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Pamplona, December 10, 2021

Xiaowei Cai

Abstract

The video game industry is growing fast. Although academic research on video games has also grown, marketing researchers still devote far less attention to this field than other entertainment industries. In this thesis, a conceptual framework is introduced to outline the main actors in the video game environment: video game platform, video game content, and video game player. Through reviewing the literature, several research gaps have been identified in the following areas: video game players' switching behaviour from traditional consoles to mobile gaming, video game players' in-game purchase behaviour, and video game players' flow experience. This thesis contains three studies, each of them fulfils the identified research gaps in the corresponding research field. The first study discusses what are the determinants that drive video game players' switching behaviour from traditional gaming to mobile gaming. The second study explores why and how video game players purchased different types of in-game goods. In the third study, the flow experience in the video game context is conceptualised, and a dispositional flow scale is developed for adult video game players.

Keywords: Video games, Switching behaviour, In-game goods, Flow experience

Resumen

La industria de los videojuegos está creciendo rápidamente. Aunque la investigación académica sobre videojuegos también ha crecido, los investigadores de marketing aún prestan mucha menos atención a este campo que otras industrias del entretenimiento. En esta tesis, se introduce un marco conceptual para delinear los principales actores en el entorno de los videojuegos: la plataforma de videojuegos, el contenido de videojuegos y el jugador de videojuegos. A través de la revisión de la literatura, se han identificado varias brechas de investigación en las siguientes áreas: el comportamiento de cambio de plataformas tradicionales a las móviles, el comportamiento de compra dentro del juego y la experiencia de *flow*[1] de los jugadores. Esta tesis contiene tres estudios, cada uno de ellos sirve para resolver las brechas de investigación identificadas en sus correspondientes campos de investigación. El primer estudio analiza cuáles son los determinantes que llevaron a los jugadores de videojuegos a cambiar desde los juegos tradicionales hasta los juegos móviles. El segundo estudio explora por qué y cómo los jugadores de videojuegos compraron diferentes tipos de bienes dentro del juego. En el tercer estudio, se conceptualiza la experiencia de *flow* en el contexto de los videojuegos y se desarrolla una escala de *flow* disposicional para los jugadores de videojuegos adultos.

Palabras claves: Videojuegos, Comportamiento de cambio, Bienes dentro del juego, Experiencia de flow

[1] *Flow* podría traducirse como flujo, que se refiere a esos momentos en los que todo se junta para crear un estado de absorción y disfrute en lo que uno está haciendo.

Contents

Introduction

In the last decades, the video game industry has become an important contributor to the global entertainment economy (Marchand & Hennig-Thurau, 2013). Moreover, this industry is growing rapidly. In just a few years, the revenue of the video game industry has almost doubled. In 2015, the global video game market generated $91.5 in revenue (Newzoo, 2015), and this number is expected to increase to $175.8 billion in 2021 (Newzoo, 2021c). The COVID-19 pandemic certainly accelerated many trends in this market, helping engagement spike across the world (Newzoo, 2021b). Therefore, the video game industry has shifted from a niche industry to a blockbuster business (Marchand & Hennig-Thurau, 2013).

The video game industry is characterised not only by rapid growth but also by a high degree of dynamic innovation (Marchand & Hennig-Thurau, 2013). The main actors in the industry, including the video game platform and video game content, are constantly changing. On the one hand, in recent years, video game developers and players' interests have moved from traditional gaming (i.e. Video game consoles including portable consoles[2], and PC) to mobile gaming (i.e. smartphones and tablets). The revenue of mobile gaming has grown steadily since 2017 (Statista, 2021). By 2018, mobile games were, for the first time, the largest subgroup in the global video game industry (Newzoo, 2018). Meanwhile, the revenue share from traditional gaming has shrunk from 63% (Newzoo, 2016) to 49% (Newzoo, 2018). Additionally, due to the lockdown during the pandemic and the development of 5G, the market share of mobile gaming increased appreciably during 2020-2021 (Newzoo, 2021b). On the other hand,

[2] In this thesis, I classified portable and hybrid consoles like Nintendo Switch as traditional gaming platforms, which aligns with the currently accepted definition in the video game industry (Newzoo, 2021c).

a new trend in the videogame industry is the freemium business model. The freemium business model offers players the chance to play the core game content for free, and the profit is generated through selling in-game goods and premium services (Hamari, Hanner, & Koivisto, 2017). Selling in-game goods has become one of the most important revenue models for video game developers (Hamari, Alha, et al., 2017), as they intend to increase players' willingness to play and to purchase (K.-L. Hsiao & Chen, 2016). Moreover, as an important actor in the video game environment, players themselves are also influenced by industrial innovations. Reports indicate that video game players are becoming more diversified regarding age, gender, attitude toward games, and platform choice (Newzoo, 2021a). The rise of mobile gaming and the freemium model is changing the demographic composite of video game players, as the ubiquitous nature of smartphones and the freemium model make almost every individual a potential player (Marchand & Hennig-Thurau, 2013).

Video game researchers in the area of marketing have conducted a series of studies to understand the important topics in the industry. For instance, video game researchers have investigated the adoption of video games in general (Hamari, Keronen, & Alha, 2015), the adoption of online games (Hsu & Lu, 2004), the adoption of social network games (Shin & Shin, 2011a; Wohn & Lee, 2013), the adoption of mobile games (Ha, Yoon, & Choi, 2007; Wei & Lu, 2014), players' loyalty towards mobile games (Balakrishnan & Griffiths, 2018; Su, Chiang, James Lee, & Chang, 2016), continuous playing intention of mobile games (Liang & Yeh, 2011), advertisements in video games (Mehrtens, Rosenboom, Chen, & Raeside, 2018), user experience in video games (Barnett, Harvey, & Gatzidis, 2018), in-game goods purchase motivations (Balakrishnan & Griffiths, 2018; Hamari, Hanner, et al., 2017; Han & Windsor,

2013; Huang, Bao, & Li, 2017), and heterogeneous nature of in-game goods (Lehdonvirta, 2009).

Although academic research on video games has grown, marketing scholars still devote less attention to this industry than to other entertainment industries, such as films, television drama, and music (Marchand & Hennig-Thurau, 2013). Several research gaps still exist in the video game literature. In the following paragraphs, we discuss the identified research gaps according to the ambits they pertain to in the video game environment: video game platforms, video game contents, and the video game player.

In the field of video game platforms, although the determinants that drive the adoption behaviour of video games are well identified (Ha et al., 2007; Hamari et al., 2015; Hsu & Lu, 2004; Shin & Shin, 2011a; Wei & Lu, 2014; Wohn & Lee, 2013), video game researchers have yet to identify the determinants that drive players to switch from traditional to mobile gaming. Understanding players' platform switching behaviour is critically important for video game firms. From a relationship marketing perspective, maintaining long-term relationships with customers is an important managerial goal because the cost of acquiring new customers is high (Hsieh, Hsieh, Chiu, & Feng, 2012). Researchers have investigated users' switching behaviour in several contexts, including instant messaging (Y. H. Fang & Tang, 2017), internet browser (Ye & Potter, 2011), cloud computing (Bhattacherjee & Park, 2014), mobile shopping (H. H. Chang, Wong, & Li, 2017), and social network service (Hsieh et al., 2012). The research gap hinders marketing researchers and practitioners' understanding the players' gaming behaviours at the micro-level under the environment of industry transformation.

Secondly, in the field of video game content, researchers have identified players' motivations

to purchase in-game goods (Balakrishnan & Griffiths, 2018; Hamari, Hanner, et al., 2017; Han & Windsor, 2013; Huang et al., 2017), apart from acknowledging the heterogeneous nature of the in-game goods (Lehdonvirta, 2009). Nevertheless, researchers still do not know whether the already identified motivations exist when purchasing all types of in-game goods, or some motivations only exist when purchasing certain types of in-game goods. Since there are important differences between different types of in-game goods, the motivations for purchasing can also vary (Hamari & Keronen, 2017). Knowing why and how video game players purchase different types of in-game goods is essentially important for video game developers, because in-game goods have become an integral part of video games, especially for freemium games (Hamari, Alha, et al., 2017).

Thirdly, in the field of video game players, researchers have found that flow experience was positively related to the intention to play video games (C. C. Chang, 2013; Hsu & Lu, 2004; Shin & Shin, 2011b; Zhou, 2013), attitude towards playing video games (Ha et al., 2007), satisfaction (Kim & Ko, 2019; Sepehr & Head, 2018), loyalty (C. H. Hsiao & Tang, 2016), and purchase intention of in-game goods (Animesh, Pinsonneault, Yang, & Oh, 2017; Hamari & Keronen, 2017; Huang et al., 2017). Flow experience refers to those moments when everything comes together to create a state of absorption and enjoyment in what one is doing (Csikszentmihalyi, 1975, 1990). To measure flow experience, researchers have developed a series of measurement instruments, including the flow questionnaire (FQ) (Csikszentmihalyi & Csikszentmihalyi, 1992), flow state scale (FSS) (Jackson & Marsh, 1996), Flow State Scale-2 (FSS-2), Dispositional Flow Scale-2 (DFS-2) (Jackson & Eklund, 2002), short versions of FSS-2 and DFS-2 (Jackson, Martin, & Eklund, 2008). However, under some circumstances, existing

measurement tools are either inappropriate or do not exist at all (DeVellis, 2016). Inducement of the flow experience is context-dependent (X. Fang, Zhang, & Chan, 2013). For instance, previous evidence suggests that the flow experienced in the video game environment is different from that experienced during physical activity, possibly because video gaming is less physically demanding than sport (Wang, Liu, & Khoo, 2009). Although DFS-2 has been verified as an adequate instrument to measure dispositional flow in some information systems, such as gamification settings (Hamari & Koivisto, 2014), its applicability in the video game context has been questioned due to the mixed findings (Procci, Singer, Levy, & Bowers, 2012; Wang et al., 2009). While the DFS-2 was valid for measuring dispositional flow in adolescent players (Wang et al., 2009), researchers failed to replicate the findings among adult players (Procci et al., 2012). There is not a valid scale to measure dispositional flow experience for adult video game players in the literature. In social science, measurement is crucial for researchers. Researchers need to realise that by making casual use of a certain measuring instrument, they run the risk of obtaining inaccurate data and results (DeVellis, 2016).

The purpose of this thesis is to cover the mentioned research gaps. The first objective is to explore what are the determinants that drive video game players' switching behaviour from traditional to mobile gaming. The second objective is to explore why and how video game players purchase different types of in-game goods. The third objective is to develop a scale to measure the dispositional flow experience of adult video game players. In this thesis, three studies are prepared to answer each one of these objectives.

The structure of this study is as follows. In the second section, the research methods used in the thesis are generally introduced. In the third section, I will briefly describe the three studies

in the thesis, including the purposes, the specific research methods, the results, and the implications. In the fourth section, a conclusion will be given, where the implications, limitations, and future research are discussed. Finally, in the appendix of this thesis, the complete articles of the three studies are included.

Methodology overview

The marketing discipline has been characterised to have a wide range of different methodological approaches (Babin & Zikmund, 2015). In this thesis, different types of research (qualitative and quantitative), data collection methods, and data analysis methods are used.

Thirty-eight years ago, researchers pointed out that in the marketing discipline, there was a phenomenon called "Paradigms lost", by which marketing researchers too long relied on a single paradigm: the quantitative paradigm (Deshpande, 1983). This phenomenon led to a serious methodological bias in marketing research. That is, researchers were using theory verification methods exclusively even in situations where theory discovery methods were more appropriate (Deshpande, 1983). While the qualitative paradigm is usually used to generate theory, the quantitative paradigm is generally used to verify the theory. Unfortunately, although the mentioned two paradigms are both important parts of the overall growth of a body of knowledge (Deshpande, 1983), a very intense dispute existed between the two paradigms in the marketing discipline (Hunt, 1991). Fortunately, in recent years, the qualitative versus quantitative debate in the field of marketing is showing a sign of slowing down (Goulding, 2005), and more and more researchers have recognised the value of qualitative research.

In this thesis, my attitude towards the debate of qualitative and quantitative research is the following: The most suitable research methods should be selected to serve the research objectives. Therefore, I chose the appropriate research methods to approach the different research questions in the three articles.

In the first article, 340 samples were collected from Chinese video game forums using the online survey method. In terms of the data analysis, I used two quantitative methods to answer the research question. On the one hand, linear regression analysis with Ordinary Least Squares (OLS) was used to estimate the proposed empirical model. On the other hand, I used an unsupervised machine learning approach, the k-mean clustering algorithm, to find the hidden segments among the video game players Clustering methods have been traditionally used by marketing researchers for market segmentation (Punj & Stewart, 1983), and I used them because they met the objective of the article: to explore the different behavioural patterns of video game players' platform switching.

In the second article, I conducted 21 in-depth interviews with qualified participants. As for the data analysis, I used a qualitative method that is becoming more used and accepted in the marketing discipline (Wagner, Lukassen, & Mahlendorf, 2010): the grounded theory (Charmaz, 2014; Corbin & Strauss, 2015; Glaser & Strauss, 1967). Grounded theory is used to study social processes or actions and explain why things happen (Corbin & Strauss, 2015), which corresponds to the aim of the second article: to explore why and how do video game players purchase different types of in-game goods.

In the third article, I used a leading online panel, Prolific[3], to reach the target population to develop a scale of dispositional flow in the video game context. The use of an online panel saves both time and money, while few disadvantages were observed (Casler, Bickel, & Hackett, 2013). With respect to data analysis, I used both qualitative and quantitative methods to approach the research question. I followed a structured procedure (Churchill, 1979; DeVellis, 2016; Hinkin, 1995; Mackenzie, Podsakoff, Podsakoff, & Mackenzie, 2011; Netemeyer, Bearden, & Sharma, 2003) to develop the scale. The whole procedure includes five phases, which are a transit from qualitative to quantitative approaches. Through reviewing literature and applying grounded theory (Charmaz, 2014), I generated the initial pool of items, which was then judged by five experts from two Spanish universities. Then, I trimmed, modified, and validated the initial item pool through different quantitative phases, including pre-test, initial scale validation, and advanced scale validation, until I had the final scale. Moreover, Structural equation modelling (SEM) was used to estimate the proposed measurement and structural models.

Table 1 shows the research methods used in the thesis. The specific research processes in each article are demonstrated in the following section.

[3] Prolific (https://www.prolific.co/) was launched in 2014, by a group of graduate students from Oxford and Sheffield Universities, as a software incubator company.

Article	Title	Type	Data collection method	Data Source	Data analysis method
1	From traditional gaming to mobile gaming: Video game players' switching behaviour	Quantitative	Survey	Chinese video game forums	Regression model, K-mean clustering
2	A grounded theory approach to understanding in-game goods purchase	Qualitative	Survey and interview	Online in-depth interviews	Grounded theory
3	Self-report measure of dispositional flow experience in the video game context: Conceptualisation and scale development	Qualitative and quantitative	Survey and interview	Prolific	Grounded theory, Structural equation modelling (SEM)

Table 1 Summary of the research methods used in the thesis.

Brief description of the studies

Study 1 From traditional gaming to mobile gaming: Video game players' switching behaviour

In this study, I explored the determinants that drive video game players' switching behaviour from traditional gaming to mobile gaming. To achieve this objective, a human migration framework, the Push-Pull-Mooring (PPM) framework, is adapted to explain the switching intention within the context of the video game industry. This framework has been widely applied by marketing researchers to explain consumer switching behaviour in other industries (Bansal, Taylor, & James, 2005; Bhattacherjee & Park, 2014; H. H. Chang, Wang, & Li, 2017; Y. H. Fang & Tang, 2017; Hsieh et al., 2012; Ye & Potter, 2011). Migration is defined as "*the movement of a person (a migrant) between two places for a certain period of time*" (Boyle, Halfacree, & Robinson, 1998, p. 34). Migration researchers have shown that every act of migration must involve a well-defined starting point, a destination, and a degree of permanence (Bansal et al., 2005; Boyle et al., 1998; Y. H. Fang & Tang, 2017).. The PPM perspective describes human migration is subject to three effects: push effects, pull effects, and mooring effects. Push effects refer to the negative forces which drive migrants away from their permanent residence, while pull effects are the positive forces attracting migrants towards a destination. Finally, mooring effects are the obstacles that prevent people from migrating from their current residence. In the conceptual framework, *Perceived time shortage for playing video games*, *Perceived time-consuming nature of traditional gaming*, and *Perceived expensiveness of traditional gaming* were conceptualised as push effects, which push video game players away from the traditional gaming. Moreover, *Perceived network*

effects from mobile gaming, *Perceived flexibility of mobile gaming*, and *Perceived simplicity of mobile gaming* were conceptualised as pull effects, which pull video game players to mobile gaming. Additionally, *Perceived cost of lost benefits*, *Perceived learning costs*, and *Perceived high performance of traditional gaming* were conceptualised as the factors that prevent video game players from platform switching. Finally, some determinants related to the gaming experience and console ownership were also included in the conceptual framework. 13 propositions were formed to specify the relationships between the mentioned determinants and players' switching intention from traditional to mobile gaming.

To verify the propositions, I developed a questionnaire to measure the variables of the conceptual framework. All the variables were measured on eleven-point Likert scales, ranging from "1" to "11", where "1" stands for "Strongly disagree" and "11" stands for "Strongly agree". To test the validity of the questionnaire, I conducted two waves of pre-tests: one among students at a Spanish University, and another among students at a Chinese University. In the Spanish University, 24 master students in Business Administration were invited to validate the measuring process in the pre-test. In the Chinese University, 16 students of all academic levels were recruited by a marketing research group to participate in the pre-test. The questionnaire was originally written in English, then translated into Simplified Chinese. Before being administered, the Chinese questionnaire was translated back into English to remove any misleading statements or translation errors. The target population in this study was Mainland Chinese players who had played traditional gaming before. A total of 340 valid samples were collected from Chinese video game forums. In the empirical part of this study, I first applied the Ordinary Least Squares (OLS) to estimate linear regression models for the

whole sample. Then, I used a posteriori clustering approach, the K-mean algorithm, to explore the different segments of video game players. Finally, I used the OLS again to estimate the empirical model for the identified segments of players.

The results from the clustering analysis show that there are two segments in the sample with different switching behaviour, labelled *Unshakable stayer* (n = 131, 39% of the whole sample) and *Moderate intentional emigrant* (n = 209, 61% of the whole sample). Switching intention from traditional to mobile gaming is low across the whole sample, although there are differences between the segments. The players in the *Moderate intentional emigrant* segment have a relatively higher mean value (mean = 4.110) of switching intention than those in the *Unshakable stayer* segment (mean = 2.771). The results from the regression analysis demonstrate that 7 of the 13 variables included in the conceptual model have a significant impact on players' switching intention, which are *Perceived expensiveness of traditional gaming*, *Perceived flexibility of mobile gaming*, *Perceived cost of lost benefits*, *Perceived high performance of traditional gaming*, *Past traditional gaming experience*, *Past mobile gaming experience*, and *Ownership of hybrid consoles*. Moreover, the influences of the determinants on players' platform switching are different according to the segments. In the *Moderate intentional emigrant* segment, 4 of the 13 variables have a significant impact on players' switching intention, including *Perceived simplicity of mobile gaming*, *Perceived high performance of traditional gaming*, *Past mobile gaming experience*, and *Ownership of hybrid consoles*. In the *Unshakable stayer* segment, 7 of the 13 variables have a significant impact on players' switching intention, which are *Perceived expensiveness of traditional gaming*, *Perceived flexibility of mobile gaming*, *Perceived cost of lost benefits*, *Perceived learning costs*,

Past traditional gaming experience, *Past mobile gaming experience*, and *Ownership of hybrid consoles*. According to the results, traditional gaming is not being substituted by mobile gaming. In turn, mobile gaming plays a complementary role for the players of traditional gaming.

This study has both theoretical and practical implications. On the theoretical side, I proposed a conceptual framework of video game players' switching behaviour, which was based on the PPM framework from the migration literature. Besides, the relationships among the key determinants of the conceptual framework were examined in the empirical study. The findings reveal video game players' behavioural patterns in platform switching. In addition, this study identified two segments of video game players with different behavioural patterns in platform switching, which expanded the current knowledge of the segmentation of video game players.

On the practical side, the findings also suggest several courses of action for practitioners in the video game industry. First, a relatively low switching intention score is observed in both the *Unshakable Stayers* and the *Moderate Intentional Emigrants* segments. Therefore, it is unwise for marketing practitioners who promote mobile gaming to focus only on the existing traditional game players because of their relatively low switching intention. Second, the significant relationship between the independent variables and video game players' platform switching intention shows some possible marketing solutions to attract traditional gaming players' attention to mobile gaming products. A practical marketing mix for managers is to reduce the price of mobile gaming, enhance the flexibility of game mechanics, and facilitate the data transition from their traditional gaming products to their mobile gaming products. Third, marketing practitioners should be aware that players do not switch to mobile gaming

because they do not have enough time to play video games, traditional gaming is too time-consuming, or mobile gaming is too simple. As a result, it is not a wise decision to introduce a timesaving simplified mobile version of the original game on traditional platforms to attract traditional game players' attention. Forth, video game companies that are about to launch a marketing campaign to direct traditional gamers to mobile gaming need to be aware that there are two distinct player segments. As a result, marketing initiatives, such as price promotions and cross-platform data migration services, may not work alike on all traditional video game players since some are insensitive to such campaigns.

Study 2 A grounded theory approach to understanding in-game goods purchase

The second study aims to establish a conceptual framework that explains video game players' purchase behaviour towards different types of in-game goods. An inductive qualitative approach, grounded theory (Charmaz, 2014; Corbin & Strauss, 2015; Glaser & Strauss, 1967), is used in this study. Grounded theory consists of systematic yet flexible guidelines for collecting and analysing qualitative data to construct theories from the data themselves (Charmaz, 2014), and has been used to study social processes or actions, and offers explanations of why things happen (Corbin & Strauss, 2015), which corresponds to the aim of this study. Grounded theory provides a tried-and-true set of procedures for constructing theory from data, which has proven to be culturally sensitive and applicable to individuals as well as larger organisations and societies (Corbin & Strauss, 2015).

Grounded theory has several methodological characteristics, being theoretical sampling the hallmark of this methodology (Draucker, Martsolf, Ross, & Rusk, 2007). Theoretical sampling is a concept-driven process, which enables researchers to discover the concepts that are relevant to the phenomena and population under study, and allows researchers to explore the concepts in depth (Corbin & Strauss, 2015). Unlike conventional sampling methods, when using grounded theory, researchers do not collect all the data before beginning the analysis (Corbin & Strauss, 2015). In turn, researchers first identify the population of interest and conduct the initial purposive sampling (Draucker et al., 2007). Once the first wave of data is collected, the analysis begins (Corbin & Strauss, 2015). Then, data collection is followed by analysis; Analysis leads to concepts; Concepts generate questions; Questions lead to more

data collection (Corbin & Strauss, 2015). The circular process continues until the research reaches the point of theoretical saturation, in which all major theoretical categories are fully developed, and gathering data no longer sparks new theoretical insight nor reveals new properties of the categories (Charmaz, 2014; Corbin & Strauss, 2015). Theoretical sampling involves a particular form of reasoning:abductive reasoning (Charmaz, 2014). "*Abductive inference entails considering all plausible theoretical explanations for the surprising data, forming hypothesis for each possible explanations, and checking these hypotheses empirically by examining data to arrive at the most plausible explanation* (Charmaz, 2014, p. 201)".

The role of literature review in grounded theory research is controversial (Charmaz, 2014). In this study, my attitude toward literature review is in line with Charmaz (2014): instead of treating prior knowledge as obstacles to the creativity of qualitative researchers, I used literature review to clarify the research boundary, identify the research gaps, and show how the current study fitted and extended the literature. Additionally, prior literature served as an important component in the theoretical sampling phase, which helped me to cultivate theoretical sensitivity and think abductively.

Through reviewing the literature, I acknowledged that there were different types of in-game goods: power-ups, expansion packages, playable characters, time-savers, cosmetic/skins, and loot boxes. Moreover, these six types of in-game goods can be classified into three categories: functional-based goods, ornamental-based goods, and probability-based goods. Additionally, in-game goods have different values, which impels players to purchase them. In the purchasing process, different psychological components, such as social influence and flow experience, play an important role.

At the same time, combining the knowledge of the typology of in-game goods and the in-game purchase behaviour, I found that researchers tended to treat in-game goods as a homogeneous concept in their empirical studies (Animesh et al., 2017; Guo & Barnes, 2011; Hamari, Alha, et al., 2017; Hamari & Keronen, 2017), ignoring the significant differences among in-game goods. Treating in-game goods as a homogeneous concept has several problems. For instance, videogame players' motivations could be different when purchasing different types of in-game goods (Hamari, Alha, et al., 2017; Hamari & Keronen, 2017), which means that the existing knowledge in the literature may not be applied equally to all types of in-game goods.

After locating the research gaps in the literature, I started the research process of grounded theory. Video game players from China were selected as informants in this research. Chinese informants were selected because China is the largest single market of video games in the world in 2018 (Newzoo, 2018). Moreover, I used online semi-structured interview as the primary mean to collect the data. In the initial purposive sampling phase, data collection began in a videogame discussion group on WeChat, the most used social media platform in China. I enrolled three qualified members of the discussion group to our research, and all the following participants were contacted through snowball sampling. Each informant experienced three steps in the research process: being contacted on WeChat, fulfilling a questionnaire on Qualtrics, and being interviewed on QQ (another popular social media in China). In the first contact with the informant on WeChat, I introduced the basic information of the research to probe the informants' willingness to participate in the study, which was interspersed with some daily chats. Moreover, this step also helped me to build the initial

rapport with the informants, which is crucial before interviewing Asian informants (Nuttavuthisit, 2019). Subsequently, I sent an link of the survey to the informant via WeChat. The online questionnaire, placed on Qualtrics, helped me to acquire some basic information related to informants' gaming habits, demographic profiles, personal contact information (QQ and email addresses), and the appropriate time to be interviewed.

Eleven informants (001-011) participated in the initial purposive sampling phase. On of them (006) filled the questionnaire and was eligible to participate in the research, but he did not show in the interview for an unknown reason. Therefore, I conducted ten interviews in the initial purposive sampling phase. Besides, in the first wave of theoretical sampling, I interviewed five informants that had already participated in the initial purposive sampling (002, 004, 007, 009, and 010). Additionally, In the second wave of theoretical sampling, I interviewed six informants (007, 009, 010, 012, 013, and 014), including three informants that had already participated in the previous two sampling phases (007, 009, 010) and three new informants that had never been incorporated in our research (012, 013, and 014). It is worth mentioning that the number of interviews in each sampling phase was not established *a priori* but *a posteriori*. In grounded theory, the analysis should ideally begin after completing the first interview, and continues that way throughout the research process (Corbin & Strauss, 2015; Glaser & Strauss, 1967). Some grounded theorists warn of the danger to collect all the data at once because this approach sets the barrier for theoretical sampling (Corbin & Strauss, 2015).

The findings in this study show that players purchase in-game goods because of the discomfort derived from external stimuli. Moreover, I identified three different purchase

processes for functional-based goods, probability-based goods, and ornamental-based goods. For functional-based goods, the external stimulus is the imbalance of challenges and skills, which generates the anxious experience and the boring experience, and the purchase of functional-based goods is a response to these two discomfort experiences. For ornamental-based goods, the external stimulus is the exposure of cosmetics/skins in the virtual world of the game, which generates the envious emotion, the need to be different and attractive, and these discomfort experiences lead to the purchase of ornamental-based goods. As for probability-based goods, the external stimulus is the purchase restrictions established in the game, which prevents players from alleviating the mentioned discomfort experiences by directly purchasing the corresponding in-game goods, and the purchase of probability-based goods is an alternative way to respond to players' discomforts.

This study has both academic and practical implications. On the academic side, first, this research provides a conceptual framework that explains why and how video game players purchase in-game goods. Meanwhile, this study provides researchers with new directions when they explore players' in-game purchase behaviour. Each of the theoretical categories in this study, such as the role of flow experience in the in-game goods purchase process, warrants further investigation. Second, our research highlights the heterogeneous nature of the in-game goods. This study clarifies the purchase processes for different types of in-game goods, which is expected to change the prevailing approach that in-game goods are treated as a homogeneous concept in the videogame literature.

On the practical implications, based on the results, this study detected some common approaches in the videogame industry, which turn out to be not advisable. First, nowadays,

videogame operators, especially those of freemium games, often increase challenges or establish obstacles to limit players' skills in the game, and the purpose of doing this is to push players away from their comfort zone and induce players to purchase functional in-game goods or probability-based in-game goods. However, the results of our research show that this approach has its danger: if players are situated in the anxiety zone or boredom zone for a long time or very frequently, they may finally abandon the game permanently. As a result, for sustainable profitability, videogame companies should avoid setting the game challenge to an extremely high level and creating too many obstacles for players' skill development in the game. Second, sometimes videogame operators would deliberately reduce the difficulty to obtain some rare cosmetics/skins through a range of different ways, especially in the promotional season. This study recommends industrial practitioners not to significantly decrease the difficulty of obtaining rare items in their games because when the population of owners of rare items is sufficiently big, it will turn itself into an avoidance group, which decrease players' motivation of having the item. Otherwise, after the original rare goods lose their value, game developers need to spend extra effort to develop new rare items to replace the position of the old ones.

Study 3 Self-report measure of dispositional flow experience in the video game context: Conceptualisation and scale development

This study has two objectives. The first objective is to conceptualise the flow experience in the video game context. The second objective is to develop a dispositional flow scale applicable to adult video game players. Csikszentmihalyi (1975) conceptualised the flow as an experience that occurs when the challenge of the task and the skill of the performer are balanced. A person in such a state can make full use of whatever skills are required and receives clear feedback on his/her action (Csikszentmihalyi, 1975). At the same time, there is no time to get bored or to worry about what may or may not happen (Csikszentmihalyi, 1975). Flow theory has important applications in video game research (Animesh et al., 2017; C. C. Chang, 2013; Ha et al., 2007; C. H. Hsiao & Tang, 2016; Hsu & Lu, 2004; Huang et al., 2017; Kim & Ko, 2019; Sepehr & Head, 2018; Shin & Shin, 2011b; Soutter & Hitchens, 2016; Zhou, 2013). Nevertheless, many social science researchers encounter measurement issues (DeVellis, 2016). Sometimes, existing measurement tools are either inappropriate or do not exist at all (DeVellis, 2016). One common response is to rely on existing measurement instruments, although they may be unsuitable or inappropriate (DeVellis, 2016). Another common response is to assume that some newly compiled scales that "look" good and use them directly in the research (DeVellis, 2016). "*In point of fact, most of our measures are only measures because someone says that they are, not because they have been shown to satisfy standard measurement criteria* (Jacoby, 1978, p. 91)." Researchers, therefore, need to realise that by making casual use of a certain measuring instrument, they run the risk of obtaining inaccurate data and results (DeVellis, 2016).

To develop a reliable and valid scale to measure the dispositional flow for the context of video games, I followed the rigorous steps of the scale development process (Churchill, 1979; DeVellis, 2016; Hinkin, 1995; Mackenzie et al., 2011; Netemeyer et al., 2003). The entire scale development process serves to ensure several types of validity, including face validity, content validity, convergent validity, discriminant validity, and nomological validity (DeVellis, 2016; Hinkin, 1995; Mackenzie et al., 2011; Netemeyer et al., 2003). There are five phases in this research, which serve to control the mentioned types of validity. While phases 1 and 2 control the face and content validity, phases 3, 4, and 5 control the convergent, discriminant, and nomological validity. Phase 5 also checks for measurement invariance across different gender and age groups among video game players.

In this study, I conducted several phases of data collection, including both online interviews and online surveys. In almost all phases (except the expert judging phase), the target population is video game players from the United States. The samples from the United States video game market were selected because the United States overtook China to be the largest gaming market in 2019 in terms of global revenue, totalling $36.9 billion (Newzoo, 2019).

Through reviewing the literature on flow experience and interviewing video game players, I adapted the conceptualisation of the nine dimensions of flow experience (Jackson, 1996) from the sports context to the video game context, including *Clear goals* (CG), *Unambiguous feedback* (UF), *Challenge-skill balance* (CSB), *Concentration* (CON), *Action-awareness merging* (AAM), *Sense of control* (SC), *Loss of self-consciousness* (LSS), *Transformation of time* (TT), and *Autotelic experience* (AE). Additionally, I proposed that flow experience could be operationalised through three different models: a unidimensional model, an independent

antecedent model, and a hierarchical antecedent model. In the unidimensional model, all the nine dimensions form a second-order factor that represents the flow experience. (Beard & Hoy, 2010; Engeser & Rheinberg, 2008; Jackson, Eklund, & Martin, 2011; Jackson et al., 2008; Jackson & Eklund, 2002; Jackson & Marsh, 1996). In the independent antecedent model, *Clear goals* (CG), *Unambiguous feedback* (UF), and *Challenge-skill balance* (CSB) are the independent antecedents that affect the flow experience (Jackson, 2012; Keller & Landhäußer, 2012; Nakamura & Csikszentmihalyi, 2012). In the hierarchical antecedent model, the *Clear goals* (CG), *Unambiguous feedback* (UF), and *Challenge-skill balance* (CSB) form a second-order factor that affects the flow experience (Keller & Landhäußer, 2012).

After conducting all the phases of scale development, I developed a 28-items dispositional flow scale named *Video Game Dispositional Flow Scale* (VGDFS). VGDFS is the first scale to measure the psychometric properties of dispositional flow experience in the video game context, and its target population are adult players between 18 to 60. Additionally, I assessed three mentioned operationalisations of flow experience, including the unidimensional model, independent antecedent model, and hierarchical antecedent model. The empirical results suggest that the hierarchical antecedent model performs slightly better than the other two models. Additionally, when specifying clear goals, unambiguous feedback, and challenge-skill balance are grouped into a second-order factor, they explain much more variance than when specified individually.

