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博士論文

Smart Service User Behaviour: Theoretical Integrations, Extensions and Empirical Insights

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Abstract

The goal of this dissertation is to investigate the user's smart service system pre-acceptance, acceptance and post-acceptance behaviour. It thus develops, analyses and tests the smart service user's three-stage behavioural framework of pre-acceptance, acceptance and post-acceptance behaviour, these three stages are redefined as "perception - decision - gratification" in this dissertation. It reflects the user's internal psychological process in the market development process of smart service consumption.

Technology diffusion theory, and uses & gratifications (U&G) theory are considered as user decision-making process models and are integrated to explain the three-stage behavioural framework theoretically. This dissertation takes smart media and smart education as representative research objects to collect empirical evidence and conducts three sub-studies, each focusing on one stage of the three-stage behavioural framework.

As a result, to understand the perception stage, the first sub-study studies smart service belief factors based on the integration with technology acceptance model (TAM). To understand the decision stage, the second sub-study considered more factors by integrating stimuli, unified theory of acceptance and use of technology (UTAUT) and flow theory. To explain the gratification stage, the third sub-study identifies five types of gratifications and investigates their effects on post-acceptance usage.

Consequently, the first sub-study identifies and studies smart service belief factors, thus facilitates a better understanding of user's perception stage in smart service, expands the overall theoretical network related to technology use. The second sub-study incorporates stimuli constructs as antecedents to the extended UTAUT, takes the extended UTAUT as primary information processing and flow as secondary information processing by combining the knowledge from neuroscience, and thus enables to better understand user's decision stage. The third sub-study derives and studies five types of user gratification concerning smart service usage based on five social science theories. It firstly employs an intelligence construct to explore user's technology gratification towards smart service, and thus enables to better understand user's gratification stage.

Significant contributions are generated. This dissertation contributes to information technology service acceptance and post-acceptance literature by systematically and holistically developing and analysing a smart service user's behavioural framework of "perception - decision - gratification". This three-stage behavioural framework can also provide theoretical reference for other service systems. It thus offers new theoretical insights for practitioners to design and implement smart service systems successfully, and for users to improve their own behaviour. Besides, this dissertation enhances our theoretical understanding by identifying and proving the new smart dimensions of smart service perceived by users across the three internal psychological stages. In addition, this three-stage behavioural framework suggests that, with the deepening of users' involvement in information technology services, the factors considered by users will change. Specifically, the user first makes a rational judgment by considering the essential and functional factors in the perception stage. In the decision stage, the user starts to consider some emotional factors. In the gratification stage, the user tends to consider more differentiated emotional factors.

Keywords: Smart service system, Technology diffusion theory, Uses and gratifications theory, The three-stage behavioural framework

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List of abbreviations

AI	Artificial intelligence
AI TV	AI-powered smart TV
ATB	Attitude toward behaviour
B2C	Business-to-consumer
CB-SEM	Covariance-based structural equation modelling
CEM	Customer experience management
CFI	Comparative fit index
CI	Continuance intention
CMC	Computer-mediated communication
ECT	Expectation confirmation theory
EEX	Effort expectancy
FC	Facilitating conditions
GFI	Goodness of fit index
GoF	Goodness of fit
IDT	Innovation diffusion theory
IP	Intention to purchase
IS	Information system
IoT	Internet of things
MBSES	Mobile-based smart education service
MPCU	Model of PC utilisation
MM	Motivational model
NFI	Normed fit index
PCC	Perceived co-creation
PLS-SEM	Partial least squares structural equation modelling
PEX	Performance expectancy
PEN	Perceived enjoyment
PEU	Perceived ease of use
PU	Perceived usefulness
PP	Perceived personalisation
PTC	Perceived two-way communication
RMSEA	Root mean square error of approximation

SCT	Social cognitive theory
SEM	Structural equation modelling
SES	Smart education service
SI	Social interaction
SINF	Social influence
SOR	Stimulus-organism-response
TAM	Technology acceptance model
TLI	Tucker-Lewis index
TPB	Theory of planned behaviour
TRA	Theory of reasoned action
U&G	Uses and gratifications
UTAUT	Unified theory of acceptance and use of technology

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"There are many marketing problems that can be handled more effectively by AI." *Philip Kotler, 2018.*

"Smart, connected products will help make people, materials, energy, and plant and equipment far more productive, and the repercussions for business processes will be felt throughout the economy." *Michael E. Porter and James E. Heppelmann, 2015.*

Chapter 1

Introduction

1.1 Research purpose and research questions:

The research purpose of this dissertation is to holistically and systematically study user's smart service system pre-acceptance, acceptance and post-acceptance behaviour, which reflects the three service consumption stages of pre-purchase, purchase and post-purchase in the classical consumer behaviour literature[1]. This dissertation thus develops, analyses and empirically tests a new theoretical framework, namely the three-stage behavioural framework, which should reflect the user's internal psychological process in the market development process of smart service consumption. This three-stage behavioural framework is formed with two main objectives.

First, it should enhance our understanding of smart service user's holistic and systematic mechanism of the internal psychological process across the smart service system pre-acceptance, acceptance and post-acceptance. It thus can offer new theoretical insights for practitioners to design and implement smart service systems successfully, and for users to improve their own behaviour.

Second, it should reflect the dynamic changes of the user's considering factors in each stage, in terms of smart service system pre-acceptance, acceptance and post-acceptance. It thus enables practitioners to evaluate better the user's usage of a smart service system.

Based on the objectives discussed above, the research questions guiding the dissertation is as follows:

Q1: How to define the user's internal psychological decision-making process across the pre-acceptance, acceptance and post-acceptance stages of the smart service system?

1 The user's three smart service consumption stage of pre-acceptance, acceptance and post-acceptance, which reflects pre-purchase, purchase and post-purchase in the classical consumer behaviour literature, are discussed in detail in section 2.3.

Q2: In the user's internal psychological process, what factors of a smart service system are different from other non-smart information technology service system that affect the user's pre-acceptance, acceptance and post-acceptance?

Q3: What are the different factors considered by users regarding the pre-acceptance, acceptance and post-acceptance, and how are the factors change dynamically in these three consumption stages?

Technology diffusion theory, and uses & gratifications (U&G) theory are considered as user decision-making process models; they are integrated, so as to explain the three-stage behavioural framework theoretically. The three-stage behavioural framework should reflect the user's internal psychological process of different service consumption stages in classical consumer behaviour literature.

This dissertation belongs to a smart service system acceptance and post-acceptance research; it reflects the user's internal psychological mechanism of information technology service consumption. It takes the smart media and smart education, which have been well commercialised, as two typical research object to collect empirical evidence.

1.2 Research background

1.2.1 Smart service

The world is becoming increasingly smarter. In the immediate future, smart services will be everywhere; particularly in many products. The improvement of the hardware such as sensors, microchips promotes not only the advancements in big data, cloud computing, AI and more broadly, computer-mediated communication technologies and the Internet of things(IoT), but also the improvement of connectivity of smart products; smart service thus emerges and develops (e.g., (Wünderlich et al., 2013)). It is estimated that 80 billion smart products will be connected to the Internet by 2025 (Kanellos, 2016), which will generate a large-scale smart service market. The novel coronavirus epidemic in 2020 will promote the penetration of AI into the various service sector and thus accelerate the development of smart service in the long run.

Smart services incorporate AI and services (Perera et al., 2014). Carstena et

al. (2018) proposed that smart service depends on the network and smart technology system. Since smart service is a data-based service, data exchange capability with systems in the environment is essential (Rabe et al., 2018). Smart service can learn, adapt, and make decisions independently on the basis of interaction data through a self-controlled smart service system (Fischer et al., 2020). Smart product is connected with embedded smart service system, which is capable of data collection and communication (e.g., (Porter and Heppelmann, 2015)).

Smart service can be regarded as the latest development of information technology service (e.g., (Beverungen et al., 2017)), so it has the inherent characteristics of information technology service, such as connectivity, ability to provide information, and networking with other resources.

However, equipped with latest AI technology, substantial innovation makes the smart service system smarter, more complex, more refined, more in line with human needs, and can enhance human capabilities through supporting technologies (Larson, 2016). As a result, it has dimensions that are very different from non-smart information technology services.

In summary, from the user's perspective, smart services have some commonalities with non-smart information technology services, but there are also crucial differences between them. These smart dimensions are discussed in detail in section 2.1.5.

In terms of the dimensions perceived by users, this dissertation suggests that the following dimensions are the biggest difference between smart services and non-smart information technology services. They are: (1) Smart service is personalised in nature; (2) Smart service can achieve flexible co-creation with smooth service experience; (3) Smart service is highly interactive, it enables natural two-way communication; (4) Smart service is characterised by intelligence; (5) Smart service is characterised by high service convenience.

1.2.2 Smart service sectors

Academics and practitioners agree that technology has been a major driving force behind the progress of today's service world (Meuter et al., 2005; Rust and Huang, 2014)., the application of AI-led to an increase of smart services in various service sectors (Larivière et al., 2017), including smart education, smart media,

smart healthcare, smart transportation, etc. (Atzori et al., 2010). As Porter and Heppelmann (2015) suggested, the types of smart services that can be realised through smart service systems are limited only by human imagination.

Some smart service sectors, such as smart media and smart education, have been well commercialised. For example, It is predicted that the end consumption market of smart education will reach roughly US $13.6 billion in 2020 and approximately US $327.3 billion in 2023 (Smart Learning Institute of Beijing Normal University, 2019).

1.3 Research gaps

Despite the accelerating development of smart service practice, the theoretical understanding concerning smart service system is still in its fancy and is not as much as our practical understanding (Beverungen et al., 2019; Fischer et al., 2020; Lim and Maglio, 2018; Wünderlich et al., 2015). Besides, much of the emerging smart service system literature focuses on the function, definition, impact, challenge, and the relationship between smart product and smart service (Grubic, 2014; Ostrom et al., 2015; Wünderlich et al., 2015).

As a result, further exploration about the effect of smart service system on user behaviour is required (e.g., (Beverungen et al. 2017; Püschel et al., 2016)). Studying the impact of smart service system on user behaviour is of great theoretical and practical significance (e.g., (Roy et al., 2017; Wuenderlich et al., 2015)).

There is a massive gap in understanding user's psychological and behavioural modes concerning smart service system. Notably, existing research lacks a systematic, holistic understanding of smart service user's mechanism of the internal psychological process across the smart service system pre-acceptance, acceptance and post-acceptance. Besides, previous studies did not consider what factors of a smart service system are different from other information technology service system that affect the user's three service consumption stage. Furthermore, another limitation associated with the prior literature is the dynamic changes of factors considered by users across the smart service system acceptance and post-acceptance stages.

1.4 Research innovations

The consumer's three-stage of service consumption in the classical consumer behaviour literature is "pre-purchase, purchase and post-purchase" (e.g., (Crane and Clarke, 1994; Frambach et al., 2007; Martinez, 2011; Mowen, 1987; Peter and Olson, 2009; Schiffman and Kanuk, 1997; Solomon et al., 2006; Solomon, 2013); it is reflected in the service marketer's market development process as "pre-service, service, and post-service" (e.g., (Rosenbaum et al., 2016)); it is reflected in the information technology service consumption as "pre-acceptance, acceptance and post-acceptance" (e.g., (Fichman, 2001; Hameed et al., 2012)). This dissertation redefines the user's relevant internal psychological process for the information technology service consumption as "perception - decision - gratification"[2].

In the three-stage behavioural framework, perception refers to pre-acceptance perception; decision refers to the decision of acceptance; gratification refers to the user's post-acceptance gratification. It should be noted that the perception stage in the three-stage behavioural framework is more generalised than that in the traditional consumer decision-making model. It includes the user's psychological process before acceptance. This issue will be discussed in detail in section 2.3.

As a theory regarding consumer decision-making, technology diffusion theory studies the user's acceptance of information systems. In fact, it considers both the pre-acceptance and the psychological process of acceptance (e.g., (Sorgenfrei et al., 2014)). As a result, in order to better reflect user's dynamic psychological process towards smart service system acceptance, the acceptance of the technology diffusion theory is divided into two psychological stages: perception and decision of acceptance.

Because U&G theory provides a cutting edge approach to segment user's satisfaction on post-acceptance usage, this dissertation applied U&G theory which was primarily involved in computer-mediated communication research, to study the effect of different types of gratifications. Besides, an information system is a medium in a broader sense (e.g., (Senadheera et al., 2017; Tayebi et al., 2019)). Using the U&G theory originally from computer-mediated communication to study

[2] The theoretical basis of the three-stage behavioural framework of “perception-decision-gratification” are discussed in detail in section 2.3.

smart service systems, can broaden the horizons of researchers who usually use information system perspective to analyse smart service systems. This dissertation also clearly relates the U&G theory to the post-acceptance of the information technology service.

The integration of technology diffusion theory and U&G theory are considered as framework concerning the consumer decision-making process. As a whole, it should theoretically cover and explain the user's internal psychological process of "perception - decision - gratification" in the smart service consumption.

Besides, based on those two theories, this dissertation combines the advantages of the management information system field and the communication field, thus providing an interdisciplinary perspective for academics and practitioners to study user's acceptance and post-acceptance behaviour as a whole.

By providing the three-stage behavioural framework, this dissertation suggests that: with the deepening of users' involvement in information technology services, the factors considered by users will change, from considering rational factors to considering both rational factors and emotional factors. The user first makes a rational judgment by considering the homogeneous, basic and functional factors in the perception stage. In the decision stage, the user begins to add some emotional considerations based on rational factors. In the gratification stage, after the usage of the smart service system, the user tends to think beyond the basic functionality by considering more differentiated emotional factors.

Therefore, the three-stage behavioural framework allows us to have a holistic and systematic understanding of the user experience across smart service system pre-acceptance, acceptance and post-acceptance. As a result, this dissertation offers new paths, new variables, creates integrations, extensions of the theories and furthers the generalizability of the theories.

1.5 Research content

This dissertation conducts three sub-studies, each focusing on one stage of the "perception - decision - gratification" behavioural framework, to examine what factors users consider in the three consumption stages of smart service, and how these factors change dynamically. As a result, to understand the perception stage, the first sub-study identifies and studies smart service belief factors based on the

integration with the technology acceptance model (TAM). To understand the decision stage, the second sub-study considered more factors by integrating stimuli, unified theory of acceptance and use of technology (UTAUT) and flow theory. To explain the gratification stage, the third sub-study identifies five types of gratifications from a U&G perspective and investigates their effects on post-acceptance usage. The three sub-studies are detailed below:

Research content 1: The first sub-study investigates user's perception stage by identifying and studying smart service belief factors based on the integration with TAM in a smart media service context. Smart media combines media and artificial intelligence (AI). This sub-study provides an original concept: smart media audience-type user. Considering that smart media can be a user-centred content service market, it is essential to understand the user's belief factors. Additionally, investigating the perceptions generated by different user experience types from a customer experience management (CEM) perspective can facilitate a better understanding. Taking AI-enabled smart TV (AI TV) as a typical research object, this sub-study (1) develops a theoretical model by integrating the technology acceptance model (TAM) with user's smart service belief factors and (2) empirically validates the model. Using data from 585 AI TV users, the covariance-based structural equation modelling (CB-SEM) analysis suggests that belief factors, including the two-way communication, personalisation, and co-creation, are valid antecedents in the extended TAM. The sub-study also indicates that the user experience type can exert positive moderating effects on two-way communication and personalisation to behavioural attitude and purchase intention.

Research content 2: This sub-study investigates the user's decision stage by integrating stimuli, UTAUT and flow, in a mobile-based smart education service (MBSES) context. In this sub-study, sensory stimuli are composed of MBSES interactivity, MBSES intelligence, MBSES convenience, and MBSES personalisation; Extended UTAUT is comprised of performance expectancy, effort expectancy, social influence, facilitating conditions, social interaction and habit. Flow is composed of perceived enjoyment and concentration. The decision in this sub-study refers to the user's intention to continue using MBSES. Based on empirical evidence collected from 494 Liulishuo users, the partial least squares structural equation modelling (PLS-SEM) analysis suggests the model is largely supported.

Research content 3: This sub-study investigates the gratification stage by explaining the effect of user's gratifications on their smart service system post-acceptance behaviour, in an MBSES context. Taking Liulishuo as a typical research object, this sub-study develops a theoretical model by incorporating five types of gratifications: technology gratification, hedonic gratification, social gratification, utilitarian gratification, and content gratification. Using data of 495 users collected by the Baidu sample service, the PLS-SEM analysis suggests the order of importance of different gratifications affecting on continuance intention towards MBSES.

1.6 Research methods

In this dissertation, literature analysis, questionnaire survey, and structural equation modelling (CB-SEM and PLS-SEM) are applied.

First, literature analysis:

After the review of the existing relevant literature, we summarised the existing relevant research results and identified the shortcomings of the prior research. Through literature analysis, this dissertation clarified the research topic and laid a solid foundation for model construction.

Second, the questionnaire survey:

The questionnaire survey is an important research method applied in the field of behavioural science and one of the main ways to obtain research data. Through questionnaire design, questionnaire distribution, and questionnaire collection, this dissertation collected empirical evidence.

Third, structural equation modelling (SEM):

Structural equation modelling (SEM) is a statistical data analysis method formed by the comprehensive application of multiple regression analysis, path analysis, and confirmatory factor analysis. Combined with the specific needs of data analysis in each sub-study, this dissertation uses the covariance-based structural equation modelling (CB-SEM) in the third chapter and the partial least squares structural equation modelling (PLS-SEM) in the fourth and fifth chapter.

1.7 Arrangement of dissertation structure

Chapter 1 – Introduction

Chapter 1 discusses the research purpose and research questions of this dissertation, and it also comprises the research gap, research background, research innovations, research content, and research methods. It closes by proposing the arrangement of dissertation structure.

Chapter 2 – Literature review and theoretical framework

Chapter 2 reviews the relevant literature and introduces the theoretical framework of the dissertation. This chapter begins with a review of existing related research. After that, the theories are discussed. It closes by providing the three-stage behavioural framework of this dissertation.

Chapter 3 – Understanding user's smart service belief factors based on the integration with TAM

Chapter 3 is a sub-study for understanding user's perception stage by identifying and studying smart service belief factors based on the integration with TAM in a smart media content service context.

Chapter 4 – Understanding smart service user's decision based on the integration with stimuli, UTAUT and flow

Chapter 4 is a sub-study of the user's decision stage based on the integration with stimuli, UTAUT and flow in an MBSES context.

Chapter 5 – Understanding smart service user's gratifications from a U&G perspective

Chapter 5 is a sub-study for understanding user's gratification stage by investigating the effects of user's gratifications on their continuance intention in an MBSES context.

Chapter 6 – Research conclusions and insights

The final chapter concludes the dissertation by summarising the findings and offer the implications to both theory and practice. Besides, limitations and recommendations for future research are also provided.

The following figure 1 illustrates the schematic flow chart of this dissertation:

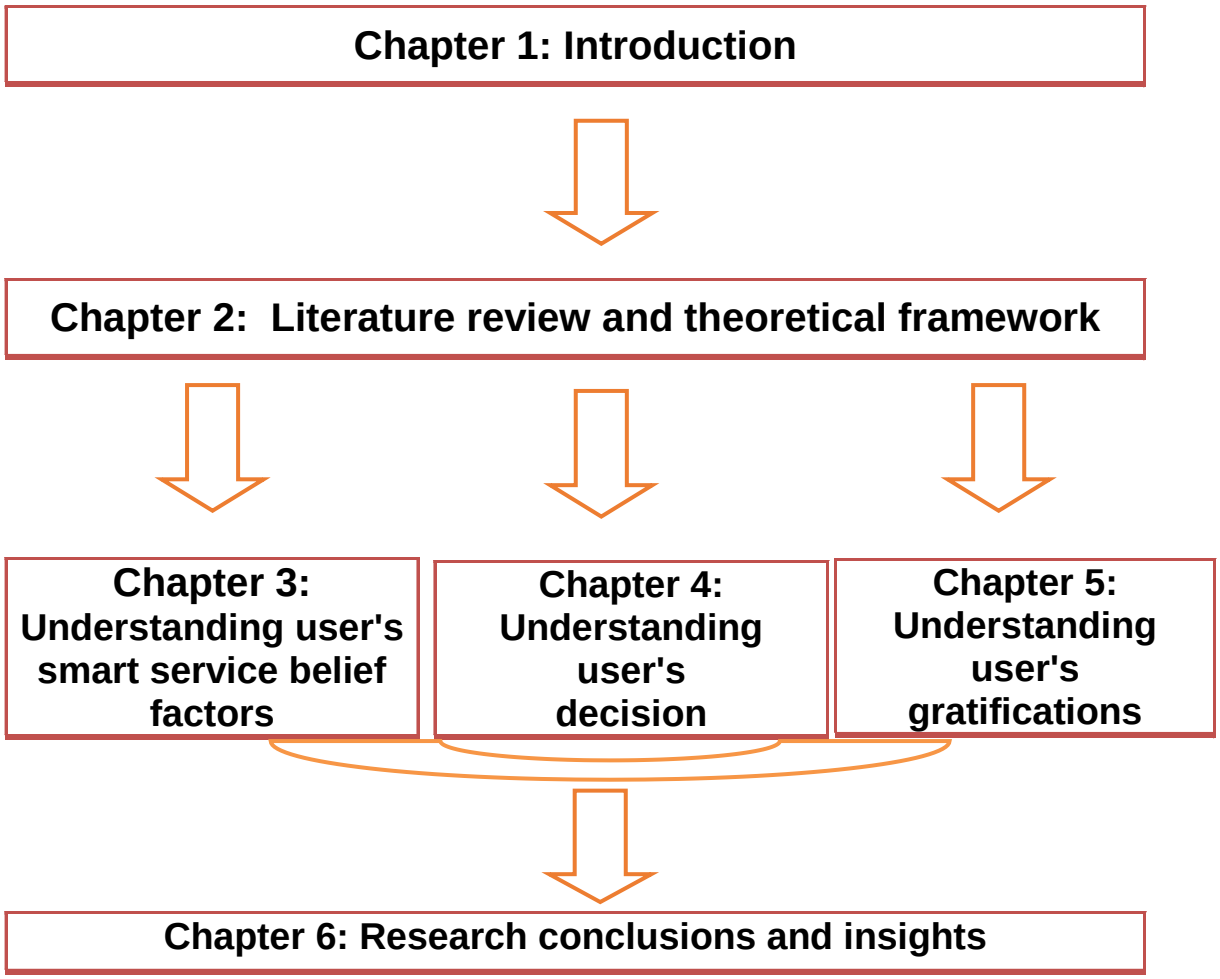


Figure 1. Schematic flow chart of the research

Chapter 2

Literature review and theoretical framework

Chapter 2 starts with an in-depth literature review concerning smart service; on this basis, it provides an in-depth discussion of the different dimensions between smart services and non-smart information services. After that, this chapter explores two theories: technology diffusion theory and U&G theory. Finally, a smart service user's three-stage behavioural framework of "perception - decision - gratification", was developed and discussed, based on the consumer decision-making framework in the classical consumer behaviour literature. The integration of technology diffusion theory and U&G theory as consumption decision-making process model can explain the three-stage behavioural framework theoretically.

