INTERNET ADDICTION CONTINUUM AND ITS MODERATING EFFECT ON AUGMENTED REALITY APPLICATION EXPERIENCES: DIGITAL NATIVES VERSUS OLDER USERS

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Abstract

Problematic online usage (POU) and Internet addiction (IA) lack a refined classification. Using 796 questionnaires, this study is the first to reveal a continuum ranging from *Casual users* (i.e., older users) to *Addicts* (i.e., digital natives) acknowledging five different severity levels of POU to IA. Depending on where users are located within the addiction continuum, usability of augmented reality (AR) applications has different effects. Most interestingly, the experience of *Casual users* is triggered by enjoyment, whilst enjoyment exerts a negative effect on the emotional and action experiences of *Addicts-in-denial*. The study provides actionable implications for IA, POU, and AR behaviour.

Keywords

Augmented reality, experience design, Internet addiction, Internet addiction continuum, emotional perception, mobile applications, digital natives, enjoyment, entertainment, behavioural intention

1 INTRODUCTION

Excessive Internet use resulting in adverse health conditions is a significant public health concern (WHO, 2021). It is defined as a "non-chemical (behavioural) addiction which involves human–machine interaction" (Griffiths, 1995, p. 15) that increases over time (Pan et al., 2020). In general, people spend more time on their phone than with their family (Techjury, 2019). Especially digital natives, i.e., Internet users born between 1997 and 2012 are among the heaviest users (Dimock, 2019). Studies indicate that digital natives prioritize using their phones over seeing their loved ones (Die Presse, 2018), with some (71%) admitting to taking their phone to the toilet (Marketagent.com, 2018), and 8% even claiming their smartphone is a part of their bodies (Knechtsberger & Schwabl, 2019). Thus, one in four children and adolescents exhibit problematic smartphone use, which may increase potential distractions that may expose users to various health and other risk factors (Sohn et al., 2019). These findings imply that addictive behaviour towards the Internet or a technology (i.e., smartphones) is a critical issue that must be considered in designing digital services and experiences.

From a theoretical point of view, there is an increasing number of studies dealing with smartphone addiction (see reviews by James et al., 2023). Previous scholars have argued that Internet and smartphone addiction share similarity in terms of users' characteristics, such as personality traits, interpersonal relationships, and communications (Cocoradă et al., 2018). Lopez-Fernandez et al. (2017) suggests high correlations between smartphone addiction and Internet usage behaviour. Importantly, Panova and Carbonell (2018) emphasise that the smartphone itself is just an object, comparable to the glass in the case of alcohol addiction or the needle in the case of drug addiction. Thus, the smartphone is not the problem per se. Instead, it facilitates constant access to the addictive Internet, or more precisely the online activities (e.g., gaming, social media) users engage in while using the smartphone, thereby leading to

continued usage of the Internet (Jeong et al., 2016; Lopez-Fernandez et al., 2017). Besides that, there is an ongoing discussion about whether one should research problematic online usage (POU) or actual Internet addiction (IA). In this vein, Yu and Sussman (2020) emphasize that, so far, POU and IA are either not defined, used interchangeably, or treated separately. To clarify the ambiguity between POU and IA, this paper (1) develops a continuum that presents the different manifestations, and (2) assesses a moderating effect of the revealed IA continuum on the usage experiences of online applications. In doing so this research explores augmented reality (AR) applications that recently gains more popularity.

AR allows mobile users to view the real surrounding overlaid with computer-generated information, such as text, images, videos, or 3D animations, by using smartphones. Considering the contribution of AR to positive perceptions such as enjoyment (Tussyadiah et al., 2018), entertainment (Jung et al., 2016), and playfulness (Olsson et al., 2013), AR applications have been applied into various areas, such as retail, education, remote technical support, and tourism. While prior research has recognised the potential of AR for marketing purposes (Rauschnabel et al., 2019), knowledge about user experiences of the application is scarce (Park & Stangl, 2020). In particular, the effects of AR usability on emotional perception, experience, and its overall influence on behavioural intention remains unexplored. Usability is a crucial factor in user satisfaction (Jang & Park, 2022) and adoption of technology (Hoehle & Venkatesh, 2015) as it refers to the ease and usefulness of a system (Atkinson et al., 2007). Highly usable systems tend to be more engaging and enjoyable to use (McLean & Wilson, 2019), leading users to spend more time on them (Van der Heijden, 2004). From the users' point of view, learning theory explains that people may develop habitual and addictive behaviour through operant conditioning by actively seeking pleasurable gratifications (Marlatt

et al., 1988). Consequently, the usability of systems and the positive emotions users experience when accessing the Internet may contribute to POU and IA.

Joint considerations of AR applications and POU/IA are highly limited. Zsila et al. (2018) only examine the relationship among gaming motivations, POU, and impulsivity. Accordingly, the current study intends to shed light on the dynamic mechanism of positive AR application experiences by comparing different groups of application users (i.e., digital natives and older generations) who reflect a continuum of IA. Thus, the first objective of the current research is to assess the sequential mechanism of AR application experiences and the potential effects of AR on user experience. The second objective is to understand how different levels of IA severity moderate the perceived positive emotions, experiences, and AR usage intentions.

The theoretical contribution gained from the current research in general and in relation to digital natives is threefold. First, the study discloses an IA continuum that comprises five groups of Internet usage severity (i.e., *Casual users*, *Initial users*, *Experimenters*, *Addicts-in-denial*, and *Addicts*) and their profiles. Second, it explains the moderating effect of the IA continuum on the perceived emotions, perceived experience, and usage intentions. Third, it provides general insights into how cognitive and emotional AR perceptions affect experience and behavioural intention. Managerial implications for AR application experience design are provided, emphasising the importance of tailoring to the needs of the identified user groups within the continuum.

