Research Article

Measuring the appeal of mobility-augmented reality games, based on the innovative models of interaction: a case study

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Abstract
This study presents the issues why gamers prefer mobility-augmented reality games to other types of game and what specific characteristics cause them to invest a large amount of their time on tireless game-play. Furthermore, the appeal of mobility-augmented reality games was studied to solve the above mentioned issues. Then, how human–computer interaction based on mobility-augmented reality games was promoted to create a new marketing mode was explored. Then, Pokémon GO, as the worldwide major mobility-augmented reality game, was selected as the research target in this study. The researcher interviewed 9 experts, collected 235 Knasei words from 33 articles, and surveyed 335 gamers through a questionnaire to collect the data about users' preferences. A preference-based study was believed to disclose the motivated reasons for the appeal of mobility-augmented reality games. The researcher analyzed the gathered Kansei concepts and questionnaires using the two-stage procedures, including evaluation grid method (EGM) and Quantification Theory Type I. During the first stage the hierarchy of the relationship among the types of appeal factors, the reasons for users' preferences, and the explicit design characteristics of Pokémon GO present the semantic structure of appeal and were determined using EGM through the accumulation of the review of articles and the interviews of experts. During the second stage the strongest two original evaluation items of Pokémon GO are determined as "social interaction" and "scenario interaction" based on the statistical analysis of Quantification Theory Type I, and their corresponding "upper-level" and "lower-level" considerations are proved to have influence on them. Finally, the paper found that the popularity of Pokémon GO can be ascribed to the design of the innovative models of game interaction, which targets the psychological preferences of gamers. This means that the interaction model between a customer and an enterprise can be developed outside the box and a new type of marketing can be formed. The study proved that the innovative models of interaction successfully drove gamers' motivations to play Pokémon GO. Designers and researchers of mobility-augmented reality games can absorb important information through this study. This study enriches the field of mobile communication, online marketing, and human–computer interaction in cyberspace.

Keywords Mobility-augmented reality game · Kansei Engineering · The evaluation grid method (EGM) · Quantification theory type I · Human–computer interaction · Marketing

1 Introduction

Many researchers started to put emphasis on mobile games because mobile phones became a part of humans' life and they create a large amount of business in the market. Rutz et al. [1] studied mobile game app from users' engagement, for instance. In addition, Ravoniarision et al. [2] explored this type of games from players' experiences. Mobility-augmented reality games could be the latest and the most representative ones in the market of mobile game. Mobility- augmented reality games provide a revolutionary human–computer interaction model

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through GPS and the Internet. In addition, mobility-augmented reality games have the ability to integrate online and offline scenarios so social interaction among gamers can happen anywhere, not only in the virtual but also in the real world. Pokémon GO, which is currently the most popular mobility-augmented reality game, attracted 26 million gamers and had earned $35 million in revenue for just 2 weeks in 2016 [3]. In addition, it is estimated that Pokémon GO has earned $1.8 billion in revenue since it was launched on July 6, 2016 [4].

The great mass fervor for Pokémon GO has sparked researchers' interests in comprehending the style, unique characteristics, and appeal of this type of game. Therefore, a study of the unique characteristics of mobility-augmented reality games and their contribution to human–computer interaction through the Internet is of great importance to the field of Internet research. We believe that the crucial reason that mobility-augmented reality games are particularly attractive to gamers lies in particular models of interaction. Hence, this research studied how these models have influence on human preferences and what the constituents of the various models of interaction were.

Compared to the interaction models of common games, mobility-augmented reality games provide gamers with various characteristics so as to make the game more attractive. I have found that mobility-augmented reality games possess particular interaction models that other types of games do not have and thus, they can attract gamers through "social interaction" and "scenario interaction". In addition, the appeal of these models of interaction are believed to have connections with human perception, cognition, affection, and the design characteristics of mobility-augmented reality games. This means that human preferences play an important role in the appeal of these models of interaction. Therefore, two of the most important issues in this study are how a mobility-augmented reality game enhances human–computer interaction and what characteristics it uses to attract gamers with are.

I put emphasis on the models of interaction to users of mobility-augmented reality game. Hence, I used both qualitative and quantitative methods which were integrated by Kansei Engineering as ways to probe this issue. To conduct a qualitative evaluation, Kansei concepts from authoritative articles and interviewed experienced game experts were gathered through the Evaluation Grid Method (EGM). For the quantitative evaluation, a questionnaire survey was conducted for selected gamers. Then, the resulting data were statistically analyzed by Quantification Theory I.

I probe mobility-augmented reality games from the perspective of human–computer interaction through the Internet in this study. In the following section, I interviewed related theories and documentation.