2.1 Literature review concerning smart service

The relationship among smart service, smart service system and smart product is as follows: Smart service refers to the process of applying specialised competencies through the behaviour, process and performance (Beverungen et al., 2017), carried out through smart service systems (e.g., (Fischer et al., 2020)). Smart service is powered by smart products (Beverungen et al., 2017; Lim and Maglio, 2018). Smart product works as a boundary object in smart service systems (Beverungen et al., 2017), between service providers and service users (e.g., (Fischer et al., 2020). This section subsequently reviews smart product, smart service system, smart service, as well as smart service and its user. Based on the comprehensive literature review, the commonalities and differences perceived by users are summarised, and different dimensions between smart services and non-smart information technology services perceived by users will be further discussed.

2.1.1 Smart product

Smart products can be products or platforms (Yoo et al., 2010). All smart products have three core components, including physical components (e.g., mechanical and electronic components); smart components (e.g., sensors, microprocessors); and connected components (e.g., port, protocol and network)

(Porter and Heppelmann, 2015). Through the processing of smart components, the results are fed back to the physical components through connected components (e.g., (Porter and Heppelmann, 2015)).

Beverungen et al. (2017) suggested that most smart products include unique identifiers, positioning devices, sensors, own processors or embedded computers, actuators, data storage, multi-mode interfaces, and connectivity. Smart products have a multi-mode, dedicated, smart human-machine interfaces (Beverungen et al., 2019) that can work in smart spaces with identities and virtual characters to connect and communicate in environmental, social and user contexts (EPoSS, 2008). Püschel et al. (2016) summarised smart product capabilities by distinguishing features including the offline functionality and significant purpose, divided into four dimensions including (1) data sources and data usage; (2) interactive compatibility; (3) acting and sensing; (4) partner, direction and multiplicity.

Smart products know the environment, including users and other smart products, because they directly acquire data with the sensor; they can store data in their repositories, including usage data, status data, and contextual data (Beverungen et al., 2019). Smart products use sensors to acquire contextual data, store and process data by themselves, exchange data with other participants, make self-governing decisions, and use actuators for physical actions (Acatech, 2011). Actuators enable smart products to interact closely with physical reality, thereby making them active rather than passive (Beverungen et al., 2019).

Smart products need a new technology-based infrastructure, which offers a gateway for data exchange between users and products (Porter and Heppelmann, 2015). They are part of the Internet of things (IoT) as an environment (Papert and Pflaum, 2017). Smart products maybe like an invisible computer under normal circumstances, naturally integrates into the user's operating environment (Satyanarayanan, 2001; Beverungen et al., 2019).

There are three ways to connect smart products, including "one to one", "one to many" and "many to many". "One to one" means that a single product is connected to a user, manufacturer or another product through an interface. "one to many" refers to the central system is connected to many products at the same time. "Many to many" means various products are connected to many other kinds of products (Porter and Heppelmann, 2014).

The IoT supports the interaction of these smart products (Ashton, 2011; Atzori et al., 2010; Serpanos and Wolf, 2018; Weiser, 1999). IoT can be used as a benchmark that supports smart services (Wortmann and Flüchter, 2015).

Since smart service relies on smart products, the properties of smart products have various theoretical implications in terms of the conceptualisation of smart service. Smart product's two essential features, which are connectivity and awareness, make smart services possible. Based on connectivity and awareness, smart products can deliver the user's behavioural data to the service provider (Allmendinger and Lombreglia, 2005).

Smart products can enable smart services in two aspects. On the one hand, smart products distribute service because they embody the skills and knowledge of service providers. On the other hand, since all participants are resource integrators in the service system, smart products should be networked with other resources owned by participants (Vargo and Lusch, 2008, 2016; Vargo, Lusch and Archpru, 2010).

2.1.2 Smart service system

The delivery of smart services is carried out through smart service systems (e.g., (Beverungen et al., 2017)). This dissertation considers smart service system as service system equipped with AI technology. Medina-Borja (2015) suggested that the smart service system learns based on the data processed, and dynamically adjusts and makes decisions to improve its response. Spohrer and Demirkan (2015) suggested that the smart service system is always co-evolve with all service sectors.

Boukhris and Fritzsche (2019) described the scope of smartness using dimensions such as decision support engine, data richness, results delivered to service users, stakeholder architecture and service process automation. Lim and Maglio (2018) summarised the multi-dimensional attributes of smartness, namely connection, calculation, collection, communication and co-creation. They work together to meet the user's needs based on the smart service system.

With the advancement of technology, more and more technologies with AI are used in service systems. As a result, the service system itself has become smarter and smarter. (Larson, 2016, Watanabe and Mochimaru, 2017). Smart service systems have already existed in many industries. Although different researchers

have a similar understanding of the nature of smart service systems, different researchers have various concerns:

Barile and Polese (2010) suggested that a smart service system is a service system that manages its goals and assets interactively and wisely, and can reconfigure itself to perform continuously, to meet the needs of all participants. Spohrer (2013) discussed that instrumentation, interconnection and intelligence characterise the smart service system. Carrubbo et al., (2015) argued that smart service system designed for the management of goals and assets, and can reconfigure itself to ensure that they maintain the ability to satisfy all participants. Gavrilova and Kokoulina (2015) proposed that the smart service system has the following characteristics: activeness, self-configuration, continuous interaction, and interconnection. Massink et al. (2010) suggested that smart service systems' standard components are space, sensor, display, and user. Specifically, the user interprets displayed information and operates accordingly.

2.1.3 Smart service

The early concept of smart service was mentioned by Szweda (1998), who believes that smart service is coming with the development of the global system for mobile communications and portable smart devices. Subsequently, the smart service concept became well established since 2010 (Dreyer et al., 2019). Although different researchers have little dispute about the fundamental of smart service, they focus on various aspects.

Beverungen et al. (2017) defined smart service as the behaviour, process, and performance supported by smart products. Gavrilova and Kokoulina (2015) suggested that smart service's attributes include IT platforms; elements; dynamic attributes; knowledge awareness; intelligence.

Furthermore, Allmendinger and Lombreglia (2005) suggested that smart service is pre-emptive in nature. The data smart utilisation technology powers smart service based on smart service system (Kabadayi et al., 2019).

2.1.4 Smart service and its user

Kabadayi et al. (2019) also suggested that smart services are adjusted based on the data of changing the user's context. To obtain user-specific data, smart services rely on data exchange through feedback products (Wuenderlich, 2009).

A key to realising the value of smart service lies in the match of service technology and user demand; smart services enable providers to establish close contacts with users from demand analysis to disposal; it can thus provide information for provider's research and development (Allmendinger and Lombreglia, 2005). Furthermore, based on the data obtained from their smart products, smart service providers can take over the user's adjacent activities. They thus evolve from hardware providers to solution providers (Allmendinger and Lombreglia, 2005).

Kabadayi et al. (2019) proposed that the primary speciality of smart services is to predict user needs. Using the acquired data, smart services are proactive to satisfy users; smart services can even suggest or provide services that users do not even realise they may like. Knowledge about usage behaviour can also be used to identify the crucial success elements of the interface, and thus customise it (Tien, 2012).

Because data obtained through smart products provides a clearer picture of user's usage behaviour and their needs accordingly, smart service offers new ways for providers to segment and provide customised services to users (Porter and Heppelmann, 2015). Smart service also brings new user relationships, because it enables continuous dialogue with users, and thus better understand user needs and satisfaction (Porter and Heppelmann, 2015).

2.1.5 Different dimensions between smart services and non-smart information technology services

From the user's perspective, smart services have a lot of commonalities with non-smart information technology services, but there are also crucial differences between them. It is worth noting that the crucial differences between smart services and non-smart information technology services in some dimensions (e.g., co-

creation, interactivity and service convenience) are not the relationship between yes and no, but the relationship between strong and very weak.

These commonalities and differences are summarised in table 1.

Table 1. The commonality and difference between smart services and non-smart information technology services

	Attribute	**Smart service**	**Non-smart information technology service**
Commonality	Connectivity	Yes!: Advanced	Yes
	Ability to provide information	Yes	Yes
	Networking with other resources	Yes	Yes
Difference	Personalisation	Yes!: Advanced	No
	Co-creation	Yes!: Flexible	Limited
	Interactivity	Yes!: Natural	Limited
	Intelligence	Yes	No
	Service convenience	Yes!: High	Limited

An in-depth analysis of the prior literature regarding the different dimensions between smart services and non-smart information technology services as perceived by users is conducted; the conclusion is discussed as follows:

• Smart service is personalised in nature: Dreyer et al. (2019) defined that smart services are personalised, highly dynamic and quality-based. Smart service users make use of the smart product's embedded functions to serve themselves, and smart products can transmit the user's usage, context and status data back to

the provider; these data are used to provide personalised solutions that match the specific context of the user (Carlile, 2002; Star and Griesemer, 1989; Star, 2010). Carrubbo et al. (2015) suggested that users need quick and personalised service by using smart service system. Carsten et al. (2017) suggested that smart service reacts based on data collection and analysis through networked, smart systems. As a result, it is capable of the automatic recognition of user's needs, and can thus actively, effectively, efficiently, safely, even greenly satisfy user's personalised needs; smart service system can satisfy not only the user's explicit needs, such as habits preferences but also their implicit needs associated with time and space, identity, life status, etc. Kabadayi et al. (2019) also suggested that smart service can predict and meet user's needs by providing pro-active and personalised services, based on the user's changing circumstances and feedback. Take smart media services as an example; users generate a large amount of data in the process of using, which allows smart media to portray user portraits. As a result, smart media can provide users with personalised programs accurately, based on smart recommendation algorithms (iResearch, 2016). Therefore, it is a user-centric media that aims to satisfy users' different personalised needs in various life scenarios.

• Smart service can achieve flexible co-creation with the smooth service experience. Beverungen et al. (2017) suggested that smart service can realise the user's co-creation of the personalised value proposition. Lim and Maglio (2018) also suggested that co-creation is an important attribute of smart service. Dreyer et al. (2019) suggested that smart service enables users and providers to co-create value together. Ostrom et al. (2015) suggested that in a smart service environment, users are increasingly creating their own experiences more dynamically and autonomously. Therefore, designing smart services to achieve flexible co-creation with smooth service experience are worthy of consideration. Wunderlich et al. (2015) also emphasised the need to explore the co-creation of users' value. Richards and Jones (2008) suggested that the adaptability of smart services aims to improve service support to users by providing co-creation chances. Take smart media as an example; it enables user's participation based on its co-creation system. In the smart media context, users can co-create activities more naturally and effectively; for example, by using intelligent voice recognition functions, users can vote for specific content and add comments, etc. Co-creation means that some

users' needs are not very clear in advance. Users will meet their needs through co-creation. Smart services can realise flexible co-creation for users (e.g., (Spohrer, 2013; Wunderlich et al., 2015)).

• Smart service is highly interactive; it can enable natural two-way communication. Püschel et al. (2016) suggested that interactivity is one of the key dimension of smart service. Similarly, Kokoulina (2015) also suggested that continuous interactivity is one of the important dimensions of the smart service system. Tien (2012) suggested that the smart, interactive elements of the interface are essential for customer-provider interaction. Barile and Polese (2010) also suggested that a smart service system serves interactively. Lim et al. (2016) proposed that smart service systems achieve interactivity through connection and automation, thereby improving their own information processing and operations. Many smart products provide users with a more natural human-computer interaction interface equipped with natural language understanding functions, which enables two-way communication between users and the system, no longer limited to physical contact.

• Smart service is characterised by intelligence. In a broader sense, intelligence refers to the implementation of AI to optimise and enhance the information system, which can thus grow and develop as a self-organisation system. As a result, the smart product gradually develops its ability to learn and understand, make decisions as well as solve the problems (Negnevitsky, 2011). Intelligence in a smart service system contains two main attributes. On the one hand, it emphasises the smart service's anthropomorphic characteristic. On the other hand, it refers to the intelligence of machines (Allmendinger and Lombreglia, 2005). Spohrer (2013) suggested that intelligence is one of the key characteristics of smart service. Similarly, Gavrilova and Kokoulina (2015) also suggested that smart service's one of the attributes is intelligence. Allmendinger and Lombreglia (2005) suggested that smart service is enabled by the intelligence of connected systems and devices; high dynamics and contextual information make it possible (Byun and Park, 2011; Oh et al., 2010). Smart service system can provide preemptive and contextual services to users based on smart products' intelligence (Allmendinger and Lombreglia, 2005).

• Smart service is characterised by high service convenience. Service convenience refers to the user's judgment based on her/his sense of control over

the utilisation and management of her/his effort and time management to achieve goals related to the service usage (Thuy, 2011). Dreyer et al. (2019) suggested that smart service brings convenience to users through field intelligence and analysis of social contextual data. Smart service convenience enables users to accomplish their tasks efficiently and effectively (Spector, 2014). On the one hand, smart service convenience in terms of software, means flexible and adaptive; in other words, how efficient it is to provide the service. On the other hand, smart service convenience in terms of hardware, means smaller, more portable, and more affordable smart device, in other words, how effective it is the service can be provided anywhere and anytime (Zhu et al., 2016).

2.1.6 The necessity of empirical research on the smart dimensions

Through the review of the existing literature on smart services, this dissertation identifies that there are primarily five different factors of smart service perceived by users and non-smart services. It is reasonable to assume that these factors would affect the user's consumption of smart services. As a result, the influence of these smart dimensions on users' behavioural intention is theoretically and practically worthy of empirical study in the following chapters. The theoretical characteristics of technology diffusion theory and U&G theory provide powerful theoretical tools for the study of smart dimensions of smart service system.

2.2 Theory

The theoretical integrations and extensions have been developed primarily based on two theories: technology diffusion theory, and U&G theory. These two theories as consumption decision-making framework, are integrated to explain smart service user's internal psychological decision-making process, and thus provides theoretical support for user's three-stage behavioural framework of "perception - decision - gratification" as the internal psychological process of user's pre-acceptance, acceptance and post-acceptance.

2.2.1 Technology diffusion theory

Technology diffusion theory focuses on the identification of user's technology acceptance determinants from the user perspective (Ghezzi et al., 2013), It has been developed around the issue of why and how technology is successfully accepted and spread across a market (Loch and Huberman, 1999).

Several theories have been developed to address the user's acceptance of new technology systems; among those theories, technology acceptance model (TAM) is proved as one of the most popular as well as robust models of information technology acceptance. TAM suggests that user's behavioural intention towards a system can be determined by her/his motivation, which is influenced by external factors such as the perceptions of the system's features (Davis, 1986).

Although TAM has theoretical simplicity, it has some limitations in terms of explanation ability and extensibility (Benbasat and Barki, 2007). Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) was later developed by integrating other constructs to investigate user's information systems acceptance.

2.2.1.1 Technology acceptance model (TAM)

The theoretical foundation for TAM

Davis (1986) takes Fishbein's model (Fishbein, 1967) which was refined by Fishbein and Ajzen (1975) by the name of theory of reasoned action (TRA), and later developed by Ajzen (1985) by the name of theory of planned behaviour (TPB), as the reference paradigm. It deconstructs the attitude construct of the TRA and TPB into two determinants: PU and PEU.

PU is defined as the degree to which a user believes that using a specific system can improve the performance; PEU is defined as the degree to which a user believes that using a particular system does not require effort; attitude refers to total evaluations toward performance (Davis, 1986).

PU is supported by outcome expectancy, cost-benefit paradigm, evaluation of information reports, channel disposition model, etc. (Davis, 1989). PEU is supported by self-efficacy, cost-benefit paradigm and adoption of innovations, evaluation of information reports, channel disposition model, etc. (Davis, 1989). According to TAM, PU and PEU can significantly predict behavioural intention

(Davis, 1986). The theoretical foundation for TAM is discussed in detail below:

The reference paradigm of TAM: TRA and TPB

According to Fishbein and Ajzen (1975), TRA originates from social psychology and describes the way people consciously determine their intended behaviour. TRA holds that a person's performance of a particular action depends entirely on the intention to perform the action, and this intention depends on two factors, including subjective norm and attitude about the action. Among the constructs, behavioural intention measures the strength of performance intention; subjective norm refers to the idea that most people who are essential to an individual think the action should or should not be performed. Attitude means an individual's evaluation of performing the corresponding behaviour.

Later, TPB was proposed by Ajzen (1985), which includes perceived behavioural control, to enhance the predictive power of the TRA. Perceived behavioural control means people's evaluations of their ability towards performing the target behaviour.

Supported constructs of perceived usefulness (PU)

Bandura (1982) distinguishes self-efficacy expectation from outcome expectancy, which came from social cognitive theory. Outcome expectancy judgement represents the degree to which the execution of behaviour is related to valuable outcomes (Bandura, 1977; Bandura, 1982), which is similar to PU in TAM (Davis, 1989). It is worth noting that Bandura (1982) suggested that behaviour can be best predicted by both self-efficacy (similar to PEU) and outcome expectancy (similar to PU).

Besides, the cost-benefit paradigm which belongs to behavioural decision theory (Beach and Mitchell, 1978; Johnson and Payne, 1985; Payne, 1982), adequately explains why decision-makers should change their selection strategies according to the changes of task complexity. Abelson and Levi (1985) proposed to consider the perceived cost and benefit of the decision-maker independently of the

decision. Perceived benefit in the cost-benefit paradigm is similar to PU in TAM (Davis, 1989).

Furthermore, in the evaluation of information reports, Larker and Lessig (1980) provided perceived importance, which is similar to PU in TAM (Davis, 1989). PU is similar to Swanson (1982, 1987) 's information quality in channel disposit model (Davis, 1989), too. It is also similar to Hauser and Simmie (1981) 's effectiveness in a study concerning user's perceptions toward alternative communication technologies (Davis, 1989).

Supported constructs of perceived ease of use (PEU)

PEU is supported by Bandura (1977; 1982) 's research on self-efficacy. Self-efficacy is defined as judgements of how well a person can perform courses of action in response to an expected situation (Bandura, 1982). Self-efficacy can be used as a proximal determinant towards performing a behaviour (Bandura (1982), which is similar to PEU in TAM (Davis, 1989).

Besides, research on the use of innovation also supports PEU in predicting technology acceptance. Tornatzky and Klein (1982) found that complexity has an important impact on a wide range of innovation types. Rogers and Shoemaker (1971) defined complexity as the degree to which an innovation is difficult to be understood and used, and is very similar to PEU in TAM (Davis, 1989).

Furthermore, in the cost-benefit paradigm, Abelson and Levi (1985) suggested that when evaluating a decision towards performing a behaviour, the decision maker's perceived cost and benefit should be considered independently. Perceived cost is similar to PEU in TAM (Davis, 1989).

In addition, in the evaluation of information reports, Larker and Lessig (1980) provided perceived usableness, which is similar to PEU in TAM (Davis, 1989). PEU is similar to Swanson (1982, 1987)'s access quality in channel disposit model (Davis, 1989), too. It is also similar to Hauser and Simmie (1981)'s ease of use in a study concerning user perceptions toward alternative communication technologies (Davis, 1989).

The major extension of TAM

To extend TAM, Venkatesh and Davis (2000) suggested an extension model called TAM 2 that proposes a considerable number of variables, such as subjective norm, output quality, job relevance, image, and result demonstrability, as antecedents to perceived usefulness. Venkatesh (2000) also proposed another TAM extension model that suggests antecedents to perceived ease of use. Two main groups are provided, adjustments and anchors.

Additionally, there are three major directions for TAM extensions. The first direction includes external variables that are attached to the two belief factors (perceived usefulness and perceived ease of use), such as demographic characteristics (Venkatesh and Davis, 1996; Venkatesh and Morris, 2000), personality traits (Gefen and Straub, 1997), and computer self-efficacy construct (Chow et al., 2012). The second direction identifies additional belief factors, such as result demonstrability (Plouffe et al., 2001), trialability (Agarwal and Prasad, 1997), visibility (Karahanna et al., 1999), and content richness (Lee and Lehto, 2013). The third direction identifies factors from related models, for instance, perceived behavioural control (Liaw and Huang, 2003), subjective norm (Barki and Hartwick, 1994), and self-efficacy (Taylor and Todd, 1995).

