

Virtual Reality, Presence, and Attitude Change: Empirical Evidence from Tourism

Abstract

The rapid development of virtual reality (VR) technology offers opportunities for a widespread consumption of VR tourism content. It also presents challenges to better understand the effectiveness of VR experience in inducing more favorable attitude toward tourism destinations and shaping visitation intention. Based on two studies, one conducted in Hong Kong with 202 participants and another in the United Kingdom with 724 participants, this research identified several positive consequences of the sense of presence in VR experiences. First, the feeling of being in the virtual environment increases enjoyment of VR experiences. Second, the heightened feeling of being there results in stronger liking and preference in the destination. Third, positive attitude change leads to a higher level of visitation intention. Therefore, this study provides empirical evidence to confirm the effectiveness of VR in shaping consumers' attitude and behavior.

Keywords: Virtual Reality; Presence; Attitude Change; Persuasion; Persuasive Technology; Tourism Marketing

62 **Highlights**

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64 • Sense of presence during VR leads to positive attitude change toward destination

65 • The effect of presence on enjoyment of VR confirms VR as hedonic experience

66 • Change in attitude leads to visit intention, confirming the persuasiveness of VR

67 • VR is more persuasive when virtual environment conveys its situated affordances

68 **Introduction**

69 One of the important technological developments expected to greatly impact the tourism industry today is
70 virtual reality (VR). Recent innovation in VR platforms, devices, and content production tools allows for
71 VR to evolve from a niche technology mainly enjoyed within the gaming communities into the realm of
72 everyday experiences. The availability of low cost VR viewers such as Google Cardboard and the
73 abundance of tourism-related VR content make it easier for anyone to experience virtual tours of cities
74 and tourism attractions from anywhere in the world. Therefore, VR today offers unbounded potentials for
75 mass virtual visitation to actual tourism destinations. The discussions on the roles of VR in tourism and
76 hospitality management and marketing have been found in tourism literature since the past three decades
77 (e.g., Cheong 1995; Dewailly 1999; Guttentag 2010; Huang et al. 2016; Williams & Hobson 1995). With
78 its unique ability to simulate intricate, real-life situations and contexts (Diemer et al. 2015), VR has been
79 touted as a substitute to actual travel (Cheong 1995; Sussmann and Vanhegan 2009), which can be
80 beneficial for the management of protected areas such as vulnerable natural and cultural heritage sites
81 where limiting the number of tourists or restricting visitations is desirable. In this case, the use of VR is
82 considered a positive contribution to environmental sustainability (Dewailly 1999). Studies also suggest
83 VR as a powerful tourism marketing tool (Huang et al. 2016; Williams & Hobson 1995; Williams 2006)
84 as it is able to offer more compelling imagery of tourism destinations to potential tourists by giving them
85 a sense of what it is like to be there, a “try before you buy” experience. However, these studies are
86 conceptual in nature, offering the potential benefits of VR applications in the tourism industry. Lacking,
87 though, is theory-driven and evidence-based research to support these suggested potentials.

88 Research in psychology has sought to explain the reason behind the effectiveness of VR in
89 shaping attitudinal and behavioral responses to virtual stimuli (Schuemie et al. 2001), most of these have
90 focused on the concept of presence. VR provides an environment where users can retrieve information in
91 multi-sensory modalities, including visual, auditory, and kinaesthetic, enabling users to perceive realistic
92 representation of the environment it portrays (Slater and Usoh 1993). Further, VR environment offers
93 situated affordances (Schuemie et al. 2001), action-supportive information on what users can do with the

94 environment. For example, to a human, the grounds afford walking. Therefore, users' perception of the
95 VR environment is dependent on possible actions. This perception leads to the sense of being "present" in
96 or "transported" to the virtual environment (Lombard and Ditton 1997; Schuemie et al. 2001; Slater 1999;
97 Zahorik and Jenison 1998). The essence of travel and tourism experience is tourists' encounters with the
98 destination environments, the "realities" of others. Tourists are tempted by the allure of places and
99 landscapes; some mainly driven by desire to experience the visual sensations of distant territories
100 (Steenjacobsen 2001), others by the deeper meaning behind interacting with the sociocultural aspects of
101 tourism destinations (Gibson 2009). Drawing from Zahorik and Jenison (1998), successfully supporting
102 actions such as sightseeing in a virtual tourism destination will lead users to perceive a sense of presence,
103 of him/herself as being in the destination. Consequently, presence explains the effectiveness of VR as
104 substitute to and/or simulation of travel.

105 Empirical evidence from various fields of studies, including in education, healthcare,
106 entertainment, retailing, etc., demonstrate that VR experience leads to positive attitudinal and behavioral
107 outcomes, such as consumer learning of products (Suh and Lee 2005), brand recognition, product recall,
108 and memory of experiences (Kim and Biocca 1997; Mania and Chalmers 2001). These outcomes are
109 suggested as the results of presence (Schuemie et al. 2001). However, these studies, as well as VR studies
110 in tourism context (e.g., Huang et al. 2016), mainly dealt with simulated virtual worlds, such as a virtual
111 office, a virtual seminar room, and 3D tourism attractions, where resemblances to real places were rather
112 coincidental. Theoretically, researching VR experience in tourism (what this study encapsulates) will
113 provide a better understanding of presence in VR experiences that involve virtual depictions of real
114 environments, where possible actions, such as navigation and sightseeing, resemble (are often
115 indistinguishable from) actual consumption. Thus, it will lead to better conceptualization of the roles of
116 VR experience in shaping attitude towards actual consumption. From a managerial point of view,
117 understanding how travel consumers respond to various VR stimuli, the attitudinal consequences of
118 "having been" in a destination, is of practical importance as destination managers are increasingly faced
119 with strategic decisions to invest in various technology platforms and modalities. Therefore, this study

120 aims to address the identified research gap in VR research in tourism context to address the
121 aforementioned theoretical and managerial challenges. Specifically, the goal of this study is to investigate
122 the sense of presence during a virtual walkthrough of a tourism destination and how presence influences
123 post-VR attitude change toward the destination. Two studies were conducted to achieve this research
124 goals. Study 1 was conducted with 202 participants in Hong Kong using VR street view of Tokyo, Japan,
125 viewed with Google Cardboard or VR video of Porto, Portugal, viewed with Samsung Gear VR. Study 2
126 was conducted in the United Kingdom with 724 participants using 360-degree VR videos of Lake District
127 National Park, United Kingdom, viewed with Samsung Gear VR.

128

129 **Virtual Reality and Tourism**

130 Since its early conception, VR has been described as a computer-simulated environment with and within
131 which people interact (Diemer et al. 2015; Schuemie et al. 2001). Using VR devices, a user can
132 experience the virtual environment as if he or she was part of it. The virtual environment is modified in
133 real time as the device senses user's reactions and motions, allowing him or her to perceive a vivid mental
134 representation of the environment, creating the illusion of interacting with and being immersed in the
135 virtual world (Wirth et al. 2007). Table 1 presents an overview of VR technologies and their advantages
136 within the tourism context. There are two kinds of established or commonly used headsets for VR, with
137 numerous technical options within those two types. The first type includes untethered headsets (also
138 referred to as mobile VR). These are headsets that work based on using a mobile device as a display. This
139 can sometimes present a limitation due to the mobile devices processing power and limited ability to
140 process real-time 3D content. The major benefits of these mobile-based systems are cost and uptake;
141 many people already have a mobile device that is capable of displaying VR content to some degree
142 (Byond, 2016). Examples of untethered or mobile VR headsets include Samsung Gear VR, Google
143 Cardboard, and Google Daydream. The second common type is a tethered device, whereby the headsets
144 contain a display alongside internal and/or external sensors to track the position of the user. These
145 tethered headsets will usually require a personal computer (PC) to process the graphics and, thus, the user

172 literature, Lombard and Ditton (1997) summarize six explications of presence: presence as social
173 richness, realism, transportation, immersion, social actor within medium, and medium as social actor (Lee
174 2004; Schuemie et al. 2001). Schuemie et al. (2001) find that presence as transportation, which is the
175 sensation of being transported to the virtual environment, dominates the discussion in presence literature.
176 Heeter (1992) suggests three types of presence: personal, social, and environmental presence, each
177 corresponds to the sense of self and encountered objects as being part of the interactive virtual
178 environment. Similarly, Lee (2004) proposes three types of presence: physical presence (i.e., virtual
179 physical objects experienced as actual physical objects), social presence (i.e., virtual social actors
180 experienced as actual social actors), and self presence (i.e., virtual self/selves experienced as actual
181 self/selves).

182 Kim and Biocca (1997) operationalize the transportation metaphor of presence with two
183 measures: arrival, which describes a feeling of being present in the virtual environment, and departure, a
184 feeling of separation from the physical environment. These were conceptualized following Gerrig's
185 (1993) theory that through a medium, a user is first transported, then arrives at a mediated environment,
186 and finally returns to the original physical environment. Kim and Biocca (1997) further argue that arrival
187 and departure are not exactly equal and may exert different influence on the user's memory and/or
188 attitude change (Kim & Biocca 1997). Slater and his colleagues (1993; 1994) propose a navigation
189 metaphor of presence in virtual environments, which includes the user's sense of being there, the extent to
190 which the VR experience becomes more real than everyday experience, and the locality of the virtual
191 environment, in that users perceive it as a 'place' instead of set of images (Slater and Wilbur 1997). Slater
192 (1999) suggest that experiencing-as-a-place is the meaning of presence: people are there, they respond to
193 what is there, and they remember it as a place. It is important to note that Slater et al.'s (1993; 1994)
194 measurement of presence, as explicated in SUS Questionnaire, include the state post VR experience,
195 namely how a user remembers the virtual environment, while others focus only on the mental state during
196 the VR experience. In fact, numerous studies regard memory of (objects within) the virtual environment
197 as a consequence of presence (e.g., Keng and Lin 2006; Kim and Biocca 1997).