This study has both theoretical and practical implications. On the theoretical side, first, I first adapted the conceptualisation of the nine flow dimensions (Jackson, 1996) to the video game context. Then, I defined each dimension of the flow experience to delineate the content

domain. Clearly defining the constructs, including dimensions and domains, is an essential step when developing a scale (Churchill, 1979; Netemeyer et al., 2003). The conceptualisation of the nine flow dimensions will guide future researchers to clarify the dimensions and domains according to the flow theory in the video game context, which will help to moderate the prevalent construct proliferation problem in the video game literature where dimensions of flow experience are used. Second, I empirically tested three operationalisations of flow experience. From both the theoretical and empirical sides, the hierarchical antecedent model is better supported. Therefore, I recommend future researchers operationalise the flow experience using the hierarchical antecedent model and explore its theoretical generalisability in other contexts.

On the practical side, the VGDFS is the first scale that faithfully conceptualises the dimensions of the original flow theory (Csikszentmihalyi, 1975, 1990) in the video game context. The appearance of the VGDFS makes up for the deficiency of the application of DFS-2 (Jackson et al., 2011; Jackson & Eklund, 2002) among adult players in the video game context (Procci et al., 2012). Therefore, practitioners in the video game industry, such as game developers and project managers, are encouraged to use the VGDFS to measure video game players' dispositional flow experience. For instance, video game developers could use the VGDFS to measure players' dispositional flow during the alpha and beta tests in the pre-launching period and evaluate its correlates with other essential factors, such as the intention to play the game, attitude toward playing the game, satisfaction, loyalty, and purchase intention. The results of the mentioned psychological correlates will provide insights regarding the game balance to the video game development process, which will improve players' gaming

experience. Furthermore, researchers may not only incorporate the flow experience as a whole in their empirical models (e.g. Animesh et al., 2017) but also include exclusively certain dimensions of flow (e.g. Patanasiri & Krairit, 2019). Therefore, the VGDFS is expected not only to be used as a whole to measure the flow experience, but also can be disassembled and used separately to measure specific dimensional facets of flow.

Finally, unlike copyrighted dispositional flow scales, such as DFS-2 (Jackson et al., 2011; Jackson & Eklund, 2002), S DFS (Jackson et al., 2011, 2008; Martin & Jackson, 2008), and C DFS (Jackson et al., 2011, 2008; Martin & Jackson, 2008), I responded the initiative of Hays et al. (2018) to remove the financial obstructs in using psychometric measures, therefore providing researchers with an open access flow scale. I believe an open access dispositional flow scale helps to build a more equitable, accessible, and innovative world for both academic researchers and industrial practitioners.

Limitations and future research

Despite the advantages this thesis has, several limitations can also be found. In this section, the most important limitations are listed.

In the first study, all the variables in our empirical model are treated as manifest variables and measured on a single-item scale. It is known that single-item measures have practical advantages such as ease of application, brevity, and lower costs associated with their use (Hair Jr, Hult, Ringle, & Sarstedt, 2016). Moreover, unlike long and complicated scales, which often result in a lack of understanding and mental fatigue for participants, single-item measures promote higher response rates as the items are easier and quicker to be answered (Fuchs & Diamantopoulos, 2009; Sarstedt & Wilczynski, 2009). Nevertheless, the use of single-item measures suffers from some challenges. From the conceptual perspective, single-item measures may not represent all dimensions in the domain of the construct to be measured (Hair, Black, Babin, & Anderson, 2013). From the psychometric perspective, unlike composite measures (measures with multiple items), single-item measures do not allow for the removal of measurement error, which decreases the reliability of the scale (Hair Jr et al., 2016). From the validity perspective, choosing single-item measures in most empirical settings is a risky decision when it comes to predictive validity considerations (Hair Jr et al., 2016). Therefore, the limitations of single-item measures leave an opportunity for future researchers to use composite measures when replicating the study.

In the second study, the conceptual framework was grounded on qualitative data obtained by semi-structured interviews through a convenience sample with a small number of players (21 interviews with 14 informants). This implies that the relationships among the categories in this

study have not been verified statistically. Consequently, the results of this study might not be generalisable to the whole population of videogame players. Researchers should not confuse the theoretical sampling of grounded theory and positivist quantitative research (Charmaz, 2014). Grounded theory is not a theory-testing method (Suddaby, 2006). In general, the ontological and epistemological assumptions of qualitative research are different from those of positivist quantitative research (Carminati, 2018; Smith, 2018). Qualitative research lacks a particular type of generalisability, the statistical-probabilistic generalizability, which therefore does not grant researchers confidence about the representativeness of their sample and broader inferences of the results (Smith, 2018). The type of generalizability that qualitative research seeks is usually analytical generalisability: researchers generalise a particular set of results to the established or new concepts/theories (Smith, 2018). Consequently, future researchers are highly encouraged to obtain quantitative data from a larger number of players and apply statistical approaches to verify the conceptual framework in this study.

In the third study, the dispositional flow scale that I developed, the VGDFS, is a composite scale with 28 items. Like other composite scales, VGDFS also suffers from the length problem. Lengthy scale increases not only the nonresponse rate (Vicente & Reis, 2010) but also the common method bias (MacKenzie & Podsakoff, 2012). Therefore, we encourage future researchers to conduct scale shortening studies (Coste, Guillemin, Pouchot, & Fermanian, 1997) to control the number of items in the VGDFS. Moreover, to further verify the nomological validity, it is important to explore the nature of lawful relationships between the focal construct and other constructs, apart from testing whether the indicators of the focal construct relate to measures of other constructs in the manner expected (Mackenzie et al.,

2011). Therefore, I encourage future researchers to conduct factor analytic studies, in which measures of other constructs are involved, such as intention to play video games, attitude towards playing video games, satisfaction, loyalty, and purchase intention of in-game goods. This approach helps to further explore the measurement structure as well as the nomological validity of the VGDFS.

At the level of the entire thesis, some limitations also can be found. In this thesis, I focused on the research gaps in three key actors in the video game environment: video game platform, video game content, and video game players. However, apart from the interactions among the three actors in the video game environment, there are also some external factors that affect them, such as the distribution and the communication channels (Marchand & Hennig-Thurau, 2013). On the one hand, the rapid development of e-commerce has had a huge impact on the video game industry. In the old years, customers were predominantly passive receivers of marketing and media information, and companies were able to avoid negative information because they almost completely controlled the brand-sharping messages (Hennig-Thurau et al., 2010). However, nowadays, companies have lost absolute control over the product information: consumers are using several portals to share comments and reviews about products or services, such as the comment area of online retailers and third-party channels (Hennig-Thurau et al., 2010). These new sources of information are especially important for consumers when purchasing video games (Zhu & Zhang, 2010, 2006) because video games, as one of the experience goods, are relatively difficult and costly to obtain information on product quality before interacting with the product (Mudambi & Schuff, 2010). Thus, it is interesting to know how consumer generated content affects video game sales. On the other

hand, the rise of social media may have a far-reaching impact on video game marketing (Marchand & Hennig-Thurau, 2013). Nowadays, while some video game operators take advantage of social media to promote upcoming and already released games, some video game developers even include social media as part of built-in features. Therefore, understanding the mutual integration between video games and social media as well as its impact on game success are interesting directions for future research.

Conclusion

In English

The video game industry has been experiencing rapid growth in recent years. Although academic research on video games has also grown, marketing scholars still devote far less attention to this industry than to other entertainment industries. Through reviewing the literature, I identified different research gaps in the following areas: video game players' switching behaviour, video game players' in-game purchase behaviour, and video game players' flow experience.

In the area of players' switching behaviour, it was unknown what were the determinants that drive video game players' switching behaviour from traditional gaming to mobile gaming. In the area of players' in-game purchase behaviour, it was unknown why and how video game players purchased different types of in-game goods. In the area of players' flow experience, there was no reliable and valid dispositional flow scale applicable for adult video game players. Later, I used three studies to fulfil the identified research gaps, using different methodological approaches.

According to the result of the first study, traditional gaming is not being substituted by mobile gaming. In turn, mobile gaming is complementary of traditional gaming for players. Moreover, in the second study, I found that players purchased functional-based goods, probability-based goods, and ornamental-based goods for different motives and through different behavioural processes. Finally, in the third study, I developed a dispositional flow scale, which was named *Video Game Dispositional Flow Scale* (VGDFS). Additionally, results show that the hierarchical antecedent model is the best structure to represent flow experience. In each study, academic

and practical implications are given. Also, some limitations of this thesis are recognised, which may guide future research.

En castellano

La industria de los videojuegos está experimentando un rápido crecimiento en los últimos años. Aunque la investigación académica sobre los videojuegos también ha crecido, los investigadores de marketing aún prestan mucha menos atención a esta industria que a otras industrias del entretenimiento. A través de la revisión de la literatura, he identificado diferentes brechas de investigación en las siguientes áreas: el comportamiento de cambio de plataforma, el comportamiento de compra dentro del juego y la experiencia de *flow* de los jugadores. En el área del comportamiento de cambio de plataforma, hasta el presente se desconocía cuáles eran los determinantes que llevaban a los jugadores de videojuegos a cambiar des los juegos tradicionales a los juegos móviles. En el área del comportamiento de compra dentro del juego, se desconocía por qué y cómo los jugadores de videojuegos compraban diferentes tipos de productos dentro del juego. En el área de la experiencia de *flow* de los jugadores, no había una escala de *flow* disposicional confiable y válida, que se podía aplicar a los jugadores de videojuegos adultos.

Una vez identificadas estas brechas en la investigación académica, he realizado tres estudios para cubrirlas, en los que se utilizaron diferentes aproximaciones metodológicas. Según los resultados del primer estudio, los juegos tradicionales no están siendo sustituidos por los juegos móviles, si no que los juegos móviles cumplen una función complementaria para los jugadores de juegos tradicionales. Además, en el segundo estudio, encontré que los jugadores compraban bienes basados en funciones, bienes basados en probabilidades y bienes

ornamentales por diferentes motivos y a través de diferentes procesos de comportamiento. Finalmente, en el tercer estudio, desarrollé una escala de *flow* disposicional,, denominada Escala de flujo de disposición de videojuegos (VGDFS). Además, los resultados muestran que el modelo antecedente jerárquico es la mejor estructura para representar la experiencia de *flow*. En cada estudio uno de los tres estudios, se proporcionan implicaciones académicas y prácticas. Asimismo, se introducen las limitaciones de esta tesis, que pueden orientar investigaciones futuras.

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Appendix

Information of the journals

All the three studies in this thesis have been published in journals indexed in the Journal Citation Reports (JCR). The following table contains the basic information of the journals:

Article	Status	Journal	Disciplinary	Ranking	Division
Article 1	Published	Entertainment Computing	Computer science, Cybernetics	18/23	Q4
			Computer science, Interdisciplinary applications	95/111	Q4
			Computer science, Software engineering	73/108	Q3
Article 2	Published	PLOS ONE	Multidisciplinary sciences	26/72	Q2
Article 3	Published	International Journal of Human-Computer Studies	Computer science, Cybernetics	6/23	Q2
			Ergonomics	4/16	Q1
			Psychology, Multidisciplinary	33/140	Q1

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From traditional gaming to mobile gaming: Video game players' switching behaviour

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ABSTRACT

This paper intends to uncover whether mobile gaming is complemental or substitutable to traditional gaming. A human migration framework, the Push-Pull-Mooring, is adopted to the context of video game switching. A total of 340 valid samples were collected from Chinese video game forums. We applied K-mean clustering to find different video game player segments. We also applied Ordinary Least Squares (OLS) to estimate linear regression models for the whole sample and the identified segments. Results demonstrate that 7 of the 13 variables included in the conceptual model have a significant impact on the switching intention, which are Perceived expensiveness of traditional gaming(PE), Perceived flexibility of mobile gaming(PF), Perceived cost of lost benefits(PCLB), Perceived high performance of traditional gaming(PGP), Past traditional gaming experience(EXPT), Past mobile gaming experience(EXPM), and Ownership of hybrid consoles(OHC). Moreover, results from the clustering analysis show that there are two segments in our sample, labelled Unshakable stayer and Moderate intentional emigrant. Switching intention from traditional to mobile gaming is low across the whole sample, although there are differences between the segments. We conclude that traditional gaming is not being substituted by mobile gaming. In turn, mobile gaming serves a complementary role for the players of traditional gaming.

1. Introduction

On February 27, 1996, a legend of video game history landed on the Japanese video game industry. Its name was Pokémon Red version/Blue version, a role-play video game developed by Game Freak and published by Nintendo for Game Boy. By 1997, Pokémon had sold 10.4 million copies in Japan [1] and its influence spread like wildfire beyond Asia, to make record sales of 9.85 million US dollars in the United States [2]. Twenty years later, the successor to the original Pokémon, Pokémon Go, set the world on fire anew. According to Newzoo [3], Pokémon Go accrued 470 million US dollars in revenues and 550 million installs within 80 days of its launch, thus catapulting itself into the Pantheon of video games.

The changes of gaming forms of Pokémon series (from traditional gaming to mobile gaming) is a good example of the development of video games. Today, the global video games market is mainly driven by mobile games, and the reasons for this development can be found in the general shift to mobile devices [4]. In recent years, game makers and players' interest have moved from traditional gaming (i.e. Video game consoles including portable consoles, and PC) to mobile gaming (i.e. smartphones and tablets)[1]. The revenue share of mobile gaming has grown steadily since 2012 [5]. By 2018, mobile games were, for the first time, the largest subgroup in the global video game industry [6]. Meanwhile, the revenue share from traditional gaming has shrunk from 63% [7] to 49% [6]. In the future, mobile gaming will produce revenues of $95.4 billion in 2022, growing with a compound annual growth rate of + 11.3% to account for almost half (49%) of the entire games market [8].

Thus, from the previous industrial data, we have observed a gradually shrinking traditional gaming market and a gradually growing mobile gaming market. Nevertheless, if we focus our attention on a more micro level, we could speculate that the observed switching tendency of revenue from traditional gaming to mobile gaming in the industry would be due to the players' switching behaviour at the individual level.

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[1] We acknowledge the existing confusion as to whether portable video game consoles should be classed as traditional or mobile gaming platforms, and where hybrid consoles like Nintendo Switch fit into the classification. In this research, we include portable and hybrid consoles like Nintendo Switch among traditional gaming platforms, in line with the currently accepted definition in the industry [87].

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Unfortunately, "although academic research on video games has grown, marketing researchers still devote much less attention to this field than to other entertainment industries, such as movies, television or music" [9]. For instance, in the context of switching from traditional video games to mobile games, video game researchers have investigated the adoption of mobile games [10,11], players' loyalty towards mobile games [12,13], in-game goods purchase in mobile games [13–16], advertisements in online mobile games [17], and user experience in mobile games [18]. However, researchers and practitioners in the video game industry have yet to identify the factors that drive video game players to switch from traditional to mobile gaming, which thus hinders marketing researchers and practitioners' understanding about the players' gaming behaviours at the micro level under the environment of industry transformation.

To explore the variables that drive players to switch from traditional to mobile gaming, a human migration framework, the Push-Pull-Mooring (PPM) framework, is adapted to explain switching intention within the context of the video game industry, as this framework has been widely applied by marketing researchers to explain consumer switching behaviour [19–24]. The population for this study is Mainland Chinese players who have played traditional gaming before. The selection of this population is based on the following facts. Firstly, Mainland China plays a leading role in the current global video game market with a revenue of 22.1 billion U.S. dollars in 2018 [4], and is set to gross 50.7 billion U.S. dollars in revenue by 2021 [6]. Respect to the empirical part of our study, in a posteriori segmentation approach, the K-mean algorithm, was used in this study to explore the different behaviours in the players' subgroups. Later, we applied the linear regression to investigate the relationships between the independent variables and players' switching intention from traditional gaming to mobile gaming.

For academic researchers, our study provides pioneer empirical evidence on traditional and mobile gaming behaviour, which provides foundations for future confirmatory studies using a larger sample size. For industrial practitioners, this study helps them to better understand the dynamics of the video game industry, which therefore helps them to improve mobile game design and marketing strategies in order to adapt the needs of players. The findings are also potentially applicable to other areas of the media industry, where mobile devices are becoming the main distribution channel.

The paper begins with an overview of video game adoption and the PPM framework. There then follows an explanation of the propositions and methodology of the study. The empirical results are then presented, and a concluding section discusses the implications and limitations of the findings.

2. Conceptual framework

2.1. Motivations for playing video games

From the academic perspective, researchers have investigated consumers' motivations for playing video games since the introduction of the early generations of consoles [9]. The motivations of video game playing which have been identified so far include intrinsic motivations (fantasy, challenge, curiosity) [25], arousal, competition, entertainment, social interaction [26], habits and addictive tendencies [27], in-game autonomy and competence [28], and self-efficacy [29].

In the past decade, moreover, increasing numbers of researchers have examined the factors that influence gamer' intention to play mobile games thanks to the development of mobile technologies [16,30–42].

Regarding to the theoretical models which researchers have applied to explain player's adoption behaviour, several classical frameworks have been developed. The first theoretical model needed to be mentioned is Technology Acceptance Model (TAM) [43], which explains new end-users' information-systems acceptance process. The classical TAM has five core constructs; namely, Perceived Usefulness, Perceived Ease of Use, Attitude Toward Using, Behavioural Intention to Use, and Actual System use, with external variables affecting Perceived Usefulness and Perceived Ease of Use. Researchers have already applied determinants from TAM to explain video game players' adoption behaviour [10,36,39,44,45]. Besides, based on the TAM and other seven theoretical models, Venkatesh, Morris, Davis, & Davis [46] developed the Unified Theory of Acceptance and Use of Technology (UTAUT) model. According to UTAUT, 10 latent constructs and manifest variables should be considered when investigating users' acceptance of information technology, which are Performance Expectancy, Effort Expectancy, Social influence, Facilitating conditions, Behavioural Intention, User Behaviour, Gender, Age, Experience, and Voluntariness of Use. Determinants of UTAUT also have been applied by researchers to study video game players' adoption behaviour [31,41,47]. Additionally, Venkatesh, Thong, & Xu [48] introduced an improved version of UTAUT model, which is named UTAUT2. This updated version includes 12 latent constructs and manifest variables, which are Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value, Habit, Behavioural Intention, Use Behaviour, Age, Gender, and Experience. Several researchers have applied UTAUT2 model to explain adoption behaviours of video games [35,49].

When considering the aforementioned studies, it is clear that these past knowledges about the players' adoption behaviours of video games may provide us with a good theoretical starting point. However, rather than video game adoption, our study addresses switching behaviour between of two different but closely connected technologies: traditional gaming and mobile gaming. In contrast to radical innovation adoption or first-time adoption, technology switching can be viewed as an instance of adopting an information system with incremental innovation [50]. Since no prior empirical evidence has shown that the aforementioned theoretical models of adoption behaviour have explanatory power for switching behaviours between different types of gaming, we turn to the PPM framework, the details of which will be provided in the following section.

2.2. Push-Pull-Mooring framework

Migration is defined as "*the movement of a person (a migrant) between two places for a certain period of time*" [51]. Migration researchers have shown that every act of migration must involve a well-defined starting point, a destination and a degree of permanence [19,22,51]. PPM, which combines the elements of the Push-Pull framework [52] with mooring factors [53,54], is a dominant paradigm in the field of migration research [19]. The PPM perspective describes human migration is subject to three effects: push effects, pull effects and mooring effects. Push effects refer to the negative forces which drive migrants away from their permanent residence, while pull effects are the positive forces attracting migrants towards a destination. Finally, mooring effects are the obstacles that prevent people from migrating from their current residence.

Although PPM was initially applied only in human migration research, it has since been extended to the field of marketing because of the similarity between human migration and consumer switching [21,23]. Bansal et al. [19] successfully verified the applicability of PPM in explaining service switching in the hairdressing industry. Later, the applicability of PPM in explaining technology service switching was proved by Ye et al. [21], in the context of Internet browsing. Hsieh et al. [23] used the PPM model to delineate the determinants of online service switching from blogs to Facebook. Bhattacherjee & Park [2] applied the PPM paradigm to explain users' switching from client-hosted computing to cloud computing. Thus, the PPM framework has successfully been applied in previous studies to explain consumer switching behaviour between offline and online services and is therefore proposed here to explain switching from traditional to mobile video game platforms.

In this study, switching between gaming platforms is similar to human migration. In the context of gaming switching, the starting point

for migration is traditional gaming and the destination is mobile gaming. Furthermore, the reduction in time spent on traditional gaming accompanied by an increase in time spent on mobile gaming is considered as the switching from traditional to mobile gaming.

3. Research model and propositions

Our research model is based on the PPM framework. Like actual migrants, video gamers engaged in the switching process are also subject to three effects: *push effects,* pushing them away from traditional gaming; *pull effects,* pulling them towards mobile gaming, and *mooring effects,* hindering them from abandoning traditional gaming. The following sections will introduce the specific variables for our research model, which will be classified according to the effects they produce. Fig. 1 describes our research model.

To our knowledge, there is no existing empirical research using the PPM framework to analyse video game players' switching behaviour. The lack of previous empirical literatures about the players' switching behaviours leads us to formulate propositions instead of hypotheses.

3.1. The components of push effects

There is a conceptual correspondence between the components of the push effects mentioned in the migration literature and many evaluative drivers of service switching intention, such as value, commitment, and price perception [19]. *Perceived time shortage for playing video games* (PTS), *Perceived time-consuming nature of traditional gaming* (PTC), and *Perceived expensiveness of traditional gaming* (PE) are the operationalisations of the mentioned theoretical components in the video game context.

Perceived time shortage for playing video games (PTS). Perceived time shortage refers to the individual's experience of lacking the necessary time to complete personal activities [55]. When traditional video game players experience a personal life change, their free time for playing video games may be reduced. However, their need for entertainment through gaming will persist, because it would be a long-term habit. When unable to achieve a specific means to satisfy certain needs, the individual may turn to a substitute [56]. Thus, with free time for traditional gaming decreasing and the need for entertainment remaining constant, it is reasonable to expect players to turn to mobile gaming in order to take advantage of its "fast to play, fast to end" nature. Besides, previous research shows that perceived time shortage strengthens the use behaviours of a specific mobile technology: mobile messages [55]. In other words, the time shortage factor functions as a force, pushing players away from traditional gaming.

Hence, the following proposition can be formulated:

P1. Perceived time shortage for playing video games is positively related to switching intention.

Perceived time-consuming nature of traditional gaming (PTC). Perceived time-consuming nature of traditional gaming refers to the perception that traditional gaming takes up more time to play. Previous researchers mentioned that the gaming time spent on mobile gaming may differ from the gaming time on traditional gaming [57]. Another interesting phenomenon among video game players is that people begin as heavy console/PC video game consumers, but, as time goes on, they turn to mobile gaming, which is usually considered a more leisurely form of gaming. A popular Chinese social Q & A website, Zhihu[2], posed an interesting question: Why do some people only play Hearthstone[3] (a mobile game) and no longer play World of Warcraft[4] (a PC game)? These two video games share some similar features, such as story and characters. The answers revealed a broad similarity of opinions: World of Warcraft is a Massively Multiplayer Role-Playing Game (MMRPG) on a traditional platform, requiring a huge time investment, and the fragmented free time of most people nowadays can only support the time input required for Hearthstone, which is considered a casual card game for mobile platforms.

This leads to the following proposition:

P2. Perceived time-consuming nature of traditional gaming is positively related to switching intention.

Perceived expensiveness of traditional gaming (PE). Economic issue is also worth considering in service migration models [19]. According to the rationale choice theory [58], consumers face a delicate balance between the costs paid for the use of a service, such as traditional gaming and mobile gaming, and the benefits yielded from using this service. Therefore, pricing issue needs to be addressed when considering the obstacles related to discontinuity of a service [59]. Respect to the empirical evidences, Karaiskos, Kourouthanassis, Lantzouni, Giaglis, & Georgiadis [60] found that perceived monetary value is the most decisive factor that drive consumers to use mobile data services. Additionally, pricing issue is also positively related to the behaviour intention to play mobile social network games [35,61]. Thus, video game players select games with reasonable prices [35], and consumers are more willing to switch if their incumbent service provider charges more than a potential competitor [19].

As well as the purchase cost of traditional gaming consoles, retail prices for traditional gaming are also much higher than for mobile gaming. In view of such a significant price difference, players may consider traditional gaming too expensive and decide to turn to mobile gaming. Although, throughout the whole customer lifetime cycle, some players may spend much more on in-app goods in mobile gaming than they would on traditional gaming. The high initial retail price of traditional gaming is a major threshold for players, which may eventually lead them towards mobile gaming. Thus, we make the following proposition:

P3. Perceived expensiveness of traditional gaming is positively related to switching intention.

3.2. The components of pull effects

Alternative attractiveness is an important theoretical component of the pull effects in both the migration and service switching intention literature [19]. In the video game context, we operationalised the alternative attractiveness as *Perceived network effects from mobile gaming* (PNE), *Perceived flexibility of mobile gaming* (PF), and *Perceived simplicity of mobile gaming* (PS).

Perceived network effects from mobile gaming (PNE). Network effects are the utility or value derived by product or service users from the network of other users of similar or compatible products [62]. In this research, we focus on the perception of the network effects. The value of a network grows as the number of its members increases [11]. When people perceive that large numbers of others are using a certain technology, they are more likely to adopt it themselves, and this phenomenon is more salient in their own social group [11,63]. There are several empirical findings linking perceived network effects to technology usage. For instance, Lin & Lu [64] that perceived network effects to be positively related to continuous use of social network sites. Sledgianowski & Kulviwat [65] found people intend to participate in social network sites when the number of users reaches a significant number. Wei & Lu [11] found empirical evidence of a positive relationship between perceived network effects and the intention to play mobile social

[2] URL: https://www.zhihu.com/question/34583233

[3] The complete name of Hearthstone is Hearthstone: Heroes of Warcraft, which is a freemium online collectible card video game developed by Blizzard Entertainment and released in 2014. Hearthstone has broadly the same features as World of Warcraft and was first released for Windows and Mac OS, with later support for IOS and Android devices.

[4] World of Warcraft is a massively multiplayer online role-playing computer game released in 2004 by Blizzard Entertainment.

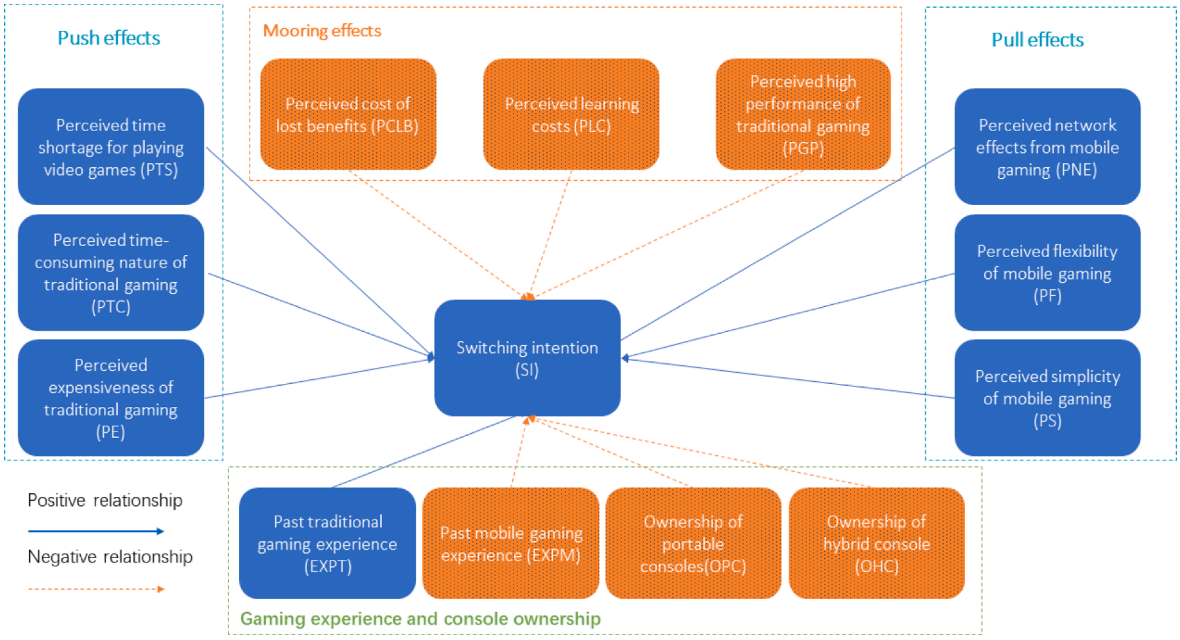

Fig. 1. Conceptual model.

games. J. Lee et al. [39] found that perceived number of friends is positively related to the intention to play mobile social network games.

We therefore propose the following proposition:

P4. Perceived network effects from mobile gaming are positively related to switching intention.

Perceived flexibility of mobile gaming (PF). Perceived flexibility of mobile gaming refers to video game players' perception that the mechanisms of mobile gaming allow that to play games anytime and anywhere. In addition, unlike traditional gaming, mobile gaming involves no time or place constraints, because mobile games run on electronic devices, such as smartphones or tablets, which players are usually able to carry with them. Therefore, the flexible feature of mobile gaming may greatly promote players to increase their frequency and duration in gaming [16]. Moreover, the mobile game mechanism enables players to begin and end their gaming sessions quickly. The characteristics of these mobile devices are therefore more accessible, portable and convenient than traditional gaming [11]. Meanwhile, compared with traditional gaming, time and access flexibility of mobile gaming can improve the service quality, which may gradually enhance players' dedication to this type of games [16]. Empirically supported evidence shows that time flexibility positively influences the adoption of mobile social games [11].

Thus, the following proposition can be formulated:

P5. Perceived flexibility of mobile gaming is positively related to switching intention.

Perceived simplicity of mobile gaming (PS). Perceived simplicity explains the degree to which users feel cheerful and find it easy to adopt and employ the system [66]. Perceived simplicity has been verified empirically as a key positive factor in the adoption of information technologies [23,43,67], online games [44], and mobile games [68]. The design of mobile gaming is generally more basic than is the case with traditional gaming, thus making learning to play easier. Besides, empirical results from previous research show that perceived simplicity is positively related to continuous intention to play mobile games [38]. Hence, we propose the following proposition:

P6. Perceived simplicity of mobile gaming is positively related to the switching intention.

3.3. The components of mooring effects

The conceptualisation of mooring effects in the migration and service switching literature includes several components, such as past behaviour and switching costs [19]. We operationalised these components in the video game context as *Perceived costs due to lost benefits* (PCLB), *Perceived learning costs* (PLC), and *Perceived high performance of traditional gaming (PGP)*.

Perceived switching costs. Switching costs are defined as "the one-time costs that customers associate with the process of switching from one provider to another" [69]. Switching costs play a vital role when users decide whether to switch or not[70]. Perceived switching costs in general are negatively associated with the switching intention [71]. More specifically, two different types of switching costs can be highlighted: *Perceived costs due to lost benefits* (PCLB) and *Perceived learning costs* (PLC).

Perceived costs due to lost benefits refers to the loyalty points, rewards, etc. that a consumer stands to lose by switching [72–75]. For example, players may lose their PlayStation Network membership if they decide to switch from PlayStation4 to a mobile platform such as IOS. Meanwhile, there are also perceived learning costs associated with the adaptation involved in switching [72,75,76]. Although their entertainment needs are served both by traditional and mobile gaming, some of the unique characteristics of mobile gaming may still make it hard for players to transfer all the knowledge they have acquired from traditional gaming to mobile gaming. Certain features, such as freemium games, which are ubiquitous on mobile platforms but are less epidemic on traditional gaming platforms, could complicate the adaptation process for players trying to adjust to the new gaming mechanism. Hence, we propose the following propositions:

P7. Perceived cost due to lost benefits is negatively related to switching intention.

P8. Perceived learning costs are negatively related to the switching intention.

Perceived high performance of traditional gaming (PGP). When players decide to switch to mobile gaming, gaming performance is undoubtedly one of the factors they take into account. Players' gaming performance requirements are increasing as video game hardware evolves. The video game industry is a 'cyclical business', which means that video game performance is heavily dependent on the technical capabilities of video

game hardware, which has experienced a dramatic evolution over the past 30 years [9]. As in other electronic industries, when a new video game console is released, the huge performance difference soon leads to the abandonment of the previous generation's hardware. For example, those used to the powerful 3D performance of PS4 games may find it hard to return to the age of the NES, when the game display consisted of a bitmap. Similarly, although mobile gaming is a more modern gaming form compared with traditional game, the performance of mobile gaming still cannot reach the output traditional gaming due to the limitation of the hardware of cell phones.

Based on the arguments stated above, the following proposition can be formulated:

P9. Perceived high performance of traditional gaming is negatively related to switching intention.

3.4. Past gaming experience

Past traditional gaming experience (EXPT) and *Past mobile gaming experience* (EXPM). Past experience has been found to be an important determinant of human behaviour [77]. "*When people act, they learn*" [78]. Learning means changes in an individual's behaviour arising from past experience [78]. Consumers tend to generalise from one purchase situation to another [79]. A positive purchase experience, for example, can motivate a shopper to return to the same supermarket and increase, the probability of this person going to this particular supermarket rather than another in the future. Thus, the previous purchase experience often leads to spatial or contiguous generalisation [79]. In information and technology user switching, when a user has more prior experience of using a particular technology product, he/she will be less likely to have the intention to use an alternative technology [21]. Previous research shows that prior experience can change the adoption intention or continued use of -learning websites [80]. The findings of Hsieh et al. [23] indicate that past social media usage experience hinders users' intentions to switch from blog to Facebook.