2.2.1.2 Unified theory of acceptance and use of technology (UTAUT)

The theoretical foundation for UTAUT

Based on the systematic analysis of the eight recognised models, including TAM, Venkatesh et al. (2003) proposed a unified model in the name of the UTAUT. It is the result of synthesising: the technology acceptance model (TAM) (Davis, 1989), the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975), the theory of planned behaviour (TPB) (Ajzen, 1985), the model of PC utilisation (MPCU) (Thompson et al., 1991), motivational model (MM) (Davis et al., 1992), social cognitive theory (SCT) (Bandura, 1986), the innovation diffusion theory (IDT) (Rogers, 1985) and the integrated model of TAM and TPB (Taylor and Todd, 1995).

As a result, Venkatesh et al. (2003) proposed that a user's acceptance and use of information technology are mainly affected by four major constructs:

performance expectancy, effort expectancy, social influence, and facilitating conditions, these factors are moderated by age, gender, experience, as well as voluntariness of use. Venkatesh et al. (2003) suggested that UTAUT may provide higher accuracy in terms of predictive power than a single theory.

The core constructs of UTAUT and their support

Performance expectancy refers to the degree to which the individual user believes that using information technology will help to improve performance (Venkatesh et al., 2003). Performance expectancy construct is associated with the perceived usefulness construct of TAM (Davis, 1989); relative advantage construct of IDT (Rogers, 1985); extrinsic motivation construct of MM (Davis et al., 1992); job-fit of MPCU (Thompson et al., 1991); and outcome expectations of SCT (Bandura, 1986).

Effort expectancy construct refers to the degree of ease related to using information technology (Venkatesh et al., 2003). It integrates the perceived ease of use construct of TAM (Davis, 1989); complexity construct of MPCU (Thompson et al., 1991); and ease of use construct of IDT (Rogers, 1985).

Social influence construct refers to the degree to which an individual user feels that people who are important to them, believe they should use information technology (Venkatesh et al., 2003). The social influence construct is relevant to the image construct of IDT (Rogers, 1985); subjective norm construct of TRA (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985); social factors construct of MPCU (Thompson et al., 1991).

Facilitating conditions construct means the degree to which an individual user believes they have adequate technical and organisational infrastructure to support their usage of the information technology (Venkatesh et al., 2003). The facilitating conditions factor is related to the compatibility construct of IDT (Rogers, 1985), the perceived behavioural control construct of TPB (Ajzen, 1985) and facilitating conditions construct of MPCU (Thompson et al., 1991).

There are three main categories of UTAUT extensions. The first category is testing UTAUT in new contexts (e.g., (Chang et al., 2007)). The second category is to add new constructs to expand the scope of the theoretical mechanisms involved in UTAUT (e.g., (Chan et al., 2008; Sun et al., 2009)). The third category

is to add antecedents to UTAUT constructs (e.g., (Neufeld et al., 2007; Yi et al., 2006)).

Extending UTAUT to consumer acceptance and use context: UTAUT2

In order to investigate acceptance and use of technology in a consumer context, (Venkatesh et al., 2012) proposed UTAUT2, which integrated three more constructs into the original UTAUT: price value, hedonic motivation, and habit. The extended UTAUT2 generated a substantial improvement in terms of variance explained in both behavioural intention and technology use.

Hedonic motivation refers to the joy of using technology. Hedonic motivation plays a vital role in determining the acceptance and use of technology. (e.g., (Brown and Venkatesh, 2005; van der Heijden, 2004)). Hedonic motivation is also considered to be an essential determinant of information system acceptance and use in the consumer context (e.g., (Brown and Venkatesh, 2005)).

Price value refers to the cognitive trade-off between the perceived benefits of users accepting and using technology and the cost of money (Dodds et al., 1991). Price value would affect consumer technology acceptance and use. Monetary prices can be conceptualised along with the quality of services or products to decide the perceived value of services or products (Zeithaml, 1988).

Habit refers to the degree that users tend to automatically do certain behaviours (Limayem et al., 2007). Habit has two differences compared to automaticity: first, habit is a prior behaviour (Kim and Malhotra, 2005); second, habit is a personal recognition of the degree of automatic behaviour (e.g., (Limayem et al., 2007)). Habit would affect user's technology acceptance and use.

Table 2 summarises the core constructs of TAM and UTAUT (technology diffusion theory), including their definitions and supported constructs.

Table 2. the core constructs of TAM and UTAUT (technology diffusion theory) and their definitions and supported constructs

Theory	Core construct	Definition	Supported construct
TAM Davis (1986) takes TRA and TRA's later evolution TPB as the reference paradigm. According to TAM, PU and PEU can significantly predict behavioural intention. It is proved as one of the most robust models of information technology acceptance.	Perceived usefulness	PU is defined as the degree to which a user believes that using a particular system can improve his or her performance (Davis, 1986).	Outcome expectancy (Bandura, 1982); Perceived benefit (Abelson and Levi, 1985); Perceived importance (Larker and Lessig, 1980); Information quality (Swanson,1982; Swanson,1987); Effectiveness (Hauser and Simmie, 1981).
	Perceived ease of use	PEU is defined as the degree to which a user believes that using a specific system does not require effort (Davis, 1986).	Self-efficacy (Bandura, 1982); complexity (Rogers and Shoemaker, 1971); Perceived cost (Abelson and Levi, 1985); Perceived usableness (Larker and Lessig, 1980); access quality (Swanson,1982; Swanson,1987); Ease of use (Hauser and Simmie, 1981).
UTAUT Venkatesh et al. (2003) suggested that it is the result of synthesising eight recognised models: the technology acceptance model (TAM) (Davis, 1989), the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975), the theory of planned behaviour (TPB) (Ajzen, 1985), the model of PC utilisation (MPCU) (Thompson et al., 1991), motivational model (MM) (Davis et al., 1992), social cognitive theory (SCT) (Bandura, 1986), the innovation diffusion theory (IDT) (Rogers, 1985) and the integrated model of TAM and TPB (Taylor and Todd, 1995). Venkatesh et al. (2003) suggested that UTAUT may provide higher accuracy in terms of predictive power than a single theory.	Performance expectancy	Performance expectancy refers to the degree to which the individual user believes that using information technology will help improve performance (Venkatesh et al., 2003).	The perceived usefulness construct of TAM (Davis, 1989); relative advantage construct of IDT (Rogers, 1985); extrinsic motivation construct of MM (Davis et al., 1992); job-fit of MPCU (Thompson et al., 1991); outcome expectations of SCT (Bandura, 1986).
	Effort expectancy	Effort expectancy construct refers to the degree of ease related to using information technology (Venkatesh et al., 2003).	The perceived ease of use construct of TAM (Davis, 1989); complexity construct of MPCU (Thompson et al., 1991); ease of use construct of IDT (Rogers, 1985).
	Social influence	Social influence construct refers to the degree to which an individual user feels that people who are important to them, believe they should use information technology (Venkatesh et al., 2003).	The social influence construct is relevant to the image construct of IDT (Rogers, 1985); subjective norm construct of TRA (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985); social factors construct of MPCU (Thompson et al., 1991).
	Facilitating conditions	Facilitating conditions construct means the degree to which an individual user believes they have adequate technical and organisational infrastructure to support their usage of the information technology (Venkatesh et al., 2003).	The facilitating conditions factor is related to the compatibility construct of IDT (Rogers, 1985), the perceived behavioural control construct of TPB (Ajzen, 1985) and facilitating conditions construct of MPCU (Thompson et al., 1991).

2.2.2 Uses and gratifications (U&G) theory

Although the initial decision to accept the smart service system is an essential first step, but the ability of the smart service system to maintain users in the long term relies on the continuance usage in the post-acceptance stage. This dissertation thus applies the U&G theory to study user's gratifications in their post-acceptance of smart service system.

The research of uses and gratifications began in the 1930s. After decades of development by many researchers, Katz et al. (1973) proposed the U&G theory. It explores users' socio-psychological needs, which can explain the individual user's medium usage (Xu et al., 2012). It has been applied to various computer-mediated medium and services based on computer-mediated communication technology, such as education service based on a mobile device (Aburub and Alnawas, 2019), and smartphone (Joo and Sang, 2013).

U&G theory explains the consequences of user's attitudes and behaviours, as well as their social or psychological desires that prompt them to choose a specific medium for gratifications of their intrinsic needs (e.g., (Rubin, 1994; Ruggiero, 2000). In U&G theory, needs that can motivate usage are the combination of psychological tendencies, environmental conditions and social factors (Katz et al., 1973). Gratification refers to the user's perceived fulfilment of her/his needs through a medium usage activity (Palmgreen, 1984).

U&G theory focuses on the following points: (1) the psychological and social origins of (2) user's needs, which can generate (3) user's expectations of (4) the medium / computer-mediated communication systems, which result in (5) different patterns of medium usage, bring about (6) gratifications of need, (7) and other results (maybe unintended consequences) (Katz et al., 1973).

Along with the development of information and communication technology, researchers have new interpretations for U&G theory. Finn (1997) suggested the integration of media and computer-mediated communication technology has changed the exposure patterns of users. Moreover, Ruggiero (2000) indicated that the Internet's interactive nature dramatically enhances the core of U&G concept in terms of active usage; computer-mediated medium also enhances the effectiveness of U&G theory. As a result, U&G theory can thus be applied to study telecommunications medium effectively and efficiently (e.g., (Ruggiero, 2000)).

Table 3 shows the uses and gratifications typologies concerning representative new (computer-mediated) mediums.

Table 3. Uses and gratifications typologies concerning representative new mediums

Representative medium	Gratification	Researcher
Home personal computer	Utility (Utilitarian gratification) Fun (Hedonic gratification) Status (Social gratification)	Venkatesh and Brown (2001)
The Internet	Education, etc. (Content gratification) Searching, surfing, etc. (Process gratification) Website (Technology gratification) Interaction, etc. (Social interaction)	Stafford et al. (2004)
Wireless advertising	Entertainment, etc. (Process gratification) Comercial relationships, personal relationships (Social gratification) Information, reminders and notifications, Customised content (Content gratification)	Perters et al. (2007)
Online game	Enjoyment, fantasy, escapism (Hedonic gratification) Social interaction, social presence (Social gratification) Achievement, self-presentation(Utilitarian gratification)	Li et al. (2015)
SNS (Microblogging -Twitter)	Self-documentation, information sharing, self-expression (Content gratification) Social interaction (Social gratification) Entertainment, passing time (Process gratification) Media appeal, convenience, social presence (Technology gratification)	Liu et al. (2016)
Instant messaging (Wechat)	Perceived enjoyment, passing time (Hedonic gratification) Social interaction, social presence (Social gratification) Self-presentation, information documentation, information sharing (Utilitarian gratification) Media appeal (technology gratification)	Gan and Li (2017)
Online video (Youtube)	Information seeking (Content gratification) Information giving (Content gratification) Self-status seeking (Social gratification) Social interaction (Social gratification) Relaxing entertainment (Hedonic gratification)	Khan (2017)
Mobile education	Cognitive gratification (No more detailed construct) Hedonic gratification (No more detailed construct) Personal integrative gratification (No more detailed construct) Social integrative gratification (No more detailed construct)	Aburub et al. (2019)

As a result, smart service system meets the U&G theory assumptions: (1) The users are active. (2) Users who choose a medium / computer-mediated

communication system are goal-oriented and purposeful with expectations. (3) Users are aware of their needs and expectations to use a specific medium / computer-mediated communication system. After the usage, user's needs would be satisfied or not satisfied. If they are satisfied, their continuance usage will be strengthened (Katz et al., 1973).

In this dissertation, we shall empirically investigate whether user's expectations towards the smart service system are gratified. Therefore, the U&G theory can obviously be applied to the research of post-acceptance of smart service system.

2.3 The three-stage behavioural framework

2.3.1 Theoretical basis of the three-stage framework

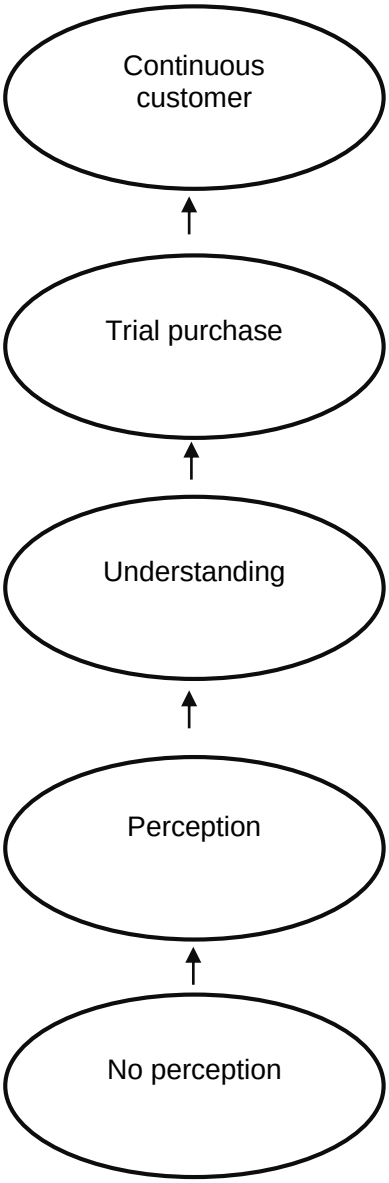
Consumer behaviour researchers (e.g., (Crane and Clarke, 1994; Frambach et al., 2007; Martinez, 2011; Mowen, 1987; Peter and Olson, 2009; Schiffman and Kanuk, 1997; Solomon et al., 2006; Solomon, 2013)) suggested that consumer behaviour is a process in which consumers take actions to meet their personal needs through "pre-purchase, purchase and post-purchase". This "pre-purchase, purchase and post-purchase" process as an external manifestation of the service consumption process, is consistent with the three-stage behavioural framework of "perception - decision - gratification" in this dissertation, which reflects the user's internal psychological processes at each stage.

For example, Solomon (2013, p.8) suggested "consumer behaviour is a process", and the stages in the consumption process involves "pre-purchase, purchase and post-purchase", and a consumer "identifies a need or desire, makes a purchase, and then disposes of the product during the three stages of the consumption process". Peter and Olson (2009, p.194) also defined the consumption process that describes "a behaviour sequence that occurs in the purchase of many consumer goods" as "pre-purchase, purchase and post-purchase". In addition, Frambach et al. (2007, p.27) suggested that "a consumer goes through three stages in his/her buying process, namely, pre-purchase, purchase, and post-purchase", in terms a complex service consumption. As a result, the user's internal psychological decision-making is described as a three-

stage process to reflect their correspondence with the consumption stages in the classical consumer behaviour literature. Accordingly, this three-stage behavioural framework of "perception - decision - gratification" reflects the user's internal psychological processes in these three consumption stages.

Tamura (2011, p.32) proposed a customer conversion process model. It suggests the process of customer conversion can be divided into five stages of "no perception - perception - understanding - trial purchase - continuous customer". The following Figure 2 shows Tamura (2011, p.32)'s model.

Figure 2. Customer conversion process



Source: Tamura (2011, p.32) In Japanese.

Tamura (2011, p.32) 's customer conversion process model can be divided into these three stages broadly, according to the three consumption stages of "pre-purchase, purchase and post-purchase". Tamura (2011) 's customer conversion process model suggests that the three-stage behavioural framework of "perception - decision - gratification" reflects the user's internal psychological processes of service consumption.

Dewey (1910) proposed a five-stage decision-making process framework, which is "problem/need recognition - information search - evaluation of alternatives - purchase decision - post-purchase behaviour". This framework is widely accepted in the field of consumer behaviour; for example, Louden et al. (1993) provided a similarly simplified four-stage decision-making process framework on this basis. This framework can be roughly divided into three stages according to "pre-purchase, purchase and post-purchase" consumption process, which is similar to the three-stage behavioural framework.

Therefore, this dissertation redefines user's five-stage decision-making framework according to the three consumption stage, as the three-stage behavioural framework of "perception - decision - gratification", which describes the user's internal psychological process. In the three-stage behavioural framework, perception refers to pre-acceptance perception; decision refers to the decision of acceptance; gratification refers to the user's post-acceptance gratification.

Traditionally, perception refers to users organising, identifying and interpreting sensory information to understand the information presented to them (e.g., (Schacter et al., 2011)). Perception is known to impact on consumer's decision (e.g., Tamura, 2011). In Tamura (2011) 's customer conversion process model, the user's conversion process actually starts from perception, which is consistent with the meaning of the concept of perception in this dissertation in terms of the starting point of consumption. However, the perception stage in the three-stage behavioural framework includes the user's psychological process before acceptance; it covers Tamura's perception stage and understanding stage; and it covers Dewey's problem/need recognition, information search and evaluation of alternatives stages.

Traditional consumer decision-making process models, such as Dewey (1910)'s and Tamura (2011) 's model, considered the consumer's decision-making

process across pre-purchase, purchase, and post-purchase, as a linear process, which is more suitable for the consumption of consumer products. By proposing the three-stage behavioural framework, this dissertation supposes that the smart service user's internal psychological process is a dynamic process. There are certain overlaps in the three stages of the smart service user's internal psychological decision-making process. That is why the concept of perception in the three-stage behavioural framework is more generalized.

The three-stage behavioural framework supposes that, in the perception stage and decision stage, users cannot fully recognise their own needs and clarify their own problem recognition. In the decision stage, the user's already recognised needs and cleared problem recognition are met. In the gratification stage, user's incompletely satisfied needs, and problem recognition will become prioritised needs and problems. At the same time, in this gratification stage, the user begins to recognise potential deep psychological needs and start new problem recognition, and thus entering a new psychological cycle of the decision-making process. Shilbury et al. (1998)'s consumer decision-making process model also suggests there are some overlaps and cycles among the steps of the consumer decision-making process. Therefore, in the three-stage behavioural framework of "perception - decision - gratification", the perception stage covers Tamura's perception stage and understanding stage and Dewey’s problem/need recognition, information search and evaluation of alternatives stages. Decision stage covers Tamura's understanding stage and trial purchase stage, and Dewey’s evaluation of alternatives and purchase decision stage. Gratification stage covers Tamura's continuous customer stage and new perception stage, and Dewey’s post-purchase behaviour and new problem/need recognition stage.

As discussed in the previous sections, the smart service system is more intelligent, more complex, more refined, has its unique dimensions compared to non-smart information technology services. Due to the characteristics of the smart service, user's newly generated needs and newly recognised problems as prioritised needs and problems in the gratification stage, can be better and dynamically identified and satisfied by smart service systems.

Towards a synthesis of four perspectives by proposing the three-stage behavioural framework

The three-stage behavioural framework of "perception - decision - gratification" is the user's internal psychological reflection of the three information technology service consumption stages of "pre-acceptance, acceptance and post-acceptance" (Fichman, 2001; Hameed et al., 2012)). Reflected in the classical consumer behaviour literature, it is the three-stage service consumption of "pre-purchase, purchase and post-purchase" from the consumer' perspective (e.g., (Peter and Olson, 2009)). Accordingly, from a service marketer's perspective, it can be considered as the market development process of "pre-service, service, post-service" (e.g., (Rosenbaum et al., 2016)). Sometimes, there may be one difference between “pre-acceptance, acceptance, post-acceptance” process in the information technology service and “pre-purchase, purchase, post-purchase” in classical consumer behaviour literature, that is, users of information technology service may not actually pay financially. But even in the case of free usage by users, this is an actual purchase in another sense ((in a two-sided market that includes a third party (such as advertisers), users spend attention and time, thus indirectly purchased services)) (e.g., (Doyle, 2013; Kim, 2016)).

The following table 4 describes the corresponding relations:

Table 4. Reflection of the three-stage framework in other perspectives

	User's internal psychological process	**User's technology service acceptance process**	**Consumer's consumption process**	**Service marketer's market development process**
The three-stage	Perception	Pre-acceptance	Pre-purchase	Pre-service
	Decision	Acceptance	Purchase	Service
	Gratification	Post-acceptance	Post-purchase	Post-service

Tamura (2011) suggested consumer's consumption process can be considered as a market development process. His customer conversion process model indicates that, as a market development process, in the perception stage, consumers are merely potential customers. After the trial purchase stage, they become customers. If they are satisfied after the trial purchase, they become continuous customers. If not satisfied, they become another customer segment. Tamura (2011) also discussed that, in the market development process, the

marketer must create customers and increase the number of continuous customers. Solomon (2013) indicated at different stages of the consumption process; the marketer should consider different factors that affect consumer behaviour. For example, in the pre-purchase stage, marketers may consider “what cues do consumers use to infer which products are superior to others?”. In contrast, in the post-purchase stage, they may consider “what determines whether a consumer will be satisfied with a product?” (Solomon, 2013, p.8). This dissertation suggests that the market development process is considered from the marketer’s perspective, while the consumption process is considered from the consumer’s perspective.

Therefore, this market development process of "pre-service, service, post-service" from a marketer's perspective indicates that the market is composed of potential customers, customers and continuous customers (high loyalty customers). The market development process focuses on the conversion rate among three customer segments; as a result, the corresponding consumer’s internal psychological factors that affect the conversion rate of the three stages, is very important. Therefore, the marketer's market development process, service consumption stage in classical consumer behaviour literature, technology service acceptance stages, and user’s three-stage behavioural framework in terms of internal psychological process, complement each other logically.