2 Review of the literature

2.1 The conditions of augmented-reality games

An augmented-reality game is different from other types of game because the real and virtual worlds can interact mutually in the game which is constructed with human's physical context. Some studies show that the potential of augmented-reality games indicate that augmented reality has a higher ability to interact than other interfaces and is suitable for use as a game interface. Augmented-reality technology provides users free control of human-game interaction. Thus, a mobility-augmented reality game can improve peoples' motivation for learning by providing a flash of intensity [5]. This also indicated that the interaction formed by mobility-augmented reality motivated the users. Although mobility-augmented reality games have a strong function of interaction, they are so complicated and difficult for people to understand.

Therefore, I used two simple bases to divide the augmented-reality games into four aspects, as shown in Fig. 1; "real-virtual" and "entity-environment". Entities include real persons, such as humans and friends, and also virtual characteristics which have virtual appearances, such avatars and monsters. Environments include both the real and virtual worlds. The real world is an environment with a physical appearance, such as parks and docks. A virtual world is a digital environment constructed by computer, such as virtual woods and castles.

Mobility-augmented reality games should be equipped with the following four conditions for human–computer interaction during gameplay. The four conditions, which are divided between the two bases, are "virtual-entity",

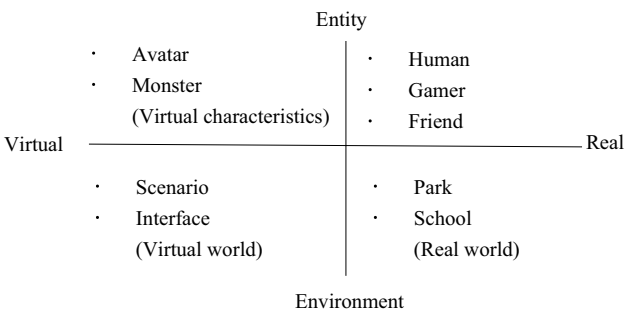

Fig. 1 The four conditions of mobility-augmented reality game. Note: The four conditions of mobility-augmented reality games are divided based on the two bases; the "real-virtual" and the "entity-environment" axes

"virtual-environment", "real-entity", and "real-environment". "Virtual-entities" are characters or items that appear in a game, such as avatars, monsters, and treasures. "Virtual-environment" are virtual worlds in a game. "Real-entity" represents people with various identifications in common life, such as gamers and friends. "Real-environment" is the real world where humans live.

More specifically, the human–computer interaction involves the four conditions, including interpersonal interaction (real-entity), human–environment interaction (real-environment), interaction among avatars, characters, and Internet friends (virtual-entity), and gamer-interface interaction (virtual-environment) (Fig. 1). All of the interaction of mobility-augmented reality games originates from human usage.

2.2 Human–computer interaction through mobility-augmented reality games

New ways of human computer interaction that is formed by the advanced mobile applications of augmented reality become increasingly important [6]. The nature of a game, as a type of advanced mobile applications, lies in human–computer interactions, which are formed in varying conditions for different types of gameplay. Then, the human–computer interaction of mobility-augmented reality games are formed with the four conditions mentioned in the former section. Compared to common digital games, the human computer-interaction of mobility-augmented reality games is more complicated because the entities and environments ranging from virtual to real worlds are considered as shown in the former section in Fig. 1. The human–computer interaction of mobility-augmented reality games have rarely been studied. Cheok et al. [7] initially explored game interaction experiences and found that social human-to-human and human-to-physical world interaction exists not only in augmented-reality but also in the virtual environment. The arrangement of human computer interaction of mobility-augmented games [7] conforms those in my study, which was formed through the study of selected articles and experts' opinions, including "face to face interaction", "virtual-real interaction", and "virtual interaction".

This study arranged the human–computer interaction of mobility-augmented reality games into four categories according to EGM, based on selected articles, experts' opinions, and the above mentioned literature, including "face-to-face interaction", "social-media interaction", "virtual interaction", and "virtual-real interaction". This study also integrated "face-to-face interaction" and "social-media interaction" with the concept "social interaction". In addition, this study classified "virtual interaction" and "virtual-real interaction" as "scenario interaction". The four classified interactions of mobility-augmented reality games conform to the four conditions of the above section and are further studied in the next two sections.

2.3 Social interaction

The appearance of game interaction creates a lot of fun for gamers. In addition, social interaction, which integrates human factors, assists a game in cultivating a platform to let gamers interact with each other so the humans in the same game can tie together tightly. Cole and Griffiths [8] demonstrated that virtual games allow gamers to express themselves comfortably as there is no need for them to consider their internal and external identifications and they can experience the process of teamwork, encouragement, and fun. Then, Wu [9] indicated that inherent sociability, as one of the design features of SNS games, influences the users' perceived curiosity and perceived enjoyment in playing this type of game. The above studies show that social interaction plays an important role in the design of popular games.

