Edinburgh Research Explorer

Differential Effects of Device Modalities and Exposure to Online Reviews on Online Purchasing: A Field Study

Routledge
Taylor & Francis Group

Differential Effects of Device Modalities and Exposure to Online Reviews on Online Purchasing: A Field Study

Larry Olanrewaju Orimoloye, Angeline Close Scheinbaum ⓘMonika Kukar-Kinney, Tiejun Ma, Ming-Chien Sung and Johnnie Johnson

ABSTRACT

We model the effect of online information search across mobile (smartphone and tablet) and nonmobile (personal computer [PC], both desktop and laptop) platforms on frequency of purchasing per online shopping session. Using clickstream data from a multinational retailer, we find that device modality drives purchase frequency, likely due to the differential ease of use of PCs, tablets, and smartphones. In particular, frequency of completed orders is highest when information search and purchase completion are highly convenient, such as when shopping via tablet. We also determine that information search in the form of reading online product reviews has no effect on mobile platforms, while it does on other platforms. These findings contribute to information search theory, suggesting that information search increases purchase likelihood when it is goal directed, extensive, and easy to conduct. Thus, the broad role of digital advertising should be to make the information search process easier and more convenient for consumers to stimulate purchases. These findings help digital advertisers understand information search patterns across device modalities. Implications for digital advertisers on electronic commerce (e-commerce) platforms are offered.

The advertising literature has a demonstrated interest in digital and mobile advertising (e.g., Ahrens and Coyle 2011; De Keyzer, Dens, and De Pelsmacker 2022; Huang et al. 2021; Lu and Du 2020; Maslowska, Malthouse, and Bernritter 2017; Okazaki, Katsukura, and Nishiyama 2007; Okazaki, Li, and Hirose 2009). This interest is in part driven by relevance to the ever-evolving electronic commerce (e-commerce) industry. Understanding mobile media and mobile consumer behavior is paramount for digital advertisers (Ford 2017), especially advertisers on e-commerce platforms. In fact, the world's biggest advertiser is the electronic retailer Amazon.com—where consumers shop from their phones, tablets, and/or personal computers (PCs). U.S. consumers alone were forecast an e-commerce spend of $933.30 billion in 2021, an increase of almost 18% from the previous year (Davidkhanian 2021).

At the same time, advertisers are projected to invest more than $167 billion on mobile advertising in the United States by 2024, a vast increase from $87.3 billion in 2019 (Perrin 2020). According to the executive vice-president of measurement and impact at NBCUniversal, advertisers are putting a new priority on cross-platform measurement because consumers are sharing their time across a wider range of screen

CONTACT Angelina Close Scheinbaum ✉ aschein@clemson.edu 🖳 Wilbur O. and Ann Powers College of Business, Clemson University, Clemson, SC 29634, USA.

types (Williams 2021). Hence, advertisers could benefit from understanding more about which screens consumers use for shopping—specifically, for conducting information search as well as for purchasing. Advertisers should find it especially valuable to understand the role that device modality (such as a smartphone, tablet, or PC) may play in consumer search and purchase frequency. Thus, device modality and consumer product information search (by way of reading product reviews) are two key concepts that call for deeper investigation.

Knowledge of consumer behavior across device modalities can help inform advertising spending share, which for 2022 is projected to be 14.2% on PC advertising and 47.9% on mobile advertising (eMarketer 2018). Knowledge of online search behavior can inform specific placement of ads across devices. Thus, there is practical reason to study shopping device types as well as exposure to online product reviews, as this information can help inform digital/mobile media placements.

This industry relevance opens a need for advertising scholarship on purchase behavior across device modalities in e-commerce and more specifically in mobile commerce (m-commerce). The term *m-commerce* refers to online shopping from mobile devices, such as smartphones and tablets. When consumers on from a PC, they presumably stay in a given location; yet consumers shopping on a mobile device tend to move about to a higher degree and often use smaller screen sizes (de Haan et al. 2018). Consumers now prefer mobile over stationary devices for online shopping (de Haan et al. 2018; Xu et al. 2017). Yet preference for shopping via mobile devices does not necessarily translate into more buying; research also suggests that customer click-through behavior in paid search advertising varies for different devices (Lu and Du 2020). Such past work shows the importance of understanding the effect of mobile device use as well as aspects of online search behavior, which includes clicking on product reviews during the online shopping process.

Consumer online search behavior (Taneja 2020) is relevant for both advertisers and advertising scholarship. An area of keen interest to digital advertisers is sponsored search advertising and understanding consumers' shopping goals (Huang et al. 2021). Advertising scholarship has made many advances in online and digital-related topics, and advertisers still need to understand many more aspects in this space (Liu-Thompkins 2019).