Kohli and Jaworski (1990) discussed the marketing concept of market orientation. They suggest marketer should collect market intelligence concerning customer’s current and future needs from the organization-wide, and thus provide corresponding products/services to satisfy customers. The two major elements of market orientation are market and customer focus (e.g., (Sharp, 1991)).

This market orientation concept suggests it is reasonable to synthesize the extant knowledge regarding the four perspectives, especially the user's internal psychological process perspective and service marketer's marketing development process perspective. This synthesis would provide an in-depth understanding of the user’s service consumption. It thus enables the marketers to satisfy users with corresponding needs in each stage of the service consumption process. Therefore, the appropriate redefinition of three-stage behavioural framework facilitates a better understanding of the consumer’s psychological mechanism in the three market development stage, such as the differences in the factors they consider at

different stages. This redefinition is theoretically and practically necessary as it can better promote market development from a market orientation perspective.

Figure 3 depicts this three-stage behavioural framework.

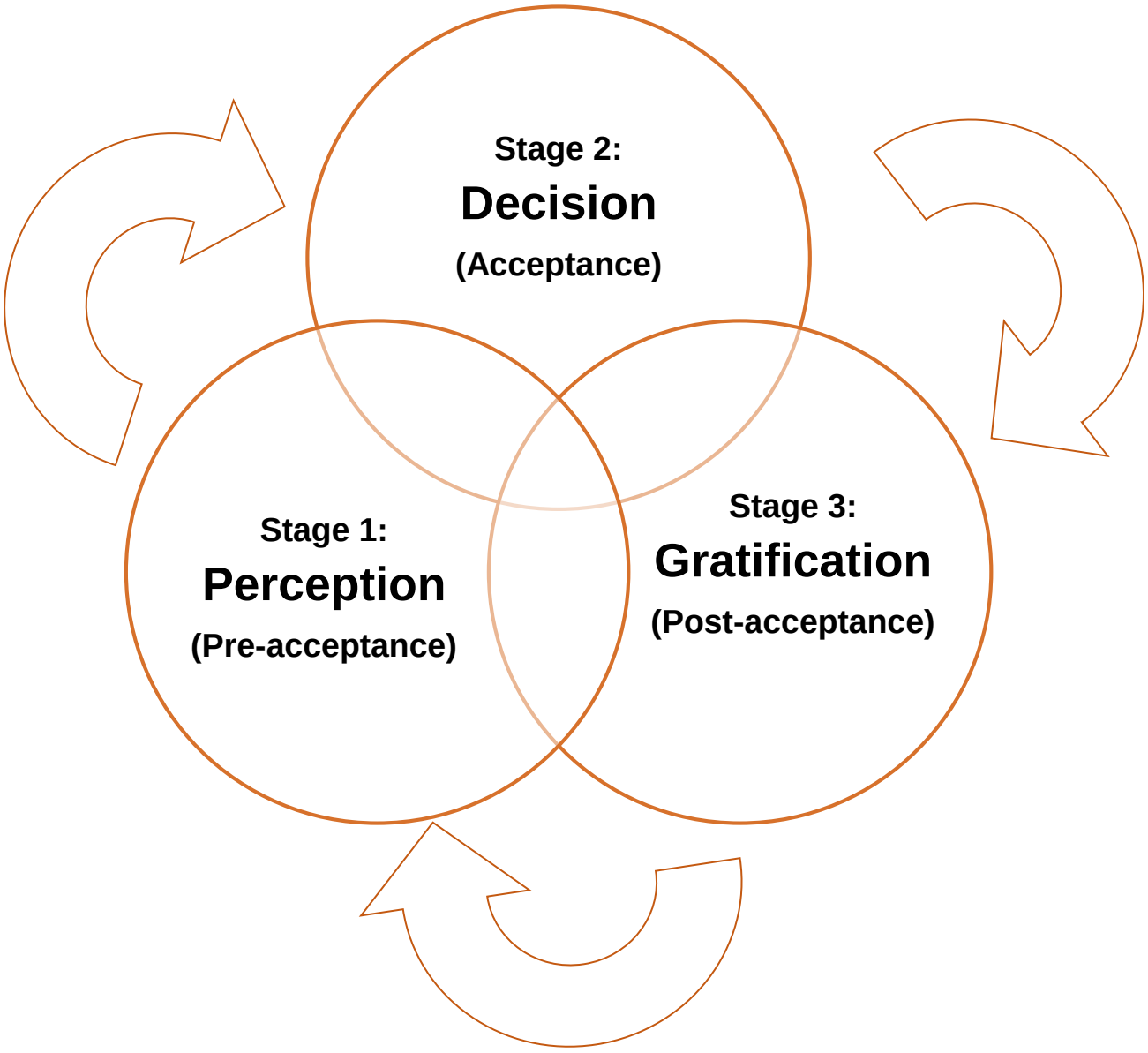


Figure 3. The three-stage behavioural framework

Technology diffusion framework and U&G framework as consumption decision-making process model

Technology diffusion theory, including TAM, UTAUT, can be considered as consumption decision-making process model. They are proved to be extremely powerful for explaining from the pre-acceptance behaviour to acceptance behaviour, in other words, for explaining the transformation from a potential user in perception stage, to a user in the decision of acceptance stage.

However, the theoretical explanation of technology diffusion theory is limited in the post-acceptance stage. In other words, TAM and UTAUT as consumer decision-making models cover the perception and decision stage, cannot fully explain the behaviour of continuous users. As a result, this dissertation applies the U&G framework to explain the gratification of consumers in the post-acceptance stage. U&G theory can be regarded as decision-making theory of users in computer-mediated communication theory, which is complementary to decision-making theory of consumer in marketing theory. Therefore, it is theoretically necessary to integrate technology diffusion theory with U&G theory. The next section will discuss the rationale for integrating the two theories in depth.

2.3.2 Integrating the two theories for the holistic understanding of the three-stage behavioural framework

Technology diffusion theory, including TAM and UTAUT, is originally designed for the technology acceptance research, (e.g., (Davis, 1986; Venkatesh et al., 2003), therefore, they cover the technology acceptance stage primarily (e.g., (Bhattacherjee, 2001; Ghapanchi and Talaei-Khoei, 2018). Even there is some research about post-acceptance based on technology diffusion theory (e.g., (Karahanna et al., 1999)), these studies use the same series of acceptance constructs to investigate post-acceptance. Therefore, these studies have limitations in post-acceptance; for example, they cannot explain why some consumers have suspended their usage after acceptance. Reflected in the user's internal psychological process, TAM and UTAUT as consumption decision-making models primarily cover the perception and decision stage.

The previous research on the post-acceptance of information technology service is mostly based on expectation confirmation theory (ECT) (Oliver, 1980), such as expectation confirmation model (Bhattacherjee, 2001). ECT is used initially in the field of consumer behaviour and service marketing to study customer satisfaction and subsequent post-purchase behaviour (e.g., (Anderson and Sullivan, 1993)).

In the ECT framework, the process for customers to generate repurchase intention is as follows (Oliver, 1980). First, customers have expectations for a particular product or service before purchasing. Second, they accept the product or service and use it. After a period of usage, they formed post-usage impressions. Third, relative to the initial expectations, they assess the extent to which expectation is confirmed in the post-usage stage. Fourth, they form satisfaction based on the confirmed level of expectation. In the end, satisfied customers will repurchase, and dissatisfied consumers will stop their subsequent purchases (e.g., (Bhattacherjee, 2001; Oliver, 1980)).

Both the ECT and U&G theory have the meaning of whether the expectation is satisfied. However, ECT theory takes satisfaction as a whole and thus has limitations to some extent, which is manifested in his inability to decompose user/consumer satisfaction into different types/segments. Therefore, it loses the opportunity to understand the user's satisfaction further. Besides, the smart service system is more complicated and has its unique dimensions compared to the non-smart information technology service. This means smart service users will have a variety of needs to meet. U&G theory provides a cutting edge approach to segment the satisfaction of consumers'/users' expectations, so as to understand whether the user's different type of expectations is met or not.

Therefore, complementary to technology diffusion theory, U&G theory is suitable for explaining user's gratification stage in the post-acceptance stage because it can explain whether a user is gratified with an information technology service after its acceptance. One of the fundamental research questions of U&G theory is, what gratifications of corresponding expectations do users get after using a particular medium? (e.g., (Ruggiero, 2000)). As a result, U&G theory provides a reasonable approach to explore the user's continuance intention in the post-acceptance stage (e.g., (Li et al., 2015)). Therefore, the theoretical integration with U&G theory can very well resolve the limitations of technology diffusion theory in

terms of explaining the user's gratification in post-acceptance usage.

Besides, in terms of the acceptance and post-acceptance of information systems, the interrelated factors that affect user decisions include (1) availability and affordability of information technology (2) user-perceived attributes of information technology (3) social factors (4) user's preference (5) user's cognition, emotion and behavioural response (Lin, 2002). At different stages of user's information technology acceptance and post-acceptance, the factors that affect users' use will change (Bhattacherjee and Premkumar, 2004; Kim and Malhotra, 2005; Lin, 2002). The conventional consumer behaviour theory also supports the change of users' consideration factors in different stages (e,g., (Solomon, 2013)). Therefore, these factors that affect the user's internal psychological “perception, decision and gratification” across the pre-acceptance, acceptance and post-acceptance of the information technology service are challenging to explain with a single theory (technology diffusion theory or U&G theory alone).

When predicting the decision of acceptance towards information technology service, most research based on technology diffusion theory ignores the emotional factors from the user's personal and social aspects. However, U&G theory involves emotional factors (personal and social) that users consider after using the information technology service. Therefore, U&G theory complements technology diffusion theory in explaining the user’s gratification of the post-acceptance usage where emotional factors from users' personal and social aspects should be considered.

Furthermore, satisfaction is more basic, like a need was fulfilled. Gratification adds a pleasure aspect to it; in other words, gratification means satisfaction plus happiness. Therefore, U&G theory is more suitable for the smart service system context of this dissertation.

In summary, technology diffusion theory, including TAM and UTAUT, is a theory that can reliably explain the user's pre-acceptance behaviour to acceptance behaviour towards information technology service consumption. U&G can provide a complete understanding of the user's post-acceptance gratification from the perspective of explaining different types of user satisfaction after usage. As consumer decision-making process models, these two theoretical genealogies are complementary for a holistic and systematic understanding of smart service user's decision-making process thus provides solid theoretical support for user's three-

stage behavioural framework of "perception - decision - gratification" as the internal psychological process of user's pre-acceptance, acceptance and post-acceptance.

2.3.3 The necessity of empirical research on the three-stage behavioural framework

Prior literature (e.g., (Bhattacherjee and Premkumar, 2004; Kim and Malhotra, 2005; Lin, 2002)) supposed that, with the deepening of users' involvement in information technology services, the factors considered by users would change. By providing the three-stage behavioural framework as a user's systematic and holistic internal psychological process, which is supported by the theoretical integration of technology diffusion theory and U&G theory, this dissertation supposes user's consideration would change from considering rational factors in the perception stage to considering both rational factors and emotional factors in the gratification stage. Specifically, this three-stage behavioural framework supposes:

• Perception stage: Combined with the past experience of relevant services, users make perceptions of the smart service. In the perception stage, this dissertation supposes the user first makes a rational judgment, and what the user shows is a kind of economic behaviour. Hence, the user in the perception stage is basically rational. They mainly consider homogeneous, basic and functional factors of smart service system. Therefore, it would be necessary to empirically study the user's smart service belief factors and TAM's original belief factors (perceived usefulness and perceived ease of use).

• Decision of acceptance stage: After the perceptions of the smart service, users will decide whether to accept the smart service. In the decision stage, this dissertation supposes that, in addition to the rational factors, the user begins to add some emotional considerations based on social and psychological perspectives. Thus, more psychological and social factors influence this internal psychological decision-making process. Therefore, it would be necessary to study MBSES attributes empirically, extended UTAUT constructs and flow constructs are

studied.

• Gratification stage: This stage is essential in this three-stage behavioural framework. According to U&G theory, users have specific expectations for the smart service system, and after the usage, the user would modify the existing impression of the smart service. If the user’s expectations are gratified, the user's continuance intention will be strengthened. Otherwise, they would suspend and start a new internal psychological decision-making cycle. In the gratification stage, after the usage of the smart service system, this dissertation supposes the user tends to consider more differentiated emotional factors by thinking beyond the basic functionality of smart service system, that is to say, on the basis of system functionality, the user is supposed to pay more attention to whether their social and psychological expectations are gratified. In other words, in the gratification stage of post-acceptance, users are supposed to consider both rational factors and emotional factors. Therefore, it would be necessary to study the user’s various gratifications empirically.

This dissertation thus would conduct three sub-studies, each focusing on one stage of the three-stage behavioural framework. Consequently, to understand the perception stage, the first sub-study would identify and study smart service belief factors based on the integration with TAM in chapter 3. To further understand the user’s decision stage, the second sub-study would consider more factors from an information-processing perspective by integrating stimuli, UTAUT and flow constructs in chapter 4. To explain user's gratification stage, the third sub-study would study the user’s various gratifications and investigates their effect on user’s continuance intention in chapter 5.

Chapter 3
Understanding the user's smart service belief factors based on the integration with TAM

The study of understanding the user's perception stage by identifying and studying smart service belief factors based on the integration with TAM in this chapter has been published in *Cell Press: Heliyon* (3.2-3.6). The discussion of smart media audience type user in this chapter has been published in *Advances in Economics, Business and Management Research* (3.1).

3.1 Smart media audience-type user

Smart media combines AI and media, which represents the latest evolution form of media. Smart media can be understood from two perspectives: the technology perspective and the user perspective. From the technology perspective, smart media consists of media, AI, communication technology and data; this perspective focuses on several core technologies leading to the development of media intelligence (Duan, 2018; Shang, 2016). However, from the user perspective, smart media is considered as a user-centric media that can sense the user's different life scenarios, and thus provide users with the corresponding service. This perspective focuses on the satisfaction of users' needs (Duan, 2018; Hu, 2016). This dissertation explains user behaviour concerning smart media service from the user perspective.

Smart media can be considered as a marketplace where online content service is traded, but it is unique in comparison with a conventional marketplace. Also, the consumer who consumes the content service in this market is exceptional. No previous research has explicitly indicated what kind of consumer it is, what belief characteristics toward smart media service features do they have, and how do those belief characteristics influence their behavioural intentions.

However, there is an existing theory to explain this. Active audience theory argues that media audiences do not just receive information passively, but are actively involved. Evidence in the field of audience research has shown that

audiences do not only receive information passively, they also take the initiative to choose media channels and even begin to create media content by different means (Chi, 2009). Newer media users tend to be increasingly more active, more selective, self-directed, receivers, as well as producers of content (Livingstone, 2004). Based on the active audience theory, a review of the evolution of the media audience, this sub-study conceptualizes a special kind of content service consumer as a smart media audience-type user.

3.1.1 The development of audience theory

The concept of media audience originated from the audiences of sports games, philosopher's speeches, and early public drama and music performances from 2000 years ago. The initial research on the audience was made by media groups to predict advertising revenue (McQuail, 1997).

The development of audience research can be roughly divided into four phases, as shown in table 5:

Table 5. The four main phases of audience research

Representative researcher	Standpoint
(Lasswell and Blumenstock, 1939; Rogerson, 1939)	Magic bullet theory, and powerful mass media theory, both consider the audience as passive recipients of promotional content, on whom a powerful effect by mass media is exerted.
(Blumer, 1946)	Introduced the sociological concept, and concluded that audiences could be called the masses characterized by large scale, anonymity, infinity, and poor stability.
(Bauer, 1964a; Bauer, 1964b; Lazarsfeld et al., 1950)	The media has an only limited effect; researchers believe that the audience is stubborn and can select and understand information content according to their own needs. However, they cannot control the release of media content.
Katz et al. (1973)	Uses and gratifications theory was proposed to explore the impact of mass communication on people from the perspective of the audience's needs and wants.

3.1.2 From the active audience to the active user

Based on active audience theory, there are parts of the meaning of consumer within the active audience concept. From a behavioural research perspective, the media audience can be considered as an active and motivated set of consumers in charge of their own experience (Katz and Blumler, 1974). Along with media evolution, driven by updates in communication technology, internet technology, and AI, the audience undergoes a userization process and turns into an audience-type user. Compared to the traditional mass audience, a smart media audience-type user applies user-centric logic. This smart media audience-type user demand "one to one" two-way communication and more personalized content services, and want to participate in the media service and co-create.

3.1.3 Discussion of smart media audience-type user

Smart media audience-type user is an original concept provided in this dissertation. We define a smart media audience-type user as the content service user of smart media, who are users of the smart media as service and audience of the smart media as content simultaneously. Smart media audience-type user no longer plays a passive and subordinate role in the process of content service consumption; instead, they demand "one to one" two-way communication, personalized content services and co-creation opportunities.

Silverstone (1994) made a comparison between the media as material/technological objects and the media as texts/symbolic messages. The former is based on the analysis of daily media use; the latter is based on a review of the audiences' interpretive activities toward particular media texts. As a result, he doubly described the audience as a consumer-viewer. From this time on, consistently and continually, media is in perpetual evolution, and so is its audience. The audience is gradually placed at the core of media service.

User, which was initially a concept from economics and marketing, usually refers to consumers and purchasers of products or services in business activities, with the initiative and the right to choose. As traditional mass media first turned into interactive media and eventually transformed into smart media, the way media service was provided fundamentally changed. As a result, the media audience has undergone a process of userization. Smart media audience-type user applies a

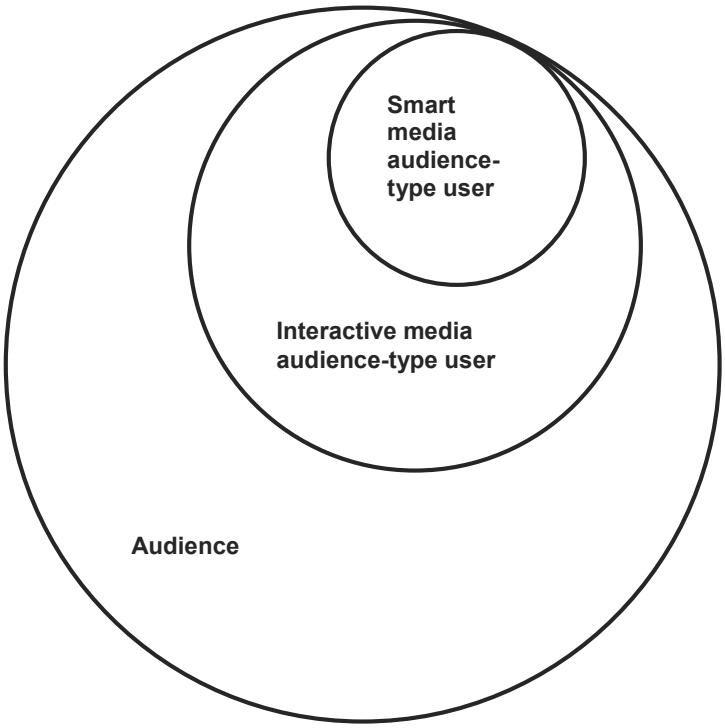
"user-centric" logic, was evolves and fragments away from traditional mass media audience.

In the context of interactive media service and the latest smart media service, the audience has more choices regarding the form and content of the media. In the context of interactive media, the audience can directly choose the content they are interested in, and they can customize the content options. As a result, the process of userization begins with the addition of specific characteristics of the audience-type user. In the smart media context, smart media based on AI and big data analysis of users can provide more personalized content services. Based on natural language understanding, smart media can facilitate more natural and effective "one-to-one" two-way communication. Users are also capable of participating in content service co-creation. As a result, the userization process of the audience is completed.

To explain the new user in smart media content service, in this sub-study, we conceptualize a special kind of smart media content service consumer as a smart media audience-type user. This concept has duality, and it refers to a user, who simultaneously consumes smart media as a service and is also an audience of smart media as content. Thus, from an active audience theory approach, we assume that smart media audience-type users are actively involved in determining how they use smart media. They no longer play a passive and subordinate role in the process of content service consumption. Instead, they are perceived to have three belief characteristics different from the mass media audience: firstly, they demand “one to one” two-way communication (two-way communication). Secondly, personalized content services are needed (personalization); thirdly, they want a share in the power as co-creator in the consumption process (co-creation). For the convenience of the statement, the rest section in chapter 3 still uses the term “user” to indicate “audience-type user”.

The relationship between audience and audience-type users is demonstrated in figure 4:

Figure 4. The relationship between audience and audience-type user



The comparison of the mass audience and the audience-type user are summarised in table 6:

Table 6. The comparison of the mass audience and the audience-type user

	Mass audience	**Interactive media audience-type user**	**Smart media audience-type user**
Media environment	Mass Media	Interactive media	Smart media
Position	Subordinate	User-centric	User-centric
Pattern	One to many	One to one; Many to many	One to one; Many to many
Level of initiative	Primarily passive, low initiative with limited options	Active with high Initiative and sufficient options	Active with higher initiative and more sufficient options
Commercial value	Relatively low	High	Higher
Profit sources	Primarily ad-supported	Paid subscribers & ad-supported users	Paid subscribers & ad-supported users
Direction of communication	Primarily one-way communication	Two-way communication	More natural two-way communication
Consumption patterns	Mass content service	Customization	Personalization
Customer management	Customer satisfaction (CS)	Customer relationship management (CRM)	Customer experience management (CEM)

3.2 Research background

Smart media content service includes all types of information content, including entertainment, economics, science, technology, culture, and other content transmitted by smart media. Smart media is capable of delivering personalized content services to each user. Through smart media, users can communicate with the content service naturally and can even co-create content.