198 The experience of presence is a complex, multidimensional perception, which is formed through
199 an interplay of multi-sensory information and various cognitive processes (Diemer et al. 2015). Lombard
200 and Ditton (1997) describe presence as the perceptual illusion of being unmediated (non-mediation), an
201 extent where the technology and the physical environment disappear from the user’s awareness. That is, a
202 user experiences the sense of presence when he or she fails to perceive the existence of a medium (i.e., a
203 VR device) and responds as if the medium were not there. The term “perceptual” in their description
204 shows that the illusion of non-mediation involves real-time responses of the sensory, cognitive, and
205 affective processing systems to objects in a person’s environment (Lombard and Ditton 1997). This
206 emphasizes the attention-directing role of activity within complex interactive situations to generate the
207 sense of presence, in addition to the immersive nature of the virtual environment (Diemer et al. 2015;
208 Witmer and Singer 1998). Indeed, Witmer and Singer (1998) stress that both fundamental psychological
209 states of involvement and immersion are necessary conditions for experiencing presence (see also
210 Witmer, Jerome, and Singer 2005). They develop the measurement of presence using Presence
211 Questionnaire (PQ) and found the following subscales of presence: involved/control, natural, and
212 interface quality (Witmer and Singer 1998). Similarly, Schubert, Friedmann, and Regenbrecht (2001)
213 conducted factor analyses and identified three dimensions of presence: spatial presence, involvement, and
214 realness. A more recent operationalization by Wirth et al. (2007) associates spatial presence with two
215 dimensions: self-location, which is the feeling of being located in mediated environments (the presence of
216 self in the virtual environment), and perceived action possibilities.

217 Further, literature suggests that vital to presence is the suppression of information that is
218 incompatible with the VR experience (Schuemie et al. 2001). With his estimation theory, Sheridan (1999)
219 postulates that presence is the result of a continuously updated mental model of the environment. He
220 assumes that people can never have true knowledge of objective reality and, instead, continuously make
221 and refine a mental model that estimates reality. Through sensing and interacting with a virtual
222 environment, designed to have a perceptual and functional similarity to a physical environment, a user
223 would create a mental model of the virtual environment and of how he or she relates to it. The structure of

1997; Lombard and Ditton 1997). The propositions and findings from previous research on presence in VR demonstrate that the enhanced sense of reality during a VR experience increases enjoyment and values of the VR experience (in itself), generates positive consequences on attitude, belief, and intention, and increases performance (Bystrom, Barfield, and Hendrix 1999; Kim and Biocca 1997; Suh and Lee 2005; Schuemie et al. 2001; Vora et al. 2002). For example, research in education and training found that virtual presence promotes enjoyment and higher cognitive engagement for better learning outcomes (Bailenson et al 2008; Lee, Wong, and Fung 2010; Mikropoulos and Strouboulis 2004) and improves task performance in training simulations (Vora et al. 2002). Research in medical sciences identified presence as the main contributor to performance during rehabilitation intervention programs and immersive Virtual Reality Exposure Therapy (VRET) to eliminate phobias (Carlin, Hoffman, and Weghorst 1997; Hodges et al. 1995; Riva, Mantovani and Gaggioli 2004). The role of presence is also suggested in the field of marketing, especially with regards to advertising effectiveness, as sense of presence in mediated environments is positively correlated with more favorable attitude toward ad and brand, brand recall or product knowledge, and purchase intention (Choi, Miracle, and Biocca 2001; Klein 2003; Li, Daugherty, and Biocca 2001; 2002; Lombard and Snyder-Duch 2013). In the context of tourism, Hyun and O'Keefe (2012) found that presence via web-mediated information directly leads to positive virtual destination image.

In essence, the consequences of presence can be separated into those during and after the VR experience. During VR experience, a higher sense of presence is associated with enjoyment of virtual environment participation, the feeling of pleasure of interacting with virtual environment (Larsson, Västfjäll, and Kleiner 2001; Li, Daugherty, and Biocca 2001). That is, virtual environments that engender a high level of presence are perceived to be more enjoyable (Sadowski and Stanley 2002; Sylaiou et al. 2010). For example, Weibel et al. (2008) found a significant positive correlation between presence and enjoyment in the context of playing online games. The effect of presence on enjoyment, however, is mediated by the state of flow (Weibel et al. 2008). Still in the context of video game experience, Shafer, Carbonara, and Popova (2011) found that spatial presence is a significant predictor of enjoyment.

276 Ijsselsteijn et al. (2006) shows that greater spatial presence leads to greater enjoyment in an exercise-
277 promoting virtual environment. More relevant to tourism, Zarzuela et al. (2013) demonstrate that through
278 a VR Serious Game, educational tourism can be designed in a fun and entertaining way, implying an
279 association between VR involvement and enjoyment, to allow tourists to learn different aspects of a city.
280 Likewise, Sylaiou et al. (2010) investigated the relationship between presence and enjoyment in a virtual
281 museum and identified a significant positive correlation between the two variables. Therefore, it can be
282 suggested that the sense of presence during VR experience with a tourism destination leads to enjoyment
283 of the VR experience.

284 *H1: Sense of Presence during VR experience has a positive effect on Enjoyment of VR Experience.*

285 Importantly, VR studies substantiate its persuasive role, suggesting that the subjective experience
286 of presence in VR can translate into real world attitude and induce behavioral change (Fox, Christy, and
287 Vang 2014). Indeed, VR applications have been designed for various persuasive goals, such as health
288 behavior change (Fox, Bailenson, and Binney 2009; Girard, Turcotte Bouchard, and Girard 2009;
289 Ijsselsteijn et al. 2006), promotion of prosocial behavior (Ahn, Le, and Bailenson 2013; Gillath, McCall,
290 Shaver, and Blascovich 2008; Rosenberg, Baughman, and Bailenson 2013), advertising and e-commerce
291 (Keng and Lin 2006; Li, Daugherty, and Biocca 2001; 2002; Suh and Lee 2005), etc. These studies found
292 that the heightened sense of realism during VR experience leads to attitude change and the effect is
293 transferred into the physical world, which is manifested in positive behavioral change. In marketing
294 literature, higher levels of presence of various advertisements communicated in computer-mediated
295 environments have been found to increase subject recall and recognition (Keng and Lin 2006), leading to
296 more positive attitude and liking toward the ad and the advertised product (Klein 2003; Sundar and Kim
297 2005). In tourism, VR provides tangible images of and experiences with the destination, inducing the
298 construction of a mental image about destination attributes (i.e., destination image) and its affordances
299 (Govers, Go, and Kumar 2007; Nicoletta and Servidio 2012), which can be a manifest of spatial presence.
300 Previous studies suggest that the ability to visit a tourism destination through VR may assist tourists in
301 developing a set of realistic expectations of tourism experience with the destination (Cheong 1995;

302 Guttentag 2010; Williams and Hobson 1995). Studies also show that encounters with images of tourism
303 destinations in mediated environments shape interest and attitude toward the destinations (Thomas and
304 Carey 2005; Tooke and Baker 1996). A potential tourist who has experienced various destinations
305 through VR will be in a better position to make an informed decision and initiate travel arrangements
306 (Sussman and Vanhegan 2009).

307 *H2:* Sense of Presence during VR experience has a positive effect on Post VR Attitude toward
308 destination.

309 *H3:* Enjoyment of VR experience has a positive effect on Post VR Attitude toward destination.

310 Attitude is a central concept in social psychology as well as consumer behavior literature as it is
311 generally accepted that attitude predicts behavior, although the degree of attitude – behavior consistency
312 may differ in various situations (e.g., Ajzen and Fishbein 1977; Glasman and Albarracín 2006; Smith and
313 Swinyard 1983). Further, based on the Belief–Attitude–Intention–Behavior hierarchy (Fishbein and Ajzen
314 1975), the relationship between attitude and (actual) behavior is mediated by behavioral intention (Kim
315 and Hunter 1993). The link between attitude toward tourism destination (with its characteristics) and
316 behavioral intention to visit the destination or to participate in tourism-related activities has been
317 supported in previous studies (e.g., Huang and Hsu 2009; Lam and Hsu 2004; Phillips, Asperin, and
318 Wolfe 2013; Ryu and Han 2010). Researching Beijing tourists’ revisit intention to Hong Kong, Huang
319 and Hsu (2009) identified significant influence of attitude on intention. Similar results were identified by
320 Lam and Hsu (2004). Phillips, Asperin and Wolfe (2013) found significant influence of attitude toward
321 consuming Korean cuisine on intention to visit Korea and to try Korean cuisine. Similar results were
322 identified by Ryu and Han (2010) in New Orleans. As supported by previous research, it can be
323 suggested that attitude toward tourism destination as a result of VR experience is a predictor of visitation
324 intention to the destination.

325 *H4:* Post VR Attitude toward destination has a positive effect on Intention to visit destination.