Based on the above review of previous research, we believe that past gaming experience also affects video game players' intention to switch to mobile gaming. The more traditional gaming experience people have, the more likely they are to continue with the same gaming option, and the same goes for those with more experience of mobile gaming., Hence, we formulate the following propositions:

P10. Past traditional gaming experience is negatively related to switching intention.

P11. Past mobile gaming experience is positively related to the intention to switch from traditional to the switching intention.

3.5. Portable and hybrid console ownership

Ownership of portable consoles (OPC). There is a possible cannibalisation effect between portable video game consoles (3DS and PSVita) and mobile gaming: a player who has a portable video game console may be less likely to switch to mobile gaming due to the similarities (mainly in terms of hardware) between portable and mobile gaming. The portable video gaming experience offers players some of the typical features of mobile games, such as touch screen, camera, gyroscope etc. Moreover, the similarity of the application scenarios for these two platforms may also cause the conflict of gaming time. Thus, the following proposition is established:

P12. *Ownership of portable consoles* is negatively related to the switching intention.

Ownership of hybrid console (OHC). Nowadays, portable consoles are not the only type of hardware equipped with mobile functionality. Nintendo introduced their latest generation of hardware in 2017 under the name of Nintendo Switch. To date, Nintendo Switch is the only existing hybrid console. This new hardware is equipped with hybrid functionalities and has three gaming models: TV model, Table model and Portable model. The TV model offers players the same experience as in traditional gaming, while the Table and Portable versions of the same hardware make gaming possible anywhere. As a result, we also posit a competitive relationship between hybrid consoles and mobile gaming.

Therefore, the following proposition is established:

P13. *Ownership of hybrid console* is negatively related to the switching intention.

4. Methodology

4.1. Measurement of variables and questionnaire design

All the variables in this research were measured on eleven-point Likert scales, ranging from "1″ to "11", where "1" stands for "Strongly disagree" and "11" stands for "Strongly agree".

Two pre-tests were conducted: one among students at a Spanish University and another among students at a Chinese University. In the Spanish University, 24 master students in Business Administration were invited to validate the measuring process in the pre-test. In the Chinese University, 16 students of all academic levels were recruited by a marketing research group to participate in the pre-test. The purpose of this was to confirm the accuracy of the translation of the questionnaire and identify ways to make it friendlier to Chinese respondents. Having achieved a satisfactory level of comprehension, the final questionnaire was drawn up (see Appendix A).

The questionnaire was originally written in English, then translated into Simplified Chinese and administered to survey participants from Mainland China. Before being administered, the Chinese questionnaire was translated back into English to remove any misleading statements or translation errors. All the questions were required to be answered, so there are no cases of missing data in completed questionnaires.

Care was also taken in this study to minimise common method bias issues, which are caused by the common method variance that is attributable to the measurement method rather than to the constructs the measures represent. [81]. Several factors may lead to the common method bias in marketing research, which includes low need for self-expression, context that arouse suspicion, and ambiguity [82]. To address these issues, we included some procedural remedies in the study. In the introduction to the questionnaire, respondents are informed that the survey is not a test or exam, and there are no correct or incorrect answers. All they need to do is state what they really think. In order to minimise any privacy concerns, the respondents are also told that the results of the survey are used exclusively for academic purposes. A glossary is also included to minimise any misunderstanding of the terminology (e.g. traditional gaming, mobile gaming, etc.) used in the introduction and in some questions.

4.2. Data collection and cleansing

The data were collected over the course of four weeks in the spring of 2018 using Qualtrics, an online questionnaire platform. The questionnaire was distributed through online discussion forums, where traditional gamers are more likely to be found. All the eligible respondents had the right to participate in a draw for an Amazon Gift card worth 100 RMB. The questionnaire was posted on 12 popular Chinese video game discussion forums, selected from the Alexa Index, a leading website-popularity measuring tool available on the Internet. In this phase, 799 samples matching the population (Players who have played traditional gaming before) were collected. Among these players, 779 respondents have also played mobile gaming before, 11 respondents have not played mobile games before, and 9 respondents did not give the answer. At the end, 358 respondents finished the entire questionnaire.

Among 358 respondents who finished the questionnaire, a multi-criteria data cleaning process was then conducted in order to mitigate non-sampling errors. The criteria include a survey provider mechanism allowing us to detect spam IPs; restriction of the sample to Mainland Chinese citizens, since they form the population for this study; the

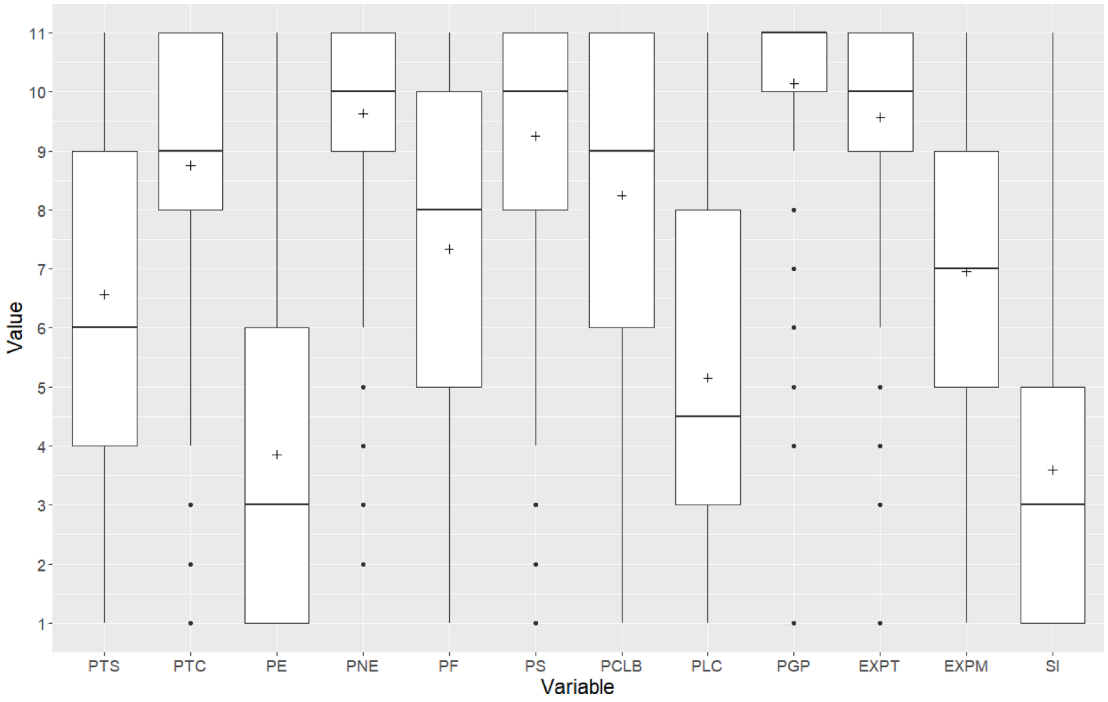

Fig. 2. Boxplots for the continuous variables.

removal of all observations with a variance of zero for the variables measured by the Likert scale to avoid acquiescence bias; restriction of the sample age range to the ages 10 to 80, assuming people in this age range to be able to understand and complete the questionnaire. Finally, other common-sense rules, such as the condition that participants in full- or part-time employment must have an income, were also applied. By the end of the data cleaning process, 340 samples remained in our dataset.

4.3. Modelling procedure

We first run clustering analysis using the K-Means algorithm to detect any groups of players with significantly different behaviour patterns. This is followed with a linear regression analysis using Ordinary Least Squares (OLS) estimation on all the observations in the dataset and the observations from the groups obtained from the K-mean clustering algorithm.

4.4. Software environment

The R programming language (R 3.5.0 with RStudio v1.1.453) is used in all the data analysis procedures, which include data inspection, data translation, data cleaning, descriptive data analysis, clustering and linear regression estimation.

5. Data analysis

5.1. Descriptive statistics

In terms of demographics, all the participants are citizens of Mainland China, and 95.1% (n = 323) are under the age of 35. The majority are male (n = 316, 92.90%) and only 24 (7.10%) are female. In terms of portable and hybrid console ownership, 36.47% respondents (n = 124) declare ownership of portable consoles (3DS or PSV), while 28.53% (n = 97) own the hybrid console (Nintendo Switch). Table 1 gives more detailed information about the categorical and nominal variables.

With respect to the descriptive statistics for the continuous variables (Appendix B), first, note that the mean value for PTS is 6.565, which

Table 1
Descriptive statistics for categorical and nominal variables.

Variables	Levels	Frequency	Percentage
Nationality	Mainland China	340	100%
Age	<= 20	25	7.40%
	21–25	131	38.50%
	26–30	109	32.10%
	31–35	58	17.10%
	36–40	15	4.40%
	>=41	2	0.60%
Gender	Male	316	92.90%
	Female	24	7.10%
Having children under the age of 14 ?	Yes	67	19.70%
	No	273	80.30%
Student	No	203	59.70%
	Yes (Part time)	15	4.40%
	Yes (Full time)	122	35.90%
Education	I have had no formal education	2	0.60%
	Primary school	0	0.00%
	Middle school	1	0.30%
	Vocational school	3	0.90%
	High school	10	2.90%
	Community college	25	7.40%
	Undergraduate	194	57.10%
	Master	76	22.40%
	PhD	29	8.50%
Job	No	121	35.60%
	Yes (Part time)	34	10.00%
	Yes (Full time)	185	54.40%
Income	Do not Know or No Answer	12	3.53%
	I have no income	75	22.06%
	<3000 RMB	7	2.06%
	3001 RMB-7000 RMB	104	30.60%
	7001 RMB-10000 RMB	37	10.90%
	>10,000 RMB	58	17.10%
Ownership of portable consoles (OPC)	Yes	124	36.47%
	No	216	63.53%
Ownership of hybrid console (OHC)	Yes	97	28.53%
	No	243	71.47%

indicates a moderate degree of perceived shortage of time for video gaming. Meanwhile, players are more likely to consider traditional video gaming more time-consuming than mobile video gaming (mean of PTC = 8.753). Furthermore, while players tend to disagree that traditional video gaming is more expensive than mobile video gaming (mean of PE = 3.853), the majority strongly perceive that traditional gaming perform better than mobile gaming (mean of PGP = 10.141, Kurtosis = 6.472). The PCLB and PL scores paint contrasting pictures: while the respondents tend to consider that switching from traditional to mobile gaming will imply loss of benefits (mean of PCLB = 8.244), the perceived learning costs is rated as relatively moderate (mean of PL = 5.150). Additionally, a high score of perceived network effects from mobile gaming is noted (mean of PNE = 9.632, Kurtosis = 2.620). This is accompanied by the perception that mobile gaming is relatively flexible (mean of PF = 7.332) and very easy for learning (mean of PS = 9.247). It is worth mentioning that players in our sample are more experienced in traditional gaming (mean of EXPT = 9.565) than mobile gaming (mean of EXPM = 6.950). Finally, the switching intention is relatively low (mean of SI = 3.594) among the respondents.

Descriptive statistics for the continuous variables can be found in Appendix B. Moreover, we visualised the descriptive statistics in Fig. 2 using boxplots, where several statistics, including the minimum, the maximum, the percentiles, and the mean (represented with cross symbol), are included.

5.2. Clustering analysis

In the first place, we applied the K-mean clustering algorithm to identify groups of players with similar profiles. Statistical criteria such as the Average Silhouette Width and the Calinski-Harabasz index indicated that the optimal number of clusters was two. These two clusters were profiled by tabulating the quantitative (Table 2) and qualitative variables (Table 3). There are more observations in the second cluster (n = 209, 63% of the total sample) than in the first (n = 131, 39% of the total sample).

The t-tests (Table 2) indicate that the majority of the mean differences are significant (P < 0.05), the exceptions being PTS, PE, EXPT, and age. This enables us to deduce that the players in cluster 1 are psychographically and behaviourally very distinct from those in cluster 2. It is worth noting that the latter exhibit a much higher switching intention than the players in cluster 1. There is also a huge difference in the mean value of PLC between the two clusters; the very high value (mean = 8.427) found in cluster 1 contrasting with the significantly lower value (mean = 3.096, p < 0.001) found in cluster 2.

Table 2
Mean values and t tests for mean differences of the continuous variables across clusters.

Variables	Cluster 1	Cluster 2	t	P value
Perceived time shortage for playing video games (PTS)	6.183	6.804	−1.842	0.067
Perceived time-consuming nature of traditional gaming (PTC)	9.328	8.392	3.377	0.001
Perceived expensiveness of traditional gaming (PE)	3.534	4.053	−1.470	0.143
Perceived high performance of traditional gaming (PGP)	10.420	9.967	2.777	0.006
Perceived costs due to lost benefits (PCLB)	9.267	7.603	5.784	0.000
Perceived learning costs (PLC)	8.427	3.096	22.689	0.000
Perceived network effects from mobile gaming (PNE)	9.244	9.876	−2.937	0.004
Perceived flexibility of mobile gaming (PF)	6.771	7.684	−9.030	0.000
Perceived simplicity of mobile gaming (PS)	8.702	9.589	−3.562	0.000
Past traditional gaming experience (EXPT)	9.763	9.440	1.612	0.108
Past mobile gaming experience (EXPM)	6.122	7.469	−4.436	0.000
Switching intention (SI)	2.771	4.110	−4.659	0.000
Age	27.466	26.383	1.908	0.058
Frequency	131	209		
Percentage of sample	39%	61%		

The results of the Chi-square tests, meanwhile, show that none of the variables in Table 3 is significantly different from zero (P > 0.05). Therefore cluster 1 and cluster 2 players cannot be easily distinguished through their demographic profile or portable/hybrid console ownership status.

5.3. Linear regression analysis

To meet the statistical assumptions for linear regression models, we did the log transformation for the dependent variable, switching intention, which is not normally distributed. After conducting the log transformation, linear regression assumptions were statistically validated using the approach of Peña & Slate [83]. The results show that statistical assumptions are met, which are summarised in Appendix C.

The results of the linear regression are given in the first column of Table 4. We first introduce the results of the global model before mentioning the results of the local models.

In terms of the results of the global model, among the push variables, neither PTS (β = 0.007, P > 0.05) nor PTC (β = -0.025, P > 0.05) is significant, suggesting low sensitivity to the time issue among these respondents and providing no support for P1 and P2. Besides, the results show that the PE has a positive influence on SI (β = 0.029, P < 0.05), thereby supporting P3.

With respect to the pull variables, the coefficients for PNE, PF, and PS are β = -0.025, (P > 0.1), β = 0.034, (P < 0.05), and β = -0.022, (P > 0.1) respectively. These results indicate that PF is the only significant pull factor towards SI. Thus, P5 is supported while P4 and P6 are not.

In terms of the mooring variables, PCLB is negatively associated with SI (β = -0.048, P < 0.01), while PLC shows no significance. Meanwhile, PGP is also negatively associated with SI (β = -0.063, P < 0.05). Therefore, P7 and P9 are supported, but P8 is not.

In terms of gaming experience, the association with SI is negative for EXPT (β = -0.078, P < 0.01) and EXPM (β = 0.073, P < 0.001). These results imply support for P10 and P11.

On the other hand, while OPC is not significant, OHC is negatively associated with switching intention (β = -0.270, P < 0.01). Thus, P12 is not supported while P13 is supported.

Among the demographic variables, only full-time student (β = 0.238, P < 0.1) and full-time job (β = 0.353, P < 0.05) prove significant, suggesting that SI is more likely to occur in the full-time employed or full-time students.

In global performance terms, the adjusted R^2 value in the global model is 0.245.

The subgroups obtained from the clustering analysis are also regressed to explore these two segments further. The linear regression results of the local models are shown in the second and third columns of Table 4. The adjusted R2 for the segments 1 and 2 regression models are 0.247 and 0.230, respectively. The linear assumptions of both models are also statistically validated using the Peña & Slate [83] approach. Note, also, that the coefficients of the following variables differ significantly between the two segments: PCLB (β = -0.063, P < 0.1), PLC (β = 0.108, P < 0.01), and PGP (β = 0.160, P < 0.05), while the coefficients of the rest of the variables are not significant.

The results of the clustering and regression analysis reveal two distinct segments of players, which we label as *Unshakable stayer* and *Moderate intentional emigrant*[5].

[5] These names are labels used by the researchers as subjective group-profile descriptions.

Table 3
Frequency, percentage, and Chi square tests for nominal and categorical variables across clusters.

Variables	Cluster 1		Cluster 2		χ^2	P value
	Frequency	% in cluster 1	Frequency	% in cluster 2		
Ownership of portable consoles					0.028	0.867
Yes	49	37%	75	36%		
No	82	63%	134	64%		
Ownership of hybrid consoles					0.058	0.809
Yes	47	36%	79	38%		
No	84	64%	130	62%		
Gender					0.961	0.327
Male	119	91%	197	94%		
Female	12	9%	12	6%		
Have children under the age of 14					0.566	0.452
Yes	29	22%	38	18%		
No	102	78%	171	82%		
Student					0.798	0.671
Yes (Part time)	7	5%	8	4%		
Yes (Full time)	44	34%	78	37%		
No	80	61%	123	59%		
Education					3.348	0.501
Have not reached university level	7	5%	9	4%		
Three-years college	13	10%	12	6%		
Undergraduate	72	55%	122	58%		
Master	26	20%	50	24%		
PhD	13	10%	16	8%		
Job					0.775	0.679
Yes (Part time)	13	10%	21	10%		
Yes (Full time)	75	57%	110	53%		
No	43	33%	78	37%		
Income					1.256	0.869
No income	31	24%	44	21%		
<3000 RMB	19	15%	35	17%		
3001 RMB-7000 RMB	45	34%	71	34%		
7001 RMB-10000 RMB	16	12%	21	10%		
>10,000 RMB	20	15%	38	18%		
Frequency	131		209			
Percentage of samples	39%		61%			

5.3.1. Segment 1: Unshakable stayers

The most prominent characteristic of this relatively small segment, (39% or n = 131 players), is a very low intention to switch from traditional to mobile gaming (mean = 2.771). Its members show a moderate level of EXPM (mean = 6.122) in contrast to their high level of EXPT (mean = 9.763), while their ratings for PLC show a mean value of 8.427.

SI in this segment is therefore mainly explained by PGP (β = -0.191, $P < 0.01$), EXPM (β = 0.092, $P < 0.001$), and OHC (β = -0.360, $P < 0.05$). The coefficient for PS is significant and negative (β = -0.047) at $P < 0.1$.

5.3.2. Segment 2: Moderate intentional emigrants

The members of this relatively large segment (61 %or n = 209 players) demonstrate a moderate degree of SI (mean = 4.110). They also have greater EXPM (mean = 7.469) (mean = 6.122) and less EXPT (mean = 9.440) than the Unshakable stayer group (mean = 9.763). PLC in this segment is very low (mean = 3.096).

In this segment, SI is positively influenced by PE (β = 0.036, $P < 0.05$), PF (β = 0.036, $P < 0.1$), PLC (β = 0.077, $P < 0.01$), and EXPM (β = 0.051, $P < 0.05$). In turn, PCLB (β = -0.050, $P < 0.01$), EXPT (β = -0.087, $P < 0.01$), and OHC (β = -0.254, $P < 0.05$) are all negatively associated with SI, while full-time employment affects it positively (β = 0.432, $P < 0.05$).

The results of the proposition testing on global model as well as on local models are given in Table 5.

6. Discussion

In this study, we examined a series of variables that may drive video game players to switch from traditional to mobile gaming. These variables are analysed within the PPM framework originally used in human migration studies. Three types of forces affecting players' intention to switch from traditional to mobile gaming are considered. The first are the so-called *push effects*, which are the performance weaknesses that push players away traditional gaming. The second are the *pull effects*, which are the strong points of mobile gaming that attract players. The third force is that exerted by *mooring effects*, that is, the retaining influence of the advantages of traditional gaming.

For our empirical work, we used *a posteriori* segmentation approach, K-mean clustering, to explore different behavioural patterns among the observations. The results reveal two distinct player segments, and that a considerable percentage of each segment (47.3% in the *Unshakable stayer* segment and 27.8% in the *Moderate intentional emigrant* segment) are extremely unwilling to switch (Likert point = 1) to mobile gaming. Furthermore, the players in the *Moderate intentional emigrant* group have a relatively higher mean value (mean = 4.110) of SI than those in the *Unshakable stayer* group (mean = 2.771), and the switching intention in the group with all observations is still low (mean = 3.594). These findings contrast with the earlier observation of a shrinking traditional gaming market due to a growing mobile gaming market [7,6]. These results reveal that actually traditional gaming is unlikely to be substituted by mobile gaming. In turn, mobile gaming seems to play a complementary role for the players of traditional gaming. One potential reason for the discrepancy between industrial level and individual level could be that the growth of mobile gaming is not in fact driven by existing players switching from traditional gaming, but by an influx of new players. Currently, the demographic player profile is changing due to the virtually ubiquitous nature of the Smartphone, making every owner a potential player [9].

Once we had two groups of observations given by K-mean clustering algorithm, we applied linear regression (OLS estimation) on all the observations and those from the two subgroups. This yielded a global

Table 4
Linear regression results.

Linear Regression Results			
	Dependent variable: log(SI)		
	All observations	Segment 1	Segment 2
Perceived time shortage for playing video games (PTS)	0.007 (0.014)	0.006 (0.022)	−0.004 (0.020)
Perceived time-consuming nature of traditional gaming (PTC)	−0.025 (0.017)	−0.037 (0.031)	−0.004 (0.021)
Perceived expensiveness of traditional gaming (PE)	0.029* (0.012)	0.003 (0.021)	0.036* (0.016)
Perceived network effects from mobile gaming (PNE)	−0.025 (0.023)	−0.039 (0.032)	−0.018 (0.036)
Perceived flexibility of mobile gaming (PF)	0.034* (0.014)	0.015 (0.020)	0.036^{+} (0.019)
Perceived simplicity of mobile gaming (PS)	−0.022 (0.021)	−0.047^{+} (0.028)	−0.017 (0.033)
Perceived cost of lost benefits (PCLB)	−0.048** (0.015)	0.012 (0.031)	−0.050** (0.018)
Perceived learning costs (PLC)	−0.009 (0.013)	−0.016 (0.029)	0.077** (0.028)
Perceived high performance of traditional gaming (PGP)	−0.063* (0.028)	−0.191** (0.058)	−0.039 (0.034)
Past traditional gaming experience (EXPT)	−0.078** (0.025)	−0.040 (0.043)	−0.087** (0.031)
Past mobile gaming experience (EXPM)	0.073*** (0.016)	0.092*** (0.026)	0.051* (0.023)
Ownership of portable consoles (OPC)	0.043 (0.088)	0.200 (0.143)	0.049 (0.114)
Ownership of hybrid consoles (OHC)	−0.270** (0.089)	−0.360* (0.151)	−0.254* (0.112)
Age	0.006 (0.012)	0.024 (0.017)	0.008 (0.017)
Gender	0.195 (0.156)	0.086 (0.222)	0.178 (0.222)
Having children under the age of 14	0.001 (0.104)	0.191 (0.150)	−0.019 (0.149)
Part time student	0.295 (0.214)	0.158 (0.344)	0.438 (0.288)
Full time student	0.238^{+} (0.141)	0.099 (0.255)	0.239 (0.175)
Three-years college	−0.112 (0.239)	−0.099 (0.345)	0.081 (0.334)
Undergraduate	−0.115 (0.193)	−0.146 (0.292)	0.044 (0.257)
Master	−0.049 (0.209)	0.237 (0.320)	−0.044 (0.274)
PhD	0.038 (0.253)	0.067 (0.376)	0.201 (0.337)
Part time job	0.001 (0.158)	−0.127 (0.248)	−0.033 (0.205)
Full time job	0.353* (0.162)	0.088 (0.271)	0.432* (0.202)
Income	−0.048 (0.048)	−0.045 (0.080)	−0.087 (0.060)
Constant	2.161*** (0.555)	2.829** (0.967)	1.586* (0.748)
Observations	340	131	209
R^2	0.301	0.392	0.322
Adjusted R^2	0.245	0.247	0.230
Residual Std. Error	0.709 (df = 314)	0.663 (df = 105)	0.709 (df = 183)
F Statistic	5.398*** (df = 25; 314)	2.709*** (df = 25; 105)	3.483*** (df = 25; 183)

Note: Values outside the parentheses represent regression coefficients.
Values inside the parentheses represent standard errors.
'***' P<0.001 '**' P<0.01 '*' P<0.05 '+' P<0.1'.

Table 5
Results of proposition verification.

	Segments		
Proposition/Independent variables:	All observations	Segment 1 (Unshakable stayer)	Segment 2 (Moderate intentional emigrant)
P1. Perceived time shortage for playing video games (PTS)	Not supported	Not supported	Not supported
P2. Perceived time-consuming nature of traditional gaming (PTC)	Not supported	Not supported	Not supported
P3. Perceived expensiveness of traditional gaming (PE)	**Supported**	Not supported	**Supported**
P4. Perceived network effects from mobile gaming (PNE)	Not supported	Not supported	Not supported
P5. Perceived flexibility of mobile gaming (PF)	**Supported**	Not supported	**Supported**
P6. Perceived simplicity of mobile gaming (PS)	Not supported	**Supported**	Not supported
P7. Perceived cost of lost benefits (PCLB)	**Supported**	Not supported	**Supported**
P8. Perceived learning costs (PLC)	Not supported	Not supported	**Supported**
P9. Perceived high performance of traditional gaming (PGP)	**Supported**	**Supported**	Not supported
P10. Past traditional gaming experience (EXPT)	**Supported**	Not supported	**Supported**
P11. Past mobile gaming experience (EXPM)	**Supported**	**Supported**	**Supported**
P12. Ownership of portable consoles (OPC)	Not supported	Not supported	Not supported
P13. Ownership of hybrid consoles (OHC)	**Supported**	**Supported**	**Supported**

model and two local models.

As for the global model, among the push effects variables, the perceived expensiveness of traditional gaming is found to have a positive effect on switching intention, which is consistent with the findings of Bansal, Taylor and James [19], albeit in a different context (hair stylist). Contrary to expectations, however, the results for perceived shortage of time for playing video games show no significant effects. This result was unexpected, which suggests that even players perceive that they are short of gaming time, their switching intention to mobile gaming is not affected. Besides, perceived time-consuming nature of traditional gaming is also not related to switching intention, and this result is consistent with the previous empirical findings [57]. This is somewhat unexpected as it makes intuitive sense that people might play mobile gaming in shorter sessions [57]. However, this result is comprehensible considering the evolution of mobile games over recent years (e.g. more advanced mobile gaming hardware allows for more sophisticated gaming mechanisms), which makes mobile gaming more time consuming than used to be the case.

Among the pull effects, we find a significant and positive relationship between perceived flexibility of mobile gaming and switching intention.

This finding is in line with the results of Wei and Lu [11], which show time flexibility to be positively associated with the intention to play mobile social games. Surprisingly, however, our proposition regarding the relationship between perceived network effects from mobile gaming and switching intention was not supported, thus contradicting the findings of Wei and Lu [11]. This discrepancy may be due to the difference in the research context. In the study of Wei and Lu [11], the participants of survey were mobile social game players. The central concept of social gaming is interacting with real people, and the total number of players and peers are key to whether or not the game is a success [84]. As a result, although the perceived network effects from mobile gaming is a significant variable in their research, this variable has not been verified as significant in our research, as we focus on the general setting of video games instead of a certain genre of games. Another unanticipated finding was the lack of any support for a relationship between perceived simplicity of mobile gaming and switching intention. Although this result differs from that of Ye and Potter [85], it is consistent with that of Hsieh et al. [23]. One possible explanation is the participants of our study are mainly hard-core players. Before switching to mobile gaming, these players have already accumulated a lot of experience of traditional gaming, which makes them not feel any significant difference regarding to the simplicity between these two types of gaming.

The results for the mooring effects support a relationship between perceived cost of lost benefits and switching intention, thus suggesting that the fear of losing benefits hinders players from switching. No significant association with perceived learning costs is found, however. Previous researchers tended to embed different types of switching costs in one latent concept [19,21,23,24,75]. However, our findings show that different types of switching costs do not affect switching intention in exactly the same way in the context of gaming switching. We observe a strong negative relationship between high perceived high performance of traditional gaming and switching intention, which indicates that players' switching intention is weakened mainly by the high performance of traditional gaming.

Apart from the push, pull and mooring effects, the other potential influences on players' switching intention discussed in this paper include past gaming experience, portable/hybrid console ownership, and demographic variables.

Past traditional gaming experience is found to influence switching intention negatively, while past mobile gaming experience affects it positively. These findings are consistent with those reported in Hsieh et al. [23], where lack of past experience on social media is negatively associated with intention to switch from blogs to Facebook. Contrary to our expectations, there is no significant link between ownership of portable consoles and switching intention. This unanticipated result may be due to the fact that, in recent years, portable consoles pose little threat to mobile gaming [7], the main competitor being the only existing hybrid console, Nintendo Switch.

In terms of the demographic variables, it is unsurprising to observe that being full-time student and full-time employment status are both positively associated with switching intention, because the flexible nature of mobile gaming adapts well to a busier pace of life. These results are also in line with the significant relationship between perceived flexibility of mobile gaming and switching intention, which we have mentioned before.

With respect to the relationships between the independent and dependent variables in each local model, with the exceptions of perceived learning costs and perceived high performance of traditional gaming, we find the same statistically significant coefficients in the Moderate intentional emigrant group as in the sample as a whole. It is somewhat surprising that the coefficient on perceived learning costs is positive in the Moderate intentional emigrant group, but non-significant in the Unshakable stayer group and in the whole sample. This could be due to the nature of video games as a form of entertainment. Players continually pursue new gaming experiences, and therefore keep challenging different games on different platforms. As a result, the increased difficulty of transferring knowledge from traditional to mobile gaming may eventually stimulate players' willingness to play mobile gaming. In the existing literature, however, provides no relevant theoretical explanation for this phenomenon, which is worth investigating in the future. In the Moderate intentional emigrant group, meanwhile, perceived high performance of traditional gaming is not significantly associated with switching intention, which reveals that the switching intention is stronger among players who are not too concerned about gaming performance.

In the Unshakable stayer group, we are surprised to find that perceived simplicity of mobile gaming is negatively associated with switching intention, which contrasts with earlier findings [21]. A reasonable explanation for this might lie in the nature of video games: if games are made generally too easy to play on certain platforms, players may feel less challenged and their intention to switch may decrease. The theoretical foundation of this claim is that when the challenge of an activity is below people's ability, they may feel bored [86]. A greater focus on this issue is suggested in future research.

6.1. Implications

This paper makes several contributions to the video game marketing literature; firstly, because it is the first empirical study of the migration of video game players from traditional gaming to mobile gaming, and the findings have major implications for further development of the PPM framework in the context of video game platform switching. Secondly, this study has enabled the identification of two groups of traditional players, one labelled *Unshakable Stayers;* and another labelled *Moderate Intentional Emigrants*. These findings have expanded the knowledge boundary of knowledge on the classification of video game players, which has until now been more focused on in-game behaviours.

Our findings also suggest several courses of action for video game industry practitioners. First, a relatively low switching intention score is observed in both the *Unshakable Stayers* group and the *Moderate Intentional Emigrants* group. Thus, it is unwise for marketing practitioners who promote mobile gaming to focus only on the existing traditional game players, because of their relatively low switching intention. Second, the significant relationship between the independent variables and switching intention shows some possible marketing solutions to attract traditional gaming players' attention on mobile gaming products. A marketing matrix worth practicing is that markers can reduce the price of mobile gaming, enhance the flexible gaming mechanism, and establish a content transferable program from their traditional gaming products to their mobile gaming products. Third, marketing practitioners should be aware that players do not switch to mobile gaming because they do not have enough time to play videogames, traditional gaming is too time-consuming, or mobile gaming is quite simple. As a result, it is not a wise decision to introduce a timesaving simplified mobile version of the original game on traditional platforms to attract traditional game players' attention. Third, video game companies about to launch a marketing campaign to direct traditional gamers to mobile gaming need to be aware that there are two behaviourally distinct player segments. As a result, marketing initiatives, such as price promotions and cross-platform data migration services may not work on all traditional gamers, since some are insensitive to such campaigns. Finally, marketing managers are further recommended not to aim marketing campaigns for their mobile gaming products at Nintendo Switch owners, because their switching intention is extremely low.

6.2. Limitations of this study

This study has several limitations. Firstly, because of the exploratory nature of this research, in the empirical body of this paper, all the variables in our empirical model are treated as manifest variables and measured on a single-item scale. This leaves future investigators the

opportunity to explore the dimensions within the variables using multi-item scales when conducting the confirmatory research.

Secondly, the use of judgement sampling limits the generalisability of the results. Future researchers are encouraged to apply quota sampling in order to control the gender and age composition of the sample, provided that credible official data are available.

Thirdly, our survey participants in general are experienced players in traditional gaming. Future researchers could recruit unexpected players in place of experienced players in their confirmatory study to examine whether these two player segments behave significantly different toward the switching to mobile gaming

Fourthly, all the participants in our survey were citizens of Mainland China. Samples from other countries might easily yield different results with respect to the sum of learned beliefs, values, and customs which drive consumer behaviour [56]. Caution is therefore required before generalising the findings of this research to other cultural contexts, and future researchers would do well to seek samples from other countries/regions when performing confirmatory analysis to validate the applicability of our empirical model.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. . Psychographic variables in the questionnaire.

All variables are measured on a scale of 1 (strongly disagree) to 11 (strongly agree).

