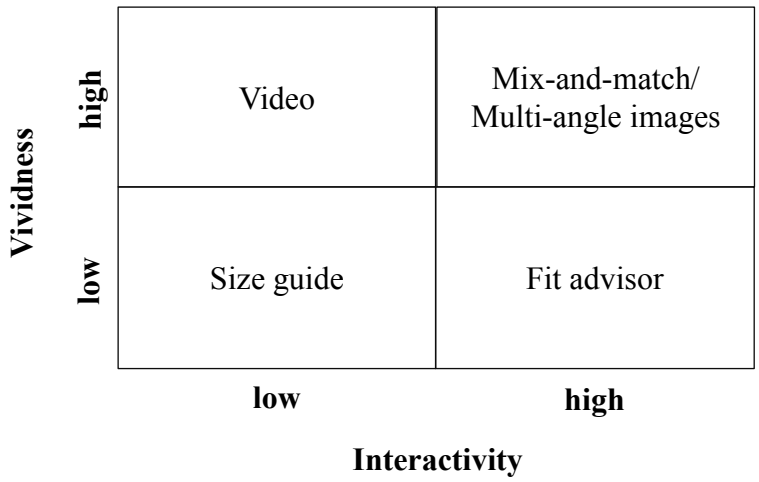
Table 4: Overview and Full Descriptions of the PPTs Used Across Study 1 and Study 2

Tool	Description	Example
Multi-angle images	Allowing customers to view and examine products from different perspectives	Displaying detailed product attributes from all possible angles (e.g., button or pattern)
Video	Presenting product information through full-motion demonstrations	Showing customers how a garment fits and how the fabric falls during movements
Mix-and-match	Providing the opportunity to combine and view multiple garments so that customers can put together an entire outfit	Functionality that lets customers put garments on virtual mannequins to put together an outfit
Size guide	Offering customers the opportunity to identify the best-fitting size of a garment by using a static table	A table that lets customers identify their shirt size based on torso measures
Fit advisor	Offering diverse input and interaction options for customers to generate an automatic size recommendation	Suggesting the size of a garment after asking customers for age, individual body measurements (e.g., size, weight, shape of the stomach, structure of shoulders), preferences concerning the fit of garments (slim fit versus wide fit), and the correct

		size of garments from previously purchased brands
Product configurator	Providing a selection of products for a specific product category according to pre-entered product expectations	Suggesting laptops that meet a customer's needs after asking customers for individual application and usage options of laptops (e.g., operating system, screen size, features, interfaces, price)

As no single online shop exists that offers all five tools, we preselected shops that differed only with respect to the PPTs employed on the product page but were not perceived significantly ($p > .10$) different by pre-test participants with respect to visual appeal ("I perceived the appearance of [online shop] as very professional"), color style ("I perceived the color style of [online shop] as very pleasant"), and user experience design ("I found my way around [online shop] very well," all anchored by 1 = "strongly disagree" and 7 = "strongly agree"; Parasuraman, Zeithaml, and Malhotra 2005). In addition, we found that awareness of the online shop ("I perceived the logo of [online shop] as very positive") and attitude toward the online shop ("I have a very positive attitude towards [online shop]," both anchored by 1 = "strongly disagree" and 7 = "strongly agree") did not significantly differ across the shops (all $p > .10$). The selected online shops had identical lenient return policies, had a highly comparable product assortment, and had no price discounts or other promotions during the time of the study. Subjects of the pre-test ($n = 196$) then evaluated perceived vividness and interactivity of the five presentation tools through multiple items measured by 7-point Likert scales (see Appendix; $M_{\text{vividness}} = 4.43$; $M_{\text{interactivity}} = 4.38$). Further, analysis of variance showed that the five tools differed significantly with respect to vividness and interactivity, indicating sufficient variation regarding both design characteristics (see results in Figure 3).

Figure 3: Categorization of PPTs Used in Study 1



Notes: Categorization of PPTs based on mean values of vividness and interactivity perception.

We ensured that presentation tools differed only with respect to the presentation format, with all other relevant characteristics being highly similar (Wang et al. 2007). The accuracy and quantity of product information content provided ("The tool gives me a lot of facts about the garment" and "The tool gives me a lot of important information about the garment," anchored by 1 = "strongly disagree" and 7 = "strongly agree") were perceived as similar as we found no significant differences ($p > .10$ for both items) across tools.

2.4.3 Procedure and Sample

We conducted the experiment using an online survey based on the real-life PPTs identified in the pre-study. First, we asked subjects to imagine they were considering the purchase of a casual pullover.[2] Then, we randomly assigned participants to one of the five PPTs by directing them to the respective product page, where they were guided on how to use the respective tool. Subjects were distributed equally across tools. They were then instructed to use the tool to examine the focal product for a few minutes as if they were shopping and

[2] We selected this product from a range of potential products because participants of the pre-study displayed moderately positive attitude levels for this product. This criterion ensured that we did not use a product to which participants had strongly positive or negative attitudes to avoid that the effects of prior attitude on behavioral outcomes confound the effects of PPTs.

deciding whether to make a purchase. Manipulation checks (i.e., ”Did you see the PPT correctly?”, Did you use the PPT?”, and “Could you get an impression of the PPT functionality?”, anchored by 1 = “yes” and 2 = “no”; “How long did you use the PPT?”, anchored by 1 = “less than 1 minute” and 7 = “more than 10 minutes”) substantiated that participants in fact used the focal tool, fulfilled the product examination task, and gathered information required for forming a purchase decision regarding the pullover. In addition, tracking of browsing time in the online shops indicated that participants indeed used the tool (Schlosser, White, and Lloyd 2006). After performing the product examination task, participants answered an online questionnaire that captured the focal constructs.

A total of 902 university students participated in the study.[3] Subjects were screened according to whether they had already purchased apparel online at least once (Wang et al. 2007). The sample consisted of 66% women, and 91% of the sample ranged from 18 to 35 years of age. This distribution is representative for online shoppers in the apparel industry (Statista 2016a). Table 5 presents further descriptive statistics.

2.4.4 Measurement

We measured constructs for PPT characteristics, mediators, behavioral outcomes, and moderators using multi-item scales adapted from prior research (see Appendix). To allow for user heterogeneity, we captured the design characteristics by using individual respondents’ perceived levels of vividness and interactivity instead of merely using dichotomous variables for capturing the static manipulation of low versus high vividness and interactivity (Baker et al. 2002; Wang et al. 2007). To validate these measures we asked four retail experts[4] to code PPTs according to their degree of vividness and interactivity. The judges received detailed coding instructions and then indicated the number of vividness and interactivity elements for

[3] Apparel is one of the online products students purchase most frequently (Comegys and Brennan 2003).
[4] The four coders were a university professor for retail management, the CEO of a retail consulting firm, an IT specialist responsible for web design and web administration at a large European multichannel retailer and a website usability expert.

each presentation tool (Cho and Cheon 2005). We then ranked the tools according to the mean coding-based and mean survey-based scores for vividness and interactivity. We obtained identical tool rankings for both design characteristics, indicating that the survey participants' perceptions resembled the objective, feature-based scores obtained through expert coding.

The scale for purchase intention referred to how likely participants were to purchase the garment they had examined earlier (Herhausen et al. 2015; Yim, Chu, and Sauer 2017). In keeping with the literature, to capture product return likelihood we asked participants to imagine they had ordered the garment and then to state their likelihood of returning the garment to the retailer (e.g., because of expected problems regarding fit; Janakiraman and Ordóñez 2012; Maity and Arnold 2013). To validate these survey measures, for a sub-sample of participants (n = 63) we obtained data on actual purchase and return behaviors in the respective online shop after examination of the PPT. In a follow-up survey, participants reported whether they purchased or returned products in the five months after the experiment. We found high correlations with the actual behaviors for purchase intentions (r = .36, p < .01) and product return likelihood (r = .32, p < .01) that are in the upper region of the range commonly reported in literature (Chandon, Morwitz, and Reinartz 2005; Sheppard, Hartwick, and Warshaw 1988).

With one exception, all Cronbach's alpha values exceed .70, suggesting that the measures are reliable (Bagozzi and Yi 1988). We achieved high discriminant validity according to the criterion of Fornell and Larcker (1981). Finally, we included control variables to isolate the effects of PPT characteristics beyond other drivers of behavioral outcomes.[5] Table 5 provides the descriptive statistics and correlations for all variables.

[5] Specifically, to rule out alternative explanations we included four additional predictors of behavioral outcomes that represent the most frequently considered predictors in related studies: gender, age, net income, and ease of use. "Ease of use" is a major predictor of behavioral responses related to new technologies (Blut, Wang, and Schoefer 2016).

Table 5: Descriptive Statistics and Correlations for Constructs in Study 1 and Study 2

	Study 1		Study 2													
Measure	M	(SD)	M	(SD)	1	2	3	4	5	6	7	8	9	10	11	12
1. Vividness	4.69	(1.16)	5.07	(1.10)	1.00	.46	-.23	.50	.45	-.25	.06	.15	-.13	-.06	-.06	.38
2. Interactivity	4.58	(1.26)	4.61	(1.29)	.54	1.00	-.05	.42	.41	-.18	-.01	.09	-.07	.02	-.07	.24
3. Cognitive effort	2.44	(1.19)	2.18	(1.32)	-.18	-.06	1.00	-.12	-.12	.20	.02	-.12	-.04	.13	.03	-.54
4. Enjoyment	4.09	(1.38)	4.15	(1.39)	.60	.56	-.03	1.00	.52	-.13	.04	.07	-.13	-.06	-.07	.22
5. Purchase intention	4.69	(1.25)	4.62	(1.43)	.50	.35	-.17	.50	1.00	-.24	.01	.12	-.13	-.05	-.03	.28
6. Product return likelihood	3.45	(1.15)	2.85	(1.23)	-.21	-.17	.16	-.20	-.26	1.00	.08	-.07	-.01	.01	-.01	-.26
7. Need for touch	5.55	(1.45)	4.94	(1.70)	-.00	-.00	-.01	-.02	-.04	.10	1.00	.10	-.16	-.15	-.06	.03
8. Advice seeking	5.24	(1.55)	5.66	(1.29)	.15	.08	-.06	.12	.17	-.06	.10	1.00	-.08	.03	-.02	.14
9. Gender	.34	(.47)	.39	(.49)	-.02	-.02	-.05	-.08	-.05	-.15	-.07	-.06	1.00	.14	.10	.01
10. Age	26.47	(7.73)	26.39	(8.11)	.01	.08	.02	-.02	.01	-.10	-.15	-.04	.03	1.00	.28	-.13
11. Income	2.64	(1.80)	2.68	(1.82)	.01	.01	-.02	-.04	-.05	.01	-.12	-.10	.10	.33	1.00	-.07
12. Ease of use	6.22	(1.10)	6.06	(1.25)	.29	.22	-.39	.20	.26	-.13	.08	.12	-.06	-.05	-.04	1.00

Notes: M = mean, SD = standard deviation. Study 1 (Study 2) correlations are reported below (above) the diagonal. For Study 1 (Study 2), correlations larger than or equal to |.07| (|.08|) are statistically significant ($p < .05$, two-tailed).

2.4.5 Methodology

We tested our hypotheses using seemingly unrelated regression (SUR) for numerous reasons. First, the relationships of our model are theoretically linked and hence error terms are likely to be nonindependent across relationships. SUR fully accounts for such correlated errors (Wallace and Silver 1988). Second, SUR accommodates omitted variables that may affect the relationship between independent and dependent variables and that may lead to an overestimation of standard errors (Greene 2011). Third, the hypothesized relationships imply that cognitive effort and enjoyment act as mediators for the effects of the PPT design characteristics on behavioral outcomes. SUR is advantageous in accounting for mediation because direct and indirect effects are tested simultaneously (Preacher and Hayes 2008). We thus estimated the following four equations simultaneously, with the first two representing the mediator models (cognitive effort, CE, and enjoyment, EN, as dependent variables) and the latter two representing the behavioral outcome models (purchase intention, PI, and product return likelihood, RL, as dependent variables):

(1) $$CE_i = \beta_0 + \beta_1 VI_i + \beta_2 IN_i + \beta_3 NT_i + \beta_4 VI_i \times NT_i + \beta_5 IN_i \times NT_i + \beta_6 AS_i + \beta_7 VI_i \times AS_i + \beta_8 IN_i \times AS_i + \beta_9 GEN_i + \beta_{10} AGE_i + \beta_{11} NI_i + \beta_{12} EU_i + \varepsilon_{1i}$$

(2) $$EN_i = \gamma_0 + \gamma_1 VI_i + \gamma_2 IN_i + \gamma_3 NT_i + \gamma_4 VI_i \times NT_i + \gamma_5 IN_i \times NT_i + \gamma_6 AS_i + \gamma_7 VI_i \times AS_i + \gamma_8 IN_i \times AS_i + \gamma_9 GEN_i + \gamma_{10} AGE_i + \gamma_{11} NI_i + \gamma_{12} EU_i + \varepsilon_{2i}$$

(3) $$PI_i = \delta_0 + \delta_1 CE_i + \delta_2 EN_i + \delta_3 VI_i + \delta_4 IN_i + \delta_5 NT_i + \delta_6 VI_i \times NT_i + \delta_7 IN_i \times NT_i + \delta_8 AS_i + \delta_9 VI_i \times AS_i + \delta_{10} IN_i \times AS_i + \delta_{11} GEN_i + \delta_{12} AGE_i + \delta_{13} NI_i + \delta_{14} EU_i + \varepsilon_{3i}$$

(4) $$RL_i = \zeta_0 + \zeta_1 CE_i + \zeta_2 EN_i + \zeta_3 VI_i + \zeta_4 IN_i + \zeta_5 NT_i + \zeta_6 VI_i \times NT_i + \zeta_7 IN_i \times NT_i + \zeta_8 AS_i + \zeta_9 VI_i \times AS_i + \zeta_{10} IN_i \times AS_i + \zeta_{11} GEN_i + \zeta_{12} AGE_i + \zeta_{13} NI_i + \zeta_{14} EU_i + \varepsilon_{4i}$$

where VI_i represents vividness and IN_i is interactivity. NT_i and AS_i refer to the moderators need for touch and advice seeking. We also included control variables: GEN_i is gender, AGE_i is age, NI_i is net income and EU_i stands for ease of use. Finally, ε_{1i}, ε_{2i}, ε_{3i}, ε_{4i}

are the disturbance terms of subject *i*. While we expect our interactions to unfold their effects in the cognitive effort and enjoyment models and hence to be mediated by these variables, we have included them in all four equations to test for full mediation.

2.4.6 Results

Test of hypotheses on the effects of PPT design characteristics on mediators. The results provide support for H_{1a}, showing that vividness exerts a significant cognitive effort reducing effect (β_1 = -.121, p < .01). H_{1b}, which states that vividness increases enjoyment, can be accepted as well (γ_1 = .509, p < .01). In contrast to vividness, interactivity has a significant cognitive effort-enhancing impact (β_2 = .076, p < .05) and H_{2a} can be confirmed. H_{2b}, which stated that interactivity drives enjoyment, can also be accepted (γ_2 = .362, p < .01).

Test of hypotheses on the effects of mediators on behavioral outcomes. Consistent with H_{3a} and H_{3b}, we found that cognitive effort reduces purchase intention (δ_1 = -.090, p < .01) but significantly increases product return likelihood (ζ_1 = .119, p < .01). Furthermore, enjoyment increases purchase intention (δ_2 = .280, p < .01) and at the same time reduces product return likelihood (ζ_2 = -.107, p < .01), providing support for H_{4a} and H_{4b}.

Test of moderating effect hypotheses. First, we investigated the role of need for touch in altering the relationships between design characteristics and mediators. As high need for touch amplifies the cognitive effort-reducing effect of vividness (β_4 = -.051, p < .05), we can confirm H_{5a}. However, H_{5b} cannot be confirmed as we found no intensified enjoyment stimulating effect of vividness for customers with high need for touch (γ_4 = .012, p > .10). While need for touch reinforces the cognitive effort-enhancing effect of interactivity (β_5 = .049, p < .05) in support of H_{6a}, we found no significant impact of need for touch on the relation between interactivity and enjoyment (γ_5 = .010, p > .10) and no evidence for H_{6b}.

Second, regarding the moderating role of advice seeking, we found no moderating influence on the effect of vividness on cognitive effort (β_7 = -.017, p > .10) or on enjoyment

(γ_7 = .012, p > .10). Thus, our results do not confirm H_{7a} und H_{7b}. Although we found that the undesirable cognitive effort-enhancing effect of interactivity is significantly increased when advice seeking is high (β_8 = .039, p < .10), we did not find a moderating effect of advice seeking on the interactivity–enjoyment link (γ_8 = .000, p > .10). Thus, the data confirm H_{8a} but not H_{8b}. Tables 6 and 7 contain the results of the four SUR equations for the hypothesized relationships.

Table 6: SUR Estimates for Cognitive Effort and Enjoyment Models for Study 1 and Study 2

	Dependent variable: Cognitive effort				Dependent variable: Enjoyment			
Independent variables	Coefficient	SE	z-Value		Coefficient	SE	z-Value	
Constant	-.002 / .013	.036 / .042	-.04 / .31		-.003 / -.001	.034 / .045	-.09 / -.01	
PPT characteristics								
Vividness	-.121*** / -.093**	.038 / .046	-3.17 / -2.02	H_{1a} (✓) / H_{1a} (✓)	.509*** / .474***	.036 / .049	14.08 / 9.67	H_{1b} (✓) / H_{1b} (✓)
Interactivity	.076** / .177***	.034 / .037	2.21 / 3.18	H_{2a} (✓) / H_{2a} (✓)	.362*** / .258***	.032 / .039	11.15 / 6.56	H_{2b} (✓) / H_{2b} (✓)
Moderators								
Need for touch	.018 / .042*	.025 / .025	.72 / 1.66		-.030 / .005	.024 / .027	-1.23 / .17	
Advice seeking	-.005 / -.065*	.024 / .034	-.20 / -1.92		.026 / -.014	.023 / .036	1.15 / -.39	
Interactions								
Vividness × need for touch	-.051** / .008	.026 / .025	-1.96 / .32	H_{5a} (✓) / H_{5a} (×)	.012 / -.012	.025 / .026	.49 / -.45	H_{5b} (×) / H_{5b} (×)
Interactivity × need for touch	.049** / -.012	.024 / .022	2.06 / -.58	H_{6a} (✓) / H_{6a} (×)	.010 / .017	.023 / .023	.44 / .74	H_{6b} (×) / H_{6b} (×)
Vividness × advice seeking	-.017 / -.078**	.022 / .034	-.79 / -2.31	H_{7a} (×) / H_{7a} (✓)	.012 / -.033	.021 / .036	.58 / -.91	H_{7b} (×) / H_{7b} (×)
Interactivity × advice seeking	.039* / .014	.022 / .028	1.80 / .48	H_{8a} (✓) / H_{8a} (×)	.000 / .060**	.020 / .030	.02 / 1.97	H_{8b} (×) / H_{8b} (✓)
Controls								
Gender (0 = female, 1 = male)	-.160* / -.096	.077 / .089	-2.08 / -1.08		-.160** / -.178*	.073 / .095	-2.19 / -1.89	
Age	.001 / .011**	.005 / .006	.26 / 1.95		-.008* / -.005	.005 / .006	-1.69 / -.91	
Net income	-.022 / -.021	.021 / .024	-1.04 / -.86		-.024 / -.009	.020 / .026	-1.21 / -.36	
Ease of use	-.415***/ -.567***	.035 / .038	-12.01 / -15.08		-.004 / .015	.033 / .040	-.13 / .38	
R^2	.179 / .319				.451 / .305			

* = $p < .10$; ** = $p < .05$; *** = $p < .01$

Notes: Study 1: $n = 902$/ Study 2: $n = 679$; results are based on two-tailed z-tests. Study 1 results are reported before the slash, and Study 2 results are reported after the slash.

Table 7: SUR Estimates for Purchase Intention and Product Return Likelihood Models for Study 1 and Study 2

	Dependent variable: Purchase intention				Dependent variable: Product return likelihood			
Independent variables	Coefficient	SE	z-Value		Coefficient	SE	z-Value	
Constant	.001 / .004	.034 / .045	.04 /.09		.000 / -.006	.036 / .045	.00 / -.14	
Mediators								
Cognitive effort	-.090*** / .048	.032 / .041	-2.83 / 1.18	H_{3a} (✓) / H_{3a} (×)	.119*** / .070*	.033 / .041	3.57 / 1.72	H_{3b} (✓) / H_{3b} (✓)
Enjoyment	.280*** / .361***	.033 / .038	8.40 / 9.47	H_{4a} (✓) / H_{4a} (✓)	-.107*** / .010	.035 / .038	-3.06 / .026	H_{4b} (✓) / H_{4b} (×)
PPT characteristics								
Vividness	.269*** / .199***	.040 / .052	6.69 / 3.83		-.070* / -.179***	.042 / .052	-1.66 / -3.43	
Interactivity	.019 / .172***	.035 / .041	.54 / 4.26		-.039 / -.071*	.036 / .041	-1.06 / -1.76	
Moderators								
Need for touch	-.042* / -.018	.024 / .027	-1.74 / -.69		.069*** / .062**	.025 / .027	2.74 / 2.30	
Advice seeking	.065*** / .052	.023 / .036	2.88 / 1.45		-.027 / -.020	.024 / .036	-1.13 / -.56	
Interactions								
Vividness × need for touch	.001 / -.003	.024 / .026	.02 / -.13		-.001 / .010	.026 / .026	-.02 / .37	
Interactivity × need for touch	-.001 / .009	.023 / .023	-.06 / .39		-.019 / -.048**	.024 / .023	-.82 / -2.12	
Vividness × advice seeking	-.000 / -.016	.021 / .036	-.02 / -.46		-.014 / .028	.022 / .036	-.66 / .78	
Interactivity × advice seeking	-.008 / -.002	.020 / .030	-.38 / -.06		.023 / -.010	.021 / .030	1.08 / -.31	
Controls								
Gender (0 = female, 1 = male)	-.050 / -.146	.073 / .094	-.68 / -1.55		-.369*** / -.032	.077 / .094	-4.80 / -.34	
Age	.005 / -.004	.005 / .006	1.11 / -.60		-.016*** / .000	.005 / .006	-3.24 / .04	
Net income	-.028 / .022	.020 / .026	-1.39 / .86		.044** / -.021	.021 / .026	2.05 / -.82	
Ease of use	.091*** / .138***	.035 / .046	2.60 / 3.00		-.041 / -.137***	.037 / .046	-1.10 / -2.99	
R^2	.338 / .354				.120 / .120			
Overall system R^2	.295 / .279							

* = $p < .10$; ** = $p < .05$; *** = $p < .01$

Notes: Study 1: $n = 902$/ Study 2: $n = 679$; results are based on two-tailed z-tests. Study 1 results are reported before the slash, and Study 2 results are reported after the slash. All variance inflation factors (VIF) are below the recommended cut-off of 5 (O´Brien 2007).

2.4.7 Mediation Testing

In testing for mediated effects, we estimated bias-corrected bootstrapped confidence intervals (5,000 draws) for testing each indirect effect (Preacher and Hayes 2004). All indirect main effects of vividness and interactivity on purchase intention and product return likelihood through cognitive effort and enjoyment are significant, as shown in Table 8. The significant direct effect of vividness on purchase intention (δ_3 = .269, p < .01) and the weakly significant effect on product return likelihood (ζ_3 = -.070, p < .10) indicate that cognitive effort and enjoyment partially mediate the effects of vividness on behavioral outcomes (Wetzel, Hammerschmidt, and Zablah 2014). Results also demonstrate that cognitive effort and enjoyment fully mediate the effects of interactivity on behavioral outcomes.