Yet despite its economic and theoretical importance, few studies examine the relationship between device modality, information search (including exposure to online product reviews), and buying (Kannan

and Li 2017). Scholarship employing e-commerce clickstream data that focuses on mobile technology for shopping is a ripe area for advertising scholarship and digital advertisers alike (Bernritter, Okazaki, and West 2021). Utilizing clickstream data across device types enables advertisers to gather information to personalize their communications and increase advertising effectiveness (Liu-Thompkins 2019). Such is similar to benefits for advertising gained by capturing information from registered customers on websites (Ahrens and Coyle 2011). Clickstream data can also advance knowledge on online information search theory, adding insights into how consumers search for information online (Browne, Pitts, and Wetherbe 2007).

Hence, our objective is to use clickstream data to explain and predict individual and joint effects of (1) consumers' online browsing across device modalities (PC, smartphone, and tablet) and (2) consumers' information search behavior—more specifically, exposure to online product reviews—on the frequency of orders completed per shopping session. We suggest and find that information search behavior increases purchase frequency, especially when it is easy and convenient. This effect is driven both by device modality and by clicking on product reviews. We also develop knowledge on the moderating role of device modality as it interacts with information search in the form of online shoppers' clicking on online product reviews. The theoretical contribution is to add behavioral insights to online information search theory. We are not testing online information search theory per se but use it as a guiding lens to inform inclusion of these two search-related aspects (i.e., device modality and reading product reviews) in the proposed model. We also aim to make a contribution to advertising practitioners. In doing so, we intend to bring industry and academic research more closely together and to supply industry-relevant insights. We also contribute by moving away from behavioral intentions and documenting actual online consumer behaviors.

Next, we supply a synopsis of the relevant literature. An overview of the empirical context follows. The subsequent section entails a description of the model used, followed by results and a discussion. We conclude with implications for information search theory and digital advertisers, along with limitations and future research areas that are relevant for advertising scholarship.

Literature Review and Theory

Here, we synthesize literature on device modalities. Then, we discuss the role of device modalities in

e-commerce and develop expectations for the effect of device modality on purchase frequency. Next, we review complementary studies in digital advertising and online reviews and link them with information search behavior research. This allows us to develop expectations for the main effect of reading product reviews. Finally, based on the synthesized literature streams, we develop rationale for the moderating role of device modality on the effect of product reviews.

Advertising, E-Commerce, and Device Modality

Broadly, advertising research in digital advertising and online consumer behavior includes the importance of distinct types of devices or cross-platform analyses. Namely, Lu and Du (2020) used data from Google's advertising platform AdWords to examine consumers' clickstream behavior after exposure to search ads. They considered whether the customer was shopping from a PC, smartphone, or tablet to see how that could impact clicking on the top search ad (Lu and Du 2020). Based on click-through behaviors on paid search advertisements, they found consumers are sensitive to position changes of the online ad (Lu and Du 2020). They also found that consumers prefer paid search advertisements that are on the top of the page (Lu and Du 2020). Similarly, Huang et al. (2021) studied online click-through behavior on a popular e-tail site in China; they found that click-through rates and conversion rates decrease when the advertising position is lower. They further found that there is a moderating effect of the type of product that the consumer searches for online; specifically, experience (versus search) products have a reduced effect of advertising position on consumer's click-through and purchase rates (Huang et al. 2021).

Complementary to advertising scholarship that has examined intention to click on digital ads (e.g., De Keyzer, Dens, and De Pelsmacker 2022), we examine click-through purchase behavior from various device modalities. Most scholarship examining purchasing using mobile devices examines one modality used in isolation (e.g., Andrews et al. 2016; Li et al. 2017; Luo et al. 2014). Two articles that focus on clickstream purchase behaviors across different device modalities are by Xu et al. (2017) and de Haan et al. (2018). First, Xu et al. (2017) examined the complementary and substitution impacts of the tablet on the smartphone and PC. They used a data set from the e-tailer Alibaba and found that adoption of tablets enhanced Alibaba's e-commerce growth. Their study examined cross-device browsing, defined in this case as when consumers browse on two different devices during a one-hour time window (Xu et al. 2017). Similarly, de Haan et al. (2018) analyzed browsing patterns across PCs, smartphones, and tablets. They analyzed device switching using e-tail clickstream data. They found that the increased adoption of mobile devices significantly affects online shopping behavior and that customers at times switch between mobile and fixed devices when shopping online. They also found that when customers switch from a mobile device to a stationary device, their conversion rate from browsing to buying is significantly higher (de Haan et al. 2018).

Device modality is linked with the process of online information search. Online information search theory is a theory from management information systems (MIS) offered by Browne, Pitts, and Wetherbe (2007) that explains and predicts consumers' online information search and notes that consumers start and end online searches depending on the type of task. While a shopping task can be entertainment related, it is often goal (purchase and/or information search) driven. Device modality can be seen as an indicator of ease and convenience of online product/information search. Mobile devices such as smartphones may be more convenient for browsing, as they can be used almost anywhere due to their small size (de Haan et al. 2018). However, they are also used for shorter shopping sessions, while stationary devices are more convenient for purchase completion (de Haan et al. 2018).