Abbreviation	Statement
PTS	***Perceived time shortage for playing video games***
	My current time schedule doesn't permit me to devote much time to playing video games.
PTC	***Perceived time-consuming nature of traditional gaming***
	I think I need more time to play traditional video games than the mobile games.
PE	***Perceived expensiveness of traditional gaming***
	I feel it is more expensive to play traditional video games than mobile games.
PNE	***Perceived network effects from mobile gaming***
	I think that there is a great number of people around me who are playing mobile games.
PF	***Perceived flexibility of mobile gaming***
	I think that the mechanisms of mobile games allow me to play anytime and anyplace.
PS	***Perceived simplicity of mobile gaming***
	I think that learning to play mobile games is easy for me.
PCLB	***Perceived cost of lost benefits***
	I think that if I switch from traditional videogame console or PC to the mobile platforms, I will partially lose some of the benefits of being a long-term player of console or PC games.
PLC	***Perceived learning costs***
	I think it would be difficult for me to transfer all the knowledge and skill I have acquired from traditional gaming to mobile gaming.
PGP	***Perceived high performance of traditional gaming***
	In general, I think that the performance on traditional video game platforms is better than on mobile platforms.
SI	***Switching intention***
	I will decrease my time playing games on traditional videogame platforms in order that I can have more time to play on mobile platforms.
EXPT	***Past traditional gaming experience***
	I consider myself very experienced in traditional video gaming.
EXPM	***Past mobile gaming experience***
	I consider myself very experienced in mobile video gaming.

Appendix B. . Descriptive statistics for continuous variables.

Variables	Mean	SD	Skewness	Kurtosis	Quantiles					n
					0%	25%	50%	75%	100%	
Perceived time shortage for playing video games (PTS)	6.565	2.988	−0.268	−0.941	1	4	6	9	11	340
Perceived time-consuming nature of traditional gaming (PTC)	8.753	2.623	−1.210	0.650	1	8	9	11	11	340
Perceived expensiveness of traditional gaming (PE)	3.853	3.235	0.976	−0.200	1	1	3	6	11	340
Perceived network effects from mobile gaming (PNE)	9.632	1.809	−1.622	2.620	2	9	10	11	11	340
Perceived flexibility of mobile gaming (PF)	7.332	3.099	−0.546	−0.774	1	5	8	10	11	340
Perceived simplicity of mobile gaming (PS)	9.247	2.102	−1.490	2.244	1	8	10	11	11	340
Perceived costs due to lost benefits (PCLB)	8.244	2.894	−0.961	0.085	1	6	9	11	11	340
Perceived learning costs (PLC)	5.150	3.306	0.390	−1.047	1	3	4.5	8	11	340
Perceived high performance of traditional gaming (PGP)	10.141	1.629	−2.442	6.472	1	10	11	11	11	340
Past traditional gaming experience (EXPT)	9.565	1.848	−1.448	2.076	1	9	10	11	11	340
Past mobile gaming experience (EXPM)	6.950	2.727	−0.132	−0.926	1	5	7	9	11	340
Switching intention (SI)	3.594	2.769	1.007	0.236	1	1	3	5	11	340

Appendix C. . Tests of statistical assumptions of linear regression.

	Test	Statistic	p-value	Decision
All Observations (n = 340)	Global test	8.995	0.061	**Assumptions acceptable.**
	Skewness directional test	0.368	0.544	Assumptions acceptable.
	Kurtosis directional test	6.237	0.013	Assumptions NOT satisfied.
	Link function directional test	2.254	0.133	Assumptions acceptable.
	Heteroscedasticity directional test	0.136	0.713	Assumptions acceptable.
Segment 1 (n = 131)	Global test	5.844	0.211	**Assumptions acceptable.**
	Skewness directional test	5.595	0.018	Assumptions NOT satisfied.
	Kurtosis directional test	0.000	0.998	Assumptions acceptable.
	Link function directional test	0.172	0.678	Assumptions acceptable.
	Heteroscedasticity directional test	0.077	0.782	Assumptions acceptable.
Segment 2 (n = 209)	Global test	5.042	0.283	**Assumptions acceptable.**
	Skewness directional test	2.584	0.108	Assumptions acceptable.
	Kurtosis directional test	1.366	0.243	Assumptions acceptable.
	Link function directional test	1.047	0.306	Assumptions acceptable.
	Heteroscedasticity directional test	0.044	0.833	Assumptions acceptable.

Note: The statistics for each test are defined in Peña & Slate (2006).

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RESEARCH ARTICLE

A grounded theory approach to understanding in-game goods purchase

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Abstract

Video game companies are increasingly diversifying their profit models. Rather than relying exclusively on the sale of video game titles or the subscription model, video game companies are maximising the revenues and extending the lifecycle of their games by means of a strategy based on the sale of in-game goods. This study contributes to the theory on in-game goods purchases by explaining why and how video game players purchase different types of in-game goods. We used an inductive approach involving qualitative data analysis based on grounded theory. Six types of in-game goods are grouped into three categories: functional-based goods, probability-based goods, and ornamental-based goods. After acknowledging the heterogeneity of the categories, a conceptual framework is developed by conducting 21 in-depth interviews, from which it emerges that players purchase functional-based goods, probability-based goods, and ornamental-based goods for different motives and through the different behavioural processes. First, the purchase of functional-based goods is a strategy for entering the flow experience. Second, the purchase of probability-based goods is a compromise for purchase restrictions. Third, the purchase of ornamental goods is driven by the synergism of intrinsic motivations and exposure in the virtual world. Therefore, video game researchers should not treat in-game goods as a homogeneous concept. The findings also suggest that it is critically important for video game developers to strike a balance between the challenges of the gameplay and the skills of players because excessively raising (or lowering) the level of difficulty could pose a threat to the company's sustainable profit.

1. Introduction

We are in an era of rapid development in the video game industry. Since the emergence of video games in the 1970s, the game market took over more than 35 years to grow into a 35 billion U.S. dollar business in 2007 [1]. However, 137.9 billion U.S. dollars were generated in 2018, which means that the 100 billion additional value was created in only 11 years [1].

Along with the growth of the market, video game is constantly evolving. For a long time, the business model in the videogame industry was very traditional. A typical traditional

business model is assigning a fixed price for the game title and allowing players unlimited playtime [2]. However, in recent years, the new trend in the videogame industry is the freemium business model. The freemium business model offers players the chance to play the core game content for free, but the profit is generated through selling in-game goods and premium services [3]. With the advent of the freemium business model, where the economic cost of adopting a game is steadily decreasing, post-adoption behaviour is becoming increasingly important. Against this background, understanding why and how players purchase in-game goods is a pertinent practical issue for videogame companies [4].

The concept of in-game goods is derived from that of virtual goods, which may be defined as digital objects that commonly exist within virtual economies, such as videogames and virtual worlds, including but not limited to characters, avatar clothing, weapons, furniture, and tokens [4,5]. In this study, we define in-game goods as virtual goods in the videogame context.

There has been a clear increase in academic studies investigating purchase motivations of in-game goods during the last decade [6]. Researchers have approached this issue from both qualitative [7–12] and quantitative perspectives [6,13–26].

Although the research on in-game purchase motivations has developed rapidly in recent years, several gaps and unsolved problems remain.

First, the theoretical foundation of the studies of in-game goods purchase behaviour is unclear and confounded. Hamari and Keronen (2016) [4] reviewed 30 articles about virtual goods purchase and found that a considerable number of studies (n = 12) 'failed to specify any clear theoretical foundation or simply selected a range of variables from different theoretical frameworks. Among the studies with a theoretical framework (n = 18), the technology acceptance model (TAM) was most used, followed by the stimulus organism response model, the theory of planned behaviour, the expectancy disconfirmation model, the unified theory of acceptance and use of technology (UTAUT), the transaction cost theory, the theory of consumption values, the virtual experiential marketing, the customer value theory, the self-presentation theory, and the social capital theory. However, none of the mentioned theories is developed in the context of in-game goods purchase. Transplanting a theory from the context where it is developed to a totally new context may reduce its explanatory power. Forcing theories from other contexts into studies of in-game goods purchase is a widespread phenomenon. For instance, the UTAUT has been used in some studies of in-game goods purchase [24,27]. However, the original theory of UTAUT [28] was developed to explain the acceptance of new technology instead of the purchase of virtual goods. We suspect that this is due to the lack of specific theoretical foundations for the video game context when addressing issues relating to in-game goods purchase behaviour.

Second, not all in-game goods are the same [5]. Industrial practitioners have identified different types of in-game goods, including *power-ups*, *expansion packages*, *playable characters*, *cosmetics/skins*, *loot boxes*, and *time-savers* [29]. Researchers, meanwhile, have so far classified in-game goods according to their different functionality, including functional-based goods [10], ornamental-based goods [10], and probability-based goods [30]. However, researchers have not yet determined whether the motivations identified so far affect the purchase of all or only certain types of in-game goods. Since there is a noticeable difference between different types of in-game goods, their associated purchase motives can also vary [5]. For instance, although flow experience (discussed in more detail in the following section) has been identified as a factor that is positively associated with the in-game purchase [5,8,9,12], it is not yet known whether this factor is a common driver of purchase behaviour in relation to all or only some types of in-game goods.

Acknowledging the research gaps, we propose our research questions:

- Why do video game players purchase different types of in-game goods?
- How do video game players purchase different types of in-game goods?

This study aims to establish a conceptual framework to explain videogame players' purchase behaviour in relation to different types of in-game goods. An inductive qualitative approach, grounded theory [31–33], is used in this study. Grounded theory has been used to study social processes or actions and explain why things happen [32], which corresponds the aim of our study.

The results of this research are expected to provide video games researchers with a theoretical foundation for the quantitative analysis of players' purchase behaviour in relation to in-game goods. It will also serve as a reference for practitioners in the videogame industry, as the excerpts from the informants may offer novel insights for game designers and marketing managers to improve the game mechanism and marketing practices.

This study is structured as follows. In the second section, we review the literature on in-game goods typology, players' purchase motivations, and their subsequent purchase processes. Then, in the third section, we introduce the methodology of this study and its procedure. The research findings are presented in the fourth section, and the results are discussed in the fifth section. The last section indicates the limitations of this research and suggests future research directions.

2. Literature review

2.1. In-game goods typology

The term "in-game goods" is a general term that includes different types of virtual goods within video games. Video game researchers have assigned in-game goods to different categories according to distinct criteria.

Academic researchers have assigned in-game goods into two categories according to their functionality [10,34]: functional-based goods and ornamental-based goods. Functional-based goods are in-game items that can enhance players' performance (numerical advantages) and functionality (new abilities and options) [10]. Ornamental-based goods are aesthetic, non-functional in-game items in games enabling players to create and communicate social distinctions and bonds. [10].

According to Jaeyoung Lee, Suh, Park, and Lee (2018) [30], in-game goods can be classified into two categories: probability-based and non-probability-based in-game goods. The main difference between probability-based in-game goods and non-probability-based in-game goods is the predictability of their expected value [30]. While the value of non-probability-based in-game goods is equal to the amount of money paid, the value of probability-based in-game goods can be either greater or smaller than the amount paid [30]. Probability-based in-game goods receive different names in different games and contexts, such as *Loot boxes*, *Card package*, *Gashapon machine*, and so on. In this paper, we use the term Loot boxes to refer to probability-based in-game goods.

Beyond the academic world, industry practice has traditionally classified in-game goods into six categories, namely, *power-ups*, *expansion packages*, *playable characters*, *cosmetics/skins*, *loot boxes*, and *time-savers* [29]. Power-ups are functional items that instantly enhance the gaming experience. For example, players can purchase diverse power-ups items (e.g. *power snow*, which freezes zombies) as a last-ditch effort when they face an overwhelming situation. Secondly, expansions are the extra story and new gaming mechanisms for an already released video game. For example, The *Fate of Atlantis* is an expansion of the videogame *Assassin's Creed Odyssey*, which sets players against mythical creatures as they uncover the mysteries of

Table 1. Classification of in-game goods.

Industry practice types	Functional-based goods	Ornamental-based goods	Probability-based goods
Power-ups	X		
Expansions packages	X		
Playable characters	X		
Time-savers	X		
Loot boxes			X
Cosmetics/Skins		X	

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the fabled sunken city of Atlantis. Thirdly, playable characters are functional characters that cannot be acquired in videogame through any gaming mechanism and necessarily involve spending real money. For instance, in *DEAD OR ALIVE 6*: *Core Fighters*, players start with a very limited number of characters but are able to purchase extra characters with real money. Fourth, cosmetics/skins are the non-functional items in video games that affect only the aesthetic appearance of in-game elements, such as characters and interface. For instance, *Dead or Alive 5 Last Round* is famous for having about 1130 costumes for its 36 characters, although most have to be paid for. Fifth, loot boxes function like a lucky draw since players do not know what is inside until they are opened. For example, players of *Hearthstone* are able to purchase card packages, and after unpacking them, players will receive five determined cards without knowing precisely which five cards they will be. Finally, time-savers are the in-game goods that enable players instant access to items that would require great effort to obtain through its original gaming mechanism. For instance, players of *Resident Evil 2* (2019 version) can purchase a key to unlock all the hidden features, which would be extremely challenging to acquire without paying real money.

Table 1 depicts the relationship between industry practice and a range of academic criteria, based on which we have classified in-game goods into three types: functional-based goods, ornamental-based goods, and probability-based goods. In the first place, while the narrow definition of functional-based goods [34] refers exclusively to *power-ups*, we include other three types of in-game goods, *expansion packages*, *playable characters*, and *time-savers*, in this concept according to the board definition of functional-based goods [10]. In the second place, ornamental-based goods correspond to the *cosmetics/Skins*, which is in line with the previous definitions of this concept [10,34,35]. In the third place, probability-based goods refer to loot boxes, which is consistent with the previous definition of this concept [30].

2.2. In-game purchase motivations

Videogame players' in-game purchase motivations are the driving force that impels them to make purchases within the games. Video game researchers have done much work to explore and verify the videogame players' in-game purchase motivations. A series of in-game purchase motivations have been identified from different perspectives, including perceived values [17,26,36], psychological factors [5], videogame design [6], and service quality [3].

From the perspective of values, Park and Lee (2011) [26] found that the purchase intention of in-game goods is driven by the integrated values of purchasing game items, which includes character competency value, enjoyment value, visual authority value, and monetary value. Later, Hsiao and Chen (2016) [36] considered that in-game purchase intention was driven by emotional value, performance value, social value, value for money, and game loyalty. According to the results, two values, loyalty and good price were found to have a positive impact on players' in-game purchase intention. Scholars also conducted experimental studies to explore

the affective value of in-game goods. In one research design [17], players were randomly assigned to one of the two different mood groups: bored group and stressful group, and the initiated mood was manipulated using artificial simulation. Researchers found that stressed players are more likely to purchase ornamental in-game goods, and bored players are more likely to purchase functional in-game goods [17].

Starting from the psychological perspective, Hamari & Keronen (2017) [5] conducted a meta-analysis using 20 published research, from which they identified ten psychological constructs of in-game purchase motivations: service use enjoyment, subjective norm, flow, attitude toward purchase, service use intention, perceived ease of use, perceived network size, perceived value, self-presentation, and social presence. The terms "flow" or "flow experience" refer to those moments when everything comes together to create a special state of absorption and enjoyment in what one is doing [37]. Entry into the flow experience is characterised by: intense and focused concentration on the present moment, merging of action and awareness, loss of reflective self-consciousness, a sense of control over one's actions, and distortion of temporal experience [38].

From the side of video game design, Hamari et al. (2017) [6] proposed a set of in-game purchase motivations through reviewing the literature. Their final list contained 19 in-game goods purchasing motivations, which were later condensed into four latent factors (unobstructed play, social interaction, competition, and economic rationale) and two manifest variables (indulging children and unlocking content). Among these variables, unobstructed play, social interaction, and economic rationale are positively associated with the purchase of in-game goods.

Meanwhile, it appears that the factors that drive players to play videogames are not necessarily the factors that drive them to purchase in-game goods. Hamari, Hanner, et al. (2017) [3] conducted survey research and found that although the four dimensions of game service quality (assurance, empathy, reliability, and responsiveness) are positively related to the intention to play, these factors do not significantly explain players' in-game purchase intention.

Therefore, the literature informs us of the existence of different types of in-game goods and different playing and purchasing motivations. However, very little is yet known about the relationship between different types of in-game purchase motivations and different types of in-game goods. Just as the nature of in-game goods varies, so may the motivations for purchasing them [3,5]. The paucity of studies reporting on the typology of in-game goods [17] is a further hindrance to the analysis of behavioural differences across distinct types of in-game goods [5].

2.3. In-game purchase process

Videogame players' in-game purchase process starts with motivation. However, in many situations, there are more components in the process of players' in-game purchase.

Previous empirical evidence shows that, while unobstructed play, social interaction and economic rationale are significantly associated with in-game purchase behaviour, this is not the case with the other three types of motivations, competition, indulging children and unlocking content [6]. These results suggest the possibility of more interrelationships between identified motivations and purchase behaviour, depending on the specific type of motivation.

Guo and Barnes (2009) [11] conducted a qualitative study among 24 Chinese videogame players, and they found a series of factors for explaining in-game goods purchase behaviour in virtual worlds, including effort expectancy, character competency, personal real resource, performance expectancy, and self-actualisation. Moreover, in different stages of the purchase, including motivation and behavioural intention, there are different factors involved. In the later quantitative research [24], researchers found that effort expectancy, performance

expectancy, perceived value, perceived enjoyment, and customisation are positively associated with purchase intention, while advancement is negatively associated with purchase intention. Moreover, purchase intention along with habit positively affect actual purchase behaviour.

Animesh et al. (2017) [23] used the Stimulus-Organism-Response (S-O-R) framework [39] to explore the impacts of technological and spatial environments on Intention to purchase in-game goods in *Second Life*, a 3D immersive video game. The central factor of their empirical model is flow experience [37], while other factors of environmental stimulus and virtual experience influence intention to purchase by affecting the flow experience.

Additionally, the life cycle of video game players in a specific game does not conclude with single in-game purchase behaviour. It is, in fact, characterised by repeated repurchase. All the consumable in-game goods are designed to be purchased multiple times. Until now, researchers found that user satisfaction and perceived value positively affect the repurchasing intention and recommendation intention within the game, while perceived enjoyment positively affects user satisfaction and perceived value [25].

2.4. Our contribution: How videogame players purchase different types of in-game goods

So far, we know that there are different types of in-game goods: power-ups, expansion packages, playable characters, time-savers, cosmetics/skins, and loot boxes. Moreover, these six types of in-game goods can be classified into three categories: functional-based goods, ornamental-based-goods, and probability-based goods. Additionally, in-game goods have different values, which impels players to purchase them. In the purchasing process, different psychological components, such as social influence and flow experience, play an important role.

At the same time, combining the knowledge of in-game goods typology and the in-game purchase behaviour, we found that researchers tended to treat in-game goods as a homogeneous concept in their empirical studies [5,6,23,24], ignoring the significant differences among in-game goods. Treating in-game goods as a homogeneous concept leads to several problems. For instance, players' motivations could be different when purchasing different types of in-game goods [5,6], which means that the existing knowledge in the literature may not be applicable equally across all types of in-game goods.

Thus, in this study, we explore why and how video game players purchase different types of in-game goods using grounded theory, which will be introduced in the following sections.

3. Methodology

3.1. Grounded theory

In this research, we choose grounded theory as the research method. Grounded theory is suitable for situations in which interactional elements are involved [40]. Consequently, grounded theory has the potential for a number of directions and contexts in marketing and consumer behaviour [40]. Moreover, grounded theory has been applied in several video games studies [41–45].

Grounded theory methodology provides a tried-and-true set of procedures for constructing theory from data, which have been proven to be culturally sensitive and applicable to individuals as well as larger organisations and societies [32]. Moreover, grounded theory consists of systematic yet flexible guidelines for collecting and analysing qualitative data to construct theories from the data themselves [33]. There are three types of grounded theory: Classic [31], Straussian [32], and Constructivist Grounded Theory [33]. These grounded theory methods have different ontological and epistemological foundations [46,47], and they are neither

homogenous nor interchangeable methods [48]. As these three grounded theory methods are based on different research philosophies, none is superior to the others. The basis of our study lies in constructivist grounded theory, which is described by Charmaz [33].

Grounded theory has several methodological characteristics, and theoretical sampling is a hallmark of this methodology [49]. Theoretical sampling is a concept-driven process, which enables researchers to discover the concepts that are relevant to the phenomena and population, and allows researchers to explore the concepts in depth [32]. Unlike conventional sampling methods, when using grounded theory, researchers do not collect all the data prior to the analysis [32]. In turn, researchers first identify the population of interest and settings, and conduct an initial purposive sampling [49]. Once the first wave of data is collected, the analysis begins [32]. Thus, data collection is followed by analysis; Analysis leads to concepts; Concepts generate questions; Questions lead to more data collection [32]. This circular process continues until the research reaches the point of theoretical saturation, at which all major theoretical categories are fully developed, and gathering data no longer sparks new theoretical insight nor reveals new properties of the categories [32,33]. Theoretical sampling involves a particular form of reasoning that characterises grounded theory, which is abductive reasoning [33]. "*Abductive inference entails considering all plausible theoretical explanations for the surprising data*, *forming hypothesis for each possible explanations*, *and checking these hypotheses empirically by examining data to arrive at the most plausible explanation* [33]". Researchers should not confuse the theoretical sampling of grounded theory with positivist quantitative research [33]. Grounded theory is not a theory testing method [50]. In general, the ontological and epistemological assumptions of qualitative research are different from those of positivist quantitative research [51,52]. Qualitative research lacks a particular type of generalisability: the statistical-probabilistic generalisability, which therefore does not grant researchers the confidence about the representativeness of their sample and broader inferences of the results [51]. The type of generalisability that a qualitative research seek is usually the analytical generalizability: researchers generalise a particular set of results to the established or new concepts/theories [51].

We also would like to highlight the position of literature review in our research. The position of literature review in grounded theory research has long been both disputed and misunderstood [33]. The classic grounded theory [31,53] advocates that the researcher should delay the literature review after completing the data analysis [33]. The idea behind this approach is to avoid importing preconceived ideas and imposing them on the researcher's work [33]. Classic grounded theory advocates that researchers should keep themselves uncontaminated by extant knowledge [53–56].

However, some researchers do not agree with Glaser and Strauss's original pronouncement [31] and Glasser's continued statements [53–55]. For instance, Suddaby (2006) [50] considered that the belief of not doing literature review before entering the field is a myth, which is based on the false premise that the researcher is a blank sheet devoid of experience or knowledge. Moreover, disregard of the previous literature could also lead researchers to "reinvent the wheel" and reproduce common-sense categories [33,57–59].

In this grounded theory research, our attitude toward the literature review is in line with that of Charmaz (2014) [33]. We do not treat prior knowledge as an obstacle to our creativity. Instead, we use a literature review to clarify our research boundary, propose research questions, and show how our work fits into and extends the current literature. Moreover, prior literature serves as an important component in the theoretical sampling phase, which helps to cultivate theoretical sensitivity and think abductively.

Some researchers in the area of videogame study have already applied grounded theory to explore players' motivations to play social network games [12]. However, in general, grounded

theory has not been widely applied in the discipline of consumer behaviour. Thus, details about this method and our research process will be provided in the next section.

3.2. Research process

Fig 1 shows the process of our research. After doing the literature review, we learned that industrial practitioners acknowledge the existence of six types of in-game goods (p*ower-ups*, *expansion packages*, *playable characters*, *time-savers*, *loot-boxes*, *cosmetics/skins*), which can be classified according to their nature: functional-based goods, ornamental based goods, and probability-based goods. Along with the research, we only mentioned the industrial classification approach with our informants to avoid cognitive bias, which may be caused by the obscure academic definitions. At the same time, we proposed our research questions because the existing knowledge could not explain well the in-game purchase of heterogeneous goods. Therefore, our research journey started with inductive reasoning to explore the answer to the research questions.

Videogame players from China were selected as informants in this research. Chinese informants were selected because China is the largest single market of video games in the world (Newzoo, 2018) [1].

In this research, we used the online semi-structured interview as the primary data collection method for several reasons. First, interviews fit well with grounded theory, because of their open-endedness [33]. In order to determine why and how video game players purchase different types of in-game goods, we needed to capture video game players' perceptions, attitudes, and actions during the behavioural process. Therefore, in this case, interviews helped us to conduct an open-ended, in-depth exploration of an area in which the interviewee has substantial experience [33]. Second, we chose the semi-structured interview rather than unstructured or structured interview because this approach enabled us to ensure a degree of consistency among the concepts covered in each interview [32] while the main conversion was still open-ended. Third, we opted for online data collection because the temporal and spatial flexibility provided by the internet benefit qualitative research [60]. The online method allowed us to reach diverse, geographically scattered populations, as well as informants who were not easily available due to timetable issues. Moreover, virtual anonymity and higher private self-awareness foment the disclosure of personal information and deep feelings [61].

In the initial purposive sampling phase, data collection began in a videogame discussion group on WeChat, the most used social media platform in China. We enrolled three qualified members of the discussion group on our research, and all the following participants were drawn from snowball sampling. The research process put each informant through three steps: they were contacted on WeChat, answered the questionnaire on Qualtrics, and were interviewed on QQ. During the initial contact on WeChat, we presented the basic information of our research to probe the informants' willingness to participate in the study, which was interspersed with some daily chats. This helped us to build some initial rapport with the informants, which is a crucial prerequisite of interviews with Asian informants [61]. Subsequently, we sent an anonymous link of survey to the informant via WeChat. The online questionnaire based on Qualtrics helped us to acquire some basic information related to informants' gaming habits, demographic profiles, the personal contact information (QQ and email addresses), and a suitable time for the interview.

With respect to ethical considerations, we would like to mention that our research is a consumer behaviour study and not a clinical trial. The researchers of this study are affiliated with a Spanish research institute. Moreover, all the informants of our research are Chinese citizens and residents in China. Thus, we should comply with the corresponding regulations of Spain

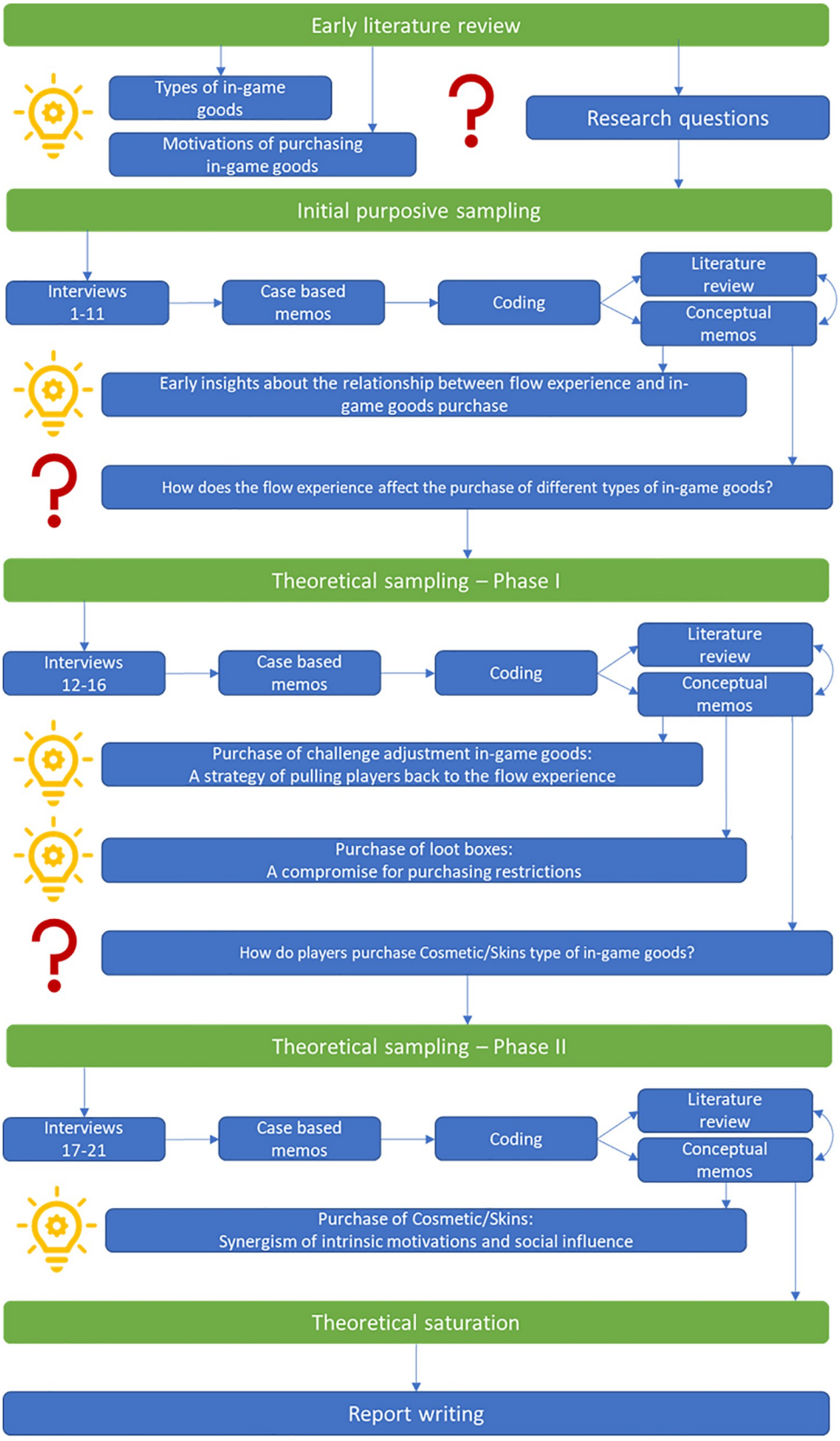

Fig 1. Research process.

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(URL: https://www.boe.es/buscar/doc.php?id=BOE-A-2015-14082) and China (http://www.nhc.gov.cn/fzs/s3576/201610/84b33b81d8e747eaaf048f68b174f829.shtml). However, as our research is a consumer behaviour study involving no clinical intervention with human subjects, the mentioned regulations are not applicable in this case. As a result, we did not seek approval from the ethics committee/IRB. However, all candidates who wished to participate in the research were required to sign a written informed consent at the beginning of the online survey, where the basic information of this study, the right of voluntary withdrawal, and the economic reward (An electronic gift card with a denomination of 100 RMB, about €15) for participating in this study were explicitly stated.

Later, semi-structured interviews were organised for eligible participants in the survey, who had played video games and purchased in-game goods in the last six months. The interviews were synchronously conducted online using QQ, a leading instant messaging software in China. Informants were encouraged to use emoticons to remedy the lack of nonverbal cues during the text-based online interview.

Of the eleven informants (001–011) who participated in the initial purposive sampling, there was one (006) who completed the questionnaire and was eligible to take part but, for some undisclosed reason, failed to show for the interview. Thus, we had ten interviews in the initial purposive sampling phase. In the first wave of theoretical sampling, we interviewed five informants who had already participated in the initial purposive sampling (002, 004, 007, 009, and 010). In the second wave of theoretical sampling, we interviewed six informants (007, 009, 010, 012, 013, and 014), including three informants that had already participated in the two previous sampling phases (007, 009, 010) and three new informants that had never been involved in our research (012, 013, and 014). It is worth mentioning that the number of interviews in each phase of the sampling was established not *a priori* but *a posteriori*. Analyses based on grounded theory should ideally begin after completing the first interview and continue that way throughout the research process [31,32]. Some grounded theorists warn of the danger of collecting all the data at once, because this approach limits the potential for theoretical sampling [32].

After the interviews, the transcriptions of the chat records were translated from Simplified Chinese to English. This enabled the initial coding which was followed by more focused coding, after which case-based and conceptual memoing were carried out [33]. We used NVivo 12 software to manage transcriptions, codes, and memos more conveniently. When conducting the initial coding, we followed the incident with incident coding. The incident with incident coding is especially ideal for grounded theory, which facilitates one of the core tenets of this qualitative method: constant comparison [33]. At each level of analysis, the data, including emerging codes, categories, and properties were constantly compared [31]. One of the authors, who is a native Chinese speaker, translated the original transcript from Chinese to English, conducted the coding, and wrote the memos. All the mentioned research materials were shared among the authors, who collaborated in the critical decision-making for each phase of the theoretical sampling and at the theory integration stage. The same procedure was used for the two following data collection phases.

After conducting the ten interviews in the initial purposive sampling phase, we acquired some early insights into the relationship between flow experience [37] and in-game goods purchase. However, we still did not know how the flow experience affected purchase behaviour across different types of in-game goods. With this question in mind, we started the first wave of theoretical sampling.

After analysing the data acquired from the first wave of theoretical sampling, we found that players purchasing functional-based goods is one of the strategies to alleviate boredom and anxiety and to reach a state of flow. Moreover, we also unanticipatedly found that the purchase

of probability-based goods was a compromise for purchasing restrictions. However, although we had strengthened our conceptual framework by incorporating the new knowledge obtained from the theoretical sampling, it still fell short of explaining the purchase of ornamental-based goods. This theoretical crack pushed us to conduct the second wave of theoretical sampling in order to explore the purchase patterns for ornamental-based goods.

The results of the data analysis in the second wave of theoretical sampling showed that the purchase of ornamental-based goods is a synergism of intrinsic motivations and social influence. At that moment, we reached the point of theoretical saturation, in which fresh data no longer sparks new theoretical insights nor reveals new properties of the theoretical categories [32,33,62–64].

4. Profiles of informants

Fourteen informants participated in our research. Among all the informants, 001, 003, 005, 008, and 011 participated only in the Initial purposive sampling phase. Informants 002 and 004 participated in the Initial purposive sampling phase and theoretical sampling phase I. Informant 007, 009, and 010 participated in all the sampling phases. Informants 012, 013, and 014 only participated in the theoretical sampling phase II. Informant 006 filled the questionnaire but did not show in the interview.