2 LITERATURE REVIEW

2.1 Internet addiction

Mo et al. (2018, p. 86) defined IA "as a psychological dependence on the Internet [which] is characterised by an increasing investment of resources on Internet-related activities, unpleasant

feelings when off-line, an increasing tolerance to the effects of being online and denial of problematic behaviour". Typical compulsive disorder behaviour includes remaining online longer than intended and the constant urge to go online until other people complain about it (Widyanto et al., 2011). Accordingly, Griffiths (2000a, 2000b) discussed IA's core components, including salience (activity becomes most important in life), mood modification (feeling of high or escape), tolerance (increasing amounts of activity is required), withdrawal symptoms (unpleasant feeling when activity is discontinued/reduced), conflict (between addict and people around him/her), and relapse (reversion after abstinence). Research has indicated that IA can affect individuals of all ages, but it is more prevalent among digital natives (Mo et al., 2018). Smartphones are the primary device that facilitates IA as it allows accessing the Internet everywhere and all the time (Cocoradă et al., 2018; Yu & Sussman, 2020).

Yu and Sussman (2020) theoretically propose that smartphone addiction may fall along a continuum of dysregulated behaviour, from mild POU to more extreme. Similar continuums have been identified in the context of alcohol (Horn et al., 1984), gambling (Cowlishaw et al., 2019), drugs (May et al., 2016), gaming (Kuss & Griffiths, 2012), and social media (Grau et al., 2019). All these studies have argued that rather than examining addiction as a dichotomous entity of whether an individual is addicted or not, it should be investigated as a continuum that ranges from low to intermediate and high (Kuss & Griffiths, 2012). Some researchers (Whang et al., 2003; Young, 1996) have suggested a continuum ranging from non-addicts to possible addicts and addicts. For consumption addiction in general, Martin et al. (2013) suggested a continuum ranging from non-use to non-addictive use, near addiction, and addiction. However, boundaries between various stages remain unclear (Clark, 2011). Thus, Shaw and Black (2008) concluded that a better understanding of IA is needed with regard to levels of severity.

Another stream of the literature has shown that IA may be part of a lifestyle in a way that Internet usage is regarded as a means to learn, gain knowledge, communicate, or maintain relationships (Kurniasih, 2017). Digital natives view the Internet as a "means of survival", requiring them to carry their phones at all times (Sharma et al., 2017). This has led to calls for amending the education system to cater to the digital generations' needs (Kivunja, 2014) as well as for adopting virtual reality as a type of cognitive behavioural therapy (Zhang & Ho, 2017).

2.2 **Augmented Reality**

AR is defined as an augmentation of the real world by using virtual content, such as images, videos, or 3D through a technological device. The topic is eliciting an increasing interest amongst practitioners and academics. Accordingly, AR has been explored in many areas as reported in recent reviews by Dey et al. (2018) and Wei (2019). The key advantage of AR is its capability to assist users' mental imagery by offering a clear and augmented representation of products, services, and experiences (McLean & Wilson, 2019). Therefore, in the absence of technical issues which means a high level of usability (Yung & Khoo-Lattimore, 2019), AR improves consumers' utilitarian and hedonic experiences (Riar et al., 2021).

The literature emphasises the importance of the cognitive (i.e., usability) and affective (i.e., emotional perception) aspects of AR applications. On the cognitive side, technical issues and usability are the biggest challenges. Getting usability right is imperative because it constitutes a critical determinant for users' experience and adoption (Hoehle & Venkatesh, 2015). Although a vast amount of usability studies exist, Dey et al. (2018) reported in their review that only 10% are actual user studies, and thus, understanding remains limited. Studies have

identified usability principles, such as usefulness, good graphic design, ease of use, user control, clear navigation, consistency, and interaction (Atkinson et al., 2007), which should be assessed. Ko et al. (2013) confirmed the claim of other authors to include enjoyment as an emotional perception to explain why some systems are successful. Emotions in such sense are affective responses or experiences induced by interactions between users and a system (McLean et al., 2018) that result in users' behavioural intention decisions (Thüring & Mahlke, 2007) which may differ depending on how problematic a person's usage of a system is (e.g., Marlatt et al., 1988). The experience design literature emphasises emotional perception, such as enjoyment, playfulness, and entertainment level, as an outcome of system usage in general and AR applications in particular (Holdack et al., 2020; Li & Fang, 2020).

As discussed, a delightful user experience depends on the cognitive (i.e., usability) and affective (i.e., emotional perception) components of AR applications. Holbrook and Hirschman (1982) modelled those links, arguing cognition affects emotions, which in turn influence experiences and other outcome variables. Answering the call for more studies to examine the aforementioned variables (Dey et al., 2018; Yung & Khoo-Lattimore, 2019), our conceptual model (Figure 1) suggests that usability affects users' emotional perception, which influences their experience and behavioural intention. By building on knowledge regarding behavioural profiles (e.g., Grau et al., 2019; Martin et al., 2013), we introduce the level of severity of IA as a moderator. The specifics of each construct and the corresponding hypotheses are discussed in the succeeding chapter.

INSERT FIGURE 1 HERE

3 HYPOTHESIS DEVELOPMENT

3.1 Usability and emotional perception

Usability refers to the clarity of a system that typically comprises components such as usefulness, ease of use, good graphic design, user control, and clear navigation structure (Atkinson et al., 2007). It plays a role as an antecedent of emotional perceptions (McLean et al., 2018), through which the different assessment patterns of users may lead to varying emotional levels that are critical for understanding consumer perceptions. This phenomenon reflects appraisal theory that regards emotions as the result of an assessment process. Emotions are "at the heart of any human experience and an essential component of user-product interactions" (Forlizzi & Battarbee, 2004, p. 264). The interaction with AR applications can evoke various emotions, which according to previous research are enjoyment, playfulness, and entertainment (Holdack et al., 2020).

