Mobile app vs. desktop browser platforms: The relationships among customer engagement, experience, relationship quality and loyalty intention

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Abstract

The growing use of mobile technologies is spawning firms' adoption of mobile relationship-building techniques, including via mobile apps. However, despite the rapid rise of these technologies, little remains known regarding consumers' mobile app- (vs desktop browser) related behaviors, as, therefore, investigated in this paper. Specifically, we explore the effect of customer engagement (CE) and customer experience (CX) on customers' relationship quality/loyalty intention across mobile app (vs. desktop browser)-based interactions. Using structural equation modeling, we analyze data collected from 420 customers. The results reveal a stronger positive association between CE/CX and relationship quality/loyalty intention for mobile app- (vs. desktop browser)-based interactions, revealing the former's strategic importance. We conclude by discussing key implications that arise from our analyses.

Keywords: Consumer behavior; Customer engagement; Customer experience; Mobile apps; Desktop browser; Relationship quality.

Summary Statement of Contribution

This study analyzes customers' differential behavior across mobile app- (vs. desktop browser)-based brand interactions. While existing research has explored customer engagement (CE) and customer experience (CX) in mobile app-based settings, few studies compare CE and CX across mobile app- (vs. desktop browser) based interactions. Moreover, given the importance of mobile apps in e-commerce, our results suggest the importance of suitably engaging patrons, and to provide an exalted mobile app based CX.

1. Introduction

Mobile app-based marketing is rapidly gaining prominence (Stocchi et al., 2018; Viswanathan et al., 2017). As most consumers tend to carry their smartphone wherever they go. Mobile apps offer up-to-the minute information, (real-time) customer/firm interactions (e.g., purchasing), and a range of entertainment or educational activities (e.g., gamification; Picoto et al., 2019). Mobile apps offer convenient, portable touchpoints that can capitalize on user location through smartphone-based GPS systems (e.g., by offering deals to customers approaching the store). However, these features are less typical in desktop browser-based interactions (Shankar et al., 2016; Mclean et al., 2018). Desktop browser (vs. mobile app) display, navigation, and usage principles also differ (e.g., QR codes are more common in mobile apps; Newman et al., 2018). Hence, mobile app (vs. desktop browser) based interactions tend to affect (e.g., accelerate) consumer decision-making in a different way (e.g., through showrooming; Kaatz, 2020).

The said differences between mobile app and desktop browser-system propelled comparative research towards the impact of mobile app marketing with respect to desktop browser-based platform (Ström et al., 2014). In response to this call, few attempts were made to grasp the difference across the mobile and desktop browser-based marketing (e.g., Goldstein & Hajaj, 2022). For instances, 1) Sreejesh et al. (2021) examined the impact of critical contextual factors such as accessed platform (mobile devices and desktop-browser) on brand attitude; 2) Kaatz et al. (2019) studied differences between the desktop and smartphone devices concerning the success of distinct marketing channel strategies; 3) mobile and desktop users participation in electronic word-of-mouth was also assessed (Okazaki, 2009; and 4) recently, Goldstein and Hajaj (2022) compared mobile and desktop users' online search behavior by studying the users' stages (states) in the conversion funnel (i.e., research, decision, or purchase).

Despite such comparative examinations, gaps surround the dynamics characterizing the differences in the mobile app- (vs. desktop browser-based) relating to customer engagement (CE) and customer experience (CX) still exists. While researchers including Tuguinay et al. (2022) and Khan et al. (2019) have explored the association of CE and CX (i.e., a customer's sensations, feelings, cognitions, and behavioral responses; Brakus et al., 2009, p. 52) in internet settings, but lacks a comparative analysis. This reveals important research gaps and raises unresolved questions around these touchpoints' respective marketing effectiveness (Alalwan et al., 2020; Wang, 2020). Hence, the present study addresses the following research questions: 1) Do the consumer interface platforms (mobile app vs. desktop browser-based) determine different CE and CX? 2) How do CE and CX are effective in determining consumer behavior outcomes (relationship quality and loyalty) across the two platforms (mobile app vs. desktop browser)?

Addressing the above-mentioned research questions, this study empirically examines and compare CE and CX for mobile app (vs. desktop browser) -based platforms to yield further insight into their respective dynamics (Ho & Chung, 2020; Khan et al., 2016). The study also investigates the effect of CE/CX on customers' perceived relationship quality (e.g., Chan, 2018) and their loyalty intent to the brand (e.g., Zhang et al., 2019; McLean et al., 2020). This assessment offers novel insight into the relative effectiveness of these touchpoints, as called for by scholars (e.g., Choudrie et al., 2018; Fagerstrøm et al., 2020; Mohd-Ramly & Omar, 2017). The development of further understanding on this (comparison) issue is important. As a stronger (vs. weaker) association in this regard would signal mobile app's (or desktop browser's) extensive (vs. lesser) effect on the customer's experience-based journey (Lemon & Verhoef, 2016), which is – likewise – gaining traction in the literature (e.g., Bleier et al., 2019).

This paper has important contributions to the CE/CX- and mobile marketing literature. For instances, the study extends scholarly understanding of the effect of CE/CX on customers' perceived relationship quality across mobile app- (vs. desktop browser-based) platforms. Our empirical findings reveal a stronger positive association between CE/CX on the one hand, and relationship quality/loyalty intention on the other, for mobile apps. This reveals the former's particular strategic importance for businesses (McLean et al., 2020). That is, our analyses identify mobile app (vs. desktop browser) -based marketing's *particular* relational capability. Thus, making an enhanced contribution to the firm's relationship marketing objectives, which however remains nebulous to date (San-Martín et al., 2016; Choudrie et al., 2018). Broadly, our analyses also respond to the Marketing Science Institute's (2020, p. 5) call for further research on the *Customer-Technology Interface*, with a focus on better understanding users' *cross*-platform-based CE/CX.