The demographic profiles of the informants are summarised in Table 2. With respect to the demographic profile of the Informants, ten informants are male, and four are female. Their ages range from 23 to 31. Most of the informants are not students, except informant 009, who is a full-time university student. Most of the informants have received higher education, except for the informants 012 (Middle school) and 014 (Vocational school). Most of the informants have full-time jobs, except the informant 006, who is unemployed. The informants' monthly incomes range from 2001 RMB to over 20001 RMB. Most of the informants live in Shanghai, China, except for the informants 006 (Tongren, Guizhou province of China) and 014 (Hunchun, Jilin province of China).

Table 3 summarises the gaming profile of the informants. They are heterogeneous in their choice of game platform, and thus include computer game players (001 and 012), mobile game players (014), console and mobile game players (008), computer and mobile game players (002, 009, 010, 011, and 013), and all-platform players (003, 004, 005, and 006). In term of the gaming habit, 7–12 hours a week is the most frequent pattern. Moreover, many Informants continuously play 1–2 hours a time. Finally, the profiles of the informants cover customers of all types of in-game goods.

5. Findings

In general, our findings show that players are driven by disturbing external stimuli to purchase in-game goods. Moreover, we have identified three different purchase processes for functional-based goods, probability-based goods, and ornamental-based goods. For functional-based goods, the external stimulus is the imbalance of challenges and skills, which generates anxiety and boredom, to which players react by purchasing functional-based goods. For ornamental-based goods, the external stimulus is the exposure of cosmetics/skins in the virtual game world, which triggers feelings of envy and the need to be different and attractive. The resulting discomfort leads players to purchase ornamental-based goods. As for probability-based goods, the external stimulus is the purchase restrictions embedded in the game, which prevents players from alleviating their discomfort through the direct purchase of a coveted item. In this situation, the purchase of probability-based goods is an alternative way to respond to players' discomforts.

Table 2. Gaming profile of the informants.

Informant	Gender	Age	Student	Education	Job	Monthly income	Town	Initial sampling	Theoretical sampling I	Theoretical sampling II
001	Male	30	No	Undergraduate	Yes (Full time)	7001 RMB -9000 RMB	Shanghai	Yes		
002	Male	29	No	Undergraduate	Yes (Full time)	More than 20001 RMB	Shanghai	Yes	Yes	
003	Male	25	No	College	Yes (Full time)	5001 RMB -7000 RMB	Shanghai	Yes		
004	Male	31	No	Undergraduate	Yes (Full time)	11001 RMB -15000 RMB	Shanghai	Yes	Yes	
005	Male	30	No	Undergraduate	Yes (Full time)	7001 RMB -9000 RMB	Shanghai	Yes		
006	Male	30	No	College	No	2001 RMB -3000 RMB	Tongren, Guizhou			
007	Male	29	No	College	Yes (Full time)	7001 RMB -9000 RMB	Shanghai	Yes	Yes	Yes
008	Female	28	No	College	Yes (Full time)	3001 RMB -5000 RMB	Shanghai	Yes		
009	Female	29	Yes	Undergraduate	Yes (Full time)	11001 RMB -15000 RMB	Shanghai	Yes	Yes	Yes
010	Female	28	No	Undergraduate	Yes (Full time)	15000 RMB -20000 RMB	Shanghai	Yes	Yes	Yes
011	Male	23	No	College	Yes (Full time)	3001 RMB -5000 RMB	Shanghai	Yes		
012	Male	28	No	Middle school	Yes (Full time)	7001 RMB -9000 RMB	Shanghai			Yes
013	Male	26	No	Undergraduate	Yes (Full time)	Don't Know/No Answer	Shanghai			Yes
014	Female	25	No	Vocational school	Yes (Full time)	Don't Know/No Answer	Hunchun, Jilin			Yes

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We will now discuss these three purchase processes in more detail.

Purchase of functional-based in-game goods: A strategy of entering the flow experience

Video game players do not purposively purchase functional-based goods. Instead, they purchase them to enter or to return to the flow state.

Our informants described the various states they entered during their flow experience, which correspond to the dimensions of flow. Informant 002 reported playing for very short periods (around 15 minutes), during which he would be very concentrated and his thoughts were focused on winning the game; Informant 010 mentioned that she was not aware of what was happening in the outside world, and she would unconsciously reply to questions from her friend; Informant 004 mentioned that he felt that he could easily kill the opposite players without considering their levels in the game, which made him feel invincible; Informant 010 mentioned that the time passed very quickly, and two hours could go by in the blink of an eye. Apart from their personal experience in the flow, our informants mentioned that having the flow experience itself is their main motivation to play video games because they can deliberately get isolated from the outside world and temporarily enter to their own virtual world. Through this way, videogame players can shut out real life for a while and enjoy their joy time.

However, players do not always acquire this enjoyable experience. Although players play the game to reach the flow state, the results of playing can also trigger negative emotions. On

Table 3. Demographic profile of the informants.

Informant	Platform	Gaming time per week	Continuous gaming time every time	Purchased in-game goods types
001	Windows	12–20 hours a week	1–2 hours at a time	Cosmetics/Skins, Loot boxes
002	Windows, Andriod, IOS	12–20 hours a week	30 minutes to 1 hour at a time	Cosmetics/Skins
003	Windows,PS4,Nintendo Switch,PS Vita,3DS,Andriod	More than 20 hours a week	More than 5 hours at a time	Power-ups,Expansion packages,Playable characters, Cosmetics/Skins,Loot boxes
004	Windows, PS4, IOS	More than 20 hours a week	2–5 hours at a time	Power-ups,Expansion packages,Playable characters, Cosmetics/Skins,Loot boxes,Time-savers
005	Windows, Nintendo Switch, Andriod, IOS	12–20 hours a week	1–2 hours at a time	Expansion packages, Playable characters, Cosmetics/Skins
006	Windows,MAC,PS4,Nintendo Switch, PS Vita,3DS,Andriod	7–12 hours a week	1–2 hours at a time	Cosmetics/Skins
007	Windows, PS4, Nintendo Switch,3DS, IOS	7–12 hours a week	30 minutes to 1 hour at a time	Expansion packages, Cosmetics/Skins
008	Nintendo Switch, IOS	4–7 hours a week	30 minutes to 1 hour at a time	Loot boxes
009	MAC, IOS	7–12 hours a week	2–5 hours at a time	Power-ups, Playable characters, Cosmetics/Skins, Loot boxes
010	Windows, Andriod, IOS	More than 20 hours a week	More than 5 hours at a time	Power-ups,Expansion packages,Playable characters, Cosmetics/Skins,Loot boxes,Time-savers
011	Windows, Andriod	7–12 hours a week	1–2 hours at a time	Power-ups,Expansion packages,Playable characters, Cosmetics/Skins,Loot boxes,Time-savers
012	Windows	More than 20 hours a week	1–2 hours at a time	Cosmetics/Skins
013	Windows, Andriod, IOS	7–12 hours a week	2–5 hours at a time	Power-ups,Expansion packages,Cosmetics/Skins,Loot boxes,Time-savers
014	Andriod	12–20 hours a week	30 minutes to 1 hour at a time	Power-ups, Playable characters, Cosmetics/Skins, Loot boxes

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the one hand, players may experience anxiety when faced with challenging situations. For instance, players may be stuck in a game stage for a long time without having the chance to advance. On the other hand, players may experience boredom when facing some insufficiently challenging situations. For example, players usually feel bored when they find they are doing repetitive tasks without any progress, and in this circumstance, the game becomes a boring loop.

The basic ingredient of a flow-inducing environment is a challenging situation [65]. It is necessary to mention that in the context of videogames, the challenge not only refers to game difficulty but also refers to its explorable content. For example, in some games, players are required to select the level of difficulty (Easy, Normal, or Difficult) and explorable content (the stages) of the game before starting the game.

The player's skill level is another key consideration in achieving the flow experience [37]. In the context of the video game, skill is determined not by the player's personal gaming ability but by the mechanics of the game. For instance, many freemium games have mechanisms that limit a player's capability in the game environment if they do not recharge. Informant 009 mentioned having played a game where some players were excluded from some major in-game activities because the abilities of their virtual characters were restricted until they were recharged.

The right balance between challenge and skills is one of the conditions to enter the flow state [37,38,65]. Otherwise, if challenges exceed skills, players will become anxious. Moreover, if skills exceed challenges, players will become bored. Informant 007 described that anxiety,

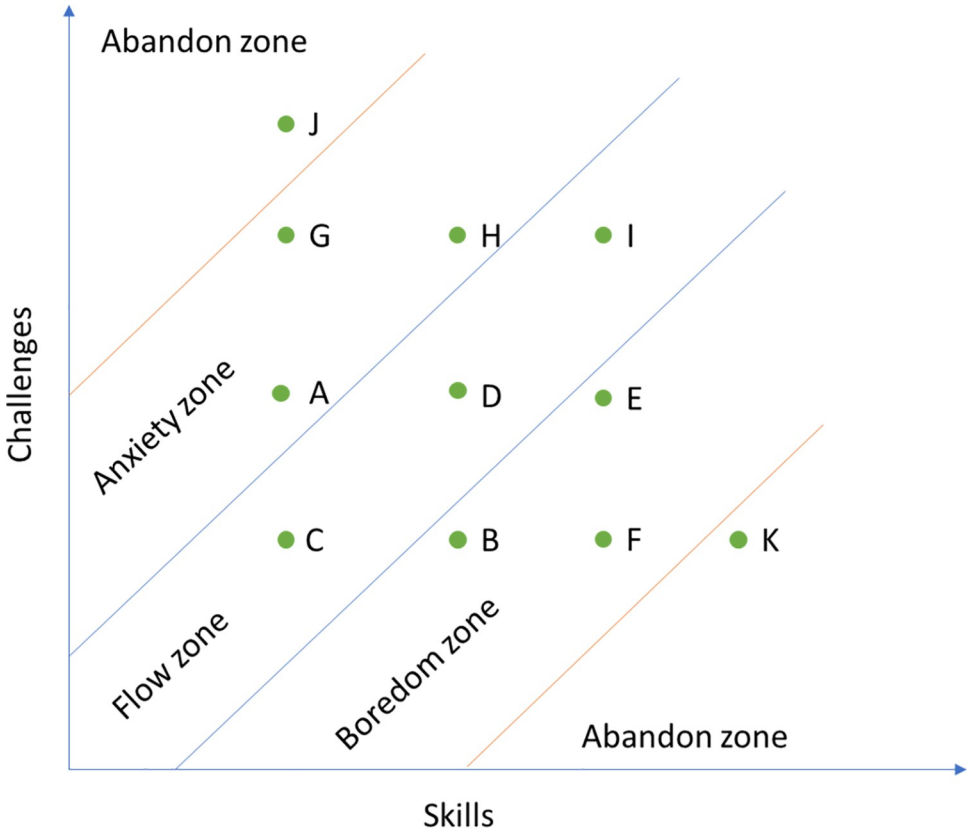

Fig 2. Flow and discomfort situations.

https://doi.org/10.1371/journal.pone.0262998.g002

boredom, and flow were three mutually exclusive states, and they could not co-exist at the same time.

Another condition to enter the flow state is having clear goals [37,38,65]. During the time and effort they devote to a game, players are guided by one or several goals. Every game is played according to the rules and mechanisms for reaching certain goals. Goals have many manifestations. For instance, in League of Legends, the goal is to win the current round, while in Luanshiwangzhe (乱世王者, a Chinese strategy mobile game developed by Tencent's Tianmei studio group), the main goal is to win the tournament in the game server.

In ideal circumstances, with clear game goals, and a correct challenge/skill balance, players enter a state of flow. This situation can be visualised in Fig 2. We assume that the player's initial state is point C (flow state). As the gameplay advances, not only do the player's gaming skills increase, but also his/her capability within the game. At the same time, the difficulty of the game is also increasing, and new game content is being introduced. If skills and challenges increase at the same rate, the player enters the balance zone, where players acquire the flow experience. Throughout the gaming experience, the player starts from point C, moves to point D, and finishes at the point I. Thus, in ideal circumstances, the player is always in the flow state during his/her gameplay, and thus enjoys a pleasant gaming experience.

Beyond the ideal circumstance, players may feel anxious or bored. If the challenges increase at a higher rate than the skills, the player's mental state moves from point C to point A, which is in the anxiety zone. If, on the contrary, the player skills increase at a higher rate than the game challenges, his/her mental state moves from point C to point B, which is in the boredom

zone. In either of the above situations, the dynamic balance between challenge and skill is broken, and the player enters the discomfort state.

At that point, there are several possible strategies for players to re-enter the flow state. In the case of the anxious experience, the player can choose to hone his/her skills (Move from point A to point D) or switch to an easier stage of the game (Move from point A to point C) to re-enter the flow state. In the case of the boring experience, the player can choose to play more challenging stages to re-enter the flow state (Move from B to D).

The situation discussed so far occurs in traditional videogames, where no in-game goods are available. However, things change completely where there is a chance to purchase in-game goods, such as in freemium games. Some freemium games are notorious because their operators raise the game challenge to an extremely high level. For instance, informant 003 mentioned:

> "*Some activities are beyond the limits of normal people. For example, the operator could design an activity that would require you to fight 7 days X 24 hours to gain the final reward.*"

Moreover, some freemium games tend to suppress players' ability inside the game. For instance, informant 009 mentioned:

> "*The ability that the game mechanism endows to the player mainly depends on whether [the player] has recharged enough money. Nothing is gained without recharging.*"

Under this circumstance, strategies such as honing one's skills or shifting to a lower-level challenge are of no use. Due to the high challenge, the player's state would be at point G, and the mentioned approaches may only help to move to points H or A, which means that the player still is in the anxious zone. Meanwhile, game operators have their own solutions to tackle the problem: offering in-game goods to players. After using, for example, Power-ups, players can become incredibly stronger, which helps to move from point G to point I. Similarly, after using Time-savers, the game challenge is significantly reduced, which helps 'to move from points G to C. In either case, players would be at the flow zone after purchasing in-game goods.

A strategy used by some freemium video game operators is to lock certain items of game content and make them exclusively purchasable. This limits the game challenge level. As informant 010 reported:

> "*Nowadays, there are a lot of games which are similar to each other. They tempt you to buy this or that. You only get a few minutes playing [the game] before they make you spending money to unlock the stages. In some very direct cases, you need to recharge a few RMBs to buy an item, and they let you continue.*"

In this case, the approach of shifting to a more challenging game state does not work, simply because the operator does not allow players to do so without purchasing in-game goods. Due to the low challenge, the player's state would be at point F, and the free challenges in the game may only allow players to reach point E, which means that players still are at the boredom zone. At this point, there are expansion packages and playable characters available in the game, and each of them serves to increase the game's challenge level. After purchasing these in-game goods, players will have a more challenging experience in the game, which enables a shift from points F to I. Thus, the player would reach the flow state after purchasing in-game goods.

However, in-game goods are not always magic wands. When the challenge far outweighs the skill (point J), players will remain in a state of high anxiety even after purchasing in-game goods, and the way they relieve this negative experience is to abandon the game. Informant 010 shared her experience:

"*When I found that, even after buying many Power-ups, I still could not catch up with the troop, I began to want to give up. This is the case with the game I'm playing now. I feel I've reached a bottleneck. All the attributes are not able to be enhanced. (I) can't be part of the main team. It makes me very sad.*"

Additionally, when the challenge is far below the skill level (point K), players will continue to be extremely bored even after purchasing in-game goods, and the way they relieve this negative experience is to abandon the game. Informant 010 shared her experience:

"*For instance, [In a game called] Mr Love: Queen's Choice, I recharged 2 or 3 times, (but) I still felt bored. So, I gave up. The same with Star Dream.*"

Although players' post-purchase behaviour is not the focus of our study, for the integrity of the behavioural loop, we will describe a few of the details. First, even once attained, the player's flow experience does not remain stable, which means it can be terminated due to a break in the balance between challenge and skill. In this case, players would re-enter the anxiety zone or boredom zone. Second, the flow experience can also be interrupted by external interferences (Calls from others, emergencies, and so on) and physiological needs (Sleep, eat, need for the bathroom, and so on), which consequently lead to the abandonment of the game.

There are two types of abandonment: *temporary abandonment* and *permanent abandonment*. We are currently concerned with temporary abandonment, which is the behavioural response to anxiety or boredom, external interferences, or physiological needs. Frequent occurrences of temporary abandonment due to anxiety or boredom can lead to permanent abandonment. When defined in terms of time, the boundary between temporary abandonment and permanent abandonment can be blurred. However, according to our Informants, a more effective way of defining these two concepts is based on the players' mindset. When in the state of temporary abandonment, players are still missing the game and use this time to recover from the negative mood caused by anxiety or boredom. After a period of temporary abandonment, players still wish to return to the game. Players in a state of permanent abandonment, however, have no room to think about the game, and their most explicit behaviour is to uninstall it.

Having abandoned the game permanently, a player is very unlikely to return to it, except for one thing, namely, nostalgia; that is, emotions reflecting the positive bond previously existing between the player and the game. Even after permanently abandoning a game, players might check for recent updates of the game and take a chance on returning.

The whole behavioural loop we have mentioned so far is illustrated in Fig 3.

We need to acknowledge some important findings regarding the transition from the discomfort zone (anxiety or boredom) to actual purchase. We will explain the details in the following paragraphs.

It is important to know that purchasing in-game goods is not the only way to get rid of the discomfort states and to enter the flow state. Freemium game players will also find their own ways to achieve flow, just as they do in traditional games where no in-game goods are available. This is because the mechanics of the game sometimes allow in-game items to be obtained free of charge. In-game items become in-game goods when players have to pay for them with real

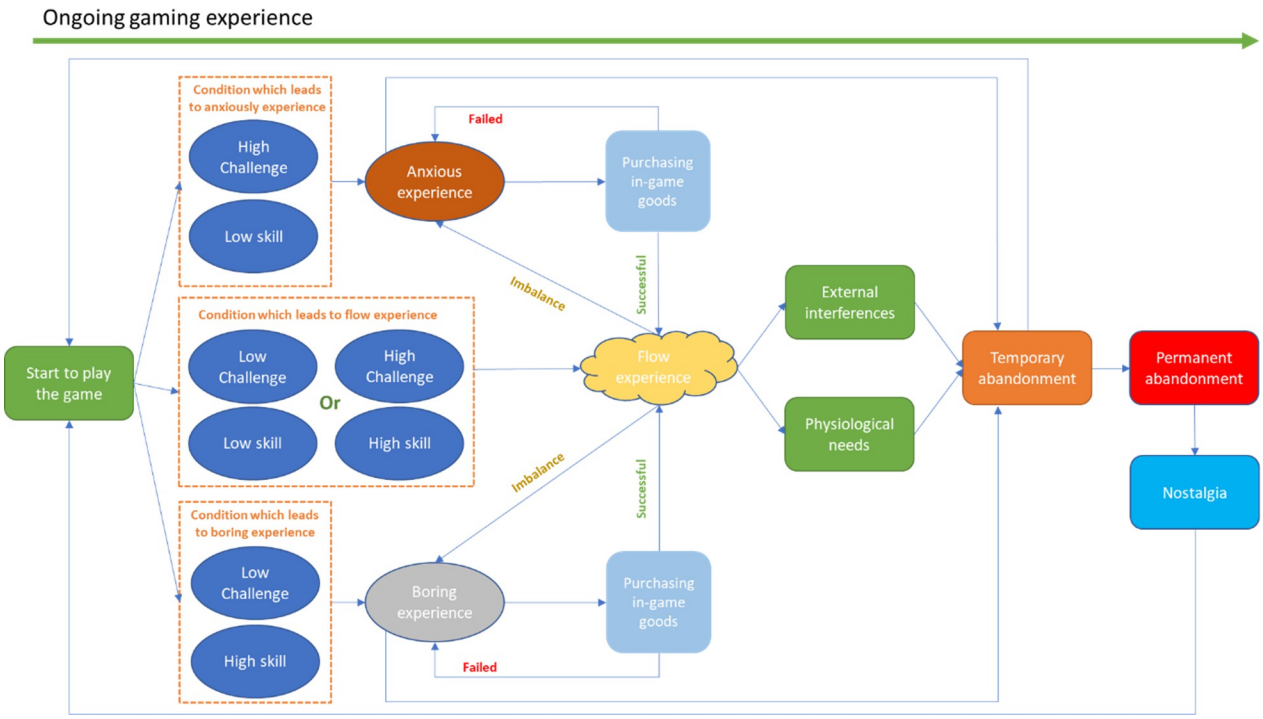

Fig 3. Purchase of challenge and skill adjustment in-game goods: A strategy of pulling players back to the flow experience.

https://doi.org/10.1371/journal.pone.0262998.g003

money. However, some players are aware that operators and developers of freemium games tend to set a series of obstacles to prevent them from having the flow experience without first purchasing in-game goods. There are three types of obstacles in the game: Preventing players from decreasing challenges, preventing players from developing skills, and preventing players from increasing challenges. The existence of these obstacles leads to the situations described previously: Instead of moving from point G to point C, players' state only could reach to point A; Instead of moving from point G to point I, players' state only could reach point H; Instead of moving from point F to point I, players' state only could reach to point E. Informant 007 shared his experience with the obstacles created by the game mechanics:

> *"I would evaluate the possibility to acquire in-game goods through a free method. But the reality is cruel. Zero investment is basically hopeless. If the alternative solution takes too much time and the requirement is too high, it is better to buy directly."*

Under this circumstance, players will have an intention to purchase in-game goods.

Social factors also have an impact on the players' purchasing process. The social influences that players receive are from the different reference groups, including family members, real-world friends, colleagues, network friends, members of the gaming league, the hosts of live broadcast platforms, and so on. There are various types of social influence. First, players are influenced by subjective norms. Players' intent to purchase in-game goods could be reinforced by encouragement from opinion leaders in their reference groups. For instance, informant 009 was a member of her gaming league, and her purchasing intention was reinforced when other members of the league expected her in-game characters to be stronger. Similarly, players' intent to purchase in-game goods could be reduced by their reference group opinion leaders advising against it. Informant 012, for instance, felt his purchasing intention weaken when his

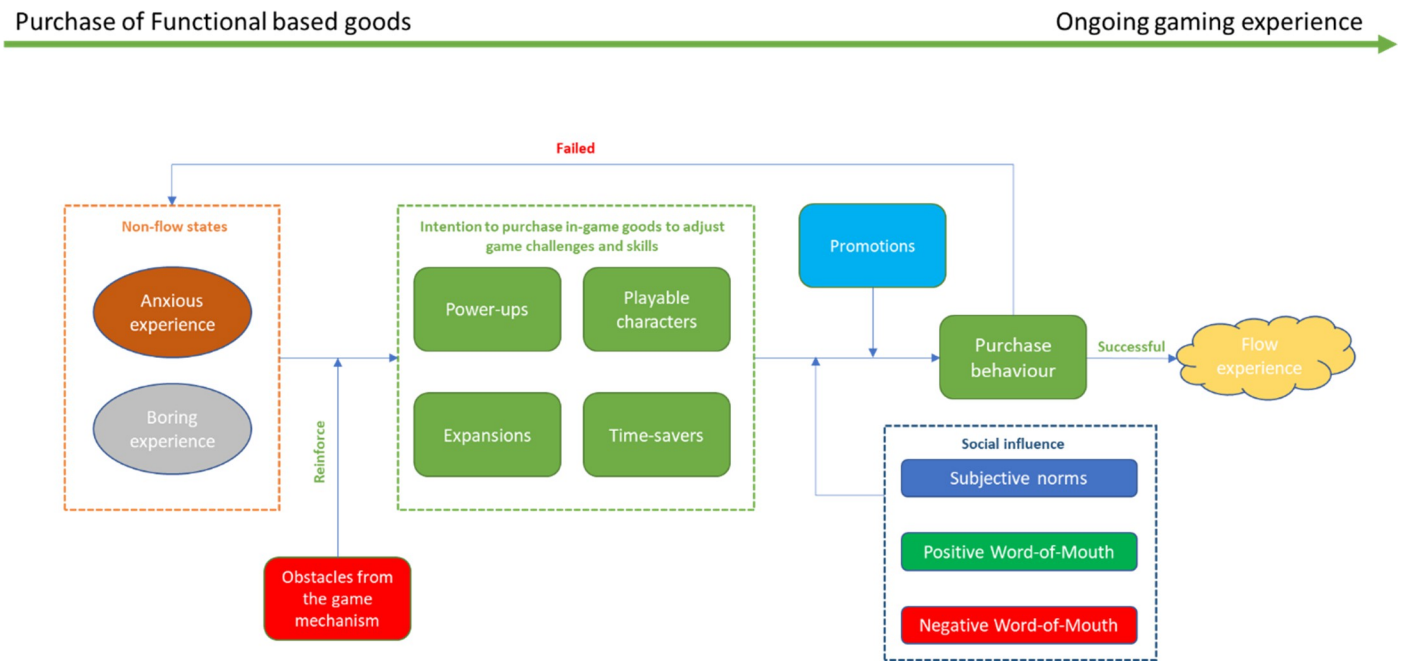

Fig 4. Purchase process between the non-flow state and actual purchase behavior.

https://doi.org/10.1371/journal.pone.0262998.g004

wife did not support his idea. Besides, players are influenced by positive and negative Word-Of-Mouth (WOM). Players value the opinions of those who have already purchased in-game goods. While positive WOM reinforces purchasing intention, negative WOM reduces it. For example, informant 007 reported that his purchasing decision was significantly affected by the positive and negative opinions given by those league members who had purchased the in-game goods that he coveted.

Promotions also play an important role in the in-game goods purchasing process. Players' purchasing intention will strengthen at the sight of promotions. Nowadays, in online games, in-game festivals or activities are often synchronized with real-world festivals, and sometimes promotions are integrated into these in-game festivals. For instance, informant 008 mentioned that her purchasing intention was stronger when she saw that there were promotions available during the in-game festivals.

The purchase process between the discomfort state and actual purchase behaviour is illustrated in Fig 4.

Purchase of probability-based goods: A compromise for purchase restrictions

So far, our grounded theory has explained the purchase of certain types of in-game goods, which serve to adjust challenges and skills. However, to explain the purchase of probability-based goods, we need to expand our existing theory. Our research has shown that the purchase of probability-based goods is a behaviour driven by purchase restrictions and the gambling experience.

Players purchase loot boxes, not for the boxes themselves, but the items inside the boxes. As we have stated above, players at discomfort zones would like to get rid of the negative state, and purchasing in-game goods is one of the strategies. However, in many freemium games, there are purchase restrictions that prevent players from purchasing certain in-game goods.

A common purchase restriction that some game operators apply is to block the direct purchase of in-game goods and, instead, offer them as prizes in a lucky draw. For example, informant 009 mentioned that the operator of the game she played did not allow players to purchase directly new playable characters, and the only way to acquire them was to purchase loot boxes. Consequently, the intention to purchase functional-based goods turns to the intention to purchase probability-based goods.

Drummond and Sauer (2018) [66] considered that loot boxes were psychologically akin to gambling because this sort of in-game goods presents several striking similarities to real-world gambling, although, in many countries, they do not legally constitute gambling. Gambling motivation also plays an important role in the process of purchasing loot boxes because players want to spend less to win more. For instance, informant 008 mentioned that she had a gambling mentality when purchasing loot boxes, which she saw as a way to get more for her money than through direct purchase, which she perceived as more expensive. After purchasing and opening the loot boxes, players would enter a gambling-like experience. In this state, players feel very anxious and experience an uncertain pleasure, which consequently leads to their intention to purchase loot boxes again.

Moreover, the result of loot boxes is binary: players either obtain their desired items, or they do not. In case players win their desired items, they can use the items to alleviate their anxious or boring experience and thus enter the flow state. In the case players do not win their desired items, some players will quit the lucky draw, but others will try more times before finally winning the desired items. The reason why players would like to iterate the lucky draw is quite straightforward: Many Chinese freemium games are not completely based on a variable ratio reinforcement schedule. Instead, many of them are based on a fixed reinforcement schedule. The fixed reinforcement schedule enables players to acquire all the items in a loot box after a given number of rounds of lucky draw. Additionally, the result of loot boxes not only affects the players themselves but also other players because players would share their experience of playing loot boxes with their friends in the same reference group. Thus, the positive and negative results of loot boxes would lead to positive WOM and negative WOM respectively. The far-reaching impact of the positive or negative WOM is that these communications can affect other players' intent to purchase loot boxes. For example, informant 010 shared her experience:

> "*Some of us was really evil. He won the item and told [us] that the reward was really good. Consequently, he encouraged us to participate in the lottery. . . When I draw, I got some rubbish! I spent 20,000 ingots and gained nothing. Then I just needed one coupon* (Play one more round, because in some games, the lottery mechanism allows players to acquire all the items in the loot box after n rounds.) *to exchange the prize, and I moved on! We all scolded him: "Are you a capper?"* "

In addition to the above, promotions also play a key role in the purchase process of probability-based goods. Informant 008 shared her experience:

> "*Playing mobile games is a common pastime, and occasionally paying to take part in a draw is very cool. For example, there is a price cut for loot boxes. . . Girls always do shopping during 11.11 and 6.18* (11.11 and 6.18 are two e-commerce promotional festivals in China.), *don't they*?"

The purchase process of probability-based goods extends the theory of Fig 5, which is illustrated in Fig 5.

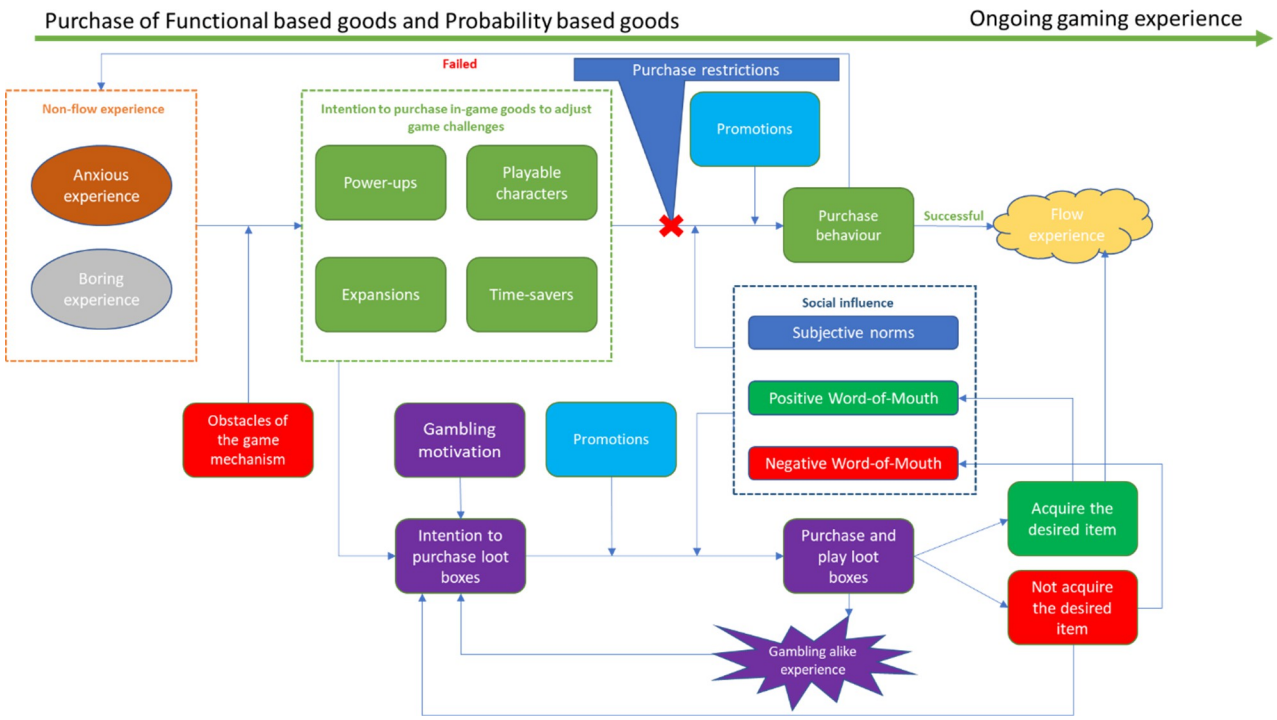

Fig 5. Purchase process between the non-flow state and actual purchase behaviour, with the existence of loot boxes.

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Purchase of ornamental-based goods: Synergism of intrinsic motivations and exposure

Although the theory described so far can explain the purchase of functional and probability-based goods, it still cannot explain the purchase of ornamental-based goods. This study reveals that the purchase of ornamental-based goods is a synergism of intrinsic motivations and social influence.

Video game players, like consumers the world over, cannot avoid the influence of other people. We found that there were three key factors (envy, the need to be unique, and the need to be attractive) that leaded players' intention to purchase ornamental-based goods.

First, players purchase ornamental-based goods because of the envious emotion. Some players are very envious when they see other player's characters wearing a coveted skin that they do not have, and consequently, they have the intention to purchase the same skin as well. "*People are jealous. If I didn't have that [skin], I certainly would be envious.*" said informant 007.

Second, players purchase ornamental-based goods to be different. Players in the video-games want their virtual appearance to be different from other players. For instance, informant 013, a *World of Warcraft* player, said he wanted *Astral Cloud Serpent* (A rare skin in *World of Warcraft*.) because of its unique appearance. Being unable to obtain this skin for free through the game mechanics, his intention was to purchase this skin directly at the in-game mall. However, he gave up this idea when he saw that many players in the virtual world already had this skin. As a result, although the need to be different firstly drives players to purchase ornamental-based goods, the intention of purchase can be weakened by the large size of avoidance group, who have already equipped the cosmetics/skins that players desired.