Enjoyment is defined as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis et al., 1992, p. 1113). Scholars have regarded enjoyment as critical, particularly in the context of mobile applications (Alalwan et al., 2018). Park and Yoo (2020) posited that the use of AR applications stimulates sensory feelings and a sense of immersion; it also creates fun/entertainment and pleasure. Entertainment is an emotional reaction to situation-specific stimuli that must be interpreted (Oliver, 1993). In AR context, entertainment is an emotion, such as fun (Park & Yoo, 2020), which is triggered by the usage of an application. The entertainment value of AR applications is suggested to be higher if a clear navigation structure (Li & Fang, 2020) and user control (Leung, 2003) are available. Playfulness refers to the intrinsic feelings of an individual when s/he is heavily engaged in an activity, such as using an AR application (Javornik et al., 2016).

Summing up, the way in which users evaluate usability of ubiquitous technology (e.g., mobile-based AR) in terms of its functional aspect exerts influences on users' affection (Kim et al.,

2013) and/or the hedonic aspect of a system (Van der Heijden, 2004). Consequently, we hypothesise:

H1–H3: AR application usability positively affects emotional perceptions, i.e., enjoyment, playfulness, and entertainment.

3.2 **Emotional perception and experience**

Emotional perceptions as the result of a cognitive assessment (usability in the current study) shape users' experiences. This condition implies that one part of our brain (i.e., the amygdala) contributes to experiences by enhancing a person's attention and encoding information, such as the perception of emotions. An experience comprises several dimensions, including cognitive (i.e., action experience) and emotional (Wang et al., 2012). Schmitt (1999) described action experience as the combination of creative and cognitive aspects and the physical operations that make users think, whilst emotional experience comprises senses and feelings. In the context of POU and IA this differentiation between cognitive and emotional experience seems imperative as grounded in the dual process theory, people often face a battle between "passion" and "reason" with regards to their addictive behaviour (Hofmann et al., 2009).

As a concept in human-computer interaction, action experience has been mostly disregarded. For emotional experience, empirical evidence shows that it is a consequence of emotional perception dimensions, such as fun and enjoyment (Zhou & Lu, 2011). Concerning mobile users, Sheng and Teo (2012) reported a positive relationship between entertainment and customer experience and McLean et al. (2018) suggested the association between enjoyment and customer experience. A few AR-related studies have reported that positive experiences are the outcome of enjoyment (Tussyadiah et al., 2018), entertainment (Jung et al., 2016), and playfulness (Javornik et al., 2016). Therefore, we propose:

H4–H9: AR application emotional perceptions (i.e., enjoyment, playfulness, and entertainment) positively affect action and emotional experiences.

3.3 Experience and behavioural intention

AR has been acknowledged as a tool that can improve user experiences (Tussyadiah et al., 2018). In fact, He et al. (2018, p. 133) provide evidence on the effect of AR design on tourists' experiences and subsequent behavioural intentions. Previous studies have also demonstrated a positive relationship between cognitive and emotional perceptions and behavioural intention (e.g., Van der Heijden, 2004). The implementation of affective components in mobile applications and its impact on user experience is strongly related to usage intention (Hur et al., 2017) and actual usage (Yang et al., 2018). However, in the field of tourism and information technology, only a few studies explored different dimensions of experiences. One such study is Zhu and Wang's (2022) investigation of AR in a museum, which presents different experiences influencing brand attitude, usage and purchasing intention. Users with negative experiences not only reduce or stop using technology but also affect the usage behaviour of other users negatively (Jung et al., 2016; Poushneh & Vasquez-Parraga, 2017), thus, we examine the impact of different dimensions of user experience on user behavior and suggest:

H10 and H11: Action and emotional experiences exert a positive effect on behavioural intention concerning an AR application.

3.4 Moderator: Internet addiction level

McLean and Wilson (2019) argue that usability makes systems more engaging and enjoyable, which may lead to users spending more time on them. Also, positive emotions such as enjoyment, playfulness, and entertainment lead to positive outcomes such as high engagement or better experiences (Turel & Serenko, 2012). On the downside, the socio-cognitive model of

unregulated use (LaRose et al., 2003) posits that such expected positive outcome can reinforce usage till it becomes problematic, compulsive or addictive. Learning theory supports this idea that active seeking for pleasurable gratifications can induce habitual and addictive behaviour through operant conditioning (Marlatt et al., 1988). If individuals have joyful experiences, they get absorbed into the process and are happy to put more effort, concentrate for a longer period of time, process more information, and may even make it a central part of their life (Turel & Serenko, 2012).

While many studies have focused on ways to increase usability and enjoyment to trigger usage, it is important to consider potential risks of technology (Turel & Serenko, 2012). People who are addicted to technology are more likely to exhibit a positive attitude towards technology in general and services offered by technology in particular (Cocoradă et al., 2018). Peele (2010) stressed that IA is a continuum of feelings and behaviour accompanied by different emotions. Hence, heterogeneous levels of enjoyment, entertainment, and playfulness resulting from experiences can be expected when using the Internet in accordance with the different levels of the addiction continuum. Note that based on previous literature it is not possible to say that perceived emotions or the experience will result in a positive or negative impact the higher up a person is on the IA continuum as different manifestations of addiction result in complex and varying perceptions along an addiction continuum (Korn & Shaffer, 1999). Hence, we postulate:

H12–H14: The relationships between usability and emotional perception, emotional perception and experience, and experience and behavioural intention are moderated by the level of severity of IA.

4 METHODOLOGY

4.1 Research context

Our model was tested using the example of the AR application Layar, which is a triggered technology (Edwards-Stewart et al., 2016) as it uses paper markers to activate augmented digital content. In other words, Layar brings printed (marketing) material (e.g., business cards, posters, magazines/newspapers) alive as it creates AR experiences by augmenting documents with digital content such as videos, image carousels, 360-degree pictures, audio or links to specific websites or platforms such as social media. Layar (https://www.layar.com/about/) was founded in 2009 and soon achieved international fame, so that thousands of developers started to create AR content using Layar and millions downloaded the app. Today, Layar is part of the Blippar group who collaborates with multi-national companies such as Coca-Cola, Procter & Gamble, Glamor, or BMW.