The paper's remainder is structured as follows. We review key literature in the areas of mobile app- and desktop browser-based interactions, online CE, CX, relationship quality and loyalty intention in section 2. We then develop a conceptual model and an associated set of research hypotheses in section 3. In section 4, we discussed research methodology, followed by an outline of the findings in section 5. We conclude by discussing the study's key implications, limitations, and further research avenues in section 6.

2. Conceptual background

2.1 The social exchange theory, CE, and CX interface

Contemporary consumers are increasingly interacting with brands via digital channels, including mobile apps, virtual/augmented reality presentations, artificially intelligent applications, etc. (Ho & Chung, 2020; Hollebeek et al., 2021). The mobile apps may be used to help answer

consumer queries, offer product/service recommendations, play brand-related (e.g., educational) games, or record customer feedback, among others (Fritz et al., 2017). Given the *interactive* aspect inherent in consumers' mobile app usage, fostering interactively generated CE with the brand has been heralded as a key performance metric for these apps (e.g., Viswanathan et al., 2017). In turn, these apps also generate a particular CX, which marketers will also wish to optimize (McLean et al., 2018). Thus, while CE and CX are conceptually related, they each cover a distinct theoretical domain. CE represents the customers' resource investment in their mobile app-based interactions, and CX reflects the customer's (e.g., behavioral) response to these investments (Hollebeek et al., 2019; Lemon & Verhoef, 2016).

Blau's (1964) social exchange theory posits that an individual (e.g., customer) will continue investing (i.e., engaging) in interactions with a particular engagement object (e.g., a brand's mobile app; Viswanathan et al., 2017), if and as long as they feel they are attaining value from doing so. It also proposes that, in such cases, customers are predicted to reciprocate their perceived value back to the brand (e.g., by making repurchases from it, by recommending the brand to others; Steinhoff et al., 2019). Accordingly, the study put forth that by engaging with a brand's mobile app and by attaining a favorable user experience, customers are predicted to reciprocate to the brand (e.g., by displaying an elevated repurchase/loyalty intent to it; Pervan et al., 2009).

2.2 Customers' mobile app- (vs. desktop browser)-based interactions

Mobile apps are defined as, "software that is downloadable to a mobile device, which prominently displays a brand identity, often via the name of the app and the appearance of a brand logo or icon, throughout the customer experience" (Bellman et al., 2011, p.191). While mobile apps were originally developed for more utilitarian purposes (e.g., to access one's email/calendar,

the weather forecast; Hsiao et al., 2016), they have evolved to fulfil more hedonic or social purposes (e.g., gaming, social networking; Salehan & Negahban, 2013).

By drawing on a mobile device's hardware/software features, mobile apps (vs. desktop browsers) can offer a more personalized CX (Mclean et al., 2020; Ebrahim et al., 2016). In addition, as mobile apps (unlike desktop browser) can be accessed from anywhere, at any time, they are conducive to engaging consumers (Stocchi et al., 2018). The way consumers make (e.g., purchase) decisions also varies across desktop browser- and mobile app-based interfaces (Kumar et al., 2018). For example, mobile app-based touchscreens can offer a greater sense of ownership (vs. mouse-clicking on an item in the case of a desktop-based browser). Moreover, touch-based interfaces can see users' differing perceived importance of product attributes and may increase the number of alternatives searched (Brasel & Gips, 2014). Thus, while customers' more traditional desktop browser-based interactions remain important, a growing role of mobile app-based interactions is observed (Newman et al., 2018). This warrants further study in this area (Sung, 2021).

2.3 Online customer engagement

Though CE has developed into a prominent metric in the last decade (e.g., Kumar et al., 2019), debate surrounds its conceptualization (Kumar & Pansari, 2016). For example, while Brodie et al. (2011) define CE as "a psychological state that occurs by virtue of interactive, co-creative customer experiences with a focal agent/object (e.g., a brand) in …service relationships" (p. 260), Hollebeek et al. (2019) propose CE as a customer's motivationally driven operant (e.g., cognitive, emotional, and behavioral) and operand (e.g., equipment-based) resource investment in their brand interactions.

We discuss key areas of definitional overlap across CE conceptualizations below. First, most authors consider CE as an *interactive* concept that centers on customer dynamics during their brand interactions (Brodie et al., 2011). Here, *interaction* implies the existence of two-way or bilateral actions featuring actively contributing actors (Vargo & Lusch, 2016). Users may have utilitarian, hedonic, or social motives for participating in an interaction (Hsu & Lin, 2016). While utilitarian motives center on getting a job done (e.g., learning), hedonic motives reflect the user's desire for diversion, entertainment, or fun. Social motives, by contrast, center on a desire to connect with relevant others (Venkatesh et al., 2012).

