Continuance use intention with mobile augmented reality games: Overall and multigroup analyses on Pokémon Go

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Purpose – As mobile augmented reality (AR) games enter the maturity stage, understanding how to improve players' continuance use intention with mobile AR games is critical. Drawing upon the uses and gratifications (U&G) theory, we investigated the effects of four major gratifications – content, process, social, and technology – and other factors – game knowledge and achievement – on continuance intention to play mobile AR games.

Design/methodology/approach – Data collected from the 280 Pokémon Go players in Germany were used to address research questions. Partial least squares method was employed to assess the relationships in the model and multigroup analysis was conducted based on survey participants' demographics and their gaming experience.

Findings – Content gratification (i.e., catching Pokémon), process gratification (i.e., entertainment), game knowledge, and achievement drive players' continuance use intention with mobile AR games. However, social and technology gratifications do not influence players' continuance use intention. Finally, multigroup analysis suggests that mobile AR game developers should capitalize on the fact that different types of gratification prompt continuance use intention of different user segments in terms of demographics (e.g., gender) and experience in general mobile games and Pokémon Go.

Originality/value – User behavior of mobile AR games has been studied at the early stage of the games, with less attention to variable continuance use intentions across different user segments. This study attempts to fill the gap by extending the U&G theory to continuance use intention with mobile AR games at the maturity stage and further investigating the importance of player heterogeneity in continuance use intention with mobile AR games. Findings of this study contribute to the literature on U&G, continuance use intention and mobile AR games.

Keywords: Continuance use intention, Augmented reality, Mobile game, Uses and gratifications

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1. Introduction

In recent years, augmented reality (AR) functionality has been embedded into mobile gaming applications, which enables players to interact with physical environment during the gameplay (Craig, 2013). Mobile AR games have been adopted promptly by game players. For instance, Pokémon Go has attracted a vast number of players during the first two weeks of its launch in 2016 (Siegal, 2017). Due to the characteristics of AR function, mobile AR game players engage in all types of physical activity such as walking, running, biking, and skating for the gameplay, which appears to enhance mental health by reducing anxiety about leaving the house and interacting with strangers (Kogan et al., 2017). However, the rapid decline of Pokémon Go players has been observed and four out of five players have quit after half year of its launch in the U.S. (Siegal, 2017). A year after its launch, 90% of its players has been lost (Peckham, 2017).

Along with the introduction of mobile AR games, researchers have started studying in this domain, especially the adoption of mobile AR games (Rauschnabel et al., 2017). Several factors, which lead to Pokémon Go players' adoption, have been found, such as nostalgia, exercise, fun, relationship initiation, achievement, and recreation (Yang and Liu, 2017; Zsila et al., 2017). In addition, continuance intention to play Pokémon Go has also been explored. For example, flow, image and, social norms influence players' reuse intention (Rauschnabel et al., 2017). However, those studies were conducted during the periods when mobile AR games were just launched. As players accumulate their experiences in a specific mobile AR game, the players' motives for the continued gameplay may change over different product life cycle or differ from those at an early stage. We assume that some gratifications will be effective for continuance use intention throughout the game life cycle, but others may not. Moreover, new gratifications might be appropriate to explain continuance use intention for the late-stage players, as well as for the early-stage players (Tabacchi et al., 2017). Therefore, it is timely and essential for researchers and game developers to understand what factors lead to continuance intention to play mobile AR games at the maturity stage because the game user base will be widened and its usage can quickly evolve across temporal intervals (Sundar and Limperos, 2013; Tabacchi et al., 2017).

Anchoring on the Uses and Gratifications (U&G) theory, this paper focuses on different types of players' gratifications and examines their effects on players' continuance use intention in the mobile AR gaming context. Specifically, we identify four gratifications – content, process, social, and technology – as the main motives for the continued gameplay.

Furthermore, we incorporate other motivational factors such as game knowledge and achievement as control variables in the model. In order to provide meaningful implications for mobile AR game developers, we attempt to investigate whether the relationship between gratifications and continuance use intention could vary across different user groups in terms of demographics (e.g., age, gender) and experience in mobile games in general and mobile AR games in particular (Kaczmarek et al., 2017).

This paper contributes to the growing body of literature on U&G and mobile AR games, especially Pokémon Go. This study extends the previous research on the continuance intention to play mobile AR games, particularly in the context of Pokémon Go, which enters the maturity stage (Kim et al., 2018; Rauschnabel et al., 2017). With the help of a professional research firm, we surveyed Pokémon Go players and answered two research questions: (1) which gratification factors affect continuance intention to play mobile AR games and (2) how these effects differ across players' demographics and gaming experience.

2. Literature review and hypotheses

2.1 Factors influencing user behavior in mobile AR games

Mobile AR game is classified as a mobile game equipped with an AR functionality that enables game players to register them spatially and temporally with the physical world and to play the game in the environment where digital and physical information is combined (Craig, 2013). Due to the flexibility and mobility of smartphone, the novel AR technology has become converged with the location-based gameplay in smartphone. Mobile AR games are composed of cross-domain components such as game, sociality and physical presence (Liszio and Masuch, 2016), which differ from the traditional mobile games. Although mobile social games have a social component, they do not integrate the physical presence in the play. Furthermore, unlike video games that promote solitary and sedentary forms of playing, mobile AR games encourage spatial exploration and player to player interaction (Gao, 2016). Because mobile AR gamers have to move in the physical world, their level of game proficiency depends on the quantity and quality of physical world exploration (Tabacchi et al., 2017).