4.2 Study design

We conducted a self-administrated online survey. The questionnaire started with questions about participants' Internet addition (Widyanto et al., 2011), items to uncover their prior augmented reality knowledge and familiarity with Layar, app proneness, exploratory behaviour, mobile technology knowledge and skills, and the time spend online. In part 2, a video was embedded in the questionnaire to show the functionalities of the app (see https://www.youtube.com/watch?v=ZR4eSmmPCxg). Next, each study participant was asked to download Layar and experience at least one of the provided examples, i.e., a cover page of a newspaper where Layar allowed watching a video, a football league table that could be completed, or a promotional leaflet where people could slide through pictures (Figure 2).

INSERT FIGURE 2 HERE

After trying the app, participants returned to the questionnaire, reported which AR enriched example/s they tried and shared their experiences with Layar. First, they evaluated usability (Hoehle & Venkatesh, 2015) and affective aspects, i.e., enjoyment (Van der Heijden, 2004), playfulness (Holbrook et al., 1984), and entertainment (Lastovicka, 1983). Second, they provided responses to action and emotional experiences (Wang et al., 2012), and, finally, to behavioural intentions (Shin, 2009). We used a 6-point Likert Scale from 1 "strongly disagree" to 6 "strongly agree". Demographics closed the questionnaire. See Appendix I for constructs and item details.

After a pretest among 43 digital natives, 796 usable questionnaires were collected at a university in the United Kingdom. Out of the total sample, 71.2% tried the promotional leaflet, 57.8% the football league table, and 55.2% the newspaper example. On average, a person tried 1.84 examples, with 32.7% trying all three examples, 18.8% trying two examples, and 48.5% trying only one example.

4.3 **Data analyses**

The data analysis comprised two main steps. First, given the central aim concerning the moderating effect of different severity levels of POU/IA on the research model, participants were categorized into distinct clusters based on their responses to the IA scale (Widyanto et al., 2011) using the Typology Representing Network TRN-32 toolkit (Mazanec, 2008). This approach leverages the power of neural network models for clustering and has been found to provide superior stability of segmentation solutions compared to traditional clustering methods such as k-means (Ganglmair & Wooliscroft, 2000). To ensure the validity of the resulting clusters, we employed two commonly used indicators: the weighted Simple Structure Index

(wSSI) to determine the correct number of groups and the Percentage of Uncertainty Reduction (%UR) to investigate cluster stability (Mazanec & Strasser, 2000). Names used for continuum levels of substance use (e.g., alcohol and drugs) are used (e.g., American Addiction Centers, 2020) as an inspiration to label the revealed groups on the IA continuum according to their severity. We also investigated the profile of each cluster and examined the age distribution, with the goal of identifying whether there were age differences between the identified IA severity clusters and to understand which cluster(s) fall into the digital natives group. Finally, we further profiled the various addiction groups considering gender, mobile technology knowledge and skills, app proneness and exploratory behaviour, and time users spent online. To determine significant differences, we used ANOVAs followed by Games Howell post-hoc tests.

For the second main step, we used the identified IA severity groups (considering revealed knowledge about differences between digital natives and older users) as a moderator in the Structural Equation Model (SEM), applying Mplus (Muthén & Muthén, 2007) with the robust MLM estimator (Satorra & Bentler, 1994). To test the model as well as the multi-group comparisons we followed common notions (Baron & Kenny, 1986; Diamantopoulos et al., 2012; Hair et al., 2019).

5 RESULTS

5.1 Sample description

The average age of the participants is 25.70 (STD = 11.44), of which 74.2% are digital natives (i.e., 24 years old and younger). More females (59.4%) answered the questionnaire. Before this study, 49.9% have heard about AR and 26.4% of the Layar app. On average, digital natives are 6.03 hours online (STD = 3.97), while older people spent 4.69 hours online (STD = 4.01; *p*

< 0.001), of which digital natives spent the entire time (i.e., 6.02 hours, STD = 4.20) on their smartphone - this also applies to older users (i.e., 4.48 hours, STD = 4.29).

5.2 Internet addiction continuum

An inspection of various cluster solutions resulted in five groups being favoured. The weighted Simple Structure Index (wSSI) for a five-cluster solution is at a very satisfactory level of 0.56 and the uncertainty reduction of 50 replications yields 86.98% (robustness = 0.93). Figure 3 provides the cluster prototypes.

INSERT FIGURE 3 HERE

Cluster 1 (14.86%, n = 119): As Figure 3 shows, participants disagree with all the IA items, thus, this group is called *Casual users*. We do not refer to them as non-addicts as on average they score 1.97. This means that while they do not show POU or addictive behaviour, they still seem to be inclined to go online.

Cluster 2 (22.86%, n = 183): This group rates all the items low, but they stay online longer than they plan. They are also in the middle of the answer scale for neglecting household chores. Considering category names inspired by substance abuse, this cluster is termed *Initial users*.

Cluster 3 (21.98%, n = 175): Participants score just above the midrange for all the items. This is the first group that feels depressed, moody, or nervous when they are not online, which disappears once they are connected again. We name this group *Experimenters*.

Cluster 4 (17.96%, n = 141): Individuals in cluster 4 indicate addictive behaviour, which means that they neglect chores to spend time online, they form new relationships online, and others complain about how much time they spend online. However, they do not report or admit that

they get anxious or depressed when they are not online. Thus, again using a name inspired by substance abuse categories, they are referred to as *Addicts-in-denial*.