Second, CE is typically viewed as a multidimensional concept that comprises cognitive, emotional, and behavioral tenets (Harrigan et al., 2018; Vivek et al., 2012). Following Hollebeek et al. (2014), cognitive CE reflects "a consumer's level of brand-related thought processing/elaboration in a… consumer/brand interaction" (p. 154). Emotional CE denotes a consumer's positive brand-related affect in an interaction, while behavioral CE is a consumer's level of "energy, effort and time spent on a brand interaction" (p. 154). Though some authors add social CE, which reflects the consumer's brand-related interactive investment vis-à-vis others (e.g., in conspicuous consumption), others limit CE to a purely behavioral perspective (i.e., *engagement behaviors*; Van Doorn et al. 2010). These latter authors assume that consumers' latent cognitive/emotional dynamics manifest through their brand-related behavioral engagement. We, however, adopt a multidimensional view of CE as a reflective second-order construct comprising cognitive CE (cognitive processing), emotional CE (affection), and behavioral CE (activation) (Harrigan et al., 2018).

Though CE may manifest online and/or offline, *online CE* represents a prolific CE research sub-stream. Owing to its interactive nature, CE fits well in online settings (e.g., Brodie et

al., 2013). In line with these developments, we center on online CE, with a particular focus on users' mobile app (vs. desktop browser)-based interactions. As a theoretical sub-set of online CE research, mobile CE transpires when customers interact with brands' mobile platforms (e.g., mobile apps) to meet their needs and/or create value (Kim et al., 2013; Viswanathan et al., 2017).

In addition to their portable, ubiquitous nature, mobile apps can be personalized to meet the consumer's unique needs. Thus, potentially stretching their engaged timespan (Bellman et al., 2011; Kim et al., 2013). Correspondingly, we adopt Hollebeek et al.'s (2014) CE conceptualization, which was designed for application in the online context. The authors define CE as "a consumer's positively-valenced brand-related cognitive, emotional and behavioral activity during or related to focal consumer/brand interactions" (p. 154), which we posit to have high applicability in the mobile app context (e.g., Wang, 2020). Mobile app-based CE is driven by personal (e.g., need-for-cognition), app-based (e.g., ease-of-use), interaction-related (e.g., hedonic/utilitarian), and situational factors (e.g., mood; Stocchi et al., 2018).

2.4 Online customer experience

CX has been defined as "the internal and subjective response that customers have to any direct or indirect contact with a company" (Meyer & Schwager 2007, p. 18). As per Homburg et al. (2015), CX is a person's affective, sensorial, cognitive, behavioral, and relational responses to a brand by being through a series of touchpoints along pre-purchase, purchase and post-purchase. Moreover, Lemon and Verhoef (2016, p. 71) define CX as "a multidimensional construct focusing on a customer's cognitive, emotional, behavioral, sensorial, and social responses to a firm's offerings during [his/her] entire purchase journey."

From these definitions, we make the following observations. First, CX covers the customer's complete purchase journey (e.g., Schmitt, 1999), thus extending beyond CE's *intra-*

interaction scope (Prentice et al., 2019). Second, CX has been modeled as a multidimensional concept comprising cognitive, emotional, behavioral, sensorial, and social tenets (e.g., Brakus et al., 2009). However, some authors highlight certain CX facets. For example, while Novak et al. (2000) focused on cognitive experience, Rose et al. (2012) highlighted the customer's emotional experience.

Third, the online CX is typified by dynamic, fast-moving, information-rich journey stages (Ciuchita et al., 2019; Novak et al., 2000). For example, Rose et al. (2012, p. 309) define online CX as a "psychological state manifested as a subjective response" to Internet-based platforms, including websites or mobile apps. As technological developments have produced smaller, more convenient devices (e.g., smartphone-based mobile apps; Newman et al., 2018), consumers' uptake of these is expected to be higher (vs. desktop browsers; Ciuchita et al., 2019; Shankar et al., 2016). In addition, bandwidth advances have facilitated mobile purchasing (Siwicki, 2014), and its real-time nature has the capacity to personalize the CX (McLean et al., 2018).

2.5 Relationship quality

Relationship quality reflects a customers' overall evaluation of their relationship with a brand (Palmatier et al., 2006; Steinhoff et al., 2019). While different conceptualizations exist (Baker et al., 1999), relationship quality is typically modeled as a higher-order construct comprising trust, satisfaction, and commitment (e.g., Itani et al., 2019; Palmatier et al., 2006). First, *trust* reflects a customer's "willingness to rely on an exchange partner in whom one has confidence" (Moorman et al., 1993, p. 82). Second, *satisfaction* reflects a customer's "overall evaluation of the performance of an offering" (Gustafsson et al., 2005, p. 210). Third, *commitment* reveals the customer's desire to uphold a relationship to warrant maximum efforts at maintaining it (Moorman et al., 1993; Morgan & Hunt 1994).

Existing research has addressed the effect of online customer/firm interactions on relationship quality (e.g., Steinhoff et al., 2019). In particular, the ubiquitous nature of mobile interactions has been linked to enhanced relationship quality (Chan, 2018), in turn favorably affecting consumers' brand-related judgments and behaviors (Kim et al., 2014), social commerce (continuance) intention (Liang et al., 2011), intent to co-create value (Tajvidi et al., 2021), and customer loyalty intent (Rafiq et al., 2013).

2.6 Loyalty intention

Customer loyalty has been defined as "a deeply held commitment to rebuy or repatronize a preferred product/service consistently in the future" (Oliver 1999, p. 34). Customer loyalty comprises including attitudinal and behavioral loyalty (Price & Arnould, 1999). Attitudinal loyalty reflects a customer's willingness to recommend a product/brand to their friends and family (Wong & Sohal, 2003). Behavioral loyalty reveals the extent to which the customer repurchases a product/brand (Sirdeshmukh et al., 2002).