The focus of the present research is on purchase completion and exposure to product reviews on various device types, rather than browsing behavior. As such, based on the literature and the assumption that it is easier to conduct an extensive search for information as well as to complete purchases on a larger, more stationary device, such as a PC or tablet (versus smartphone), we expect that both tablets (per Xu et al. 2017) and PCs (per de Haan et al. 2018) should be more effective in increasing purchase frequency than smartphones. However, the question of which type of device—PC or tablet—is more effective is still open, and we hope to also shed light on this relationship.

Reading Product Reviews and Device Modality

While our work builds on the contrasting findings about device modality from Xu et al. (2017) and de Haan et al. (2018), there is complementary advertising scholarship in the areas of mobile advertising and online reviews (e.g., Andrews et al. 2016; Bart,

Stephen, and Sarvary 2014; Ford 2017; Grewal and Stephen 2019; Luo et al. 2014; Okazaki, Katsukura, and Nishiyama 2007; Okazaki, Li, and Hirose 2009). Research shows that product reviews positively affect purchase probability (Allard, Dunn, and White 2020). Purchase probability is also influenced by product review features, with some reviews being less believable (Maslowska, Malthouse, and Bernritter 2017). However, mobile product reviews are different (Ransbotham, Lurie, and Liu 2019); specifically, reviews posted from a mobile device drive purchase intentions due to less perceived effort and enhanced credibility (Grewal and Stephen 2019). This literature is used to further inform the model and help interpret the findings for advertising practice.

Similar to device modality, consumer behavior in the form of reading online product reviews is also intricately linked with the process of online information search. Specifically, reading product reviews can serve as an indicator of an extensive and involved online information search (Kukar-Kinney et al. 2022). When consumers are conducting an extensive search, they may be more committed to a purchase and closer to making the purchase decision. Existing research shows that there is an effect of product reviews on online consumer purchase intentions and behavior (Liu et al. 2020; Maslowska, Malthouse, and Bernritter 2017) and that exposure to product reviews ultimately results in positive consumer responses (Allard, Dunn, and White 2020). We extend this reasoning to purchase behavior and suggest that reading product reviews will positively affect frequency of orders completed.

However, reading online product reviews and moving between different product review pages when using a mobile device, especially a small one such as a smartphone, can be cumbersome and time-consuming, and it may be less effective in helping the customer make the final purchase decision (Kukar-Kinney et al. 2022). As such, it is important to address the following research question:

> **RQ:** How does device modality interact with information search in terms of reading online product reviews to influence the frequency of purchasing?

Consumers use smartphones for convenience and shorter shopping sessions (de Haan et al. 2018) rather than for conducting extensive product research and information searches, including reading customer reviews. Consumer exposure to mobile advertising and user-generated content (such as consumer reviews) does not work the same way as it does for nonmobile online media (Grewal and Stephen 2019;

Melumad, Inman, and Pham 2019). While there is a growing literature on product reviews in advertising (e.g., Allard, Dunn, and White 2020; Maslowska, Malthouse, and Bernritter 2017; Ransbotham, Lurie, and Liu 2019), there is little other evidence for the effect of product reviews on frequency of orders completed for different devices using behavioral data.

Based on the information search literature pertaining to online product reviews (Allard, Dunn, and White 2020; Liu et al. 2020; Maslowska, Malthouse, and Bernritter 2017) and works on device modality (de Haan et al. 2018; Xu et al. 2017), we anticipate that information search in the form of reading online product reviews, which represents goal-directed and involved search behavior, will be most effective in stimulating a higher frequency of purchase completion when conducted on a stationary device with the largest screen size (i.e., on a PC) in comparison with mobile devices. Such devices are also more fitting for longer, more involved. and more complex shopping sessions. Tablets should follow next, while searching through online product reviews should be least effective in stimulating purchase completion when conducted on smartphones.

Table 1 synthesizes the relevant literature on e-commerce/mobile consumer behavior and device modalities that employs field study data. Each of these articles considers mobile consumer behavior as relevant to online shopping, and many consider either multiple types of devices and/or consumer reviews. These articles are featured because they rely on field data and have a focal area or dependent variable that is relevant to advertisers or e-tailers.

Methods

Data

We use individual-level clickstream data (see Kukar-Kinney et al. 2022) to develop a model to explain consumers' search and buying behavior across device modalities. The data are from a large European (British) multipurpose retailer with home products, sportswear/clothing, and footwear with a large multinational presence (more than 500 stores worldwide). We use observations from customers who engaged in two or more sessions during the observed time period. A session is one continuous period where customers are active on the site that begins when they enter the site and ends either when they leave the site or after being inactive for at least 30 minutes.