Due to the introduction of Pokémon Go in 2016, research on mobile AR games has been increased rapidly (e.g., Kogan et al., 2017; Marquet et al., 2018; Rauschnabel et al., 2017; Tabacchi et al., 2017). Prior research on user behavior in mobile AR games has focused on players' motivations and benefits with Pokémon Go, which is one of the most popular mobile

AR games (Landi, 2016). For example, Yang and Liu (2017) identified that nostalgia, exercise, fun, escapism, friendship maintenance, relationship initiation, and achievement as motivations. Zsila et al. (2017) also indicated nostalgia, coping, escape, competition, fantasy, boredom, recreation and outdoor activity as motives. Some studies have explored the impact of playing Pokémon Go on health benefits. For example, Pokémon Go positively influences social interactions because of more time spent walking with a dog, all types of physical activity, such as walking, running, biking and skating, and mental health by reducing anxiety (Kogan et al., 2017; Marquet et al., 2018). However, these studies have paid more attention to the Pokémon Go user behavior at the early stage, but less attention to the drivers of attitudinal and intentional reactions, such as attitude toward playing Pokémon Go and intention to reuse (Rauschnabel et al., 2017). Reasoning could be that, due to recent introduction of Pokémon Go and the limited temporal intervals, researchers could not incorporate the evolution of Pokémon Go in their studies.

2.2 Factors influencing continuance intention to play mobile AR games
Mobile AR games are new, experience-oriented media that fulfill users' particular needs and motivations, which further affect intention to reuse mobile AR games (Rauschnabel et al., 2017). Understanding continuance intention to play mobile AR games is critical for the development and growth of mobile AR gaming industry. However, to date, only one study has investigated players' continuance intention to play mobile AR games: Rauschnabel et al. (2017) employed hedonic, emotional, and social benefits to explain players' continuance intention with Pokémon Go. Although providing interesting findings on the intention to reuse Pokémon Go, this study was performed toward the early-stage players whose cumulative experiences are relatively short. Research on the usage behavior of early-stage players can be beneficiary for better understanding the popularity of the game and monitoring the evolution of its usage (Tabacchi et al., 2017). However, continuance use intention should be defined as a momentary belief on the part of a player that has sustained playing a certain mobile AR game based on previous experiences (Wu et al., 2007; Wu and Liu, 2007). There are two key characteristics of this definition: (a) status of the player's momentary belief and (b) the player's previous experiences. That is, continuance intention of playing a specific mobile AR game needs to be viewed as futuristic intention for the gameplay while previous experiences represent the cumulative experiences from playing the game. Therefore, it is timely and worthwhile to investigate what motivational factors lead continuance intention to play mobile

AR games at the maturity stage when game players have experienced mobile AR games, especially Pokémon Go.

In explaining factors influencing continuance intention to play mobile AR games, U&G approach can be applied. Because the U&G theory assumes that media users have specific motivations for their use of the media technology (Weibull, 1985), it has been applied to various new media contexts, such as social media (Hsu et al., 2015; Malik et al., 2016), microblogging (Liu et al., 2016; Mirkovski et al., 2018), online games (Wu et al., 2010), and mobile social games (Wei and Lu, 2014). It has been also used in research related to the continuance use of various mass media (Eighmey and McCord, 1998). If the motivations are fulfilled (i.e., gratifications), people will use the new media more often, leading to an increase in users' continuance intentions (Weibull, 1985).

Given that mobile AR game players have player-to-player interaction (Gao, 2016) and thus a sense of community with other players (Rauschnabel et al., 2017; Yang and Liu, 2017; Zsila et al., 2017), this study focuses on the relationship between gratifications identified in the social networking context and continuance use intention with the mobile AR games. Shao (2009) identified that user-generated media users consume contents for fulfilling their information and entertainment needs, interacting with the content as well as with other users, and produce their own contents for self-expression and self-actualization. Hence, Liu et al. (2016) suggested four types of motivations for microblogging: content motivations (information sharing, self-documentation, self-expression), process motivations (passing time, entertainment), social motivations (social interaction), and technology motivations (convenience, medium appeal, social presence). Recently, Trammell et al. (2017) also identified information, passing time, entertainment, and social interaction as motivations for using blogs.

In line with the aforementioned studies, this study incorporates these four types of gratifications that may encourage users to continue playing mobile AR games: (1) content gratification (i.e., the content a mobile AR game conveys) (Stafford and Stafford, 2001), (2) process gratification (i.e., the experience of the gameplay process itself) (Cutler and Danowski, 1980), (3) social gratification (i.e., interactions among the game players) (Cho and Cheon, 2003), and (4) technology gratification (i.e., the place where players use the mobile AR game) (Shao, 2009). Detailed descriptions and related hypotheses of the four major motivations are explained subsequently.

2.3 Research hypotheses

Content gratification. Content gratification is the fulfillment of information expectation (Culter and Danowski, 1980). Content gratification deals with the inclination of a user to seek information through the use of any media source (Amiel and Sargent, 2004; Khang et al., 2013). People visit a certain media for more content or interact with the content when they have high content motivation and perceive that the mediated content satisfies their content needs (Ko et al., 2005). Mobile AR games act as a great way of playing outside and thus requiring physical activity of the player (Marquet et al., 2018). For instance, Pokémon Go involves catching pocket monsters (Pokémon) at specific places with smartphones or other mobile devices. Research has shown that physical activity can significantly improve psychological well-being and other positive outcomes (Berger and Owen, 1998). Physical activity through playing Pokémon Go (e.g., catching Pokémon) can lead to not only a positive attitude toward playing the game (Rauschnabel et al., 2017), but also the continued usage of Pokémon Go (Dorward et al., 2017). Hence, the following hypothesis is proposed:

> *H1.* Content gratification of a mobile AR game will positively affect players' intention to continue playing the mobile AR game.