Xu et al. [10] also explored physical and social interaction in specific augmented-reality games and found that most participants can form strategies for social play by leveraging visual, aural and physical cues from the shared space. Xu et al.'s [10] study indicated that game information, provided not only from virtual world but also from real environment can influence on gamers when they are forming social interaction. As mentioned above, the factor of real environment plays an important role in the social interaction of mobility-augmented reality games and provides a wonderful field for gamers to meet together. Compared to common online games, gamers cannot meet together directly in Pokémon GO. Hence, except for gamer-to-gamer interaction in the virtual world, social interaction of an augmented-reality game is evoked differently through face-to-face encounters and social media.

In the aspect of face-to-face interaction, the real interpersonal interaction occurs when gamers, guided by GPS, go to the same real location, representing a virtual place, such as the gym in Pokémon GO. This study named the social interaction which happens in a real environment as "face-to-face interaction". This often happens in the offline mode of game so gamers can share their experiences through social media. This study called the social interaction that happens in social media from a gameplay as social media interaction. This study proposed "social-media interaction" to clarify the involvement of mobility-augmented reality games. "Social-media interaction" can be viewed as a channel of gamers to let them convey their opinions and feedback for mobility-augmented reality games, though the way is not officially set in the game itself. Gamers often use social media, such as Facebook,

to share their experience in gameplay, so a game can be promoted through a fan group of a website.

Based on two aspects, a mobility-augmented reality game provides gamers with a completely different mode of social interaction compared to other type of games. This study classified the "social interaction" of mobility-augmented reality games as "social-media interaction" and "face-to-face interaction".

2.4 Scenario interaction

The scenario of augmented-reality games is constructed through virtual and real environments. The interaction that happens in virtual and real game worlds is called scenario interaction. Compared to common virtual games, mobility-augmented reality games provide gamers with interaction, not only through the virtual environment, but also through the real one, with the support of GPS technology, so gamers can meet together with true colors.

"Scenario", as a professional term for game design, indicates a defined inner space or environment within a game world. This kind of hierarchy construction involves the level design of the game. Carroll [11] argued that scenarios of use support the integration of cognitive and organizational approaches to human–computer interaction (HCI) by providing a rich representation of activity from which cognitive and organizational perspectives can be developed. The above argument indicates that the design of game scenarios plays an important role in human–computer interaction. In mobility-augmented reality games, game scenarios integrate a virtual world with a real one through GPS technology in a revolutionary way. Hence, human–computer interaction evoked in the scenario of augmented mobility is more varied and needs to be explored further.

This study categorizes the scenario of interaction of Pokémon GO into two types, virtual and virtual-real interaction, based on EGM. The virtual interaction of mobility-augmented reality games indicates that interactivities happens among gamers, characters, properties, and environments in the virtual world. For example, Pokémon or virtual treasures fight against each other in a game. Virtual-real interaction means that interactivities between a gamer and a real surrounding during the play of mobility-augmented reality game. For instance, a gamer gets virtual supplies while taking a bus in the real world. A successful virtual-real interaction should be realized through a strong integration of online and offline channels, which will be the new business of trend. Chang [12] found that online satisfaction reinforced behavioral intentions toward an offline channel, and vice versa. This means that the integration of users' virtual and real experience could be the important assignment for the future online business.

2.5 Kansei Engineering

Kansei Engineering is applied to the study of user preferences for products by evaluating humans' emotions and perceptions. Furthermore, the interaction between humans and products can be considered by this method. The principle of Kansei Engineering can evaluate the experience of human-production interaction by the design characteristics of goods. Although the nature of a product is totally different from that of a game, both of them have individual properties so they can be evaluated through Kansei Engineering. More specifically, Kansei Engineering can evaluate products through their real texture, shape, and color and so forth. For example, crossover b-car interiors from the design of seats to space utilization [13] was successfully studied. In addition, Kansei Engineering can also assess games with their virtual scenario and music. SNS games were also studied through their characteristics, such as the style of avatars [13]. Generally speaking, Kansei Engineering can explore the product issues involving micro function and usability [14], as well as macro social culture [14]. This study probed the functional issue of mobility-augmented reality games to show that the unique appeal factor of this type of games lies in the models of interaction. In addition, the significant difference between a game and a product lies in the interaction of the former. Kansei Engineering can evaluate the interaction of a game using humans' sense of sight and hearing. Barnes and Pressey [15] study the factors that motivate an individual's higher-order human preferences in virtual worlds based on the way similar to Kansei Engineering. This study was divided into two stages. In the first stage, EGM (Evaluation Grid Method) which was used to classify the design of Pokémon GO into three-level structure as a category classification belongs to Kansei Engineering Type I [16] . In the second stage, Quantification Theory Type I, as a mathematical model, which was applied to the analysis of user preferences statistically, belongs to Kansei Engineering Type III [16] . The two-stage study was used to construct a mixed-method Kansei Engineering system for the investigation of Pokémon GO from human emotions. The mobility-augmented reality game attracts gamers from a virtual world to real society and gives them completely different feelings. Hence, it is necessary to use a reliable research tool to gauge gamers' emotions and perceptions to augmented-reality games. Kansei Engineering is probably the best tool to conduct this type of research.