Relatedly, customer loyalty intent signals a customer's resolve to stay committed to a brand (Srinivasan et al., 2002), which may transpire to varying degrees (Ajzen & Fishbein, 1973). Therefore, while loyalty intent comprises a strong attitudinal component, its behavioral facet can lag. Following Cyr et al. (2006) and Kumar et al. (2018), we denote a customer's platform loyalty intention as an individual's intent to re-use a brand's mobile app (vs. desktop browser system). We next develop our research model and hypotheses.

3. Research model and hypotheses

Literature groups consumer interface platforms mainly into two key categories: mobile application platforms and desktop-browser platforms (Goldstein & Hajaj, 2022). As depicted in the

introduction section, this study is an attempt to study CE and CX across the two platforms (mobile app vs. desktop browser). Both these platforms vary in terms of the interface, as mobile apps (unlike desktop browsers) can be accessed from anywhere, anytime, and they are highly conducive to engaging consumers and delivering personal experiences (Stocchi et al., 2018; Viswanathan et al., 2017). The way consumer makes decision also varies across the desktop browser-based platform and mobile apps (Kumar et al., 2018; Lemon & Verhof, 2016). Consequently, the study relates the CE and CX with their subsequent proposed outcomes (i.e., relationship quality and loyalty) and examined across the two platforms. See figure 1 for our proposed research model.

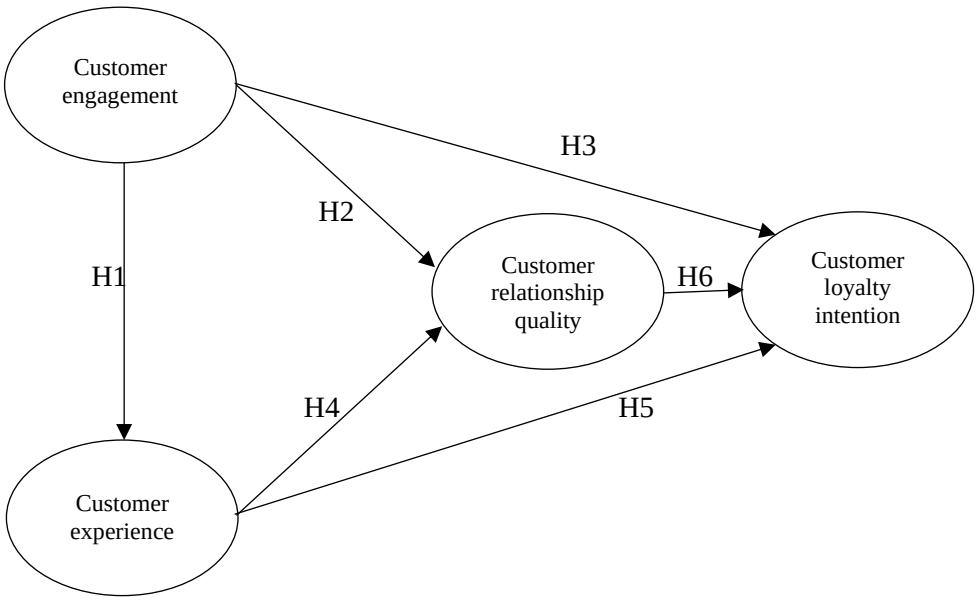


Figure 1. Conceptual model

Source: Authors' own elaboration.

3.1 Main effects

While existing authors have previously explored the CE/CX interface, their findings remain inconclusive. For example, while Khan et al. (2019) view CE as a CX antecedent, Zhang et al.

(2017) reverse this association (i.e., by viewing CE as a CX consequence). Based on our review, we take Khan et al.'s (2019) view based on the rationale that *intra*-interaction CE impacts *trans*-interaction CX in the mobile app- and desktop browser-based contexts (McLean et al., 2018; Hollebeek & Rather, 2019). Correspondingly, Nysveen and Pedersen (2014, p. 184) state: "To create positive brand experiences, [customers need to be] engaged." We, therefore, view CE as an important *prerequisite* to CX (Mollen & Wilson, 2010). Though the CE/CX interface has received prior empirical testing (e.g., Ahn & Back, 2018), little remains known regarding the dynamics typifying this association in the mobile app- (vs. desktop browser)-based contexts (Kim et al., 2013), as therefore explored in this paper. We theorize:

> H1. Customer engagement positively affects the customer experience in (a) mobile-app- and (b) desktop browser-based interactions.

Though the CE/relationship quality interface has been explored in prior conceptual research (e.g., Sashi, 2012; So et al., 2016), empirical validation of this relationship lags behind to date. For existing customers who have pre-established brand satisfaction levels (Van Doorn et al., 2010), trust (So et al., 2016), and commitment (Vivek et al., 2012), relationship quality appears as a CE antecedent (Brodie et al., 2011). However, CE can also act as a relationship quality antecedent (i.e., by improving relationship quality). For example, by interacting with a brand, customers' brand trust – one of relationship quality's constituent concepts – is likely to develop (So et al., 2016). Therefore, CE-based interactivity, as activated through mobile app- or desktop browser-based interactions (Demangeot & Broderick, 2016), supports the development of lasting relationships that espouse customer trust, satisfaction, and commitment (Brodie et al., 2011), thus raising customer-perceived value (Kim & Baek, 2018). We propose:

H2. Customer engagement positively affects relationship quality in (a) mobile app- and (b) desktop browser-based interactions.