Further, all moderated effects are mediated by cognitive effort and enjoyment as the indirect interaction effects of PPT characteristics and moderators on behavioral outcomes are significant (Table 9). In addition, we found no significant direct effects of any of the hypothesized interaction terms on purchase intention and product return likelihood (p > .10). Consequently, the moderating effects are fully mediated by cognitive effort and enjoyment. These findings support our theorizing that the hypothesized moderations play a role in the first step of the chain shown in Figure 2.

Table 8: Mediation Testing for Study 1

Mediated effects			Path coefficient	SE[a]	LLCI	ULCI
Vividness	→ Cognitive effort	→ Purchase intention	.011	.005	.005	.022
Vividness	→ Enjoyment	→ Purchase intention	.142	.021	.112	.180
Vividness	→ Cognitive effort	→ Product return likelihood	-.014	.006	-.028	-.006
Vividness	→ Enjoyment	→ Product return likelihood	-.055	.019	-.085	-.024
Interactivity	→ Cognitive effort	→ Purchase intention	-.007	.004	-.016	-.002
Interactivity	→ Enjoyment	→ Purchase intention	.101	.014	.080	.127
Interactivity	→ Cognitive effort	→ Product return likelihood	.009	.005	.003	.019
Interactivity	→ Enjoyment	→ Product return likelihood	-.039	.014	-.062	-.016

Notes: n = 902; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

Table 9: Mediated Moderation Testing for Study 1

Mediated moderation effects			Path coefficient	SE[a]	LLCI	ULCI
(Vividness x need for touch)	→ Cognitive effort	→ Purchase intention	.005	.003	.001	.010
(Vividness x need for touch)	→ Enjoyment	→ Purchase intention	.003	.007	-.008	.015
(Vividness x need for touch)	→ Cognitive effort	→ Product return likelihood	-.006	.004	-.013	-.001
(Vividness x need for touch)	→ Enjoyment	→ Product return likelihood	-.001	.003	-.007	.003
(Interactivity x need for touch)	→ Cognitive effort	→ Purchase intention	-.004	.003	-.011	-.001
(Interactivity x need for touch)	→ Enjoyment	→ Purchase intention	.003	.006	-.007	.013
(Interactivity x need for touch)	→ Cognitive effort	→ Product return likelihood	.006	.004	.001	.014
(Interactivity x need for touch)	→ Enjoyment	→ Product return likelihood	-.001	.003	-.006	.003
(Vividness x advice seeking)	→ Cognitive effort	→ Purchase intention	.002	.002	-.001	.006
(Vividness x advice seeking)	→ Enjoyment	→ Purchase intention	.003	.006	-.005	.013
(Vividness x advice seeking)	→ Cognitive effort	→ Product return likelihood	-.002	.003	-.008	.002
(Vividness x advice seeking)	→ Enjoyment	→ Product return likelihood	-.001	.002	-.006	.002
(Interactivity x advice seeking)	→ Cognitive effort	→ Purchase intention	-.003	.003	-.009	-.000
(Interactivity x advice seeking)	→ Enjoyment	→ Purchase intention	.000	.006	-.009	.009
(Interactivity x advice seeking)	→ Cognitive effort	→ Product return likelihood	.005	.003	.001	.011
(Interactivity x advice seeking)	→ Enjoyment	→ Product return likelihood	-.000	.002	-.004	.004

Notes: n = 902; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

2.4.8 Discussion

Study 1 provides initial evidence that the use of vivid PPTs results in desirable customer behavior for retailers in terms of increased purchase intention and lowered product return likelihood. As our results show, these effects occur because vividness reduces cognitive effort and increases enjoyment. In contrast, for interactive tools the results reveal an ambiguous picture. While high levels of interactivity trigger enjoyment, they increase cognitive effort, leading to lower purchase intention and higher inclination to return products in case of an order. These counterbalancing effects confirm that interactive PPTs are double-edged swords. In the setting of Study 1 (hedonic products), the cognitive effort-reducing effect of high vividness is amplified for customers with high need for touch. Alarmingly, the detrimental effects of interactivity are aggravated for customers with high need for touch and for advice seekers without being offset by increased beneficial effects of interactivity.

However, this study also invites criticism with respect to the generalizability of the findings to other settings. Plausibly, the association of interactivity with high cognitive effort might be related to the hedonic domain of Study 1, as minimizing effort is an important goal when shopping hedonic products (Batra and Ahtola 1990; Peck and Childers 2003b). Also, as in the affect-rich hedonic shopping context sensory aspects are highly relevant whereas cognitive aspects like advice seeking are less relevant, the strong moderating role of need for touch could be context-dependent.

To bolster confidence in our findings regarding the bright- and dark-side effects of PPT characteristics and to reveal more nuanced insight into the context-dependent roles of customer characteristics for shaping the impact of PPTs, we conducted a second experimental study in the more cognitively driven context of shopping utilitarian products.

2.5 Study 2: Testing the Model in a Utilitarian Shopping Context

2.5.1 Setting

The context for Study 2 is consumer electronics. Specifically, we focus on a laptop as the focal product in the experiment. Laptops are characterized as primarily providing instrumental and functional benefits and hence represent typical utilitarian products (Dhar and Wertenbroch 2000; Sela and Berger 2012). Thus, Study 2 complements the hedonic focus of Study 1 and collectively the two studies provide broader insights into the repercussions of PPTs across different product settings.

2.5.2 Pre-Study

Participants of a pre-test (n = 24) classified the laptop as a utilitarian product ("I think that laptops should only be purchased if necessary," M = 5.76; Voss, Spangenberg, and Grohmann 2003). We then selected suitable PPTs for Study 2. Multi-angle images and videos, as were used in Study 1, are also widely established tools in consumer electronics retailing. In addition, in this setting product configurators are prevalent (Table 4 provides a description). Together, these three PPTs represent the tools currently employed in consumer electronics online shops.

We identified one online shop that offered all three focal PPTs comparable with those used in Study 1. Further in line with the previous study, vividness and interactivity scores across the three tools ($M_{\text{vividness}}$ = 4.30; $M_{\text{interactivity}}$ = 4.44; n = 24) significantly differed. Again, PPTs differed only with respect to the presentation format, with all other relevant characteristics being comparable.

2.5.3 Procedure, Sample, and Measurement

As in Study 1, we randomly assigned subjects to one of the three tools and instructed subjects to use the respective PPT to examine the laptop. A total of 679 university students participated in the study. The measurement of all variables was the same as in Study 1 (see Appendix). We achieved reliable measurement (all Cronbach's alphas above .70) and high discriminant validity (Fornell and Larcker 1981). Table 5 provides the descriptive statistics and correlations.

2.5.4 Methodology and Results

Test of main effect hypotheses. For the same reasons as in Study 1, we use SUR to test the hypotheses and estimate the same set of equations. All hypothesized main effects were significant and in the anticipated direction and replicated the results from Study 1, with the exception of H_{3a} and H_{4b}.

Test of moderating effect hypotheses. We found no significant moderating effect of need for touch, for neither the links between vividness and cognitive effort (β_4 = .008, p > .10) nor vividness and enjoyment (γ_4 = -.012, p > .10) or the effects of interactivity on cognitive effort (β_5 = -.012, p > .10) and on enjoyment (γ_5 = .017, p > .10). Thus, we cannot confirm H_{5a} through H_{6b}. In contrast, advice seeking exerts moderating effects. Advice seeking reinforces the cognitive effort-reducing effect of vividness (β_7 = -.078, p < .05) in support of H_{7a}, although no significant moderating effect occurs on the vividness–enjoyment link (γ_7 = -.033, p > .10), which lends no support for H_{7b}. While H_{8a} is not confirmed since we find no stronger cognitive effort-increasing effect of interactivity for highly advice-seeking customers (β_8 = .014, p > .10), the moderating effect of advice seeking on the interactivity–enjoyment link is significant (γ_8 = .060, p < .05), in support of H_{8b}. Tables 6 and 7 contain the results of the four SUR models.

2.5.5 Mediation Testing

For mediation testing we used the same procedure as in Study 1 (see Tables 10 and 11 for results). All indirect effects were significant with exception of the indirect effects of vividness on purchase intention via reduced cognitive effort, of vividness on product return likelihood via enjoyment, of interactivity on purchase intention via cognitive effort, and of interactivity on product return likelihood through enjoyment. However, the two independent variables demonstrate direct effects on both purchase intention and product return likelihood. Together with the identified significant indirect effects of vividness and interactivity through cognitive effort, these results show that cognitive effort partially mediates the effects of both design characteristics on product return likelihood. Furthermore, enjoyment partially mediates the effects of vividness and interactivity on purchase intention.

The results show that cognitive effort does not mediate the effect of the interaction between vividness and advice seeking on purchase intention and enjoyment does not mediate the effect on product return likelihood. Consistent with Study 1, we found no direct effect for any of the interaction terms and thus the moderating effects are fully mediated by cognitive effort and enjoyment.

Table 10: Mediation Testing for Study 2

Mediated effects			Path coefficient	SE[a]	LLCI	ULCI
Vividness	→ Cognitive effort	→ Purchase intention	-.004	.005	-.018	.000
Vividness	→ Enjoyment	→ Purchase intention	.171	.028	.129	.221
Vividness	→ Cognitive effort	→ Product return likelihood	-.007	.006	-.022	-.001
Vividness	→ Enjoyment	→ Product return likelihood	.005	.020	-.030	.037
Interactivity	→ Cognitive effort	→ Purchase intention	.006	.005	-.001	.016
Interactivity	→ Enjoyment	→ Purchase intention	.093	.019	.064	.128
Interactivity	→ Cognitive effort	→ Product return likelihood	.008	.006	.001	.020
Interactivity	→ Enjoyment	→ Product return likelihood	.003	.011	-.016	.021

Notes: n = 679; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

Table 11: Mediated Moderation Testing for Study 2

Mediated moderation effects			Path coefficient	SE[a]	LLCI	ULCI
(Vividness x need for touch)	→ Cognitive effort	→ Purchase intention	.000	.002	-.001	.005
(Vividness x need for touch)	→ Enjoyment	→ Purchase intention	-.004	.011	-.021	.014
(Vividness x need for touch)	→ Cognitive effort	→ Product return likelihood	.001	.002	-.002	.006
(Vividness x need for touch)	→ Enjoyment	→ Product return likelihood	-.000	.001	-.003	.002
(Interactivity x need for touch)	→ Cognitive effort	→ Purchase intention	-.001	.001	-.005	.000
(Interactivity x need for touch)	→ Enjoyment	→ Purchase intention	.006	.009	-.008	.021
(Interactivity x need for touch)	→ Cognitive effort	→ Product return likelihood	-.001	.002	-.006	.001
(Interactivity x need for touch)	→ Enjoyment	→ Product return likelihood	.000	.001	-.001	.003
(Vividness x advice seeking)	→ Cognitive effort	→ Purchase intention	-.004	.004	-.014	.000
(Vividness x advice seeking)	→ Enjoyment	→ Purchase intention	-.012	.014	-.037	.010
(Vividness x advice seeking)	→ Cognitive effort	→ Product return likelihood	-.005	.005	-.018	-.000
(Vividness x advice seeking)	→ Enjoyment	→ Product return likelihood	-.000	.002	-.006	.002
(Interactivity x advice seeking)	→ Cognitive effort	→ Purchase intention	.001	.002	-.001	.006
(Interactivity x advice seeking)	→ Enjoyment	→ Purchase intention	.022	.013	.002	.044
(Interactivity x advice seeking)	→ Cognitive effort	→ Product return likelihood	.001	.003	-.002	.008
(Interactivity x advice seeking)	→ Enjoyment	→ Product return likelihood	.001	.003	-.003	.007

Notes: n = 679; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

2.5.6 Discussion

The results of Study 2 confirm that the effectiveness of vividness and interactivity for triggering desirable outcomes differs. Also for utilitarian products we find that while highly vivid tools are effective in driving purchase intention and inhibiting product return likelihood, high degrees of interactivity backfire because interactivity fuels cognitive effort, yielding an undesirable increase in customers' anticipated product returns.

Further, Study 2 adds to Study 1 by showing that across utilitarian and hedonic settings, different customer characteristics affect the impact of PPT characteristics on customers' responses. While Study 1 shows that in hedonic contexts need for touch is the key moderator, Study 2 shows that in the utilitarian setting advice seeking determines the extent to which vividness and interactivity drive behavioral outcomes. A possible explanation for this finding is that purchasing utilitarian products represents a more cognitively driven decision-making process, where subjective, sensory experiences are less relevant (Dhar and Wertenbroch 2000; Voss, Spangenberg, and Grohmann 2003). Instead, for utilitarian decisions it is important to get others' opinions before making a purchase to arrive at a more objective information base (Batra and Ahtola 1990).

2.6 General Discussion

As retail sales increasingly shift from brick-and-mortar stores to online stores (eMarketer 2017), many retailers have begun to revamp their online channel by replacing static product images with advanced PPTs to support purchase decisions. As retailers can vary the level of vividness and interactivity when designing such tools, evidence of the impact of these design characteristics on shopping behavior is strongly needed, yet is missing in literature. Across two studies in two product domains, this paper provides robust evidence that using PPTs can trigger both beneficial outcomes (increased purchases) and undesirable outcomes (increased

product returns) and that both outcomes depend on the degree of vividness and interactivity. Furthermore, the results indicate that customer characteristics (need for touch and advice seeking) are decisive as to whether the desirable or undesirable effects of vividness and interactivity prevail for retailers. These findings have important implications for both researchers and retail managers, which we discuss next.

2.6.1 Theoretical Implications

The present research contributes to the literature on visual information presentation formats and how information presentation affects consumer behaviors. PPTs represent distinct visualization formats for online product information because they create distinctive combinations of vivid and interactive experiences. First, to the best of our knowledge, our research is unique in providing a holistic perspective on the behavioral outcomes of enhancing vividness and interactivity of PPTs. On the one hand, we confirm the findings of previous research that vivid and interactive tools induce bright-side effects in terms of improved purchase behavior (Park, Lennon, and Stoel 2005; Suh and Lee 2005). On the other hand, we expand current research as our results show that high levels of interactivity also entail dark-side effects in terms of increased product return likelihood, revealing the potential dueling effects of presentation tools.

Second, in line with the requirements of the visual representation framework, our studies reveal the cognitive and affective mechanisms through which the design characteristics work to explain these differential effects. On the one hand, enhanced purchase behaviors are a result of enhanced enjoyment of shopping initiated by high degrees of both vividness and interactivity (Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007). On the other hand, high degrees of interactivity can mentally exhaust customers, leading to greater cognitive effort that produces dark-side effects in terms of increased product returns. In this way, our results provide explanations for the varying effects of PPTs found in prior studies.

While some studies found that such tools enhanced firm-beneficial behaviors, others found that they backfire and lead to undesired consequences (De, Hu, and Rahman 2013; Köhler et al. 2011; Mimoun, Poncin, and Garnier 2012). Our research suggests that studies exploring PPTs' effectiveness should consider the levels of vividness and interactivity implemented in such tools as both characteristics differ in their impact on cognitive effort and enjoyment. A deeper understanding of these countervailing paths triggered by PPT characteristics is essential to determine whether the desirable or undesirable behavioral outcomes of such tools prevail. In advancing the visual representation framework, this study pioneers by showing that through inflicting high cognitive effort on the customer, high interactivity is a potentially harmful characteristic of PPTs.

Finally, this research demonstrates that unfavorable versus favorable behavioral outcomes of PPT use depend on customer characteristics, whose effects in turn depend on product domains. For hedonic products, the cognitive effort-reducing effect of vividness is enhanced for customers high in need for touch. However, at the same time the dark-side effects of interactivity are amplified for customers with high need for touch because this target group experiences no compensating increase in enjoyment. For customers shopping for utilitarian products, advice seeking determines how PPTs trigger cognitive effort and enjoyment and, in consequence, purchases and product returns. While for advice seekers and sensation-oriented customers the favorable responses to vividness are reinforced, for advice seekers the enjoyment-enhancing effect also emerges for interactivity without accentuating the detrimental cognitive effort-increasing effect. This result makes the utilitarian context more suited to employing advanced PPTs.

2.6.2 Practical Implications

The key implication of our study is that retailers should not view vivid and interactive PPTs as silver bullets for enhancing purchase rates and driving down product returns. It may well

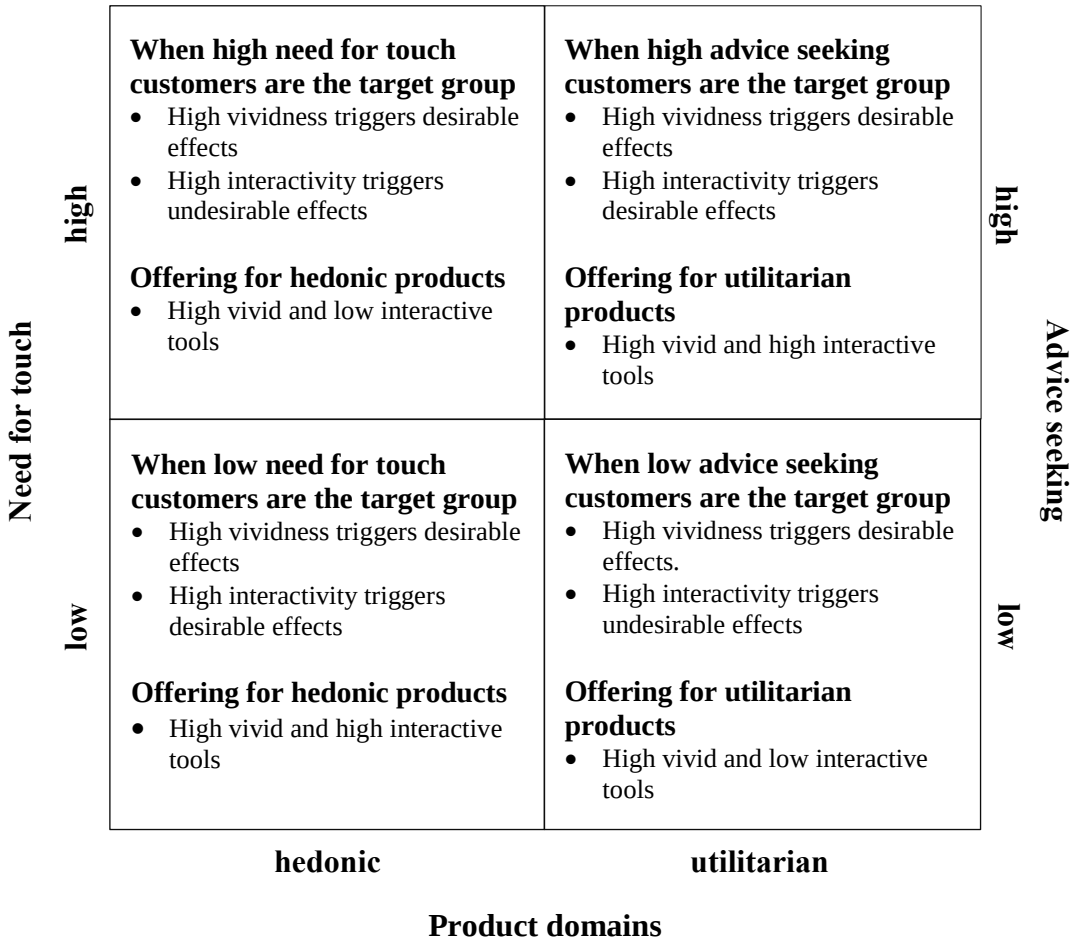
be that the opposite is true. Our research provides actionable implications for how tools should be designed to minimize unwanted effects such as enhanced product returns that hurt retailers owing to high reverse logistic costs.

First, retailers have to carefully adjust the degree of vividness and interactivity when implementing PPTs. However, the prevailing presumption of user experience designers is that making tools as vivid and interactive as possible encourages favorable customer behaviors. Our two studies show that the "more is better" decision rule holds only for adjusting vividness. Vivid product presentations reduce cognitive effort and increase enjoyment. This response promotes desirable behavior – an increase in purchases and a reduction in product returns. However, loading tools with interactive features can be detrimental. Highly interactive tools require users to make high investments of both time and effort. If the level of enjoyment evoked by highly interactive tools does not sufficiently countervail enhanced cognitive efforts, undesirable behaviors can dominate in terms of fewer purchases and more product returns in case of an order. Interactivity is thus a double-edged sword that can backfire quickly. As a result, interactive PPTs are not only associated with high up-front costs for development and testing, but also with significant follow-up costs in terms of increased product returns, making highly interactive tools potential "double whammies" for retailers. This possibility is especially alarming since an increase of purchases and the reduction of product returns are essential goals for implementing PPTs in online shops. Thus, retailers are advised to focus on high vividness but low interactivity to strengthen desirable behaviors while mitigating undesirable behaviors. Videos are tools that particularly exhibit this favorable mix of design characteristics levels, as Figure 3 indicates.

Second, if retailers deviate from the above recommended "less is more" strategy regarding interactivity, they need to carefully consider the product domain they operate in and the characteristics of target customers. Retailers operating in hedonic product domains can employ high-vividness, high-interactivity tools if they target customers with a low need for

touch. Providing tools with high interactivity levels is a less dangerous strategy for such a context, since a low need for touch leads to lower cognitive effort associated with interactive tools. Offering tools providing high interactivity in addition to high vividness is also a viable option for retailers in a utilitarian context if they target high advice-seeking customers. Retailers can offer such tools to support advice seekers in their extensive decision-making process without risking economic disadvantages, since for advice seekers the enjoyment enhancing effect of interactivity is accentuated without fueling the cognitive effort-increasing effect. In turn, purchases are triggered and product returns are reduced. Such full-fledged PPTs are mix-and-match tools or multi-angle images (Figure 3). Figure 4 gives an overview on which levels of vividness and interactivity should be offered for which customer segments.

Figure 4: Recommendations for Designing PPTs for Different Customer Segments and Product Domains in Study 1 and Study 2



Thus, both customer characteristics have high discriminant power in that they support the customization of optimal tools for different customer segments. The characteristics are relatively easy for retailers to observe or measure. For example, an intense search for haptic product attributes (e.g., material texture) is typical for customers with high need for touch. Advice seekers can be identified via cookies and log data, which track the use of product reviews, blogs, or test reports.

Finally, our results are also relevant from a broader strategic perspective. They imply that providing well configured PPTs can be effective in lowering product return rates and a viable alternative to stricter return policies. Several studies confirm that making return policies less lenient may have devastating consequences for customer evaluation of the retailer and hence should be the measure of last resort (Janakiraman, Syrdal, and Freling 2016). Our results show how retailers can reduce product return likelihood without changing return policies. Our results also emphasize the need for a comprehensive view when assessing the costs of PPTs. Instead of considering only the direct development and implementation costs, retailers should give weight to the more indirect, "end-of-pipeline" costs of presentation tools stemming from increased product returns.

2.6.3 Avenues for Further Research

This research has some limitations that offer fruitful avenues for future research. First, our choice of competing mediators enabled us to explain why design characteristics of PPTs can exhibit undesirable outcomes beyond the desirable outcomes considered in the literature so far. Our finding that the behavioral impact of design characteristics is mediated by cognitive effort and enjoyment indicates that these counterbalancing constructs are meaningful in explaining the consequences triggered by customers' use of vivid and interactive PPTs (Rucker et al. 2011). Even though our research identified two important mediators, other mediators likely offer additional explanatory value. To develop an integrated framework,

future studies could consider traditional bright-side mediators, such as decision satisfaction or perceived trust (Heitmann, Lehmann, and Herrmann 2007; Schlosser, White, and Lloyd 2006), or other presently unknown dark-side mediators.