The market share of smart TVs has steadily increased throughout the world, including the United States, Europe, China, and elsewhere (Mordor intelligence, 2019). Smart TV is undergoing a gradual intellectualization process; it is becoming smarter with time. As a combination of Artificial Intelligence (AI) technology and original smart TV, AI-powered Smart TV (AI TV, also known as Smart TV 2.0) meets the characteristics of the smart media. AI TVs have added AI functions such as voice interaction and smart recommendation, as compared to Smart TVs. Representative brands of AI TVs include LG, Sony, Samsung, TCL, Skyworth, and others (Misal, 2018).

AI technology is profoundly reshaping the media. Nowadays, AI technologies, such as speech recognition and natural language understanding, are making the two-way exchange of information between AI TV and users more natural (Fernandes et al., 2019). It can be considered that voice interaction is to AI, just as touch screen is to mobile Internet. Besides, AI TV, which is currently based on data analysis of the user's media habits, is capable of accurately offering personalized service (Foss et al., 2019). No data, no AI. Furthermore, in the context of smart service, AI TV with smart technologies allow for co-creation (Beverungen et al., 2017). AI-powered Smart TV is a platform for smart content services. For example, since 2017, many companies, including Netflix and Tencent, have started interactive programs where users participate in personalized TV programs through a variety of interactions with AI TVs. In order to explore smart media, this sub-study takes AI TV as a representative research object.

Customer experience is holistic throughout the process of pre-acceptance, acceptance, and post-acceptance; it includes the user's perception of the provider in terms of cognition, emotion, affection, physical and social responses (Brakus et al., 2009; Verhoef et al., 2009). Customer experience is generated not only by factors that the provider can control over, such as product type, service interface

but also by factors that the provider cannot control, such as user's purpose, social influence (Verhoef et al., 2009).

Homburg et al. (2017) defined CEM: CEM is a cultural perspective towards customer experience, a strategic direction for customer experience design, and a firm ability to constantly update and enhance customer experience, aiming at achieving and maintaining long-term customer loyalty.

Customer experience includes every point of contact at which the customer interacts with the service; based on this, customer experience management (CEM) represents a business strategy designed to manage the customer experience (Grewal et al., 2009). Practitioners have evaluated CEM as one of the most hopeful marketing methods in the consumer industry (e.g., (Grewal et al., 2009; Homburg et al., 2017)).

Grönroos (2004) suggested that interaction can be regarded as a process, and this interaction process, as a service flow, can be included in the marketing mix. In terms of the management of customer experience, the identification of the user's smart service belief factors is significant. Because in the case of smart media service consumption, smart service belief factors function as drivers of users' perceptions toward smart service elements; these user's belief factors concerning key elements of smart services play a critical role in the interaction process. However, there is a lack of research on the smart service belief factors in the prior literature (Beverungen et al., 2017; Macinnis, 2011; Wünderlich et al., 2013; Wünderlich et al., 2015). Upon the identification of the user's smart service belief factors, customer experience can thus be effectively managed.

This sub-study defines the smart media market as a two-sided market wherein smart content service is consumed by users. A smart media market can be considered as a "two-sided market;" the two separate outputs that smart media produces are: content service and ad-supported users (Doyle, 2013; Kim, 2016). Nowadays, the content service directly consumed by paid subscribers has become a more important source of profit (e.g., (Gaivoronski et al., 2017; Lambrecht and Misra, 2016)). In other instances, free content is provided as a marketing strategy or to generate revenues from advertising (Lambrecht and Misra, 2016; Pauwels and Weiss, 2008). However, content service providers, who intend to move online service offerings from free to fee, are faced with users' unwillingness to pay (Brax and Jonsson, 2009; Lambrecht and Misra, 2016; Pauwels and Weiss, 2008). When

properly targeted, however, there are markets where users will be willing to pay for a variety of reasons. However, existing research lacks an understanding of differences in perceptions across different payment groups, based on the user experience type. (e.g., (Choi et al., 2010; Kim et al., 2018; Venkatesh et al., 2012)). Thus, research on converting free users to new paid subscribers while keeping existing subscribers by studying differences in smart service perceptions between paid subscriber groups and ad-supported user groups is theoretically and practically important.

Smart media, which combines media and AI, is an information system using up-to-date smart technology. This sub-study thus employs the technology acceptance model (TAM) as a research framework. On this basis, a theoretical model that integrates a user's smart service belief factors toward AI TV into TAM and applies user experience type as a moderator from a CEM perspective is developed. The model is tested using structural equation modeling (SEM) of survey data.

This sub-study is expected to make important theoretical and managerial contributions to smart media services. It applies TAM and an understanding of smart service belief factors from a CEM perspective. By extending prior research with this theoretical integration, this sub-study expects to make three key contributions. First, by identifying smart service belief factors, studying the relationships between smart service belief factors and users' attitude toward behaviour, and analyzing intention to purchase, the knowledge gained will facilitate a better understanding of interactive user behaviour in smart media content service. Second, by incorporating three smart service belief factors into TAM, this sub-study has expanded the overall theoretical network related to technology use and has furthered the generalizability of TAM to a smart media service context. Third, by taking user experience type as an original moderator, this sub-study should demonstrate how to convert ad-supported users into new paid subscribers, while keeping existing subscribers, by fulfilling their smart service requirements, from a CEM perspective.

3.3 Research framework and hypothesis formulation

3.3.1 Background

Storey et al. (2010) defined smart media object as a combination of data, representation, channel, and intelligence. Accordingly, smart media objects are capable of perceiving users' different needs in different life situations. By analyzing user's data, these objects can predict, adapt to, react to, participate in, evolve, and convert users' needs. A smart device can be defined as an information processing device that facilitates the interaction between user and service (Lim et al., 2012). Maybury (1999) concluded that smart refers to an improvement in the naturalness, effectiveness, and efficiency of human-machine interaction, based on advances in human-machine interfaces. Smart media channels link the users with the smart media devices. In this sense, smart media plays a mediation role when users interact with smart services (Storey et al., 2010).

The functional awareness and connectivity of services provided through smart products are known as smart services (Allmendinger and Lombreglia, 2005). Smart services are transmitted to or through smart devices that have a sensibility and are capable of real-time data collection and continuous communication (Wünderlich et al., 2015). Smart services are characterized by intelligence, connectivity and interaction (Allmendinger and Lombreglia, 2005; Rijsdijk et al., 2007; Rijsdijk and Hultink, 2010; Wünderlich et al., 2013). In this context, the interaction between the smart service and users in an internet environment plays an essential role. For example, Verhoef et al. (2017) analyzed the interaction among users, smart objects, and the physical environment. Volpentesta (2015) focused on user interaction with a smart service in a ubiquitous environment.

Smart media is a "user-centric" media that focuses on satisfying users' needs. Therefore, user's perceptions concerning key elements of smart services play a key role in the interaction process. Previous literature suggests there is a large gap in understanding how smart services impact the perceptions of end-users in B2C environments (Beverungen et al., 2017; Macinnis, 2011; Wünderlich et al., 2013; Wünderlich et al., 2015). The existing literature has only captured a small number of relevant factors to understand users' attitude and adoption behaviour. Smart service belief factors comprising a user's perceptions toward key elements of smart

service need to be clearly identified. In the context of smart service, smart technologies facilitate higher levels of human-machine interaction (Gretzel et al., 2016). They bring about personalization and co-creation (Neuhofer et al., 2015). Based on a literature review, three key belief factors associated with the model have been identified in this sub-study: perceived two-way communication, perceived personalization, and perceived co-creation.

Another limitation associated with the emerging new media service and information system literature is that, there is a lack of research on the differences in smart service perceptions generated by different user experience types across groups with different payment types. This sub-study thus explores how users' perceptions concerning smart service change across different user experience groups in terms of payment type as users gain different types of experience. This is done by developing a theoretical model that accounts for smart technology and user interaction from a CEM perspective, determinants of user perceptions toward smart services are analyzed with user experience type as a moderator.

3.3.2 Smart service belief factors

3.3.2.1 Two-way communication

Smart communication between users and AI-enabled devices is a type of human-machine communication; it theorizes the smart device as a communicator with which users communicate, not merely a channel (Guzman, 2018). The data exchange, which can be automated read-outs, saving or analysis, or simply transfer of data, can be in the form of one-way or two-way communication (Borgmeier, 2002; Wünderlich, 2009). The concept of two-way communication is closely related to the term interactivity. In the communication approach to defining interactivity, Pavlik (1997) defined interactivity as a bi-directional communication between a source and a receiver. Concerning two-way communication, some researchers proposed that information sharing and exchange are critical elements within the communication process (Bretz and Schmidbauer, 1983; Rafaeli, 1988; Williams et al., 1988). According to other researchers, two-way communication can be characterized by a mutual discourse (Burgoon et al., 1999; Hanssen et al., 1996;

Williams et al., 1988). It can also be described as the ability to engage in mutual communication (Liu and Shrum, 2002; Liu, 2003) because user demand is no longer just “one-to-many” but may be “one-to-one” or even “many-to-many.” Additionally, two-way communication can be described as the ability to give feedback (Duncan and Moriarty, 1998; Ha and James, 1998; Newhagen et al., 1996).

Two-way communication is one of the essential characteristics of smart services. Advanced smart service systems enhance two-way communication, such that all users are connected in real-time so continuous communication and information sharing can be achieved (Lee et al., 2018; Li et al., 2018). Recurrent two-way communication increases the possibilities of an in-depth understanding of users, promotes relationships between users and smart service providers, and also allows for more targeted service designs for users (Valencia et al., 2015).

Previous literature has suggested that users’ perceived two-way communication can exert a positive influence on users’ attitudes and involvement toward new media (McMillan and Hwang, 2002; Sundar et al., 2016). Thus, in the context of the AI TV content service, users’ perceived two-way communication can very likely affect users’ attitude toward behaviour and behavioural intention, whereby attitude toward behaviour refers to the user’s overall evaluation of performance behaviour (Davis, 1986; Davis, 1989) and the key behavioural intention is the intention to purchase. In addition, based on the two-way communication system, AI TV’s human-computer bi-directional exchange process of information is very likely to impact users’ perceived usefulness of the service. Abdullah et al. (2017) suggested a positive impact of the two-way communication on perceived usefulness. Thus,

H1a. Perceived two-way communication of an AI TV service has a positive direct effect on intention to purchase.

H1b. Perceived two-way communication of an AI TV service has a positive direct effect on attitude toward behaviour.

H1c. Perceived two-way communication of an AI TV service has a positive direct effect on perceived usefulness.

3.3.2.2 Personalization

Personalization enables service providers to differentiate a service on the basis of each user, which means that users are more likely to accept that their needs are met by the service's offerings (Anand and Shachar, 2009). Personalization also involves tailoring the marketing mix performed by the service provider (Arora et al., 2008; Rust and Huang, 2011), such that the service provider decides what marketing mix is suitable for each user on the basis of user data (Nunes and Kambil, 2001). All in all, personalization goes one step further than customization, because the service provider determines the proper degree of customization and thus, anticipates what the user needs (Montgomery and Smith, 2009).

With users' personal data, smart service systems can develop broader customer understanding (Demirkan et al., 2015; Peters et al., 2016) and thus, create a better user experience based on innovative value propositions, as well as deeper customer relationships, as a result of personalization (Ostrom et al., 2015; Thomas et al., 2017). In the context of a content service, smart media can offer personalized services (Kim et al., 2017). AI functions, such as AI speaker recognition, make personalized service for each individual user feasible.

DeZoysa (2002) suggested that users are highly receptive to personalized services. In addition, personalized recommendations, according to each user's preferences, can generate better responses (Xu and Araki, 2006). Prior literature has suggested that users' attitudes and behaviours can be affected by personalization (Ho and Bodoff, 2014; Kim and Gambino, 2016). Thus, it is possible that users' perceived personalization affects users' attitude toward behaviour and behavioural intention. Additionally, personalization was found to be a significant factor influencing perceived usefulness in the online environment (Chau and Lai, 2003; Desai, 2018). AI TV's smart recommendation system, aided by machine learning based on a large amount of data, is capable of personalization by monitoring and identifying the habits and needs of users, and it is very likely to impact users' perceived usefulness. Thus,

H2a. Perceived personalization of an AI TV service has a positive direct effect on intention to purchase.

H2b. Perceived personalization of an AI TV service has a positive direct effect on attitude toward behaviour.

H2c. Perceived personalization of an AI TV service has a positive direct effect on perceived usefulness.

3.3.2.3 Co-creation

Co-creation is based on a wider trend whereby users, who are no longer satisfied with their traditional role as an end-user, tend to get involved in creating and developing services, as well as sharing their experiences with others (Ramaswamy and Gouillart, 2010). Smart service systems serve users better, create more opportunities for win-win situations, and increase co-creation, which creates value for both service providers and end-users (Beverungen et al., 2017). In the co-creation process, service providers make a value proposition and users play an active role in refining the value proposition, so the user obtains value by using the service (Barile and Polese, 2010). Users' co-creation activity is critical to encourage participation based on interactions with a co-creation system (Füller and Matzler, 2007; Nambisan and Nambisan, 2008).

The development of smart communication technologies fosters value co-creation with end-users (Bassano et al., 2018). Smart service systems enable value creation between service providers and end-users through their joint performance of service activities (Anke, 2018). Smart service systems digitally mediate the interaction between service providers and end-users, thus achieving the personalized co-creation of value (Beverungen et al., 2017). Smart media makes users much more active and productive in terms of co-creation by offering a wide range of co-creative opportunities. Active users demand a smart media platform that can facilitate personalized participation without barriers. They demand an increase in the scope for co-creation and participation, and are more willing to pay for the content with which they engage.

Previous literature (e.g., (Duan and Dai, 2018)) has suggested that users' perceived degree of co-creation may very likely affect users' attitude toward behaviour and behavioural intention. Besides, as users' perceived degree of co-

creation is based on their interaction with the AI TV co-creation system, it is very likely to impact users' perceived usefulness. Thus,

H3a. Perceived co-creation of an AI TV service has a positive direct effect on intention to purchase.

H3b. Perceived co-creation of an AI TV service has a positive direct effect on attitude toward behaviour.

H3c. Perceived co-creation of an AI TV service has a positive direct effect on perceived usefulness.

3.3.3 Technology acceptance model

TAM has been validated as a reliable theoretical model to explore smart services, such as smart sharing services (Lai, 2015), smart watches (Kim and Shin, 2015), smart wearable devices (Gao et al., 2016), a smart car service (Yoon and Cho, 2016) and a smart home service (Kim et al., 2017; Park et al., 2017). Furthermore, TAM provides empirical support for many studies on internet-based TV (Jang and Noh, 2011; Jung et al., 2009; Wagner et al., 2017). In addition, TAM is well-verified by the fact that many scholars use it for research on the online service context to explore users' behavioural patterns and their willingness to pay (Chen et al., 2002; Gefen and Straub, 2000; Gefen et al., 2003; Lin and Lu, 2000). Therefore, TAM is considered to be a suitable framework for this sub-study.

TAM suggests that the user's behavioural intention can be determined by three constructs: perceived usefulness, perceived ease of use, and attitude toward behaviour (Davis, 1986). Perceived usefulness refers to the degree of users' belief that using the system can increase their efficacy (Davis, 1986; Davis, 1989). Perceived ease of use refers to the degree of users' belief that using the system would be effortless (Davis, 1986; Davis, 1989). Attitude toward behaviour refers to users' overall evaluation of performance behaviour (Davis, 1986; Davis, 1989).

In the TAM extension models, the effect of the extended factors on intentions can be mediated by perceived usefulness (Ooi and Tan, 2016; Venkatesh and Davis, 2000; Wu and Chen, 2016) and attitude (Davis et al., 1989). Thus, this

extended TAM model positions perceived usefulness and attitude as mediating variables in the context of smart service consumption, to explain the influence mechanism of smart service belief factors on intention to purchase.

This research is one of the first studies to test a new extension of TAM in the context of smart media, represented by AI TV. This extended TAM model incorporates users' smart service belief factors (perceived two-way communication, perceived personalization, and perceived co-creation) as additional theoretical constructs and develops a theoretical basis for the causal relationships in the model. An original moderator of user experience type is introduced in this extended TAM framework to explore how users' belief factors may change with payment type as users gain different types of experience.

AI TV content service users need to believe that using AI TV content is a useful way to enjoy high-quality content more conveniently. In addition, users must consider the service to be easy to use. Both perceived usefulness and perceived ease of use are belief variables affecting the attitude toward behaviour. The perceived ease of use impacts the perceived usefulness (Davis, 1989). Furthermore, when individuals form positive attitudes toward an AI TV content service, they are likely to have stronger purchase intentions (Agag and El-Masry, 2016; Cronin et al., 2000; Jang and Noh, 2011; Wagner et al., 2017). Thus,

H4a. Perceived ease of use of an AI TV service has a positive direct effect on perceived usefulness.

H4b. Perceived usefulness of an AI TV service has a positive direct effect on attitude toward behaviour.

H4c. Perceived ease of use of an AI TV service has a positive direct effect on attitude toward behaviour.

H4d. Attitude toward behaviour of an AI TV service has a positive direct effect on intention to purchase.

3.3.4 The moderating role of the user experience type in the extended TAM

In the previous TAM studies, differences in perceptions across groups are considered in terms of certain moderating effects, such as age (Liébana-Cabanillas et al., 2014), gender (Kim et al., 2018), and inexperienced and experienced groups (Castañeda et al., 2007; Choi et al., 2010; Kim et al., 2018).

Researchers have defined the concept of experience in the marketing field, as well as in the information systems field. From the perspective of CEM in the marketing field, Hirschman and Holbrook (1982) explained customer experience as a personal event with significant emotional importance based on interactions with consumer products and services stimuli. Meyer and Schwager (2007) defined customer experience as customers' internal and subjective responses to direct or indirect contact with the service provider. Gentile et al. (2007) considered customer experience to be a psychological structure that encompasses a customer's holistic and subjective response to retailers. Novak et al. (2000) concluded that online customer experience refers to the state of that experience during online navigation.

In the information systems field, Thompson et al. (1991) gave an example of experience using a particular software package and considered it as a direct experience with a particular system. Dishaw and Strong (1998) defined experience as a two-dimensional variable: previous and past experiences. However, they did not provide an explicit definition. Venkatesh (2000) defined experience as a direct and hands-on experience of using a system. Similarly, Choi et al. (2010) defined experience as the direct experience of using a target system.

Constantinides (2004) suggested that the set of service elements that comprise the online user experience includes usability and interactivity. The evaluation depends on a comparison between the stimulus from the customer's expectations and the interaction with the service provider (Gentile et al., 2007). The user experience of a smart service is the culmination of a series of interactions with smart service systems. This experience is a personalized occurrence based on instantaneous two-way communication, and it involves service elements that can affect users' evaluations.

This sub-study defines the user experience type as users who share the same type of experience while using smart service. In the context of smart media content service consumption, the two different payment types (paid subscriber and ad-

supported user) essentially lead to the two most crucial user experience types in terms of understanding the content consumption. Furthermore, the consequence of the two payment types fundamentally creates two different qualities of customer service experience. Therefore, from a CEM perspective, the exploration of user experience type is both theoretically and practically important.

As a result, user experience type in this sub-study is generated by users of two different payment types. It refers to paid subscriber users' experiences and ad-supported users' experiences. As they enjoy different qualities of customer service experience, they are very likely to perceive the smart service elements differently. Thus, the different user experience types are likely to have different behavioural attitudes, as well as intentions to purchase.

There is evidence that the direct impact of belief factors on attitude toward behaviour and purchase intention may vary according to different types of user experiences. Studies comparing different user experience groups concerning IT system usage suggested the need to develop a TAM for each individual user experience group. For example, based on user experience groups, Castañeda et al. (2007) found a moderating effect on the importance of TAM belief factors as determinants of the future intention to use a website. Choi et al. (2010) also evidenced a positive moderating effect on the relationship between belief factors and behavioural intention in the context of IPTV. In addition, Kim et al. (2018) showed that the user experience type had a moderating role in the association between belief factors and behavioural intention in the context of social media. In this sub-study, user experience type is employed to compare effect sizes between constructs across the two payment type groups in order to determine whether user experience type moderates the impact of users' perceptions on the users' attitude toward behaviour and purchase intention. Thus,

H5a. The user experience type has moderating effects on smart service belief factors as determinants of intention to purchase.

H5b. The user experience type has moderating effects on smart service belief factors as determinants of attitude toward behaviour.