Customers' loyalty intention is crucial to a company's long-term success (Thakur, 2016). While prior studies pinpoint CE's role in driving customer loyalty intent (Harrigan et al., 2018; Leckie et al., 2016), little remains known regarding these dynamics in the mobile app- (vs. desktop browser)-based context. We postulate:

H3. Customer engagement positively affects customer loyalty intention in (a) mobile app- and (b) desktop browser-based interactions.

CX offers an important basis for developing and strengthening customer/firm relationships (Evard & Aurier, 1996). Despite the existence of a preliminary understanding of CX's effect on relationship quality's components (i.e., trust, satisfaction, and commitment), empirically derived insight into this association remains sparse (Lemon & Verhoef, 2016). We propose that CX with mobile app- (vs. desktop browser)-based interactions may vary, given the former's (but not the latter's) ubiquitous nature (Wang et al., 2015). We hypothesize:

H4. Customer experience positively affects relationship quality in (a) mobile app-, and (b) desktop browser-based interactions.

CX represents an important driver of customer loyalty (Foroudi et al., 2016). Prior research highlights an effective CX to result in a heightened re-visit intention (Shobeiri et al., 2015) and greater mobile app usage frequency (McLean et al., 2018). We postulate:

H5. Customer experience positively affects customer loyalty intentions in (a) mobile app- and (b) desktop browser-based interactions.

As the cost of attracting new customers is substantially higher than that of keeping existing ones (Reichheld & Sasser, 1990), firms are advised to retain their customers. Strong customer relationships are conducive to developing customer loyalty, thereby in turn enhancing profitability and lifetime value (Rust et al., 2004). While the association of relationship quality and loyalty intent is discussed in prior literature (e.g., Henning-Thurau et al., 2002), insight into the dynamics characterizing this association in the mobile app- (vs. browser)-based context remains nebulous. Moreover, existing Internet-based research has also identified relationship variables (e.g., e-satisfaction/e-trust/e-commitment) to play a significant role in driving customer loyalty intent (Kassim & Asiah Abdullah, 2010). We propose:

H6. Relationship quality positively affects customer loyalty intentions in (a) mobile app- and (b) desktop browser-based interactions.

4. Methodology

4.1 Measures

We adapted measurement scales developed and validated in online environments for CE (Hollebeek et al., 2014), CX (Morgan-Thomas & Veloutsou, 2013; Luo, 2002), relationship quality (Liang et al, 2011; Tajvidi et al., 2021), and loyalty intention (Hausman & Siekpe, 2009), as shown in Table 1. We first conducted a pilot study to assess questionnaire clarity, readability, and comprehensibility (Malhotra et al., 2017). In the pilot study, we deployed a sample of 54 college students who were experienced users of both mobile app- and desktop browser-based interactions to verify the questionnaire's contents and psychometric properties. Few adjustments in the language of the survey questionnaire were made following the pilot survey. Five-point Likert-type scales (1= strongly disagree, to 5= strongly agree) were used to collect the responses.

4.2 Survey and sample

We considered products/services available for purchase on mobile app- and desktop browser-based platforms, including online banking, grocery/fashion shopping, hotel room/airline ticket bookings, and so on. Random intercept interviews were carried out on both weekends and weekdays during the morning and evening hours to reduce possible bias (Davis et al., 2019). Every potential respondent was approached by trained interviewers (e.g., high streets, shopping malls) so that they would have an equal chance to be included in the survey. The interviewers identified themselves and explained the aim of the study upon approaching the participants. Interviewers then interacted with the possible participant, and after completing the questionnaire they approached the next possible participant. Participants were requested to answer to a structured questionnaire.

Prior to the main survey, the respondents were screened to ensure they have previously used mobile app- *and* desktop browser-based platforms. The following screening questions were used: (i) "Have you used mobile apps to look for and/or purchase an item?" (ii) "Have you used desktop browser-based interactions to look for and/or purchase an item?" and (iii) "Please estimate the total number of days you have used mobile app/desktop browser-based platforms for shopping purposes." Only those who responded "yes" to the first two questions, and a minimum of 90 days to the third question, were invited to participate in the main survey (e.g., Khan et al., 2019). The respondents were assured thru questionnaire instructions regarding the respondents' anonymity. We also explained them that there were no right or wrong answers, they should answer as per their viewpoint. The main survey questionnaire had three sections. The first section detailed the purpose of the study and instructions for completing the survey. The second part includes questions related

to the construct employed in the study. Finally, the third section asked about the respondents' gender, age, among others.

Respondents were then requested to complete the questionnaire based on any mobile app they had used recently to look for products or to make a purchase. After a break, they were asked to answer the same survey questions pertaining to a desktop browser-based platform. We contacted 600 respondents to participate in the main survey. Out of 600 respondents, 438 agreed for participation and provided filled questionnaires. After that we screened questionnaires to get the valid (usable) responses for the analysis. During the screening process, we found that 18 questionnaires were incomplete having more than 10% missing data. Hence, these 18 questionnaires were dropped (as recommended by Hair et al., 2006), leaving with us 420 valid (usable) responses for further analysis. The sample comprised 52% male (48% female) respondents, and 40% were aged 18-30, followed by 34% being 31-42, and 26% being over 42 years of age.

5. Results

5.1 Data analysis

To analyze the data, we deployed a three-step data-analytical procedure using SPSS and AMOS software. First, confirmatory factor analysis was used to examine the internal consistency and discriminant validity of our constructs. Second, the hypotheses were tested by examining the structural equation models for our mobile app- (desktop browser-based) platforms, respectively.