Cluster 5 (22.36%, n = 178): In contrast to the previous groups, cluster 5 agrees with all the items. They show IA behaviour and recognise its negative impact on their life. Thus, they are labelled *Addicts*.

Figure 4 summarizes the levels of severity on the revealed IA continuum.

INSERT FIGURE 4 HERE

In view of previous literature (e.g., Peele, 2010; Pénard et al., 2013), we profiled the five groups (see Table 1). An examination of age shows that *Casual users* (on average 33.4 years) and *Initial users* (on average 26.1 years) tend to be older. The three groups who are higher up the addiction scale are digital natives with an average age between 22.8 to 24.3 years of age. Gender was not significant. In terms of mobile technology knowledge and skills, *Addicts* and *Addicts-in-denial* (i.e., digital natives) are equally confident while there is a decrease towards the older *Casual users'* side of the continuum. There is also a decrease in app proneness and exploratory behaviour. While *Addicts* are the keenest, *Addicts-in-denial* and *Experimenters* are less eager followed by *Initial users* and *Casual users* who are least interested in apps and exploring. Hence, digital natives are more prone to apps and exploratory behaviour than older users. In addition, digital natives spend more time online. In fact, the time users spend online increases with the addiction level confirming the underlying issues of the IA manifestations of the various groups. Digital natives, i.e., *Addicts* spend significantly more time (1.6 times more!) online than *Casual users*. *Addicts*, *Addicts-in-denial*, and *Experimenters* spend about the same time online. Interestingly, *Initial users* report that they stay online longer than intended, however, the 4.68 hours they on average spend online per day seems to be quite moderate.

INSERT TABLE 1 HERE

5.3 **Model testing**

The measurement model and the structural model meet all the required standards. The factor loadings are between 0.727 and 0.910, which is well above the suggested value of 0.7 (Hair et al., 2019). Composite reliability measures were between 0.768 and 0.948 (values should be within the range: 0.70 and 0.95; Diamantopoulos et al., 2012). The AVE values of all constructs were > 0.625 and thus above the recommended 0.50. A comparison of the AVE and correlations of the constructs confirmed discriminant validity for all constructs apart from between emotional and action experience (Fornell & Larcker, 1981). However, the Fornell-Larcker criteria is perceived as very conservative (Voorhees et al., 2016) and following Krause (2012), one should not only purely believe in mathematical calculations and rather revisit the items for appropriateness. The review indicated that the constructs differ as action experience focuses on the cognitive side which is different from emotional focus of the second construct. Also, the differentiation is of theoretical importance as addicted people lose cognitive control and are often emotionally driven (Hofmann et al., 2009). As a result, all the indices are at a satisfactory level: RMSEA is 0.065, SRMR is 0.082, the CFI is 0.916, and TLI is 0.905.

Before the interpretation of the multi-group results, we followed the notion of Baron and Kenny (1986) and revealed group differences. Results show that the findings for the various groups are different; only 6 group path comparisons out of 99 are not significant. For details, refer to Table 2.

Regarding the model results (Table 2), an interesting but not surprising finding is that usability is highly important for all emotional perception constructs (i.e., entertainment, playfulness, and

enjoyment). This is true for all IA severity groups but is highest for *Initial users* (G2) who also have the strongest effect on behavioural intention. Interestingly for *Addicts-in-denial* (G4) (who represent digital natives) entertainment has the strongest impact on both types of experiences while enjoyment has a negative impact on both (for *Addicts* (G5) that impact of enjoyment on both experiences is lowest). Generally, the emotional experience for all groups is driven by entertainment. Playfulness has the highest impact on emotional and action experience for *Initial users* (G2) and *Addicts* (G5). Enjoyment is not relevant for *Initial users* (G2) but is most important for *Casual users* (G1) and has the strongest impact on emotional and action experience for that older user group (G1). In terms of behavioral intention, for all groups besides for casual users only the emotional experience is relevant. Thus, the cognitive side of an experience only affects older users, which are the *Casual users*, who also have the lowest impact of the emotional experience on future behaviour.

Surprisingly, the β-coefficient for emotional experience on behavioral intention for *Addicts-in-denial* (G4) is above one, also known as Heywood case (Dillon et al., 1987). To rule out multicollinearity (Kline, 2011) and the possibility of an inflated estimate (Dillon et al., 1987), we checked the variance inflation factor, tolerance, and residuals, which all were satisfactory. Also, the coefficients can be interpreted as regression coefficients, which implies that values greater than one are acceptable. Thus, the model is successful.

INSERT TABLE 2 HERE

6.0 DISCUSSION

6.1 Theoretical implications

The primary objective of this study was twofold: First, we aimed to contribute to clarifying the ambiguity between POU and IA by developing a continuum that presents the different

manifestations. Second, our study added to a better understanding of the moderating effect of the revealed IA continuum on the usage experiences of AR applications. Thus, the key theoretical contributions are as follows: 1) to present a general IA continuum that ranges from *Casual users* to *Addicts*, to provide profiles for the five groups on the continuum, and to show where digital natives compared to older users are on this continuum; 2) to shed light onto the moderating effect of the severity of IA on the perception and experience with an AR application, emphasising differences between digital natives and older users, and 3) to provide general insights into how cognitive and emotional AR perception aspects affect experiences, and subsequently, behavioural intention. In this regard, the current research contributes to knowledge regarding the negative consequences of technology usage, the field of system experience design, and marketing in general.