The data have unique device identifiers that allow us to track and link a consumer identifier to the

Table 1. Synthesis of relevant studies with field data in e-commerce/m-commerce.

Source	Focal Area or Dependent Variable	Considers Device Types	Considers Consumer Reviews	Key Findings
Ghose, Goldfarb, and Han (2013)	Click behavior	Yes	No	Clicks based on brand posts can differ by two device types (mobile versus PC).
Andrews et al. (2016)	Mobile ads	No	No	Consumers in more-crowded trains are approximately twice as likely to make a purchase from a mobile offer (versus those in less-crowded trains).
Li et al. (2017)	Mobile promotion	No	No	Mobile promotion effectiveness is better (and faster) in sunny weather compared to cloudy weather and is lower (and slower) when it rains.
Marz, Schubach, and Schumann (2017)	Helpfulness, value	Yes	Yes	Differences in real online reviews written on mobile versus nonmobile devices can determine how helpful or valuable they are to customers.
Xu et al. (2017)	Tablets and e-commerce sales	Yes	No	Tablets are substitutes for computers but complements to smartphones. Tablets bring more impulse product sales and a bigger variety of types of products bought. Cross-device browsing enhances sales.
de Haan et al. (2018)	Device switching	Yes	No	When customers switch from a phone to a desktop, the sales conversion rate is higher. The effect is larger when there is more product category risk and higher prices.
Grewal and Stephen (2019)	Purchase intentions, review perceptions	Yes	Yes	Consumers knowing a review was done on a mobile device brings higher purchase intentions/may be perceived as more trustworthy.
Melumad, Inman, and Pham (2019)	Emotionality	Yes	Yes	Differences in mobile (versus nonmobile) user-generated content exist for content emotionality.
Ransbotham, Lurie, and Liu (2019)	Value	Yes	Yes	Mobile reviews are more affective, less extreme, and more concrete when written via mobile devices.
Kukar-Kinney et al. (2022)	Cart abandonment	Yes	Yes	Online cart abandonment is driven by uses and gratifications: cart use, items in the cart from a past session, seeing sold-out items, visiting clearance pages, removing items from the cart, seeing reviews, and seeing many products. A convenience motivation moderates purchase, economic control, organization, and research/information motivations on online cart use.
The current research	Frequency of orders completed	Yes	Yes	The effect of reading reviews on purchase frequency is the most positive on PCs, followed by tablets. Reading reviews on smartphones is not effective in stimulating purchase completion.

devices used on the site. We use data from registered customers because registration is necessary to place an order or complete a purchase. Registration is also important because in digital advertising, advertisers gather information based on registration on e-commerce sites in order to send customized communications (Ahrens and Coyle 2011). While the original data had more than 1 million shopping session observations, removing nonregistered customers and those who did not engage in two or more sessions during the time period leaves the final sample at 179,473 customers who engaged in 958,859 sessions in a two-week period in July and August 2018.

Addressing Endogeneity

Because there was no random assignment to the device modality (treatment), there could be self-selection bias across the device modalities. To address this, we use propensity score matching and make a control group. First, with binary logistic regression, we estimate each consumer's propensity to use a certain device modality to purchase. Second, for the matching process, each consumer in the treatment group is paired with a statistical twin from the control group who did not purchase using a particular device modality (but had the same propensity to use that device type). We match each treatment case to its nearest neighbor if two propensity scores fall within a tolerance zone. Limiting the scores to differ by no more than 0.001, we match 179,473 customers from the treatment customers. Third, we compute percentage reductions in bias for the matches (i.e., 91%), showing a reduction in self-selection biases. Fourth, we compute standardized differences in averages before and after matching. The matched sample is used in further analysis.

Variables

The variables are selected in line with the previous review of the literature in advertising and marketing and online information search theory. The dependent variable is frequency of purchasing during the session. The dependent variable brings novelty to existing work, which typically focuses on if whether sale was

made. The two independent variables are device modality and product reviews accessed. Device modality is also examined as a potential moderator. Thus, an interaction of device modality and product reviews is included in the model.

Control variables include time spent shopping (in seconds), number of pages seen, cart value, and dummy variables denoting a visit to the website before work, during lunch, after work, and during the evening. To control for any impact of user interfaces, device screen sizes are also included. Finally, we control for variation in geographical differences by using six dummy variables to account for continents where the consumer is browsing from, with Asia as the baseline (versus Africa, North America, South America, Europe, and Australia).

Empirical Models and Analyses

To model the frequency of orders completed and a random intercept to account for customer heterogeneity at the individual level, we compare three models: the Poisson regression model, the negative binomial regression model, and the zero-inflated negative binomial. We supply a Supplemental Online Appendix for a comparison of the three models introduced (as well as Markov chain Monte Carlo [MCMC] parameter estimates to enhance validity). We conducted analysis using R. Based on the smallest Bayesian information criterion (BIC) value and the Vuong test statistic, negative binomial regression (NB) is the preferred model. Hence, results presented next are based on the NB model (see the Supplemental Online Appendix).