3 Research objectives

Pokémon GO, which integrated with the latest augmented-reality technology, created new models of interaction and went viral all over the world. Hence, Pokémon GO was the

major representative of mobile augmented-reality game nowadays and was selected as my research target. The key point of a successful augmented-reality game can thus be ascribed to its innovative models of interaction because the success of the game lies in the design of human–computer interaction. Furthermore, the complicated system of interaction for mobility-augmented reality game from human's motivation was also studied. Why gamers prefer this type of game and what specific characteristics attract them to indulge in a game play based on the design of their innovative models of interaction are the two crucial issues in this study. Hence, the most important types of appeal factors, and the explicit design characteristics, and reasons for users' preference are recognized and the relationships among them are determined through EGM. Then, the different weights given to these factors, reasons and the characteristics of the appeal factors are quantified through Quantification Theory Type I. Experts' opinions and gamers' reactions can then be integrated through Kansei Engineering to determine the appeal of Pokémon GO. How the interaction design of Pokémon GO can attract gamers can then be found.

4 Research methods

The study probes the appeal of the interaction models of Pokémon GO using two steps to evaluate the points of view of related subjects. First, the study employed the Evaluation Grid Method (EGM) to gain editors' analyses by digesting a large amount of literature and experts' opinions during the phase of in-depth interviews with individual experts. Secondarily, a questionnaire was distributed for gathering gamers' reactions and the data collected were used for statistical analysis by applying Quantification Theory Type I. Both EGM and Quantification were integrated into the theory of Kansei Engineering and established the whole research proceddure.

4.1 Evaluating using EGM

Interviewees with professional expertise need more time to be interviewed so their knowledge can be excavated completely. This type of opinions, with the feature of high quality and less quantity, and are not suitable for survey through a questionnaire. Therefore, the key evaluation items which are used to determine the appeal of product have to be captured through a reliable method. In this study, the EGM, as a qualitative method, was used for semantic analysis and to determine the appeal factors, reasons and design characteristics of a Pokémon GO, and the hierarchical diagram showing the appeal elements for the interaction models of this type of games was constructed.

Sanui [17] used a special way to assess objects by comparing them. At the beginning a researcher would ask participants to answer how they got impressions of these objects. Then, the specific meaning or conditions of the participants' answers were clarified through more additional questions. The above mentioned processes, as the repertory grid method, could be integrated into the EGM [17] . This mechanism made it possible to codify interviewees' reasoning into a hierarchical structure. The method, which can organize interviewees' words from the abstract to the concrete, is called the "Evaluation Grid Method" (EGM).

The EGM, as a qualitative method, is used for deep interviews. Interviewees can express their arguments completely during a specific time period by answering the results of paired comparisons. In addition, the EGM can also be used to arrange related and authoritative articles by capturing concepts related to interaction and the professional descriptions of specific characteristics, such as "scenario". Interpretive structural modeling shows the results of the accumulated concepts and is used for structural identification. Dong [18] similarly studied "The Evaluation Method for Product Form Attractiveness" based on "Miryoku Engineering" and provided successful results. In our study, the EGM captured the appeal factors, reasons and design characteristic for Pokémon GO and shows the results of EGM study by using a hierarchical diagram of the appeal interaction of this game.

The EGM-based interviews were used to understand the appeal factors, reasons and design characteristics of the interaction of Pokémon GO. This study interviewed four male and five female experts between the ages of 18 to 62. All of the participants consisted of experienced mobility-augmented reality game players and editors. In addition, related game designers or professionals were also interviewed through the EGM. Pokémon GO, which was the major representative of mobility-augmented reality games in the global market, was chosen as the research target for the interviews. These selected experts, all of whom had played Pokémon GO, were asked about how they prefer the interaction of Pokémon GO through comparisons among design characteristics.

The procedures of the EGM are listed as followings: 58 sample cards, with pictures showing characteristics and necessary annotation about the interaction design of Pokémon GO, were designed for interview, the nine experts were then asked individually to group the 58 sample cards into three stacks according to their preferences, from high to low, the study then asked these experts to express their opinions toward the grouped sample cards through a series of questions, from abstract to specific. Hence, the experts' images and reasons about their preferences were obtained. The appeal and specific design

characteristics were also found through the interview. EGM can be also practice through the collection of the concepts of interaction and the descriptions of specific characteristics. This study collected 235 Kansei and professional words from 33 articles involved with user experience in the interaction of Pokémon GO from authoritative websites and magazines. All the editors' images, reasons and their favorite design characteristics of Pokémon GO were recorded within the scope of the gameplay interaction. This study named all the collected descriptive phrases as Kansei words.