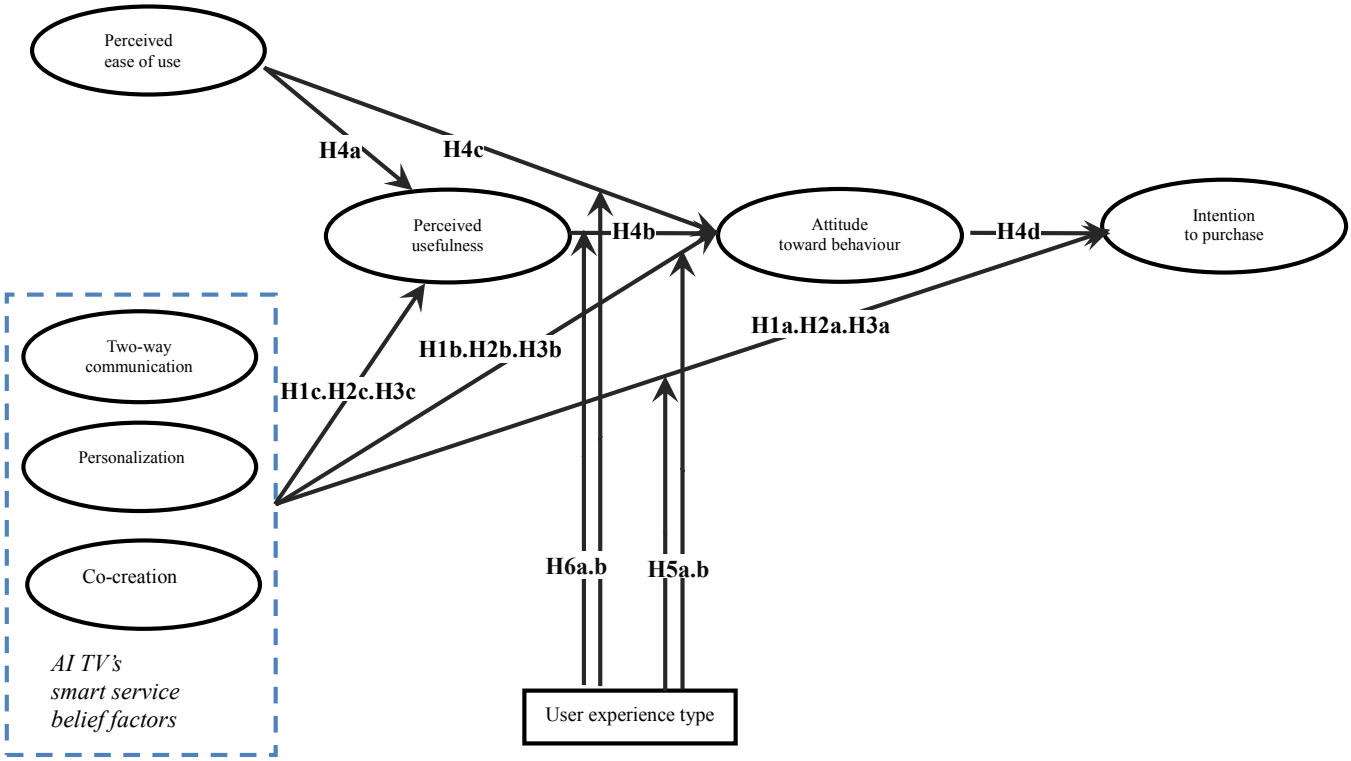
H6a. The user experience type has a moderating effect on perceived usefulness

as a determinant of attitude toward behaviour.

H6b. The user experience type has a moderating effect on perceived ease of use as a determinant of attitude toward behaviour.

Figure 5 presents the proposed research model which summaries the hypothesized relationships.

Figure 5. The proposed research model of chapter 3



3.4 Research method and data

3.4.1 Measurement development

Measurement scales in a questionnaire survey were adapted from relevant prior literature. Twenty-six measurement items corresponding to the seven constructs were measured using a seven-point Likert scale. To measure two-way communication, a scale provided by McMillan and Hwang (2002) is adapted. Personalization is adapted from Kim and Han (2014), which is modified from Xu, Liao and Li (2008), and Ünal et al. (2011). Co-creation is revised from Mathis et al. (2016). The measurement scale for ease of use and usefulness are modified from Venkatesh and Davis (2000). Intention to purchase is revised from Pavlou (2003). Attitude toward behaviour is adapted from Davis (1993). User experience type is a directly accessible objective variable. Thus, it was not explicitly measured and was simply coded based on the user payment type.

3.4.2 Data collection methods

Participants in this sub-study are household users who owned an AI TV and used AI TV content service. Only respondents who answered “yes” to question one, “Have you used AI-Powered smart TV?” were allowed to complete the rest of the questionnaire. On answering question two, participants were divided into two groups, according to their payment type (paid subscribers or ad-supported users).

The internet questionnaire survey was hosted by Baidu company. As a leading Chinese multinational internet company, Baidu specializes in internet-related services, products, and AI (Prince, 2019). The questionnaire sample service relied on the database of the Baidu Company, based on internet user demographic characteristic tags and the application of logical screening mechanisms to accurately locate target respondents. Through a series of anti-cheat mechanisms such as basic account information verification, the reliability of the questionnaire samples was ensured. In order to solicit a pool of respondents who would be as close to the target AI TV users as possible, a simple random sampling procedure was conducted. Ethical approval of this sub-study was obtained, as a sub-study of

the research project “Building a Research-Based International Collaboration Education System” by the Graduate School of Business Administration, Kobe University. All participants were informed of the aims of this sub-study. Participants completed an online questionnaire voluntarily and anonymously. All data were analyzed statistically, and all personal information remained strictly confidential. Since China is a major manufacturer of AI-powered TVs, and the latest smart media services are offered in China, a Chinese sample is representative of a broad user-based and thus, can adequately verify the validity of the theory.

The questionnaire collection was conducted for an approximate duration of two weeks. A total of 1801 questionnaires were distributed in China, and 588 responses were received. Three respondents who were obviously uninterested in the survey were eliminated. The answering duration of two respondents was less than 150 seconds, and one respondent gave the same rating to all items. Hence, 585 responses were retained for analysis.

3.4.3 Pilot test

This sub-study conducted a pilot test on 107 AI TV users, who were not included in the main survey. The results of the pilot test were evaluated using Cronbach’s alpha reliability and factor analysis. The analysis results of the measurement scales were all within the satisfactory range, except for the original two-way communication scale and co-creation scale. After the analysis, the two items in the original seven items in the two-way communication scale, which used reverse formulations showed inconsistency. Therefore, the two reverse items were deleted. In addition, the original co-creation scale with five items was adapted from previous literature on tourism services, which share common features with content services. After the analysis, two of the items did not significantly contribute to the reliability of the measures. They were also relatively unimportant to the AI TV co-creation system; therefore, they were eliminated. After re-testing all the measurement scales, this sub-study found preliminary evidence that they were reliable and valid.

3.5 Data analysis and results

3.5.1 Descriptive statistics

Table 7 summarizes the demographics of the respondents.

Table 7. Demographic characteristics of respondents of chapter 3

Item	Type	Frequency	Percentage
Gender	Male	288	49.2%
	Female	297	50.8%
Age	18-25	156	26.7%
	26-35	332	56.8%
	36-45	75	12.8%
	46+	22	3.8%
Monthly income (RMB:Yuan)	3000-	124	21.2%
	3001-5000	204	34.9%
	5001-10000	191	32.7%
	10001+	66	11.3%
Payment type	Paid subscribers	310	53.0%
	Ad-supported users	275	47.0%

A test of homogeneity was done. All scale items were tested against demographic controls (gender, age, monthly income, and payment type), by applying ANOVA, which was adopted from Cho (2006). At the 95% confidence level, no difference was found in the mean scores of the items. As a result, the survey responses could be mixed as a single dataset.

3.5.2 Data analysis

SEM was considered as the most appropriate method to answer the research questions here, since it can examine overall data fit indices and handle the existing multiple relationships among dependent, mediating, moderating, and independent

variables (Zweig and Webster, 2003). As suggested by Arbuckle (2003), both the measurement model and the structural model were subsequently examined using Mplus Version 7 with maximum likelihood estimation.

3.5.2.1 Measurement model

Confirmatory factor analysis enables the convergent validity, discriminant validity, and reliability of each latent variable to be tested. In SEM analysis, before the examination of the structural model, the measurement model is usually first evaluated (Anderson and Gerbing, 1988). Hair et al. (1998) suggested that loading factors greater than 0.5 can be considered significant. In the initial test, each loading factor exceeded 0.6.

Subsequently, this sub-study conducted validity evaluations, including content, discriminant, and convergent validity. Content validity was established based on a review of the past literature by adopting scales validated by others. The discriminant validity was evaluated to test the correlations of measurements. Convergent validity was established by examining the average variance extracted (AVE), and the composite reliability (CR) of the measurements. In the test, AVE estimates were greater than 0.5, and CR estimates were greater than 0.7, which indicate a satisfactory range (Hair et al., 1998). The estimation of the model's statistical values is shown in Tables 8 and 9.

Table 8. Measurement items, validity and reliability of chapter 3

Construct	Adapted scale	Standar-dized loading	CR	AVE	Cronb-ach's Alpha
Intention to purchase	IP1: It is likely that I will purchase the AI TV content services within the next 6 months.	0.764			
Pavlou (2003)	IP2: Given the chance, I intend to purchase the AI TV content service.	0.655	0.752	0.503	0.750
	IP3: I recommend my family and friends to purchase the AI TV content service.	0.705			
Attitude toward behaviour	ATB1: Using the AI TV is a good idea.	0.813			
	ATB2: Using the AI TV is a wise idea.	0.826			
Davis (1993)	ATB3: I like the idea of using the AI TV.	0.766	0.876	0.588	0.876
	ATB4: Using AI TV is pleasant.	0.735			
	ATB5: I have a positive impression toward using AI TV.	0.684			
Two-way communication	PTC1: AI TV enables two-way communication.	0.820			
	PTC2: AI TV enables concurrent communication.	0.784			
McMillan and	PTC3: AI TV is interactive.	0.745	0.846	0.527	0.845
Hwang (2002)	PTC4: AI TV is interpersonal.	0.647			
	PTC5: AI TV enables conversation.	0.612			
Personalization	PP1: I feel that AI TV content service	0.824			
Kim and Han (2014)	recommendations are tailored to my interests.				
	PP2: I feel that AI TV content service recommendations are personalized.	0.761	0.840	0.569	0.838
	PP3: I feel that AI TV content service is personalized for my use.	0.769			
	PP4: I feel that AI TV content service recommendations are delivered in a timely way.	0.653			
Co-creation	PCC1: I feel comfortable co-creating content	0.728			
Mathis et	(including comments) on AI TV.				
al.(2016)	PCC2: The setting of the AI TV allows me to effectively co-create content.	0.767	0.806	0.580	0.805
	PCC3: My AI TV using experience was enhanced because of my content co-creation activity.	0.789			
Ease of use	PEU1: I found that learning to operate AI TV is easy.	0.735			
Venkatesh and	PEU2: The operation of AI TV is clear and	0.820			
Davis (2000)	understandable.		0.807	0.583	0.805
	PEU3: Operating AI TV does not require a lot of my mental effort.	0.733			
Usefulness	PU1: Using the AI TV makes "TV watching" more	0.761			
Venkatesh and	convenient.				
Davis (2000)	PU2: Using the AI TV can enhance the effectiveness of "TV watching."	0.825	0.786	0.553	0.780
	PU3: Using the AI TV can assist my life.	0.631			

Table 9. Correlation matrices and discriminant validity of chapter 3

	1	2	3	4	5	6	7
1. Usefulness	**0.744**						
2. Ease of use	0.645***	**0.764**					
3.Two-way communication	0.593***	0.558***	**0.726**				
4. Personalization	0.575***	0.580***	0.650***	**0.754**			
5. Co-creation	0.607***	0.534***	0.561***	0.653***	**0.762**		
6. Attitude toward behavior	0.653***	0.621***	0.628***	0.631***	0.586***	**0.767**	
7. Intention to purchase	0.402***	0.340***	0.490***	0.507***	0.452***	0.485***	**0.709**

Note: 1: Zero-order correlation (***:p< 0.001,**:p< 0.01,*:p< 0.05).
2: The bold number on the diagonal is the square root of AVE. Off-diagonal numbers are correlations among constructs.

3.5.2.2 Structural model

Test 1: Testing the base model

To test the base model, smart service belief factors, including perceived two-way communication (PTC), personalization (PP), co-creation (PCC), and ease of use (PEU), were set as independent variables, while perceived usefulness (PU) and attitude toward behaviour (ATB) were set as mediating variables. The intention to purchase (IP) was adopted as a dependent variable.

The theory-trimming technique developed by James et al. (1982) and applied by both Chang and Chen (2008) and Mavondo and Rodrigo (2001), was applied in this sub-study. The base model was thus re-examined by removing the following non-significant hypothesized relationships: PCC to ATB, PCC to IP, and PP to PU links.

As a result, the value of the chi-square distributed with degrees of freedom became 2.638, and the following values for the remaining indices were obtained: Goodness of fit index (GFI)=0.903; Normed fit index (NFI)=0.910; Comparative fit index (CFI)=0.942; Tucker Lewis Index (TLI)=0.934, Root mean square error of approximation (RMSEA)=0.053; Standard root mean square residual (SRMR)=0.040. Thus, as suggested by Hair et al. (1998), and Jöreskog and Sörbom (1994), all the goodness of fit estimates satisfied the recommended levels, indicating that the base model fits the data well. Table 10 shows the results.

Table 10. Goodness of fit indices of chapter 3

Model T indices	Result	Recommended value
Chi-square/degree of freedom	2.638	<3
Goodness of fit index (GFI)	0.903	>0.9
Normed fit index (NFI)	0.911	>0.9
Comparative fit index (CFI)	0.942	>0.9
Tucker Lewis index (TLI)	0.934	>0.9
Root mean square error of approximation (RMSEA)	0.053	<0.08
Standard root mean square residual (SRMR)	0.039	<0.05

Relationships between smart service belief factors and TAM

First, PTC significantly and directly affects IP, ATB and PU, which supports H1a (β=0.187, P<0.05), H1b (β=0.206, P<0.001) and H1c (β=0.191, P<0.001). In addition, PTC significantly indirectly affects IP via PU and ATB. Second, PP significantly and directly affects IP and ATB, which supports H2a (β=0.345, P<0.001) and H2b (β=0.216, P<0.001). However, PP does not impact PU significantly. Thus, H2c is not supported. Additionally, PP significantly indirectly affects IP via ATB. Third, PCC significantly and directly affects PU, which supports H3c (β=0.287, P<0.001). PCC does not directly impact IP and ATB significantly, which means that H3a and H3b are not supported. However, PCC significantly indirectly affects IP through PU and ATB.

Relationships in TAM

H4a (β=0.495, P<0.001) and H4b (β=0.383, P<0.001) are supported at the 99.9% confidence level, and H4d (β=0.203, P<0.01) is supported at the 99% confidence level. However, H4c (β=0.127, P<0.10) is only supported at the 90% confidence level. In addition, PEU significantly, indirectly affects IP through PU and ATB.

Indirect effects on intention to purchase

When testing the mediation, the indirect effect 95% bias-corrected bootstrap confidence is significant. The indirect effects of PEU, PTC, PP and PCC on IP were 0.038, 0.015, and 0.044, and 0.022, respectively. The analytical results confirm that PEU, PTC and PCC indirectly increase IP through the serial mediators PU and ATB. PP indirectly increases IP through the mediator ATB.

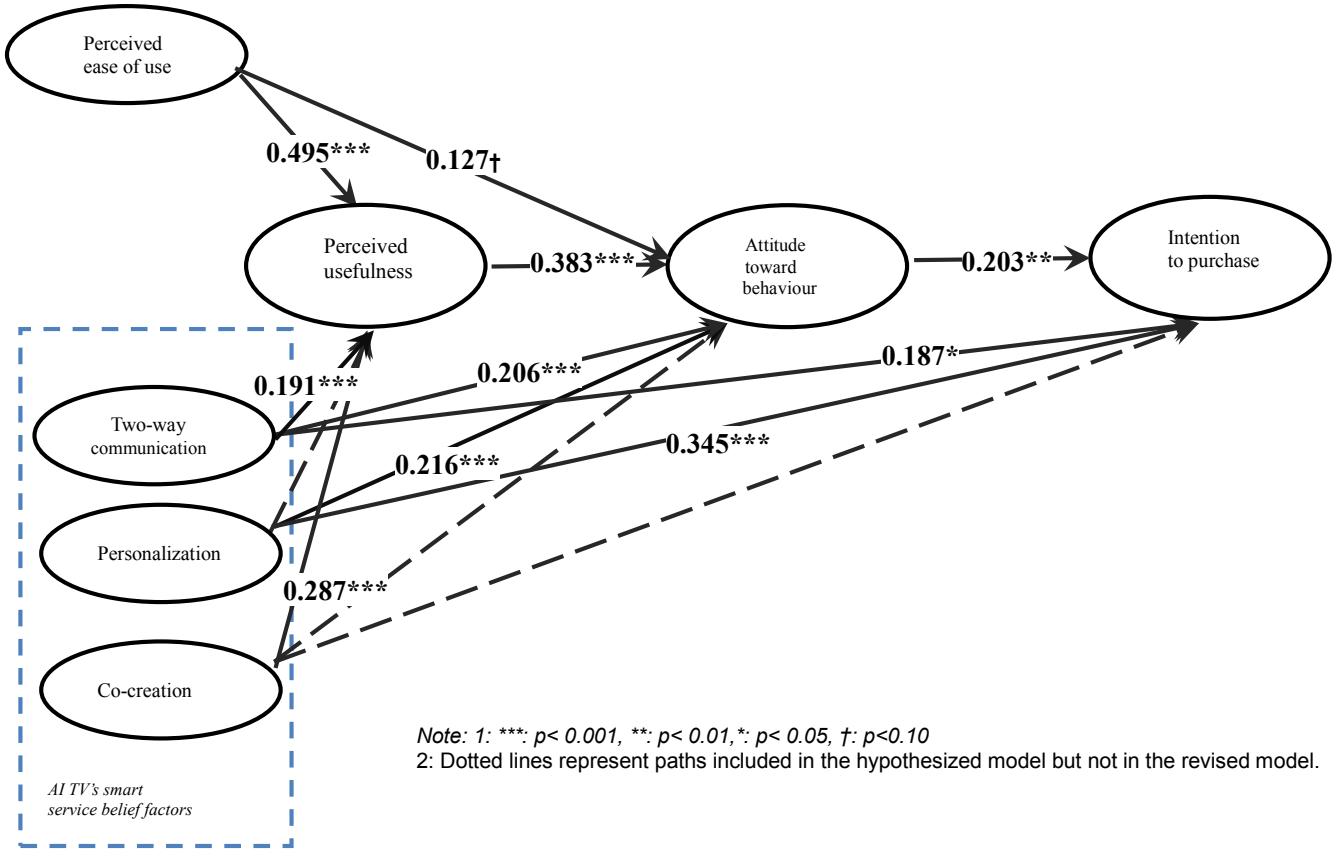
The testing results of the hypothesized relationships within the base model are demonstrated in Table 11 and Figure 6. The indirect effects of PTC, PP, PCC and PEU on IP are demonstrated in Table 12.

Table 11. Hypothesis testing of test 1 (chapter 3)

The hypothesis	Path coefficient	P-value	Result
H1a: Two-way communication -> Intention to purchase	0.187	*	Yes
H1b: Two-way communication -> Attitude toward behaviour	0.206	***	Yes
H1c: Two-way communication -> Usefulness	0.191	***	Yes
H2a: Personalization -> Intention to purchase	0.345	***	Yes
H2b: Personalization -> Attitude toward behaviour	0.216	***	Yes
H2c: Personalization -> Usefulness	n.s	n.s	No
H3a: Co-creation -> Intention to purchase	n.s	n.s	No
H3b: Co-creation -> attitude toward behaviour	n.s	n.s	No
H3c: Co-creation -> Usefulness	0.287	***	Yes
H4a: Ease of use -> Usefulness	0.495	***	Yes
H4b: Usefulness -> Attitude toward behaviour	0.383	***	Yes
H4c: Ease of use -> Attitude toward behaviour	0.127	†	Yes
H4d: Attitude toward behaviour -> Intention to purchase	0.203	**	Yes

*Note: ***: p< 0.001, **: p< 0.01, *: p< 0.05, †: p<0.10*

Figure 6. Path analysis of chapter 3



*Note: 1: ***: p< 0.001, **: p< 0.01,*: p< 0.05, †: p<0.10*
2: Dotted lines represent paths included in the hypothesized model but not in the revised model.

Table 12. Indirect effects of chapter 3

Pathway	Path coefficient	LLCI	ULCI
Ease of use → Usefulness → Attitude toward behaviour → Intention to purchase	0.038	0.006	0.171
Two-way communication → Usefulness → Attitude toward behaviour → Intention to purchase	0.015	0.008	0.195
Personalization → Attitude toward behavior → Intention to purchase	0.044	0.002	0.144
Co-creation → Usefulness → Attitude toward behavior → Intention to purchase	0.022	0.002	0.078

Note: 2,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.

Test 2: Testing for the moderating effect of the user experience type

To test the hypotheses with respect to the moderating effects of user experience type, this sub-study applied multiple-group analysis, which is given by Jöreskog and Sörbom (1994), adopted by Chang and Chen (2008) and Kim et al. (2018). It is comprised of four steps:

The data was first divided into two groups based on the user experience type (a paid subscribers group and an ad-supported users group). Subsequently, a path model was estimated. All path values in the two sub-models formed from the two sub-group samples were restricted to be equal, except the moderating path that was tested. After that, the moderating path values in the path models were estimated. The path from PTC and PP to ATB and IP, and from PU and PEU to ATB, were allowed to vary between the two sub-models. Finally, in order to determine the moderating effect, the Wald test as proposed by Asparouhov (2007); Satorra and Bentler (2010), was applied between the groups to identify whether the moderating paths of the two sub-models were significantly different.

Results show that the provided models all suggest a good fit (Hair et al., 1998; Jöreskog and Sörbom, 1994). When the two sub-groups are different in terms of variability, unstandardized estimates, rather than standardized, should be compared (Kline, 2005). Owing to the fact that the impact of PCC on the ATB link and the impact of PCC on the IP link are insignificant, this sub-study does not test the moderating effects on those two links. Table 13 depicts all the details of results generated by test 2.