326

327

328 **Research Design**

329 The main goal of this research is to assess the effects of VR experience on post-VR attitude and
330 behavioral intention to visit a tourism destination. Key to VR experience is the extent of presence, which
331 contributes to the level of enjoyment of VR participation. In order to assess the relative contribution of
332 VR experience in inducing more favorable attitude toward VR stimuli (i.e., the tourism destination), it is
333 crucial to measure post-VR attitude change, comparing attitude before and after VR experience. That is,
334 identifying whether and how much a user's attitude changes as a result of being exposed to the virtual
335 environment will delineate the specific effect of VR experience. Previous studies suggest that VR induces
336 more positive attitude toward stimuli. Therefore, a positive change in attitude (i.e., stronger attitude) after
337 VR experience is expected. Finally, this research tests the influence of attitude change on visit intention to
338 the destination. The research framework is illustrated in Figure 1.

339 == Figure 1 about here ==

340

341 *Measurement Items*

342 *VR Presence.* In order to assess presence in VR experience, subjective measures of spatial presence as
343 conceptualized and operationalized in Wirth et al. (2007) and Vorderer et al. (2004) were utilized.

344 Following the research framework, the main interest in this study is to assess presence as the subjective
345 mental states of being in and interacting with the virtual environment during the VR experience. Two
346 constructs from MEC Spatial Presence Questionnaire (MEC-SPQ; Vorderer et al. 2004): Self-Location
347 and Possible Actions scales, each measured with four items, were included in the questionnaire. The
348 measurement items were presented in a 5-point Likert-type scale with “Strongly disagree” – “Strongly
349 agree” anchored statements (see Appendix A for a list of measurement items). VR presence was
350 operationalized as a second-order variable, consisting of the two first-order constructs.

351 *VR Enjoyment.* In order to measure VR enjoyment, this research refers to Davis, Bagozzi, and Warshaw's
352 (1992) definition of perceived enjoyment, which is the extent to which the activity of using VR
353 technology to experience tourism destination is enjoyable in its own right. Measurement items from

354 previous research on technology acceptance and use (e.g., Moon and Kim 2001; Van der Heijden 2003)
355 were consulted. As a result, a 5-item perceived enjoyment scale was utilized. The items were presented a
356 5-point Likert-type scale with “Strongly disagree” – “Strongly agree” anchored statements.

357 *Post VR Attitude Change.* In literature, the measurement of attitude change has been conducted in a
358 variety of different ways, mostly involving taking multiple measurements at different times (generally in
359 longitudinal studies) to measure an increase or decrease in the level of attitude (see Hughes 1967). In this
360 study, a limited time allotted for VR experiment and survey only allows for the questionnaire to be
361 distributed to participants after they have experienced VR. Therefore, attitude change was measured using
362 self-reported change in intensity of preference, liking, and interest in the destination after experiencing
363 VR on a 5-point Likert-type scale from 1 – “Much weaker” to 5 – “Much stronger,” with 3 – “About the
364 same” as the middle point.

365 *Visit Intention.* Visit Intention was measured by 3-item scale targeting behavioral intention to visit the
366 destination in the future, validated in previous studies on tourists’ intention to visit or revisit a destination
367 in the future (e.g., Kozak and Rimmington 2000; Phillips, Asperin and Wolfe 2013). The scale was
368 presented a 5-point Likert-type scale with “Strongly disagree” – “Strongly agree” anchored statements.

369 370 *Data Analysis*

371 In order to assess the measures given the data in this study context and test the hypotheses, data analyses
372 were conducted using covariance-based structural equation modeling (CB-SEM) following the two-step
373 approach suggested by Anderson and Gerbing (1988). The first step was to test the adequacy of the
374 measurement model with a confirmatory factor analysis (CFA), then the second step to assess the
375 adequacy of the structural model for hypotheses testing. The analysis was performed using MPlus
376 program (Muthén and Muthén 1998-2012). Based on skewness and kurtosis values of all variables, an
377 appropriate parameter estimate was selected. Several criteria were used to assess the model fit. The
378 analysis will determine if the complete set of paths specified in the model is plausible given the sample,

379 thus the proposed causal model is a sufficiently “good” way to model the relationships among the
380 variables (Gefen, Straub, and Boudreau 2000).

381

382 **Study 1. Stimuli: Tokyo, Japan or Porto, Portugal**

383 In March 2016, undergraduate and graduate students enrolled in a university in Hong Kong were invited
384 to participate in the study as part of an experiential component of a course on tourism and technology
385 strategy. In order to ground this research in the context of personal use of VR, existing free VR
386 applications and personal VR devices were used in the study. Participants with Apple’s iOS smartphones
387 were asked to download the Cardboard app and use Google Cardboard VR viewer to experience a virtual
388 walkthrough of Tokyo, Japan, experiencing VR street view with Urban Hikes on Cardboard app
389 (developed by Google). Other participants were asked to use Samsung Gear VR with a Samsung
390 smartphone to visit Porto, Portugal, experiencing interactive 360-tour with Porto Interactive app
391 (developed by Vertigo VR Studios). Participants experienced VR for about 10 minutes after a short period
392 of familiarization with the device. After the VR experience, all participants were asked to complete the
393 questionnaire online. A total of 202 participants completed the questionnaire. As presented in Table 3, the
394 majority of participants are between the ages of 18 and 24 (98%), female (79%), and have a 4-Year
395 University Degree (76%). Most participants (N = 136; 67%) used Google Cardboard, and most had never
396 visited the destination portrayed in the VR experience (N = 144; 71%). In order to account for non-
397 normality in the data distribution (see Table B1 in Appendix B), the analysis was performed using
398 maximum likelihood parameter estimate with standard errors and a mean adjusted Chi-square test statistic
399 (Satorra-Bentler corrections) that are robust to non-normality (MLM).

400 == Table 3 about here ==

401

402 *Findings*

403 The results from the analysis suggest that the measurement model is adequate based on several criteria.

404 As presented in Table 4, all factor loadings are above .6 and the average variance extracted (AVE) values

405 of all latent variables are above the cutoff point of .5 (Hair, Black, Babin, and Anderson 2010). Therefore,
406 convergent validity was supported. The composite reliability (CR) values of all latent variables are above
407 the cutoff criteria of .7 (Hair et al. 2010). Further, the values of square roots of AVE of all latent
408 variables, which are presented in the diagonal, are larger than the correlations between the corresponding
409 variable and any other variables (see Table 5). This indicates that discriminant validity is supported.
410 Further, the fit indices are above the thresholds of .9 (Hu and Bentler 1999): Comparative Fit Index (CFI)
411 = .963 and Tucker Lewis Index (TLI) = .957. The value of Root Mean Square Error of Approximation
412 (RMSEA = .056) indicates good model fit (Hu and Bentler 1999) and the value of Standardized Root
413 Mean Square Residual (SRMR = .047) is below the threshold of .09 (Hu and Bentler 1999). These criteria
414 suggest the adequacy of the measurement model.

415 == Table 4 about here ==

416 == Table 5 about here ==

417 In order to estimate the relationships between the variables hypothesized in the research
418 framework, the structural model was consulted (see Figure 2). As a second-order variable, the paths from
419 VR Presence to its two lower-order variables are significant (Presence → Self-Location = .894, $p = .000$;
420 Presence → Possible Actions = .849, $p = .000$). As hypothesized, Presence has a significant positive
421 effect on Enjoyment of VR participation ($\beta = .620$; $p = .000$; $R^2 = .384$; $p = .000$), providing support for
422 H1. Both Presence and Enjoyment have significant positive effects on attitude change (Presence →
423 Attitude Change = .240, $p = .000$; Enjoyment → Attitude Change = .255, $p = .000$; $R^2 = .198$; $p = .000$),
424 supporting H2 and H3. It can be observed from the R^2 value that about 20% of the amount of variance in
425 Post VR attitude change can be explained by the model. Finally, a significant positive effect of Attitude
426 Change on Intention ($\beta = .333$; $p = .000$) was also identified ($R^2 = .111$; $p = .000$), providing support for
427 H4. About 11% of variance in visit intention can be explained by the model.

428 == Figure 2 about here ==

429

430 *Discussion*

431 The results provide support for all hypothesized relationships in the model (see Table 6). The sense of
432 presence during VR experience significantly leads to enjoyment of the experience, supporting Hypothesis
433 1. With regards to the consequences of presence on post VR attitude change, a significant effect was also
434 identified, supporting Hypothesis 2. Further, enjoyment of VR experience also positively impacts post
435 VR attitude change with a similar magnitude as the effect of VR presence, supporting Hypothesis 3.
436 Finally, the relationship between post VR attitude change and visit intention is also significantly positive,
437 which supports Hypothesis 4. Therefore, it can be suggested from these results that VR can be an
438 effective tool for tourism marketing as it induces the sense of presence, which leads to enjoyment. These,
439 in turn, induce positive attitude change that contributes to visit intention to the tourism destination
440 portrayed in VR. Further, the indirect effects of VR presence and enjoyment on visit intention were
441 calculated (see Table 7). Specifically, a significant positive indirect effect of VR presence on post VR
442 attitude change, by way of enjoyment, was found. Other indirect effects, although smaller in magnitude,
443 were also significant. The total effects of VR presence on post VR attitude change is .778; while total
444 effects on visit intention is .133.