Process gratification. Process gratification refers to the fulfillment of playing mobile AR game as a kind of behavior (Culter and Danowski, 1980). This study adopts passing time and entertainment as constructs of process motivation because mobile gamers are interested in killing time with on-demand entertainment (Engl and Nacke, 2013). *Passing time* is a human activity aimed at spending leisure time with no apparent aim or objective (Khang et al., 2013). For example, social network services, video games, and mobile games in online space have replaced pastime activities in physical world (Granich et al., 2011). Hence, playing mobile AR games is likely to fill up free time (Trammell et al., 2017). *Entertainment* involves with the need for humans to keep themselves entertained (Amiel and Sargent, 2004; Ellison et al., 2007; Hsu and Lu, 2007; Khang et al., 2013). Seeking entertainment has been extensively shown as a strong determinant of the intention to use hedonic information systems (Engl and Nacke, 2013; Turel et al., 2010; van der Heijden, 2004) or play online games (Hsu and Lu, 2007; Wu and Liu, 2007). The advent of Pokémon Go which presents a spatial exploration and player to player interaction (Gao, 2016; Wagner-Green et al., 2017) has increased the level of entertainment during the game play. Therefore, we propose that two factors of process gratification, passing time and entertainment, are likely to motivate people to continue playing mobile AR games. Thus:

H2. Process gratification – (a) passing time and (b) entertainment – of a mobile AR game will positively affect players' intention to continue playing the mobile AR game.

Social gratification. Social gratification is to the result of fulfillment of social interaction in playing mobile AR games. Social interaction includes meeting new people during the gameplay (Ellison et al., 2007; Chang et al., 2014). Pokémon Go players tend to meet each in hotspots where the chances of catching Pokémon are high. Because people have similar interests, social interactions occur in hotspots, which help them form positive emotions and friendship initiation/intensification (Bonus et al., 2017). Many Pokémon Go players use Poke-walks as an excuse to go out with friends or engage with other Pokémon players, supporting the social benefits of playing Pokémon Go (LeBlanc and Chaput, 2017; Serino et al., 2016). According to a recent study, 74% of Pokémon Go players prefer playing the game with others over playing alone, and 52% have made new friends or acquaintances during the game play (MFour, 2016). Because mobile AR game players often engage in physical activities to spend time with other players, we propose that social interaction increases gaming time (Kaczmarek et al., 2017) and further motivate the players to continue playing mobile AR games. Hence, the following hypothesis is proposed:

H3. Social gratification of a mobile AR game will positively affect players' intention to continue playing the mobile AR game.

Technology gratification. Technology gratification refers to the fulfillment of playing a mobile AR game as a technically innovative gaming platform. According to Weibull (1985), media structure can contribute to an individual's media use based on media output, which means he volume and character of the media content. In the online gaming context, presence is identified as an importance characteristic of media output because most games provide a psychological sense of self-awareness immersed in a game environment (Teng, 2010; Weibel et al., 2008). Most games provide players spatial presence – the illusion of being physically present in a mediated space, as well as social presence – the psychological sense of physically interacting with a mediated person (Teng, 2010; Weibel et al., 2008). The spatial presence can be regarded as *medium appeal* of mobile games due to the characteristics of a psychological sense of 'being there' inside the game world anytime and anywhere. Medium appeal has been used as a characteristic of technology gratification in the communication literature (James et

al., 1995; Liu et al., 2015). In the context of mobile AR games, medium appeal of mobile AR games lies with the practical advantage of technical innovation of the mobile gaming platform, as allowing users to play mobile games in both virtual and physical worlds. On the basis of U&G, medium appeal might strengthen the possibility for players to gratify their needs, and further positively influence players' continued usage of a mobile AR game. Hence, the following hypothesis is proposed:

> *H4.* Technology gratification, i.e., medium appeal, of a mobile AR game will positively affect players' intention to continue playing the mobile AR game.

Guided by the U&G theory, we propose that four major gratifications, in respect of content, process, social, and technology, are adopted as players' gratifications for continuance use intention with mobile AR games – the extent that the game players' motivations are satisfied based on their previous experiences, and further drive players' intention to reuse the games. Besides the four gratifications, players' game knowledge and existing achievement could also affect their continuance use intention (Hsiao and Chiou, 2012). *Game knowledge* refers to a player's mobile AR game-relevant experience that influences his or her abilities to play the mobile AR game and perform game tasks successfully (Alba & Hutchinson, 1987; Hsiao and Chiou, 2012). When a player's Pokémon Go game knowledge increases, he or she will have more ability to compete successfully with other players. *Achievement* involves the desire to gain power, gather virtual game objects and valuable performance points, as well as competing with other players (Hartmann and Klimmt, 2006). For example, as Pokémon Go players catch more Pokémon, their achievement level will go up and their Pokémon will be stronger when in battle against another Pokémon. Thus, the two control variables – game knowledge and achievement – are included in our model.

3. Methodology

3.1 Data collection and sample

We applied survey methodology to analyze the proposed model. For the analysis, Pokémon Go was selected as the study context because it is one of the most representative mobile AR games and enabled us to collect a large sample of questionnaires. Most studies on mobile AR games have collected questionnaires from potential or existing Pokémon Go users (Marquet et al., 2018; Rauschnabel et al., 2017). Another advantage of this approach is that it provides a

theory-driven explanation of continuance intention to play a controversial mobile AR game that used to be a huge Pokémon Go hype but has been rapidly cooled down (Peckham, 2017; Siegal, 2017). It implies that Pokémon Go appears to enter the maturity stage.

For this research, we selected Germany as the study area due to several reasons. First a prior study (Rauschnabel et al., 2017) on continuance use intention of early-stage Pokémon Go users was conducted in Germany, so randomly selected German respondents with Pokémon Go experiences might enable us to compare players at the two different stages (i.e., early versus late). Second, Germany is one of the most popular Pokémon Go markets, following USA, UK, Japan and Spain (Alcorn, 2016), which may make us to collect a relatively large sample of respondents. Finally, English-written questionnaire is easily filled by German respondents.