The study then accumulated these Kansei words from the interview plus editors' articles and these were then processed to construct its corresponding "upper-" and "lower-level" concepts. "Upper-level" concepts indicated that the meaning of the collected words are more emotional, abstract, and widely in the hierarchical structure of semantics. In contrast to "upper-level" concepts, "lower-level" ones means that the meaning of the selected words are more professional, specific, and narrow in the semantic hierarchical structure. After all the "upper-level" and "lower-level" concepts were determined, the original evaluation items could be evolved from the arrangement of the "upper-level" words and were known as "appear factors" in this study.

4.2 Evaluating using quantification theory type I

Compared to EGM that is capable of integrating experts' ideas to form their common values, Quantification Theory Type I is a statistic tool used to analyze the survey on gamers' experience in interacting with Pokémon GO in this study. Hence, it was important to design a questionnaire to fit the work of Quantification Theory Type I. In order to quantify the appeal factors and give a score of importance for the design items in mobility-augmented reality games, the questionnaire used the structure to transfer from the results of EGM, including the original evaluation items, and "upper-level" and "lower-level" concepts from wide to specific questions. Hence, the questionnaires were created using the attribute and categories as shown in Table 3. In order to measure the weights of the appeal factors and attributes in Pokémon GO, the strongest two criteria that determine their attractiveness, related to their innovative models of interaction, were selected from the original evaluation items using the EGM. In addition, the study made the questions in the questionnaire more condensed and precise in order to collect more data within limited period of time.

A purposive sample from general gamers is used in this study. Hence, snowball sampling, which means that most interviewees were proposed to participate in the survey, was adopted. More specifically, the selected interviewees were also asked to offer other willing gamers who fit the research conditions, such as the age of users, so that the reliability of the questionnaire could be maintained. Thus, this study distributed a total of 653 questionnaires. Among the collected 365, 335 were valid for analysis (giving a valid return rate of 51.3%). These valid respondents consisted of 180 males and 176 females, with the ages ranging from 18 to 62.

Quantification Type I Method, as a quantitative tool, was used to analyze the importance of the appeal factors, reasons and characteristics of the interaction which was formed through Pokémon GO in this study. More specifically, Quantification Type I Method could measure and quantify the upper-l and lower-level items using the importance levels from the original evaluation items. Quantification Theory Type I can statistically predict the relationship between a response value and the categorical values using multiple linear regression methods [19]. Moreover, in the field of design, the weights of the factors of users' preferences can be evaluate using Hayashi's Quantification Theory Type I [20, 21]. In addition, Kansei Engineering can apply Quantification Type I Method to measure users' emotions and perceptions while they interact with products. Nagamachi [22] declared that Quantification Theory Type I is a successful technique to depict the relationships between the design characteristics and Kansei classifications. The technique of Quantification Theory Type I, which could be transferred to a type of mathematic formula, was executed through Excel Macro for statistical analysis.

5 Analysis and results

5.1 EGM analysis for reviewing literature and surveying experts

The structure of the evaluation items, which were collected from every participant and reviewed literature were constructed using the process EGM. More specifically, these evaluation items were classified as three administrative levels according to the degree of abstraction, including original evaluation items, reasons of preferences, and specific design characteristics. In addition, the contents of the interviews were recorded and summarized in the form of hierarchy diagrams (Figs. 2 and 3), which were then used as the foundation for the design of a questionnaire.

Furthermore, this EGM structure composed of these selected evaluation items was also used for design of the questionnaire and could then be transferred to the following table, which shows their ranking by the number of accumulated times (Table 1). In order to measure the weights of the attributes and their importance in

Pokémon GO, the strongest two criteria that determine their attractiveness, related to their models of interaction, were selected from the original evaluation items with higher number of times using the EGM. These chosen original evaluation items, which conformed to the focus of this paper, were "social-interaction" and "scenario-interaction". The upper-level reasons with the higher number of times were also determined using the EGM, as shown in Table 2. In order to quantify the selected items and to give a score to the correspondent appeal factors for Pokémon GO, questionnaires were created using a level-based construction, which is composed of upper and lower levels based on EGM, as shown in Table 3.