Finally, although we validated our results by using actual purchase and return behavior of a subsample of customers, our study data did not allow us to consider the actual revenue and cost effects of enhancing vividness and interactivity. Future research using financial performance data could offer valuable insights regarding the profitability implications of different vividness and interactivity combinations.

3 Interactivity – Boon or Bane? The Nonlinear Relationship between the Interactivity of Product Presentation Tools and Product Returns (Paper 2)

(with Waldemar Toporowski, Maik Hammerschmidt, and Welf H. Weiger)[6]

Keywords: interactivity, product returns, product presentation tools, online retailing

[6] This paper was created in cooperation with the listed co-authors. I was responsible for the literature research, the contribution statement, the theoretical foundation, the conceptual framework, the hypotheses development, the data management, the methodology, and the empirical analysis. My co-responsibilities comprised the positioning.

3.1 Introduction

The absence of "touch-and-feel" experiences in online retailing limits the amount and quality of product information available to consumers and increases their uncertainty. Consumers cannot fully assess key product characteristics (e.g., fit and fabric) to judge whether they match their preferences prior to purchase (Dunn 2015; Flavián, Gurrea, and Orús 2016). However, as product choices are primarily driven by individual fit and personal taste, many customers order the same product in different variants (e.g., different sizes or colors) (Dishman 2014; Jing 2018). After trying the products at home, often some or all of the ordered products are returned (Petersen and Kumar 2009). Hence, product return rates as high as 75% are nothing out of the ordinary, especially in the apparel industry (Optoro 2017).

Product returns are a huge problem for consumers and retailers alike since they are costly for both. Consumers expend substantial amounts of time and effort in order to return unwanted products, claim refunds, and re-order new products. For retailers, product returns are highly critical since they ultimately undermine profitability through additional processing, depreciation and logistics costs (Janakiraman, Syrdal, and Freling 2016). Return costs vary between $6 and $18 per product (The Economist 2013) and, overall, product returns cost U.S. retailers over $280 million (Terry 2014) representing 8.1% of total revenues on average per retailer (The Retail Equation 2015). The return costs can significantly reduce the overall profit margin and only those retailers that can manage the "necessary evil" can operate profitably (Petersen and Kumar 2009).

For overcoming the liability of intangibility, retailers enthusiastically introduced product presentation tools (PPTs, e.g., videos and fit advisors) in their online shops to convey detailed information about tangible product characteristics. When configuring PPTs, retailers often focus on providing high levels of interactivity of such tools. Interactivity reflects the various opportunities (e.g., clicking, dragging, flipping, and zooming) through which

customers can actively control the display of product-related content (Steuer 1992; Suh and Lee 2005). Thus, high interactivity levels are expected to allow customers to perceive themselves as using the product without physically trying it out and, in turn, to improve their understanding of product characteristics before purchase (Hilken et al. 2017; Yim, Chu, and Sauer 2017).

Given the potential benefits of high interactivity, it has previously been assumed that highly interactive tools leads to less uncertainty and more realistic product expectations (Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007), which reduce product returns. However, market reality shows that often the opposite seems to be true (Randall 2015). Users have to intensively participate in the process of creating (personalized) product information in real-time through highly interactive PPTs. This complex participation could complicate the purchase process rather than simplifying it leading to suboptimal product choices despite using such tools. Hence, several retailers like Tesco and Land's End demonized interactive PPTs and quickly withdrew them from their online shops because product return rates increased after the introduction of highly interactive tools (POQ Commerce 2013). However, it could well be that those undesirable effects of interactivity in terms of higher product returns only occur for lower levels of interactivity on which tools might not exhibit the necessary sophistication for effectively conveying compelling product information. Thus, the beneficial effects of interactive tools might kick in once a certain threshold of interactivity has been crossed so that such technologies are not only tools but real helpers. Considering these arguments there is great uncertainty regarding the direction of the effects of interactivity and whether the effect direction switches across the range of interactivity.

Furthermore, research lacks insight into how the effects of interactivity vary across customer groups which exhibit different online shopping habits. However, such insight is crucial for retail managers to fine-tune PPTs. They need to decide which level of interactivity

should be chosen for which target group in order to achieve desirable and mitigate undesirable behavior.

Given these knowledge gaps, our study seeks to answer the following research questions: (1) Does interactivity trigger product returns? (2) What are the mediating mechanisms between interactivity and product returns? (3) How does the influence of interactivity on product returns change depending on consumer characteristics? To answer these questions, we present a framework that explores potential nonlinear effects (e.g., first positive and then negative effect) of interactivity on cognitive effort and enjoyment as psychological customer responses that significantly determine product return likelihood (Herrmann et al. 2013; Maity and Arnold 2013). Both are critical intervening variables because individuals strive to absorb useful information with low cognitive effort especially in the online channel, while enjoying the use of information tools as much as possible (Parasuraman, Zeithaml, and Malhotra 2005). The framework also considers advice seeking and tool experience as moderators that shape the functional form of the links between interactivity and psychological responses because they strongly influence customers´ purchase decision process and hence their responses to PPTs.

Through an experimental study using real-life tools of existing online shops, we contribute to PPT literature in several ways. First, we focus on potentially undesirable behavior triggered by interactive tools. This approach distinguishes from previous research, which so far has only examined desirable behavior like purchase intentions or loyalty (e.g., Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007). Specifically, through accounting for nonlinear relationships between interactivity and consumer responses, we account for the possibility that undesirable effects occur nonmonotonically and might vanish once a certain interactivity level has been surpassed. So, we expand research by providing knowledge about the shape of the relationship between interactivity of PPTs and outcome variables.

Second, we shed light on how differential effects of interactivity on product returns can be explained. For this purpose, we consider cognitive effort and enjoyment as competing, potentially offsetting mediating mechanisms that link interactivity and product returns (Babin, Darden, and Griffin 1994; Childers et al. 2001). Doing so allows for generalizable implications for retailers to calibrate optimal levels of interactivity.

Third, our model helps to discern which levels of interactivity are most effective for particular customer segments in order to minimize undesirable product returns. Thus, we guide retailers in deciding how to design effective interactive tools for each segment.

After presenting our conceptual framework and developing our hypotheses, we describe an empirical study to test our framework in the industry with the highest product return rates – apparel industry. The results offer managerial recommendations for online retailers adjusted to a high product return category and target groups.

3.2 Conceptual Framework

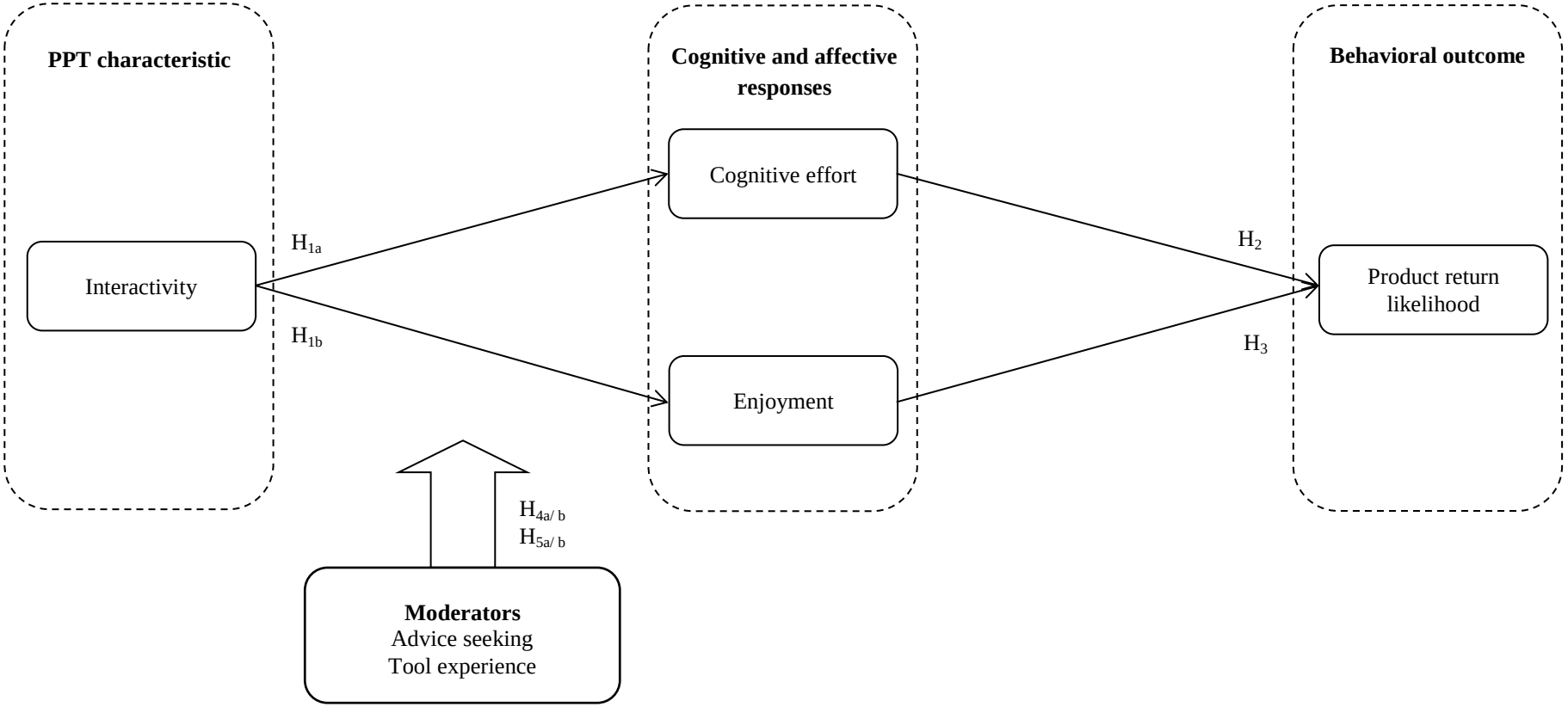
Our proposed framework is theoretically rooted in the visual representation framework (e.g., Jiang and Benbasat 2007; Lurie and Mason 2007). It elaborates on how different forms of product information visualization in virtual settings influence customer behavior. More precisely, it posits that the level of interactivity is the main source of cognitive and affective responses to a tool. Both responses represent customers' perceived costs and benefits of tool usage, which in turn determine their behavioral responses. Benefits obtained should outweigh the efforts invested (Xie, Bagozzi, and Troye 2008). Hence, drawing on this framework we consider cognitive effort and enjoyment as two key mediating variables that link interactivity and behavioral responses (i.e., product return likelihood).

For elaborating on the effects of interactivity on psychological and behavioral responses we draw on the limited capacity model (Lang 2000). According to this model, the processing of information through PPT use requires vast cognitive resources. However, as an

individual's capacity to process information is limited, any increase in complexity and perceived cognitive burden caused through PPT use results in poorer information processing and hence worse decision outcomes. By contrast, positive affective processes in terms of enjoyment and the retrieval of existing mental representations support the processing of information.

We further argue that two moderators – advice seeking and tool experience – determine when PPTs lead to a more or less undesirable outcome for retailers in terms of product returns. Figure 5 depicts the framework. We next elaborate on the selection of model variables and precisely define all variables.

Figure 5: Research Model



Interactivity

The visual representation framework suggests that interactivity is the key characteristic of PPTs and retail managers can easily configure interactivity levels. For consumers, various forms of interactive visualization enhance realism of product presentation in the virtual world. Hence, interactivity levels determine how users can interact with a product and hence the usefulness of information retrieved. However, in doing so interactivity requires consumers to participate intensively and actively, which takes up extensive cognitive capacity. Therefore, it seems that interactivity is a double-edge sword.

We define *interactivity* as the extent to which users can engage with presentation tools and modify virtual objects in real time to extract (personalized) product information (Steuer 1992; Suh and Lee 2005). Three dimensions contribute to interactivity and reflect the different levels of interactivity in PPTs: (1) *speed* is the rate of assimilating user input, (2) *range* refers to the number of possible user actions, and (3) *mapping* is the ability to control changes in the mediated environment in a natural and predictable manner (Lurie and Mason 2007; Steuer 1992). These three dimensions are perceived subjectively by the users. A fit advisor, which offers diverse input and interaction options for users (high degrees of speed, range and mapping) to generate an automatic size recommendation, is considered as a highly interactive tool.

Cognitive and Affective Responses to Interactivity

The visual representation framework emphasizes that perceived costs and benefits of technology usage regulate customers' behavioral outcome. That is, when using different levels (low to high) of interactive tools to gather (personalized) information, individuals translate the usage process and the information presentation into cognitive and affective costs and benefits. Therefore, the various levels of interactivity could create different extents of costs and benefits. In accordance with the limited capacity model, the translation into

perceived costs and benefits depends on users available cognitive resources. However, the cognitive resources of users are stressed to different degrees by various levels of interactivity. Drawing on these insights, we classify cognitive effort as a construct that captures costs and enjoyment as a key benefit. As both characterize the processing and evaluation of product information, we include both as mediating mechanisms while keeping in mind that an individual's available cognitive resources for information processing are limited (Parasuraman 2000; Thompson, Hamilton, and Rust 2005).

The two constructs operate in parallel and may reveal counterbalancing mediating paths in the relationship between different levels of interactivity and the behavioral outcome (Franke and Schreier 2010; Maity and Arnold 2013). We define *cognitive effort* as the extent to which a consumer experiences mental strain during the use of interactive PPTs. It is the subjectively perceived extent of invested mental effort and time to modify the degree of speed, range and mapping of interactive tools. More specifically, cognitive effort represents how demanding the consumer finds the activity required to fully use an interactive PPT (Haumann et al. 2015). In contrast, we define *enjoyment* as the extent to which the consumer perceives using an interactive tool to be emotionally stimulating, pleasant, and fun (Babin, Darden, and Griffin 1994). Thus, enjoyment represents the positive affective reaction to different levels of interactivity of PPTs (Franke and Schreier 2010).

Product Return Likelihood as Behavioral Outcome

We propose that cognitive effort and enjoyment associated with using interactive tools determine the likelihood of product returns. This measure is directly linked with retailers' operating costs and thus with their profits (Janakiraman, Syrdal, and Freling 2016). We defined *product return likelihood* as customer's expected propensity to return products to the retailer after receiving and testing them in exchange for money or an equivalent. This can be, for example, due to expected problems with products after having used PPTs in the order

process (Bechwati and Siegal 2005; Maity and Arnold 2013). Product return likelihood is a reliable predictor of a consumer's actual return behavior, and can therefore be used as an estimates of product return rates (Maity and Arnold 2013).

Moderators

Online shopping is characterized by intangibility (e.g., 25% of all online shops provide only one static image per product; Bleier, Harmeling, and Palmatier 2017). This results in uncertainty regarding the right product choice and higher willingness to order the same product in different variations (Dishman 2014). Therefore, customers seek for additional and particularly authentic information (e.g., reviews about the fit of a garment). This is because customers are unwilling to rely entirely on information provided by PPTs for decision-making. By seeking additional information, customers combine various external and individual sources of information for a confident (purchase) decision (Gottschalk and Mafael 2017). Thus, we consider these two uncertainty-reducing aspects as moderating variables that regulate the extent to which cognitive effort and enjoyment result from different levels of interactivity. *Advice seeking* is defined as the individual preference for product recommendations given by others for supporting (purchase) decisions (Brooks, Gino, and Schweitzer 2015). *Tool experience* captures whether an individual has already used a particular interactive PPT to perform shopping tasks (Parasuraman 2000).

3.3 Hypotheses Development

Effects of Interactivity on Cognitive Effort and Enjoyment

If retailers start to enrich tools with interactive features, customers gain possibilities to influence the amount and configuration of product-related content which makes it easier (less effortful) to obtain relevant information and realistic product experiences. However from a certain point, further increasing the level of interactivity could demand substantial

participation effort (i.e., perceived time spent, learning, and potential hassle) for gathering desired product information (Etgar 2008; Köhler et al. 2011). This process depletes a user's limited cognitive resources and reduces the processing capacity available for thoroughly evaluating information which could yield a positive effect of interactivity on cognitive effort (Lang 2000). Increasing levels of interactivity could even lead to a cognitive overload in terms of increasing the burden imposed on customers and at the same time raising customer's doubts as to whether he or she has the adequate capabilities to use the interactive tool to its full potential. Such an overload effect could exaggerate the positive effect on perceived cognitive effort with increasing levels of interactivity. This argumentation speaks for a U-shaped effect of interactivity on cognitive effort. This means an initially negative effect of interactivity on cognitive effort which, from a certain point, turns into increasingly positive effects on cognitive effort.

On the other hand, one could argue that introducing some basic interactive features is less likely to provide significant information value while at the same time nevertheless requires customers to invest efforts for mastering the new features. Such feelings of having more trouble than worth lead to frustration and hence to the perception of excessive cognitive effort (Thompson, Hamilton, and Rust 2005). With increasing interactivity levels, a tool likely provides more meaningful and sophisticated features that allow an effective control over obtaining the right information for decision making (Ariely 2000; Lang 2000). Thus, only if a certain threshold level of interactivity is exceeded, the tool unfolds true benefits for users that justify invested efforts and set this tool apart from "low-end tools". In addition, with increasing numbers of interactive features, learning effects set in, which make the tool more familiar. Increasing capabilities for handling the tool improves the user's performance and understanding of the tool, reducing perceived cognitive effort (Venkatesh 2000). This argumentation suggests an inverse U-shaped effect of interactivity on cognitive effort. This

means an initially positive effect of interactivity on cognitive effort which, from a certain point, turns into increasingly negative effects on cognitive effort.

Given the different forms of nonlinear effects (U-shaped or inversed U-shaped) that could be reasonably argued we refrain from formulating specific ("directional") hypotheses on the type of nonlinear effect. Instead we only generally propose the existence of nonlinearities in the relationship between interactivity and cognitive efforts and determine the type of nonlinearity empirically.

H1a. Interactivity has a nonlinear effect on cognitive effort.

While interactivity may lead to desirable or undesirable cognitive responses, it may also be beneficial or unfavorable in terms of emotional responses. In general, individuals enjoy in discovering something new (e.g., new interactive features). However, once they realize that further interactive features can only be effectively used through more active participation, enjoyment may decrease. Thus, the fun and arousal that interactive mechanisms provide might be hampered if it takes time before feedback from the tool occurs. However, as soon as the users understand the interactive features and realize that this participation conveys compelling product information, their interest is stimulated and the use of the numerous interactive features creates increasing enjoyment. Feelings of enjoyment that emerge from higher interactivity levels are due to creative freedom and a sense of self-determination that are associated with high interactivity (Ariely 2000; Suh and Lee 2005). This argumentation speaks for a U-shaped effect of interactivity on enjoyment. Thus, an initially negative effect of interactivity on enjoyment becomes increasingly positive from a certain point.

On the other hand, it can be argued that interactive features stimulate users and give them the feeling of actually entering the virtual world. More precisely, users may find engaging with interactive tools to obtain an outcome relevant to them personally to be inherently arousing and entertaining (Franke and Schreier 2010). However, the desire of users

to constantly try out more interactive features might wear off and the number of interactive features might reach a level of oversaturation at which users lose interest leading to decreased enjoyment. Thus, initial euphoric reactions may turn into boredom, although the tool still offers numerous interactive features. This argumentation speaks for an inverted U-shaped effect of interactivity on enjoyment. This shape manifests in an initially positive effect of interactivity on enjoyment which, from a certain point, becomes increasingly negative.

Given the different forms of nonlinear effects between interactivity and enjoyment we only generally propose the existence of nonlinearities in this relationship and determine the type of nonlinearity empirically.

H1b. Interactivity has a nonlinear effect on enjoyment.

Effects of Cognitive Effort and Enjoyment on Behavioral Outcome

Increased costs of obtaining information may deplete cognitive resources necessary for a thorough product evaluation and may lead customers to partly overlook available information (Etgar 2008). Reducing confidence in the decision-making process might also spark the feeling of overlooking important information while choosing the products (Heitmann, Lehmann, and Herrmann 2007). The apprehension of making a poor choice coincides with the customer's expectation that a product may have to be returned. This uncertainty may in turn make customers more inclined to order the same product in different variants (e.g., fit or colors), thus increasing the anticipated likelihood for product returns.

H2. Cognitive effort has a positive effect on product return likelihood.

Pleasant and visually appealing experiences help to distract consumers from problems outside the virtual shopping environment and release resources for forming shopping decisions (Pham 2004; Wang et al. 2007). This allows the customers´ to more intensely examine the quality of their decision. Individuals who experience enjoyment while shopping are more intensively involved and satisfied with the shopping process. Therefore, they focus more on the selected

product and believe more strongly that this particular product satisfies their needs. This conviction makes it more likely that the customer will decide to keep the product, ultimately if the product does not meet expectations after the purchase (Maity and Arnold 2013; Van Noort, Voorveld, and van Reijmersdal 2012). A greater enjoyment also improves attitudes and trust toward the retailer (Schlosser, White, and Lloyd 2006). Customers will be less willing to "hurt" the company (i.e., by returning products).

H3. Enjoyment has a negative effect on product return likelihood.

Moderating Effects of Advice Seeking

We propose that the responses to technological stimuli differ considerably across customer groups. As explained above, advice seeking and tool experience are key consumer characteristics that constitute different types of customers who exhibit substantially different decision-making processes in technology-mediated settings. Therefore, we expect that those customer characteristics influence the functional shape of the relationships between interactivity and mediators. However, as we do not formulate specific expectations about the type of nonlinearity, we also refrain from formulating directional hypotheses on the moderating effects. We only provide arguments why the customer characteristics should have a moderating influence on the effects of interactivity per se and leave the directions of the moderating effects as empirical questions.

Low versus high advice seekers differ in how strong they value a quick and easy availability of comprehensive information that reduce their search costs and support their (purchase) decision process (Brooks, Gino, and Schweitzer 2015; Reinecke Flynn, Goldsmith, and Eastman 1996). Thus, the degree of information brokering through interactive tools is valued differently depending on the level of advice seeking. Low interactivity tools provide strong advice seekers with barely usable information to secure their decisions. Thus, the costs (i.e., time and effort of use) may exceed the benefits. On the other hand, increasing

interactivity allows high advice seekers to obtain more detailed and personalized information, increasing its usefulness and reducing perceived costs because the increasing participation is perceived as less effortful. Further, strongly advice seeking customers search for quasi-social interactions on their online journey (Berger 2014; Van Doorn et al. 2017). Increasing interactive features involve high advice seekers and create intensive social interactions leading to stronger emotional benefits (i.e., higher enjoyment).

Thus, differences in advice seeking reflect different preferences for information and social influence which may alter the cognitive costs and emotional benefits that individuals associate with interactive tools. Therefore, advice seeking is likely to determine responses to interactivity and in turn the shape of the effects of interactivity.

H4a. Advice seeking moderates the effect of interactivity on cognitive effort.

H4b. Advice seeking moderates the effect of interactivity on enjoyment.

Moderating Effects of Tool Experience

Experiences in the use of tools could simplify the participation process because the users are more familiar with the tool (Venkatesh 2000) and exhibit habituation effects (Cauberghe and De Pelsmacker 2010; Fiore, Jin, and Kim 2005). Differences in tool experience determine whether the costs or benefits of using interactive tools dominate for customers. Highly experienced customers can use highly interactive tools quickly and effortless but are likely to experience high cognitive efforts when using PPTs with only few interactive features as it is perceived as a waste of time. Regarding enjoyment, low interactivity might be boring for highly experienced customers because they quickly know all the features leading to low or no emotional benefits. As a result, for highly experienced customers benefits (e.g., obtaining information and enjoyment) increase with higher interactivity levels while at the same time getting these benefits requires only low cognitive effort. Thus, the degree of tool experience is

likely to determine cognitive and emotional responses to interactivity and in turn the shapes of the effects of interactivity.