Third, players purchase ornamental-based goods to be attractive. During the interviews with the Informants, the word "Good looking" appeared repeatedly. The pursuit of beauty is a

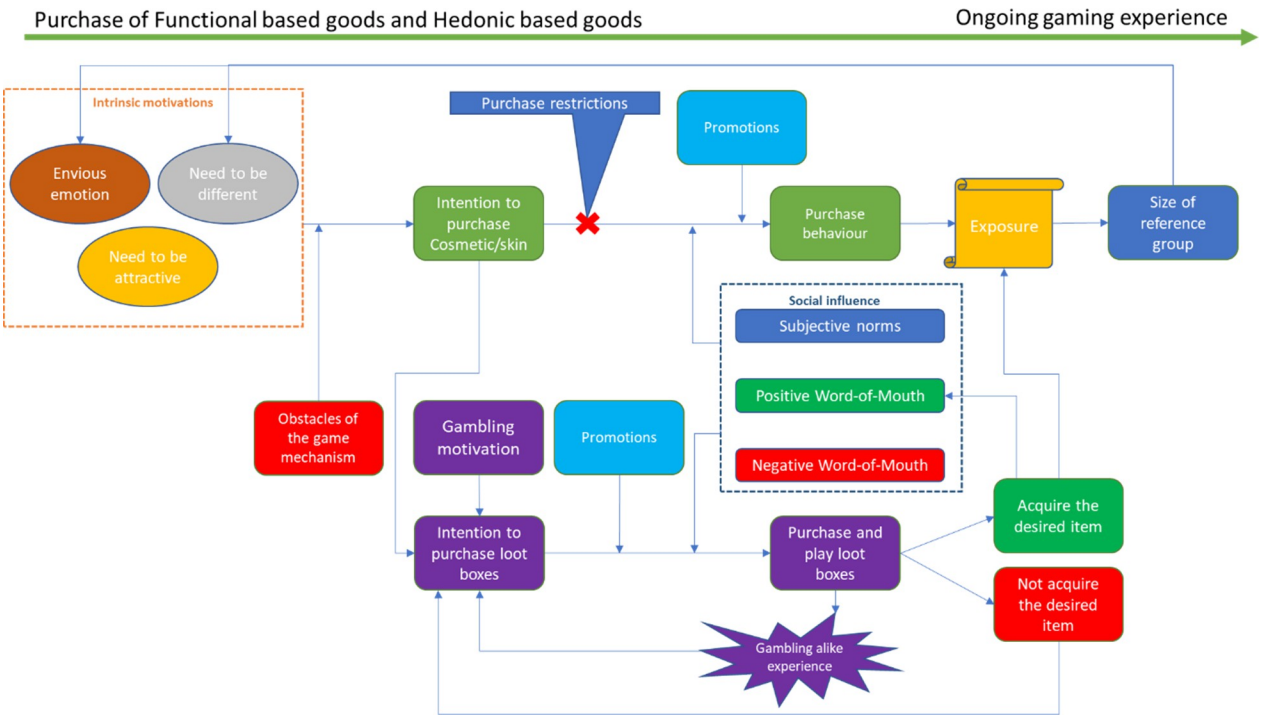

Fig 6. Purchase process of cosmetic/skins, with the existence of loot boxes.

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human instinct, and players transfer this need to their virtual characters or assets in video games. Some Informants mentioned that their virtual characters and assets should be attractive for that they could reach self-satisfaction.

One important outcome from the purchase of ornamental goods worth mentioning is exposure. Whether intentionally or unintentionally, the purchaser of in-game ornamental goods, exhibits the item to other players. The exposure of ornamental-based goods increases the size of the reference group (number of owners of a certain skin in the virtual world), thus fomenting other players' envy and need to be different.

We also found that some theoretical components mentioned in the previous sections had the same roles in the purchase process of ornamental-based goods. First, the obstacles of acquiring ornamental-based goods through game mechanics reinforce players' purchasing intention. Second, purchase restrictions of ornamental-based goods push players to purchase probability-based goods where there are ornamental-based goods, and the post-purchase behaviour remains consistent with what we have mentioned in the previous section. Third, social influences, including subjective norms, and positive and negative WOM, also influence players' purchase intention of ornamental-based goods, just as they do in other categories. Fourth, promotions also reinforce players' purchasing intentions.

The purchase process of ornamental-based goods is illustrated in Fig 6.

6. Discussion

In this study, we classified six types of in-game goods into three categories: functional-based goods, probability-based goods, and ornamental-based goods. After acknowledging the heterogeneity within each category of in-game goods, we used grounded theory to explore why and how video game players purchased each category of in-game goods. According to our

conceptual framework, in-game goods purchase behaviour is a response to discomfort from external stimuli. Specifically, we found three players' motivational patterns to response the discomfort: purchasing functional-based goods to achieve the flow experience, purchasing probability-based goods to unlock the restrictions, and purchasing ornamental-based goods for exposure in the virtual world. We also found three behavioural patterns of players when they purchase each of the three categories of in-game goods.

According to our findings, players' purchase of functional-based goods is a response to a negative mental state (anxious and boring experience) caused by an external stimulus (Imbalance of challenge and skill). Moreover, the flow state is not stable and can be terminated by anxious or boring experiences, external interferences or physiological needs. This finding broadens the existing knowledge. Previous findings from two survey-based research show that the flow experience is positively related to purchase intention of in-game goods [23,67], while our theory considers that the purchase intention is driven by the desire to reach the flow state. A possible explanation for this discrepancy may be that the results of Animesh et al. (2017) [23] and Huang et al. (2017) [67] described a specific fragment of the purchase process of functional-based in-game goods: After having the flow experience, players re-enter the discomfort state due to the imbalance of challenges and skills, at which point they regain the intention to purchase in-game goods. Thus, we call for future research to verify the relationship between the purchase intention of in-game goods and the flow experience using experimental research designs. Our theory further shows that players purchase in-game goods when there is a sharp imbalance between challenges and skills; otherwise, they would consider acquiring the items through the game mechanism. This finding explains an unusual result in the study of Hamari et al. (2017) [6]: The empirical results of their study show that the unlocking content is not significantly associated with the amount of money spent. A very plausible explanation is that some players unlock in-game contents through game mechanics instead of spending real money to purchase them. In addition, according to our theory, anxious experience and boring experience only affect players' purchase behaviour of functional-based goods without affecting the case of ornamental-based goods. Our results differ from the results of Bae et al. (2019) [17], in which researchers found while bored players intended to purchase functional-based goods, anxious players intended to purchase ornamental-based goods. This discrepancy may be related to the origin of anxiety and boredom. Whereas, in our study, both the anxious and boring experiences were derived from the video game, in the experimental design of Bae et al. (2019) [17] these mental states were derived from the factors not related to the video game. Thus, we would encourage future research on the relationship between in-game goods purchase behaviour and anxious/boring experiences with different origins. Our theory also explains other counterintuitive phenomena observed in previous studies. In the first place, researchers found that increasing the quality of a freemium game had surprisingly little effect on the demand for premium services directly [3]. A possible explanation is that due to the high quality of the game, players are always in the flow zone, where the challenges and skills are well balanced, which prevents them from having the intention to purchase in-game goods. In the second place, researchers found that regardless of how satisfied players were with the game itself, they did not necessarily have the intention to purchase in-game goods [26]. The explanation could be similar: the increase in satisfaction triggered by the flow experience does not directly enhance purchase intention unless the balance between challenges and skills is broken.

We also argue that the purchase of probability-based goods is a compromise due to purchase restrictions, and the behaviour is stimulated by gambling motivation and gambling experience. On the one hand, our findings are consistent with previous empirical evidence, which show that gambling motivation is positively related to the intention to purchase probability-

based in-game goods [30]. On the other hand, we found that players did not purchase probability-based goods completely voluntarily. It is the purchase restrictions that prevent players from purchasing functional-based goods through a direct way and encourages them to participate the lottery. We suggest future researchers study the short- and long-term effects of inducing players to purchase probability-based goods by restricting direct purchase, especially in terms of player satisfaction and loyalty to the game itself. Our findings also echo those of Drummond and Sauer (2018) [66]: our informants considered that probability-based goods were psychologically very close to gambling. Moreover, we observed a dilemma: the profit-maximising strategy of blocking the direct purchase of functional items to force the purchase of probability-based goods can backfire, since players may abandon the game on finding that a loot box does not contain the item on which they were relying to take them out of the discomfort zone. Future researchers might try to find the balance point between profit maximisation and user retention for video game companies employing this strategy.

Our findings also show that the purchase of ornamental-based goods is a synergism of intrinsic motivations and exposure. Envy, the need to be different, and the need to be attractive, are three factors that lead players to purchase ornamental-based goods in video games. Moreover, the use of ornamental-based goods inevitably increases their exposure, which consequently leads to a bigger size of the reference group. Then, a bigger size of the reference group simultaneously increases the envious emotion and the need to be different. At the same time, envy will be greater within a smaller reference group, where the coveted item would be even rarer. The larger the reference group, the sooner the item loses its rarity value, thereby increasing the purchase intention for some other item to satisfy the need to be different. This result is partially consistent with previous empirical evidence [18], which reveals that when players can see the in-game goods inside the virtual world, they are more like to adopt these goods, which consequently leads to further exposure of these goods. Due to the limitation of the qualitative method, we are unable to estimate the effect of the relationship between the intention to purchase ornamental-based goods and these three variables. Thus, future researchers should conduct quantitative studies to confirm the relationship between the size of the reference group, the envious emotion, and the need to be different.

Apart from the mentioned three purchase processes of in-game goods, our research also highlights the importance of social influence on purchase intention: while subjective norms and positive WOM reinforce the purchase intention, negative WOM weakens the purchase intention. These results are consistent with those of Guo and Barnes (2009) [11], who found that players' decision making was likely to be influenced by other players.

7. Implications

Our research has several academic and practical implications. From the academic side, first, our research provides, up to our knowledge, the first native research of in-game goods purchase that is grounded by qualitative data in the context of video games. Meanwhile, our study provides researchers with new directions for the exploration of players' in-game purchase behaviour. Each of the major theoretical categories mentioned in this study, such as the role of flow experience in the in-game goods purchase process, warrants further investigation. Second, our research highlights the different nature of distinct categories of in-game goods. The results of our study clarify the purchase processes for different types of in-game goods, which is expected to change the prevailing approach in video game research, which is to treat in-game goods as a homogeneous concept.

In terms of the practical implications, based on our results, we have detected some common approaches in the videogame industry which turn out to be not advisable. First, a frequent

current practice among video game operators, especially those of freemium games, is to increase challenges or establish obstacle to limit players' skills in the game, and the purpose of doing this is to push players away from their comfort zone and profit from players' response: the purchase functional in-game goods or probability-based in-game goods to acquire functional in-game goods. However, the results of our research show that this approach has its danger: prolonged or frequent bouts of anxiety or boredom may lead players to abandon the game permanently. To sustain their profits, therefore, videogame companies should avoid setting the game challenge to an extremely high level or excessively cramping players' skill development in the game. Second, sometimes videogame operators would deliberately reduce the difficulty to obtain some rare cosmetics/skins through a range of different ways, especially during promotional campaigns. We recommend industrial practitioners not to significantly decrease the difficulty of obtaining rare items in their games because a sufficient number of owners could constitute an avoidance group, which would reduce the desirability of the item and place pressure on game developers to devise new items as others lose their rarity value. Limitations

As well as the above implications, this study also has several limitations.

First, this study is grounded on qualitative data obtained by semi-structured interviews through a convenience sample with a small number of players (21 interviews with 14 informants). This implies that the relationships among the categories in our study have not been verified statistically. Consequently, the results of this study might not be generalisable to the whole population of videogame players. Future researchers may gather data from a larger number of players and apply statistical approaches to verify our findings.

Second, the sample of our study is restricted to China. We cannot be sure that our findings are generalisable to other regions and cultures. Further research could verify their applicability in other cultural contexts, such as North America and Western Europe, which are the second and the third largest markets after the Asia-Pacific region [68].

Third, the interviews were conducted through a text messenger (QQ). Although this approach was ideally suited to reach Chinese players, it also deprived us of the opportunity to capture players' body languages and facial expressions during the interviews. Thus, future researchers could conduct the similar study in a cultural setting where face-to-face interviews are more socially acceptable, which may generate fresh insights to the theory.

Supporting information

S1 File.
(ZIP)

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Formal analysis: Xiaowei Cai.

Funding acquisition: Javier Cebollada, Mónica Cortiñas.

Investigation: Xiaowei Cai.

Methodology: Xiaowei Cai.

Project administration: Xiaowei Cai.

Software: Xiaowei Cai.

Supervision: Javier Cebollada, Mónica Cortiñas.

Visualization: Xiaowei Cai.

Writing – original draft: Xiaowei Cai.

Writing – review & editing: Javier Cebollada, Mónica Cortiñas.

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Self-report measure of dispositional flow experience in the video game context: Conceptualisation and scale development

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Scale development

ABSTRACT

The flow theory has been widely applied to explain video game players' gaming and purchasing behaviour. However, due to the conceptual and empirical flaws of the current measurement instruments, researchers can hardly apply them to measure dispositional flow experience of adult video game players. In this research, we conceptualised flow experience and developed its measurement instrument in the video game context. To achieve these objectives, we conducted five phases with different participants in each of them: conceptualisation of the constructs and item generation ($n = 13$), expert judging ($n = 5$), pre-test ($n = 96$), initial development and validation ($n = 289$), and advanced development and validation ($n = 593$). We applied both qualitative and quantitative analysis to conceptualise and measure flow experience of video game players, including grounded theory and several statistical tools of latent variable modelling. We obtained a scale of 28-items that performs well in the first-order model. Moreover, we tested three hierarchical structure of flow experience: unidimensional model, independent antecedent model, and hierarchical antecedent model. Results show that hierarchical antecedent model is the best structure to represent flow experience. We named our scale *Video Game Dispositional Flow Scale* (VGDFS).

1. Introduction

Flow experience refers to those moments when everything comes together to create a state of absorption and enjoyment in what one is doing (Csikszentmihalyi, 1975, 1990). Researchers have argued that the flow experience is responsible for the positive emotions during video game playing (Hoffman and Novak, 1996; Michailidis et al., 2018; Nah and Hall, 2014). Therefore, flow theory has been widely applied in video game studies. On the one hand, researchers have studied the consequences of flow experience, and found that flow experience was positively related to the intention to play video games (Chang, 2013; Hsu and Lu, 2004; Shin and Shin, 2011; Zhou, 2013), attitude towards playing video games (Ha et al., 2007), satisfaction (Kim and Ko, 2019; Sepehr and Head, 2018), loyalty (Hsiao and Tang, 2016), and purchase intention of in-game goods (Animesh et al., 2017; Hamari and Keronen, 2017; T. Huang et al., 2017). Thus, due to the positive consequences of flow experience, studying flow experience is critical to analyse gaming behaviour for both researchers and practitioners in the video game industry. On the other hand, researchers have investigated the antecedents of flow experience and found that players' character identification (Soutter and Hitchens, 2016) and functional-based in-game goods purchase (Cai et al., 2020) lead to flow experience.

In marketing and consumer research, the questionnaire approach is widely used to measure psychometric properties. The first step in a scale development process is the conceptualisation (DeVellis, 2016; Mackenzie et al., 2011; Netemeyer et al., 2003), as the validity of what is being measured rest largely on the conceptual definition of the domain (Netemeyer et al., 2003). In defining flow experience, Csikszentmihalyi (1975) described six components. Later, other researchers established their measurement models of flow in different contexts. Among the various conceptualisations of flow, Jackson's (1996) nine components structure in the context of sports stands out, because it offers a comprehensive characterization of flow (Moneta, 2012). Moreover, scholars established the conceptualisation of flow in the video game context by incorporating two additional dimensions, immersion and social interaction, and they named it *GameFlow* (Sweetser et al., 2017; Sweetser and Wyeth, 2005). However, as Michailidis et al. (2018) pointed out, immersion and flow do not appear to be conceptually

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distinct. Therefore, a problem of construct proliferation[1] (Bergkvist and Eisend, 2021; Podsakoff et al., 2016) may exist in the GameFlow framework.

The various conceptualisations of flow experience have given rise to distinct flow measurement scales. Drawing on the original study of flow (Csikszentmihalyi, 1975), researchers developed the first self-report measure, the flow questionnaire (FQ) (Csikszentmihalyi and Csikszentmihalyi, 1992). Moreover, following Jackson's (1996) conceptualisation of flow in the sports context, she and her colleagues conducted a great number of studies to develop and refine the flow scale, including the development of the flow state scale (FSS) (Jackson and Marsh, 1996), the establishment of the nomological network of flow (Jackson et al., 1998), the development of the refined version of FSS, Flow State Scale-2 (FSS-2), the dispositional version, Dispositional Flow Scale-2 (DFS-2) (Jackson and Eklund, 2002), and the development of the short versions of FSS-2 and DFS-2 (Jackson et al., 2008). While the dispositional scale measures the frequency of the flow experience across time domains, the state scale measures the extent of the flow experienced in an activity.

In the context of video games, researchers built upon the Gameflow measurement model (Sweetser et al., 2017; Sweetser and Wyeth, 2005) to develop *EGameFlow*, a scale to measure learners' enjoyment of e-learning games (Fu et al., 2009). Additionally, researchers refined items used in the previous conceptual and empirical studies to develop a flow scale for the video game context (Fang et al., 2013). Researchers have also developed several flow alike scales to measure the immersion and engagement in the context of video games, in which the flow experience is one of the key dimensions. These scales are the immersion questionnaire (IQ) (Jennett et al., 2008), the game engagement questionnaire (GEQ) (Brockmyer et al., 2009), the user engagement scale (UES) (Wiebe et al., 2014), and the consumer video engagement scale (CVES) (Abbasi et al., 2017, 2019).

However, under some circumstances, existing measurement tools are either inappropriate or does not exist at all (DeVellis, 2016). Inducement of the flow experience is context-dependent (Fang et al., 2013). Previous evidence suggests that the flow experienced in the video game environment is different from that experienced during physical activity, possibly because video gaming is less physically demanding than sport (Wang et al., 2009). Furthermore, previous attempts to measure flow experience in video game context (Fang et al., 2013) combined items meant to measure dispositional flow with items for measuring state flow. Meanwhile, although DFS-2 has been verified as an adequate instrument to measure dispositional flow in some information systems, such as gamification setting (Hamari and Koivisto, 2014), its applicability in the video game context has been questioned due to the mixed findings (Procci et al., 2012; Wang et al., 2009). While the DFS-2 was valid for measuring dispositional flow in adolescent players (Wang et al., 2009), researchers failed to replicate the findings among adult players (Procci et al., 2012). Similarly, although the EGameFlow scale was validated for the e-learning games context, researchers found that the original 31-item scale underperformed in the entertainment game setting (Chen et al., 2018). Meanwhile, IQ, GEQ, UES, and CVES contain only some of the dimensions of the flow experience. Dropping any component implies the loss of the corresponding definitional aspects of flow experience (Engeser and Schiepe-Tiska, 2012).

This research has two objectives. The first objective is to conceptualise the flow experience in the video game context while avoiding the construct proliferation problem. The second objective is to develop a dispositional flow scale applicable to adult video game players.

Through reviewing the literature of flow experience and interviewing video game players, we adapted the conceptualisation of the nine dimensions of flow experience (Jackson, 1996) from the sports context to the video game context. Additionally, we proposed that flow experience could be operationalised through three different models: an unidimensional model, an independent antecedent model, and a hierarchical antecedent model. Through reviewing literature and applying grounded theory (Charmaz, 2014), we generated an initial pool of 64 items. Later, we followed a structured scale development procedure (Churchill, 1979; DeVellis, 2016; Hinkin, 1995; Mackenzie et al., 2011; Netemeyer et al., 2003) to trim, modify, and validate the initial item pool through different quantitative phases, including pre-test, initial scale validation, and advanced scale validation, until we had a refined scale with 28 items. Finally, we named the scale that we created in this research as *video game dispositional flow scale* (VGDFS).

This study has both theoretical and practical implications. On the theoretical side, we clarified the dimensions of the flow experience in the video game context, as well as introducing the most supported operationalisation of flow: the hierarchical antecedent model. On the practical side, we developed a 28-items dispositional flow scale. Compared with previous research (Procci et al., 2012), we found that the VGDFS outperformed the DFS-2 for adult players in the video game context. The adult players in the entire gamer population are especially important because the majority of video game players (67%) are adults between 20 and 50 (Bosman, 2020). Moreover, unlike copyrighted scales like DFS-2, we responded to the initiative of Hays et al. (2018) by removing potential financial barriers to the use of psychometric measures.

2. Literature review on flow theory, flow scales, and their application in video game studies

Csikszentmihalyi (1975) conceptualised the flow as an experience that occurs when the challenge of the task and the skill of the performer are balanced. A person in such a state can make full use of whatever skills are required and receives clear feedback on his/her action (Csikszentmihalyi, 1975). At the same time, there is no time to get bored or to worry about what may or may not happen (Csikszentmihalyi, 1975).

In essence, flow theory is a set of intercorrelated constructs, with their definitions and propositions, that systematically describe the relationships among the constructs to explain and predict a set of measurable outcomes (Moneta, 2012). Thus, "*flow cannot be reduced to a single component, and all attempts to take one component of flow as the definitional aspect of flow will consequently disregard essential parts* (Engeser and Schiepe-Tiska, 2012, p. 4)". Csikszentmihalyi (1975) proposed six components of flow experience based on interviews, including *merging of action and awareness, centring of attention, loss of self-consciousness, the feeling of control, coherent and noncontradictory demands*, and *autotelic nature*. In the sports context, Jackson (1996) proposed nine dimensions of flow experience based on the original flow theory (Csikszentmihalyi, 1975, 1990): *clear goals, unambiguous feedback, challenge-skill balance, concentration, action-awareness merging, sense of control, loss of self-consciousness, transformation of time*, and *autotelic experience*. In the video game context, Sweetser and Wyeth (2005) proposed an eight-dimension flow framework (GameFlow), in which *challenge* and *skill* were separated into two distinct dimensions, while *immersion* and *social Interaction* were incorporated as two new dimensions. Previous empirical evidence warranted that flow experience could be represented by a single higher order component only (Beard and Hoy, 2010; Engeser and Rheinberg, 2008; Hamari and Koivisto, 2014; Jackson and Eklund, 2002; Jackson and Marsh, 1996). However, this conclusion is premature (Engeser and Schiepe-Tiska, 2012). Some researchers argued that clear goals, unambiguous feedback, and challenge-skill balance are actually the antecedents of flow experience rather than flow per se (Jackson, 2012; Keller and Landhäußer, 2012; Moneta, 2012; Nakamura and Csikszentmihalyi, 2012). These antecedents were conceptualised to affect flow experience either individually (Jackson, 2012; Nakamura and Csikszentmihalyi, 2012) or jointly (Keller and Landhäußer, 2012; Moneta, 2012).

[1] Construct proliferation problem exists when constructs appears under different names but the conceptual domains overlap (Podsakoff et al., 2016).

Apart from the antecedents of flow, researchers have discussed its consequences (Finneran and Zhang, 2003). One of the most important consequences of flow experience is the enjoyment (Csikszentmihalyi, 1975; Engeser and Schiepe-Tiska, 2012; Landhäußer and Keller, 2012; Sherry, 2004). This consequence is especially important in the video game context. Researchers found that, while enjoyment increased the willingness to play video games, it reduced the willingness to purchase in-game goods (Hamari, 2015). As flow experience and enjoyment are conceptually distinct (Landhäußer and Keller, 2012), researchers also developed a scale to measure enjoyment in the video game context (Fang et al., 2010).

Flow theory has important applications in video game research (Animesh et al., 2017; Chang, 2013; Ha et al., 2007; Hsiao and Tang, 2016; Hsu and Lu, 2004; T. Huang et al., 2017; Kim and Ko, 2019; Sepehr and Head, 2018; Shin and Shin, 2011; Soutter and Hitchens, 2016; Zhou, 2013). Nevertheless, many social science researchers encounter measurement issues (DeVellis, 2016). Sometimes, existing measurement tools are either inappropriate or do not exist at all (DeVellis, 2016). One common response is to rely on existing measurement instruments, although they may be unsuitable or inappropriate (DeVellis, 2016). Another common response is to assume that some newly compiled scales that "look" good and use them directly in the research (DeVellis, 2016). "*In point of fact, most of our measures are only measures because someone says that they are, not because they have been shown to satisfy standard measurement criteria* (Jacoby, 1978, p. 91)." Researchers, therefore, need to realise that by making casual use of a certain measuring instrument, they run the risk of obtaining inaccurate data and results (DeVellis, 2016).

Nevertheless, the development and validation of a new scale is a time-consuming and potentially costly endeavour (Netemeyer et al., 2003). Therefore, if a reliable scale already exists, the value of a new measure may be reduced compared to the costs of developing it (Netemeyer et al., 2003). A new scale should capture the targeted factor either more accurately or more efficiently than existing scales to have incremental validity (Clack and Watson, 1995). Thus, a literature review on flow scales allows us to understand whether we really need a new flow scale in the video game context.

In the video game context, researchers attempted to create a flow scale by refining the previous conceptual and empirical results of flow research (Fang et al., 2013). However, the scope for its application is limited by two problems. On the one hand, when researchers (Fang et al., 2013) created the initial item pool, items to measure both dispositional and state flow were included. Therefore, after refinement, there are both items to measure dispositional flow and those to measure state flow in the final scale, which makes it difficult for users to capture either dispositional or state flow. On the other hand, two pairs of two-indicator measures are found in the scale of Fang et al. (2013), which violates the three-indicator rule. Scales that contains two-indicator measurement can lead to some potential problems when estimating the model, such as failure of model identification and Heywood cases (Hair et al., 2013).

There have also been several attempts to measure flow experience capturing some of its components. We name these scales as "flow alike scales". These scales are immersion questionnaire (IQ) (Jennett et al., 2008), game engagement questionnaire (GEQ) (Brockmyer et al., 2009), user engagement scale (UES) (Wiebe et al., 2014), and consumer video engagement scale (Abbasi et al., 2017, 2019). Researchers later refined UES and introduced a shortened version of this scale, although not for the context of video games (O'Brien et al., 2018).

However, measuring all components of flow experience is becoming more prevalent (Engeser and Schiepe-Tiska, 2012). This approach has its advantage because dropping any component implies the loss of the corresponding definitional aspect (Engeser and Schiepe-Tiska, 2012). Based on the original six-components operationalisation of flow (Csikszentmihalyi, 1975), Csikszentmihalyi and Csikszentmihalyi (1988) developed the first measurement instrument of flow experience. Later, Jackson and her colleagues developed a set of scales to measure flow experience in the sports context. These include Long, Short, and Core flow scales, which serve for distinct research purposes (Jackson et al., 2011; Jackson et al., 2008; Jackson and Eklund, 2002; Jackson and Marsh, 1996; Martin and Jackson, 2008). The mentioned scales also have the trait and state versions, thus bringing the total to six different scales. Like other psychological concepts, flow experience also exhibits trait-state distinctions (Jackson et al., 2011). "*It is proposed that flow is a specific Psychological state amenable to state-based assessments, and also that people differ in their propensity to experience flow on a regular basis* (Jackson et al., 1998, p. 360)". While dispositional/trait scales of flow measure the general tendency to experience flow, state scales of flow measure the particular incidence of flow characteristics during a specific event (Jackson et al., 2011).

The flow scales developed by Jackson and her colleagues (Jackson et al., 2011, 2008; Jackson and Eklund, 2002; Jackson and Marsh, 1996) were intended for use in the sports setting. Therefore, other researchers questioned the applicability of these scales outside the sport context, especially in the video game context, because of the relative lack of physical movement involved (Procci et al., 2012). amongst the flow scales developed by Jackson and her colleagues (Jackson et al., 2011, 2008; Jackson and Eklund, 2002; Jackson and Marsh, 1996), FSS-2 and DFS-2 have been assessed in the video game context. The results of the state flow measure, however, were somewhat frustrating: when using FSS-2, video games that were not likely to induce flow still offered participants the opportunity for high levels of sense of control and merging of action awareness (Klarkowski et al., 2015). Regarding the dispositional flow measure, mixing findings have been found. Wang et al. (2009) recruited 1578 secondary school students, and they found that DFS-2 was a valid measurement instrument for assessing dispositional flow experience among child and adolescent video game players. Nevertheless, Procci et al. (2012) replicated the research by recruiting 762 undergraduate students, and they found that DFS-2 was not an adequate measurement instrument for adult video game players. Procci et al., considered that participants' age might affect the validity of DFS-2 in the research. Thus, there is no research in the current literature that empirically demonstrates a valid dispositional measure of flow in the video game context for adult players.

Scholars also have developed flow measures in the video game context. Based on the conceptualisation of the GameFlow framework (Sweetser and Wyeth, 2005), Fu et al. (2009) developed a self-report flow measure in the e-learning game setting, and they named it as EGameFlow. However, although the validity of the EGameFlow scale was verified in the e-learning game setting, researchers assessed its performance in the entertainment game setting and found it to yield low model fit (CFI = 0.892, TLI = 0.879, RMSEA = 0.087) (Chen et al., 2018). Therefore, the applicability of the EGameFlow scale may be limited to the e-learning game setting.

We summarised the above-mentioned dispositional flow scales in Table 1.

A review of the literature revealed two gaps in the research, as viewed both from the conceptual and the operational perspective. On the one hand, there is a lack of conceptual clarity of flow experience in the video game literature, where several frameworks of flow experience co-exist in the literature. On the other hand, we did not find a valid scale to measure dispositional flow experience for adult video game players in the literature. The following sections describe our conceptualisation of the flow experience and our approach for measuring its dispositional aspect in the video game context.

3. General methodology

To develop a reliable and valid scale to measure the dispositional flow for the context of video games, we followed the rigorous steps of the scale development process (Churchill, 1979; DeVellis, 2016; Hinkin, 1995; Mackenzie et al., 2011; Netemeyer et al., 2003). The entire scale

Table 1
Summary of flow scales and flow alike scales.

Scale type	Name of scale	Author(Year)	Theoretical foundation	Psychometric type	Number of items	Number of points	Structure	Context of development	Validation in video game context	Performance in video game context
Flow scales	LONG Dispositional flow scale (DFS-2)	Jackson and Eklund (2002)	Flow theory	Dispositional	36 items	5 point	Second-order	Physical activity	Yes	Performed well amongst adolescents but underperformed amongst adults
	SHORT Dispositional flow scale (S DFS)	Jackson et al. (2008)	Flow theory	Dispositional	9 items	5 point	First-order	Physical activity	No	Unknown
	CORE Dispositionnal flow scale (C DFS)	Martin and Jackson (2008)	Flow theory	Dispositional	10 items	5 point	First-order	Physical activity	No	Unknown
	LONG Flow state scale (FSS-2)	Jackson and Eklund (2002)	Flow theory	State	36 items	5 point	Second-order	Physical activity	Yes	Questionable
	SHORT Flow state scale (S FSS)	Jackson et al. (2008)	Flow theory	State	9 items	5 point	First-order	Physical activity	No	Unknown
	CORE Flow state scale (C FSS)	Martin and Jackson (2008)	Flow theory	State	10 items	5 point	First-order	Physical activity	No	Unknown
Flow alike scales	EGameFlow	Fu et al. (2009)	GameFlow	Dispositional	56 items	7 point	First-order	Serious video game	Yes	Performed well in the serious game setting but underperformed in the entertainment game setting
	Game engagement questionnaire (GEQ)	Brockmyer et al. (2009)	Flow theory, immersion, presence, absorption, dissociation	Dispositional	19 items	3 point	First-order	Violent video game	Yes	Performed well in the scale development study
	Consumer video engagement scale	Abbasi et al. (2017)	Engagement	Dispositional	29 items	7 point	Second-order	General video game	Yes	Performed well in the scale development and validation studies
	Immersion questionnaire	Jennett et al. (2008)	Flow theory, cognitive absorption, presence, immersion	State	31 items	5 point	First-order	First person shooter game	Yes	Performed well in the scale development study
	User engagement scale (UES)	Wiebe et al. (2014)	Engagement	State	28 items	5 point	First-order	Online video game	Yes	Performed well in the scale development study
	Refined user engagement scale (R UES)	O'Brien et al. (2018)	Engagement	State	30 items	5 point	First-order	E-shopping	No	Unknown
	Short user engagement scale (S UES)	O'Brien et al. (2018)	Engagement	State	12 items	5 point	First-order	E-shopping	No	Unknown

development process serves to ensure several types of validity, including face validity, content validity, convergent validity, discriminant validity, and nomological validity (DeVellis, 2016; Hinkin, 1995; Mackenzie et al., 2011; Netemeyer et al., 2003). There are five phases in our research, which serve to control the mentioned types of validity. While phases 1 and 2 control the face and content validity, phases 3, 4, and 5 control the convergent, discriminant, and nomological validity. Phase 5 also checks for measurement invariance across different gender and age groups among video game players. Table 2 summarises the research process.

In this research, we conducted several phases of data collection, including both online interviews and online surveys. In almost all phases (except the expert judging phase), our target population are video game players from the United States. We selected the samples from the United States video game market because it was the largest gaming market in terms of global revenue, totalling $36.9 billion in 2009 (Newzoo, 2019a). Driven by growth in console game revenues, it overtook China for the number one position (Newzoo, 2019a).

To approach the target population, we use a leading online panel, Prolific,[2] which serves as the sampling frame in our research. The use of an online panel saves both time and money while few disadvantages were observed (Casler et al., 2013). Among the online panels available, we selected Prolific because of several merits. On the one hand, Prolific has no reported functional shortcomings (Palan and Schitter, 2018). On the other hand, empirical results show that the participants on Prolific are more honest and less exposed to common research tasks than participants on other online panels, such as Mturk (Peer et al., 2017). Nevertheless, due to the policy restrictions of Prolific,[3] researchers are not able to screen the participants inside the questionnaire. If researchers wish to acquire a customised population that the default screening function does not provide, they need to conduct a two-steps sampling process[4] to precisely locate the target population. The participant pool in the pre-test phase, initial scale validation phase, and advanced validation phase are 624, 1671, and 1950 respectively.