A professional market research firm which we selected had the largest online panel of Pokémon Go users in Germany. Based on Qualtrics method, we submitted our questionnaires to the pool of online panelists who reported having installed and played Pokémon Go on a mobile device. In order to collect valid responses, we inserted four trap questions to filter out bad quality responses. After 5 days of fieldwork, we collected a total of 445 responses and, among them, 280 responses successfully provided all the information and received financial compensations for participation through the market research firm. Table 1 presents the sample characteristics including demographics (i.e., gender, age, education level, profession), user experiences with smartphone games and Pokémon Go, and behavioral engagement with Pokémon Go.

Table 1.
Sample characteristics

Variable	Classification	Frequency (N)	Percentage (%)
Gender	Male	135	48.2
	Female	145	51.8
Age	Younger than 26	150	53.6
	26–35	105	37.5
	36 or over	25	8.9
Education level	High school	86	30.7
	1 to 3 years college	76	27.1
	4 year university	62	22.1
	Graduate school	51	18.2
	Above graduate school	5	1.8
Profession	Student	134	47.9
	Professional	8	2.9
	Employed	94	33.6
	Employed in a leading position	23	8.2
	Self-employee/freelancer	4	1.4

	Unemployed	6	2.1
	Parental leave	1	0.4
	Other	10	3.6
Seniority of playing smartphone game	Less than 1 year	2	0.7
	1 year	10	3.6
	2 years	33	11.8
	3 years	47	16.8
	4 years	49	17.5
	5 years	34	12.1
	Over 5 years	105	37.5
Seniority of playing Pokémon Go	Less than 6 months	7	2.5
	0.5–1 year	57	20.4
	1–1.5 years	152	54.3
	1.5–2 years	53	18.9
	Over 2 years	11	3.9
Behavioral engagement of playing Pokémon Go in the past 3 months (Minutes/visit)	Less than 10 minutes	149	53.2
	10–20 minutes	39	13.9
	21–30 minutes	32	11.4
	31–40 minutes	28	10.0
	41–50 minutes	8	2.9
	51–60 minutes	8	2.9
	Over 1 hour	16	5.7
Behavioral engagement of playing Pokémon Go in the past 3 months (Frequency/week)	Never	109	38.9
	Once	28	10.0
	2 times	41	14.6
	3 times	37	13.2
	4 times	21	7.5
	5 times	15	5.4
	Over 5 times	29	10.4

N = 280.

3.2 Measurement model and validation

To ensure the reliability and validity of survey constructs, we adopted the established scales to the research context. We used seven-point Likert scales (1 = strongly disagree; 7 = strongly agree). Table 2 shows the detailed measurements and sources for each construct.

Table 2.
Construct items

Construct	Scale item	Sources
Dependent Variable	**Continuance use intention** (Mean=3.839, SD=1.739) 1. In the future, I will continue playing Pokémon Go. 2. My intentions are to continue playing Pokémon Go rather than discontinue playing it. 3. I intend to continue playing Pokémon Go rather than discontinue playing it.	Chang et al., 2013; Hsiao and Chiou, 2012; Rauschnabel et al., 2017
Content Gratification	**Catching Pokémon** (Mean=4.433, SD=1.646) 1. I generally play Pokémon Go to catch Pokémon monsters. 2. I generally play Pokémon Go because Pokémon monsters are valuable for me. 3. I generally play Pokémon Go because I feel happy when I catch Pokémon monsters.	Ko et al., 2005

Process Gratification	**Passing time** (Mean=4.218, SD=1.690) 1. I generally play Pokémon Go in order to pass time. 2. I generally play Pokémon Go when I have nothing better to do.	Ko et al., 2005; Liu et al., 2016
	Entertainment (Mean=4.727, SD=1.461) 1. I generally play Pokémon Go because it's enjoyable. 2. I generally play Pokémon Go because it's entertaining.	Ko et al., 2005; Liu et al., 2016
Social Gratification	**Social interaction** (Mean=3.906, SD=1.789) 1. I generally play Pokémon Go because I wonder what monsters other people catch. 2. I generally play Pokémon Go because I enjoy playing Pokémon Go with others. 3. I enjoy playing Pokémon Go because I can meet other Pokémon Go players while playing.	Rauschnabel et al., 2017; Trammell et al., 2017; Zsila et al., 2017
Technology Gratification	**Medium appeal** (Mean=4.236, SD=1.660) 1. I like Pokémon Go because I can capture computer-generated monsters in real-world environment. 2. I like playing Pokémon Go because I enjoy the interaction of computer game and surrounding physical environment. 3. Pokémon Go is more appealing with its augmented feature.	Liu et al., 2016
Game Knowledge	**Game knowledge** (Mean=4.236, SD=1.660) 1. As compared to other people, I have a lot of gaming knowledge about Pokémon Go. 2. As compared to other people, I know a lot about Pokémon Go. 3. Overall, I well understand how to play Pokémon Go.	Hsiao and Chiou, 2012
Achievement	**Game level** (Mean=22.045, SD=18.149) 1. What is your level in Pokémon Go game?	

Note: N=280, Items were pretested (N=15).

Table 3.
Factor loadings, reliability, and validity of constructs

Construct	Code	Loading	Cronbach's alpha	Composite reliability	Average variance extracted	PT	EN	CP	SI	MA	GK	GL	CI
Passing time (PT)	PT1	0.951	0.761	0.885	0.794	0.891							
	PT2	0.838											
Entertainment (EN)	EN1	0.942	0.877	0.942	0.891	0.291	0.944						
	EN2	0.946											
Catching Pokémon (CP)	CP1	0.814	0.776	0.869	0.689	0.251	0.663	0.830					
	CP2	0.847											
	CP3	0.824											
Social interaction (SI)	SI1	0.746	0.766	0.865	0.682	0.215	0.358	0.473	0.873				
	SI2	0.832											
	SI3	0.900											
Medium appeal (MA)	MA1	0.866	0.808	0.887	0.724	0.296	0.478	0.546	0.206	0.851			
	MA2	0.889											
	MA3	0.802											
Game knowledge (GK)	GK1	0.940	0.856	0.912	0.778	0.069	0.492	0.488	0.206	0.446	0.946		
	GK2	0.947											
	GK3	0.734											
Game level (GL)	GL1	1.000	1.000	1.000	1.000	0.085	0.217	0.236	0.299	0.141	0.332	1.000	
Continuance Use Intention (CI)	CI1	0.932	0.940	0.962	0.893	0.212	0.528	0.528	0.206	0.406	0.266	0.324	0.945
	CI2	0.958											
	CI3	0.947											

Next, we used a partial least square-structural equation modeling (PLS-SEM) to perform the overall and multigroup analyses for this study. Specifically, Smart PLS 3.0 was used to analyze the data.