445 == Table 6 about here ==

446 == Table 7 about here ==

447 While the data confirmed the hypotheses, this study has some limitations. First, the participants in
448 this study are dominated by young, female consumers. Recent studies have found that the younger the
449 customers, the more likely they are to be interested in VR (eMarketer, 2015; Global Web Index, 2016). It
450 can be suggested that participants in this study represent a group of customers who are highly likely to
451 experience and be influenced by VR. However, the imbalance in gender may or may not influence the
452 results. Second, participants were exposed to different stimuli with an unbalanced ratio: 67% used Google
453 Cardboard. Several independent-samples *t*-tests were conducted to identify the differences across stimuli
454 in terms of all variables (i.e., presence, enjoyment, attitude change, and intention). The differences were
455 not statistically significant. Nonetheless, conducting a follow up study with consistent stimuli is desirable
456 to verify the results further. Lastly, the sample size is relatively low ($N = 202$). Previous literature

457 suggests a minimum 100 – 150 sample size to test a simple model (Anderson and Gerbing 1988; Ding,
458 Veliver, and Harlow 1995) or 10 observations for every indicator variable (Nunnally 1967). Based on a
459 power analysis suggested by MacCallum, Browne, and Sugawara (1996), the minimum sample size for a
460 close of fit (Power = 90%, significance level = .05; RMSEA₁ = .05, and RMSEA₀ = .08) is 128. A further
461 study to test the model with a larger sample size will further support these findings.

462

463 **Study 2. Stimuli: Lake District National Park, UK**

464 Festival goers visiting Kendall Calling Festival in July 2016 and Lakes Alive Festival in August 2016 in
465 the Lake District, UK were invited to participate in this study. Participants were asked to experience Bird
466 Hive Lake District National Park VR application using Samsung Gear VR headset for about five minutes.
467 The content for VR experience was captured by a drone and it contained a flight over the natural
468 landscape of the Lake District National Park including its mountains, lakes, and forests. After the VR
469 experience, all participants were asked to complete a questionnaire. A total of 741 participants completed
470 the questionnaire. After eliminating responses with missing data and outliers, 724 responses were
471 included in the analysis (see Table 8). In contrast with Study 1, participants in Study 2 are relatively
472 balanced in gender (57% female). While the majority of participants is young (41% younger than 35),
473 older participants are also represented in this study (about 34% are 45 years or older). A majority of
474 participants make less than £60,000 annually. A quarter of participants (25%) have tried VR before the
475 experience. Contrary to Study 1, most participants in Study 2 (89%) have visited the destination before
476 being exposed to this study. Data from Study 2 are presented in Table B2 in Appendix B. The analysis
477 was performed using the same approach as in Study 1 (covariance-based SEM with MLM).

478 == Table 8 about here ==

479

480 *Findings*

481 Based on several criteria, it can be suggested that that the measurement model in this study is adequate.
482 As presented in Table 9, all factor loadings are above .6 and the AVE values of all latent variables are

483 above the cutoff point of .5 (Hair et al. 2010). Therefore, convergent validity was supported. The CR
484 values of all latent variables are above the cutoff criteria of .7 (Hair et al. 2010). Further, the values of
485 square roots of AVE of all latent variables, which are presented in the diagonal of Table 10, are larger
486 than the correlations between the corresponding variable and any other variables. This demonstrates that
487 discriminant validity is supported. The fit indices are above the thresholds of .9 (Hu and Bentler 1999):
488 CFI = .945 and TLI = .935. The value of RMSEA (.071) indicates moderate fit (Hu and Bentler 1999) and
489 the value of SRMR (.087) is below the threshold of .09 (Hu and Bentler 1999).

490 == Table 9 about here ==

491 == Table 10 about here ==

492 The structural model is illustrated in Figure 3. The paths from VR Presence as a second-order
493 variable to its two first-order variables are significant (Presence → Self-Location = .838, $p = .000$;
494 Presence → Possible Actions = .833, $p = .000$). Presence has a significant positive effect on Enjoyment of
495 VR participation ($\beta = .519$; $p = .000$; $R^2 = .270$; $p = .000$), providing support for H1. Both Presence and
496 Enjoyment have significant positive effects on attitude change (Presence → Attitude Change = .567, $p =$
497 $.000$; Enjoyment → Attitude Change = .116, $p = .000$; $R^2 = .403$; $p = .000$), supporting H2 and H3. This
498 indicates that 40% variation in the Post VR attitude change can be attributed to variations in VR presence
499 and enjoyment. Finally, a significant positive effect of Attitude Change on Intention ($\beta = .305$; $p = .000$)
500 was also identified ($R^2 = .093$; $p = .000$), providing support for H4. The low R^2 value, however, indicates
501 that only extremely small portion of variation in visit intention to the national park (less than 10%) can be
502 explained by Post VR attitude change.

503 == Figure 3 about here ==

504

505 *Discussion*

506 As with Study 1, the results from Study 2 also provide support for the hypothesized model (see Table 11).
507 The sense of presence during VR experience significantly leads to enjoyment of VR participation,
508 supporting Hypothesis 1. Presence's influence on post VR attitude change is positive and significant,

509 supporting Hypothesis 2. The positive effect of enjoyment of VR experience on post VR attitude change
510 is also significant, although with less magnitude than the VR presence, supporting Hypothesis 3. Finally,
511 the relationship between post VR attitude change and visit intention is significant, albeit resulting in a
512 small R^2 value. This supports Hypothesis 4. In summary, these results demonstrate the effectiveness of
513 VR for tourism marketing as VR induces the sense of presence, leading to enjoyment, which affects
514 positive attitude change that contributes to visit intention. Further, the indirect effects of VR presence and
515 enjoyment on visit intention were calculated (see Table 12). Specifically, a significant positive indirect
516 effect of VR presence on visit intention, by way of post VR attitude change, was found. Other indirect
517 effects, although smaller in magnitude, were also significant. The total effects of VR presence on post VR
518 attitude change is .569; while total effects on visit intention is .191.

519 == Table 11 about here ==

520 == Table 12 about here ==

521 From the results, it can be observed that the Satorra-Bentler corrected Chi-square value is quite
522 large (Chi-square = 673.059; df = 146), which is likely due to large sample size ($N = 724$). As suggested
523 in previous research, with large sample size, the chi-square values will be inflated (statistically
524 significant), thus might erroneously implying a poor data-to-model fit (see Schumacker and Lomax
525 2004). However, the relative Chi-Square value (Chi Square / degree of freedom ratio) in this study is
526 smaller than the suggested ratio of 5:1 as a rule of thumb for a reasonable fit (Marsh and Hocevar 1985;
527 Schumacker and Lomax, 2004).

528

529 *An Alternative Model*

530 In order confirm the significance of post VR attitude change as a consequence of presence and to test if
531 there are direct effects of VR presence and VR enjoyment on visit intention, an alternative model was
532 tested. As can be seen in Figure 4, a positive direct effect of VR enjoyment on visit intention was
533 identified ($\beta = .250$; $p = .000$), with a slightly larger magnitude compared to that of Post VR attitude
534 change. However, the direct effect of VR presence on visit intention was not identified. Therefore, it can

535 be confirmed that the effect of the sense of presence during VR experience on visit intention is mediated
536 by post VR attitude change. Compared to the main model, the R^2 value of visit intention increases in the
537 alternative model ($R^2 = .139, p = .000$), indicating that the alternative model better explains the variance
538 in visit intention. That is, the sense of being in the virtual environment directly results in more positive
539 attitude toward the environment. On the other hand, the significant effect of VR enjoyment on visit
540 intention demonstrate the role of hedonic experience with technological device in instilling behavioural
541 intention. That is, the inflated sense of pleasure and/or excitement during a virtual walkthrough leads to
542 positive intention for an actual walkthrough. Considering that 25% of participants have tried VR and 89%
543 have visited destination before, the model was run for the different groups of participants (prior use of
544 VR, prior visitation to destination) to further explicate the role of novelty. However, no significant
545 differences were identified.

546 == Figure 4 about here ==

547

548 **General Discussion**

549 This study hypothesized that the sense of presence during a VR experience with a tourism destination will
550 lead to positive consequences, which include positive VR experience from enjoyment of VR participation
551 and, importantly, an increased level of preference, liking, and interest in the tourism destination, which
552 leads to visit intention. The results of two studies, conducted in with different stimuli (i.e., cities and
553 national parks) among participants with varied characteristics (i.e., students and festival goers), support
554 all hypotheses. Firstly, significant support was found for VR presence as a second-order variable
555 consisting of self-location and possible action, as suggested in Wirth et al.'s (2007) measures of spatial
556 presence. Self-location denotes the sense of locating the self in the virtual environment, which is
557 consistent with the definition of personal presence (Heeter 1992) or self presence (Lee 2004), although it
558 is not about perceiving the existence of virtual self in the virtual environment, but about being part of the
559 virtual environment. To some extent, this can support the concept of arrival (Kim and Biocca 1997), as
560 participants feel present in the city or national parks depicted in VR. Possible Actions denote the

561 immersive nature and affordances of the virtual environments, which is consistent with the definition of
562 physical presence (Lee 2004) and environmental presence (Heeter 1992). Importantly, it is about
563 participants recognizing the action-supportive information from the virtual environment; the virtual
564 environment conveying its situated affordances (Schuemie et al 2001).

565 Secondly, the significant effect of presence on enjoyment of VR confirms the positive value of
566 VR as a hedonic experience. This is consistent with Shafer et al. (2011), Sylaiou et al. (2010), and Weibel
567 et al. (2008). However, this study shows the direct effect that the sense being in the tourist city or the
568 national park has on the feeling of pleasure while doing the virtual walkthrough. Meanwhile, Weibel et al.
569 (2008) found the effect of presence on enjoyment to be mediated by the perceived state of flow in the
570 context of playing video games. In the context of virtual museum, Sylaiou et al. (2008) only demonstrated
571 positive correlations between presence and enjoyment. Therefore, this study contributes to a better
572 understanding of the causal relationship between the two experiences in VR that involves interactions
573 with tourism destinations, with enjoyment being the consequence of the sense of presence.