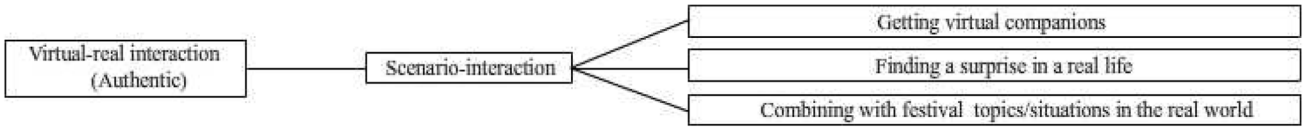

Fig. 2 An example of a participant's evaluation structure. Note: The No. 5 evaluation structure was constructed by retrieving the answers from an experienced gamer, who is 42 years old

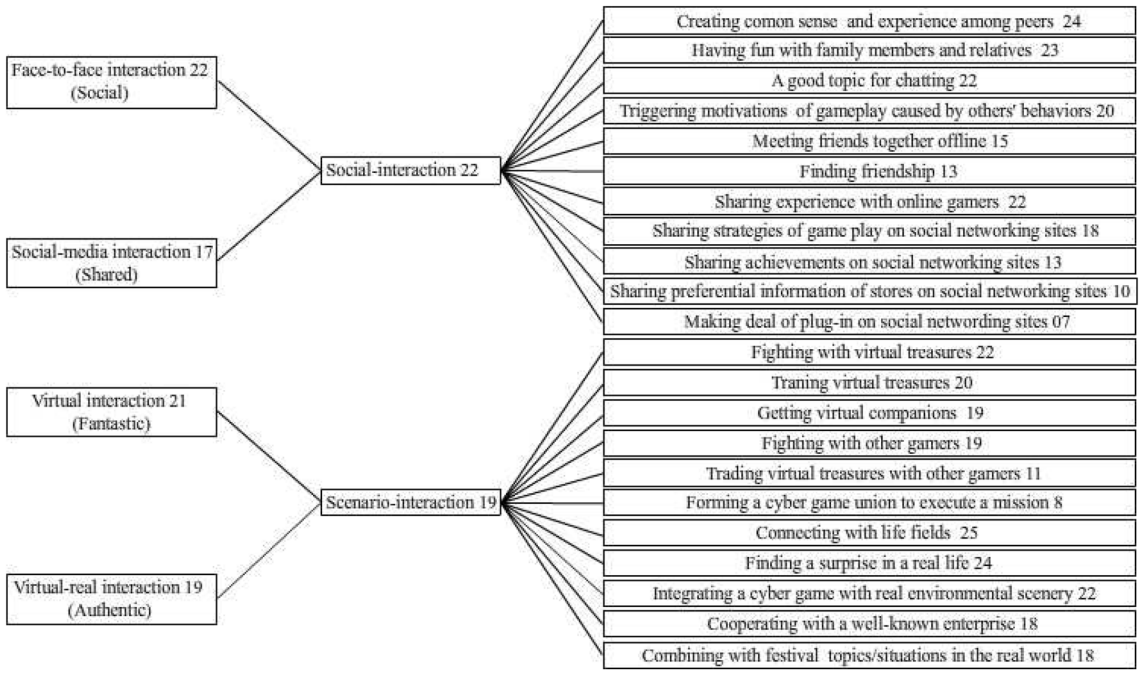

Fig. 3 The hierarchical diagram of preferences for a mobility-augmented reality game, determined by the EGM. Note: In the hierarchical diagram of preferences for mobility augmented-reality game, determined by the EGM, the general hierarchical diagram was constructed by retrieving the answers from all nine experts. The numbers on the right side of the answers indicate the number of times that the same opinion appeared

Table 1 The ranking from the hierarchical diagram by the number of times the descriptions appeared

Original images	Upper level (reasons)	Lower level (specific attributes)
Social-interaction 22	Face-to-face interaction (social) 22	Connecting with life fields 25
Scenario-interaction 19	Virtual interaction (fantastic) 21	Creating common sense and experience among peers 24
Sensory interaction 6	Virtual-real interaction (authentic)19	Finding a surprise in a real life 24
Dressing interaction 5	Social-media interaction (shared)17	Having fun with family members and relatives 23
Role play interaction 3	Media interaction (communicable) 8	A good topic for chatting 22

5.2 Quantification type I analysis for surveying gamers

For the quantitative research, this study selected the first two reliable appeal factors by measuring their coefficient of determination and analyzed their corresponding upper-level and lower-level word further. Tables 4 and 5 shows the partial correlation coefficients, the category scores and the coefficient of determination for the factor of "social-interaction" and "scenario-interaction".

The first appeal factor categorized was "social-interaction", which included "face-to-face interaction (social)" and "social-media interaction (shared)". The classifications indicated that gamers had the impression of "social-interaction" on the game of Pokémon GO because of the two above-mentioned reasons. The results of the

Table 2 The best four "original images and reasons" selected from the hierarchical diagram by the higher number of times they appeared

Classified	Original images	Reasons (upper level)
First	Face-to-face interaction (social) 22	Creating common sense and experience among peers 24 Having fun with family members and relatives 23
Second	Virtual interaction (fantastic) 21	Fighting with virtual treasures 22 Training virtual treasures 20
Third	Virtual-real interaction (authentic) 19	Connecting with life fields 25 Finding a surprise in a real life 24
Forth	Social-media interaction (shared)17	Sharing experience with online gamers 22 Sharing strategies of game play on social networking sites 18