Table 3 reveals the item loadings and the reliabilities and validities of the constructs. The values of Cronbach's alpha and composite reliability, which are greater than 0.70, and the values of Average Variance Extracted (AVE), which are much greater than 0.50, indicate the satisfactory reliability and convergent validity for all these constructs (Fornell and Larcker, 1981). The discriminant validity is also satisfactory, since the square roots of the AVE are much greater than any of the inter-construct correlations. Given the satisfactory measurement model, our survey data would be tested by examining the structural model. Common method bias was also assessed by performing the following statistical analyses. First, since a VIF (Variance Inflation Factor) greater than 3.3 is considered as indications of collinearity and contamination by common method bias (Kock, 2015), inner VIF values of the variables in our model were calculated. As they were all lower than 3.3, it indicated that our model was free of common method bias. Second, Harmon one-factor test was conducted on the variables in our research model. Results showed that unrotated first factor accounted less than 40% of the variance, indicating that common method bias does not likely contaminate our results (Liang et al., 2007).

4. Results

4.1 Structure model assessment

Figure 1 illustrates the results of PLS-SEM using the sample data. Concerning the gratifications, we find that content gratification, a motive of catching Pokémon ($\beta = 0.185$, p < 0.05), and process gratification in a form of entertainment ($\beta = 0.159$, p < 0.05) positively affect players' continuance intention with Pokémon Go. However, passing time (process gratification), social interaction (social gratification), and technology gratification do not lead to players' continuance use intention. These results indicate that content and process gratifications are the main drivers to encourage mobile AR game players to continue playing the games. Interestingly, the social interactions with other players during the gameplay and the AR technology implemented in the mobile game do not lead to players' continuance use intention with the games. For control variables, game knowledge ($\beta = 0.328$, p < 0.001) and game level, as a proxy for achievement, ($\beta = 0.106$, p < 0.05) lead to a greater continuance

intention of playing Pokémon Go, which shows that more knowledgeable or high-achievement game players tend to continue playing mobile AR games.
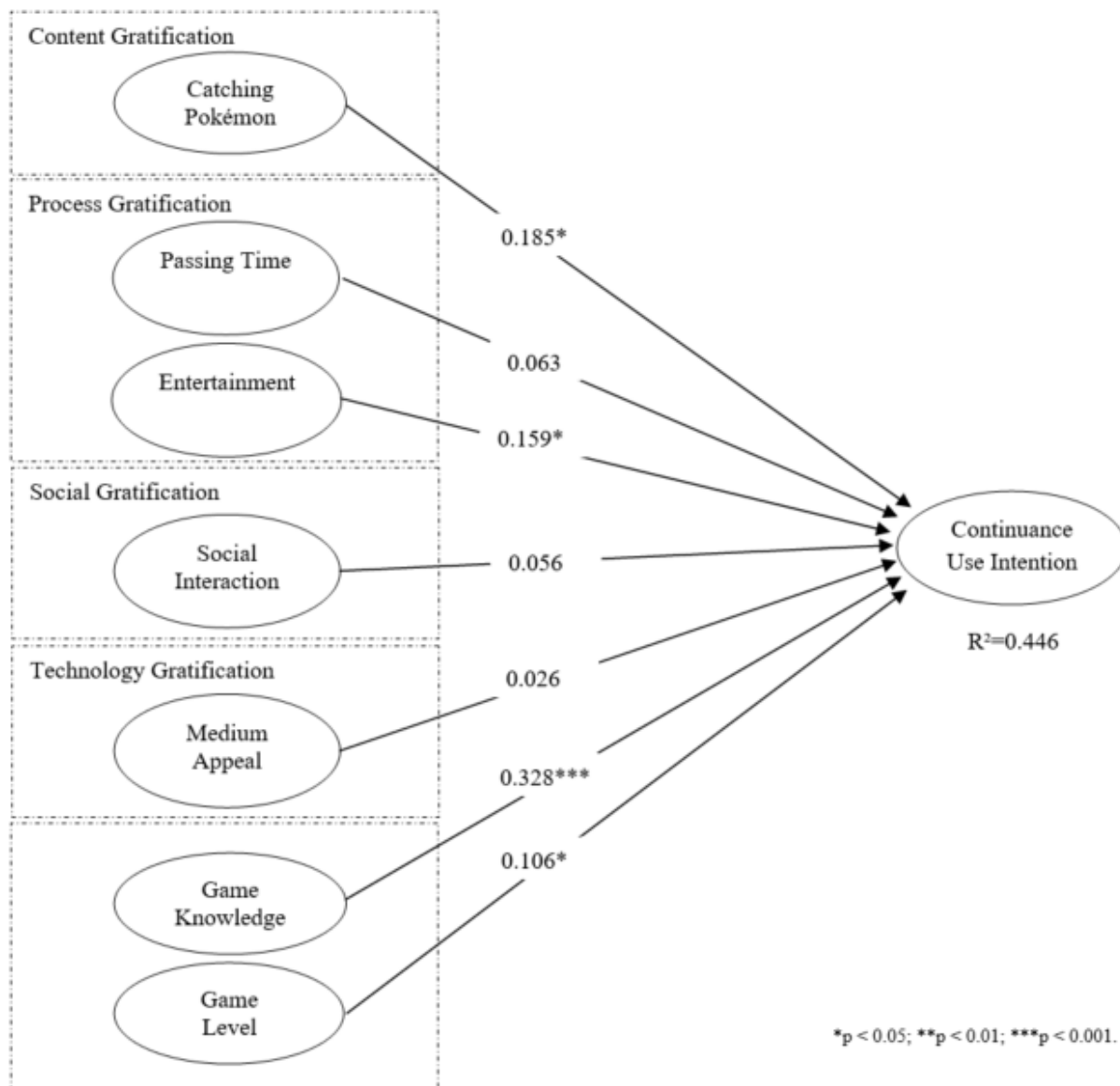