574 Thirdly, a significant direct effect of presence on attitude change confirms that the extent to
575 which participants process information in the virtual environment influences changes in liking,
576 preference, and interest in the actual environment. While previous research in advertising identified
577 positive correlations between presence and more favorable attitude toward ad and brand (Choi, Miracle,
578 and Biocca 2001; Klein 2003; Li, Daugherty, and Biocca 2001; 2002), this study clarifies that presence
579 indeed leads to attitude change. In this case, the feeling of being part of a city or a park and afforded the
580 action of sightseeing results in more favorable attitude toward the city and the park. Similar result was
581 identified by Hyun and O'Keefe (2012), where presence results in positive virtual destination image.
582 Furthermore, by measuring Post VR attitude change instead of attitude, this study was able to delineate
583 specific role of VR presence on attitude formation.

584 Lastly, the change in attitude positively leads to visit intention. Those whose preference, liking,
585 and interest in the city or park become stronger (i.e., more favorable attitude) after the VR experience
586 tend to have higher level of visit intention. It is important to note that while in Study 1 the proportion of

587 participants who have visited the destination prior to the VR experience is small, most participants in
588 Study 2 have visited the park. Therefore, the novelty effect of VR might be lacking and its role is more of
589 a reminder rather than product introduction. Further, it is also important to note that the nature of
590 traveling to the cities and the attraction depicted in stimuli is different: traveling to Tokyo or Porto for
591 participants in Hong Kong may require a substantial effort compared to visiting a local national park for
592 participants in the UK. It can be observed that the mean values of visit intention items in Study 2 are
593 positively skewed, indicating that most participants intend to visit the national park in the future.
594 Nevertheless, both studies yielded positive results, indicating that VR presence can be effective to induce
595 intention for first time visitation and/or revisit intention, to visit faraway destinations or domestic tourism
596 attractions. In conclusion, this study demonstrates that VR allows subjective experience in a virtual
597 environment (e.g., virtual walkthrough or sightseeing in a tourist city or a national park) to eventually
598 translate into real behavior (i.e., actual visitation), confirming the persuasive power of VR for tourism
599 marketing.

600

601 **Conclusion and Implication**

602 The development of VR platforms and devices for convenient personal use in recent years offers great
603 potential for a widespread consumption of VR tourism content. As suggested in earlier literature, the
604 replication or creation of tourism experiences through VR will greatly impact the tourism industry
605 (Williams and Hobson 1995). VR development presents research challenges to better understand the
606 effectiveness of VR in providing alternative or surrogate tourism experiences and shaping consumer
607 attitudes toward tourism destinations. Moreover, destination managers are also faced with challenges to
608 make strategic investment decisions in order to leverage VR technology to influence consumers' travel
609 decisions. In order to answer these challenges, this study investigates the sense of presence during VR
610 experience involving virtual walkthrough of tourism destinations and attractions using personal devices.
611 This study contributes to a better understanding of presence and its consequences on user attitudes in
612 experiences involving depictions of real tourism destinations. The results show that presence contributes

613 positively to attitude change toward destinations. That is, a higher sense of presence during VR
614 experiences leads to stronger interest and liking toward the destinations. Therefore, it provides theoretical
615 explanation for the effectiveness of VR in influencing users' response to marketing stimuli, which is
616 helpful for destination marketers justifying investment in VR and empirical support for previous
617 conceptual research suggesting the role of VR in tourism marketing and management (e.g., Cheong 1995;
618 Dewailly 1999; Guttentag 2010; Huang et al. 2016; Williams and Hobson 1995).

619 Williams and Hobson (1995) suggested that "VR has the potential to revolutionize the promotion
620 and selling of tourism" (p. 425) as it has the ability to offer interactive experience and provide rich data to
621 potential tourists seeking destination information (Guttentag 2010). Cheong (1995) argued that through
622 VR, potential tourists can "'sample' the delights and have a 'feel' of each destination's atmosphere before
623 making their decision" (p. 419). This study shows how VR users interact with the destination's
624 characteristics, 'feel' the destination's atmosphere, and, thus, sample the destination experience as
625 indicated by the sense of presence. It is reflected in the ability to locate the self in the destination and
626 perceive the affordances of the destination (action possibilities), as significantly found in this study to
627 form the sense of spatial presence in the virtual environment (Wirth et al. 2004; Vorderer et al. 2007). To
628 justify the effectiveness of VR as marketing tools, this study demonstrates how VR capabilities in
629 inducing the sense of presence actually lead to users having more favorable attitude toward the
630 destinations depicted in VR, which, in turn, affects intention to visit the destinations. Results from two
631 studies, conducted with different groups of participants using different stimuli, consistently support the
632 hypotheses. The consequences of presence on positive attitude change is observed in situations involving
633 experience with faraway tourism destinations (international tourism) as well as local attractions (domestic
634 tourism). No significant differences were found between participants who have visited the destinations
635 depicted in VR and those who have not (in both studies), between participants who have used VR before
636 and those who used it for the first time during the study (in Study 2), and between participants using
637 different VR viewers (in Study 1). Therefore, this study provides empirical evidence from the field of
638 tourism to support previous research suggesting the positive consequences of presence in VR on attitude

639 and behavior (e.g., Choi, Miracle, and Biocca 2001; Klein 2003; Li, Daugherty, and Biocca 2001; 2002;
640 Lombard and Snyder-Duch 2013).

641 Despite of the contributions, this study has some limitations, which should be addressed in future
642 research. First, as a result of data collection procedure, the proportion of female participants in Study 1 is
643 way larger than male participants and all of them are younger than 35 years. This generate a concern in
644 terms of representativeness when interpreting the results. However, Study 2, which included more
645 balanced proportion of gender and age groups, also yields the same results. This confirms that the results
646 from Study 1 can be replicated in a different context with a more representative sample. Nevertheless,
647 future studies applying this model in different contexts will further verify the results. Second, this study
648 uses subjective measurements of VR presence and enjoyment, which are experienced during VR, based
649 on participants' evaluation after VR experience. Therefore, it relies on participants' recall of the VR
650 experience. Even though participants responded to the questionnaire right after the experience, responses
651 may still contain inaccurate information and biases. Future research should include objective
652 measurements of presence and enjoyment, such as using sensors and psychophysiological analysis, to
653 eliminate potential bias. Third, while in Study 1 different groups of participants used different devices and
654 stimuli, the small number of participants using Samsung Gear VR compared to Google Cardboard does
655 not allow for testing a meaningful comparison. Experimental studies testing the model with devices with
656 varying levels of immersive capabilities and content with varying levels of affordances (e.g., stimulating
657 different types of action and interaction) will add to better understand how presence comes about. The
658 same goes for differences between participants with prior experience and those without, in order to
659 explicate the role of novelty in effectiveness of VR experience. Last, this study focuses mainly on the
660 consequences of presence, but not on its antecedents. Future studies focusing on antecedents and different
661 correlates of VR presence will be helpful to inform the design of VR for tourism and better predict the
662 resulting visit intention.

663 Finally, the results of this study provide destination marketers, travel agents, and other tourism
664 suppliers with validation that VR can be an effective marketing tool. As personal VR devices becomes

665 more accessible to a wider group of consumers, investing in VR technology for tourism marketing can be
666 a good strategy. However, as various tourism destinations have started to embrace this technology, it is
667 important to develop an overall VR experience that is presence-inducing and all around enjoyable in order
668 to make sure the user experience with VR will translate into stronger interest in the tourism destination.
669 The key is to generate VR content that can transport participants to the destination, heighten the senses of
670 being in the virtual environment and suspend sensory stimuli from the actual physical environment.

671 Another immersive technology application closely related to VR and highly relevant to tourism is
672 augmented reality (AR) (e.g., Jung and tom Dieck, 2017; Tussyadiah, Jung, & tom Dieck, 2017). While
673 VR creates simulated reality for its users (i.e., virtual worlds), AR provides an enhanced version of reality
674 by adding digital information (i.e., sound, video, haptics) to augment the elements of the natural
675 environment. Due to the nature of user interaction and experience with these immersive technologies, the
676 key concept explored in this study, spatial presence, is most appropriate to apply in VR contexts,
677 especially in connection to the notion of suspension of disbelief. In AR experiences, the concept of
678 presence can be relevant in terms of how users perceive the virtual objects to be part of (and interact with)
679 the natural environments. Therefore, this research approach to measuring presence and its behavioral
680 outcomes will not explain experiences with AR to the same extent as with VR. Future studies comparing
681 presence in VR and AR experiences will shed light into this issue.

682

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925

926 **Statement of Contribution**

927 Iis P. Tussyadiah contributed to conception and research design, data analyses and interpretation, and
928 writing the first draft of the manuscript. Dan Wang contributed to conception and research design, data
929 collection in Study 1, and revision of the manuscript. Timothy H. Jung and M. Claudia tom Dieck,
930 together, contributed to data collection in Study 2 and revision of the manuscript. All authors reviewed
931 the final version of the manuscript.