Results and Discussion

Findings

The Effect of Device Modality on Frequency of Completed Orders

Device modality has a significant effect on the frequency of orders completed. Particularly, the coefficient of frequency of completed orders on smartphones is 0.226 lower ($p < .001$) than for those using PCs. However, for those on tablets, the estimate of the coefficient of the frequency of completed orders is significantly higher versus PCs by 0.101 ($p < .001$). Thus, purchase frequency is highest when consumers shop via tablets, followed by PCs, and lowest when shopping occurs via smartphones. Our finding showing the strength of tablets is consistent with Xu et al. (2017) in that both show tablets are the strongest device type for online sales. Our finding is also

consistent with complementary work on purchase intentions when using mobile devices. Studies by Bart, Stephen, and Sarvary (2014) as well as Grewal and Stephen (2019) find a positive impact of mobile devices on purchase intentions. Another study about mobile devices finds a positive role of mobile devices (Luo et al. 2014) on purchase of a promoted movie. Despite this, our finding contradicts the finding from de Haan et al. (2018), who found that PCs have a higher conversion rate than mobile devices. Other work examining mobile devices also found a negative impact of mobile devices: Ghose, Goldfarb, and Han (2013) found less clicks from a mobile device, and Marz, Schubach, and Schumann (2017) and Ransbotham, Lurie, and Liu (2019) found less perceived helpfulness from mobile reviews.

In support of our finding that there is a positive effect for e-commerce conversions when tablets are used, we find that e-cart value is also highest with tablets. The average total e-cart value of shoppers shopping via tablets (£33.00 or $40.71) is higher than of those shopping via PCs (£29.84 or $36.81) or smartphones (£24.24 or $29.90). Thus, we find that consumers have the highest-valued e-cart when shopping on tablets and lowest-valued e-cart when on smartphones.

Effect of Exposure to Product Reviews on Frequency of Orders Completed

A further result concerns the impact of information search in the form of clicking on product reviews on online purchase frequency. There is a positive main effect of exposure to product reviews on frequency of orders completed (0.002, $p < .001$) overall. This is consistent with our expectation and in line with both Maslowska, Malthouse, and Bernritter (2017) and Liu et al. (2020), who showed that product reviews impact online consumer purchase intentions and behavior. Our finding also extends work by Allard, Dunn, and White (2020), who found that exposure to product reviews ultimately results in positive consumer responses. As depicted in Figure 1, in addition to the significant main effect of product reviews, we also find a significant interaction effect of device modality and exposure to product reviews.

We expected that device modality will moderate the effect of searching product reviews on the frequency of orders completed, with information search of product reviews conducted on stationary devices leading to the largest positive effects. Our findings show that customers who are exposed to product reviews on PCs complete more orders than those using smartphones and tablets.
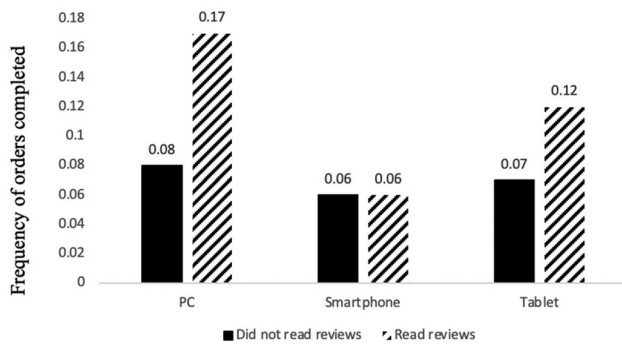
Figure 1. Moderating effects: Interaction between visiting product reviews and device modality on frequency of orders completed.

Further, the moderating effects via the interaction between visiting product review pages and device modality on frequency of orders completed show that for smartphone-based shopping, the frequency of orders completed is the same regardless of if consumers read reviews or not. Information search in the form of reading online product reviews has no effect on mobile (while it does so on other platforms). Thus, we supply evidence showing that viewing product reviews increases the frequency of completed online shopping orders, but primarily so for PCs.

Effects of Control Variables on Frequency of Orders Completed

The number of pages viewed has a positive relationship with frequency of purchase completion (0.051, $p < .001$). Also, shopping before typical work hours (0.044, $p < .001$) and during lunch hours (0.032, $p < .001$) has a positive relationship with purchase frequency, while shopping in the evening has a negative relationship (-0.051, $p < .001$). Time spent online searching for items (in seconds) is positively related with purchase frequency (0.0003, $p < .001$), while e-cart value is negatively related with it (-0.00004, $p < .01$). Finally, larger screen sizes have a significant positive effect, while smaller screen sizes have a negative or nonsignificant effect on purchase frequency (see the Supplemental Online Appendix).