In this research, we paid much attention to item redundancy, which is one of the theoretical bases of scale development (DeVellis, 2016). Although in the final scale, redundancy is undesirable, during the scale development phases, two items are worth keeping even if they differ by one word (DeVellis, 2016).

During the scale development, if an item did not perform well in the quantitative phase, we would create more items to reword the problematic item. Additionally, during scale development, items are often added, dropped, or reworded (Netemeyer et al., 2003). Therefore, re-estimating the measurement model using a new sample of data is important (Mackenzie et al., 2011). In this research, all the samples in the quantitative phases, including pre-test, initial scale validation, and advanced scale validation, are mutually independent, which helps to mitigate the common method variance (Hinkin, 1995).

The literature generally agrees that the response rate is the key metric to identify nonresponse (Callegaro et al., 2015). For the research using the non-probability-based panel, Callegaro and Disogra (2008) suggest reporting the completion rate, break-off rate, screening completion rate, and study-specific eligibility rate. Table 3 summarises the number of participants and the response rates for all the questionnaires that we launched in this research.

In this research, we applied several procedural methods to mitigate common method variance using. First, respondents' anonymity needs to be protected, which reduces evaluation apprehension (Podsakoff et al., 2003). In the instructions, we informed the participants that their responses were entirely anonymous, and there were no right or wrong answers. Second, another approach to control common method bias is to counterbalance question order (Hulland et al., 2018; Podsakoff et al., 2003). In this research, we randomised the items at two levels. On the one hand, we randomised the items inside the pages of constructs. On the other hand, we randomised the orders of the pages of constructs in the questionnaire. Third, it is also possible to reduce common method bias through careful construction of the items themselves (Podsakoff et al., 2003). Following the suggestions of Tourangeau et al. (2000), we (1) kept questions simple, specific, and concise; (2) avoided double-barrelled questions; (3) decomposed questions relating to more than one possibility into simpler, more focused questions; (4) avoided complicated syntax.

In our research, we also used a screening strategy to minimise the effects of survey satisficing. Survey satisficing refers to "*an alternative behaviour choice for respondents who lack survey engagement, but who for whatever reasons (such as a contract, incentives, embarrassment, habit or curiosity), still participate in a survey* (Callegaro et al., 2015, p. 102)" Detecting satisficing behaviour helps to reduce the common method bias. Previous empirical evidence (J. L. Huang et al., 2012) has shown that several psychometric properties improve, including item interrelatedness, facet dimensionality, and measurement structure, after removing the observations with satisficing behaviour. As a result, before conducting any data analyse, we needed to apply strategies to detect the participants who conducted satisficing behaviour during the survey. The detailed screening strategy is described in Appendix 1. The mentioned strategy was applied to all the quantitative phases (Phases 3–5).

With respect to the software environment, we used NVivo 12 for the qualitative data analysis. To conduct the quantitative data analysis, we used the R programming language in the RStudio environment, and we used *lavaan*[5] (Rosseel, 2014) to conduct the latent variable modelling.

4. Phase 1: conceptualisation of the constructs and item generation

Literature review and qualitative evidence are two ways to enhance the accuracy and comprehensiveness of construct definition (Netemeyer et al., 2003). In this study, we first reviewed the literature for an *a priori* specification of the dimensionality of the constructs of flow and further refined the conceptualisation by interviewing video game players. After conceptualising the dimensions of flow in the video game context, we generated the items for the corresponding constructs. There are two main sources to generate items: literature and the population of interest (Hinkin, 1995; Netemeyer et al., 2003). We first reviewed the previous studies of dispositional flow to explore how researchers operationalised the constructs, which helped us to develop the theoretical sensibility. Then, we applied a specific qualitative approach, grounded theory (Charmaz, 2014; Corbin and Strauss, 2015; Glaser and Strauss, 1967), to conduct the theoretical sampling and qualitative data analysis. Several researchers have suggested grounded theory as a useful tool in the initial phase of scale development (Bearss et al., 2016; Hinkin, 1995; Rowan and Wulff, 2007). Moreover, interviewing with members of the population can provide insights into item wording and response formats (Netemeyer et al., 2003).

[2] Prolific (https://www.prolific.co/) was launched in 2014, by a group of graduate students from Oxford and Sheffield Universities, as a software incubator company.

[3] URL: https://researcher-help.prolific.co/hc/en-gb/articles/360010165173-Can-I-screen-participants-within-my-survey-

[4] A two-step sampling process seperates the questionnaire into two parts: While the first questionnaire only charges the function to screen the target population, the second questionnaire contains the questions for the primary research. In the pre-screening questionnaire, apart from the demographic questions, we asked the participants the following question: Have you played videogames in the last six months?In the pre-screening questionnaire for both the qualitative and quantitative phase, we selected the participants with the following demographic characteristics to take part in the study: U.S. citizen, age ranging from 18 to 60, and they should have played video games in the last six months.

[5] URL: https://lavaan.ugent.be/

Table 2
Research process.

Research steps	Objectives	Details	Methodology
1. Conceptualisation of the constructs and item generation			
• Literature review	Finding the established conceptualisation of the flow measures	Reviewing literature related to flow experience.	Literature review
• In-depth interviews	Conceptualising the dimensions of flow in the video game context	13 in-depth online interviews with 11 informants	Grounded theory
• Item generation	Generating the initial item pool	Using both inductive and deductive reasoning to generate items	Grounded theory and literature review
Number of items: 64			
2. Expert judging			
• Expert judging	Assessing face validity	5 specialists from marketing and consumer research	Expert judging
Number of items: 64			
3. Pre-test			
• Survey 1		Total sample = 103; Valid sample = 96	
• Pilot data analysis	Pilot assessment of reliability	Assessing the reliability in the whole sample and in subgroups	Examination of Cronbach's alpha
	Pilot examination of measurement structure	Examining the measurement structure of the nine-dimension flow model	Exploratory factor analysis
	Pilot assessment of validity	Assessing the nomological validity	Correlation test
Number of items: 51			
4. Initial development and validation			
Number of items: 62			
• Survey 2		Total sample = 313; Valid sample = 289	
• Initial data analysis	Initial examination of measurement structure	Examining the measurement structure of the nine-dimension flow model	Exploratory factor analysis (All observations and subgroup analysis)
	Initial assessment of validity	Assessing the convergent validity, discriminant validity, and nomological validity	Confirmatory factor analysis
Number of items: 47			
5. Advanced development and validation			
Number of items: 71			
• Survey 3		Total sample = 637; Valid sample = 593	
• Advanced data analysis	Advanced examination of measurement structure	Examining the measurement structure of the nine-dimension flow model	Exploratory factor analysis and confirmatory factor analysis
	Advanced assessment of validity (I)	Assessing the convergent validity of the reduce item pool.	Confirmatory factor analysis
	Assessment of measurement invariance	Assessing the configural invariance, weak invariance, strong invariance, and strict invariance	Omnibus Test
	Advanced assessment of validity (II)	Assessing the convergent validity and discriminant validity of the final item pool.	Confirmatory factor analysis
	Examination of hierarchical structure	Examining the different specification of flow structure	Confirmatory factor analysis and structural equation modelling
	Advanced assessment of validity (III)	Assessing the nomological validity of different specification of flow structure	Structural equation modelling (All observations and subgroup analysis)
Number of items: 28			

Table 3
Summary of response rates.

Questionnaire	Introduction breakoff rate (IBR)	Questionnaire breakoff rate (QBR)	Total breakoff rate (TBR)	Completion rate (CR)	Screening completion rate (S_COMP)	Study specific eligibility rate (S_ELIG)
Pre-screening questionnaire (n = 624)	3.69%	0.00%	3.69%	96.30%	96.30%	99.50%
Pre-screening questionnaire (n = 1047)	3.53%	0.89%	4.39%	95.60%	95.60%	99.00%
Pre-screening questionnaire (n = 279)	8.96%	0.39%	9.32%	90.70%	90.70%	99.20%
Integrated pre-screening questionnaire (n = 1671)	3.59%	0.56%	4.13%	95.90%	95.90%	99.20%
Integrated pre-screening questionnaire (n = 1950)	4.36%	0.54%	4.87%	95.10%	95.10%	99.20%
Pre-test questionnaire (n = 103)	0.00%	1.94%	1.94%	98.00%	98.10%	99.00%
Initial scale validation questionnaire (n = 313)	1.92%	2.28%	4.15%	95.80%	96.50%	99.30%
Advanced scale validation questionnaire (n = 637)	0.94%	1.43%	2.35%	97.60%	97.80%	99.40%

We conducted 13 semi-structured Interviews with 11 video game players, who were recruited on Prolific. Appendix 2 demonstrates the demographic and gaming profiles of the informants.

Reviewing the relevant literature of flow experience helped us to cultivate theoretical sensitivity (Charmaz, 2014; Corbin and Strauss, 2015) when conducting fieldwork and analysing qualitative data using grounded theory (Charmaz, 2014). After we conducted initial and focus coding, nine categories emerged through inductive reasoning, which was in line with the nine-dimensions conceptualisation of flow experience (Jackson, 1996). We summarise the definitions of each construct in Table 4.

Researchers advocate that scale developers should consult several sources when generating the item pool (Netemeyer et al., 2003). Previous studies and members of the target population are the two main sources to generate items (Netemeyer et al., 2003). Therefore, in this research, we generated the initial item pool based on the items of previous scales (Abbasi et al., 2017, 2019; Brockmyer et al., 2009; Fu et al., 2009; Jackson et al., 2011; Jennett et al., 2008; O'Brien et al., 2018; Wiebe et al., 2014) and the qualitative results from phase 1. Although there are no hard-and-fast rules for the size of an initial item pool (Netemeyer et al., 2003), we followed the advice of DeVellis (2016) to generate a pool with at least twice the size of the final scale. Eventually, we generated an initial item pool with 64 items, which is shown in Appendix 3. The items in the initial pool as well as the questionnaires in the rest of the scale development phases were measured using a 7-point ordinal scale with the following anchor labels: 1-Never, 2-Almost never, 3-Rarely, 4-Sometimes, 5-Frequently, 6-Almost always, 7-Always.

Regarding the conceptualisation of flow experience at the level of second-order factors, factor analyses warranted the components represented a unidimensional structure (Beard and Hoy, 2010; Engeser and Rheinberg, 2008; Jackson et al., 2011, 2008; Jackson and Eklund, 2002; Jackson and Marsh, 1996) However, this conclusion may be premature (Engeser and Schiepe-Tiska, 2012). The components of flow experience can be highly correlated but at the same time dissociated (Engeser and Schiepe-Tiska, 2012). Researchers proposed that three of the nine dimensions, Clear goals, Unambiguous feedback, and Challenge-skill balance, were the antecedents of flow experience (Jackson, 2012; Keller and Landhäußer, 2012; Nakamura and Csikszentmihalyi, 2012). According to this conceptualisation of flow experience, the three antecedents may affect flow experience separately, which we named it as independent antecedent model. Moreover, the three antecedents can also be conceptualised as a second-order factor that leads to flow experience. Keller and Landhäußer (2012) considered that it is not meaningful to consider the three antecedents as distinct factors, because it is simply not possible to perceive a fit of skills and task demands when engaging in an activity without clear task instructions or without diagnostic information regarding one's progress or success in the activity. Following the proposition of the previous researchers (Landhäußer and Keller, 2012), we conceptualised that the three antecedents of flow formed a reflective second-order factor, which we named it as Perceived fit of Goal-Feedback-Balance (PFGFB), and we called this conceptualisation approach as hierarchical antecedent model. Moreover, we also took the methodological considerations into the account when conceptualising the PFGFB. We conceptualised the PFGFB as reflective instead of formative because the reflective measurement approach aims at maximising the overlap between the indicators (Hair Jr, Hult, Ringle, and Sarstedt, 2016). Moreover, formative indicators have no individual measurement error terms and assume error-free in a conventional sense (Hair Jr et al., 2016), which is unlikely to happen in survey research. We concluded the three conceptualisations of flow experience at the edges of Table 4.

5. Phase 2: expert judging

As part of the scale development process, expert judging helps to control the content and face validity of an emerging scale (DeVellis, 2016; Netemeyer et al., 2003). We developed a questionnaire for the purpose of expert judging. In this questionnaire, all the items, response formats, number of scale points, and instructions were listed for judging, as suggested by previous researchers (Netemeyer et al., 2003). On the qualitative side, we created an open-ended question for each construct of the scale as well as for the whole scale, so that experts could give their

Table 4
Definitions of the flow constructs and different approaches of conceptualisation.

		Constructs	Definitions		
Hierarchical antecedent model	Perceived fit of Goal-Feedback-Balance (PFGFB)	Clear goals (CG)	Players know clearly which operations they are supposed to do in the next phases. The clarity of purpose keeps players fully connected to the in-game tasks and responsive to appropriate cues.	Antecedent 1	Independent antecedents model
		Unambiguous feed back (UF)	Players receive immediate and unambiguous feedback about how well they are processing towards the in-game goals.	Antecedent 2	
		Challenge-skill balance (CSB)	In the video game contexts, challenges are the in-game tasks to be completed, and skills are the subjective belief or confidence that players have to overcome the challenges. When players experience the balance between challenge and skill, they may enter the flow experience.	Antecedent 3	
	Flow experience	Concentration (CON)	When players are in the flow state, they totally focus on the specific gaming tasks, and they concentrate on the task at hand in the game world.	Flow experience	
		Action-awareness merging (AAM)	When players are in the flow state, their action and awareness would be merged. Through total absorption in the game world, video game players are associated with the game world and feel that they are a part of the game world.		
		Sense of control (SC)	When players are in the flow state, they have a sense of natural control in the game world.		
		Loss of self-consciousness (LSS)	When video game players have flow state, their ego disappears in the real world. The impact of stimulus from the real world on video game players' self-consciousness is reduced.		
		Transformation of time (TT)	When players are in the flow state, players' perception of time is affected. Players cannot perceive the time or lose the awareness of time.		
		Autotelic experience (AE)	Autotelic experience describes the intrinsically rewarding experience that flow brings to the individual. Autotelic experience is the source of enjoyment that flow experience brings to the individual.		
		Unidimensional model			

commentary at both item level and scale level. On the quantitative side, we applied the method of Zaichkowsky (1985), which is the most common way to conduct quantitative expert judging (Hardesty and Bearden, 2004). We invited seven professors from two Spanish universities to form the expert panel, who were specialised in consumer behaviour. Among the experts, five completed the questionnaire, and two engaged in the questionnaire but not finished it.

We used three rules for the evaluation of expert judging results: sum score rule, complete rule and not representative rule (Hardesty and Bearden, 2004). Table 5 demonstrates the descriptive statistics of the quantitative results of expert judging. According to these results, the face validity of the overall initial item pool is acceptable. The complete quantitative results of expert judging can be found in Appendix 3.

Combining the quantitative and qualitative feedbacks from the expert, we did not trim any items from the initial pool.

6. Phase 3: pre-test

103 participants recruited from Prolific participated in the pre-test. After applying the screening strategy that we mentioned in Appendix 1, 96 samples remained in our dataset. Tables 6 and 7 demonstrate the demographic and gaming profile of the participants, respectively. We applied exploratory factor analysis (EFA) to examine the measurement structure and assess the validity of the scale. EFA can be used for two primary purposes in scale development (Netemeyer et al., 2003). On the one hand, it reduces the number of items in a scale so that the remaining items maximise the explained variance and reliability in the scale. On the other hand, it helps to identify the underlying dimensions in a scale.

Internal consistency reliability should be assessed in the pre-test when developing a new scale (Netemeyer et al., 2003). The estimates of alpha coefficient across all the observations and each subgroup are summarised in Appendix 4. According to the results, we observed that all the coefficients were acceptable except for the measure of Challenge-skill balance (0.66) in the female group.

Then, we applied EFA using a recommended procedure in the literature (Hair et al., 2013, p. 104). We used principal axis factoring (PAF) as the factor extraction method and the PROMAX method when there was a need to obtain a rotated solution.. PROMAX, as an oblique rotation method, was used because this rotation method looks for the degree to which multiple scales/dimensions correlate, which reveals more meaningful theoretical factors in scale development (Netemeyer et al., 2003). We followed *a priori* criterion to set the number of factors as nine, as this number of flow dimensions were theoretically (Jackson, 1996, 2012; Nakamura and Csikszentmihalyi, 2012) and empirically (Jackson et al., 2011, 2008; Jackson and Eklund, 2002; Jackson and Marsh, 1996) supported in previous research. As suggested in the literature (Hair et al., 2013), we conducted unrotated solution before PROMAX solutions to trim the items in the pool. Appendix 4 demonstrates the full results of EFA. After dropping the unqualified items (communality value < 0.5; factor loading < 0.5), 51 items remained in the pool. Then, we re-ran the PROMAX solution using the remaining items. We found that no communality value was lower than 0.5, all factor loadings exceeded 0.5 without a cross-loading problem, and all eigenvalues were greater than 1.

7. Phase 4: initial development and validation

At the end of the pre-test, only two items remained in the factor Challenge-skill balance, indicating violation of the three-indicator rule (Hair et al., 2013). In addition, the spearman coefficient between Challenge-skill balance and Loss of self-consciousness was low (0.057), suggesting a potential problem against the previous measurement model (Jackson et al., 2011). Therefore, in this study, we modified the item pool and assessed the modified scale using a larger sample. In the modified item pool, there were 62 items. Additionally, we needed a larger sample to initially validate the generalisability of the scale across gender and age groups.

We recruited 313 participants recruited from Prolific participated in the initial scale validation. After applying the screening strategy that we mentioned in Appendix 1, 289 samples were left in our dataset. Tables 6 and 7 show the demographic and gaming profiles of the participants, respectively. Later, we conducted a series of assessments suggested in the literature, including an initial examination of measurement structure and initial assessment of validity (Netemeyer et al., 2003). We repeated the procedure of conducting EFA as we did in the pre-test using the new dataset.

After conducting the EFA, 51 items remained in the pool. Later, we repeated the PROMAX solution using the remaining items, and no communality or loading problem was found, and the eigenvalues were greater than 1. Appendix 5 shows the full results of the factor matrix. Moreover, when attempting to define the underlying structure among items, validation of any factor analysis result is essential (Hair et al., 2013). In this study, we used the split sample analysis. We classified the observations into four groups according to their gender and age (under 30 and over 30). The results of multiple group EFA can be found in Appendix 5. Later, we dropped the items that had either communality or loading problems (communality value < 0.5; factor loading < 0.5) in any two of the four groups, and 47 items were left in the pool.

We also conducted an initial assessment of convergent and discriminant validity. To assess these validities, we specified a confirmatory factor analysis (CFA) model using the remaining 47 items. To estimate the CFA model with ordered categorical data with more than six points, we used maximum likelihood with Satorra-Bentler scaling, as suggested by Finney and DiStefano (2013). We used the pre-defined thresholds of model fit indices to check the fit of the models: the model fit is acceptable when χ^2 statistic is significant, CFI > 0.90, TLI > 0.9, RNI > 0.90, SRMR < 0.1, RMSEA < 0.08) (Hair et al., 2013). The chi-squared statistic ($\chi^2 = 2064.028$, df $= 1188$, $p < 0.001$) and the model fit indices (CFI $= 0.921$, TLI $= 0.915$, RNI $= 0.921$, SRMR $= 0.057$, RMSEA $= 0.051$) demonstrate that the CFA model is acceptable. Moreover, all the standardised loading estimates and the values of average variance extracted (AVE) were higher than 0.5, which suggests adequate convergence (Hair et al., 2013). As for assessing the discriminant validity, a robust approach to test the discriminant validity is to compare

Table 5
Descriptive statistics of quantitative results of expert judging.

	Mean	SD	Minimum	1st quartile	Median	3rd quartile	Maximum	Not representative	Somewhat representative	Clearly representative
Expert 1	2.58	0.56	1	2	3	3	3	2	23	39
Expert 2	2.62	0.6	1	2	3	3	3	4	16	44
Expert 3	2.53	0.69	1	2	3	3	3	7	16	41
Expert 4	2.56	0.56	1	2	3	3	3	2	24	38
Expert 5	2.19	0.83	1	1	2	3	3	17	18	29
Sumscore rule	12.48	1.73	8	12	12	14	15			
Complete rule	2.98	1.33	1	2	3	4	5			
Not representative rule	0.5	0.69	0	0	0	1	3			

Table 6
Demographic profile of the participants.

Group		Pre-test (n = 96)		Initial scale validation (n = 289)		Advanced scale validation (n = 593)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gender	Male	51	53.12%	142	49.13%	296	49.92%
	Female	45	46.88%	147	50.87%	297	50.08%
Age	≤30 years old	47	48.96%	138	47.75%	289	48.74%
	>30 years old	49	51.04%	151	52.25%	304	51.26%
Student	Yes (Full time)	22	22.92%	61	21.11%	113	19.06%
	Yes (Part time)	6	6.25%	11	3.81%	30	5.06%
	No	68	70.83%	217	75.09%	450	75.89%
Education	Middle school and below	1	1.04%	2	0.69%	3	0.51%
	Vocational school	0	0.00%	4	1.38%	15	2.53%
	High school	26	27.08%	54	18.69%	136	22.93%
	Community college	13	13.54%	52	17.99%	101	17.03%
	Undergraduate degree	46	47.92%	146	50.52%	252	42.50%
	Master's degree	6	6.25%	28	9.69%	70	11.80%
	PhD	4	4.17%	3	1.04%	16	2.70%
Employment	Yes (Full time)	33	34.38%	119	41.18%	255	43.00%
	Yes (Part time)	17	17.71%	51	17.65%	116	19.56%
	No	46	47.92%	119	41.18%	222	37.44%
Income	I don't have an income	21	21.88%	55	19.03%	115	19.39%
	Less than 1000 USD	21	21.88%	53	18.34%	98	16.53%
	1001 USD −2000 USD	10	10.42%	42	14.53%	97	16.36%
	2001 USD −3000 USD	13	13.54%	30	10.38%	86	14.50%
	3001 USD −5000 USD	6	6.25%	53	18.34%	72	12.14%
	5001 USD −7000 USD	5	5.21%	22	7.61%	36	6.07%
	More than 7001 USD	17	17.71%	25	8.65%	74	12.48%
	Don't Know/No Answer	3	3.12%	9	3.11%	15	2.53%

Table 7
Gaming profile of the participants.

Group		Pre-test (n = 96)		Initial scale validation (n = 289)		Advanced scale validation (n = 593)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gaming time per week	Less than 4 hour a week	21	21.88%	66	22.84%	107	18.04%
	5–7 h a week	17	17.71%	65	22.49%	119	20.07%
	8–12 h a week	17	17.71%	66	22.84%	127	21.42%
	13–20 h a week	12	12.50%	48	16.61%	111	18.72%
	More than 20 h a week	29	30.21%	44	15.22%	129	21.75%
Gaming time per session	Less than 1 h at a time	19	19.79%	78	26.99%	125	21.08%
	1–2 h at a time	33	34.38%	102	35.29%	214	36.09%
	2–3 h at a time	24	25.00%	68	23.53%	149	25.13%
	3–5 h at a time	12	12.50%	31	10.73%	78	13.15%
	More than 5 h at a time	8	8.33%	10	3.46%	27	4.55%
Platform	Windows	80	83.33%	225	77.85%	469	79.09%
	MAC	7	7.29%	17	5.88%	45	7.59%
	PS4/PS4 Pro	40	41.67%	112	38.75%	256	43.17%
	Xbox One/Xbox One X	21	21.88%	78	26.99%	143	24.11%
	WII U	7	7.29%	17	5.88%	37	6.24%
	Nintendo Switch	39	40.62%	141	48.79%	289	48.74%
	PS Vita	0	0.00%	5	1.73%	20	3.37%
	3DS	15	15.62%	46	15.92%	85	14.33%
	Android	43	44.79%	155	53.63%	288	48.57%
	IOS	27	28.12%	98	33.91%	207	34.91%

the values of AVE for any two factors with the square of the correlation estimate between these two factors (Fornell and Larcker, 1981). In our case, all the values of AVE were greater than the squared correlation estimates of the corresponding factors, which suggests a good discriminant validity. All the mentioned results are summarised in Appendix 5.

In conclusion, the evidence shows that the 47-item scale had both convergent and discriminant validity.

8. Phase 5: advanced development and validation

After conducting the first four studies, we had already had a prototype scale. Later, we re-worded the problematic items that we detected in the previous study. Then, we sent the modified item pool to a native English speaker for proofreading. In this modified and proofread item pool, there were 71 items.

In this study, we finalise the scale and further establish its psychometric properties. To do so, we conducted a series of advanced examinations to assess the measurement structure at the item level, the measurement invariance, the convergent validity, the discriminant validity, the hierarchical measurement structure, and the nomological validity. 637 participants recruited from Prolific participated in the initial scale validation. After applying the screening strategy that we mentioned in Appendix 1, 593 samples were left in our dataset. Table 6 and Table 7 give the demographic and gaming profiles of the participants, respectively.

We first applied the EFA to examine the measurement structure of the flow experience. After trimming the unqualified items in the unrotated and PROMAX solutions (communality value < 0.5; factor loading < 0.5), 62 items remained in the item pool.

Then, we conducted the CFA using the 62 items to further assess the validity of the scale. We specified a nine-factor first-order model using maximum likelihood with S-B scaling. The chi-squared statistic (χ^2 =

4693.595, $p < 0.001$) and model fit index (CFI = 0.902, TLI = 0.897, RNI = 0.902, SRMR = 0.055, RMSEA = 0.052) demonstrate that the CFA model is acceptable. However, as the factor loading should be higher than 0.5, ideally higher than 0.7 (Hair et al., 2013), we removed six items from the pool. Although the ultimate goal of confirmatory factor analysis (CFA) is to obtain an answer as to whether a given measurement model is valid, the process of CFA provides additional diagnostic information that may suggest modifications for either addressing unsolved problems or improving the model's test of measurement theory (Hair et al., 2013). There are a series of *post hoc* tools available to improve the model performance, such as standardised residuals, modification indices, and specification searches (Hair et al., 2013). In the scale development process, these *post hoc* tools are useful for assessing items that have correlated measurement errors or load strongly on a factor other than their intended factor (Netemeyer et al., 2003). Standardised residuals greater than |4.0| suggest a potentially unacceptable degree of error that may call for the deletion of an offending item (Hair et al., 2013). After examining the standardised residuals, we found that 23 items were affected. Additionally, according to the results of the modification index power test (Saris et al., 2009), 25 items were affected. When deciding to drop the unqualified items, we took all the mentioned results into consideration. For instance, the standardised residual between SC7P and SC3P is −4.057, which is greater than |4.0|. Meanwhile, the MI power test shows that the relationship between SC7P and SC5 is misspecified. Additionally, the factor loading of SC7P (0.739) is much lower in comparison to other items in the same factor: SC3P (0.745), SC4 (0.772), SC5 (0.775). Taking all these pieces of information together, we decided to drop the SC7P. We generalised this logic to all the pool to trim items, and 43 of them were left. Later, we used the 43 items to specified again the nine-factor first-order model. According to the model fit indices (CFI = 0.969, TLI = 0.966, RNI = 0.969, SRMR = 0.037, RMSEA = 0.035), the performance of 43-items model is much better than that of 63 items model.

In this research, we paid great attention to assess the measurement invariance. Measurement invariance is a logical prerequisite when studying differences across groups (Jiang et al., 2017). Measurement invariance refers to the consistency of a measurement instrument across groups (Nimon and Reio, 2011), which concerns whether scores from the operationalisation of a construct have the same meaning under different conditions (Meade and Lautenschlager, 2004). If evidence supporting a measure's invariance is lacking, conclusions based on that scale are at best ambiguous and at worst erroneous (Steenkamp and Baumgartner, 1998). Thus, unless measurement invariance is established, conducting cross-group comparisons of a mean difference or other structural parameters is meaningless (Schmitt and Kuljanin, 2008). Moreover, if there is empirical evidence for measurement invariance, the generalisability of the scale is enhanced (Marsh, 1994; Netemeyer et al., 2003; Steenkamp and Baumgartner, 1998).

We assessed the measurement invariance using the Omnibus test approach (Fischer and Karl, 2019; Kline, 2015; Steenkamp and Baumgartner, 1998). In this study, we concerned about the measurement invariance in two basic demographic variables of video game players: gender and age. In the video game context, gender and age are two critical variables that serve to separate the market (ESA, 2019; Newzoo, 2019b). The results are shown in Table 8. According to the results, the 43-items model has weak invariance across both the gender groups ($p = 0.617$) and the age groups ($p = 0.674$). However, results show that this model does not prove strong invariance in gender groups ($0.674 < 0.001$) and in the age groups ($0.674 < 0.001$). Therefore, we repeated the approach of Saris et al. (2009) in the models where the factor loadings and intercepts are constrained to be equal across groups to further refine the scale. The results showed that the relationships of 17 items were misspecified in the gender groups, and the same number of items were also misspecified in the age groups. Meanwhile, we refined the scale using the modification index. Items with a higher modification index were trimmed until there were three items in each factor, which complies with the three-item rule that avoids identification problems (Hair et al., 2013). Besides, controlling the length of the scale enhances the brevity of the questionnaire and limits fatigue for the participants (Netemeyer et al., 2003). Finally, 28 items were left on the scale, which are shown in Table 9.

We then specified a CFA model using the mentioned 28 items. According to the model fit index (CFI = 0.988, TLI = 0.985, RNI = 0.988, SRMR = 0.027, RMSEA = 0.026), the 28-item model reached the best performance amongst the models that we had specified. Additionally, all the factor loadings were greater than 0.7, which reach an ideal level (Hair et al., 2013).

All the mentioned results of factor loadings, standardised residuals (results greater than |4.0|), modification index, and expected parameter change are summarised in Appendix 6.

Later, we re-run the tests of measurement invariance using the remaining 28 items. The results are shown in Table 8. We found that although the 28-items model still failed to reach strong invariance across the gender groups for a significance level of 0.05, the measurement invariance was improved significantly considering that the p-value was approaching the acceptable level ($p = 0.04$). Additionally, we found that the 28 items model reached strict invariance across the age group.

Regarding the convergent and discriminant validity of the 28-items model, we repeated the assessment procedure as we did in the previous study. According to the results shown in Table 10, all the AVEs are greater than 0.5, with all the estimates of composite reliability and Cronbach's alpha higher than 0.7. These results suggest that the 28-item model has solid convergent validity. Moreover, all the values of AVE are greater than the squared correlation estimates of the corresponding

Table 8
Results of measurement invariance tests.

Model	Group	Constraints	DF	AIC	BIC	Chi-square statistic	Chi-square difference	DF difference	p value
43 items model	Gender	Configural	1648	60,778	62,226	2570.9			
		Weak	1682	60,749	62,047	2609.9	30.969	34	0.617
		Strong	1716	60,731	61,880	2659.1	67.128	34	<0.001 ***
		Strict	1759	60,731	61,692	2745.8	38.508	43	0.666
	Age	Configural	1648	60,856	62,303	2483.4			
		Weak	1682	60,831	62,129	2526.2	29.803	34	0.674
		Strong	1716	60,818	61,967	2581.1	78.619	34	<0.001 ***
		Strict	1759	60,810	61,771	2659.7	36.836	43	0.735
28 items model	Gender	Configural	628	41,469	42,522	874.94			
		Weak	647	41,448	42,417	891.27	13.673	19	0.802
		Strong	666	41,436	42,322	917.71	31.072	19	0.040 *
		Strict	694	41,438	42,201	975.16	32.026	28	0.273
	Age	Configural	628	41,577	42,630	846.27			
		Weak	647	41,560	42,529	867.3	15.35	19	0.700
		Strong	666	41,546	42,432	890.91	27.702	19	0.089
		Strict	694	41,527	42,290	928.09	19.755	28	0.873

Table 9
Items in the video game dispositional flow scale.

Number	Second order factor	First order factor	Codes during development	Item description
				When playing video games,…
Item 1	Perceived fit of Goal-Feedback-Balance (PFGFB)	Clear goals (CG)	CG2NMP	…I know how to proceed during the gaming session.
Item 2			CG5P	…I clearly understand the goals.
Item 3			CG6M	…I know which operations to do in the game world.
Item 4		Unambiguous feed back (UF)	UF2	…I perceive immediate feedback from the game mechanics.
Item 5			UF3	…I receive immediate feedback on my gaming progress.
Item 6			UF5N	…I perceive immediate feedback on my actions in the game world.
Item 7		Challenge-skill balance (CSB)	CSB1MM	…I feel that my gaming skills are proportional to the in-game challenges.
Item 8			CSB2NP	…I feel that my gaming skills are at a similar level to the in-game challenges.
Item 9			CSB5NP	…I feel that my gaming skills are balanced with the in-game challenges.
Item 10			CSB7NP	…I feel that my gaming skills are up to the in-game challenges.
Item 11	Flow experience (FE)	Concentration (CON)	CON2	…I focus on the game.
Item 12			CON3	…I remain concentrated.
Item 13			CON4N	…I concentrate on the task at hand in the game world.
Item 14		Action-awareness merging (AAM)	AAM5N	…I am associated with the game world.
Item 15			AAM7	…I feel that I am the character in the game.
Item 16			AAM10NP	…I feel that I am part of the game world.
Item 17		Sense of control (SC)	SC3P	…I can perceive the natural control of the game.
Item 18			SC4	…I feel a sense of control in the game.
Item 19			SC5	…I fully control my operations in the game world.
Item 20		Loss of self-consciousness (LSS)	LSS2R	…I forget about things in the real world.
Item 21			LSS3RP	…I tune out everything else around me.
Item 22			LSS5R	…I forget about what is occurring in the real world.
Item 23		Transformation of time (TT)	TT4N	…I cannot perceive the flow of time.
Item 24			TT6P	…I lose my awareness of time.
Item 25			TT7M	…I forget about time.
Item 26		Autotelic experience (AE)	AE1P	…I enjoy each gaming session to the full.
Item 27			AE7M	…the gaming session makes me feel great.
Item 28			AE8	…I feel rewarded.

factors. This evidence demonstrates that the 28-item model has good discriminant validity.