932

933 **Appendix A. Measurement Items**

Scale Items	Constructs	Sources
	VR Presence – Self-Location	
SELF_LOCATION1	<i>I felt like I was actually there in the VR environment.</i>	Wirth et al. (2007); Vorderer et al. (2004)
SELF_LOCATION2	<i>It seemed as though I actually took part in the action of the VR (sightseeing).</i>	
SELF_LOCATION3	<i>It was as though my true location had shifted into the VR environment.</i>	
SELF_LOCATION4	<i>I felt as though I was physically present in the VR environment.</i>	
	VR Presence – Possible Actions	
POSSIBLE_ACTIONS1	<i>The objects in VR gave me the feeling that I could do things with them.</i>	Wirth et al. (2007); Vorderer et al. (2004)
POSSIBLE_ACTIONS2	<i>I had the impression that I could be active in the VR environment.</i>	
POSSIBLE_ACTIONS3	<i>I felt like I could move around among the objects in VR.</i>	
POSSIBLE_ACTIONS4	<i>It seemed to me that I could do whatever I wanted in the VR environment.</i>	
	VR Enjoyment	
ENJOYMENT1	<i>It was fun.</i>	Moon and Kim (2001); van der Heijden (2003)
ENJOYMENT2	<i>It was pleasant.</i>	
ENJOYMENT3	<i>It was enjoyable.</i>	
ENJOYMENT4	<i>It was exciting.</i>	
ENJOYMENT5	<i>It was interesting.</i>	
	Post VR Attitude Change	
ATTITUDE_CHANGE1	<i>After the VR experience, my liking toward [Destination] is...</i>	
ATTITUDE_CHANGE2	<i>After the VR experience, my preference toward [Destination] is...</i>	
ATTITUDE_CHANGE3	<i>After the VR experience, my interest in visiting [Destination] is...</i>	
	Visit Intention	
VISIT_INTENT1	<i>I expect to visit [Destination] in the future.</i>	Kozak and Rimmington (2001)
VISIT_INTENT2	<i>It is likely that I visit [Destination] in the future.</i>	
VISIT_INTENT3	<i>I can see myself visiting [Destination] in the future.</i>	

934

935 **Appendix B. Summary of Variables**

936 Table B1. Study 1: Summary of Variables

Variable	N	Mean	St. Dev.	Skewness (S.E. = .171)	Kurtosis (S.E. = .341)
SELF_LOCATION1	202	3.39	1.012	-.893	-.018
SELF_LOCATION2	202	3.46	.968	-1.002	.553
SELF_LOCATION3	202	3.24	.996	-.648	-.354
SELF_LOCATION4	202	3.17	.976	-.573	-.258
POSSIBLE_ACTIONS1	202	3.08	1.032	-.539	-.520
POSSIBLE_ACTIONS2	202	3.25	.983	-.620	-.135
POSSIBLE_ACTIONS3	202	3.24	1.030	-.684	-.320
POSSIBLE_ACTIONS4	202	2.71	1.092	-.033	-.886
ENJOYMENT1	202	4.16	.845	-1.163	1.664
ENJOYMENT2	202	4.18	.853	-1.178	1.616
ENJOYMENT3	202	4.00	1.012	-1.061	.806
ENJOYMENT4	202	3.71	.989	-.728	.218
ENJOYMENT5	202	4.29	.786	-1.443	3.081
ATTITUDE_CHANGE1	202	3.54	.582	.379	-.612
ATTITUDE_CHANGE2	202	3.47	.608	.268	.626
ATTITUDE_CHANGE3	202	3.64	.649	-.142	.601
VISIT_INTENT1	202	3.99	.763	-.586	.312
VISIT_INTENT2	202	3.89	.830	-.312	-.514
VISIT_INTENT3	202	3.73	.908	-.412	-.187

937

938

939 Table B2. Study 2: Summary of Variables

Variable	N	Mean	St. Dev.	Skewness (S.E. = .091)	Kurtosis (S.E. = .181)
SELF_LOCATION1	724	3.518	1.068	-.436	-.593
SELF_LOCATION2	724	3.532	1.073	-.480	-.515
SELF_LOCATION3	724	3.773	.969	-.668	.006
SELF_LOCATION4	724	3.548	1.091	-.409	-.642
POSSIBLE_ACTIONS1	724	3.489	1.087	-.344	-.727
POSSIBLE_ACTIONS2	724	3.558	1.050	-.438	-.583
POSSIBLE_ACTIONS3	724	3.243	1.091	-.039	-.847
POSSIBLE_ACTIONS4	724	3.139	1.165	-.052	-.902
ENJOYMENT1	724	4.533	.622	-1.333	2.449
ENJOYMENT2	724	4.583	.571	-1.220	2.011
ENJOYMENT3	724	4.300	.823	-1.082	.749
ENJOYMENT4	724	4.599	.554	-1.084	.734
ENJOYMENT5	724	4.528	.621	-1.167	1.268
ATTITUDE_CHANGE1	724	3.776	.828	.261	-.957
ATTITUDE_CHANGE2	724	3.858	.827	.255	-1.462
ATTITUDE_CHANGE3	724	4.289	.726	-.588	-.594
VISIT_INTENT1	724	4.569	.667	-1.377	1.030
VISIT_INTENT2	724	4.572	.675	-1.562	2.384
VISIT_INTENT3	724	4.576	.680	-1.689	3.187

940

941

942

943 **Appendix C. Questionnaire**

944

945 Have you used virtual reality before?

946 Yes (1)

947 No (2)

948

949 Have you been to [Destination]?

950 Yes (1)

951 No (2)

952

953 **VIRTUAL REALITY EXPERIENCE**

954 Please use [Google Cardboard or Samsung Gear VR] to visit [Destination]. You are about to visit
 955 [Destination] with this [Google Cardboard or Samsung Gear VR]. Please imagine yourself as a tourist and
 956 experience the attractions. Please take your time, but do not take longer than 10 minutes.

957

958 Please click NEXT when you finished your Virtual Reality experience.

959

960 Please indicate the extent to which you agree with the following statements regarding your virtual reality
 961 (VR) experience.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I felt like I was actually there in the VR environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It seemed as though I actually took part in the action of the VR (sightseeing).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It was as though my true location had shifted into the VR environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt as though I was physically present in the VR environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

962

963 Please indicate the extent to which you agree with the following statements regarding your virtual reality
 964 (VR) experience.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
The objects in VR gave me the feeling that I could do things with them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had the impression that I could be active in the VR environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt like I could move around among the objects in VR.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It seemed to me that I could do whatever I wanted in the VR environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

965

966 Please indicate the extent to which you agree with the following statements regarding your virtual reality
 967 (VR) experience.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
It was fun.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It was pleasant.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It was enjoyable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It was exciting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

968
 969 Please indicate the extent to which you agree with the following statements regarding your interest in
 970 visiting [Destination].

	Much Weaker (1)	Somewhat Weaker (2)	About the same (3)	Somewhat Stronger (4)	Much Stronger (5)
After VR experience, my liking toward [Destination] is...	<input type="radio"/>				
After VR experience, my preference toward [Destination] is...	<input type="radio"/>				
After VR experience, my interest in visiting [Destination] is...	<input type="radio"/>				

971
 972 Please indicate the extent to which you agree with the following statements regarding your intention to
 973 visit [Destination].

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I expect to visit [Destination] in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is likely that I visit [Destination] in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can see myself visiting [Destination] in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

974
 975 Your gender:
 976 Male (1)
 977 Female (2)
 978

- 979 Your age:
- 980 Under 18 (1)
- 981 18 - 24 (2)
- 982 25 - 34 (3)
- 983 35 - 44 (4)
- 984 45 - 54 (5)
- 985 55 - 64 (6)
- 986 65 - 74 (7)
- 987 75 - 84 (8)
- 988 85 or older (9)
- 989
- 990 Your highest level of education:
- 991 Less than high school (1)
- 992 High school graduate (2)
- 993 Some college (3)
- 994 2 year degree (4)
- 995 4 year degree (5)
- 996 Master's degree (6)
- 997 Doctoral degree (7)
- 998

999 **Table 1.** Virtual Reality: Types and Benefits

1000

VR	Examples and Literature
VR types	<ul style="list-style-type: none"> • Untethered/Mobile VR devices (e.g., Samsung Gear VR, Google Daydream, Google Cardboard) • Tethered VR devices (e.g., HTC Vive, Oculus Rift, OSVR) <p>*More headsets exist on the market, but the aforementioned are considered at the forefront of current VR developments (Greenwald, 2017)</p>
Benefits of VR in tourism contexts	
For customers	<p>Enhanced experiences (Bonetti et al., 2018; Moorhouse et al., 2018)</p> <p>Full immersion (Castro et al., 2017; Jones & Dawkins, 2018; Tromp, 2017)</p> <p>Engagement (Gibson & O’Rawe, 2018)</p> <p>Entertainment (Guttentag, 2010; Jung et al., 2018; Moorhouse et al., 2018; Tromp, 2017)</p> <p>Social interactions and connectivity (Castro et al., 2017; Jung et al., 2018; Moorhouse et al., 2018)</p> <p>Personalization (Moorhouse et al., 2018)</p> <p>Accessibility (Guttentag, 2010; Hobson & Williams, 1995)</p> <p>Image formation (Gibson & O’Rawe; Moorhouse et al., 2018)</p> <p>Place attachment (Pantelidis et al., 2018)</p> <p>Staged experiences (Hobson & Williams, 1995)</p>
For businesses and destinations	<p>Marketing and promotion (Gibson & O’Rawe, 2018; Williams & Hobson, 1995; Huang et al., 2016; Moorhouse et al., 2018)</p> <p>Sales and distribution (Gibson & O’Rawe, 2018; Hobson & Williams, 1995; Tromp, 2017)</p> <p>Revenue generation, upselling (Radde, 2017; Tromp, 2017)</p> <p>Planning and management (Guttentag, 2010)</p> <p>Heritage preservation (Guttentag, 2010; Hobson & Williams, 1995)</p> <p>Training (Guttentag, 2010)</p> <p>Competitive advantage (Jung & tom Dieck, 2017)</p> <p>Gamification (Xu et al., 2016)</p>