H5a. Tool experience moderates the effect of interactivity on cognitive effort.

H5b. Tool experience moderates the effect of interactivity on enjoyment.

3.4 Data and Research Method

3.4.1 Setting

The study uses a large-scale experiment to test the hypotheses. We focus on online apparel retailers because the appeal of fashion depends on design and fit, which are typical subjective attributes. These aspects are difficult to evaluate before purchase. Thus, they are the main reasons for the high product return rates in the apparel industry (Hong and Pavlou 2014). Unlike most previous studies, we use PPTs embedded in real-life online shops instead of fictitious tools on mock websites. In doing so, we ensure a realistic and natural shopping environment to establish external validity (De, Hu, and Rahman 2013; Wang et al. 2007).

3.4.2 Pre-Study

We selected potential interactive PPTs by examining tools that are most frequently employed by established apparel online shops by asking 102 apparel online shoppers. We identified five generic tools: multi-angle images (presenting garments from different perspectives), video (presenting garments in full-motion demonstrations), mix-and-match (presenting garments in customized outfits), size guide (offering a static table to identify ideal fitting size), and fit advisor (generating automatic size recommendations based on user input). Table 12 gives full descriptions of these tools.

Table 12: Overview and Full Descriptions of PPTs Used in the Study

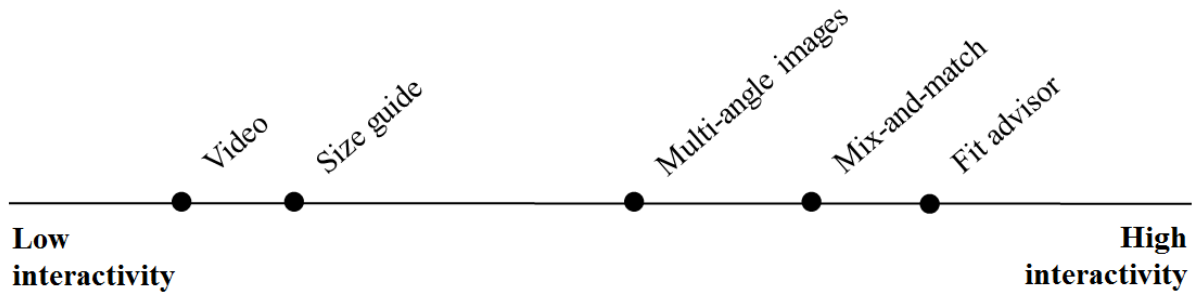
Tool	Description	Example
Video	Presenting information about the actual use of a garment through full motion demonstration with low opportunities to control the presented content	Showing customers how a garment fits and how the fabric falls during movements
Size guide	Offering customers the opportunity to identify their best-fitting size of a garment based by using a static table	Providing a table that lets customers identify their garment size based on torso measures
Multi-angle images	Allowing customers to view and control garments from different perspectives	Displaying more detailed product attributes from all possible angles (e.g., pattern)
Mix-and-match	Providing customers numerous opportunity to combine and view multiple garments according to personal taste so that they can put together an entire outfit and view it from different perspectives	Letting customers combine and view multiple garments to put together an entire outfit
Fit advisor	Offering diverse input and interaction options for customers to generate an automatic size recommendation according to their body measures	Suggesting the size of a garment after asking customers for age, individual body measurements (e.g., size, weight, shape of the stomach, structure of shoulders), preferences concerning the fit of the garments (slim fit versus wide fit), and the optimal size of garments from previously purchased brands

No single shop exists that offers all five tools. Therefore, we preselected shops that differed only with respect to the interactive PPTs employed on the product page but were not perceived significantly ($p > .10$) different by pre-test participants with respect to visual appeal ("I perceived the appearance of [online shop] as very professional"), color style ("I perceived the color style of [online shop] as very pleasant"), and user experience design ("I found my way around [online shop] very well," all anchored by 1 = "strongly disagree" and 7 = "strongly agree"; Parasuraman, Zeithaml, and Malhotra 2005). In addition, we found that awareness of the online shop ("I perceived the logo of [online shop] as very positive") and attitude toward the online shop ("I have a very positive attitude towards [online shop]," both anchored by 1 = "strongly disagree" and 7 = "strongly agree") did not significantly differ across the shops (all $p > .10$). The selected online shops had identical lenient return policies, a

highly similar product assortment, and no price discounts or other promotions during the time of the study.

Subjects of the pre-test (n = 102) then evaluated the perceived interactivity of the five tools through multiple items measured by 7-point Likert scales (see Appendix; M = 4.68). Further analysis of variance showed that the five presentation tools differed significantly with respect to interactivity (low to high level), indicating sufficient variation in interactivity (see results in Figure 6).

Figure 6: Characterization of PPTs Used in the Study



Notes: Ordering of PPTs based on mean values of perceived interactivity.[7]

We ensured that the tools differed only with respect to the presentation format, with all other relevant characteristics being highly similar (Wang et al. 2007). The accuracy and quantity of product information content provided ("The tool gives me a lot of facts about the garment" and "The tool gives me a lot of important information about the garment," anchored by 1 = "strongly disagree" and 7 = "strongly agree") were perceived as similar, as we found no significant differences (p > .10 for both items) across tools.

3.4.3 Procedure and Sample

We conducted the experiment using an online survey based on the real-life PPTs identified in the pre-study. First, we asked subjects to imagine they were considering the purchase of a

[7] The five tools significantly differ with respect to interactivity ($M_{\text{fit advisor}}$ = 5.64 > $M_{\text{mix-and-match}}$ = 5.49 > M_{images} = 4.89 > $M_{\text{size guide}}$ = 3.51 > M_{video} = 3.42; p < .05).

casual pullover.[8] Then, we randomly assigned participants to one of the five PPTs by directing them to the respective product page, where they were instructed on how to use the respective tool. Subjects were distributed equally across PPTs. They were then told to use the tool to examine the casual pullover for a few minutes as if they were shopping and deciding whether to make a purchase. Manipulation checks (i.e., "Did you see the tool correctly?", "Did you use the tool", and "Could you get an impression of the tool functionality?", anchored by 1 = "yes" and 2 = "no"; "How long did you use the tool", anchored by 1 = "less than 1 minute" and 7 = "more than 10 minutes") substantiated that participants in fact used the focal tool, fulfilled the product examination task, and gathered information required for forming a purchase decision regarding the casual pullover. In addition, tracking of browsing time in the online shops indicated that participants indeed used the PPT (Schlosser, White, and Lloyd 2006). After performing the product examination task, participants answered an online questionnaire that captured the focal constructs.

A total of 990 university students[9] participated in the study. Subjects were screened according to whether they had already purchased apparel online at least once (Wang et al. 2007). The sample consisted of 67% women, and 90% of the sample ranged from 18 to 35 years of age. This distribution is representative of online shoppers in the apparel industry (Statista 2016a). Table 13 presents further descriptive statistics.

3.4.4 Measurement

We measured interactivity, product return likelihood, the mediators, and the moderator advice seeking using multi-item scales adapted from prior research (see Appendix). The moderator tool experience is a single item. To allow for user heterogeneity, we captured interactivity by

[8] We selected the pullover from a range of potential products because participants of the pre-study displayed moderately positive attitude levels for this product. This criterion ensured that we did not use a product to which participants had strongly positive or negative attitudes to avoid any distortion of the effects of interactive PPTs by the effects of prior attitudes.

[9] Apparel is one of the online products students purchase most frequently (Comegys and Brennan 2003).

using individual respondents' perceived levels instead of merely using dichotomous variables for capturing the static manipulation of low versus high interactivity (Baker et al. 2002; Wang et al. 2007). To validate the interactivity measures, we asked five retail experts[10] to code PPTs according to their degree of interactivity. The experts received detailed coding instructions and then indicated the number of interactive elements for each presentation tool (Cho and Cheon 2005). We then ranked the tools according to the mean coding-based and mean survey-based scores for interactivity. We obtained identical tool rankings, indicating that the survey participants' perceptions resembled the objective, feature-based scores obtained through expert coding.

To capture product return likelihood, we asked participants to imagine that they had ordered the garment and then to state their likelihood of returning the garment to the retailer (e.g., because of expected problems regarding fit; Janakiraman and Ordóñez 2012; Maity and Arnold 2013).

With one exception, all Cronbach's alpha values exceed .70, suggesting that the measures are reliable (Bagozzi and Yi 1988). We also achieved high discriminant validity according to the criterion of Fornell and Larcker (1981). Finally, we included control variables to isolate the effects of interactivity from other drivers of behavioral outcomes.[11] Table 13 provides the descriptive statistics and correlations for all variables.

[10] The five coders were a professor for multichannel retailing, the CEO of a retail consulting firm, a website usability expert and two retail specialists.

[11] Specifically, to rule out alternative explanations we included four additional predictors of behavioral outcomes that represent the most frequently considered predictors in related studies: gender, age, net income, and ease of use. "Ease of use" is a major predictor of behavioral responses related to new technologies (Blut, Wang, and Schoefer 2016; Davis 1989).

Table 13: Descriptive Statistics and Correlations for Constructs in the Study

Measure	M	(SD)	1	2	3	4	5	6	7	8	9	10
1. Interactivity	4.80	(1.25)	1.00									
2. Cognitive effort	2.46	(1.07)	-.18	1.00								
3. Enjoyment	4.12	(1.53)	.42	-.17	1.00							
4. Product return likelihood	3.42	(1.19)	-.16	.24	-.15	1.00						
5. Advice seeking	5.20	(1.60)	.10	-.09	.07	-.07	1.00					
6. Tool experience	5.68	(1.59)	.11	-.13	.13	-.06	.18	1.00				
7. Gender	.33	(.47)	.02	.02	-.04	-.14	-.05	-.06	1.00			
8. Age	26.56	(8.06)	.04	-.05	-.03	-.08	.02	.03	.03	1.00		
9. Net income	2.69	(1.82)	.02	-.02	-.07	.05	-.03	.03	.11	.33	1.00	
10. Ease of use	6.26	(1.11)	.23	-.41	.19	-.09	.07	.18	-.08	-.06	-.03	1.00

Notes: M = mean, SD = standard deviation. Correlations larger than or equal to |.42| are statistically significant ($p < .05$, two-tailed).

3.4.5 Methodology

For the same reasons as in Paper 1 we test our hypotheses using SUR. The framework presented in Figure 5 suggests three equations, one for each dependent variable. We thus estimated the following three equations simultaneously, with the first two representing the mediator models (cognitive effort, *CE*, and enjoyment, *EN*, as dependent variables) and the third representing the product return likelihood model (*PR*, as dependent variable):

(1) $$CE_i = \beta_0 + \beta_1 IN_i + \beta_2 IN_i^2 + \beta_3 AS_i + \beta_4 TE_i + \beta_5 IN_i \times AS_i + \beta_6 IN_i^2 \times AS_i + \beta_7 IN_i \times TE_i + \beta_8 IN_i^2 \times TE_i + \beta_9 GEN_i + \beta_{10} AGE_i + \beta_{11} NI_i + \beta_{12} EU_i + \varepsilon_{1i}$$

(2) $$EN_i = \gamma_0 + \gamma_1 IN_i + \gamma_2 IN_i^2 + \gamma_3 AS_i + \gamma_4 TE_i + \gamma_5 IN_i \times AS_i + \gamma_6 IN_i^2 \times AS_i + \gamma_7 IN_i \times TE_i + \gamma_8 IN_i^2 \times TE_i + \gamma_9 GEN_i + \gamma_{10} AGE_i + \gamma_{11} NI_i + \gamma_{12} EU_i + \varepsilon_{2i}$$

(3) $$PR_i = \delta_0 + \delta_1 CE_i + \delta_2 EN_i + \delta_3 IN_i + \delta_4 IN_i^2 + \delta_5 AS_i + \delta_6 TE_i + \delta_7 IN_i \times AS_i + \delta_8 IN_i^2 \times AS_i + \delta_9 IN_i \times TE_i + \delta_{10} IN_i^2 \times TE_i + \delta_{11} GEN_i + \delta_{12} AGE_i + \delta_{13} NI_i + \delta_{14} EU_i + \varepsilon_{3i}$$

where IN_i is the linear term of interactivity and IN_i^2 is the squared independent variable. AS_i and TE_i refer to the moderators advice seeking and tool experience. We also included control variables: GEN_i is gender, AGE_i is age, NI_i is net income, and EU_i is ease of use. Finally, ε_{1i}, ε_{2i}, and ε_{3i} are the disturbance terms of subject *i*. While we expect our interactions to unfold their effects in the cognitive effort and enjoyment models and hence to be mediated by these variables, we have included them in all three equations to test for full mediation.

3.5 Results

As is summarized in Table 14, we report three models. We first estimate a linear main-effects model (Model 1) and then add the quadratic main effect of interactivity (Model 2). In Model 3 we also include the interactions between both the linear and the quadratic interactivity term and the moderators (i.e., interactivity × advice seeking, interactivity^2 × advice seeking,

interactivity × tool experience, and interactivity^2 × tool experience) for the proper interpretation of the results (Aiken and West 1991; Cohen et al. 2013). When comparing the model that contains the interaction effects with those that do not, we find that the adjusted R-square is larger when we include the interactions, thus pointing to Model 3 for further hypotheses testing.

Table 14: SUR Estimates for the Three Models

	Model 1			Model 2			Model 3		
Dependent variables Independent variables	Cognitive effort	Enjoyment	Product return likelihood	Cognitive effort	Enjoyment	Product return likelihood	Cognitive effort	Enjoyment	Product return likelihood
Constant	2.472***	4.27***	3.609***	2.522***	4.196***	3.665***	2.766***	3.992***	3.648***
	(26.62)	(32.49)	(19.53)	(25.77)	(30.27)	(19.52)	(22.92)	(23.30)	(17.57)
Main effects									
Interactivity	-.074***	.492***	-.079**	-.088***	.515***	-.098***	-.188***	.438***	-.079
	(-2.91)	(13.71)	(-2.47)	(-3.28)	(13.55)	(-2.68)	(-3.09)	(5.08)	(-1.09)
Interactivity^2				-.025	.040*	-.029*	-.122***	.062	.024
				(-1.60)	(1.82)	(-1.61)	(-3.33)	(1.19)	(-.56)
Cognitive effort			.241***			.238***			.239***
			(6.49)			(6.42)			(6.41)
Enjoyment			-.068***			-.065**			-.065***
			(-2.59)			(-2.50)			(-2.46)
Moderating effects									
Advice seeking							-.194*	-.084	-.015
							(-2.44)	(-.75)	(-.16)
Tool experience							-.167*	.360***	.012
							(-1.98)	(3.01)	(.12)
Interaction effects									
Interactivity × advice seeking							.129*	.091	.031
							(2.30)	(1.14)	(-.47)
Interactivity^2 × advice seeking							.077**	.071	-.042
							(2.31)	(1.51)	(-1.07)
Interactivity × tool experience							.020	.009	-.038
							(.33)	(.10)	(-.52)
Interactivity^2 × tool experience							.062	-.098*	-.031
							(1.57)	(-1.75)	(-.68)

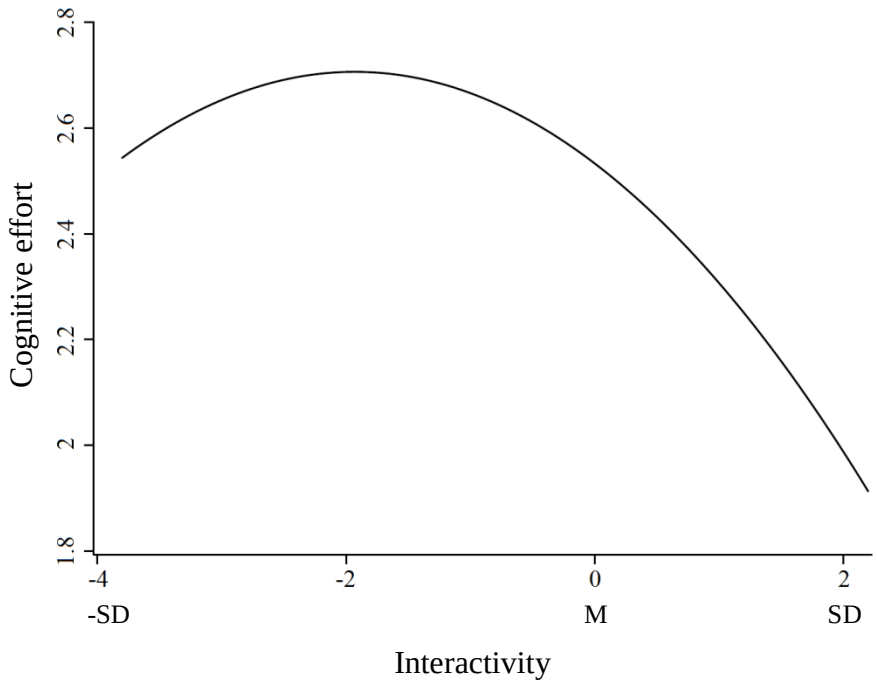
Control variables									
Gender	-.009	-.120	-.381***	-.017	-.106	-.391***	-.031	-.096	-.387***
	(-.13)	(-1.28)	(-4.96)	(-.26)	(-1.13)	(-5.08)	(-.47)	(-1.03)	(-5.02)
Age	-.008**	-.004	-.014***	-.008**	-.005	-.013***	-.009**	-.005	-.013***
	(-2.06)	(-.66)	(-2.96)	(-1.94)	(-.80)	(-2.84)	(-2.12)	(-.91)	(-2.84)
Income	-.007	-.053**	.065***	-.007	-.052**	.065***	-.006	-.056**	.064***
	(-.38)	(-2.11)	(3.12)	(-.41)	(-2.08)	(3.10)	(-.34)	(-2.22)	(3.09)
Ease of use	-.380***	.125***	.020	-.375***	.118***	.024	-.368***	.099**	.024
	(-13.32)	(3.10)	(.55)	(-13.11)	(2.91)	(.66)	(-12.76)	(2.42)	(.67)
R^2	.182	.194	.109	.184	.197	.111	.197	.206	.115
Adjusted R^2	.181	.193	.108	.183	.196	.110	.196	.205	.114

* = p < .10; ** = p < .05; *** = p < .01

Notes: *n* = 990; results are based on two-tailed z-tests. All variance inflation factors (VIF) are below the recommended cut-off of 5 (O´Brien 2007).

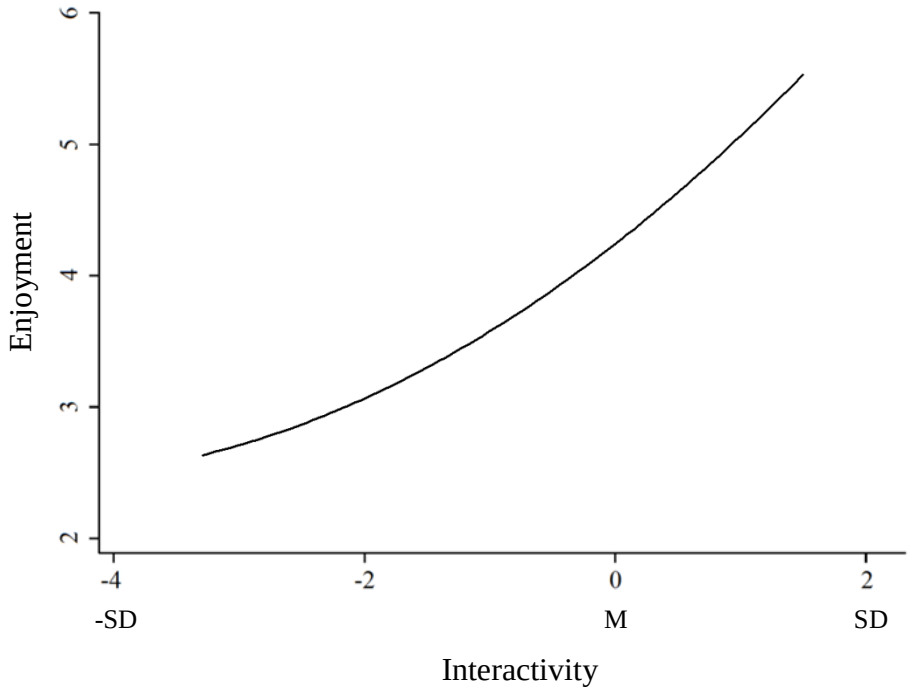
Test of hypotheses on the effects of interactivity on mediators. In Model 3, the linear and quadratic terms of interactivity are relevant for hypotheses testing. The effect of interactivity on cognitive effort is described by significant negative linear (β_1 = -.188, p < .01) and quadratic effects (β_2 = -.122, p < .01). These results support the presence of an inverted U-shaped relationship between interactivity and cognitive effort. We depict this relationship graphically in Figure 7 and show that interactivity has a positive effect on cognitive effort in the lower range of interactivity. Only when the degree of interactivity moves beyond a certain point does interactivity unfolds a negative effect on cognitive effort (i.e., an effort-reducing effect) at a rapidly increasing rate. Thus, H_{1a} can be confirmed. Hence, from a certain point, increasing interactivity is associated with more and more desirable effects for retailers in terms of less cognitive costs imposed on customers and in turn less product returns. However, medium levels of interactivity create high undesirable effects in terms of a maximum cognitive effort. Starting to add few interactive feature demands high cognitive capacities for understanding the features and learn how to handle them (Thompson, Hamilton, and Rust 2005). As a small number of basic features might not provide real informational value for customers in return for the learning costs, the users might be frustrated and perceive high cognitive effort because efforts seem to be "worthless". With increasing number of interactive features, the tool becomes more meaningful and sophisticated and starts to effectively support customers in obtaining helpful information (Cauberghe and De Pelsmacker 2010; Liu and Shrum 2002). As a result, perceived efforts go more and more unnoticed and hence decrease at a progressive rate at higher levels of interactivity.

Figure 7: Main Effect of Interactivity on Cognitive Effort



We find no significant quadratic effect of interactivity on enjoyment (γ_2 = .062, p > .10) while a positive linear effect is highly significant (γ_1 = .438, p < .01). All else equal, therefore, higher levels of interactivity are associated with higher enjoyment. We depict this relationship graphically in Figure 8 and show that increasing interactivity levels increase enjoyment at a constant rate. So, there exists no nonlinear relationship and H_{1b} cannot be confirmed. Thus, the interactive tools currently available in the market emotionally stimulate customers instead of saturating them, thereby likely entailing more benefits than costs with increasing interactivity.