Figure 1. PLS-SEM results.

4.2 Post-hoc analysis: Multigroup tests

To obtain further insights, multigroup analysis was conducted based on survey participants' demographic information (i.e., gender, age, education background, and profession) and their experience of mobile games, in general, and Pokémon Go, in particular. Tables 4–11 report the path coefficients for each group and the significance test for the difference of group-specific results based on the method of PLS-MGA (Partial Least Squares Multi-Group Analysis). We find that game knowledge significantly affects players' continuance use intention for most subgroups, which implies that game knowledge is the most important factor

for continuance use intention with mobile AR games, regardless of players' demographics and experience. Concerning the group differences, the results of path coefficient difference test show that there are significant differences between two subgroups in terms of three player characteristics: gender, seniority of playing mobile game, and seniority of playing Pokémon Go. Specifically, achievement is an important driver for male players' continuance use intention, but not for female players ($\beta = 0.168$, $p < 0.05$). Game knowledge plays a critical role for less game-experienced players ($\beta = 0.220$, $p < 0.05$) and entertainment for less experienced Pokémon Go players ($\beta = 0.459$, $p < 0.01$).

Regardless of the group differences, we find that the effects of four gratifications and other factors on continuance use intention vary across player characteristics. From the age perspective, the achievement motive (i.e., game level) plays a critical role in younger players' continuance use intention, but the motives of catching Pokémon ($\beta = 0.239$, $p < 0.10$) and entertainment ($\beta = 0.227$, $p < 0.10$) are important factors for older players' continuance use. From the gender perspective, the social interaction motive ($\beta = 0.157$, $p < 0.10$) of male players influences their continuance use intention, while the entertainment motive ($\beta = 0.163$, $p < 0.05$) significantly affects female players' intention. In addition, In terms of other demographics and gaming experiences, the motive of catching Pokémon is found significant for the players who have college degree and below ($\beta = 0.205$, $p < 0.05$), are non-student players ($\beta = 0.252$, $p < 0.05$), have over 5 years of mobile game experience ($\beta = 0.159$, $p < 0.05$), have over 1.5 years of Pokémon Go experience ($\beta = 0.473$, $p < 0.001$), played Pokémon Go over 10 minutes per visit ($\beta = 0.266$, $p < 0.05$), or played Pokémon Go over twice per week ($\beta = 0.473$, $p < 0.001$). Moreover, the entertainment motive is found significant for the players who have higher education ($\beta = 0.259$, $p < 0.10$), have less sonority of playing Pokémon Go ($\beta = 0.271$, $p < 0.01$), play Pokémon Go over 10 minutes per visit ($\beta = 0.195$, $p < 0.10$), or have played once or less per week in the past 3 months ($\beta = 0.196$, $p < 0.10$).

The results also provide insights into the social and technology gratifications that affect continuous use intentions of certain player groups, although not overall players. The social interaction motive has a marginally significant effect for non-student players ($\beta = 0.156$, $p < 0.10$). In addition, the technology gratification is also marginally significant on continuance use intention for more experienced Pokémon Go players ($\beta = 0.253$, $p < 0.10$) who play over 1.5 years and more behaviorally engaged players ($\beta = 0.155$, $p < 0.10$) who play over 10 minutes per visit. The detailed implications from the overall and multigroup analyses will be discussed in the next section.

Table 4.
Multi-group analysis (Age: younger than 26 vs. 26 and older)

Construct		Younger than 26 (N=150)	26 and older (N=130)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.135	0.239†	0.104
Process gratification	Passing time	0.076	0.035	0.040
	Entertainment	0.115	0.227†	0.112
Social gratification	Social interaction	0.067	0.059	0.008
Technology gratification	Medium appeal	0.049	0.011	0.038
Game knowledge		0.351***	0.275*	0.075
Achievement	Game level	0.121*	0.078	0.044

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 5.
Multi-group analysis (Gender: male vs. female)

Construct		Male (N=135)	Female (N=145)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.165	0.124	0.041
Process gratification	Passing time	0.080	0.049	0.031
	Entertainment	0.135	0.163*	0.029
Social gratification	Social interaction	0.157†	0.050	0.108
Technology gratification	Medium appeal	-0.085	0.074	0.158
Game knowledge		0.287***	0.461***	0.174
Achievement	Game level	0.189†	0.020	0.168*

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 6.
Multi-group analysis (Education: college degree and below vs. university and higher degree)

Construct		College degree and below (N=162)	University and higher degree (N=118)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.205*	0.130	0.075
Process gratification	Passing time	0.103	0.048	0.055
	Entertainment	0.100	0.259†	0.159
Social gratification	Social interaction	0.040	0.079	0.038
Technology gratification	Medium appeal	0.016	0.038	0.022
Game knowledge		0.370***	0.261**	0.109
Achievement	Game level	0.087	0.143*	0.056

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 7.
Multi-group analysis (Profession: student vs. non-student)

Construct		Student (N=134)	Non-student (N=146)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.067	0.252*	0.185
Process gratification	Passing time	0.071	0.079	0.008
	Entertainment	0.161	0.164	0.003