Table 3 The setting of the level-based construction of questionnaire

Level of questionnaire	The first level	The second level	The third level
The type of question	Original evaluation item	Upper level	Lower level
The example of question	Scenario interaction	Virtual interaction (fantastic)	Training virtual treasures

Table 4 The partial correlation coefficients, the category scores and the coefficient of determination for the factor of "social-interaction"

Items	Categories	Category scores	Partial correlation coefficients
Face-to-face interaction (social)	Creating common sense and experience	0.046	0.552
	Having fun with family members and relatives	0.224[a]	
	A good topic for chatting	−0.195	
	Triggering motivations of gameplay caused by others' behaviors	−0.179	
	Meeting together offline	0.115	
	Finding friendship	−0.044	
Social-media interaction (shared)	Sharing experience with online gamers	0.084	0.449
	Sharing strategies of game play on social networking sites	−0.160	
	Sharing achievements on social networking sites	0.061	
	Sharing preferential information of stores on social networking site	0.018	
	Making deal of plug-in on social networking sites	0.067	
C	0.681		
R =	0.655		
R^2 =	0.429		

[a]indicated the most positive "category score", which means the category (lower-level concept) has the most positive influence on the corresponding "item" (upper-level concept)

Table 5 The partial correlation coefficients, the category scores and the coefficient of determination for the factor of "scenario-interaction"

Items	Categories	Category scores	Partial correlation coefficients
Virtual interaction (fantastic)	Fighting with virtual treasures	0.164[a]	0.581
	Training virtual treasures	0.008	
	Getting virtual companions	0.073	
	Fighting with other gamers	−0.048	
	Trading virtual treasures with other gamers	−0.045	
	Forming a cyber game union to execute a mission	−0.271	
Virtual-real interaction (authentic)	Connecting with life fields	0.058	0.404
	Finding a surprise in a real life	−0.087	
	Integrating a cyber game with real environmental scenery	−0.040	
	Cooperating with a well-known enterprise	0.112	
	Combining with festival topics/situations in the real world	0.016	
C	0.758		
R =	0.634		
R^2 =	0.403		

[a]indicated the most positive "category score", which means the category (lower-level concept) has the most positive influence on the corresponding "item" (upper-level concept)

Quantification Theory Type I shows the coefficient of determination ($R^2 = 0.429$) in this study and means standard reliability for our survey results. The reason of "face-to-face interaction (social)", with the highest partial correlation coefficient, had the most influence on the appeal factor "social-interaction". "Creating common sense and experience among peers", "having fun with family members and relatives", "a good topic for chatting", "triggering motivations of gameplay caused by others' behaviors", "meeting friends together offline", and "finding friendship" were included in this category. According to the partial correlation coefficients, "face-to-face (social) interaction" had a stronger effect on "social-interaction". In addition, according to the category scores, "having fun with family members and relatives" had the most positive influence on "face-to-face interaction (social)" and "a good topic for chatting" had the most negative effect on "face-to-face interaction (social)".

The second factor to be analyzed was "scenario-interaction", which comprised "virtual interaction (fantastic)" and "virtual-real interaction (authentic)" in the upper-level assessment. According to the results of the Quantification Type I, the coefficient of determination (R^2) was 0.403 and shows standard reliability for the survey instrument. "Virtual interaction (fantastic)" contributed most to the "scenario interaction" factor because it had the highest correlation coefficient (see Table 5). The categories that belong to "virtual interaction (fantastic)" included "fighting with virtual treasures", "training virtual treasures", "getting virtual companions", "fighting with other gamers", "trading virtual treasures with other gamers", and "forming a cyber game union to execute a mission". The partial correlation coefficient of Table 5 shows "virtual interaction (fantastic)" had a stronger effect on "scenario interaction" then "virtual-real interaction (authentic)". Furthermore, according to the category scores, "fighting with virtual treasure" had more positive effect on "virtual interaction (fantastic)" of all the categories. Then, "forming a cyber game union to execute a mission" had more negative influence on "virtual interaction (fantastic)" of all the categories.

6 Discussion

A hierarchical diagram of Pokémon GO preferences, which was determined by the EGM (Fig. 2), present the results of this study. In order to probe the issues related to the interaction of Pokémon GO, the most representative factors of appeal of Pokémon GO were determined to be "social-interaction" and "scenario-interaction", based on the EGM. The reasons that gamers preferred Pokémon GO, is based on the following four appeal factors of interaction, including "face-to-face interaction (social)", "social-media interaction (shared)", "virtual interaction (fantastic)" and "virtual-real interaction (authentic)". These results also show that mobility-augmented reality games have various kinds of interaction to attract gamers. Then, each appeal factor has its corresponding characteristics, as shown in the EGM hierarchical diagram (Fig. 2). The weights of the features of

Pokémon GO were analyzed using Quantification Theory Type I. The test reliability of all of the four appeal factor were standard, showing that gamers played the game for the pure reason of leisure in the past; nowadays, people play mobility-augmented reality games for the cause of interaction, which can make them get in touch with others and explore the outside real world from the virtual one; hence, this type of games seems healthier and more approachable than others.