Considering the major indicators of IA (Widyanto et al., 2011), this study identified five levels of Internet usage manifestations with digital natives being part of the three severity levels higher up the continuum while older users occupy the two least addicted groups. The identification of five addiction levels is in line with previous studies that have concurred that IA is a continuum rather than a dichotomous differentiation between addicted and not being addicted (e.g., Grau et al., 2019; Kuss & Griffiths, 2012). Thus far, however, continuum levels suggest a range from low to intermediate and high addiction (Kuss & Griffiths, 2012) or from non-addicts to possible addicts and Internet addicts (Young, 1996). Thus, this research suggests a more refined insight by identifying a continuum of five different addiction groups – which is similar to general addiction continuums (e.g., Martin et al., 2013).. People with the highest compulsion to go online are called *Addicts* (which are digital natives), whilst the group who goes online the least are referred to as *Casual users* (which are older users). The fact that the least addicted group is called *Casual users*, means our research follows the terminologies

proposed by Kuss and Griffiths (2012) as the term "non-addicts" (Young (1996) is not used. The three newly identified groups between the two continuum extremes, which were previously summarised as intermediate (Kuss & Griffiths, 2012) or possibly addicted (Young, 1996), are called *Initial users*, *Experimenters* and *Addicts-in-denial*. An interesting insight is the significant increase in the time of staying online and neglecting household chores of *Addicts, Addicts in denial, and Experimenters (i.e., digital natives)* compared to *Casual users*. Meanwhile, digital natives of the *Addicts-in-denial* group admit that they stay online longer than intended (similar agreement level as *Addicts*), neglect household chores and have other people complaining about the excessive time they spend online; however, they do not report (or admit) feeling depressed or having bad temper when they are not online. The existence of denial is consistent with the result of Grau et al. (2019). For the profiles of the five groups, as expected, a clear difference exists between *Addicts* (digital natives) and *Casual users* (older users). Confirming previous studies (Mo et al., 2018), digital natives in the *Addicts* group tend to be younger, more prone to download new applications and more exploratory. They spend more hours online and have better mobile technology knowledge and skills compared to older users (i.e., *Casual users)*. Thus, suggestions that more time online results in an expert status are supported (Pénard et al., 2013). Although the profiles of the groups between the continuum endpoints are not as distinguishable (Clark, 2011), the observation that *Addicts-in-denial* are similar to *Addicts* is interesting. *Initial users* are considerably different from the more addicted groups of digital natives, but they also differ from *Casual users*. *Initial users* behave similarly to the less addicted, older, *Casual users* only in terms of application proneness and time spent online.

The results of the current study confirmed that Internet users are not a homogeneous group, but instead, usability, emotional perceptions, experiences, and behavioural intention depend on the

level of severity to which users belong to, within the IA continuum. Given the effect of usability on emotional perception, previous studies have claimed that heavy users/digital natives want to be in control, resulting in a higher demand for well-designed systems for more addicted users (Jang et al., 2016). Our research shows that the effects of usability on entertainment, playfulness, and enjoyment are the lowest for the older, the least addicted group, i.e., *Casual users*. Thus, we confirm that usability is highly important for digital natives which belong to the more addicted groups, who spend more time online (e.g., Griffiths, 1998) and exerts a strong influence on their emotional perception.

Although research that examined the link between emotional perception dimensions, such as entertainment, playfulness and enjoyment, and users' experiences is extremely limited, evidence exists that positive emotions are generally overtaken by negative ones as users move up the continuum (Korn & Shaffer, 1999), and consequently, experiences are negatively affected (Jung et al., 2016). Our research is the first to demonstrate that entertainment exerts a strong positive effect on emotional experience for all the groups in an AR context. In terms of action experience, entertainment is also significant, but it exhibits less effect than emotional experience. Moreover, we highlight that entertainment exerts a particularly strong effect amongst *Addicts-in-denial* on emotional and action experiences while enjoyment has a negative influence on their experiences. So, *Addicts-in-denial* seem to be highly entertained but do not enjoy their experience which might show their struggle with denying their addiction. They admit being entertained but cannot admit enjoying it, resulting in a negative impact on their emotional and their action experience. Interestingly enjoyment also has only a minor positive impact for *Addicts*, is not relevant for *Initial users* at all but has a quite strong impact on the experiences of *Casual users*. For the other addiction groups, our study confirms the tendency that enjoyment level decreases as it moves towards digital natives' higher addiction levels

(Grau et al., 2019; Korn & Shaffer, 1999) for emotional and action experiences. Generally, our results seem to confirm (Korn & Shaffer, 1999) that there is no clear direction in terms of impact of the different severity levels (IA continuum) on the perception and future usage of an AR app but a wide array of different issues incorporating the benefits and struggles of each IA group such as contradictive feelings can be observed.

In line with previous studies that showed that negative experiences not only reduce or stop the use of technology (Jung et al., 2016; Poushneh & Vasquez-Parraga, 2017), we contribute by demonstrating that emotional experience exerts a positive effect on behavioural intention. Action experience, which drives users to contemplate (Schmitt, 1999), only affects the behavioural intention of the older, *Casual users*. Thus, the combination of cognitive aspects and physical operation experience components (Schmitt, 1999) is irrelevant for the intention of the more addicted digital natives. This means the battle between "passion" and "reason" with regards to their addictive behaviour (Hofmann et al., 2009) does not seem to be prevalent in the IA context, instead more severely addicted user groups are driven by their emotional experience only. At the same time there seems to be a battle between feeling entertained and not allowing oneself to feel enjoyment. The only group who also considers the cognitive experience in terms of future behaviour are *Casual users* who also allow themselves feeling enjoyment. Theoretically, the results confirm the importance of differentiating between emotional and action experience (Wang et al., 2012).

From a general perspective, our study contributes to the knowledge of information system experience. Our study confirms that usability is an antecedent of emotional perception (McLean et al., 2018). In particular, usability exerts the strongest effect on enjoyment, followed by entertainment and playfulness. Therefore, the current study supports the crucial role of

enjoyment in the context of mobile applications (Alalwan et al., 2018) and that usability triggers playfulness (Li & Fang, 2020). In terms of entertainment, this study is the first to study usability instead of more specific constructs, such as control or navigation structure (Li & Fang, 2020). Emotional experience is clearly driven by entertainment, followed by playfulness and enjoyment. First insights into action experience in an AR context exhibit that playfulness is the strongest driver, followed by enjoyment, whilst entertainment exhibit the weakest effect. Emotional experience is considerably strong with regard to influencing users' behavioural intention. Interestingly, action experience, which is about cognition in accordance with its definition (Schmitt, 1999), is irrelevant.