1001

1002

Table 2. Dimensions and Measurements of Presence

Key Literature	Definition and Dimensions	Measurements
Heeter (1992)	Types of Presence: <ul style="list-style-type: none"> • Personal presence – the extent to which the person feels like she/he is part of the virtual environment; • Social presence – the extent to which other beings also exist in virtual environment; • Environmental presence – the extent to which the environment itself acknowledges and reacts to the person in virtual environment. 	Conceptual
Lee (2004)	Types of Presence: <ul style="list-style-type: none"> • Physical Presence – a psychological state in which virtual physical objects are experienced as actual physical objects in either sensory or non-sensory ways; • Social Presence – a psychological state in which virtual social actors are experienced as actual social actors in either sensory or non-sensory ways; • Self Presence – a psychological state in which virtual self/selves are experienced as actual self/selves in either sensory or non-sensory ways. 	Conceptual
Slater (1999); Slater and Wilbur (1997); Slater, Steed and Usoh (1993); Slater, Usoh, and Steed (1994)	Aspects of Presence: <ul style="list-style-type: none"> • The sense of being there in the environment depicted by the virtual environment; • The extent to which the virtual environment becomes the dominant one (that participants will tend to respond to event in the virtual environment rather than the real world); • The extent to which participants, after the virtual environment experience, remember it as having visited a place rather than just having seen computer-generated images. 	Subjective measure, Slater, Usoh, and Steed (SUS) Questionnaire
Kim and Biocca (1997)	Dimensions of Presence as transportation: <ul style="list-style-type: none"> • Arrival – a feeling of being present in the virtual environment; • Departure – a feeling of separation from the physical environment. 	Subjective measure, questionnaire
Witmer and Singer (1992; 1999)	Subscales of Presence: <ul style="list-style-type: none"> • Involved/Control – perceived control of events in the virtual environments; • Natural – the extent to which the virtual environment was consistent with reality; • Interface Quality – whether control devices of display devices interfere or distract from task performance. 	Subjective measure, Presence Questionnaire (PQ)
Schubert, Friedmann, and Regensburg (2001)	Dimensions (lower-order factors) of Presence: <ul style="list-style-type: none"> • Spatial presence – the sense of being in virtual environment; • Involvement – the level of attention to real and virtual environments; • Realness – judgement of realness of virtual environments. 	Subjective measure, questionnaire
Wirth et al. (2007); Vorderer et al. (2007)	Dimensions of Spatial Presence: <ul style="list-style-type: none"> • Self-location – a feeling of being located in mediated environments; • Possible actions – perceived action possibilities in the virtual environments. 	Subjective measure, Spatial Presence Questionnaire (SPQ)

1005 **Table 3.** Study 1: Characteristics of Participants

Characteristics	Frequency	Percent	Characteristics	Frequency	Percent
<i>Gender</i>			<i>Education</i>		
Male	40	19.6	High School Graduate	3	1.5
Female	161	78.9	Some College	36	18.0
<i>Age (years)</i>			2-Year Degree	8	4.0
18 – 24	196	98.0	4-Year Degree	152	76.0
25 – 34	4	2.0	<i>Prior Experience</i>		
			Tried VR	0	0
			Visited destination	58	28.7

1006

1007 **Table 4.** Study 1: Factor Loadings, Composite Reliability (CR), and Average Variance Extracted (AVE)

	Factor Loadings	Composite Reliability	Average Variance Extracted
Self-Location		.911	.720
Self-Location → SELF_LOCATION1	.801		
Self-Location → SELF_LOCATION2	.833		
Self-Location → SELF_LOCATION3	.866		
Self-Location → SELF_LOCATION4	.891		
Possible Actions		.884	.656
Possible Actions → POSSIBLE_ACTIONS1	.860		
Possible Actions → POSSIBLE_ACTIONS2	.842		
Possible Actions → POSSIBLE_ACTIONS3	.793		
Possible Actions → POSSIBLE_ACTIONS4	.739		
Enjoyment		.938	.753
Enjoyment → ENJOYMENT1	.932		
Enjoyment → ENJOYMENT2	.878		
Enjoyment → ENJOYMENT3	.886		
Enjoyment → ENJOYMENT4	.776		
Enjoyment → ENJOYMENT5	.858		
Attitude Change		.899	.748
Attitude Change → ATTITUDE_CHANGE1	.887		
Attitude Change → ATTITUDE_CHANGE2	.897		
Attitude Change → ATTITUDE_CHANGE3	.808		
Visit Intention		.885	.722
Visit Intention → VISIT_INTENT1	.760		
Visit Intention → VISIT_INTENT2	.949		
Visit Intention → VISIT_INTENT3	.829		

1008

1009

1010 **Table 5.** Study 1: Correlations and Square Roots of AVE

	Correlation				
	(1)	(2)	(3)	(4)	(5)
(1) Self-Location	.848				
(2) Possible Actions	.759	.810			
(3) Enjoyment	.554	.526	.878		
(4) Attitude Change	.355	.337	.398	.865	
(5) Visit Intention	.118	.112	.132	.134	.850

Note: Square roots of AVE in the diagonal; AVE = average variance extracted.

1011

1012 **Table 6.** Study 1: Hypothesis Testing

Hypotheses	Path Coefficients	Support for Hypotheses
H1: Presence → Enjoyment	.620 (.000)	Supported
H2: Presence → Attitude Change	.240 (.006)	Supported
H3: Enjoyment → Attitude Change	.255 (.001)	Supported
H4: Attitude Change → Visit Intention	.333 (.000)	Supported

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1014 **Table 7.** Study 1: Direct and Indirect Effects

	Direct Effects	Indirect Effects
Presence → Enjoyment	.620 (.000)	
Presence → Attitude Change	.240 (.006)	
Enjoyment → Attitude Change	.255 (.001)	
Attitude Change → Visit Intention	.333 (.000)	
Presence → (Enjoyment) → Attitude Change		.158 (.001)
Presence → (Attitude Change) → Visit Intention		.080 (.010)
Presence → (Enjoyment) → (Attitude Change) → Visit Intention		.053 (.015)
Enjoyment → (Attitude Change) → Visit Intention		.085 (.011)

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1016 **Table 8.** Study 2: Characteristics of Participants

Characteristics	Frequency	Percent	Characteristics	Frequency	Percent
<i>Gender</i>			<i>Education</i>		
Male	314	43.4	No Formal Qualification	31	4.3
Female	410	56.6	GCSE/O-level	93	12.8
			A-level	128	17.7
<i>Age (years)</i>			Undergraduate Degree	224	30.9
18 – 24	146	20.2	Postgraduate Degree	171	23.6
25 – 34	149	20.6	Doctoral Degree	24	3.3
35 – 44	183	25.3	Professional Degree	53	7.3
45 – 54	139	19.2			
55 – 64	72	9.9	<i>Income</i>		
65+	35	4.8	Less than £20,000	192	26.5
			£20,000 - £39,999	245	33.8
<i>Prior Experience</i>			£40,000 - £59,999	123	17.0
Tried VR	181	25.0	£60,000 - £79,999	73	10.1
Visited destination	640	88.7	£80,000 - £99,999	48	6.6
			£100,000+	43	5.9

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1018 **Table 9.** Study 2: Factor Loadings, Composite Reliability (CR), and Average Variance Extracted (AVE)

	Factor Loadings	Composite Reliability	Average Variance Extracted
Self-Location		.915	.729
Self-Location → SELF_LOCATION1	.889		
Self-Location → SELF_LOCATION2	.891		
Self-Location → SELF_LOCATION3	.764		
Self-Location → SELF_LOCATION4	.865		
Possible Actions		.706	.706
Possible Actions → POSSIBLE_ACTIONS1	.747		
Possible Actions → POSSIBLE_ACTIONS2	.827		
Possible Actions → POSSIBLE_ACTIONS3	.917		
Possible Actions → POSSIBLE_ACTIONS4	.862		
Enjoyment		.922	.704
Enjoyment → ENJOYMENT1	.890		
Enjoyment → ENJOYMENT2	.921		
Enjoyment → ENJOYMENT3	.758		
Enjoyment → ENJOYMENT4	.816		
Enjoyment → ENJOYMENT5	.801		
Attitude Change		.850	.661
Attitude Change → ATTITUDE_CHANGE1	.868		
Attitude Change → ATTITUDE_CHANGE2	.927		
Attitude Change → ATTITUDE_CHANGE3	.609		
Visit Intention		.944	.848
Visit Intention → VISIT_INTENT1	.928		
Visit Intention → VISIT_INTENT2	.932		
Visit Intention → VISIT_INTENT3	.902		

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1020 **Table 10.** Study 2: Correlations and Square Roots of AVE

	Correlation				
	(1)	(2)	(3)	(4)	(5)
(1) Self-Location	.854				
(2) Possible Actions	.698	.840			
(3) Enjoyment	.435	.432	.840		
(4) Attitude Change	.525	.522	.627	.813	
(5) Visit Intention	.160	.159	.191	.125	.921

Note: Square roots of AVE in the diagonal; AVE = average variance extracted.