Social gratification	Social interaction	0.035	0.156†	0.120
Technology gratification	Medium appeal	0.037	0.016	0.022
Game knowledge		0.344***	0.286**	0.058
Achievement	Game level	0.154*	0.039	0.115

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 8.
Multi-group analysis (Seniority of playing mobile game: less than 5 years vs. 5 years and more)

Construct		Less than 5 years (N=141)	5 years and more (N=139)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.159	0.176	0.071
Process gratification	Passing time	0.046	0.077	0.031
	Entertainment	0.170†	0.192†	0.022
Social gratification	Social interaction	0.041	0.076	0.035
Technology gratification	Medium appeal	-0.014	0.085	0.099
Game knowledge		0.440***	0.220*	0.220*
Achievement	Game level	0.114*	0.115*	0.000

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 9.
Multi-group analysis (Seniority of playing Pokémon Go: less than 1.5 years vs. over 1.5 years)

Construct		Less than 1.5 years (N=216)	Over 1.5 years (N=64)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.113	0.473***	0.359
Process gratification	Passing time	0.084	0.036	0.032
	Entertainment	0.271**	-0.188	0.459**
Social gratification	Social interaction	0.083	-0.095	0.178
Technology gratification	Medium appeal	-0.035	0.253†	0.288
Game knowledge		0.320***	0.360**	0.040
Achievement	Game level	0.113*	0.076	0.037

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 10.
Multi-group analysis (Behavioral engagement of playing Pokémon Go in the past 3 months: less than 10 minutes/visit vs. over 10 minutes/visit)

Construct		Less than 10 minutes/visit (N=149)	10 minutes or more/visit (N=131)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.159	0.266*	0.108
Process gratification	Passing time	0.123	-0.007	0.130
	Entertainment	0.126	0.195†	0.069
Social gratification	Social interaction	0.119	0.043	0.076
Technology gratification	Medium appeal	0.014	0.155†	0.1141
Game knowledge		0.263**	0.199†	0.063
Achievement	Game level	0.015	-0.033	0.048

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 11.

Multi-group analysis (Behavioral engagement of playing Pokémon Go in the past 3 months: once or less/week vs. over 2/week)

Construct		Once or less/week (N=137)	Over 2/week (N=143)	Path Coefficient Difference Test (PLS-MGA)
Content gratification	Catching Pokémon	0.088	0.300**	0.212
Process gratification	Passing time	0.080	0.016	0.064
	Entertainment	0.196†	0.130	0.066
Social gratification	Social interaction	0.042	0.047	0.006
Technology gratification	Medium appeal	0.132	0.073	0.060
Game knowledge		0.226*	0.235*	0.009
Achievement	Game level	-0.004	0.008	0.013

†p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

5. Discussion

The objectives of this study are to examine which motives affect continuance intention to play mobile AR games, specifically Pokémon Go, and (2) how these effects differ across user demographics and gaming experience. Drawing upon the previous U&G literature, we identified four major gratifications – content, process, social and technology – that might affect players' continuance use intention with mobile AR games, and built structural models based on overall and multigroup samples of Pokémon Go players. The overall structural model demonstrated there are causal relationships among factors in the model we tested. Furthermore, the results of multigroup analysis explained why the relationship between gratifications and continuance use intention can vary across user characteristics.

Our results provide evidence that players' intention to continue playing mobile AR games is driven by content gratification (i.e., catching Pokémon) and process gratification (i.e., entertainment) rather than social and technology gratifications. These results are in line with prior research that physical activity through playing Pokémon Go tend to drive players more positive toward playing the game (Rauschnabel et al., 2017) and also lead them to continue to play the game (Dorward et al., 2017). In contrast to our expectation that social gratification may play an important role in players' reuse intention with mobile AR games (Kaczmarek et al., 2017), players tend to have less emphasis on social interactions in terms of reusing the games (Rauschnabel et al., 2017). In addition, the technical innovation of mobile AR games is less likely to drive the maturity-stage players to continue the gameplay. Furthermore, we observe that game knowledge and achievement also encourage mobile AR gamers to play these games continuously. Finally, with a comparable number of two-sided participants in the sample, we find that game knowledge is the most pronounced driver for continuance use intention regardless of any player backgrounds, but whether other gratifications are significant varies across player segments. As such, our findings confirm the

importance of various motives in continuance use intention with mobile AR games, which are also identified in prior studies on digital games (e.g., Huang and Hsieh, 2011) and social media (e.g., Liu et al., 2016), as well as mobile AR games (Kaczmarek et al., 2017; Kim et al., 2018; Rauschnabel et al., 2017).

5.1 Implications for theory

This study contributes to the existing literature in three ways. First, the U&G approach was used to identify these four major types of gratifications for players' continuance use intention with mobile AR games. Specifically, we identified content, process, social, and technology gratifications that may affect users' continuance intention to play mobile AR games at the maturity stage. Among the four types, many studies have mainly focused on social gratification as the driver of attitudinal and intentional reactions toward the early-stage Pokémon Go (Kaczmarek et al., 2017; Rauschnabel et al., 2017). Recent studies have showed flow and attitude to be important for increasing intention to use Pokémon Go (Kim et al., 2018). However, previous research has failed to incorporate other factors, such as content, process and technology gratifications, that might affect continuance use intention with the maturity-stage AR games. This empirical study reveals that gratifications can change not only for new media but also for the same media over time, therefore calling for a need to explore and validate new dimensions for different types and different stages of new media (Greenberg et al., 2010; Sundar and Limperos, 2013). Thus, this study contributes to the U&G theory by showing the importance of applying new gratifications from other media context (e.g., content and process gratifications from social media) or same gratifications at different media stage (e.g., social interaction at the early and maturity stages) to the new media in interest (e.g., mobile AR games). Under the U&G theory, researchers can better understand the specific drivers of specific output variables (e.g., continuance use intention) across different media lifecycle.