Regarding the hypotheses testing results, first, H5a was supported. The Wald test result was 4.426 ($P < 0.05$) for the PTC – IP link, and 2.871 ($P < 0.10$) for the PP – IP link. The PTC – IP link shows a significant, positive moderating effect at the 95% confidence level. The PP – IP link shows a significant, positive moderating effect at the 90% confidence level. Thus, the user experience type moderates the effects of both PTC and PP on IP. In terms of the PTC – IP link, the paid subscriber group has more positive results than the ad-supported user group. In the ad-supported user group, the impact of PTC on IP is insignificant (ad-supported user group: 0.139; paid subscriber group: 0.338**). However, in both groups, PP positively impacts IP (ad-supported user group: 0.221* at the 95% confidence level; paid subscriber group: 0.432*** at the 99.9% confidence level). Second, H5b was partially supported. The Wald test result of 5.090 ($P < 0.05$) for the PP – ATB link shows a significant, positive moderating effect at the 95% confidence level. In both groups, PP impacts ATB positively (ad-supported user group: 0.247***; paid subscriber group: 0.144†), although in the ad-supported user group, PP impacts ATB more significantly. However, the Wald test result is 1.185 ($P > 0.10$) for the PTC – ATB link. Therefore, the user experience type only moderates the effect of

PP on the ATB path. Finally, H6 was not supported. The Wald test result is 1.770 ($P > 0.10$) for the PU – ATB link (H6a) and 1.487 ($P > 0.10$) for the PEU – ATB link (H6b). However, PEU impacts ATB significantly at the 95% confidence level ($\beta=0.165$, $P < 0.05$) in the ad-supported user group, whereas the impact of PEU on ATB is insignificant ($\beta= 0.097$, $P > 0.10$) in the paid subscriber group.

Table 13. Chi-square difference test between paid subscriber and ad-supported user groups

Path	Base model	H5a:Support				H5b:Partially Support				H6a:Not Support		H6b:Not Support	
		Model 1: Two-way communication – Intention to purchase		Model 2: Personalization – Intention to purchase		Model 3: Two-way communication- Attitude toward behavior		Model 4: Personalization – Attitude toward behavior		Model 5: Usefulness - Attitude toward behavior		Model 6: Ease of use - Attitude toward behavior	
	Full sample	Ad-supported	Paid	Ad-supported	Paid	Ad-supported	Paid	Ad-supported	Paid	Ad-supported	Paid	Ad-supported	Paid
Unstandardized estimates													
Usefulness - Attitude toward behavior	0.390***	0.393***	0.393***	0.392***	0.392***	0.388***	0.388***	0.393***	0.393***	**0.419*** **	**0.331*** **	0.390***	0.390***
Ease of use - Attitude toward behavior	0.129†	0.129†	0.129†	0.128†	0.128†	0.130†	0.130†	0.124†	0.124†	0.139†	0.139†	**0.169***	**0.090**
Two-way communication – Attitude toward behavior	0.190***	0.183**	0.183**	0.184**	0.184**	**0.207*** **	**0.141***	0.179**	0.179**	0.178**	0.178**	0.179**	0.179**
Personalization – Attitude toward behavior	0.193***	0.161**	0.161**	0.162**	0.162**	0.174**	0.174**	**0.241*** **	**0.113**†	0.175**	0.175**	0.169**	0.169**
Attitude toward behavior – Intention to purchase	0.238**	0.191*	0.191*	0.196*	0.196*	0.178*	0.178*	0.176*	0.176*	0.175*	0.175*	0.175*	0.175*
Two-way communication – Intention to purchase	0.202*	**0.133**	**0.322****	0.207*	0.207*	0.207*	0.207*	0.208*	0.208*	0.208*	0.208*	0.208*	0.208*
Personalization – Intention to purchase	0.361***	0.281***	0.281***	**0.219***	**0.366*** **	0.318***	0.318***	0.318***	0.318***	0.319***	0.319***	0.319***	0.319***
Ease of use - Usefulness	0.493***	0.500***	0.500***	0.501***	0.501***	0.501***	0.501***	0.501***	0.501***	0.500***	0.500***	0.502***	0.502***
Two-way communication - Usefulness	0.173**	0.174**	0.174**	0.172**	0.172**	0.173**	0.173**	0.173**	0.173**	0.172**	0.172**	0.172**	0.172**
Co-creation - Usefulness	0.289***	0.284***	0.284***	0.284**	0.284**	0.283***	0.283***	0.283***	0.283***	0.285***	0.285***	0.283***	0.283***
Standardized estimates													
Usefulness - Attitude toward behavior	0.383***	0.402***	0.394***	0.402***	0.394***	0.389***	0.398***	0.385***	0.415***	**0.416*** **	**0.343*** **	0.389***	0.402***
Ease of use - Attitude toward behavior	0.127†	0.129†	0.134†	0.129†	0.134†	0.128†	0.139†	0.119†	0.136†	0.135†	0.149†	**0.165***	**0.097**
Two-way communication – Attitude toward behavior	0.206***	0.204**	0.199**	0.204**	0.200**	**0.224*** **	**0.157***	0.189**	0.205**	0.192**	0.200**	0.194**	0.200**
Personalization – Attitude toward behavior	0.216***	0.175**	0.196**	0.175**	0.196**	0.183**	0.217**	**0.247*** **	**0.144**†	0.183**	0.219**	0.177**	0.211**
Attitude toward behavior – Intention to purchase	0.203**	0.180*	0.184*	0.183*	0.190*	0.162*	0.178*	0.164*	0.173*	0.161*	0.174*	0.160*	0.174*
Two-way communication – Intention to purchase	0.187*	**0.139**	**0.338****	0.215*	0.219*	0.205*	0.232*	0.205*	0.233*	0.206*	0.232*	0.206*	0.232*
Personalization – Intention to purchase	0.345***	0.287***	0.331***	**0.221***	**0.432*** **	0.305***	0.397***	0.304***	0.401***	0.307***	0.399***	0.307***	0.399***
Ease of use - Usefulness	0.495***	0.490***	0.520***	0.491***	0.521***	0.491***	0.521***	0.491***	0.521***	0.491***	0.519***	0.491***	0.522***
Two-way communication - Usefulness	0.191**	0.188**	0.187**	0.187**	0.186**	0.188**	0.188**	0.187**	0.188**	0.187**	0.186***	0.187**	0.187**
Co-creation - Usefulness	0.287***	0.270***	0.292***	0.270***	0.292***	0.270***	0.291***	0.270***	0.290***	0.272***	0.292***	0.270***	0.290***
Attitude toward behavior - R^2	0.701***	0.658***	0.698***	0.658***	0.698***	0.676***	0.683***	0.697***	0.668***	0.683***	0.675***	0.679***	0.681***
Intention to purchase - R^2	0.451***	0.297***	0.610***	0.307***	0.599***	0.368***	0.547***	0.371***	0.544***	0.368***	0.547***	0.368***	0.547***
Usefulness - R^2	0.751***	0.702***	0.798***	0.702***	0.798***	0.701***	0.799***	0.701***	0.800***	0.705***	0.795***	0.702***	0.798***
Wald test		**4.426***		**2.871†**		**1.185**		**5.090***		**1.770**		**1.487**	
P-value		**0.035**		**0.090**		**0.276**		**0.024**		**0.183**		**0.223**	
Chi-square/ Degree of freedom	2.638	2.017		2.020		2.023		2.016		2.022		2.022	
Comparative fit index (CFI)	0.942	0.917		0.917		0.917		0.918		0.917		0.917	
Tucker Lewis index (TLI)	0.934	0.912		0.912		0.912		0.913		0.912		0.912	
Root mean square error of approximation (RMSEA)	0.053	0.059		0.059		0.059		0.059		0.059		0.059	

3.6 Discussions and conclusions

3.6.1 Discussions

The data analysis results show that smart service belief factors, including perceived two-way communication and personalization, are found to be critical determinants of a user's attitude toward behaviour and intention to purchase in the extended TAM. These findings are consistent with the prior literature (e.g., (Kim and Gambino, 2016; Sundar et al., 2016)). Besides, perceived two-way communication is found to be an important antecedent for perceived usefulness in this sub-study, which is consistent with the finding from Abdullah et al. (2017). Through logical reasoning and empirical analysis, this sub-study also found that perceived co-creation is an important antecedent for perceived usefulness, which has not previously been explored to the best of our knowledge. It is worth noting that two-way communication is the most active variable, which positively impacts three constructs directly; namely perceived usefulness, attitude toward behaviour, and intention to purchase. Perceived co-creation does not positively impact attitude toward behaviour and purchase intention directly. This is inconsistent with the findings from Duan and Dai (2018). However, it can be explained both theoretically and practically. In practice, as users' perceived degree of co-creation is based on their interaction with the AI TV's co-creation system, it impacts users' perceived usefulness, as data analysis results suggest. However, at present, the co-creation functions are still technologically primitive. The lack of a direct relationship suggests that primitive co-creation features seem to increase customer apathy. Furthermore, in the sense of co-creation, content services such as interactive content enhance the users' sense of participation. However, using the co-creation content requires users to continually switch between active and passive modes. In addition, users' co-creation activities through AI TV functions on smart systems can often obscuring the screen and program content, and thus, influencing the user's basic viewing experience negatively. As a result, since a pleasant viewing experience is the main criteria (Coppens et al., 2004) for AI TV usage, co-creation functions do not directly enhance users' attitude toward behaviour and intention. Additionally, an unexpected result of this sub-study is the insignificance of

perceived personalization on perceived usefulness. This is inconsistent with the findings from previous literature (e.g., (Desai, 2018)). In the context of AI TV content service, a plausible explanation is that, personalization is the service provider's decision of what is suitable for the individual consumer, based on an intelligent recommendation system and user data analysis. Thus, personalization is more of a marketing approach, and therefore, it positively influences attitude toward behaviour and intention to purchase, rather than perceived usefulness.

All the relationships in the basic TAM were empirically confirmed in the context of smart media service. These findings are consistent with the previous literature (e.g., (Davis, 1989; Gao et al., 2016)). However, the line between perceived ease of use and attitude toward behaviour only supported at the 90% confidence level. This is consistent with the findings in recent studies in the context of Internet TV from Jang and Noh (2011); Jung et al. (2009); Wagner et al. (2017), in which this link was also found to be insignificant at the 95% confidence level. This is because the AI TV content service can be easily and effortlessly accessible for the average user. Thus, the user's attitude mainly depends on its functionality.

In light of the existing TAM literature, serial mediation effects are found in this sub-study, such that perceived usefulness and attitude toward behaviour mediates the relationships between smart service belief factors as well as perceived ease of use, and intention to purchase. The findings of perceived usefulness and attitude toward behaviour as mediators are consistent with the prior literature (e.g., (Davis et al., 1989; Ooi and Tan, 2016; Wu and Chen, 2016)), in which perceived usefulness and attitude toward behaviour also play mediating roles. The indirect effects of two-way communication, personalization, co-creation and perceived ease of use on intention to purchase were both found to be significant and positive. Therefore, in the context of smart media service consumption, this sub-study confirmed that perceived usefulness and attitude toward behaviour served as crucial mediating variables in the extended TAM model.

In this sub-study, the user experience type in terms of ad-supported user groups and paid subscriber groups are found to exert a positive, moderating effect on the relationship between both personalization and two-way communication and attitude toward behaviour and intention to purchase. These findings are consistent with the previous literature (e.g., (Choi et al., 2010; Kim et al., 2018)), in which there is a moderating effect on the association between belief factors and

behavioural intention, based on user experience groups. The smart service belief factors of perceived two-way communication and perceived personalization appear to more significantly influence intention to purchase in paid subscriber groups (Test 2, H5a). This is probably due to the fact that the paid subscriber group has already paid for the content service and hence, has had a better smart service experience and will have a stronger intention to keep purchasing in comparison with the ad-supported user group. In both the paid and ad-support groups, perceived personalization positively impacts purchase intention. However, in the ad-supported user group, perceived two-way communication has an insignificant impact on intention to purchase, which means that the paid experience is a requirement for the two-way communication to intention to purchase causal path to be established. Additionally, although perceived personalization appears to have a significant effect on attitude toward behaviour in both user groups, the user experience type can exert a moderating effect on perceived personalization to attitude toward behaviour. However, perceived personalization appears to more significantly influence attitude toward behaviour in ad-supported user groups (Test 2, H5b). This means that perceived personalization generates better evaluations in ad-supported users' attitudes. Therefore, enhanced perceived personalization will more effectively influence ad-supported users' attitudes, and their purchase intentions will be influenced via their attitudes. Furthermore, results show that the user experience type does not exert a positive moderating effect on perceived ease of use to attitude toward behaviour. However, perceived ease of use impacts attitude toward behaviour significantly in the ad-supported user group, whereas perceived ease of use does not impact attitude toward behaviour significantly in the paid subscriber group. Davis et al. (1989) concluded that the effect of perceived ease of use on attitude toward a technology dissolves with users' increased experience. This indicates that the paid subscriber's attitude toward behaviour depends on perceived usefulness and other smart service belief factors, rather than perceived ease of use. Additionally, statistical analysis result shows that, although perceived two-way communication appears to more significantly influence attitude toward behaviour in the ad-supported user group, there was an insignificant difference between both user experience type groups on perceived influence of two-way communication on attitude toward behaviour. Similarly, although perceived usefulness appears to more significantly influence attitude

toward behaviour in ad-supported user groups, there was no significant difference between the two user experience type groups on the relationship between perceived usefulness and attitude toward behaviour. In the context of AI TV, a possible explanation could be that users perceive the usefulness and two-way communication of AI TV as natural to its basic functions, these functions successfully satisfy both user groups' basic needs and thus, lead to similar evaluations in their attitudes.

3.6.2 Theoretical contributions

This sub-study contributes to the literature on user's perception stage in smart service consumption by identifying the belief factors of users concerning smart services. By studying the relationships among smart service belief factors (perceived two-way communication, perceived personalization, and perceived co-creation), perceived usefulness, attitude toward behaviour, as well as intention to purchase, the knowledge gained can facilitate a better understanding of user's perception stage in the context of a smart media content service.

This knowledge leads to an additional theoretical contribution of this sub-study; the extension of TAM by adding three smart service belief factors (perceived two-way communication, perceived personalization, and perceived co-creation) in the context of smart media service. The mediating effects of perceived usefulness and attitude toward behaviour, which are consistent with the prior literature (e.g., (Davis et al., 1989; Ooi and Tan, 2016; Wu and Chen, 2016)), provide explanations of the influence mechanism of smart service belief factors on intention to purchase and thus clarify the predictive relationship among the constructs in the context of smart service consumption.

This sub-study also found support for the original TAM with the remaining constructs in the model performing as expected in the smart media context. By doing so, this sub-study has expanded the overall theoretical basis related to technology use, as well as expanding the scope and generalizability of TAM to be more applicable to the smart media service environment.

In addition, this sub-study contributes to the literature by conceptualizing user experience type and investigating how user experience type moderates the effect of user perceptions concerning smart service on attitude toward behaviour and

intention to purchase. In the context of smart media service consumption, the two different payment types essentially lead to the two most important user experience types and fundamentally create two different qualities of customer service experience. Thus, the addition of user experience type as a moderator is crucial in expanding the generalizability of this extended TAM model to understand smart media content consumption.

As CEM represents a strategy for managing customer experience, and as customer experience comes from a series of interactions involving customer at various levels (Gentile et al., 2007; Homburg et al., 2017), this suggests that a comprehensive approach to managing customer experience must be taken. By developing an extended TAM model which incorporates smart service belief factors, as well as user experience type as a moderator, this sub-study furthers the fundamental understanding of the nature of users' perceptions of smart services across two experience type groups. The understanding of the influence of users' perceptions on purchase intention is also furthered. Thus, this sub-study is important if we are to better understand how to manage the customer experience within a smart media service environment.

3.6.3 Managerial implications

Many of our findings offer guidance to management and smart media practitioners. In a smart media context, enhancing intention to purchase is a difficult challenge that may require consideration by smart media practitioners wishing to differentiate themselves from competitors. This sub-study suggests that smart media practitioners should consider focusing more on enhancing users' perceptions in user's perception stage, in their marketing strategies.

This sub-study also confirmed that users' smart service belief factors in user's perception stage are consistent with smart media interactive communication features in practice. The better the features are, the more positive the attitudes will be and the stronger the intention to purchase the smart media content service will be.

Two-way communication directly impacts purchase intention, attitude toward behaviour and perceived usefulness. Personalization directly impacts purchase intention and attitude toward behaviour. Thus, the enhancement of two-way

communication and personalization can significantly improve the smart content service flow by making it more satisfactory to users. This will enhance both the user's attitude and intention to purchase.

When practitioners have limited resources for their marketing efforts, personalization and two-way communication could be two of the easier factors to target for enhancing users' evaluations of service performance and thus, enhancing purchase intentions. For example, smart media practitioners can focus on improving speech recognition capabilities by developing advanced implanted voice algorithms and thus, make two-way communication more effective. They can also invest substantially in self-learning technology and content aggregation search engine functionality to more accurately provide personalized content to each individual user.

Recognizing the differences between paid subscriber groups and ad-supported user groups' smart service perceptions, we can formulate proper CEM strategies for each group and effectively enhance intention to purchase. Increasing the level of a user's personalization and two-way communication awareness will more effectively increase the purchase intention levels of paid subscribers over ad-supported users. Hence, this strategy is more effective for retaining existing paid subscribers than acquiring new subscribers. However, increasing the level of a user's personalization awareness will effectively increase the behavioural attitude levels in ad-supported users, and will subsequently influence their purchase intention. Thus, it is an effective strategy for attracting new paid subscribers.

Consequently, from a CEM perspective, this research provides a further step toward better management of customer experience within the smart media content service market. It practically contributes to solving the problem of how to build a more scientific smart media service CEM system to attract new paid subscribers, while retaining existing subscribers.

3.6.4 Conclusions

Drawing broadly on TAM and the study of smart services, this sub-study explores user's perception stage by identifying key smart service belief factors and conceptualized the user experience type, based on a review of the extant literature. This sub-study developed and extended TAM by integrating smart service belief

factors in the context of smart media and employed user experience type as a moderator. This theoretical framework reconciled three streams in the literature. First, TAM studies explain users' behavioural patterns and intention to purchase. Second, service studies explain users' key belief factors toward smart service elements. Third, this sub-study attempts to explicate how the user experience type moderates the influence of smart service perceptions on attitude toward behaviour and purchase intention from a CEM perspective.

An analysis of 585 AI TV user samples largely supported the hypothesized relationships in the model. These results contribute to the extant literature on smart services by providing a new way to analyze users' belief factors in the smart media service context. This sub-study confirms the validity of TAM in a smart media context and identifies new belief factors that can be integrated into the extended TAM. It highlights the importance of the moderating role of the user experience type. Thus, it furthers the generalizability of TAM to the smart media service context. The findings of this research contribute in a practical way to solving problems associated with building a more scientific smart media content services CEM system.

3.6.5 Limitations and directions for future research

The findings of the sub-study are subject to the following limitations. First, the generalizability would be enhanced if results could be compared with a sample from a developed country. Second, as a cross-sectional study, this research is difficult to explore the trends in the development of the research object. Finally, this sub-study is a prospective study, which was conducted in the context of developing smart media technology. AI TV technology is developing at such a rapid pace, richer and better application scenarios of AI TV content service will be presented in the future; however, the basic belief factors of smart service are very likely to remain the same.

Future studies can empirically examine other types of smart media. Theoretically, additional psychological and behavioural constructs can be explored by further extending TAM. Additionally, the effects of users' lifestyle, personality traits, and demographic factors can be explored by applying them as external variables in an extended TAM model for a more complete understanding of user's

perception stage in the context of smart services.

Chapter 4

Understanding smart service user's decision based on the integration with stimuli, UTAUT and flow

4.1 Research background

Artificial intelligence (AI) is profoundly reshaping educational services. AI technology can support inclusive and ubiquitous learning access, help ensure educational opportunities, promote personalized learning, and enhance learning outcomes (UNESCO, 2019). Prior literature suggested that AI is very effective in motivating students and improving students' performance; for example, Shute (1989) confirmed that students using an intelligent tutoring system performed as well as students taking economics courses; still, the time to study all course content was reduced by half.

To understand smart service user's decision stage in mobile-based smart education service (MBSES), this sub-study takes Liulishuo as a typical research object. Liulishuo is a mobile education service based on AI, which has strong technical characteristics.

Liulishuo is a smart language learning application that uses AI technology based on speech recognition. It integrates AI technology system with an innovative, user-friendly front-end interface (Liulishuo.com, 2020). With Liulishuo, users (learners) can personalize learning according to their own learning pace, and gradually improve their level. It thereby creates a user-centric smart product and smart service system which brings a personalized, interactive, convenient, and smart learning experience for each user.

The existing research lacks an understanding of the user's decision towards MBSES. Prior literature indicates that the following aspects are still limited: (1) what smart service attributes impact user's MBSES selection; (2) to what extent these motivations influence user's internal evaluation towards MBSES; (3) to what extent the internal evaluation impact user's flow state as well as continuance intention towards MBSES. The gaps mentioned above suggest that more rigorous research needs to be done.

To fill the research gaps, this sub-study (1) takes information processing theory as the research framework; (2) employs extended UTAUT to measure user's

internal evaluation; (3) applies flow theory to understand user's continuance intention towards MBSES better.