Implications for Theory and Advertising Scholarship

While strengths of the work here are in the timely topic, behavioral nature of data, methodological rigor, and interest by advertisers who want to learn more about online consumer behavior, our contributions to theory are also useful to advertising scholars. Online information search theory (Browne, Pitts, and Wetherbe 2007) has been used more traditionally in

the MIS field than in advertising; however, the shift toward digital and mobile advertising has sparked a need to consider modern ways to explain or predict how characteristics of online information search can impact purchasing online. A contribution to online information search theory is that device modality drives purchase frequency, which is likely due to the differential ease of use and convenience of PCs, tablets, and smartphones when conducting extensive information search and completing purchases. An individual search tendency in the form of clicking on customer reviews further increases online purchases, but only when such behavior is easy to complete, such as on a PC. These findings contribute to information behavior research, suggesting that when information search is goal directed, extensive, and easy to conduct, it will increase purchase frequency in e-tail. As such, a broad role of digital advertising should be to make the information search process easier and more convenient for consumers to stimulate purchases.

In addition to theory, one area in advertising scholarship that this work extends is in online/consumer reviews. It has been established that the features of online reviews impact consumer probability to buy and that some reviews may seem too good to be true or untrustworthy (Maslowska, Malthouse, and Bernritter 2017). Similarly, our work adds to past findings that product reviews have a positive impact (Allard, Dunn, and White 2020) and that mobile product reviews are distinct (Ransbotham, Lurie, and Liu 2019). It also adds to the finding that reviews posted from a mobile device bring higher purchase intentions (Grewal and Stephen 2019) by examining the role of visiting product reviews on actual purchase behavior.

As a further contribution to advertising scholarship, this research also adds to existing literature relevant to mobile advertising. Within advertising, the work is again complementary to the growing body of research in mobile advertising (e.g., Andrews et al. 2016; Bart, Stephen, and Sarvary 2014; Ford 2017; Grewal and Stephen 2019; Luo et al. 2014; Okazaki, Katsukura, and Nishiyama 2007; Okazaki, Li, and Hirose 2009) by studying the effect of device modalities on purchase frequency and by using behavioral data. We next discuss specific actions that could be undertaken by digital advertisers to maximize online purchase frequency.

Implications for Digital Advertisers

Our work brings industry and academic research more closely together and supplies advertising-industry-relevant insights for advertisers who are keenly interested in

findings from clickstream data. These findings should lead to updated strategies with respect to advertisers' e-commerce and m-commerce media placements and integrated brand promotions in the areas of device modality and product review pages.

Device Modality

Our work confirmed a conversion gap, which is a discrepancy in browsing versus buying among device modalities. Advertisers can place more emphasis on tablets, as advertising to consumers who shop from tablets may be especially effective. This implication is based on our finding that the conversation rate is highest when consumers shop via tablets, followed by PCs and then smartphones, as well as the fact that the values of items in e-carts are highest for tablets. However, if the goal is to increase conversion rates of consumers shopping on PCs and smartphones, pushing other ads or promotions to those devices may be needed to stimulate their purchase completion.

Product Review Pages

Our findings further suggest that advertisers can encourage consumers to read product reviews, especially from stationary devices such as PCs. When taking device modality into account, considerable evidence suggests that viewing product reviews increases the frequency of orders purchased. However, when consumers read reviews from PCs, the effect is intensified for conversions. The finding that reading online product reviews has no effect on mobile (while it does on other platforms) is an unintended negative consequence of mobile technology to marketers who are interested in conversions from browsing to buying.

Limitations and Areas of Future Research

There are limitations that may set advertising scholars on a path for future research. First, we do not have data on how the e-commerce company incorporated digital advertising into their shopping platform. It would be helpful to add to our model any impact of exposure to a digital ad while shopping, and such an extension would supplement well with the advertising study by Lu and Du (2020), who analyzed clickstream behavior after exposure to search ads. Thus, we encourage advertising scholars to work with companies or ad agencies to obtain the data needed to model the extent to which exposure to digital ads while shopping impacts conversions on different devices. This opportunity is in line with a trend for

advertising research to become more quantitative in nature (Chang 2017).

A second limitation is that while we used data based on a multinational sample spanning hundreds of brands and several countries, the data do not include purchasing services online. Future research can replicate this work in the context of services or experiential goods, such as sports event tickets.