Figure 8: Main Effect of Interactivity on Enjoyment

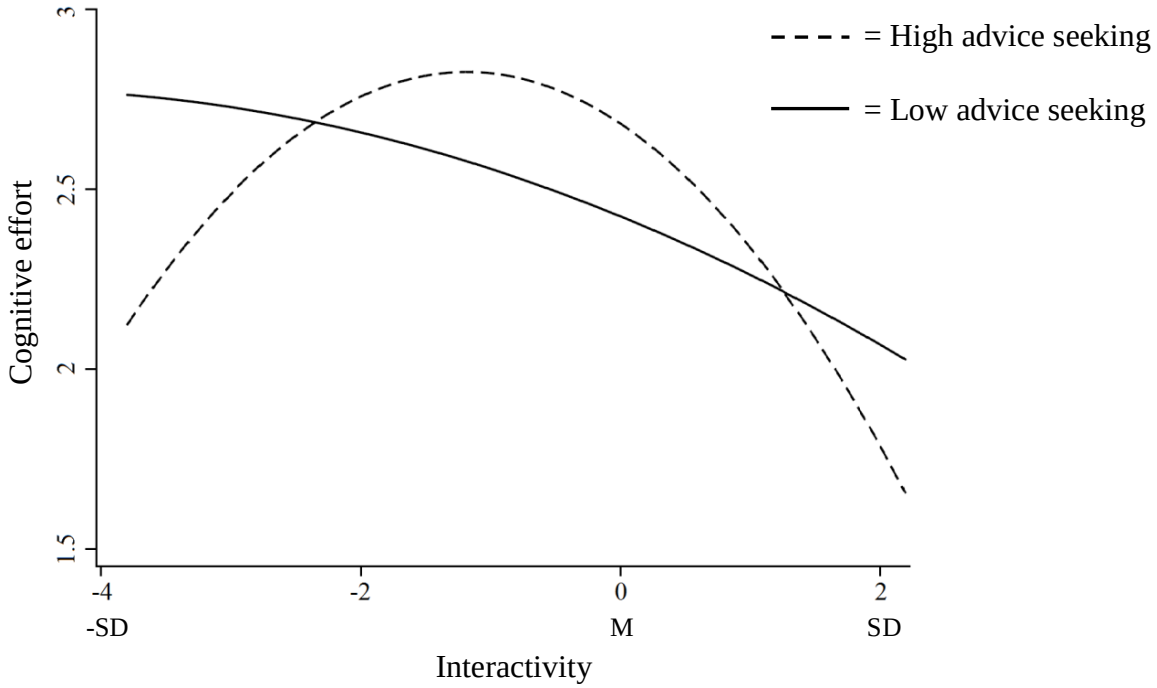


Test of hypotheses on the effects of mediators on behavioral outcome. The results provide support for H_2, showing that cognitive effort has a significant positive effect on product return likelihood (δ_1 = .239, p < .01). Further, enjoyment has a significant negative effect on product return likelihood (δ_2 = -.065, p < .01), which confirms H_3.

Test of moderating effect hypotheses. In Model 3, the quadratic by linear interaction terms are relevant for hypotheses testing of moderating effects. A significant positive quadratic by linear interaction effect for advice seeking (β_6 = .077, p < .05) confirms H_{4a}. Figure 9 shows this effect graphically. The figure shows that the existing inverted U-shape effect of interactivity on cognitive effort is accentuated for high advice seeking customers. As high advice seekers value comprehensive information, they gain more value from increased control over the tool as this allows them to receive more detailed and customized information. This process lowers the extent of cognitive costs that are subjectively perceived by customers and hence increased interactivity causes cognitive efforts to decrease more rapidly. Further,

there exists no significant quadratic by linear interaction effect between interactivity and advice seeking on enjoyment (γ_6 = .071, p > .10). Hence, we reject H_{4b}.

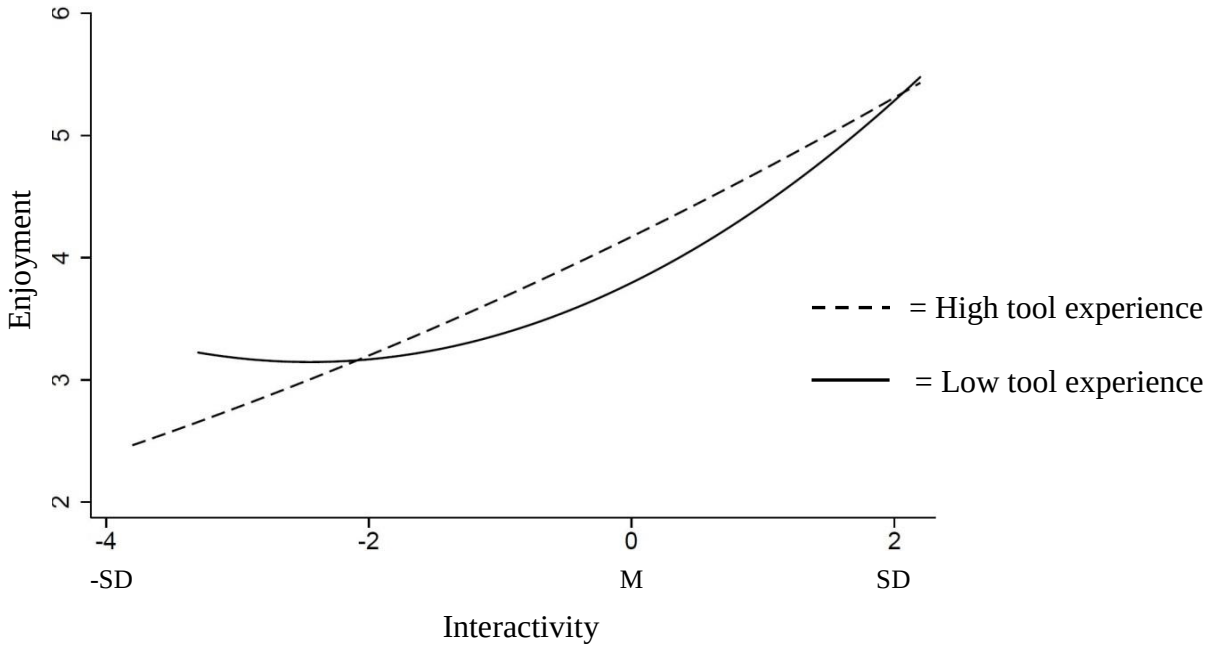
Figure 9: Moderating Effect of Advice Seeking



We found no significant quadratic by linear interaction effect of tool experience on the relation between interactivity and cognitive effort (β_8 = .062, p > .10); thus, H_{5a} cannot be confirmed. However, we find a significant negative quadratic by linear interaction effect between interactivity and tool experience on enjoyment (γ_8 = -.098, p < .10) providing support for H_{5b}. This finding is notable as it suggests that the occurrence of the expected nonlinear relationship between interactivity and enjoyment strongly depends on tool experience. Figure 10 shows this effect graphically. The figure shows that the overall linear effect of interactivity on enjoyment turns into a sharp nonlinear effect (U-shaped relationship) for low experience customers. At the beginning of the interactivity range, enjoyment is inhibited for less experienced customers as they are afraid of doing something wrong. After this negative wear-in effect, enjoyment progressively increases with higher interactivity levels for customers with low tool experience. In other words, it is easier to emotionally thrill customers with low

tool experience through interactive features as for such customers, recognizing that direct feedback from a tool can be induced through own interactions with the tool is more surprising and not taken for granted. The initial fear of making mistakes is quickly overcome by learning effects and an increasing number of interactive options can be more and more enjoyed without restrictions. In contrast, enjoyment for customers with high tool experience increases at a lower rate due to habituation effects, though almost linearly across the entire range of interactivity because tool experts have no inhibitions (i.e., fear of making mistakes) when using a tool.

Figure 10: Moderating Effect of Tool Experience



Interestingly, while advice seeking is only important as a moderating factor for interactivity's effect on cognitive effort, tool experience has an influence on the interactivity-enjoyment link only. This pattern can be explained by the different orientation of high advice seekers and low experience customers. The fundamental purpose of advice seeking is to secure purchase decision-making. This should be done quickly and easily (Brooks, Gino, and Schweitzer 2015). Thus, high advice seekers are not searching for distraction or fun while

using an interactive PPT. However, customers that are novices with respect to presentation tools are actively looking for enjoyment and arousal. Tool usage is a kind of entertainment activity for them.

Mediation Testing

In testing for mediated effects, we estimated bias-corrected bootstrapped confidence intervals (5,000 draws) for testing each indirect effect (Preacher and Hayes 2004). The indirect main effects of the linear and quadratic interactivity term on product return likelihood through cognitive effort are significant. The indirect linear main effect of interactivity through enjoyment is also significant (Table 15). The insignificant direct linear and quadratic effects of interactivity on product return likelihood (δ_3 = -.079; δ_4 = .024, both $p > .10$) indicate that cognitive effort and enjoyment fully mediate the effect of interactivity on product return likelihood (Wetzel, Hammerschmidt, and Zablah 2014). Further, all hypothesized moderated effects are fully mediated by cognitive effort and enjoyment as the indirect interaction effects of interactivity and the moderators on product return likelihood are significant (Table 16). In addition, we found no significant direct effects of any of the hypothesized interaction terms on product return likelihood ($p > .10$). Consequently, the moderating effects are fully mediated by cognitive effort and enjoyment. These findings support our theorizing that the hypothesized moderations play a role in the first step of the chain shown in Figure 5.

Table 15: Mediation Testing

Mediated effects			Path coefficient	SE[a]	LLCI	ULCI
Interactivity	→ Cognitive effort	→ Product return likelihood	-.045	.016	-.073	-.022
Interactivity^2	→ Cognitive effort	→ Product return likelihood	-.029	.009	-.046	-.016
Interactivity	→ Enjoyment	→ Product return likelihood	-.028	.014	-.056	-.009
Interactivity^2	→ Enjoyment	→ Product return likelihood	-.004	.004	-.013	.001

Notes: n = 990; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

Table 16: Mediated Moderation Testing

Mediated moderation effects			Path coefficient	SE[a]	LLCI	ULCI
(Interactivity x advice seeking)	→ Cognitive effort	→ Product return likelihood	.031	.015	.008	.057
(Interactivity^2 x advice seeking)	→ Cognitive effort	→ Product return likelihood	.018	.010	.003	.036
(Interactivity x advice seeking)	→ Enjoyment	→ Product return likelihood	-.006	.006	-.021	.001
(Interactivity^2 x advice seeking)	→ Enjoyment	→ Product return likelihood	-.005	.004	-.014	-.000
(Interactivity x tool experience)	→ Cognitive effort	→ Product return likelihood	.005	.015	-.020	.030
(Interactivity^2 x tool experience)	→ Cognitive effort	→ Product return likelihood	.015	.010	-.000	.033
(Interactivity x tool experience)	→ Enjoyment	→ Product return likelihood	-.001	.006	-.011	.009
(Interactivity^2 x tool experience)	→ Enjoyment	→ Product return likelihood	.006	.005	.001	.017

Notes: n = 990; number of bootstrap resamples = 5,000; 90% confidence interval; [a] Standard errors from the mean result of the bootstrapping procedure; LLCI = lower-level confidence interval; ULCI = upper-level confidence interval.

3.6 Discussion

Highly interactive PPTs were introduced with the expectation to reduce product returns. After the unexpected increase in product return rates, many retailers quickly removed them from their online shops. Hence, clear evidence of the undesirable impact of interactivity on product return behavior is urgently needed. For the product category with the highest product return rate, this study provides robust evidence that the undesirable and desirable outcomes depend on the levels of interactivity. Furthermore, the results indicate that customer characteristics are decisive as to whether the bright- or dark-side of interactivity prevails. These findings have important implications for both researchers and retail managers, which we discuss next.

3.6.1 Theoretical Implications

The present research contributes to the literature on visual information presentation formats by analyzing how the effects of interactive information presentation influence a generally undesirable behavior. First, we show that the relationships between interactivity and mediating mechanisms are not just linear, as previously assumed (e.g., Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007). To the best of our knowledge, our research is unique in analyzing nonlinear effects to pay more attention to the varying effects of different levels of interactivity. On the one hand, we confirm the findings of previous research and practice that interactivity is a highly critical PPT characteristic that triggers product returns. On the other hand, the results show that interactivity can also have beneficial effects in terms of diminishing product returns. This expands research by providing more realistic insights about the direction of the effects of interactivity.

Second, in line with the visual representation framework, our study reveals the cognitive and affective mechanisms explain the different effects of interactivity levels on the desirable or undesirable consequence. The inverse U-shape effect on cognitive effort shows

that low and high levels of interactivity are associated with low cognitive effort leading to decreased product return likelihood (bright-side effect). This is because starting to add some interactive features inhibits the perception of high cognitive effort due to high newness and offering high levels of interactivity provides the necessary degree of sophistication to enable effortless tool usage. This finding that cognitive effort caused at low and high interactivity levels is only minor is in accordance with the limited capacity model. At the same time, both interactivity levels increases enjoyment, which facilitates information processing and decreases product return likelihood in turn. However, a medium level of interactivity mentally exhausts customers because of limited cognitive resources. This leads to greater cognitive effort that produces the dark-side effect (increasing product return likelihood). At the same time, a medium level of interactivity does not trigger high enjoyment which could counterbalance this undesirable outcome. However, the limited capacity model suggests that such positive affective processes are crucial to improve the ease of information processing (Lang 2000). Our research suggests that studies exploring PPTs' effectiveness should consider the level of interactivity because it determines in the direction and strength of its impact on cognitive effort and enjoyment. A deeper understanding of these countervailing paths is essential to determine whether the bright- or dark-side effect of interactive tools will prevail. In advancing the visual representation framework, this study adds insights by considering nonlinear effects.

Finally, this research demonstrates that the behavioral outcomes of interactivity depend on customer characteristics. The cognitive effort-reducing effect of high interactivity is particularly pronounced among high advice seekers. The sense of control makes PPT use more familiar and information processing easier. Thus, the bright-side effect in terms of decreased product return likelihood prevails. At the same time, there is no moderating influence regarding enjoyment that could further reinforce the beneficial effects with respect to cognitive effort. Further, for consumers with low tool experience enjoyment increases,

because of unknown and interesting interactive features, causing a bright-side outcome. Furthermore, tool experience is not linked to cognitive effort, which supports the bright-side effect. These results show that advanced interactive PPTs like mix-and-match and fit advisors are most suited tools for both consumer groups.

3.6.2 Managerial Implications

The key implication of this study is that retailers should not degrade highly interactive PPTs as a per se negative thing. The opposite can be true. The design in terms of implementing optimal levels of interactivity matters. The insights gained from this study help technology designers and e-commerce managers to decide how interactive tools should be developed and maintained in order to reduce product returns that hurt retailers by generating considerable reverse logistics costs. First, retailers have to carefully adjust the level of interactivity when implementing PPTs. User experience designers generally assume that making tools as interactive as possible encourages favorable customer behaviors. Our study shows that a "more is better" decision rule is not fully warranted. Increasing the degree of interactivity reduces cognitive effort and increases enjoyment (and hence boost profitability for retailers) only if starting from intermediate interactivity levels. While low interactivity also are associated with low cognitive effort, advancing weakly interactive tools towards a medium level of interactivity is a dangerous move as a medium level requires users to invest a lot of time and cognitive effort. If the amount of enjoyment does not sufficiently countervail the increased cognitive effort, undesirable behavior can dominate. Therefore, retailers are advised to either offer tools that remain on a low level of interactivity or to significantly boost interactivity to upper levels of the range. Videos and fit advisors are tools that particularly fit this profile. Sticking at moderate interactivity levels because of half-hearted initiatives to develop presentation tools should be avoided as such moderate levels perform worst as they entail high cognitive costs for customers accompanied by low enjoyment.

Second, technology designers and retailers have to design and use interactivity levels adapted to their specific target group. This is important because although interactivity is useful in principle, it can also have undesirable effects on certain customers. Providing tools with high interactivity is a perfect decision for high advice seeking customers as they come with low cognitive effort for such customers. Due to this bright-side effect, the lack of particularly high enjoyment levels is not problematic for retailers in achieving lower product return rates. For retailers targeting customers with low tool experience, it is also a wise decision to offer highly interactive tools. Retailers can offer such tools to support these customers in their decision-making process without risking economic disadvantages because highly interactive tools create minimal cognitive effort. In turn, product returns are minimal. Fit advisors or mix-and-match are examples of such full-interactivity PPTs (Figure 6). Thus, both customer characteristics have high distinctive power in that they allow the design of optimal tools for different customer segments. Retailers can relatively easy observe or measure these characteristics. For example, advice seekers can be identified via cookies and log data, which track the use of product reviews, blogs, or test reports. Analyzing consumer behavior (e.g., user profile, frequency of online shop visits, use of search engines, and frequency of online purchases) can effectively capture customers' tool experience.

Finally, our results are also relevant from a broader strategic perspective. They suggest that providing well configured interactive PPTs can be effective in lowering product return rates and a viable alternative to stricter return policies which come with strong drawbacks for retailers (Janakiraman, Syrdal, and Freling 2016). Our results show that by fine-tuning interactivity levels of online tools, retailers can reduce product returns without making return policies more rigorous. Further, our results also emphasize the need for a comprehensive view when assessing the costs of interactive PPTs. Instead of considering only the direct development and implementation costs, retailers should also take into account the more

indirect, "end-of-pipeline" costs of interactive presentation tools stemming from increased product returns.

3.6.3 Avenues for Future Research

This research has some limitations that offer fruitful avenues for future research. First, our choice of the counterbalancing mediators – cognitive effort and enjoyment – enables us to explain why interactivity differs in its undesirable and desirable outcomes. Even though our research identified two important mediators to explain nonlinear effects of interactivity, other mediators likely offer additional explanatory value with regard to nonlinear relationships. To develop an integrated framework, future studies could consider traditional shopping behavior constructs. These are associated with additional bright-side mediators, such as customer satisfaction or loyalty (Heitmann, Lehmann, and Herrmann 2007; Srinivasan, Anderson, and Ponnavolu 2002), or other currently unknown dark-side mediators.

Second, our results should be replicated by evaluating actual product returns to validate and generalize the intention measures. It is possible that in other industries (e.g., office supplies) personal taste and touch-and-feel experiences are less relevant for product evaluation than objective product features. Therefore, not only the industry but also the type of product (e.g., search or experience product) should be considered. Further, numerous other aspects can influence product return rates. For example, the distinction between well-known brands and lesser-known brands should be taken into account.

Third, this study has only focused on explaining how interactive PPTs can reduce product return intentions. Future studies could examine how much is returned and whether presentation tools have an influence on the quantity and frequency of returned products as this would allow to quantify actual revenue and cost effects of different degrees of interactivity. Future research using financial performance data could offer valuable insights into return on interactivity.

4 Stand by Me: How Online Retailers Can Survive Against the High Street (Paper 3)

(with Welf H. Weiger, Maik Hammerschmidt, and Waldemar Toporowski)[12]

A previous version of this paper has been published as: Ahrend, Nadine, Welf H. Weiger, Maik Hammerschmidt, and Waldemar Toporowski (2018): Stand by Me: Escaping the Webrooming Dilemma through Integrating Product Presentation Tools and Product Reviews, in: Gal, David, Kelly Hewett, and Satish Jayachandran (ed.): *Proceedings of the 29th AMA Summer Academic Conference Big Ideas and New Methods in Marketing*, Boston, MA.

Keywords: vividness, interactivity, product presentation tools, product reviews, purchase behavior

[12] This paper was created in cooperation with the listed co-authors. I was responsible for the literature research, the theoretical foundation, the conceptual framework, the hypotheses development, the data management, the methodology, the empirical analysis, and the implication section. My co-responsibilities comprised the positioning and the contribution statement.

4.1 Introduction

There is no week in which business press does not tout the mantra that retailers have to become multi-channel players and provide omnichannel experience. While several retailers follow this route, many online pure players are neither willing nor able to become multichannel providers. For example, many current online pure players such as Amazon, Bonobos and Fab.com opened stationary stores but after a short time retreated to a pure play business model (Armstrong 2017; Levitt 2018; Taylor Jr. 2018) due to prohibitive costs for staff, rent, and storage (Avery et al. 2012; Pauwels and Neslin 2015). As many new retailers do not have the resources for opening physical stores, the online pure play business model is expected to be on the rise in the next years according to a recent Bain & Company study (Cheris, Rigby, and Tager 2016; Dimov 2017).

For online pure players which do not have offline stores, customers who search for product information online but purchase offline – so called webroomers – are an existential threat as losing those customers to the high street inevitably means losing them (and their sales) to competitors (Ansari, Mela, and Neslin 2008; Van Baal and Dach 2005). While keeping customers in the online channel might be a relevant goal for all retailers operating online channels, it is vital for online pure players. This huge challenge is the starting point for this research.

In order to provide the same experience online as in physical stores and to engage customers in the online channel, retailers invest heavily in product presentation tools (PPTs; e.g., videos, product configurators). Such tools evoke "touch-and-feel" experiences usually obtained in offline stores when trying out products (Flavián, Gurrea, and Orús 2016; Verhoef, Neslin, and Vroomen 2007). Vividness and interactivity have frequently been identified as the key design characteristics of PPTs being highly configurable by managers (Yim, Chu, and Sauer 2017). Vividness captures the richness of product information presentation to the senses

and supports imagination of actual product use (Li, Daugherty, and Biocca 2003; Steuer 1992). Interactivity describes the opportunity to actively control the display of product-related information in real-time (Lurie and Mason 2007; Steuer 1992).

However, while it has been shown that highly vivid and interactive PPTs provide a more realistic experience online, it is unknown whether increasing vividness and interactivity indeed enhances online purchases and prevents shoppers from migrating to the offline channel (i.e., decreases offline purchases). Influencing both purchase metrics concurrently is critical for online retailers because almost 40% of customers do not focus either channel for purchasing but purchase the same products simultaneously in both channels (Ansari, Mela, and Neslin 2008; Kumar, Bezawada, and Trivedi 2018). Thus, online and offline purchase often is no zero-sum game[13] and in response to marketing activities employed in the online channel (like introducing advanced PPTs) customers often increase their purchase volume in both online and offline environments (Geyskens, Gielens, and Dekimpe 2002; Herhausen et al. 2015). However, for online pure players each offline purchase (also if in addition to an online purchase) means lost sales. Thus, pure players must trigger online purchase but not offline purchase. In fact, they even need to reduce the amount of purchases from offline competitors in an effort to shift such purchases to their online shops. Thus, our study seeks to answer the following research questions: (1) Do vividness and interactivity trigger online purchase behavior while reducing purchases at offline stores? (2) How does combining both design characteristics impact online and offline purchase behavior? (3) When should high levels of the design characteristics be pursued?

To answer these questions, we present a framework that focuses on the impact of vividness and interactivity on online and offline purchase behavior. We propose that the level of vividness and interactivity in information provision through PPTs determines purchase

[13] Consistent with this logic, model-free evidence in our data reveals only a weak negative correlation between online and offline purchase behavior of -.25.

decisions regarding both the online and offline channel. However, the effectiveness of vivid and interactive information provision for triggering purchases is conditional on the authenticity of those product information. A high authenticity can be achieved by attaching a social "proof" to the information (Motyka et al. 2018) in terms of offering product reviews by like-minded peers in the online shop (Babić et al. 2016; You, Vadakkepatt, and Joshi 2015; Flavián, Gurrea, and Orús 2016). Therefore, we integrate product reviews as a moderator in our model. By imitating the process of touching and feeling (through vividness and interactivity of PPTs) and by facilitating social influence (through product reviews), both key advantages of the offline channel are reproduced in the online channel, making the online channel more attractive and the offline channel obsolete.

To examine our model, we conduct a large-scale online experiment and an experiment combined with a field survey with both studies using real-life tools of existing online shops. In each study, we test our model across two product categories to account for whether product attributes can easily be described online (digital products) or not due to higher relevance of sensory experiences (nondigital products). The reason is that the extent of the webrooming dilemma and hence the extent of channel migration may depend on which type of a product attribute prevails (Lal and Sarvary 1999; Van Baal and Dach 2005).

Through both experimental studies we contribute to retailing literature in several ways. First, our findings show that the levels of vividness and interactivity are decisive for whether online purchases can be triggered and purchases at offline competitors be mitigated. We are pioneering in showing that decisions regarding the design of presentation tools not only enhance the purchase attractiveness of the online channel but are also potent means for making rival channels (offline stores in our case) less attractive. Thus, we provide a more complete understanding of the impact of online PPTs through elaborating customer responses that transcend the online sphere.