Multi-group structural equation-based invariance models were tested for the mobile app- and desktop browser-based interaction samples to confirm the scale items were measuring similar cross-group traits. The invariance testing encompassed configural invariance, metric invariant model, and factor variance invariance tests (Steenkamp & Baumgartner, 1998).

5.2 Measure validation

Confirmatory factor analysis (CFA) was performed to examine model fit and scale items' internal consistency and discriminant validity (Gerbing & Anderson, 1988). The mobile app-based CFA results provided a reasonably good fit to the data: $\chi 2 = 345$, $df = 174$, $\chi 2/df = 1.985$, CFI = 0.97, IFI = 0.97, NFI = 0.94, GFI = 0.93, RMSEA = 0.048. Similarly, we attained the following results for desktop browser-based interactions: $\chi 2=506$, $df=174$, $\chi 2/df=2.91$, CFI=0.94, IFI=0.94, NFI=0.91, GFI=0.90, RMSEA=0.068.

Internal consistency was next tested by examining the factor loadings, Cronbach alpha, and composite reliability scores, as shown in Tables 1-2. Each factor loading was significant and exceeded the value of 0.60 (Bagozzi & Yi, 1988), indicating internal consistency. Moreover, for each construct, Cronbach alpha and composite reliability values exceeded the recommended 0.70 threshold (see Table 2). Discriminant validity was established, as the square root of the average variance extracted (AVE) exceeded the correlation between each construct pair, as shown in Table 2 (Fornell & Larcker, 1981). Overall, the results strongly support the proposed measurement model across the mobile app- and desktop browser-based interactions.

Table 1. Measurement items

Construct and Items	Factor loading
Customer engagement (CE)	
• Using X mobile application/desktop browser gets me to think about it.	.907/.*920*
• I think about X a lot when I'm using its mobile application/desktop browser.	.825/.*730*
• Using X mobile application/desktop browser stimulates my interest to learn more about it.	.769/.*707*
• I feel very positive when I use X mobile application/desktop browser.	.764/.*705*
• Using X mobile application/desktop browser makes me happy.	.926/.770
• I feel good when I use X mobile application/desktop browser.	.912/.*904*
• I'm proud to use X mobile application/desktop browser.	.897/.*860*
• I spend a lot of time using X mobile application/desktop browser, compared to the other mobile application/desktop browser.	.862/.*714*

• Whenever I'm using mobile application/desktop browser, I usually use X mobile application/desktop browser.	.834/*.875*
• X's mobile application/desktop browser is one of the mobile application/desktop browser I usually use when I use mobile application/desktop browser.	.870/*.883*
Customer experience (CX)	
• The layout of the X mobile application/desktop browser appeals to my senses.	.967/*.858*
• The X mobile application/desktop browser is easy to navigate.	.886/*.860*
• Results are always returned promptly when using the X mobile application/desktop browser.	.857/*.835*
• The information obtained from X mobile application/desktop browser is useful.	.690/*.855*
• I think results obtained from X mobile application/desktop browser are helpful.	.716/*.702*
Relationship quality	
• I feel a sense of belonging to this mobile application/desktop browser.	.895/*.813*
• I am satisfied with using this mobile application/desktop browser.	.835/.958
• This mobile application/desktop browser is a reliable mobile application/desktop browser.	.831/*.898*
Loyalty intention	
• I intend to use this mobile application/desktop browser in the future.	.951/*.847*
• I will buy goods/services using this mobile application/desktop browser in the future.	.836/*.931*
• I prefer this mobile application/desktop browser to others (with the same goods/products).	.774/*.820*

***Note*:** X represents a brand's mobile app/desktop browser-based interaction selected by respondents; non-Italic (italic) values are used to denote the mobile app- (desktop browser)-based interaction results.

Table 2. Measurement properties and correlations

Construct	Mean	SD	CR	CA	Correlations			
					CE	CX	RQ	LI
Mobile app data								
Customer engagement (CE)	3.21	1.04	0.96	0.80	*0.85*			
Customer experience (CX)	3.84	1.83	0.91	0.91	0.14	*0.82*		
Relationship quality (RQ)	3.57	1.73	0.89	0.89	0.11	0.13	*0.84*	
Loyalty intention (LI)	3.09	1.84	0.89	0.89	-0.03	0.08	0.05	*0.85*
Desktop browser data								
Customer engagement (CE)	3.21	0.99	0.95	0.75	*0.81*			
Customer experience (CX)	3.50	1.68	0.91	0.91	0.04	*0.82*		
Relationship quality (RQ)	2.92	1.78	0.92	0.92	0.17	-0.07	*0.89*	
Loyalty intention (LI)	2.74	1.80	0.90	0.89	0.23	-0.18	0.08	*0.86*

***Notes*:** SD= Standard deviation, CR= Composite reliability, and CA= Cronbach alpha. AVE (square root) values are shown diagonally in italics.