A third limitation is that we could not account for consumer trust perceptions of the reviews or other details about the product review pages. Hence, related topics for added scholarship in mobile research include examining the role of trust in digital advertising (Okazaki, Katsukura, and Nishiyama 2007) or perceived trust or believability of product reviews of varying valences (Maslowska, Malthouse, and Bernritter 2017; Grewal and Stephen 2019), as overly positive or overly negative reviews may not be very trustworthy. It would be further beneficial to examine any differential impact of reviews either written from or read from a mobile device (Ransbotham, Lurie, and Liu 2019; Grewal and Stephen 2019). Here, we are able to consider only what type of device consumers used to look at the reviews. It is not known what types of devices the reviews were written on; nor do we have the details of the review contents. We encourage scholars to combine the work done here with studies on how advertisers and e-commerce sites could communicate trust of the site, products, and consumer reviews.

A final area for future research, such as seen in Okazaki, Li, and Hirose (2009) via mobile advertising in Japan, can more deeply examine the country-based location impact of mobile e-commerce than what was controlled for in the current study. This factor is important, given that 61% of global advertising revenue is now forecast to be digital and 114 advertisers exceeded $1 billion for advertising investments worldwide in 2020 (Ad Age 2020). Overall, information search theory development that blends online consumer behavior and e-commerce research is an exciting and ripe area for continued advertising scholarship in digital and mobile contexts.

Acknowledgments

ORCID

Angeline Close Scheinbaum 🆔 http://orcid.org/0000-0003-4770-0277

References

Ad Age. 2020. "Global Advertising Forecast to Set a New Record in 2021: Five Key Takeaways from Ad Age Marketing Factpack 2021." December 21, 2020, https://adage.com/article/datacenter/global-advertising-forecast-set-new-record-2021/2302256.

Ahrens, Jan, and James R. Coyle. 2011. "A Content Analysis of Registration Processes on Websites: How Advertisers Gather Information to Customize Marketing Communications." *Journal of Interactive Advertising* 11 (2):12–26. doi:10.1080/15252019.2011.10722181

Allard, Thomas, Lea Dunn, and Katherine White. 2020. "Negative Reviews, Positive Impact: Consumer Empathetic Responding to Unfair Word of Mouth." *Journal of Marketing* 84 (4):86–108. doi:10.1177/0022242920924389

Andrews, Michelle, Xueming Luo, Zheng Fang, and Anindya Ghose. 2016. "Mobile Ad Effectiveness: Hyper-Contextual Targeting with Crowdedness." *Marketing Science* 35 (2):218–33. doi:10.1287/mksc.2015.0905

Bart, Yakov, Andrew T. Stephen, and Miklos Sarvary. 2014. "Which Products Are Best Suited to Mobile Advertising? A Field Study of Mobile Display Advertising Effects on Consumer Attitudes and Intentions." *Journal of Marketing Research* 51 (3):270–85. doi:10.1509/jmr.13.0503

Bernritter, Stefan, Shintaro Okazaki, and Douglas West. 2021. "Call for Papers: Mobile Technology and Advertising." *Journal of Advertising*.

Browne, Glenn, Mitzi Pitts, and James Wetherbe. 2007. "Cognitive Stopping Rules for Terminating Information Search in Online Tasks." *MIS Quarterly* 31 (1):89–104.

Chang, Chingching. 2017. "Methodological Issues in Advertising Research: Current Status, Shifts, and Trends." *Journal of Advertising* 46 (1):2–20. doi:10.1080/00913367.2016.1274924

Davidkhanian, Suzy. 2021. "US E-Commerce Forecast 2021." *Insider Intelligence*, July 2021, https://store.businessinsider.com/products/us-ecommerce-forecast-2021.

de Haan, Evert, P. K. Kannan, Peter Verhoef, and Thorsten Wiesel. 2018. "Device Switching in Online Purchasing: Examining the Strategic Contingencies." *Journal of Marketing* 82 (5):1–349. doi:10.1509/jm.17.0113

De Keyzer, Freya, Nathalie Dens, and Patrick De Pelsmacker. 2022. "How and When Personalized Advertising Leads to Brand Attitude, Click, and WOM Intention." *Journal of Advertising* 51 (1):39–56. doi:10.1080/00913367.2021.1888339

eMarketer. 2018. "Mobile Ad Spending to Surpass TV in 2018." April 19, 2018. https://www.emarketer.com/content/mobile-advertising-is-expected-to-surpass-tv-ad-Spending.