Second, as suggested by prior research (Jiang and Benbasat 2007), we examine the interplay of the two PPT characteristics. In doing so, we add to the debate on whether high levels of vividness and interactivity should be combined in PPT design or whether retailers should focus on implementing either vivid or interactive tools to prevent channel free-riding. Insights on whether both design characteristics positively or negatively interplay enable technology designers to find the right mix of the characteristics that does not irritate customers resulting in enhanced desire to inspect products in a physical store to secure purchase decisions.

Third, we are the first to account for the fact that the combined impact of high vividness and interactivity of PPTs on purchases may differ depending on whether tools are complemented with the display of product reviews. Product reviews promote a social component in online shops and the opinions of other customers make a product more tangible and familiar (Darke et al. 2016). Thus, authentic consumer-generated information contained in product reviews strengthens customers' ability to make informed purchase decisions online by using presentation tools.

After presenting our conceptual framework and developing our hypotheses, we describe two experimental studies to test our framework for digital and nondigital products for which PPTs are widely used. By combining the results from both categories, we provide managerial recommendations for online pure players regarding the repercussions of vivid and interactive tools across varied product attributes.

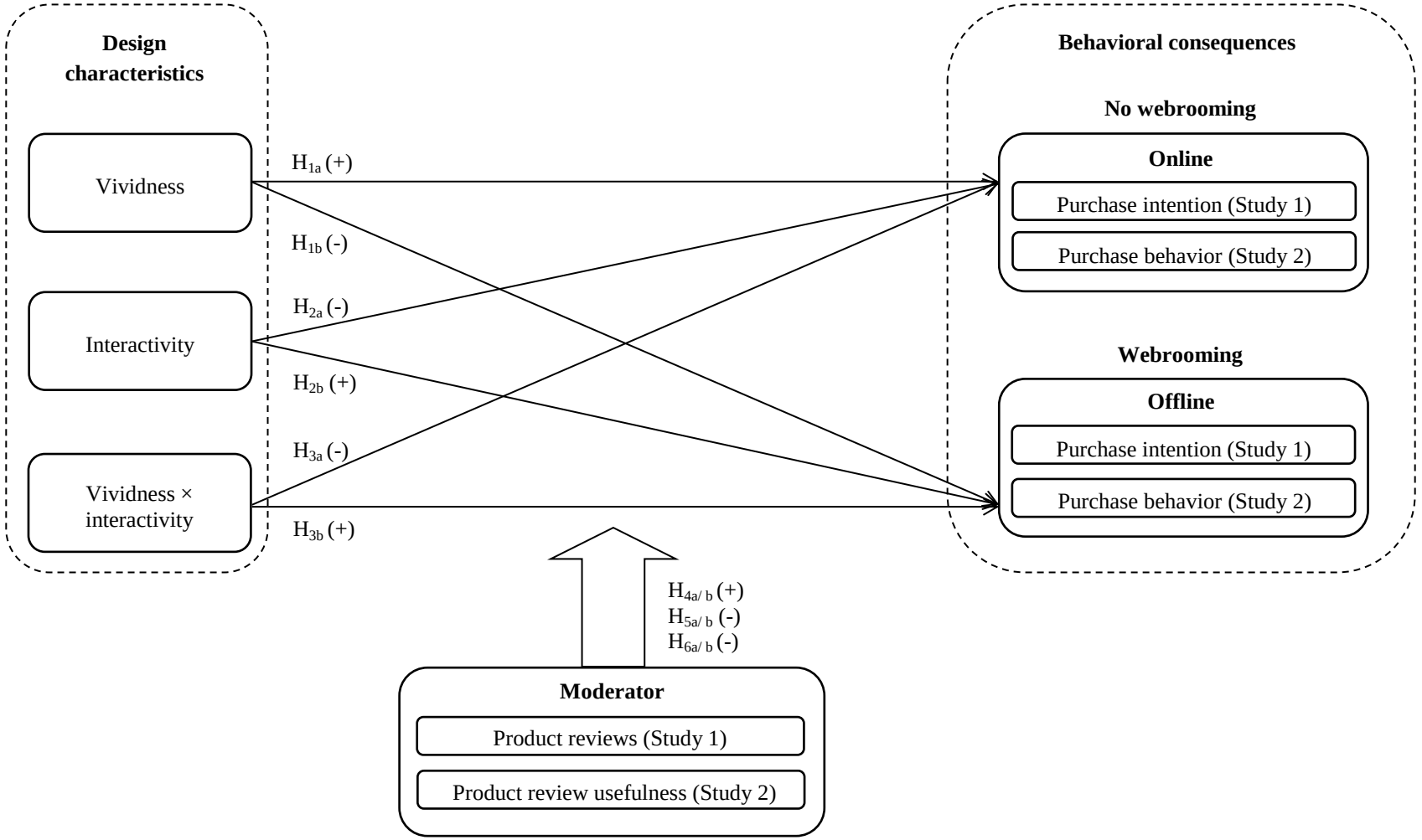
4.2 Conceptual Framework

Our proposed framework draws upon a theoretical tandem of cost-benefit approach and visual representation framework (e.g., Jiang and Benbasat 2007; Lurie and Mason 2007). The first approach suggests that cost-benefit calculations determine which channel is used for the purpose of information search and which for purchase (Frambach, Roes, and Krishnan 2007;

Mehra, Kumar, and Raju 2013; Verhoef, Neslin, and Vroomen 2007). Specifically, the perceived relative costs (i.e., uncertainty and mental effort of information search) and benefits (i.e., quick and easy finding of detailed information) of the online channel compared with the offline channel drive the decision of whether the online channel is predominantly used as purchase venue or both online and offline channels are attractive for purchase.

The visual representation framework proposes that the costs and benefits associated with shopping in the online channel are determined by the format of product information visualization. Such formats or tools manifest in terms of the implemented extent of vividness and interactivity of information presentation. According to the visual representation framework, the levels of both design characteristics determine customers' mental product experience and uncertainty regarding the product choice and hence the relative costs and benefits of purchasing online (Bleier, Harmeling, and Palmatier 2017). Figure 11 depicts our conceptual framework. Next, we elaborate on the selection of model variables and precisely define each of them.

Figure 11: Research Model for Study 1 and Study 2



Design Characteristics of PPTs

The visual representation framework suggests vividness and interactivity as the two constituting characteristics of PPTs because they are highly configurable by managers and are expected to evoke touch-and-feel experiences among online shoppers. More precisely, by imitating the process of touching and feeling products in virtual settings, the two PPT characteristics help consumers to envision a quasi-sensory experience. This helps customers remember relevant product information (Nisbett and Ross 1980) and to imagine the actual usage of a product before purchasing it (Lemon and Verhoef 2016; Müller-Stewens et al. 2017).

We define *vividness* as the richness of (product) information representation to the senses (Lurie and Mason 2007; Steuer 1992). Vividness refers to the ability of a tool to hold the attention and excite the imagination to an extent that is (emotionally) stimulating. High vividness of information presentation produces a sensory rich environment which is imagery-provoking (Nisbett and Ross 1980; Steuer 1992). Specifically, vividness is closely tied to increased perceptions of tangibility. This enables online pure players to present products in a way that communicates actual product quality (Darke et al. 2016; Holzwarth, Janiszewski, and Neumann 2006). For instance, videos showing product use in real-life situations are considered highly vivid.

We define *interactivity* as the extent to which users can engage with presentation tools and modify virtual objects to extract relevant product information (Jiang and Benbasat 2007; Suh and Lee 2005). Thus, interactivity refers to the number of possible user actions, the speed of adaption to user input, and the ability to provide immediate feedback (Lurie and Mason 2007; Steuer 1992). For example, a product configurator, which enables users to visually assess and compare products by specifying different product attributes, is considered to be

highly interactive. Since the two characteristics are frequently combined in practice, we also account for their interaction.

Behavioral Consequences

Insights from the cost-benefit approach suggest that customers' behavioral responses to using presentation tools depend on the perceived costs and benefits that are associated with the design characteristics of such tools. High (cognitive) costs (e.g., time and mental effort) of using such tools in the online channel may push consumers to shop at the offline channel (Kollmann, Kuckertz, and Kayser 2012; Punj and Staelin 1983). However, low costs and high benefits of such tools (e.g., quick and easy finding of detailed information) may convince customers to purchase online. Therefore, we consider customers' inclination to purchase in the online channel and the intention to migrate to offline stores after having gathered information through PPT use (i.e., webrooming behavior) as two important behavioral outcomes of PPTs that ultimately determine financial performance of online pure players (Chiu et al. 2011; Jing 2018). *Online purchase behavior* is highly desirable for online pure player as it is associated with increased revenues and hence profits. *Offline purchase behavior* is a consequence that is highly undesirable for online pure players as it is associated with lost profit. We define online and offline purchase behavior as the act of purchasing in the online shop of the online pure player or the act of purchasing at stationary stores (i.e., competitors) respectively (Gupta, Su, and Walter 2004; Herhausen et al. 2015).

Moderator

Online shops that provide customer support through presentation tools instead of service employees are characterized by intangibility and social distance. Both attributes create uncertainty regarding the right product choice (Flavián, Gurrea, and Orús 2016; Walsh and Mitchell 2010). Thus, customers search for authentic information to support them in their

product selection by cross-validating the authenticity of information provided by the retailer through PPTs. Information provided by other customers are considered as particularly authentic as they represent first-hand, trustworthy experiences of customers, which allow realistic expectations about the quality and functionality of products (Gottschalk and Mafael 2017; Minnema et al. 2016). Therefore, we take into account the moderating role of product reviews for shaping the influence of presentation tools on consumers' purchase behavior. We define *product reviews* as product-related opinions and experiences provided by other consumers (Minnema et al. 2016). Product reviews can be customer-generated content containing an assessment of a product and/ or a simple rating (e.g., five-star rating) (Babić et al. 2016).

4.3 Hypotheses Development

Effects of Vividness and Interactivity on Online and Offline Purchase Behavior

Several studies suggest that vivid presentation tools (e.g., videos presenting the product) allow customers to imagine tactile product experiences even in the absence of physical stimuli (Choi and Taylor 2014; Park, Lennon, and Stoel 2005). This sensory activation resembles the feeling of actually using the product (Venkatesh 2000). Due to facilitating effortless information processing, vivid presentation allows a quick and general understanding of product attributes and functionalities (Mosteller, Donthu, and Eroglu 2014; Shulman, Coughlan, and Savaskan 2009). Highly vivid information allow customers to immerse themselves in the digital customer journey without distraction (Jiang and Benbasat 2007; Orús, Gurrea, and Flavián 2017). Thus, it offers an easy and cost-saving way to evaluate the product online so that a purchase decision can be made online. Becoming aware that an effective purchase process is possible online through vivid PPTs reduces the relative purchase attractiveness of offline stores or even makes offline store visits dispensable.

H1. Vividness has (a) a positive effect on online purchase behavior and (b) a negative effect on offline purchase behavior.

Interactivity allows a multitude of possible actions in tool usage. Regardless of the tool's intuitiveness, this requires a substantial participation effort in terms of perceived time spent, learning, and potential hassle to gather the desired information (Etgar 2008; Köhler et al. 2011; Meuter et al. 2005). The greater the participation required by highly interactive tools, the less likely it is that the product information obtained will compensate for the associated cognitive wearout (Franke and Schreier 2010). Moreover, every additional interactive feature is another risk factor for potential misunderstandings and faulty performance (Thompson, Hamilton, and Rust 2005). Overcharging a tool with interactive features makes it less likely that consumers will be able to use the tool to its full potential before they are overwhelmed and tired. In this case, the (cognitive) costs of PPT use overweigh the benefits and hence make the online channel unattractive for purchase. However, a switching to the offline channel for purchase is an easy escape from such negative experiences. Thus, we conjecture:

H2. Interactivity has (a) a negative effect on online purchase behavior and (b) a positive effect on offline purchase behavior.

A combination of highly vivid and interactive tools (e.g., mix-and-match) might stimulate multisensory imagination and dynamic understanding of the product (Suh and Lee 2005; Shulman, Coughlan, and Savaskan 2009). At the same time, however, loading tools with a large number of vivid and interactive features which require choices between many options and strenuous participation processes can increase usage effort (i.e., time spend, learning and cognitive effort) (Haumann et al. 2015). Such effortful processes consume customers' cognitive capacity, which undermines the development of pleasant product experiences. As a result, making an purchase decision online becomes more difficult, effortful and consequently cost-intensive compared to an offline purchase (Gupta, Su, and Walter 2004). This will result

in fewer purchases made online and makes a migration to the offline channel as a purchase venue more attractive. We hypothesize that:

H3. The interaction of vividness and interactivity has (a) a negative effect on online purchase behavior and (b) a positive effect on offline purchase behavior.

Moderating Effects of Product Reviews

Browsing a product website that provides information through technological instead of human agents puts insecurity on customers, which may generally inhibit their information processing. To reduce this insecurity when using impersonal and intangible PPTs, customers require cues for product quality provided by individuals to cross-validate the detailed information provided by technology. Enhancing PPT-based information with product reviews by other customers enables such a validation by providing a more authentic and realistic picture of product attributes and quality (Chen and Xie 2008). Through utilizing product reviews, customers' certainty, confidence, and satisfaction of using vivid or interactive PPTs increase (Fitzsimons and Lehmann 2004). Thus, product reviews serve to simplify customers' purchase process in tool-based online settings. Consequently, the beneficial effects of PPTs with respect to supporting online purchase might be reinforced while undesirable effects of PPTs might be attenuated. The increased purchase attractiveness of the online channel achieved by complementing PPTs with product reviews might reduce the benefits of migrating to the offline channel. Therefore, we postulate:

H4. Product reviews strengthen (a) the positive effect of vividness on online purchase behavior and (b) the negative effect of vividness on offline purchase behavior.

H5. Product reviews weaken (a) the negative effect of interactivity on online purchase behavior and (b) the positive effect of interactivity on offline purchase behavior.

As discussed above, tools that bundle many vivid and interactive features may be complex and thus put high cognitive burden and additional insecurity on customers. To cope with these challenges, customers are particularly forced to rely on interpersonal information to cross-validate the recommendation obtained from the tool. Product reviews are a powerful and cost-saving source for customers to check if information outcomes of PPTs are trustworthy (Gupta, Su, and Walter 2004; Sen and Lerman 2007). The comparison of product information enabled through a combination of different sources increases customers´ perceived control over the purchase process. They will be more confident in their purchase decisions online and believe that they make the right product choice (Flavián, Gurrea, and Orús 2016; Schul and Mayo 2003). Thus, the disadvantages of the online channel caused by a combination of high vividness and interactivity are alleviated through complementing such "full-fledged" tools with product reviews. Alleviating barriers for online purchase might also shift purchases made at offline stores to the online shop and hence reduce offline purchases.

H6. Product reviews weaken (a) the negative effect of the interaction of vividness and interactivity on online purchase behavior and (b) the positive effect of the interaction of vividness and interactivity on offline purchase behavior.

4.4 Study Overview

To test our hypotheses, in Study 1 we first conduct a large-scale online experiment in a purchase intention setting. Purchase intentions allow to capture individual responses to stimuli (i.e., PPTs) immediately after being exposed to the stimuli and thus safeguard high internal validity (Smith, Bolton, and Wagner 1999). Although intentions have been shown to be valid predictors of behavior, they might lack external validity (Fishbein and Ajzen 1975). Therefore, to increase external validity, in Study 2 we conduct an experiment combined with a follow-up field survey to examine the impact of PPT characteristics on actual online and offline purchase behavior. In both studies we use PPTs embedded in real-life online shops

instead of fictitious tools presented on mock web sites which is the norm in most previous research. In doing so, we ensure a realistic and natural shopping environment (De, Hu, and Rahman 2013; Wang et al. 2007). To assure generalizability, in both studies we consider two product types (digital and nondigital products) frequently used when comparing drivers of online versus offline shopping (Kumar, Mehra, and Kumar 2018). Digital products (e.g., consumer electronics) have several objective and functional features (e.g., capacity, size), which can easily be described or displayed on product pages. Nondigital products (i.e., furniture) comprise many subjective and sensitive features (e.g., material, style), that are more easily evaluated through physical inspection in an offline store (Lal and Sarvary 1999).

4.5 Study 1: Testing the Modell in a Purchase Intention Context

Study 1 uses an online experiment to test how vividness, interactivity and the interaction of both characteristics affect online and offline purchase intentions (H_1 - H_3). Further, we examine whether these effects are moderated by product reviews (H_4 - H_6).

4.5.1 Pre-Studies

First, to test whether customers categorized the focal products (a laptop or a couch) as digital or nondigital, we asked 46 subjects to evaluate it using the items "The [product] is very suitable for a purchase on the Internet" and "The [product] is very suitable for a purchase in a stationary store" (anchored by 1 = "strongly disagree" and 7 = "strongly agree") (Lal and Sarvary 1999). The average ratings were strongly below or above the respective scale midpoints ($M_{\text{consumer electronics\_digital}} = 5.74$; $M_{\text{consumer electronics\_nondigital}} = 3.98$ / $M_{\text{furniture\_digital}} = 2.98$; $M_{\text{furniture\_nondigital}} = 6.61$), confirming that consumers perceived a laptop as a digital product and a couch as a nondigital product.

We then selected potential PPTs by examining tools that are most frequently employed by established consumer electronics and furniture online shops and by asking 123 online

shoppers in the consumer electronics category and 81 online shoppers in the furniture product category. We identified four generic tools in furniture online shops: multi-angle images (presenting products from different perspectives), video (presenting products in full-motion demonstrations), product configurator (suggesting products based on user input) and mix-and-match (combining products in a personalized room). In consumer electronics online shops only the former three tools are employed by retailers. Table 17 gives full descriptions of all tools.

Table 17: Overview and Full Descriptions of the PPTs Used Across Study 1 and Study 2

Tool	Description	Example	Study	Industry
Multi-angle images	Allowing customers to view and examine products from different perspectives	Displaying detailed product attributes from all possible angles (e.g., pattern)	1 & 2	Furniture, consumer electronics, and apparel
Video	Presenting product information through full-motion demonstrations	Showing customers how a product works and how a piece of furniture is processed	1 & 2	Furniture and consumer electronics
Mix-and-match	Providing the opportunity to combine and view multiple products (e.g., piece of furniture) so that customers can put together an entire accommodation	Functionality that lets customers combine and view multiple piece of furniture to put together an entire accommodation	1	Furniture
Product configurator	Providing a selection of products for a specific product category according to pre-entered product expectations	Asking customers for individual application and usage options of laptops (e.g., operating system, screen size, features, interfaces, price) respectively design of a couch (e.g., material, form, price) and suggesting products to meet their needs	1 & 2	Furniture and consumer electronics
Size guide	Offering customers the opportunity to identify their best-fitting size of a garment by using a static table	Providing a table that lets customers identify their garment size based on torso measures	2	Apparel
Fit advisor	Offering diverse input and interaction options for customers to generate an automatic size recommendation	Asking customers for age, individual body measurements (e.g., size, weight, shape of the stomach, structure of shoulders), preferences concerning the fit of the garments (slim fit versus wide fit), and the optimal size of garments from previously purchased brands	2	Apparel

In the pre-tests (consumer electronics: $n = 123$; furniture: $n = 81$), subjects evaluated perceived vividness and interactivity of the four or three presentation tools respectively through multiple items measured by 7-point Likert scales (see the Appendix; $M_{\text{vividness\_consumer electronics}} = 4.41$; $M_{\text{interactivity\_consumer electronics}} = 5.14$; $M_{\text{vividness\_furniture}} = 4.40$, $M_{\text{interactivity\_furniture}} = 4.73$). Further, analysis of variance showed that the tools differed significantly with respect to vividness and interactivity, indicating sufficient variation regarding both design characteristics.[14]

As no single online shop offers all four/ three tools simultaneously, we preselected shops that differed only with respect to the PPTs employed on the product page but were not significantly different ($p > .10$) with respect to visual appeal ("I perceived the appearance of the [online shop] as very professional"), color style ("I perceived the color style of the [online shop] as very pleasant"), and user experience design ("I have seen the [online shop] as very inviting," all anchored by 1 = "strongly disagree" and 7 = "strongly agree"; Parasuraman, Zeithaml, and Malhotra 2005). In addition, we found that awareness of the online shop ("I perceived the logo of the [online shop] as very positive"), and attitude toward the online shop ("I have a very positive attitude towards the [online shop]," both anchored by 1 = "strongly disagree" and 7 = "strongly agree") did not significantly differ across the shops (all $p > .10$). The selected online shops had identical lenient return policies, had a highly comparable product assortment, and had no price discounts or other promotions during the study period.

We ensured that PPTs differed only with respect to the presentation format, with all other relevant characteristics being highly similar (Wang et al. 2007). The product information content provided ("While using the tool …" "…I can judge the [product] very well by the information provided," and "… I can familiarize myself with the [product] very well through the information provided," anchored by 1 = "strongly disagree" and 7 =

[14] Consumer electronics sample: Vividness: $M_{\text{images}} = 4.54 > M_{\text{video}} = 4.36 > M_{\text{configurator}} = 4.23$ ($p < .05$); interactivity: $M_{\text{configurator}} = 5.29 > M_{\text{images}} = 5.20 > M_{\text{video}} = 4.88$ ($p < .05$). Furniture sample: Vividness: $M_{\text{images}} = 4.68 > M_{\text{configurator}} = 4.67 > M_{\text{mix-and-match}} = 4.63 > M_{\text{video}} = 3.58$ ($p < .05$); interactivity: $M_{\text{mix-and-match}} = 5.30 > M_{\text{images}} = 4.92 > M_{\text{configurator}} = 4.52 > M_{\text{video}} = 4.15$ ($p < .05$).

"strongly agree") was perceived as similar as we found no significant differences across tools (both items $p > .10$).

4.5.2 Procedure and Sample

We conducted the experiment using an online survey based on the real-life PPTs identified in the pre-study. After randomly assigning the subjects to one of the two products (laptop or couch), we first asked subjects to imagine they were considering the purchase of the respective product.[15] Then, we randomly assigned participants to one of the PPTs by directing them to the respective product page, where they were instructed on how to use the respective tool. Subjects were distributed equally across tools. They were then instructed to use the tool to examine the focal product for a few minutes as if they were shopping and deciding whether to make a purchase. Manipulation checks (i.e., "Did you see the tool correctly?", "Did you use the tool?", and "Could you get an impression of the tool functionality?", anchored by 1 = "yes" and 2 = "no"; "How long did you use the tool", anchored by 1 = "less than 1 minute" and 7 = "more than 10 minutes") substantiated that participants in fact used the focal tool, fulfilled the product examination task, and gathered information required for forming a purchase decision regarding the focal product. In addition, tracking of browsing time in the online shops indicated that participants indeed used the tool (Schlosser, White, and Lloyd 2006). After performing the product examination task, participants answered an online questionnaire that captured the focal constructs.

A total of 1,104 university students participated in the study. Subjects were screened according to whether and when they had purchased consumer electronics and furniture online and offline at least once (Wang et al. 2007). The sample consisted of 72% women, and 94% of the sample ranged from 18 to 35 years of age. Students are a major group of internet

[15] We selected these products from a range of potential products because participants of the pre-studies displayed moderately positive attitude levels for these products. This criterion ensured that we did not use products to which participants had strongly positive or negative attitudes to avoid that the effects of prior attitude on behavioral outcomes confound the effects of PPTs.

shoppers (Lim et al. 2006) and are more open to new and innovative technologies compared to other age groups (Yim, Chu, and Sauer 2017). Table 18 presents further descriptive statistics.