6.2 Managerial implications

The results of this study are of managerial relevance for interface designs and marketing purposes, given that IA also focuses on improving the understanding of behaviour associated with different manifestation levels of compulsive behavioural disorder, i.e., differences between digital natives and older users.

This is especially crucial for AR application designers and organisations looking to implement such applications as they use our results to design more enjoyable, entertaining, and playful experiences to cater the needs of different user groups. In doing so, results of this study demonstrate that getting usability right is a prerequisite for positive emotional perceptions and experiences. In addition, the findings help in tailoring AR applications to target different digital natives versus older user groups. Specifically, enjoyment features are most important for older users belonging to the least addicted group of *Casual users*, whilst entertainment features are important for digital natives in the group of *Addicts-in-denial*. In general, user needs, especially emotional experiences, must be considered to design and deploy successful mobile AR applications. For instance, service providers (e.g. hotels) can exploit the entertainment features

by targeting digital natives through enabling AR-based games such as PokemonGo. This will not only keep them entertained at the premises but also deepen their experiences.

The finding of this research demonstrated the importance of evaluating users' experiences with AR applications and systems in general. In a world where people are forced to connect digitally and access information online, the desire for more playful, entertaining and/or enjoyable applications is increasing, and AR application evaluations must be an integral part of the design process. Apart from bearing in mind the varying cognitive and emotional preferences of digital natives versus older users with different mobile technology knowledge and skills and whose eagerness to explore and download new applications varies, the presented IA continuum is also relevant from a public health point of view. Organisations, such as addiction centres or WHO, which are dealing with people suffering from different manifestations of IA, can use the results of the current study to provide a more targeted sensitisation and awareness campaigns to specific groups. For instance, messages targeted at the Addicts-in-denial could awaken their consciousness to their current realities with a view to recognising the necessity for self-rehabilitation.

6.3 Limitations and future research

First of all, this research only examined one AR application type, one that is triggered by paper markers, and thus, other types (Edwards-Stewart et al., 2016) and examples of AR can be further examined, offering more diverse services. User perceptions of the differences amongst offered AR services will further add to the literature. The emphasis of our study was on positive emotions only because this aligns with the typical goals of AR applications (Kourouthanassis et al., 2015). However, negative emotions, such as frustration and discomfort, may also influence user experience and behaviour, especially when the technology is not used correctly or is poorly designed. Therefore, future research could investigate the possibility of including

negative emotional dimensions in the proposed model to provide a more comprehensive understanding. In the light of the extremely limited number of studies that examined user experiences in general and different types of experiences in particular, this avenue of research exhibits high potential in terms of contributing to the existing AR knowledge base. Finally, we call for more cross-sectional and longitudinal studies that include users' experiences combined with IA. Given the current pandemic that requires people to work from home by using the Internet and socialise online, the importance of IA and the phenomenon called Internet fatigue are highly relevant topics.

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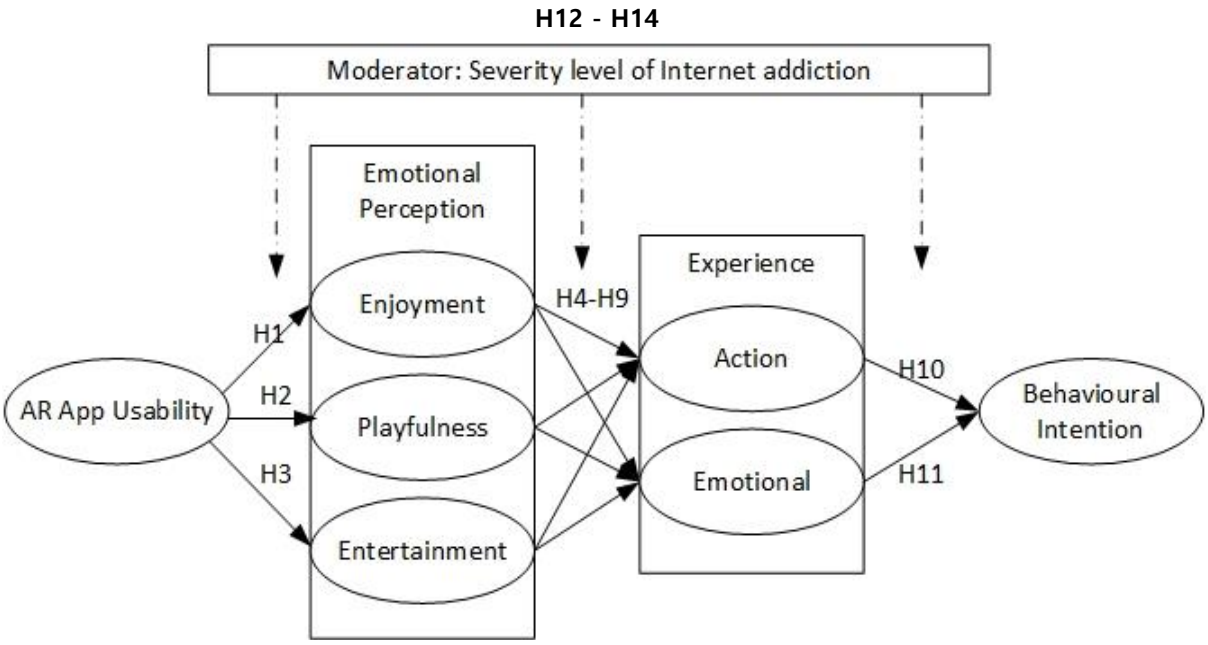