After confirming the first-order factor structure, we proceeded to explore the hierarchical structure of the scale, because theoretically, the nine dimensions of flow do not exist separately. Therefore, we specified three models using different conceptualisations of flow experience, including the unidimensional model, the independent antecedent model, and the hierarchical antecedent model. We applied CFA to estimate the unidimensional model, as there was no path estimate according to the conceptualisation. Meanwhile, we used structural equation modelling (SEM) to estimate the independent antecedent model and the hierarchical antecedent model, as there are paths between the antecedents of flow and flow per se. The statistical significance of the path coefficients provides key information of nomological validity (Mackenzie et al., 2011). If these paths are significant, it means that other factors (in this case, the antecedents of flow) and related to the focal factor (in this case, the flow experience) as specified in the nomological network, which therefore enhances the confidence of the nomological validity (Mackenzie et al., 2011).

The estimated results of the unidimensional model are shown in Table 11 (See also Fig. 1 for the visualisation). The results show that all the factor loadings of the first-order factors are significant ($p < 0.001$). Moreover, all the loadings are greater than 0.5, except for LSS (0.367) and TT (0.291). The model fit indices (CFI = 0.954, TLI = 0.949, RNI = 0.954, SRMR = 0.086, RMSEA = 0.048) demonstrate that the CFA model is acceptable. The Akaike's information criterion (AIC) and Bayesian information criterion (BIC) are 41,759.168 and 42,044.205, respectively.

The estimated results of the independent antecedent model are shown in Table 11 (See also Fig. 2 for the visualisation). According to the results, all the factor loadings of the first-order factors are significant ($p < 0.001$). Besides, all the loadings are greater than 0.5, except for LSS (0.411) and TT (0.331). The path estimates show that all the coefficients are positive and significant: CG ($\beta = 0.300$, $p < 0.001$), UF ($\beta = 0.253$, $p < 0.001$), and CSB ($\beta = 0.376$, $p < 0.001$). The r-squared of flow experience is 0.553. The model fit indices (CFI = 0.956, TLI = 0.95, RNI = 0.956, SRMR = 0.083, RMSEA = 0.048) demonstrate that the SEM model is acceptable. The AIC and BIC are 41,746.903 and 42,045.096,

Table 10
Correlation matrix with AVE, composite reliability, and Cronbach's alpha.

	CG	UF	CSB	CON	AAM	SC	LSS	TT	AE	Composite reliability	Cronbach's alpha
CG	**0.65**	0.16	0.28	0.25	0.07	0.37	0	0	0.16	0.94	0.94
UF	0.4	**0.71**	0.16	0.16	0.05	0.2	0.05	0.02	0.13	0.88	0.88
CSB	0.53	0.41	**0.68**	0.19	0.09	0.38	0.03	0.03	0.19	0.94	0.94
CON	0.5	0.39	0.44	**0.6**	0.14	0.28	0.12	0.05	0.28	0.9	0.9
AAM	0.26	0.23	0.31	0.38	**0.58**	0.14	0.22	0.15	0.26	0.93	0.92
SC	0.61	0.45	0.62	0.53	0.38	**0.57**	0.03	0.01	0.26	0.84	0.84
LSS	0.05	0.23	0.16	0.35	0.47	0.19	**0.72**	0.36	0.06	0.95	0.95
TT	0	0.14	0.16	0.22	0.38	0.11	0.6	**0.67**	0.06	0.95	0.95
AE	0.4	0.36	0.43	0.53	0.51	0.51	0.24	0.25	**0.58**	0.92	0.92

Table 11
Summary of the results of CFA and SEM in advanced scale validation.

Model	Second order factor	First order factor	Factor loading estimates					Path estimates				
			All observations	Male group	Female group	Under 30 group	Over 30 group	All observations	Male group	Female group	Under 30 group	Over 30 group
Unidimensional model	Flow experience (FE)	Clear goals (CD)	0.663 ***	0.765 ***	0.569 ***	0.681 ***	0.655 ***	NA				
		Unambiguous feedback (UF)	0.555 ***	0.596 ***	0.534 ***	0.574 ***	0.542 ***					
		Challenge-skill balance (CSB)	0.690 ***	0.686 ***	0.670 ***	0.735 ***	0.641 ***					
		Concentration (CON)	0.707 ***	0.724 ***	0.658 ***	0.661 ***	0.747 ***					
		Action-awareness merging (AAM)	0.544 ***	0.374 ***	0.730 ***	0.461 ***	0.600 ***					
		Sense of control (SC)	0.790 ***	0.950 **	0.653 ***	0.846 ***	0.734 ***					
		Loss of self-consciousness (LSS)	0.367 ***	0.230 **	0.510 ***	0.318 ***	0.388 ***					
		Transformation of time (TT)	0.291 ***	0.233 **	0.395 ***	0.232 **	0.331 ***					
		Autotelic experience (AE)	0.686 ***	0.627 ***	0.755 ***	0.612 ***	0.734 ***					
Independent antecedents model	NA	Clear goals (CD)	NA					0.300 ***	0.431 ***	0.192 *	0.280 **	0.350 ***
		Unambiguous feedback (UF)						0.253 ***	0.252 ***	0.285 ***	0.228 **	0.274 ***
		Challenge-skill balance (CSB)						0.376 ***	0.318 ***	0.407 ***	0.437 ***	0.307 **
	Flow experience (FE)	Concentration (CON)	0.720 ***	0.735 ***	0.651 ***	0.675 ***	0.760 ***	NA				
		Action-awareness merging (AAM)	0.582 ***	0.390 ***	0.766 ***	0.494 ***	0.633 ***					
		Sense of control (SC)	0.763 ***	0.946 *	0.621 ***	0.835 ***	0.705 ***					
		Loss of self-consciousness (LSS)	0.411 ***	0.249 **	0.559 ***	0.355 ***	0.428 ***					
		Transformation of time (TT)	0.331 ***	0.249 **	0.441 ***	0.263 **	0.368 ***					
		Autotelic experience (AE)	0.711 ***	0.640 ***	0.757 ***	0.643 ***	0.744 ***					
	R squared							0.553	0.677	0.49	0.6	0.534
Hierarchical antecedent model	Perceived fit of Goal-Feedback-Balance (PFGFB)	Clear goals (CD)	0.702 ***	0.791 ***	0.633 ***	0.711 ***	0.700 ***	0.873 ***	0.942 **	0.830 ***	0.894 ***	0.873 ***
		Unambiguous feedback (UF)	0.576 ***	0.606 ***	0.559 ***	0.589 ***	0.565 ***					
		Challenge-skill balance (CSB)	0.736 ***	0.705 ***	0.752 ***	0.772 ***	0.691 ***					
	Flow experience (FE)	Concentration (CON)	0.721 ***	0.734 **	0.656 ***	0.674 ***	0.758 ***	NA				
		Action-awareness merging (AAM)	0.581 ***	0.390 **	0.763 ***	0.493 ***	0.633 ***					
		Sense of control (SC)	0.766 ***	0.948 •	0.628 ***	0.838 ***	0.710 ***					
		Loss of self-consciousness (LSS)	0.407 ***	0.246 *	0.550 ***	0.353 **	0.422 ***					
		Transformation of time (TT)	0.327 ***	0.247 *	0.432 ***	0.259 **	0.365 ***					
		Autotelic experience (AE)	0.711 ***	0.639 **	0.758 ***	0.641 ***	0.746 ***					
	R squared							0.763	0.887	0.688	0.799	0.762

respectively.

The estimated results of the hierarchical antecedent model are shown in Table 11 (See also Fig. 3 for the visualisation). The results demonstrate that all the factor loadings of the first-order factors are significant ($p < 0.001$). In addition, all the factor loadings of the first-order factors that form PFGFB are greater than 0.5. However, there are two factor loadings of the first-order factors that form flow experience are lower than 0.5, which are LSS (0.407) and TT (0.327). The path estimate shows that the coefficient between the PFGFB and flow experience is positive and significant ($\beta = 0.873$, $p < 0.001$). The r-squared of flow experience is 0.763. The model fit indices (CFI = 0.956, TLI = 0.951, RNI = 0.956, SRMR = 0.083, RMSEA = 0.047) demonstrate that the SEM model is acceptable. The AIC and BIC are 41,744.727 and 42,034.150, respectively.

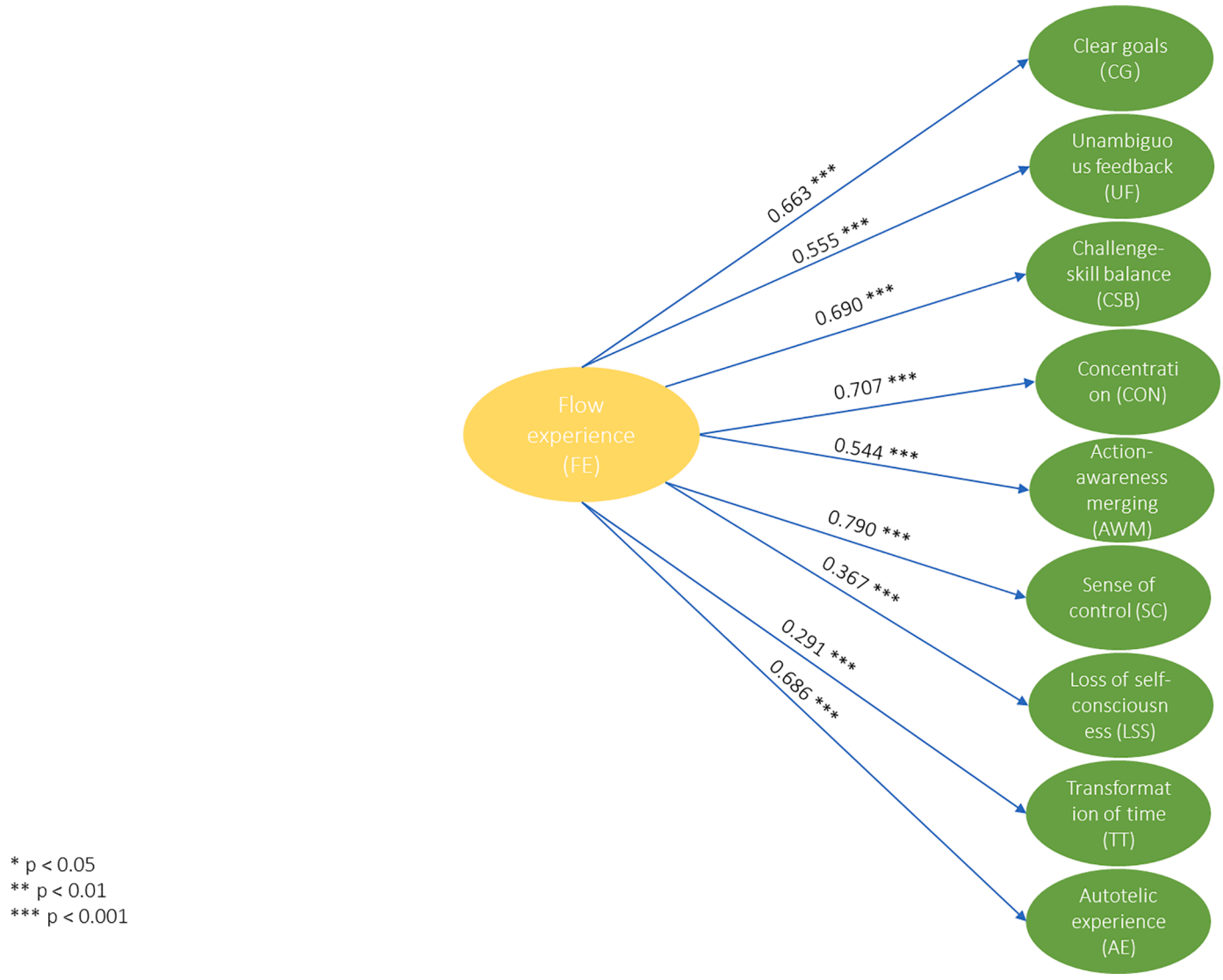

Fig. 1. Estimated results of the unidimensional model.

Finally, after confirming the measurement invariance and measurement structure, we conducted the subgroup analysis across the four groups: male group ($n = 296$), female group ($n = 297$), under 30 group ($n = 289$), over 30 group ($n = 304$). The main purpose of conducting subgroup analysis is to assess whether values of model parameters of substantive interest vary appreciably across different samples (Kline, 2015). We estimated the three mentioned models using observations from each of these groups. The results are shown in Table 11. According to the results, all the estimates of factor loadings are significant at a p-value of 0.05, except for the estimates between sense of control and flow experience in the hierarchical antecedent model in the male group, which is significant at a p-value of 0.1 (0.948, $p = 0.088$). Meanwhile, all the path estimates are significant across all the subgroups at a p-value of 0.05. Finally, all the model fit indices that we have mentioned in this section are summarised in Table 12.

9. Discussion

In this research, we conceptualised the flow experience in the video game context and developed a new scale named *Video Game Dispositional Flow Scale* (VGDFS) through five phases. VGDFS is the first scale to measure the psychometric properties of dispositional flow experience in the video game context, and its target population are adult players between 18 and 60. The birth of the VGDFS is a response to the conceptual flaw and mixing empirical findings in the video game flow literature. On the one hand, although the EGameFlow scale (Fu et al., 2009), the Game engagement questionnaire (Brockmyer et al., 2009), the User engagement scale (Wiebe et al., 2014), and the Consumer video engagement scale (Abbasi et al., 2017, 2019), were developed and verified in the video game context, the content domains overlapped, and the problem of construct proliferation was noted. On the other hand, while the DFS-2 (Jackson et al., 2011; Jackson and Eklund, 2002) seems suitable to assess the flow experience amongst adolescent players (Wang et al., 2009), the results failed to be replicated among adult players (Procci et al., 2012). We also responded to the initiative of Hays et al. (2018) to remove the copyright restrictions of self-report measures, which promotes the advancement of flow research in the video game context. In the following paragraphs, we introduce several results that are highlighted in this research.

First, we conceptualised nine flow dimensions in the video game context. Our conceptualisation of flow dimensions was based on the original flow theory (Csikszentmihalyi, 1975, 1990), the flow dimensions in the sports context (Jackson, 1996), and the qualitative data from the interviews. We conceptualised the flow dimensions at the beginning of the scale development, not only because this step clarifies the content domain (DeVellis, 2016; Netemeyer et al., 2003), but also

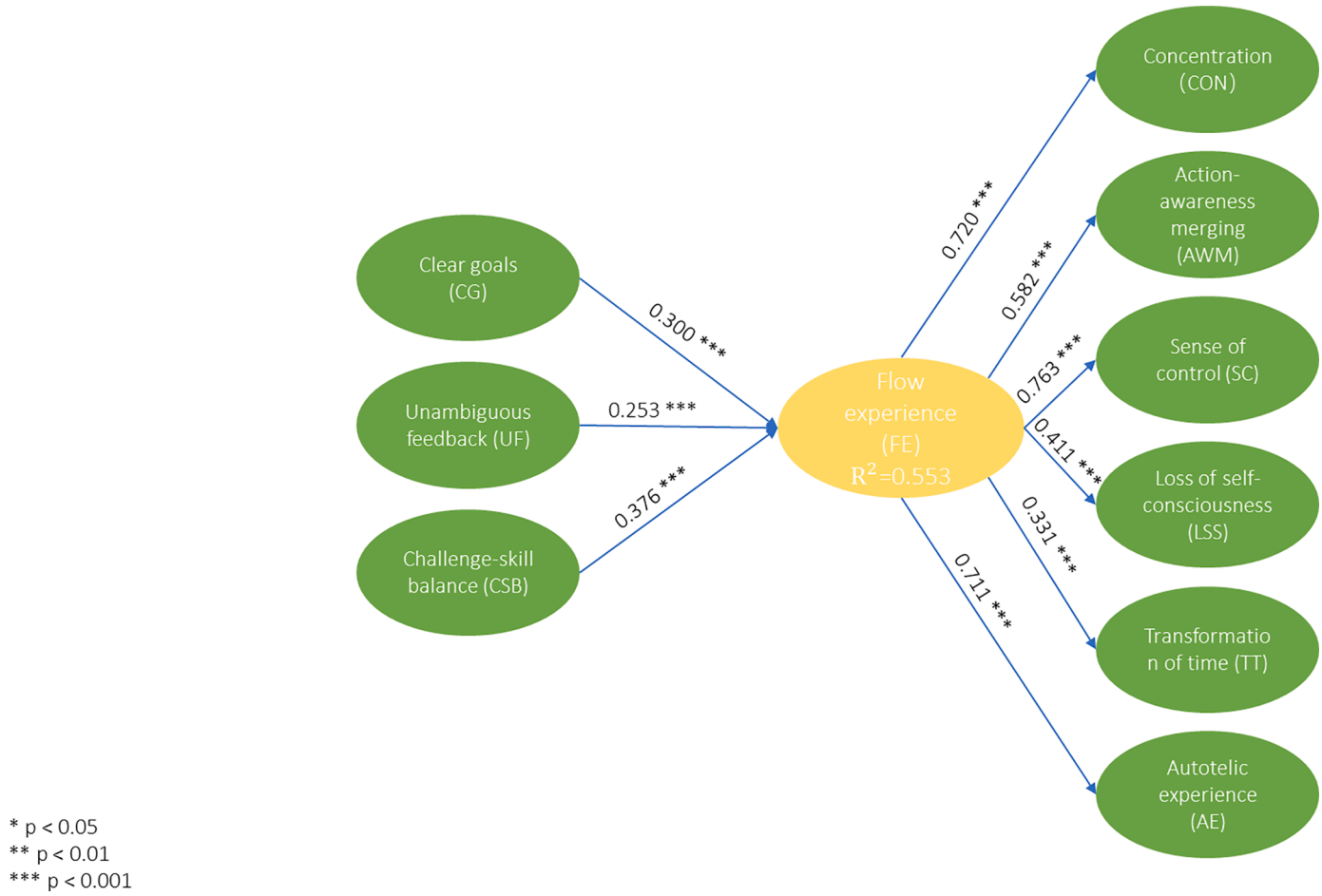

Fig. 2. Estimated results of the independent antecedent model.

because it is a response to the prevalent construct proliferation problem in the video game literature. The current literature on video games assimilates multiple terms that emulate flow experiences (Michailidis et al., 2018), such as immersion (Brown and Cairns, 2004; Ermi and Mäyrä, 2005; Jennett et al., 2008; Procci and Bowers, 2011) and engagement (Abbasi et al., 2017, 2019; Brockmyer et al., 2009; Wiebe et al., 2014). We recognise that the content domains of flow experience, immersion, and engagement have a certain degree of intersection. However, we also agree that any attempts to take some of the components of flow experience as the definitional aspect of flow will consequently disregard essential parts (Engeser and Schiepe-Tiska, 2012). Additionally, compared with the previous conceptualisation of flow experience in the video game context, the GameFlow (Sweetser and Wyeth, 2005), our conceptualisation of flow experience is closer to the original flow theory (Csikszentmihalyi, 1975, 1990). For instance, instead of dividing challenging and skill into two distinct dimensions, we consider that the balance of these two components forms a critical dimension to enter the flow experience. Moreover, we did not include social interaction into the content domain of flow experience, as the own researchers who conceptualised GameFlow (Sweetser and Wyeth, 2005, p. 10) stated that "*social interaction is not an element of flow, and often can even interrupt immersion in games*". Therefore, we consider that social interaction is more likely to be an extraneous factor to affect flow experience in the nomological network instead of being a component of flow per se. In conclusion, our conceptualisation of flow experience is highly consistent with the original flow experience (Csikszentmihalyi, 1975, 1990), which delineates the content domain of flow for future video game researchers to avoid the construct proliferation problem. However, we also encourage future researchers to provide more behavioural and neurophysiological evidence in experimental settings to refine the conceptualisation of flow experience in the video game context.

Second, we developed a 28-item dispositional flow sale, VGDFS, which is applicable in the video game context. Empirical results suggest that the VGDFS is a reliable and valid scale to measurement dispositional flow experience among Adult American video games players. Moreover, results also suggest that our scale has weak invariance across gender groups and strict invariance across age groups. The existence of measurement invariance enhances the generalisability of a scale (Netemeyer et al., 2003). However, we would still urge future researchers to conduct replication studies to verify the applicability of VGDFS in a more border population outside the United States, such as players from other English-speaking countries (e.g. Canada and the United Kingdom) and developing countries where English is one of the official languages (e.g. India and the Philippines).

Third, we assessed three operationalisations of flow experience, which are the unidimensional model, independent antecedent model, and hierarchical antecedent model. The AIC and BIC suggest that the hierarchical antecedent model performs slightly better than the other two models. Additionally, when specifying clear goals, unambiguous feedback, and challenge-skill balance are grouped into a second-order factor, they explain much more variance than when specified individually. Therefore, we recommend future researchers specify the flow experience using the hierarchical antecedent model, as it is better supported both theoretically (Keller and Landhäußer, 2012) and empirically. However, we also noted that the factor loadings of loss of self-consciousness and transformation of time are relatively low even in the hierarchical antecedent model. Considering the good performance

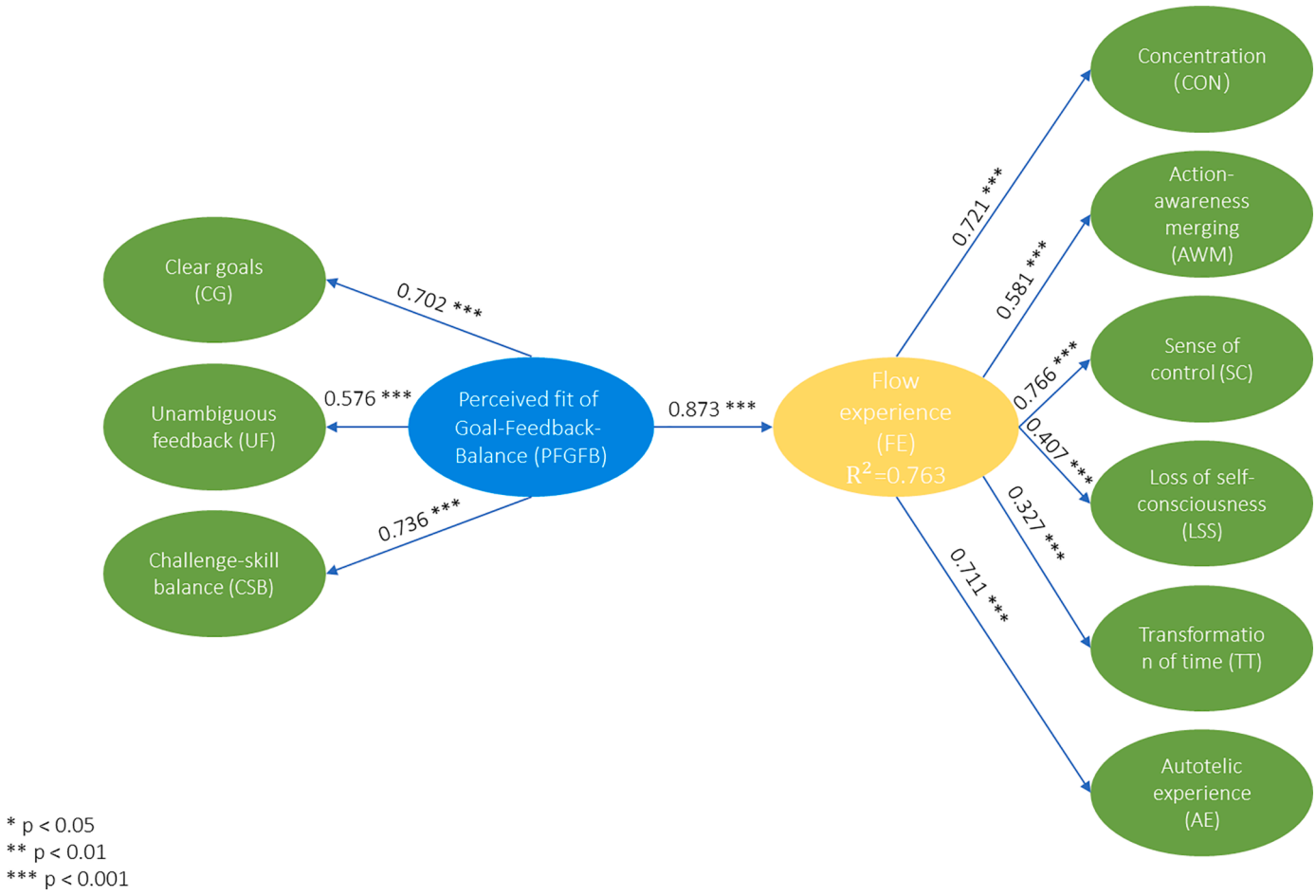

Fig. 3. Estimated results of the hierarchical antecedent model.

Table 12
Model fit index.

Model specification	Group	χ2	df	p value	CFI	TLI	RNI	SRMR	RMSEA
First-order model (62 items)	All observations (n = 593)	4693.595	1793	<0.001	0.902	0.897	0.902	0.055	0.052
First-order model (43 items)		1409.09	824	<0.001	0.969	0.966	0.969	0.037	0.035
First-order model (28 items)		438.475	314	<0.001	0.988	0.985	0.988	0.027	0.026
Unidimensional model (28 items)	All observations (n = 593)	811.026	341	<0.001	0.954	0.949	0.954	0.086	0.048
	Male group (n = 296)	682.996	341	<0.001	0.933	0.926	0.933	0.099	0.058
	Female group (n = 297)	590.562	341	<0.001	0.953	0.948	0.953	0.084	0.05
	Under 30 group (n = 289)	607.388	341	<0.001	0.946	0.94	0.946	0.088	0.052
	Over 30 group (n = 304)	640.849	341	<0.001	0.944	0.938	0.944	0.094	0.054
Independent antecedents model (28 items)	All observations (n = 593)	792.76	338	<0.001	0.956	0.95	0.956	0.083	0.048
	Male group (n = 296)	678.714	338	<0.001	0.933	0.925	0.933	0.097	0.058
	Female group (n = 297)	574.094	338	<0.001	0.955	0.95	0.955	0.081	0.048
	Under 30 group (n = 289)	600.089	338	<0.001	0.947	0.941	0.947	0.085	0.052
	Over 30 group (n = 304)	631.28	338	<0.001	0.945	0.939	0.945	0.092	0.053
Hierarchical antecedent model (28 items)	All observations (n = 593)	794.584	340	<0.001	0.956	0.951	0.956	0.083	0.047
	Male group (n = 296)	680.092	340	<0.001	0.933	0.926	0.933	0.097	0.058
	Female group (n = 297)	577.503	340	<0.001	0.955	0.95	0.955	0.082	0.048
	Under 30 group (n = 289)	600.73	340	<0.001	0.947	0.941	0.947	0.086	0.052
	Over 30 group (n = 304)	632.964	340	<0.001	0.945	0.939	0.945	0.092	0.053

of the first-order factors of the VGDFS, we speculate that there are other possible operationalisations of flow experience. For example, it is possible that loss of self-consciousness and transformation of time are actually the consequences of flow experience rather than the flow per se. Therefore, we encourage future researchers to explore the operationalisation of flow experience more deeply using both conceptual and experimental approaches.

10. Implications

This research has both theoretical and practical implications.

On the theoretical side, first, we first adapted the conceptualisation of the nine flow dimensions (Jackson, 1996) to the video game context. We then defined each dimension of the flow experience to delineate the content domain. Clearly defining the constructs, including dimensions and domains, is an essential step when developing scale (Churchill, 1979; Netemeyer et al., 2003). Our conceptualisation of the nine flow

dimensions guides future researchers to clarify the dimensions and domains according to the flow theory in the video game context, which helps to moderate the prevalent construct proliferation problem in the video game literature where dimensions of flow experience are used. Second, we empirically tested three operationalisations of flow experience. From both the theoretical and empirical sides, the hierarchical antecedent model is better supported. We, therefore, recommend future researchers operationalise the flow experience using the hierarchical antecedent model and explore its theoretical generalisability in other contexts.

On the practical side, the VGDFS is the first scale that faithfully conceptualises the dimensions of the original flow theory (Csikszentmihalyi, 1975, 1990) in the video game context. The appearance of the VGDFS makes up for the deficiency of the application of DFS-2 (Jackson et al., 2011; Jackson and Eklund, 2002) among adult players in the video game context (Procci et al., 2012). Therefore, practitioners in the video game industry, such as game developers and project managers, are encouraged to use the VGDFS to measure video game players' dispositional flow experience. For instance, video game developers could use the VGDFS to measure players' dispositional flow during the alpha and beta tests in the pre-launching period, and evaluate its correlates with other essential factors, such as the intention to play the game, attitude toward playing the game, satisfaction, loyalty, and purchase intention. The results of the mentioned psychological correlates will give insights regarding the game balance to the video game development process, which improves players' gaming experience. Moreover, in many cases, researchers not only incorporate the flow experience as a whole in their empirical models (e.g. Animesh et al., 2017) but also include exclusively certain dimensions of flow (e.g. Patanasiri and Krairit, 2019). Therefore, the VGDFS is expected not only to be used as a whole to measure the flow experience but also can be disassembled and used separately to measure the dimensional facets of flow.

Finally, unlike copyrighted dispositional flow scales, such as DFS-2 (Jackson et al., 2011; Jackson and Eklund, 2002), S DFS (Jackson et al., 2011, 2008; Martin and Jackson, 2008), and C DFS (Jackson et al., 2011, 2008; Martin and Jackson, 2008), we responded the initiative of Hays et al. (2018) to remove the financial obstructs in using psychometric measures. We believe an open assess dispositional flow scale helps to build a more equitable, accessible, and innovative world for both academic researchers and industrial practitioners.

11. Limitations

Despite the implications that our research has, several limitations are noted.

First, we used Prolific, a non-probability-based panel, to recruit the participants. Non-probability-based panels, or volunteer opt-in panels, involve a self-selection process by the people who want to join the panel (Callegaro and Disogra, 2008; Callegaro et al., 2015). Non-probability-based panels do not include the non-internet population (Callegaro et al., 2015). Thus, although Prolific has several advantages (Palan and Schitter, 2018) that we have introduced and nowadays there are fewer video game players in developed countries lack Internet access, we strongly recommend future researchers to use probability-based panels to recruit their participants if they intend to conduct a replication study in developing countries with limited internet access, which serves to reduce the coverage error.

Second, in this research, we tested the measurement invariance of the VGDFS across gender and age groups, which are two key demographic profiles among video game players (ESA, 2019; Newzoo, 2019b). However, there are more variables that can be tested, such as the measurement invariance across nations (Steenkamp and Baumgartner, 1998) and over time (Kline, 2015, p. 396). Therefore, we encourage future researchers to verify the measurement invariance of VGDFS across different countries and at different time points, which are important for the future cross-cultural and longitudinal studies of video game flow experience.

Third, the VGDFS was developed in the general video game context. However, there exist different video games according to different classification methods, such as action/strategy games, online/offline games, console/portable games, paid/freemium games, etc. Therefore, future researchers are encouraged to conduct replication studies to test the applicability in the mentioned sub-contexts of video games. Replication studies are likely to generate new insights (Evanschitzky and Scott Armstrong, 2013) and they are critical to improve the external validity (Easley et al., 2000).

Forth, the VGDFS is a composite scale with 28 items. Like other composite scales, VGDFS also suffers from the length problem. Lengthy scale increases not only the nonresponse rate (Vicente and Reis, 2010) but also the common method bias (MacKenzie and Podsakoff, 2012). Therefore, we encourage future researchers to conduct scale shortening studies (Coste et al., 1997) to control the number of items in the VGDFS.

Fifth, in this research, we assessed the nomological validity of the VGDFS by estimating the path between the antecedents of flow and flow experience per se. However, researchers should note that the results were derived from the correlational study. To further confirm the causal relationship between antecedents of flow and flow experience, researchers should employ experimental designs. Moreover, to further verify the nomological validity, it is important to explore the nature of lawful relationships between the focal construct and other constructs, apart from testing whether the indicators of the focal construct relate to measures of other constructs in the manner expected (Mackenzie et al., 2011). Therefore, we encourage future researchers to conduct factor analytic studies, in which measures of other constructs are involved, such as intention to play video games, attitude towards playing video games, satisfaction, loyalty, and purchase intention of in-game goods. This approach helps to further explore the measurement structure as well as the nomological validity of the VGDFS.

12. Conclusions

In this research, we conceptualised flow experience and developed a dispositional flow scale in the video game context. We named our 28-item scale *Video Game Dispositional Flow Scale* (VGDFS). We found that the VGDFS fitted well in the commonly operationalised structure, including unidimensional model, independent antecedent model, and hierarchical antecedent model, although the last of these gives the best degree of model fit. The VGDFS empowers both the academic and industrial research of dispositional flow experience in the video game context. video game researchers and practitioners are therefore encouraged to use the VGDFS to explore the correlates between flow experience and other variables. We also mentioned the limitations of this research and provided the directions for future researchers.

CRediT authorship contribution statement

Xiaowei Cai: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Javier Cebollada:** Conceptualization, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Mónica Cortiñas:** Conceptualization, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijhcs.2021.102746.

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