Second, this study finds that while content and process gratifications are important factors to drive continuance use intention of the maturity-stage Pokémon Go users, but social and technology gratifications are not found to be influential. Our finding is in line with prior research on the online gaming industry, which lies at the maturity stage. Researchers have found that perceived entertainment influences their loyalty toward an online game, but social interaction has negligible effects on the players' loyalty (Huang and Hsieh, 2011). Research on mobile AR games also finds that social gratification has no relationship with intention to reuse Pokémon Go at the early stage (Rauschnabel et al., 2017). Such finding can be

explained by two reasons. One is, social motivation is likely to increase the Pokémon Go players' gaming time but may decrease their physical activity, which cancels out two usage behaviors and further produces the non-significant total effect (Kaczmarek et al., 2017). The other is, experienced players at the maturity stage, who have played Pokémon Go from its launch and may have a more introverted profile (Tabacchi et al., 2017), are less influenced by player-to-player interactions. Our study also suggests that the personality profile of Pokémon Go users is similar to that of video game users (Tabacchi et al., 2017), which can be explained by the different gratification factors between genders.

Finally, our multigroup study enabled us to examine what factors drive continuance use intention with Pokémon Go across different player groups. Unlike the total sample-based model, the disaggregated sample-based models identified that social and technology gratifications can be important for certain players' continuance use intentions. Such results are explained by two perspectives. Theoretically, individual player differences such as age, gender and experience can moderate the effects of gratifications on continuance use intention of mobile AR games (Venkatesh et al., 2012; Williams et al., 2008; 2009). Methodologically, the overall effect of a certain gratification on continuance use intention can be insignificant because there may exist heterogenous effects inside the sample. Regarding age, younger players tend to be motivated by higher self-efficacy (e.g., achievement) than older players (Chung et al., 2010). Concerning gender, male players are reported to be influenced by the motives of social gratification and achievement, whereas female players are likely to have more interest in the entertainment motive. This finding reinforces the existing theory that men are more task- and achievement-oriented in IT use (Venkatesh et al., 2012) and online game use (Williams et al., 2008; 2009). Conversely, our finding that female players are not motivated by social factors is not congruent with findings in the online game context (Williams et al., 2008; 2009) but congruent with those in the video game context (e.g., female players put less emphasis on player-to-player interactions) (Jansz et al., 2010; Lucas and Sherry, 2004). Finally, technology gratification takes a critical role in increasing continuance use intention of more experienced or behaviorally engaged Pokémon Go players. It suggests that greater experience may lead to greater familiarity with the AR technology, which reduces player dependence on external support for playing mobile AR games (e.g., Alba and Hutchinson, 1987). As such, multigroup analysis enables researchers and practitioners to understand that gratifications can be dynamic, rather than static, and such notion has been expressed in the recent studies on video games (Greenberg et al., 2010) and mobile AR games (Kaczmarek et al., 2017).

5.2 Implications for practice

Our research has provided clear implications for mobile AR game developers in terms of how to improve players' continuance use intention. The findings of this study reveal that players' content and process gratifications significantly affect their continuance intention for playing mobile AR games. Specifically, mobile AR game designers need to ensure that their games provide or reinforce appealing contents (e.g., catching Pokémon) and entertaining components as these games enter the maturity stage. Interestingly, because social gratification, a widely-recognized motivation, is not found significant for players' continuance use intention, developers do not need to enrich the user interface to facilitate player-to-player interaction at the maturity stage, as well as at the early stage (Rauschnabel et al., 2017). Furthermore, as mobile AR games are technologically innovative gaming service due to the AR technology, their medium appeal may be an important motivation for early-stage players. However, managers should keep in mind that such technical innovation of the mobile AR games does not drive the maturity-stage players to continue playing these games in the long run.

Our findings from the multigroup study may be of interest to mobile AR game developers. Although developing segment-specific mobile AR games seems costly and creates discrimination concerns, game marketers can perform different communications toward different player segments. For instance, marketers can put greater emphasis on communicating the entertainment features of their games toward female players while emphasizing social benefits and achievement (e.g., game level) toward male players. Content and entertainment motivations should be communicated to older players, compared to younger players to whom game knowledge and achievement are main drivers for the continued game playing. Finally, this study reveals the importance of players' behavioral engagement in the game upgrades and marketing. Specifically, managers might offer advanced features toward more engaged players once their levels increase, but rather communicate entertainment and social interaction features toward less engaged players.

6. Limitations and future research directions

The present study suffers from many of the limitations that are inherent to data collection of Pokémon Go players at the maturity stage. First, this study failed to differentiate whether gratifications influencing continuance use intention of the same Pokémon Go players change over time. Although this study attempted to compare the results with those of Rauschnabel et

al. (2017)'s study on early-stage Pokémon Go users in Germany, the differences of sample and population with past studies cannot remedy the concern of methodological inappropriateness. Because mobile AR games (e.g., Pokémon Go) undergo continuing significant changes, future research need to replicate such work over time (e.g., early versus maturity) toward the same cohort of respondents. Second, we mainly anchored on the gratifications from the U&G theory to develop our constructs. Although the explanatory power of the research model was relatively high (about 46% of the variance), future research could identify more related constructs to account for the remaining unexplained variance in continuance use intention with mobile AR games. Finally, although Pokémon Go is the most popular mobile AR games, the findings from focusing on Pokémon Go players in a single country cannot be generalized in the mobile AR gaming industry. Different types of players' gratifications might drive continuance use intention with mobile AR games depending on different games and different countries. Therefore, future research can investigate what gratifications drive different mobile AR game(s) of players in different countries. Nevertheless, we hope that this study inspires future research on the role of U&G in terms of continuance use intention with mobile AR games, in general, and Pokémon Go, in particular.

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