Due to the self-report nature of the questionnaire, we also tested for potential common method bias by using Harman's single-factor test, which uses exploratory factor analysis to ensure

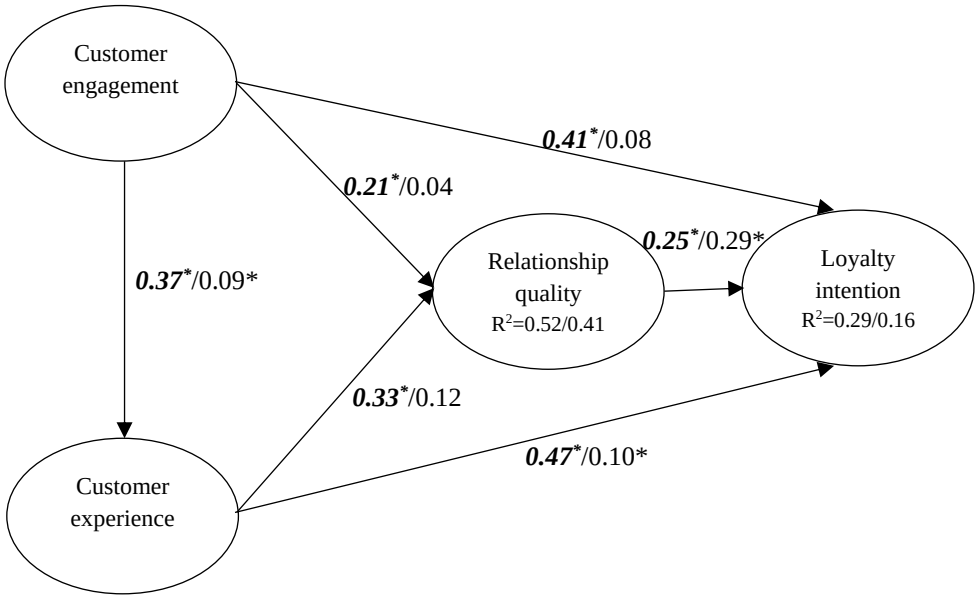
that no single factor accounts for the majority (i.e., over 50%) of the total observed variance (Podsakoff et al., 2003). The results suggested that the first factor accounted for 30.8% of the total variance, thus passing Harman's single-factor test. We further tested for common method bias by incorporating all the variables in a single-factor CFA model and comparing the fit to a multi-construct CFA model. The analyses indicated that the single (vs. multi)-factor model is unacceptable (Podsakoff et al., 2003). Hence overall, the results suggest that common method bias is not an issue in our data.

5.3 Structural model analysis

Results (path coefficients) of the structural equation model assessment for the mobile app- and desktop browser-based interactions are shown in Figure 2. Both mobile app- (χ2=366, *df*=180, χ2/*df*= 2.03, CFI=0.96, IFI=0.96, NFI=0.94, GFI=0.93, RMSEA=0.050) and desktop browser-based interaction (χ2=548, *df*=180, χ2/*df*=3.04, CFI=0.93, IFI=0.93, NFI=0.90, GFI=0.90, RMSEA=0.068) models offered good fit to the data. The study deployed χ^2-difference tests to ensure that path coefficient estimates across the mobile-app and desktop browser data are statistically greater or not. The differences were found significant in the χ^2 analysis.

CE was found to have a significant, positive effect on CX for mobile app- (β=0.37, p<0.05) and desktop browser-based interactions (β=0.02, p<0.05), supporting H1a-b. While CE exerted a significant effect on relationship quality in mobile app-based interactions (β=0.21, p<0.05), its association with relationship quality was non-significant for desktop browser-based interactions (β=0.04, p>0.05), leading to H2a's acceptance and H2b's rejection. Moreover, CE was only found to have a significant impact on customer loyalty intention for mobile app- (β=0.41, p=0.000), but not for desktop browser-based interactions (β=0.08, p>0.05), leading us to accept H3a but reject H3b.

We also identified a significant, positive effect of CX on relationship quality for mobile app-based interactions (β=0.33, p<0.05), but not for desktop browser-based interactions (β=0.08, p>0.05), leading to the acceptance of H4a but rejection of H4b. In addition, CX was found to exert a significant, positive effect on customer loyalty intention for both mobile app- (β=0.47, p=0.000) and desktop browser-based interactions (β=0.19, p=0.001), leading us to accept H5a-b. Moreover, relationship quality was found to significantly affect loyalty intention for mobile app- (β=0.25, p=0.000) and desktop browser-based interactions (β=0.29, p=0.000), consistent with H6a-b. For the mobile app and desktop browser data, the model explained 61% and 58% of the variance of CX, 52% and 41% of the variance for relationship quality, and 29% and 16% of the variance of loyalty intention, respectively.



***Note*:** First (second) set of numbers (italics/bold) denotes mobile app (desktop browser) results, respectively.

Figure 2. SEM results: Mobile app- and desktop browser-based interactions

6. Discussion

6.1 Theoretical implications

This study yields two main theoretical implications. First, our results offer novel insight into key consumer behavior-related dynamics across mobile app (vs. desktop browser)-based brand interactions. Though prior research has variously explored CE and CX in either the mobile app (e.g., McLean et al., 2018; Newman et al., 2018) or the desktop browser-based context (e.g., Morgan-Thomas & Veloutsou, 2013), few studies have compared customers' engagement and experience-based dynamics across these platform types, which each have unique features, as therefore examined in this research.

The reported empirical findings, indeed, corroborate the existence of consumer behavior-based differences across these platforms. Specifically, we identify a stronger positive association between CE/CX on the one hand, and relationship quality/loyalty intention on the other, for mobile app- (vs. desktop browser)-based interactions, revealing the pertinence of mobile app-based interactions. Based on this finding, we empirically confirm the potential of mobile app-based marketing interactions in contemporary firms' relationship marketing strategy (e.g., Hollebeek et al., 2019; Wongsansukcharoen et al., 2022). However, despite this preliminary finding, opportunities for further research abound (Choudrie et al., 2018; Stocchi et al., 2018). For example, what mobile app, communication, or other features optimize CE and CX, respectively, and how do these affect customer-perceived relationship quality and loyalty (intent)? How do marketers ensure consistently elevated CE and CX are attained across their different customer segments and across product/service categories?