Among all the four appeal factors, "face-to-face interaction (social)" and "virtual interaction (fantastic)", with higher partial correlation coefficients (0.552 and 0.581), were proved to have attraction to gamers and were more extraordinary than other types of games. On the basis of the study, the characteristic "having fun with family members and relatives" played an active role in influencing a gamer's impression of "face-to-face interaction (social)". This evidence shows that Pokémon GO has the function that it can enhance parent–child interaction and communication. The characteristic "cooperating with a well-known enterprise" had stronger effect on the factor "virtual-real interaction (authentic)". This means that Pokémon GO can merge the resources of a well-known enterprise by combining its store with game space so the influence of this game can be expanded. Generally speaking, Pokémon GO changes the features of games in a revolutionary way by "face-to-face (social)" and "virtual-real (authentic)" interaction and these make this game more attractive than other types of games.

7 Conclusions

7.1 Findings and managerial implications

This study initially probed the appeal of mobility-augmented reality games through Pokémon GO from the perspective of mobility human–computer interaction. Although augmented reality games have been developing over a period of time, this type of game has been widely applied to mobile phone for humans' entertainment in recent years.

In order to probe the influence of mobility-augmented reality games, I used a preference-based study to disclose the appeal of Pokémon GO. As the results of the study show, compared to traditional digital games, which were designed for a limited population of professional gamers, the features of Pokémon GO can make them a part of common human life because of their novel model of interaction which is composed of the four appeal factors. Hence, I can see that more and more of the population can easily accept this type of game because they can share in the pleasure with their familiars or new friends in the real world. The results of the study can help readers to comprehend the implications that Pokémon GO brings us rather than just know how much fun it can create. Hence, designers or researchers not only understand how to motivate gamers of Pokémon GO through the study, but also are shown the clear principles to develop this type of games based on the results of this study.

Compared to traditional gaming systems, such as Nintendo and PlayStation, a Pokémon GO does not require special equipment but needs just a mobile phone which almost everybody has. Hence, gamers can have freedom and mobility while play AR game and enjoy different and various kinds of interaction without the limitation of space. This design, which breaks the limitation between virtual and real space, creates unlimited possible interactions for users. This also means that the interaction model between a customer and an enterprise can be developed outside the box. Hence, I can see that more and more businesses are created through the Pokémon game. McDonalds, which was the first paying sponsor of Pokémon, successfully launched so-called location-based advertising [3]. This type of advertising instantly appears on a consumer's mobile phone while they are playing Pokémon game in the real world. In addition, the local government is more willing to cooperate with Pokémon GO to create a cluster of industry in Taiwan because of its' excellent cost-effectiveness, such as 2018 lantern meeting in Chiayi and tourism activities in Tainan. This kind of virtual-real business offers marketers unlimited opportunities and creates a new type of marketing.

This study attempted to explore gamers' psychology, content, devices, and marketing of Pokémon GO and echoes what Liao [23] argued about the future directions of mobile augmented reality. Hence, professionals can apply the findings of this study to practice marketing through this type of games. The results of the study can contribute to the field of media interaction, communication and marketing.

7.2 Limitations

The results of this study showed the appeal of Pokémon GO and could not be inferred to other mobility-augmented reality games; however, Pokémon GO, as the major popular mobility-augmented reality around the world, was worth studying and had representative for other mobility-augmented reality games to some extent. This study aimed to probe the interaction between Pokémon GO and gamers based on Kansei Engineering. Hence, it did not explore other subjects which were irrelevant to human–computer interaction of mobility. In addition, experts and interviewees with the above-mentioned knowledge in Taiwan were selected in this study so the results of this research can only represent

the achievements in this area. Then, the ages which were set in this study ranged from eighteen to sixty two partly because the interviewees must be capable of reading and comprehending questionnaires; however, the range of the ages in fact could be wider because the gameplay of Pokémon GO is very popular.

7.3 Future research

The author plans to study more mobility-augmented reality games, in addition to Pokémon GO, when they become more popular. Then, besides the interaction models of game play, mobility-augmented reality games also bring revolutionary changes to humans' leisure activities. For example, Pokémon GO can encourage a gamer at home to go outside for the gameplay. Hence, why consumers prefer augmented reality games to other types of games from the perspective of leisure, and what kind of game features of leisure can make them tirelessly play the game are the two interesting topics to be explored by the future study.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval The research does not have any studies with human subjects or animals performed by any of the authors.

Informed consent All participants were informed ethical principles in advance and agreed to participate this study.

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