Ford, John B. 2017. "What Do We Know about Mobile Media and Marketing?" *Journal of Advertising Research* 57 (3):237–8. doi:10.2501/JAR-2017-032

Ghose, Anindya, Avi Goldfarb, and Sang Pil Han. 2013. "How Is the Mobile Internet Different? Search Costs and Local Activities." *Information Systems Research* 24 (3):613–31. doi:10.1287/isre.1120.0453

Grewal, Lauren, and Andrew T. Stephen. 2019. "In Mobile We Trust: The Effects of Mobile versus Nonmobile Reviews on Consumer Purchase Intentions." *Journal of Marketing Research* 56 (5):791–808. doi:10.1177/0022243719834514

Huang, Qing, Bingjia Shao, Xiaoling Li, Tao He, Juanyi (Sunny) Liu, and Xinjian Li. 2021. "The Challenge of a Prominent Position: Decomposing Shopping Goals in Sponsored Search Advertising." *Journal of Advertising*. doi:10.1080/00913367.2021.1961646

Kannan, P. K., and Hongshuang (Alice) Li. 2017. "Digital Marketing: A Framework, Review and Research Agenda." *International Journal of Research in Marketing* 34 (1):22–45. doi:10.1016/j.ijresmar.2016.11.006

Kukar-Kinney, Monika, Angeline Close Scheinbaum, Olanrewaju Orimoloye, Jeffrey Carlson, and Heping He. 2022. "A Model of Online Shopping Cart Abandonment: Evidence from e-Tail Click-Stream Data." *Journal of the Academy of Marketing Science*, in press. doi:10.1007/s11747-022-00857-8

Li, Chenxi, Xueming Luo, Cheng Zhang, and Xiaoyi Wang. 2017. "Sunny, Rainy, and Cloudy with a Chance of Mobile Promotion Effectiveness." *Marketing Science* 36 (5):762–79. doi:10.1287/mksc.2017.1044

Liu, Zhen, Shao-hui Lei, Yulang Guo, and Zhi-an Zhou. 2020. "The Interaction Effect of Online Review Language Style and Product Type on Consumers' Purchase Intentions." *Palgrave Communications* 6 (1):11. doi:10.1057/s41599-020-0387-6

Liu-Thompkins, Yuping. 2019. "A Decade of Online Advertising Research: What We Learned and What We Need to Know." *Journal of Advertising* 48 (1):1–13. doi:10.1080/00913367.2018.1556138

Lu, Chongyu, and Rex Yuxing Du. 2020. "Click-through Behavior across Devices in Paid Search Advertising." *Journal of Advertising Research* 60 (4):394–406. doi:10.2501/JAR-2020-004

Luo, Xueming, Michelle Andrews, Zheng Fang, and Chee Phang. 2014. "Mobile Targeting." *Management Science* 60 (7):1738–56. doi:10.1287/mnsc.2013.1836

Marz, Armin, Sebastian Schubach, and Jan H. Schumann. 2017. ""Why Would I Read a Mobile Review?" Device Compatibility Perceptions and Effects on Perceived Helpfulness." *Psychology & Marketing* 34 (2):119–37. doi:10.1002/mar.20979

Maslowska, Ewa, Edward C. Malthouse, and Stefan F. Bernritter. 2017. "Too Good to Be True: The Role of Online Reviews' Features in Probability to Buy." *International Journal of Advertising* 36 (1):142–63. doi:10.1080/02650487.2016.1195622

Melumad, Shiri, J. Jeffrey Inman, and Michel Tuan Pham. 2019. "Selectively Emotional: How Smartphone Use Changes User-Generated Content." *Journal of Marketing Research* 56 (2):259–75. doi:10.1177/0022243718815429

Okazaki, Shintaro, Akihiro Katsukura, and Mamoru Nishiyama. 2007. "How Mobile Advertising Works: The Role of Trust in Improving Attitudes and Recall." *Journal of Advertising Research* 47 (2):165–78. doi:10.2501/S0021849907070195

Okazaki, Shintaro, Hairong Li, and Morikazu Hirose. 2009. "A Study of Mobile Advertising in Japan." *Journal of Advertising* 38 (4):63–77. doi:10.2753/JOA0091-3367380405

Perrin, Nicole. 2020. "US Mobile Ad Spend in 2019 Was Lower than Previously Estimated." eMarketer, March 31. https://www.emarketer.com/content/us-mobile-ad-spend-in-2019-was-lower-than-previously-estimated.

Ransbotham, Sam, Nicholas H. Lurie, and Hongju Liu. 2019. "Creation and Consumption of Mobile Word of Mouth: How Are Mobile Reviews Different?" *Marketing Science* 38 (5):773–92. doi:10.1287/mksc.2018.1115

Taneja, Harsh. 2020. "The Myth of Targeting Small, but Loyal Niche Audiences: Double-Jeopardy Effects in Digital-Media Consumption." *Journal of Advertising Research* 60 (3):239–25. doi:10.2501/JAR-2019-037

Williams, Robert. 2021. "Cross-Platform Measurement Is Ready: NBC Universal's Kelly Abcarian." December 22, 2021. https://www.beet.tv/2021/12/cross-platform-measurement-is-ready-nbcuniversals-kelly-abcarian.html.

Xu, Kaiquan, Jason Chan, Anindya Ghose, and Sang Pil Han. 2017. "Battle of the Channels: The Impact of Tablets on Digital Commerce." *Management Science* 63 (5):1469–92. doi:10.1287/mnsc.2015.2406