Figure 1. Conceptual model

Video augmented Newspaper

Interactive football league table

Image carousel augmented promotional leaflet

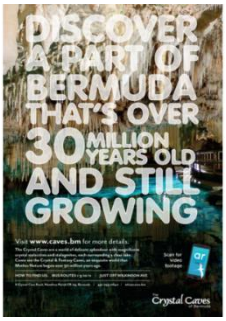
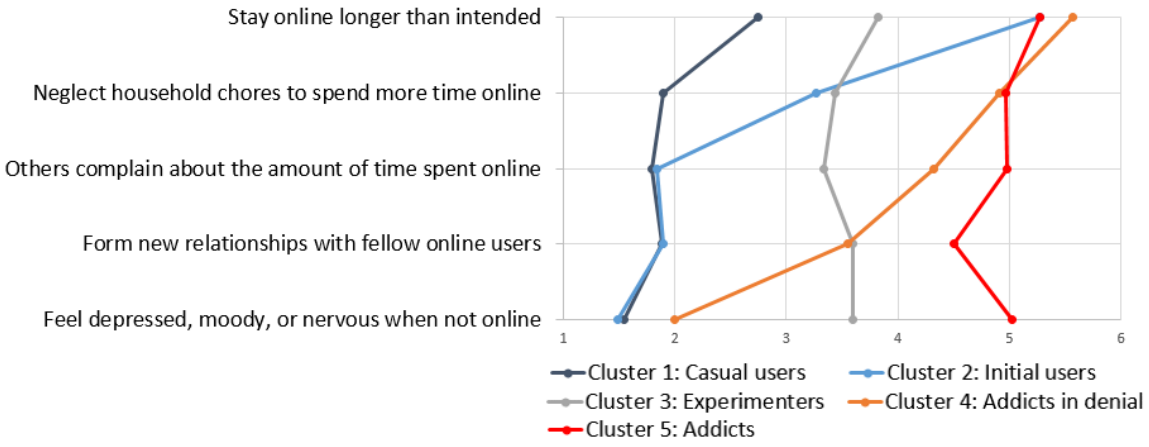


Figure 2. AR examples



Note: Answer scale 6-point Likert scale ranging from 1 = “strongly disagree” to 6 = “strongly agree”

Figure 3. Cluster prototypes

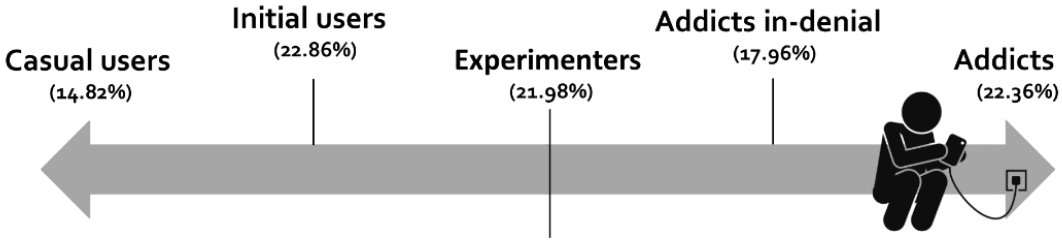


Figure 4. Internet addiction continuum

Table 1: Internet addiction continuum group profiles

	Addicts	**Addicts in denial**	**Experi-menters**	**Initial users**	**Casual users**
Age (in years)	24.34				33.43
Mobile technology knowledge	4.69		4.16		3.57
Mobile technology skills	4.78		3.81		3.73
Innovativeness/App proneness	4.41	3.72			2.89
Exploratory behavior	4.84	3.99		3.48	3.01
Time online (in hours per day)	6.22	◄	———	►	3.91

Note: All items apart from age and the time spent online (adjusted for extremes, i.e., 2 SD) are measured on a 6-point Likert scale ranging from 1 = "strongly disagree" to 6 = "strongly agree".
In case there was no significant difference between the groups we provide the average value of the combined groups.

Table 2. Standardized path estimates and significances

Independent variables	Dependent variables	Overall model	G1	G2	G3	G4	G5
Usability	Entertainment	0.625**	0.466**	0.717**	0.563**	0.718**	0.635**
	Playfulness	0.576**	0.339**	0.639**	0.586**	0.582**	0.636**
	Enjoyment	0.756**	0.664**	0.813**	0.736**	0.756**	0.760**
Entertainment	Emotional Experience	0.505**	0.618**	0.535**	0.639**	0.855**	0.529**
Playfulness		0.495**	0.288**	0.569**	0.191*	0.462**	0.554**
Enjoyment		0.199**	0.479**	n.s.	0.293**	-0.192*	0.145*
Entertainment	Action Experience	0.172**	0.252**	0.206**	0.285**	0.734**	0.141*
Playfulness		0.460**	0.117*	0.587**	n.s.	0.484**	0.539**
Enjoyment		0.210**	0.411**	n.s.	0.316**	-0.184*	0.259**
Emotional Experience	Behavioral Intention	0.810**	0.600**	0.878**	0.745**	1.821**	0.891**
Action Experience		n.s.	0.224*	n.s.	n.s.	n.s.	n.s.

Note: ** Significant at a 0.01 level. * Significant at a 0.05 level. n.s = not significant.
T-tests are calculated between all groups.
G1 = Casual users, G2 = Initial users, G3 = Experimenters, G4 = Addicts in-denial, G5 = Addicts.
Path coefficient > 1 is an accepted exception, which is explained in the results section.
Out of a total of 99 group path comparisons 93 are significant, only 6 are not significant, namely
G1 vs. G4 usability → entertainment; G3 vs. G4 usability → playfulness; G4 and G5 usability → enjoyment; and
G1 vs. G5 usability → playfulness; entertainment → emotional experience; actions experience → behavioral intention.