Relatedly, unlike prior research, our findings suggest that CE does not significantly drive customer-perceived relationship quality or loyalty intent for desktop browser-based interactions. Consequently, for these platforms, CE appears to take a less strategic role (vs. in mobile app-based interactions). This finding makes intuitive sense, as consumers tend to carry their mobile app-containing smartphone with them most of the time, facilitating their ubiquitous engagement through this platform (KPMG, 2017). However, desktop browser-based interactions see lower levels of consumer-perceived convenience (e.g., by allowing lower personalization levels; Kumar et al., 2018; Shankar et al., 2016). Based on this finding, we recommend future scholars to further examine the strategic role and benefits of mobile app-based platforms and their most suitable contexts (vs. those for desktop browser-based interactions). For example, how might different (e.g., smartphone) screen sizes affect CE and CX? How consumers combine their mobile app-based interactions with physical (e.g., in-store) interactions? Thus, reflecting their potential *phygital* shopping/browsing dynamics (e.g., through (reverse) showrooming; Mele and Russo-Spena, 2021).

6.2 Managerial implications

This study also raises several important managerial implications. First, firms' inclusion of CE as a key strategic metric is more warranted on mobile app- (vs. desktop browser-based) platforms. Particularly, customers who possess higher brand-related knowledge tend to value interacting with mobile app-based interactions, which afford greater personalization and control (Kim et al., 2013). Second, CX with mobile apps (vs. desktop browsers) was found to exert a stronger effect on relationship quality and loyalty intentions. Therefore, firms are advised to offer perceived valuable mobile apps to facilitate and leverage their customer journeys and relationships.

However, while engaging customers may improve CX for desktop browser-based interactions, based on our results its strategic benefits do not extend to fostering relationship quality. Moreover, though our results suggested CX's conducive effect on customer loyalty on desktop browser-based interactions, this association was weak, which may be due to desktop browsers' more limited personalization and less ubiquitous usage (Kim et al., 2013; McLean et al., 2018).

Consequently, important implications arise for mobile app design and implementation. To successfully engage customers and deliver superior experiences through mobile apps, managers are advised to carefully design their apps based on their segments' needs. That is, apps considered *relevant* are significantly more likely to succeed, given their greater ability to maintain customer attention and interest (Alalwan, 2020; Fang et al., 2017).

To optimize customer learning on desktop browser-based interactions, the use of personalized content is suggested to enhance user-perceived relevance of brand-related content. Here, opt-in content marketing can be used, which is conducive to ensuring user-perceived relevance. Moreover, differing levels of brand-related content access may be given to different customers (e.g., with those displaying high brand-related learning needs or VIP customers being afforded greater access).

6.3 Conclusions

Though CE and CX are the subject of extensive research in recent years, little remains known regarding their manifestation through mobile app (vs. desktop browser)-based interactions, as therefore investigated in this study (Bleier et al., 2019; Demangeot & Broderick, 2016; Shankar et al., 2016). This study attempts to offer an understanding of online customers' engagement and

experience across the platforms (mobile app vs. desktop browser). Identifying whether the effect of CE and CX on relationship quality and loyalty intention differs between the mobile app vs. desktop browser-based platform. A quantitative survey-based method was used to achieve the objectives of the study. The empirical results corroborate CE's and CX's impact on customer-perceived relationship quality and loyalty intention through these platforms (e.g., Hollebeek et al., 2019), with differing strength. For instance, both CE and CX has a stronger effect on loyalty intention for mobile app than desktop browser-based platforms. However, perceived relationship quality appeared as a critical driver of customer loyalty intent for both desktop mobile-app and browser-based interactions.

6.4 Limitations and future research directions

This study is also subject to several limitations, from which we identify further research opportunities. First, while we explored a particular CE/CX-based nomological network for mobile app- and desktop browser-based interactions, alternate networks may exist that merit further scrutiny. Moreover, though we explored mobile app/desktop browser-based interactions, researchers may wish to include other online/offline platforms (e.g., artificial intelligence-based interactions) to further advance insight (Ramaswamy & Ozcan, 2016). As most consumers tend to use multiple platform types, further investigation of the design of various platforms and their optimal composition represents an important research issue. For example, how are brand communications best designed across mobile app-, website-, online community-, social media-, and offline communications?

Second, this study did not examine potentially adverse effects of elevated CE/CX, including draining, fatigue, or addictive behavior, which warrant further study. Third, the moderating role of culture, age/gender, cashback/rewards may exist, which may affect the modeled

associations. Fourth, though our findings offer important insight into consumer behavior-related dynamics pertaining to mobile app (vs. desktop browser-based) platforms, future validation of these results is required. We, therefore, recommend the undertaking of further (e.g., experimental, qualitative) research to further delve into these issues. For example, qualitative research may be used to unveil the potential existence of other salient concepts (e.g., platform attachment/love) in driving users' platform usage behaviors. Moreover, experimental research may manipulate the levels of specific variables (e.g., high-low platform exposure) to validate, refine, and extend our attained insight.

Finally, while we used social exchange theory to inform our analyses, alternate theoretical frames may be utilized to understand the associations (direction of causality) between the modeled constructs. For example, future scholars may wish to further tease out the association of CE/CX by examining CX as an antecedent of CE, and across different types of online/offline platforms (e.g., magazine/social media content; Zhang et al., 2017), which may be compared/contrasted to the present findings.

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