4.5.3 Measurement

We measured vividness, interactivity and purchase intentions using multi-item scales adapted from prior research (see the Appendix). To allow for user heterogeneity, we captured the PPT characteristics by using individual respondents' perceived levels of vividness and interactivity.

The scales for online and offline purchase intention captured how likely participants were to purchase the focal product they had examined earlier in the respective retailer's online shop or at physical stores (Herhausen et al. 2015; Yim, Chu, and Sauer 2017). We measured our moderator product reviews using a dummy variable (1 = product reviews displayed on focal product page; 0 = otherwise).

With one exception, all Cronbach's alpha values exceed .70, suggesting that the multi-item measures are reliable (Bagozzi and Yi 1988). We also achieved high discriminant validity according to the criterion of Fornell and Larcker (1981). Finally, we included control variables to isolate the effects of PPT characteristics above and beyond other drivers of purchase intentions.[16] Table 18 provides the descriptive statistics and correlations for all constructs and manifest variables.

[16] Specifically, to rule out alternative explanations we included eight additional predictors of behavioral outcomes that represent the most frequently considered predictors in related studies: gender, age, net income, need for touch, advice seeking, ease of use, brand awareness, and product category.

Table 18: Descriptive Statistics and Correlations for Constructs in Study 1

Measure	M	(SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Vividness	4.53	(1.29)	1.00												
2. Interactivity	4.91	(1.11)	.13	1.00											
3. Online purchase intention	3.93	(1.32)	.30	-.04	1.00										
4. Offline purchase intention	4.31	(1.42)	-.09	.11	-.34	1.00									
5. Product reviews	.63	(.48)	.19	-.16	.12	-.14	1.00								
6. Gender	.28	(.45)	-.11	-.04	-.01	-.14	.06	1.00							
7. Age	25.28	(6.96)	-.07	.01	-.11	-.00	-.03	.09	1.00						
8. Net income	3.15	(1.97)	-.01	-.00	.02	-.02	.00	.06	.24	1.00					
9. Need for touch	5.22	(1.60)	.00	.06	-.23	.41	-.08	-.12	-.01	-.06	1.00				
10. Advice seeking	5.40	(1.37)	.08	.11	.10	-.02	.04	-.06	-.10	-.03	.05	1.00			
11. Ease of use	6.12	(1.15)	.12	.32	-.08	.06	-.03	-.05	-.05	-.04	.17	.27	1.00		
12. Brand awareness	4.20	(1.48)	.22	.14	.28	-.06	.08	-.05	-.13	.02	-.11	.12	.07	1.00	
13. Product category	.61	(.49)	.04	.08	.29	-.23	.18	.02	-.14	.07	-.40	.17	-.03	.31	1.00

Notes: M = mean, SD = standard deviation. Correlations larger than or equal to |.41| are statistically significant ($p < .05$, two-tailed).

4.5.4 Methodology

For the same reasons as in Paper 1 we test our hypotheses using SUR. We specify the following equation system for online (*ONPI*) and offline purchase intention (*OFPI*) models:

$$(1)\quad ONPI_i = \beta_0 + \beta_1 VI_i + \beta_2 IN_i + \beta_3 VI_i \times IN_i + \beta_4 PR_i + \beta_5 VI_i \times PR_i + \beta_6 IN_i \times PR_i + \beta_7 VI_i \times IN_i \times PR_i + \beta_8 GEN_i + \beta_9 AGE_i + \beta_{10} IC_i + \beta_{11} NFT_i + \beta_{12} AS_i + \beta_{13} EU_i + \beta_{14} BA_i + \beta_{15} PC_i + \varepsilon_{1i}$$

$$(2)\quad OFPI_i = \gamma_0 + \gamma_1 VI_i + \gamma_2 IN_i + \gamma_3 VI_i \times IN_i + \gamma_4 PR_i + \gamma_5 VI_i \times PR_i + \gamma_6 IN_i \times PR_i + \gamma_7 VI_i \times IN_i \times PR_i + \gamma_8 GEN_i + \gamma_9 AGE_i + \gamma_{10} IC_i + \gamma_{11} NFT_i + \gamma_{12} AS_i + \gamma_{13} EU_i + \gamma_{14} BA_i + \gamma_{15} PC_i + \varepsilon_{2i}$$

where VI_i represents vividness and IN_i is interactivity. PR_i refers to the moderator product reviews. We also included control variables: GEN_i is gender, AGE_i is age, IC_i is net income, NFT_i stands for need for touch, AS_i is advice seeking, EU_i stands for ease of use, BA_i is brand awareness and PC_i stands for product category. Finally, ε_{1i} *and* ε_{2i}, are the disturbance terms of subject *i*.

4.5.5 Results

Test of hypotheses on the effects of vividness and interactivity on purchase intentions. The results provide support for H_{1a}, showing that vividness has a significant positive effect on online purchase intention (β_1 = .261, p < .01). H_{1b}, which states that vividness decreases offline purchase intention, can be accepted as well (γ_1 = -.161, p < .01). In contrast, interactivity significantly reduces online purchase intention (β_2 = -.185, p < .01) and increases offline purchase intention (γ_2 = .224, p < .01). Consequently, H_{2a} and H_{2b} can be confirmed. The interaction of vividness and interactivity reduces online purchase intention (β_3 = -.134, p < .01), and at the same time, increases offline purchase intention (γ_3 = .125, p < .05), providing support for H_{3a} and H_{3b}.

Test of moderating effect hypotheses. In regard to the moderating role of product reviews, the results neither show significant effects of the interaction of product reviews and vividness in the online purchase intention model ($\beta_5 = .075$, $p > .10$), nor in the offline purchase intention model ($\gamma_5 = .035$, $p > .10$). Consequently, H_{4a} and H_{4b} are not confirmed. Furthermore, we found no significant interaction effects between product reviews and interactivity in the online purchase intention model ($\beta_6 = .079$, $p > .10$) or in the offline purchase intention model ($\gamma_6 = -.109$, $p > .10$). Thus, there is no support for H_{5a} and H_{5b} either. However, the results show a significant three-way interaction effect between product reviews, vividness, and interactivity on online purchase intention ($\beta_7 = .163$, $p < .01$) and on offline purchase intention ($\gamma_7 = -.171$, $p < .01$). Consequently, H_{6a} and H_{6b} are supported. Table 19 contains the results of the two SUR equations for the hypothesized relationships.

Table 19: SUR Estimates for Online and Offline Purchase Intention Models for Study 1

	Dependent variable: Online purchase intention				Dependent variable: Offline purchase intention			
Independent variables	Coefficient	SE	z-Value		Coefficient	SE	z-Value	
Constant	-.711***	.137	-5.17		-.416***	.149	-2.78	
Design characteristics								
Vividness	.261***	.052	5.03	H_{1a} (✓)	-.161***	.057	-2.84	H_{1b} (✓)
Interactivity	-.185***	.067	-2.78	H_{2a} (✓)	.224***	.072	3.09	H_{2b} (✓)
Moderator								
Product reviews	-.057	.079	-.72		-.103	.086	-1.20	
Interactions								
Vividness × interactivity	-.134***	.046	-2.93	H_{3a} (✓)	.125**	.050	2.52	H_{3b} (✓)
Vividness × product reviews	.075	.063	1.19	H_{4a} (×)	.035	.069	.52	H_{4b} (×)
Interactivity × product reviews	.079	.076	1.04	H_{5a} (×)	-.109	.083	-1.31	H_{5b} (×)
Vividness × interactivity × product reviews	.163***	.052	3.13	H_{6a} (✓)	-.171***	.057	-3.02	H_{6b} (✓)
Controls								
Gender (0 = female, 1 = male)	.043	.080	.55		-.333***	.087	-3.84	
Age	-.008	.005	-1.52		-.004	.006	-.72	
Net income	.008	.018	.44		.007	.020	.34	
Need for touch	-.344***	.079	-4.35		1.036***	.086	12.03	
Advice seeking	.162**	.075	2.16		-.091	.081	-1.12	
Ease of use	-.101***	.034	-2.97		-.027	.037	-.73	
Brand awareness	.139***	.026	5.38		.018**	.028	.63	
R^2	.233				.212			

* = $p < .10$; ** = $p < .05$; *** = $p < .01$

Notes: n = 1,104; results are based on two-tailed z-tests. All variance inflation factors (VIF) are below the recommended cut off of 10 (Hair et al. 1995).

4.5.6 Discussion

Study 1 provides initial evidence that the use of vivid PPTs increases online purchase intentions. Most interestingly, the impact of PPT use in the online sphere spills over to the purchase intentions regarding the physical channel. Thus, high vividness of PPTs benefits not only the online channel but at the same time makes stationary competitors less attractive for purchasing. In contrast, the results paint a less positive picture for interactive tools. High interactivity can be harmful since it can cognitively overwhelm customers by demanding effort-intense participation. Thereby, interactive PPTs drive customers into stationary retailing, causing significant loss of sales to competitors for online pure players. These effects emphasize that interactivity should be used with caution.

Perhaps even more dramatically, when combining high levels of vividness and interactivity, the desirable effects of vividness on purchase intentions in both channels is undermined by the resource-depleting effect of interactivity, yielding highly undesirable effects for online pure players. One promising solution is to complement vivid and interactive PPTs with product reviews as they convey authentic product information that generates trust and social closeness. In this way, they promote the willingness to purchase online after PPT use and prevent loosing sales to stationary competitors.

To advance several aspects of Study 1, we conduct a second study using a combination of experiment and field survey. First, to increase the external validity of Study 1 results based on purchase intentions, in Study 2 we consider actual online and offline purchase behavior in the time after using the PPT. Second, Study 2 examines not only whether product reviews are displayed at the online shop but their usefulness for evaluating the quality and performance of products (Filieri 2015; Park and Lee 2008). Third, we use another nondigital product category (apparel) in Study 2. Remember that the results of Study 1 show that using PPTs in the online channel exerts an influence on customers' offline

purchase intentions that goes above and beyond the influence of the product category. That is, although the intention to purchase in physical stores can to a certain extent be explained by the consideration of a nondigital product (versus a digital product), there is an additional significant effect of online PPT use on offline purchase intention even when controlling for product type. Using another nondigital product category in Study 2 serves to bolster confidence in the robustness of this finding. Our choice of another nondigital product also recognizes that customers might be more skeptical of recommendations provided by product reviews for nondigital product due to the idiosyncratic nature of experiences with tangible product attributes (e.g., fit, material; Jiménez and Mendoza 2013). Therefore, using a second category of nondigital products also serves to check the robustness of the moderating effects of product reviews.

4.6 Study 2: Testing the Modell in an Actual Purchase Context

4.6.1 Setting

As in Study 1, the context for Study 2 is online retailers of digital and nondigital products. Like in Study 1, also in Study 2 we use a laptop for representing the digital product category. We use a casual pullover as the nondigital product in Study 2. The choice of apparel as a second nondigital product category serves to increase generalizability. Apparel is a highly appropriate product category since it is associated with particularly intensive webrooming behavior (eMarketer 2016). In addition, as this category is characterized by tangible attributes (e.g., fit, material) there is a higher need for pre-purchase information than for digital products. Therefore, information obtained through PPTs and product reviews have a greater impact on purchases in this category (Jiménez and Mendoza 2013). Moreover, apparel purchases are characterized by shorter purchase cycles than furniture (Statista 2018a), which makes it easier to capture the actual online and offline purchase behavior representing the

dependent variables in Study 2. Thus, Study 2 complements the purchase intention context of Study 1. Together, both studies provide broader insights into the repercussions of PPTs across different product settings.

4.6.2 Pre-Studies

Using the same items as in Study 1, apparel is classified in the pre-test ($n = 46$) as a nondigital product category ($M_{apparel\_digital} = 3.59$; $M_{apparel\_nondigital} = 6.33$). We selected suitable PPTs for apparel sample of Study 2 by asking 98 apparel online shoppers. Multi-angle images, which were used in Study 1, are also a widely established tool in apparel online retailing. In addition, in this setting a size guide (offering a static table to identify ideal fitting size) and a fit advisor (generating automatic size recommendations based on user input) are prevalent (Table 17 provides a description of all tools). Together, these three PPTs represent the tools currently employed in apparel online shops.

For consumer electronics, we used the currently available PPTs (known from Study 1 i.e., multi-angle images, product configurator, and video) surveyed again by 85 subjects. There are no apparel or consumer electronics online shops that offer all three focal PPTs concurrently. Further, in line with Study 1, vividness and interactivity scores across the three tools ($M_{vividness\_consumer\ electronics} = 5.84$; $M_{interactivity\_consumer\ electronics} = 5.11$; $n_{consumer\ electronics} = 85$/ $M_{vividness\_apparel} = 5.19$; $M_{interactivity\_apparel} = 5.30$; $n_{apparel} = 98$)[17] significantly differed. Again, PPTs differed only with respect to the presentation format, with all other relevant characteristics being comparable. Table 17 provides an overview of all PPTs used in Study 2.

[17] Consumer electronics sample: Vividness: $M_{images} = 6.18 > M_{video} = 5.36 > M_{configurator} = 3.56$ ($p < .05$); interactivity: $M_{images} = 5.81 > M_{configurator} = 5.00 > M_{video} = 3.60$ ($p < .05$). Apparel sample: Vividness: $M_{images} = 6.38 > M_{fit\ advisor} = 4.69 > M_{size\ guide} = 4.28$ ($p < .05$); interactivity: $M_{images} = 6.13 > M_{fit\ advisor} = 5.17 > M_{size\ guide} = 4.59$ ($p < .05$).

4.6.3 Procedure, Sample, and Measurement

As in Study 1, we randomly assigned subjects to one of three tools in a consumer electronics or an apparel online shop and instructed subjects to use the respective PPT to examine a laptop or a casual pullover.

512 subjects participated in the study. Subjects were screened according to whether they had already purchased consumer electronics and apparel online and offline at least once (Wang et al. 2007). The sample consisted of 51% women, and 62% of the sample ranged from 18 to 35 years of age. This distribution is representative for online shoppers in the consumer electronics and apparel industries (Statista 2016b; Statista 2018b).

The measurement of the independent variables was the same as in Study 1 (see the Appendix). In keeping with extant literature, the actual online purchase behavior was measured as the extent to which the focal product examined by using the specific presentation tool was bought at the respective online shop in the following six months (Kleinlercher et al. 2018). Similarly, drawing on extant research, actual offline purchase behavior was captured as the extent to which the focal product was bought at stationary stores in the six months after tool usage (Gupta, Su, and Walter 2004). Both purchase measures were captured by a follow-up study asking participants to retrospectively state the amount of online and offline purchases during the six months after the treatments (i.e., usage of the PPT). To support the reconstruction of purchase behavior, participants were instructed to use a diary for recording the purchase activities in both channels. The time interval for collecting behavioral data after a treatment has been used by previous studies and deemed appropriate to allow for accurate statements (De Keyser, Schepers, and Konuş 2015; Kleinlercher et al. 2018). To provide generalizability of our findings across different measures of our moderator product reviews, in Study 2 we captured product reviews as the real helpfulness of product reviews to understand

the product and to support the purchase decision (Filieri 2015). All scales were anchored by 1 = “strongly disagree” and 7 = “strongly agree.

We achieved reliable measurement (all Cronbach’s alphas were above .70) and high discriminant validity (Fornell and Larcker 1981). Table 20 provides the descriptive statistics and correlations.

Table 20: Descriptive Statistics and Correlations for Constructs in Study 2

Measure	M	(SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Vividness	5.54	(1.11)	1.00												
2. Interactivity	5.65	(.96)	.58	1.00											
3. Online purchase behavior	3.31	(1.88)	.02	-.17	1.00										
4. Offline purchase behavior	3.50	(1.83)	-.08	.01	-.25	1.00									
5. Product review usefulness	4.00	(1.96)	-.02	-.11	.64	-.00	1.00								
6. Gender	.49	(.50)	.08	.02	-.02	-.03	-.05	1.00							
7. Age	33.67	(8.12)	.05	.19	-.04	-.01	-.05	-.01	1.00						
8. Net income	3.80	(1.85)	-.02	-.03	.02	.02	-.01	-.04	.32	1.00					
9. Need for touch	4.67	(1.62)	-.08	.00	-.10	.29	.09	.06	-.17	-.05	1.00				
10. Advice seeking	5.47	(1.38)	.20	.24	.00	-.06	.10	-.01	-.01	-.04	.08	1.00			
11. Ease of use	6.36	(.98)	.36	.54	-.08	-.08	-.04	.05	.15	-.04	.00	.28	1.00		
12. Brand awareness	4.74	(1.23)	.22	.19	.00	-.01	.05	.02	.06	.00	.07	.12	.16	1.00	
13. Product category	.49	(.50)	.14	.01	.10	-.23	.01	-.07	.03	.05	-.24	.08	-.02	.17	1.00

Notes: M = mean, SD = standard deviation. Correlations larger than or equal to |.64| are statistically significant ($p < .05$, two-tailed).

4.6.4 Methodology and Results

For the same reasons as in Study 1, we use SUR to test the hypotheses and estimate two equations with actual online and offline purchase behavior as dependent variables.

Test of main effect hypotheses. All hypothesized paths were significant with the anticipated direction. Study 2 replicates the results from Study 1.

Test of moderating effect hypotheses. Regarding the moderating role of product review usefulness, the results show neither a significant interaction effect for vividness (β_5 = .016, p > .10) or interactivity (β_6 = -.054, p > .10) on online purchase behavior nor significant interactions effects on offline purchase behavior (vividness: γ_5 = -.056; interactivity: γ_6 = -.007, both p > .10). Consequently, H_{4a} - H_{5b} cannot be confirmed. However, we found a significant three-way interaction effect between product review usefulness and the two PPT characteristics for online purchase behavior (β_7 = .049, p < .05) and offline purchase behavior (γ_7 = -.110, p < .01). Thus, H_{6a} and H_{6b} are supported. Table 21 contains the results of the two SUR equations for the hypothesized relationships.

Table 21: SUR Estimates for Online and Offline Purchase Models for Study 2

	Dependent variable: Online purchase behavior				Dependent variable: Offline purchase behavior			
Independent variables	Coefficient	SE	z-Value		Coefficient	SE	z-Value	
Constant	.353**	.143	2.46		-.160	.176	-.91	
Design characteristics								
Vividness	.223***	.070	3.18	H_{1a} (✓)	-.180**	.086	-2.09	H_{1b} (✓)
Interactivity	-.301***	.092	-3.27	H_{2a} (✓)	.255**	.113	2.26	H_{2b} (✓)
Moderator								
Product review usefulness	.606***	.035	17.27		.051	.043	1.19	
Interactions								
Vividness × interactivity	-.115**	.057	-2.01	H_{3a} (✓)	.150**	.070	2.13	H_{3b} (✓)
Vividness × product review usefulness	.016	.034	.46	H_{4a} (×)	-.056	.042	-1.33	H_{4b} (×)
Interactivity × product review usefulness	-.054	.041	-1.32	H_{5a} (×)	-.007	.051	-.14	H_{5b} (×)
Vividness × interactivity × product review usefulness	.049**	.025	1.98	H_{6a} (✓)	-.110***	.031	-3.59	H_{6b} (✓)
Controls								
Gender (0 = female, 1 = male)	.101	.123	.82		-.216	.151	-1.43	
Age	-.001	.008	-.06		.003	.010	.29	
Net income	.024	.035	.69		.019	.043	.45	
Need for touch	-.542***	.128	-4.23		.959***	.157	6.10	
Advice seeking	-.226*	.137	-1.65		-.174	.168	-1.04	
Ease of use	.003	.076	.04		-.167*	.094	-1.78	
Brand awareness	-.011*	.053	-.21		-.008***	.065	-.12	
R^2	.471				.159			

* = p <.10; ** = p <.05; *** = p <.01

Notes: n = 512; results are based on two-tailed z-tests. All variance inflation factors (VIF) are below the recommended cut off of 10 (Hair et al. 1995).

4.6.5 Discussion

The results of Study 2 confirm the desirable effects of high vividness on online and offline purchases for online pure players. By offering vivid PPTs, they can counteract the webrooming dilemma. Moreover, the results confirm the undesirable effects of interactivity regarding both purchase behaviors. Interactive tools encourage webrooming behavior and drive consumers into stationary retailing, resulting in significant loss of sales for online pure players. Furthermore, the results of Study 2 replicate the undesirable effects on online purchases that online pure players suffer as a result of the combination of high vividness and interactivity. Further, not only providing product reviews on the product pages (Study 1) but also improving their specific usefulness as an adjunct benefit to the information obtained through PPTs is a viable way for reducing the undesirable effects of PPTs on online and offline purchases. Further, Study 2 adds to Study 1 as it replicates all effects of the intention measures based on externally valid real behavior data. Both studies show consistent results for intention and behavior measures, as well as across different product categories (digital versus nondigital). This sparks confidence in the generalizability as well as internal and external validity of the results.

4.7 General Discussion

Obstacles to entering a new market are significantly lower online (i.e., lower costs for staff and storage). Thus, many retailers start as online pure players (Ackermann and von Wangenheim 2014; Ansari, Mela, and Neslin 2008; Pauwels and Neslin 2015). Some of them make the decision to permanently operate in the online channel only. Others plan to establish offline stores and pursue a multi-channel strategy in the future but currently follow an online pure play business model. Still other retailers have opened offline stores but returned to be online pure players as they had to withdraw from the offline channel (Avery et al. 2012).

Together, all these retailers have the same essential problem: losing customers and their sales to the offline channel means losing them to competition. Therefore, getting knowledge on how and when PPTs can be used for keeping customers in the online channel and decreases channel migration is a major challenge for all online-only retailers. This paper serves to provide this crucial knowledge.

This paper provides robust evidences (across two studies and three product categories) that PPTs evoke touch-and-feel experiences and at the same time product reviews offer additional information through social influence. We prove that, particularly if retailers combine vivid presentation tools with product reviews, the key benefits of the offline channel can be effectively resembled online. So, if designed and managed in the right way, employing PPTs can marginalize the last two benefits of physical stores that so far were unique for this channel and the main reason for choosing this channel.

The consistency of the effects of PPT characteristics on purchase found across intention and actual behavior measures gives researchers and retailers high flexibility for data collection. Both can use the data source (intention versus actual purchase data) that is most readily available to them. The findings have important implications for both researchers and retail managers, which we discuss next.

4.7.1 Theoretical Implications

The present study contributes to the literature on visual information presentation by showing how the presentation of information affects the success of online retailers that have to compete against stationary competitors. Employing information presentation tools can enable customers to access product information more efficiently and hence reduce the (cognitive) costs and increase the benefits of the online channel (Benlian, Titah, and Hess 2012). If the benefits of the online channel are felt to be greater than the (cognitive) costs, migration to the offline channel can be avoided.

First, to the best of our knowledge, our research is unique in providing a holistic perspective on cross-channel consequences of vivid and interactive PPTs. On the one hand, we confirm the findings of previous research that tools induce bright-side effects in terms of improved online purchase behavior (Fiore, Jin, and Kim 2005; Jiang and Benbasat 2007). On the other hand, we additionally consider the consequences of PPTs for offline channel-related purchase behavior. We expand current research as our results show that highly vivid PPTs can enhance purchases in the online channel and concurrently make competing offline stores less attractive for shopping. In contrast, overly interactive tools push customers into the offline channel and exacerbate the webrooming dilemma making interactivity a potentially harmful characteristic of PPTs. Our research is the first to elaborate on the cost and benefit implications of presentation tools for both the online and offline channel.