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1022 **Table 11.** Study 2: Hypothesis Testing

Hypotheses	Path Coefficients	Support for Hypotheses
H1: Presence → Enjoyment	.519 (.000)	Supported
H2: Presence → Attitude Change	.567 (.000)	Supported
H3: Enjoyment → Attitude Change	.116 (.003)	Supported
H4: Attitude Change → Visit Intention	.305 (.000)	Supported

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1025 **Table 12.** Study 2: Direct and Indirect Effects

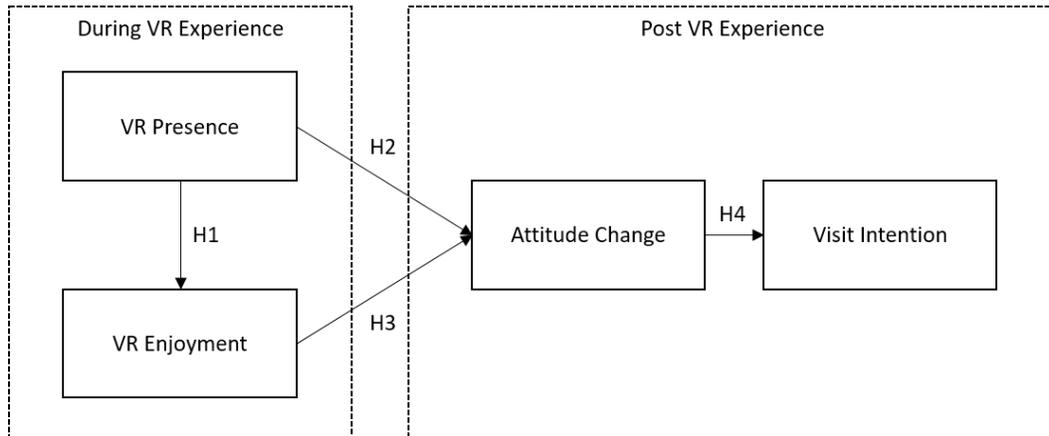
	Direct Effects	Indirect Effects
Presence → Enjoyment	.519 (.000)	
Presence → Attitude Change	.567 (.000)	
Enjoyment → Attitude Change	.116 (.003)	
Attitude Change → Visit Intention	.305 (.000)	
Presence → (Enjoyment) → Attitude Change		.060 (.002)
Presence → (Attitude Change) → Visit Intention		.173 (.000)
Presence → (Enjoyment) → (Attitude Change) → Visit Intention		.018 (.004)
Enjoyment → (Attitude Change) → Visit Intention		.035 (.005)

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1029 **Figure 1.** Research Framework and Hypotheses

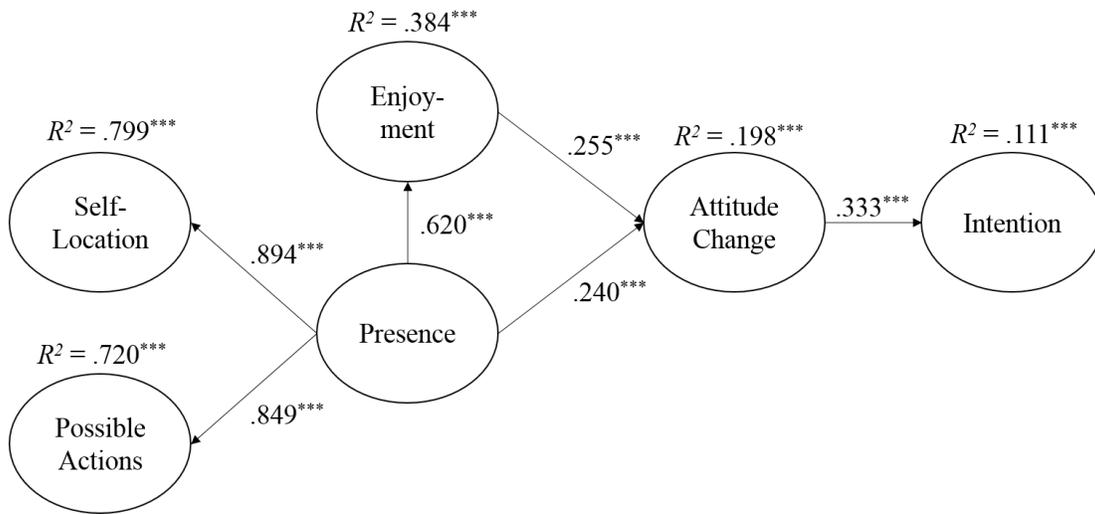


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1033 **Figure 2.** Study 1: The Structural Model



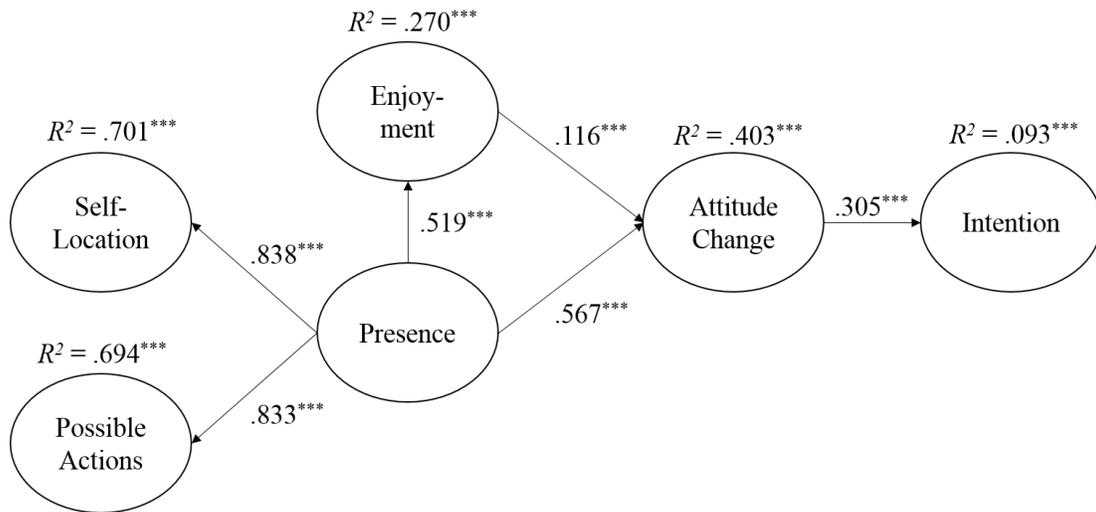
1034

1035 Model Fit Criteria: AIC = 6736.165; BIC = 6941.715; Sample-size Adjusted BIC = 6742.147; Chi-square =
 1036 233.977; df = 146; p = .000; RMSEA = .056 (90%: .042 - .069); CFI = .963; TLI = .957; SRMR = .047; N = 202.

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1039 **Figure 3.** Study 2: The Structural Model



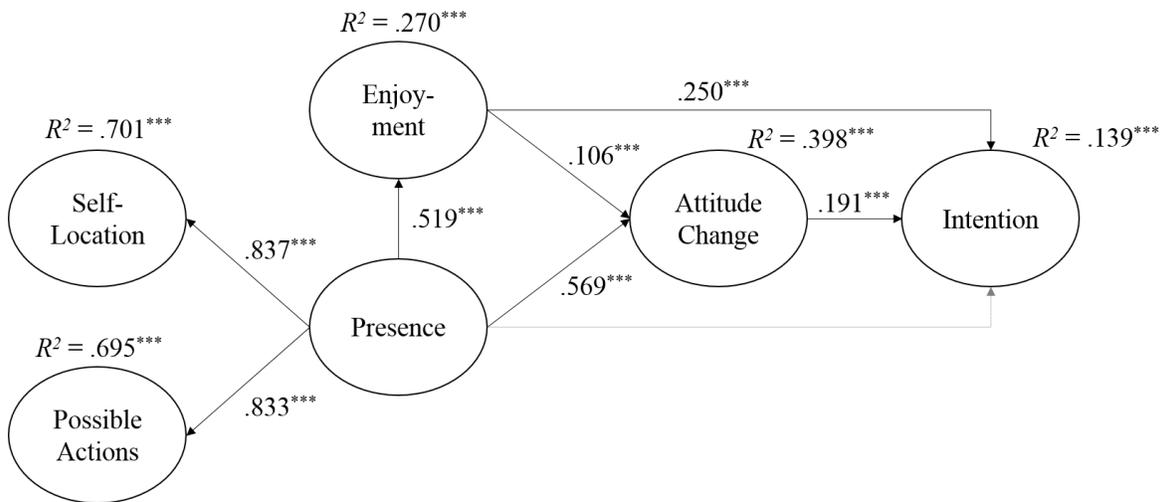
1040

1041 Model Fit Criteria: AIC = 23347.085; BIC = 23635.927; Sample-size Adjusted BIC = 23435.883; Chi-square =
 1042 673.059; df = 146; p = .000; RMSEA = .071 (90%: .065 - .076); CFI = .945; TLI = .935; SRMR = .087; N = 724

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1045 **Figure 4.** Study 2: An Alternative Model



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1047 Model Fit Criteria: AIC = 23314.791; BIC = 23612.803; Sample-size Adjusted BIC = 234612.409; Chi-square =
 1048 642.265; df = 144; p = .000; RMSEA = .069 (90%: .064 - .075); CFI = .948; TLI = .938; SRMR = .069; N = 724

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