Second, our study provides a novel finding in that we show that bundling high levels of vividness and interactivity creates overly complex tools. Such "overkill" tools exhaust customers and make the costs of information visualization outweigh its benefits. Such tools therefore yield undesirable consequences for online pure players by turning customers into webroomers that use the offline channel for making the final purchase. With these findings we add to the discussion on whether both characteristics have synergistic or dissynergistic effects when combined. A deeper understanding of the bundling effects of vividness and interactivity is essential to determine whether the desirable or undesirable effects of such tools will prevail.

Finally, this research demonstrates that the negative impact of combining both design characteristics can be counterbalanced by complementing them with product reviews. In this way, setting up a stationary store and the high costs this would entail can be avoided. By revealing the synergistic effect of product reviews and PPTs, both studies show that not only digital (e.g., consumer electronics) but also nondigital product categories (e.g., furniture and apparel) can be effectively presented and sold online.

4.7.2 Managerial Implications

The key implication of our studies is that retailers should not consider highly vivid and interactive PPTs as silver bullets to decrease online-to-offline channel migration. It may well be that the opposite is true. Our research provides actionable implications for how tools should be designed to provide the same experience online as offline and hence prevent customer migration to physical stores. This is important not only for online pure players as even multichannel retailers might be negatively impacted by offline migration as a certain share of migrating customers will be lost on the journey to competitors' offline stores (Van Baal and Dach 2005; Neslin et al. 2006).

First, technology designers and e-commerce managers have to adjust the degree of vividness and interactivity carefully when implementing PPTs to prevent customer migration to the offline channel. We recommend that online pure players regard vivid tools as the primary option for delivering retailer-provided information. This is because vivid tools are the ones that most effectively promote desirable behavior, i.e., online purchases and decreased rates of webrooming. However, loading tools with interactive features backfires. Highly interactive tools require more efforts from customers when using these tools online, which exhaust them and drive them towards the offline channel. Highly interactive tools might therefore be a double whammy for online retailers. They not only require high up-front costs for development and testing, but also reside with significant follow-up costs in terms of lost online sales. Thus, online pure players are advised to focus on highly vivid tools that contain less or not interactive features to strengthen online and preventing offline purchase behavior. Videos are tools that particularly exhibit this favorable configuration of tool characteristics.

Second, offering tools that combine high vividness and interactivity can be a dangerous strategy for preventing channel switching. By undermining the positive effect of vividness through the resource-depleting effect of interactivity, such high-feature tools

aggravate the webrooming dilemma. All else equal, online pure players should therefore refrain from using full-fledged PPTs such as mix-and-match or multi-angle images.

Third, retailers should only combine highly vivid and interactive features when enhancing them with consumer-provided information in the form of product reviews. Through combining PPTs with product reviews retailers can improve customers' trust and perceived social proximity to other users (Darke et al. 2016; Jiang and Benbasat 2007) without having to open offline stores. The increased availability of visualized information through PPTs and product reviews ensures that customers are more knowledgeable and therefore able to make easy and cost-saving purchase decisions online. In some cases, however, online pure players may need to avoid including product reviews. This can be the case, for example, in product categories that are inherently associated with a higher need for privacy among customers. In this case, online pure players should only rely on vivid PPTs to keep customers in the online channel. Otherwise, they would risk harmful channel migration behavior.

Finally, the results from both studies show that online pure players should offer vivid and interactive PPTs in combination with product reviews in order to convey digital and nondigital product attributes for a better understanding of the product and to create a (social) shopping experience without the need for visiting offline stores. Thus, the online channel offers a double benefit. This knowledge makes it possible to present both types of product attributes (digital and nondigital) in an online shop without having to open cost-intensive stationary stores.

4.7.3 Avenues for Further Research

This research has some limitations that offer constructive avenues for future research. First, although we analyze our results by using actual online and offline purchase behavior, our study data did not allow us to consider the actual revenue and cost effects of enhancing vividness and interactivity. Future research using financial performance data could offer

valuable insights regarding the profitability implications of different vividness and interactivity combinations to study the potential consequences of research shopping on online pure player's profit.

Second, our model is just a good beginning. Much more remains to be done in the webrooming context. Indeed, we have shown that PPT characteristics influence online and offline (purchase) behavior, but how that happens remains unclear. In this context, future research could explore potential mediators (e.g., cognitive effort and enjoyment) that more concretely explain the relationships to derive further recommendations for tool design. We hope other researchers can enrich the model by incorporating missing variables (e.g., mediators) and relationships.

Finally, other forms of product reviews offer numerous research perspectives. Product reviews could be extended to reviews by experts. There could be a distinction between official independent experts (i.e., test reports) and individual dependent experts (i.e., blogs, and influencers). Within these categories, a further distinction could be made between textual and visual reviews (e.g., videos) of experts for differentiated effects on channel switching behavior. Further, the influence of identical and different experts could also bring interesting results for resolving the channel migration problem.

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5 General Discussion

The starting point of this dissertation was the significant challenge of online retailing regarding the physical barrier in the purchase situation. The implementation of PPTs provides a promising approach to overcome this obstacle. Recent research has yielded valuable insights into how presentation tools reduce uncertainty prior to purchase and, consequently, promote purchase intentions (e.g., Jiang and Benbasat 2007; Park, Lennon, and Stoel 2005). Practical evidence, however, suggests that this perspective is one-sided. Presentation tools also favor undesirable behavior as for example high product return rates (Jin 2018; Randall 2015). Despite these warnings, previous research has so far largely ignored undesirable outcomes of PPTs. This dissertation advances this one-sided view and offers extensive answers for research and practice to the questions of *whether*, *how* and *when* the implementation of presentation tools is advisable.

For research, the identification of undesirable behavioral outcomes, in addition to the previously studied desirable effects, is a valuable extension. This requires a fine-grained consideration of the effects of single design characteristics of PPTs instead of tools as a whole together with exploring mediating mechanisms that explain these effects.

For technology designers and retailers, an understanding of the overall effects of presentations tools on behavioral outcomes for different contextual settings supports the optimal design and successful implementation of PPTs. Therefore, this dissertation accounts for retailers' target groups and their characteristics and controllable online shop characteristics when examining the effects of PPTs.

5.1 Research Implications

As a general conclusion of the three papers, there is clear evidence that the implementation of PPTs makes sense in principle. Across the three papers, the design options for tools (degree

and combination of PPT characteristics), mediating mechanisms (cognitive effort and enjoyment), consumer characteristics (need for touch, advice seeking, and tool experience), and retailer-specific factors (online shop characteristics) have been taken into account. The results of the three papers show the relevance of these important factors.

First, Paper 1 shows for the first time dual effects of presentation tools. Vividness is a beneficial design characteristic that favors desirable effects. However, interactivity is a potentially harmful PPT characteristic. Interactivity can quickly backfire unless sufficient care is taken. Paper 2 picks up on these results by more intensively analyzing nonlinear effects of interactivity. The results indicate that interactivity is useful in general. However, it can trigger undesirable consequences for certain levels and under certain conditions (i.e., according to mediating and moderating mechanisms). In general, the identification of undesirable in addition to desirable outcomes extends current research. Both papers broaden the perspective on the effects of PPTs and offer extensive answers to the research question of "*whether*" PPTs can backfire.

Second, for answering the "*how*" question Paper 1 identifies the competing and compensatory mediating mechanisms (cognitive effort and enjoyment) through which PPTs' effects work and which are further substantiated in Paper 2. These counterbalancing constructs are unique in research to date. While vividness generally decreases cognitive effort which supports bright-side outcomes, interactivity can decrease or increase cognitive effort which triggers bright- or dark-side effects. Enjoyment, however, is uniformly triggered by both design characteristics and causes desirable effects. Nonlinear relationships allow more realistic statements about the effects of interactivity on cognitive effort. Paper 2 shows that only a medium level of interactivity is harmful because it creates high cognitive effort. Low and high levels of interactivity reduce cognitive effort and causes desirable effects. At first glance, this finding seems to be inconsistent with Paper 1. However, in fact, the findings of both papers reveal intriguing and complementary insights. Paper 2 isolates the effects of

interactivity as a critical PPT characteristic as it excludes the interplay with other characteristics like vividness. If one PPT characteristic is considered exclusively, its effects may differ compared to the ones obtained in a common analysis that examines a mix of characteristics. Furthermore, Paper 2 confirms Paper 1 results in replicating a cognitive overload effect of interactivity; however, this effect occurs only up to a certain (medium) level of interactivity. Beyond this level, tools reach a level of sophistication that supports purchase decisions and reverses the dysfunctional cognitive effect of interactivity into a cognitive effort-reducing effect. Overall, both papers provide a deeper understanding of the important role of cognitive effort as a mediating mechanism. This is essential for providing explanations for the different effects of vivid and interactive tools on behavior.

Third, in adding a consumer research perspective to PPT research, the results of Paper 1 and Paper 2 indicate that consumer characteristics (need for touch, advice seeking and tool experience) play an important role for answering the question "*when*" the desirable or undesirable effects of presentation tools prevail. Further, consumer characteristics are also decisive for revealing whether linear or nonlinear relationships between PPT characteristics and psychological consumer responses exist. They strongly determine the functional shape of the relationships between PPT characteristics and mediating variables. However, the explanatory value of consumer characteristics is closely linked to the product category (i.e., apparel and consumer electronics) considered.

Fourth, Paper 3 extends the channel context by including the offline channel, alongside the online channel, which has been analyzed in Paper 1 and Paper 2. This approach provides broader insights regarding the effects of PPTs. The results show that there are both desirable and undesirable effects of the design characteristics regarding both channels. While highly vivid tools keep customers in the online channel, overly interactive tools push them into the offline channel and promote the webrooming behavior. This research is unique in

providing a holistic perspective on behavioral consequences of presentation tools across two channels.

Finally, the inclusion of synergistic or dissynergistic effects in the analysis broadens the discussion of "*when*" a separation or bundling of the design characteristics is more advantageous to promote desirable and reduce undesirable behavior. Paper 3 shows that negative effects of combining both PPT characteristics can be compensated by the complementary provision of product reviews in the online shop.

Overall, the results of this dissertation show that the implementation of vivid and interactive tools can be advisable depending on the constellation of mediating and moderating mechanisms. Nevertheless, the three papers have some limitations that provide fruitful opportunities for future research. First, the choice of competing mediators (cognitive effort and enjoyment) in Paper 1 and Paper 2 has made it possible to explain undesirable outcomes of PPTs. However, it is likely that in addition to these two important mediators, there are others that can provide additional explanatory value. To develop an integrated framework, future studies should consider traditional bright-side mediators such as decision satisfaction or perceived trust (Heitmann, Lehmann, and Herrmann 2007; Schlosser, White, and Lloyd 2006) or other previously unknown dark-side mediators.

Second, future research should use the results of the papers as a good starting point. Additional studies have to examine further undesirable behavioral outcomes triggered by the design characteristics of presentation tools, as these have so far mostly been disregarded.

Third, the research on the effects of vivid and interactive tools on the offline channel highlighted in Paper 3 is still in its infancy. Further research should be conducted to explore additional influences (e.g., visit frequency and retailer loyalty). Much more remains to be done in the context of channel switching. Researcher should seek to advance the understanding of the influence of PPTs on this phenomenon. In this context, future research could explore potential mediators (e.g., cognitive effort and enjoyment) of the relationships

between PPT characteristics and online and offline-related outcomes to derive further recommendations for tool design.

Finally, none of the three papers provides data on the actual revenue and cost effects of varying levels of vividness and interactivity. In future research, the inclusion of financial performance data could provide valuable insights into the profitability implications of different combinations of vividness and interactivity.

5.2 Managerial Implications

A successful implementation of vivid and interactive tools requires a comprehensive understanding of their impact on consumer behavior. To achieve this aim, the three papers provide concrete recommendations for the effective design of PPTs, considering different target groups and online shop-related characteristics.

First, the levels of the two design characteristics are essential for predicting consumer-related outcomes of PPTs. Technology designers and e-commerce managers need to design them wisely. To this end, the results of the dissertation provide comprehensive guidelines for their design. Paper 1 shows that high vividness increases enjoyment and lowers cognitive effort, promoting desirable effects (increasing purchases). Interactivity, however, is a double-edged sword that should be used with caution. Although highly interactive tools generate enjoyment, this can be canceled out by cognitive effort which nurtures undesirable effects (increasing product returns). Paper 2 further deepens these differentiated effects of interactivity and shows that interactivity is not a harmful characteristic per se. Just a medium level of interactivity is dangerous (in terms of triggering high cognitive effort and subsequently increasing product returns). Paper 3 confirms the effects across both online and offline channels. Thereby, the paper supports evidence of the desirable effects of high vividness (increasing channel loyalty) and the undesirable effects of high interactivity (driving defection to competitors' channel). Overall, retailers are well advised to focus clearly on high

vividness. In a combination of both characteristics high interactivity should be avoided. If retailers focus on interactivity when designing tools, they should avoid a "medium level trap" regarding interactivity. However, the findings also imply that retailers that strive for highly interactive tools and view moderate interactivity levels only as a transitory stage they should not be deterred by temporarily increased product returns when passing through the middle zone of the interactivity range as they can finally achieve sharp reduction in product returns when achieving upper levels of interactivity. Thus, retailers should offer simple tools like videos or advanced PPTs as product configurators, which particularly exhibit a favorable mix of characteristics levels.

Second, the results of Paper 1 and Paper 2 offer retailers guidelines for controlling the desirable and undesirable effects via influencing mediating mechanisms (cognitive effort and enjoyment) between PPT characteristics and behavioral outcomes. Therefore, it is imperative for technology designers and e-commerce managers to understand that these mechanisms determine whether the desirable or undesirable effects of such tools prevail. Retailers should therefore ensure that the level of enjoyment created through PPT characteristics is sufficient to counteract the (increased) cognitive effort required in order to promote desirable behavior.

Third, targeting is key in successfully implementing presentation tools. Paper 1 and Paper 2 show that e-commerce managers should offer tools for different purposes, rather than a universal, feature-rich tool. For example, customers with high need for touch and high advice seeking should be offered highly vivid PPTs (e.g., videos) to promote desirable effects. However, highly interactive tools (e.g., fit advisors) should only be offered to customers with low need for touch and high advice seeking behavior, in order to support the bright-side outcomes. Paper 2 complements the results of Paper 1 in emphasizing that not only high advice seekers should be the target for highly interactive tools in order to trigger desirable effects. Also customers with low tool experience should be addressed through highly

interactive PPTs as novice tool users can easily be excited through interactive features while this is more difficult for expert users.

Finally, retailers should not only consider customer-related aspects for a successful implementation. They also have controllable and easy-to-implement online shop characteristics to leverage the effects of PPTs. Paper 3 provides empirical evidence that the webrooming dilemma can be compensated if offering PPTs is combined with the provision of product reviews that convey authentic information from other customers and allow tool users to cross-validate the information provided by PPTs. This very effective online shop characteristic can be used by retailers without much financial and time effort.

Overall, the results of the dissertation provide technology designers and e-commerce managers with precise guidelines for an effective design and successful implementation of presentation tools, taking into account retailers' target groups and contextual factors. As a result, the findings of all three papers highlight that the question of "*whether*" the implementation of PPTs is advisable cannot be unambiguously answered. The decision for the implementation depends on "*how*" the mediating mechanisms operate in triggering desirable and undesirable behavior and "*when*" presentation tools fully unfold their desirable impact without exhibiting undesirable side effects. Consequently, if vivid and interactive PPTs are designed properly, nowadays the online channel clearly represent a "substitute for traditional transaction channels" (Peterson, Balasubramanian, and Bronnenberg 1997).

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7 Appendix

Table 22: Measurement Items for Key Constructs (Paper 1)

Construct	Item loadings Study 1	Study 2
Vividness (adapted from Choi and Taylor 2014; Jiang and Benbasat 2007) [a]		
The product presentation …		
… is lively in terms of a realistic illustration.	.815	.823
… helps me to image how the garment fits me (the laptop works).	.783	.787
… is visually appealing.	.772	.784
… encourages my imagination about how the garment (laptop) looks in reality.	.759	.699
Interactivity (adapted from Jiang and Benbasat 2007; Novak, Hoffman, and Yung 2000)		
The tool …		
… is interactive.	.847	.878
… transfers a lot of information based on my actions (e.g., clicks or scrolls).	.847	.878
Cognitive effort (adapted from Franke and Schreier 2010; Haumann et al. 2015)		
Using the tool …		
… is very demanding for me.	.795	.897
… is very time-consuming for me.	.795	.897
Enjoyment (adapted from Childers et al. 2001)		
Using the tool is …		
… inspiring.	.915	.912
… interesting.	.880	.874
… enjoyable.	.901	.905
Purchase intention (adapted from Herhausen et al. 2015) [a]		
How likely is it that …		
… you would purchase the garment (laptop)?	.832	.869
… you could gather more information through which you would decide to purchase?	.800	.849
… you would have a great willingness to purchase the garment (laptop)?	.887	.889
Product return likelihood (based on Janakiraman and Ordóñez 2012; Maity and Arnold 2013) [a]		
In case you had ordered the garment (laptop), how likely is it that …		
… you would return it?	.884	.905
… you would not keep it?	.902	.908
… you have not made the right choice?	.846	.860
Need for touch (based on Peck and Childer 2003a; b)		
I feel more comfortable when purchasing a product, if I have actually touched it.	.946	.945
I feel safer when purchasing a product, if I have touched it.	.942	.954
I have more confidence in the quality of a product that I can touch before purchasing.	.895	.934
Advice seeking (based on Reinecke Flynn, Goldsmith, and Eastman 1996)		
I often read other online product reviews because …		
… I´m looking for advice and support from other users of the product.	.939	.914
… I can form an authentic opinion about the experiences of others with a certain product.	.939	.914
Ease of use (adapted from Davis 1989)		
The tool …		
… is easy for me to learn.	.960	.956
… is easy to use.	.960	.956

Notes: [a] Brackets indicate measures used in Study 2. Purchase intention and product return likelihood were measured on seven-point scales anchored by 1 = "very unlikely" and 7 = "very likely." All other constructs were measured on seven-point scales anchored by 1 = "strongly disagree" and 7 = "strongly agree".

Table 23: Measurement Items for Key Constructs (Paper 2)

Construct	Item loadings
Interactivity (adapted from Jiang and Benbasat 2007; Novak, Hoffman, and Yung 2000)	
The tool …	
… provides additional information while performing certain activities (e.g., clicks or scrolls).	.843
… offers the possibility of performing intended activities (e.g., clicks or scrolls).	.843
Cognitive effort (adapted from Franke and Schreier 2010; Haumann et al. 2015)	
Using the tool …	
… is very exhausting for me.	.857
… is very demanding for me.	.775
… is very complex for me.	.881
… is very time-consuming for me.	.602
… is very risky for me (could lead to wrong decisions, for example, that the garment does not fit).	.908
… could lead to mispurchases of garments.	.905
Enjoyment (adapted from Childers et al. 2001)	
Using the tool is …	
… interesting.	.925
… inspiring.	.925
Product return likelihood (based on Janakiraman and Ordóñez 2012; Maity and Arnold 2013)	
In case you had ordered the garment, how likely is it that …	
… you would return the garment?	.890
… you would not keep the garment?	.881
… you have not made the right choice with the garment?	.828
… you would return all of the ordered variants of the garment (e.g., sizes, colors)?	.790
Advice seeking (adopted from Reinecke Flynn, Goldsmith, and Eastman 1996)	
I often read online product reviews of others because …	
… I expect information about a certain garment.	.935
… I can form an authentic opinion about the experiences of others with a certain garment.	.935
Tool experience (based on Giebelhausen et al. 2014)	
How often do you use different tools when purchasing online?	-
Ease of use (adapted from Davis 1989)	
The tool …	
… is easy for me to learn.	.962
… is easy to use.	.962

Notes: Product return likelihood were measured on seven-point scales anchored by 1 = "very unlikely" and 7 = "very likely." All other constructs were measured on seven-point scales anchored by 1 = "strongly disagree" and 7 = "strongly agree."

Table 24: Measurement Items for Key Constructs (Paper 3)

Construct	Item loadings Study 1	Study 2
Vividness (adapted from Choi and Taylor 2014; Jiang and Benbasat 2007)		
The product presentation …		
… is lively in terms of a realistic illustration.	.697	.805
… helps me to imagine how the [product] might look in reality.	.755	.757
… imparts appealing information about the [product] and its attributes (e.g., design and material).	.691	.822
Interactivity (adapted from Jiang and Benbasat 2007; Novak, Hoffman, and Yung 2000)		
The tool …		
… provides additional information while performing certain activities (e.g., clicks or scrolls).	.651	.604
… reacts very fast to my activities (e.g., clicks or scrolls).	.779	.656
… offers the possibility of performing intended activities (e.g., clicks or scrolls).	.805	.713
Online purchase intention (adapted from Herhausen et al. 2015)		
How likely is it that …		
… you will buy the [product] in the [online shop]?	.877	-
… you will have a higher intention of buying the [product] in the [online shop]?	.851	-
… you have gathered enough information for making a decision to buy the [product] in the [online shop]?	.832	-
Offline purchase intention (adopted from Herhausen et al. 2015)		
How likely is it that …		
… you would go to a stationary store to buy the [product] there?	.892	-
… you won‘t have gathered enough information about the [product] and therefore enter a stationary store for buying the [product] there?	.731	-
… you would go to a stationary store to buy the [product] you tested with the tool?	.889	-
Online purchase behavior (adapted from Gupta, Su, and Walter 2004; Kleinlercher et al. 2018)		
When buying the [product] in the last six months since October 2017 …		
… I often bought at the [online shop] instead of at a stationary store.	-	.966
… I often chose the [online shop] instead of a stationary store.	-	.966
… I found it much easier to make a purchase at the [online shop] than at a stationary store.	-	.920
Offline purchase behavior (adapted from Gupta, Su, and Walter 2004; Kleinlercher et al. 2018)		
When buying the [product] in the last six months since October 2017 …		
… I often decided to shop in a stationary store instead of the [online shop].	-	.954
… I often chose a stationary store instead of the [online shop].	-	.960
… I found it much easier to make to shop at a stationary store than at the [online shop].	-	.905
Product review usefulness (based on Filieri 2015)		
When buying the [product] at the [online shop] in the last six months since October 2017 product reviews were really helpful …		
… to familiarize myself with the attributes of the [product].	-	.956
… to understand the products attributes (e.g., material and size) and evaluate the product performance.	-	.961
… for my purchase decision-making.	-	.941
Need for touch (based on Peck and Childers 2003a; b)		
I feel more comfortable when purchasing a [product], if I have actually touched it.	.937	.960
I feel safer when purchasing a [product], if I have touched it.	.917	.961
I have more confidence in the quality of a [product] that I can touch before purchasing.	.901	.938

Advice seeking (adopted from Reinecke Flynn, Goldsmith, and Eastman 1996)		
I often read online product reviews of others because …		
… I´m looking for advice and support from other users of a certain [product].	.886	.930
… I expect information about a certain [product].	.906	.916
… I can form an authentic opinion about the experiences of others with a certain [product].	.890	.917
Ease of use (adapted from Davis 1989)		
The tool …		
… is easy for me to learn.	.959	.971
… is easy to use.	.959	.971

Notes: The focal product was a laptop or a couch (Study 1) and a laptop or a casual pullover (Study 2). In Study 1 online and offline purchase intention were measured on seven-point scales anchored by 1 = "very unlikely" and 7 = "very likely." All other constructs were measured on seven-point scales anchored by 1 = "strongly disagree" and 7 = "strongly agree". Product reviews was measured using a dummy variable (1 = product reviews displayed on focal product page; 0 = otherwise). The dummy variable (Study 1) was replaced by product review usefulness in Study 2. Online and offline purchase intention (Study 1) was replaced by online and offline purchase behavior in Study 2.