Therefore, based on the information processing framework which reflects the traditional SOR framework, this sub-study develops a model to investigate the effects of technological features (intelligence, convenience, interactivity, personalization) of mobile-based smart education service on users' internal evaluation (performance expectancy, effort expectancy, social influence, facilitating conditions, social interaction, and habit) as primary information processing, subsequently on flow as secondary information processing, and finally on their continuance intention. This research also attempts to investigate the serial mediation effects among the constructs in the model through a PLS-SEM data analysis procedure. Consequently, by building on, integrating and extending theories relevant to this sub-study, we expect to make the following potential contributions.

First, based on an information processing framework, this sub-study establishes a theoretical model that can explain the user's decision stage towards mobile-based smart education service, and thus develops the information processing theory.

Second, to explain mobile-based smart education users' psychological and behavioural mechanism, this sub-study incorporates stimuli constructs as antecedents to the extended UTAUT.

Third, to explain the user's final decision, this sub-study adapts flow theory as a partial mediator between UTAUT and user's behavioural intention.

Fourth, this sub-study furthers the generalizability of UTAUT to a mobile-based smart education service (MBSES) context by adding social interaction and habit as additional constructs into UTAUT.

4.2 Theoretical framework

To lay a solid theoretical basis for this research, based on an information processing framework, literature relevant to stimuli (including intelligence, convenience, interactivity, personalization), extended UTAUT, flow, was reviewed in a logical order.

4.2.1 Information processing theory

Information processing theory is established on the premise that humans process information about the relationship between behaviour and outcome. Through information processing, people form expectations and make decisions about choosing appropriate behaviours (Hann et al., 2007).

In the field of cognitive psychology, information processing theory provides a way to understand the way humans think, similar to the way computers process information (Shannon and Weaver, 1963). Computers provide a metaphor for cognitive psychologists. They can compare the way computers process information to the way humans process information. (e.g., (Shannon and Weaver, 1963)).

Information processing theory describes how our brain filters information by explaining how information is encoded into our memory (e.g., (Shannon and Weaver, 1963)). Newell and Simon (1972) proposed that information processing combines a two-store interpretation of the memory structure; the incoming data is temporarily stored in the primary memory with limited capacity, can be rehearsed, and then put into a more extensive secondary memory.

Based on information processing theory, information refers to a series of multi-dimensional attributes (cues) of the stimulus (Bither and Ungson, 1975). Information processing is the process by which people process information; this process usually requires a series of conscious mental operations, which are necessary for decision (e.g., (Chestnut and Jacoby, 1977)). The entire information processing system is divided into three phases, reflecting the traditional stimulus-organism-response (SOR) framework (Chestnut and Jacoby, 1977).

In this sub-study, we consider MBSES attributes as sensory stimuli, perceived extended UTAUT factors as primary information processing process, flow factors as secondary information processing process. This logic can be supported by neuroscience. From the perspective of neuroscience, cognition is related to the prefrontal region that makes up the explicit system, and flow state is related to the basal ganglia that make up the implicit system (e.g., (Dietrich, 2004; Peifer, 2012; Peifer et al., 2014)).

4.2.2 Stimuli

Eroglu et al. (2003) suggested that, in an online context, stimuli refer to the design attributes of the online system that users interact with. This sub-study considers that MBSES attributes (personalization, interactivity, convenience, and intelligence) as stimuli, which have a significant influence on the user's perceived extended UTAUT factors as primary information processing, and flow state as secondary processing, eventually influence the user's behavioural intention.

Interactivity

With the development of AI technology, such as natural language understanding and image recognition, the way of human-computer interaction is changing from machine-centred interaction to user-centred interaction, which is more natural and more like interpersonal communication.

Different researchers focus on various aspects of the concept of interactivity. From a communication approach, interactivity is associated with message exchanges and communicator; information sharing and exchange are the key elements in this communication approach (e.g., (Bretz, 1983; Rafaeli, 1988; Williams et al., 1988). From a media environment approach, Steur (1995) suggested that the telepresence and vividness are two crucial elements of interactivity; in this sense, latency, real-time interaction, and the immediacy of response are critical. McMillan and Hwang (2002) proposed that interactivity is related to both parties of communication; it refers to the ability to hold and control information, as well as to participate in active communication in real-time. They suggested that the user's impression of communication direction, control, and time forms the core of the perceived interactivity. Johnson et al. (2006) defined interactivity as the extent an individual gets involved in a communication process; they emphasized on the interchange of the communication, responsiveness, response speed, and non-verbal information. Wu (2006) suggested that perceived interactivity could be defined as an interactive process; it is the psychological state experienced by visitors. Florenthal and Shoham (2010) indicated that interactivity refers to the degree to which one or more individuals can react to when they are using specific information sources.

In addition to the service provided by the smart service system, interactivity of the system is also necessary (Baldoni et al., 2010; Demirkan et al., 2015; Wünderlich et al., 2013). The degree of naturalness concerning human-computer interaction is one of the critical differences between MBSES and other non-smart online education services. The MBSES applies natural language understanding technology to achieve natural human-computer interaction; users(learners) can thus speak to the smart service system, just like talking to a human teacher (Bajaj and Sharma, 2018).

Previous literature has suggested that interactivity can very likely impact on users' performance expectancy (e.g., (Abbad et al., 2009)), effort expectancy (e.g., (Abbad et al., 2009)), social interaction (e.g., (Auter, 1992)). Besides, as interactivity can effectively improve learning efficiency and experience, it is reasonable to assume that: (1) people who are important to users will influence the user to use MBSES with higher interactivity; (2) users believe technical factors in the environment are adequate with a more interactive MBSES; (3) users tend to perform learning behaviours more automatically with a more interactive MBSES. Thus,

H1. A higher degree of interactivity is associated with a higher degree of perceived UTAUT factors: (a) performance expectancy, (b) effort expectancy, (c) social influence, (d) facilitating conditions, (e) social interaction, (f) habit.

Intelligence

Intelligence means the ability of the MBSES system to intelligently and automatically adjust according to user needs during operation (Dong et al., 2017). It is manifested in the simplification and automation of smart service system operation (Dong et al., 2017). MBSES system can analyze the data obtained from the users and the environment; Zhang et al. (2009) suggested that the user interface of a smart system has three levels of functionality; in the high level, MBSES system will intelligently perform all operations without user's confirmation. If there are multiple ways to complete the task, the MBSES system will intelligently make the best choice (Zhang et al., 2009); as a result, users will realize that the MBSES system is intelligently adjusted according to their usage preferences; this

approach is effective, efficient and comfortable in the context of online education, and is therefore smart.

Intelligence also refers to that the MBSES system can store memory through continuous self-learning (Ritter et al., 2011). The intelligence of MBSES system is shown in the aspects of competence, sensitivity and smartness (Bartneck et al., 2009). User's perceived intelligence is a subjective existence, which means the user's subjective assessment of the smartness, intelligence, and capabilities of the MBSES system (Lee et al., 2007).

As intelligence can enable users to achieve better learning outcomes, it is reasonable to assume that (1) users will believe that using a smarter MBSES will help improve performance; (2) users will find a smarter MBSES is easy to use; (3) people who are important to users will influence the user to use more intelligent MBSES; (4) users believe technical factors in the environment are adequate with more intelligent MBSES; (5) users tend to interact with each other more effectively with a smarter MBSES; (6) users tend to perform learning behaviours more automatically with a more intelligent MBSES. Thus,

H2. A higher degree of intelligence is associated with a higher degree of perceived UTAUT factors: (a) performance expectancy, (b) effort expectancy, (c) social influence, (d) facilitating conditions, (e) social interaction, (f) habit.

Convenience

Convenience is one of the most prevalent incentives for users to use information technology services (Chen et al., 2002). Previous studies suggest that convenience can positively impact on user's intentions to use information technology services (e.g., (Ozturk et al., 2016)). Jiang et al. (2013) suggested that users regard convenience as one of the critical factors for the success of information technology services.

Researchers need to understand and measure the concept of convenience from different dimensions. Brown (1990) suggested five dimensions for understanding and measuring convenience: (1) providing products and services at a more convenient place; (2) providing products and services at a more convenient time; (3) the ability to make the transaction more convenient; (4) more convenient

delivery of the products and services; (5) the products and services are more convenient to be used.

In the MBSES usage context, it is evident that users (learners) who have strong learning purpose, will utilize fragmented time to learn anytime, anywhere, and can thus learn more effectively and efficiently. Therefore, in this sub-study, we identified the dimension of convenience as time, place and usage convenience. In the context of mobile-based smart education services, the time and place convenience the individual's belief of how they use MBSES technology to complete learning at a more convenient time and place. The usage convenience refers to the user's belief of how convenient MBSES technology can be used in the learning process.

Previous literature has suggested that convenience may very likely affect users' performance expectancy (e.g., (Teo et al., 2014)), effort expectancy (e.g., (Teo et al., 2014)), facilitating conditions (e.g., (Krishnaraju et al., 2016; Vinodh and Mathew, 2012)), social interaction (e.g., (Carmel et al., 2009)) and habit (e.g., (Pan and Yan, 2012)). Besides, as the convenience can make users learn more effectively and efficiently, it is reasonable to assume that people who are important to users will influence the user to use more convenient MBSES. Thus,

H3. A higher degree of convenience is associated with a higher degree of perceived UTAUT factors: (a) performance expectancy, (b) effort expectancy, (c) social influence, (d) facilitating conditions, (e) social interaction, (f) habit.

Personalization

Personalization is fundamental to AI learning because education is personal in nature; smart education primarily focuses on creating efficient systems like one-to-one human teaching (VanLehn, 2011). Online education is one of the earliest service sectors, where personalization has been attempted (Ashman et al., 2014). Personalization in education can show learners when and what they need to know (Ashman et al., 2014). This sub-study defines personalization as providing personalized education service by deciding what is suitable for each user (learner), based upon the data analysis of each user's usage habits.

Shute (1995) proposed that education information systems with personalized functions are prefered to non-personalized systems. Russell (1997) pointed out that educators should recognize and identify the learning differences of each learner and utilize technology as much as possible to provide education services for them. Martinez (2001) suggested that learners will achieve better results with a system that supports their personalized learning. As a result, the personalized attribute of MBSES is essential to improve the users' learning effect.

The goal of personalization in education is to address the shortcomings of each learner so that learners can achieve their best results (Ashman et al., 2014). MBSES system can recognize the weaknesses of different learners (users) through their feedback. For instance, different learners (users) could have different shortcomings in English language learning. User A may not master the subjunctive mood well; user B may often make mistakes in conditional sentences; user C may have problems in oral pronunciation. When the MBSEM system discovers the user's personal weaknesses, it can provide personalized guidance, and help users overcome their personal shortcomings.

Previous literature has suggested that personalization may very likely affect users' performance expectancy (e.g., (Chau and Lai, 2003; Liang et al., 2012)), effort expectancy (e.g., (Ahmad and Al-Zu'bi, 2011; Beninger, 1987; Mathew and Stone, 2003; Wang et al., 2017)), facilitating conditions (e.g., (Krishnaraju et al., 2016; Vinodh and Mathew, 2012)), social interaction (e.g., (Carmel et al., 2009)) and habit (e.g., (Pan and Yan, 2012)). Besides, as personalization can effectively improve learning efficiency and results, people who are important to users, very likely believe they should use MBSES with a higher degree of personalization, in other words, personalization can very likely affect social influence. Thus,

H4. A higher degree of personalization is associated with a higher degree of perceived UTAUT factors: (a) performance expectancy, (b) effort expectancy, (c) social influence, (d) facilitating conditions, (e) social interaction, (f) habit.

4.2.3 Extended UTAUT

There are many studies based on UTAUT to explain the education information system (e.g., (Abdullah and Ward, 2016; Al-Gahtani, 2016; Decman, 2015; Tarhini et al., 2013)). However, currently, UTAUT is still rarely applied to explore mobile-based smart education services.

Based on a review and analysis of eight recognized models, Venkatesh et al. (2003) proposed UTAUT. According to UTAUT, four constructs affect users' usage of a specific technology (performance expectancy, effort expectancy, social influence, and facilitating conditions) (Venkatesh et al., 2003). This sub-study applies the original four constructs of UTAUT to explain the user's decision towards MBSES technology. According to UTAUT, performance expectancy refers to the degree of expectation of using specific technology can benefit users in a particular activity (Venkatesh et al., 2003); effort expectancy refers to the degree of ease perceived by users towards specific technology (Venkatesh et al., 2003); social influence refers to the user's perceived degree of other people important to them believe that they should use specific technology (Venkatesh et al., 2003); facilitating conditions means the user's beliefs of the understanding of the resources and supporting devices and network conditions required to perform a specific behaviour (Venkatesh et al., 2003).

When considering the MBSES, UTAUT's original four constructs are not adequate to measure the user's continuance intention. To account for the unique characteristics of MBSES, this sub-study proposes an extended UTAUT by adding two extra constructs. First, this sub-study added a social interaction construct based on MBSES's social media attribute. Second, a habit construct from UTAUT2 (Venkatesh et al., 2012), was adopted in this sub-study better to understand the dynamic acceptance of MBSES by users. This sub-study thus expands the generalizability of UTAUT to the MBSES research context.

Interaction means two or more parties communicating and influencing each other (Laurel, 1993). Under the context of MBSES research, computer-mediated communication enables social interaction between two or more users (King et al., 2010). Take the online game with attributes close to MBSES as an example; Voiskounsky et al. (2004) suggested that the reason users like online games are because they can increase social connections. Through social interaction, users

present themselves and provide emotional and informational support to other users (Liang et al., 2011).

MBSES system like Liulishuo is improving its social interaction functionality. Since Liulishuo version 4.0, a social system which has been built in Liulishuo supports mutual attention and private letter interaction between users. Because the Liulishuo version 4.0 has also added the "attention stream", this function is derived from the original function of the internal message between users. Users can see the dynamic of other users in the attention portal, including the release of new posts, video dubbing, and sharing, etc. Liulishuo also utilizes WeChat (a messaging app) for social interaction. All paid learners with similar payment levels will be invited to join a WeChat group where they can communicate with each other. As a result, user stickiness will be increased through social interaction. Because there is no real teacher in MBSES, community, and social interaction will give users a natural feeling.

Figure 7. Liulishuo's social interaction functionality



Finally, a habit construct from UTAUT2 (Venkatesh et al., 2012), was adopted to the extended UTAUT in this sub-study. Habits are defined as repetitive behaviours triggered by environmental stimuli automatically (e.g., (Cheung and Limayen, 2005; Guinea and Markus, 2009)). Guinea and Markus (2009) suggested that the meaning of automaticity is broader than habit. To be specific: first, habit is a prior behaviour (Kim and Malhotra, 2005); second, habit refers to the personal recognition degree to which users tend to do certain behaviours automatically (e.g., (Limayem et al., 2007)). As a result, Limayem et al. (2007) used a measurement scale based on a questionnaire survey. Previous literature suggested that habit can influence intentions to use information technology (e.g., (Gefen, 2003)).

Original UTAUT constructs, including performance expectancy, effort expectancy, social influence and facilitating conditions, were found to have a positive impact on user's continuance intention (e.g., (Venkatesh et al., 2003; Venkatesh et al., 2012)). Moreover, social interaction was found to have a positive influence on user's continuance intention (e.g., (Wang and Chiang, 2009)). Furthermore, the habit was found to have a positive impact on user's behavioural intention (e.g., (Gefen, 2003; Venkatesh et al., 2012)). Thus,

H5. A higher degree of perceived extended UTAUT factors: (a) Performance Expectancy, (b) Effort Expectancy, (c) Social influence, (d) Facilitating conditions, (e) Social interaction, (f) Habit is associated with a higher degree of continuance intention.

4.2.4 Flow experience

Csikszentmihalyi (1977), Csikszentmihalyi and Csikszentmihalyi (1988) defined flow as the holistic feeling when people act with full involvement. Csikszentmihalyi (1977) suggested that people who are in the flow state, fully concentrate on activities, lose self-consciousness and feel they can command the environment around them. The flow experience in a specific activity will enable users to achieve higher performance in the activity. In the long run, flow as a pleasant experience will bring positive impact and happiness to users. Therefore, flow is related to higher subsequent motivation for continued performance.

Csikszentmihalyi (1997) suggested that the flow is a combination of factors consisting of challenge matching skills, loss of self-awareness, concentration, the transformation of time, self-control, feedback, clear goal, etc.

From a neuroscience perspective, Dietrich (2004) proposed that flow is a period in which high-level skills are achieved in the knowledge base of the implicit system without being disturbed by the explicit system. During this period, the activity of the human basal ganglia increases, while the activity of the prefrontal cortex and middle temporal lobe decreases (e.g., (Dietrich, 2004; Peifer, 2012; Peifer et al., 2014)).

In the flow state, users can better realize the functions of the brain. In the flow state, brain activity can produce more creative solutions, shorten response time and make decisions more effectively; the skills and patterns learned by the user are transferred from short-term memory to long-term memory in the flow state (positivepsychlopedia.com, 2020).

Hoffman and Novak (1996) initially suggested that online websites can benefit from promoting a user's flow state, and the marketing objective of online websites should be aimed at offering the user with flow opportunities to make users completely absorbed in website usage. In three series of papers concerning the concept of flow (Hoffman and Novak, 1996; Novak et al., 2000; Novak et al., 2003), flow is considered from two aspects: goal orientation and experience activities.

Flow theory is extensively applied in the online user behaviour context. Koufaris (2002) integrated flow with TAM to explore online user behaviour. Hausman and Siekpe (2008) investigated the effect of web interface features on user online purchase intentions on the perspective of flow theory. Mollen and Wilson (2010) discussed how the constructs of interactivity, flow and involvement are related to each other in an online environment. Ding et al. (2010) explored the impact of service system design and flow on user satisfaction in online financial services.

Additionally, flow theory is widely applied in the management information system context. Lu et al. (2009) explored users' acceptance of instant messaging using TPB, TAM, and flow. Jung et al. (2009) investigated user adoption of mobile TV, examined flow and media content. Choi et al. (2006) explored ERP training with a web-based electronic learning system from the flow perspective. Wan and Chiou (2006) researched online game addiction on the perspective of flow

theory and humanistic needs theory. Hsu and Lu (2004) explored why people play online games based on an integration of TAM, social influence and flow.

Choi et al. (2007) suggested that the operational definitions of the flow applied by various researchers are inconsistent and usually measured in multiple dimensions. For example, to measure flow, Ghani (1995) applied two dimensions: concentration and enjoyment. Moon and Kim (2001) employed three dimensions: perceived enjoyment, curiosity and concentration. Koufaris (2002) applied three dimensions: perceived enjoyment, concentration and perceived control. Huang (2003) applied four dimensions: control, curiosity, intrinsic interest and attention focus. Li and Browne (2006) used four dimensions to measure: including temporal dissociation, control, curiosity and focused attention.

In the research context of MBSES, like Ghani (1995), this sub-study adapts two dimensions: perceived enjoyment and concentration. In this sub-study, the facilitating conditions in the extended UTAUT are similar to perceived behavioural control in the flow, so we would not conduct a second test. Besides, because MBSES users aim at learning knowledge, curiosity is less relevant to this sub-study.

If Liulishuo is perceived to be useful, the customer will be happy and have a flow experience. Similarly, when Liulishuo can be used with less effort, it can improve efficiency for users and can also bring pleasure. When research into online customer experience on e-travel websites, Liu et al. (2016) found perceived usefulness and perceived ease of use, which are very similar to performance expectancy and effort expectancy, are positively related to flow experience. Besides, when people who are essential to users believe they should use MBSES, users are more likely to concentrate and have a flow state. Furthermore, perceived behavioural control which is similar to facilitating conditions, was found to have a positive influence on flow state (Liu et al., 2016). As facilitating conditions refer to users' beliefs of the resources and support available to perform a behaviour (Brown and Venkatesh, 2005; Venkatesh et al., 2003), if user's feel they are sufficiently facilitated when they use Liulishuo, they will be more likely to get immersed and enter a flow state. Moreover, social interaction has been found to influence the flow experience (e.g., (Kim et al., 2005)). Choi and Kim (2004) proposed that people will feel the flow, the optimal experience if they can interact with other people effectively. Therefore, it is reasonable to expect that social interaction will increase players' satisfaction by helping them to enter a flow state, thereby promoting their

intention to accept Liulishuo. Lastly, if a user performs behaviours automatically, they are more likely to enter a flow state. Thus,

H6. A higher degree of perceived extended UTAUT factors: (a) Performance Expectancy, (b) Effort Expectancy, (c) Social influence, (d) Facilitating conditions, (e) Social interaction, (f) Habit is associated with a higher degree of flow.

Flow experience is related to users' online behavioural intentions (Lee and Tsai, 2010). Besides, Flow experience can prolong website usage (Rettie, 2001). Additionally, Hsu and Lu (2004) also proved that flow could influence online game usage positively. Thus,

H7. A higher degree of perceived flow experience is associated with a higher degree of continuance intention.

Figure 8 (p.97) presents the research model that adopted UTAUT as a reference model and guided this sub-study. It is formulated based on the integration of extended UTAUT, flow, stimuli from an information processing perspective.

4.3 Research method and data

4.3.1 Measurement development

The questionnaire has two versions: one in English and the other in Chinese. The questionnaire items were measured using seven-point Likert scales, ranging from strongly disagree (1) to strongly agree (7). To ensure that high-quality data were obtained, several methods were adopted to increase validity and avoid measurement errors. In this sub-study, measurement scales were adopted from past literature and adjusted to the context of the current research on MBSES.

The following table 14 depicts the measurement items:

Table 14. Measurement items of chapter 4

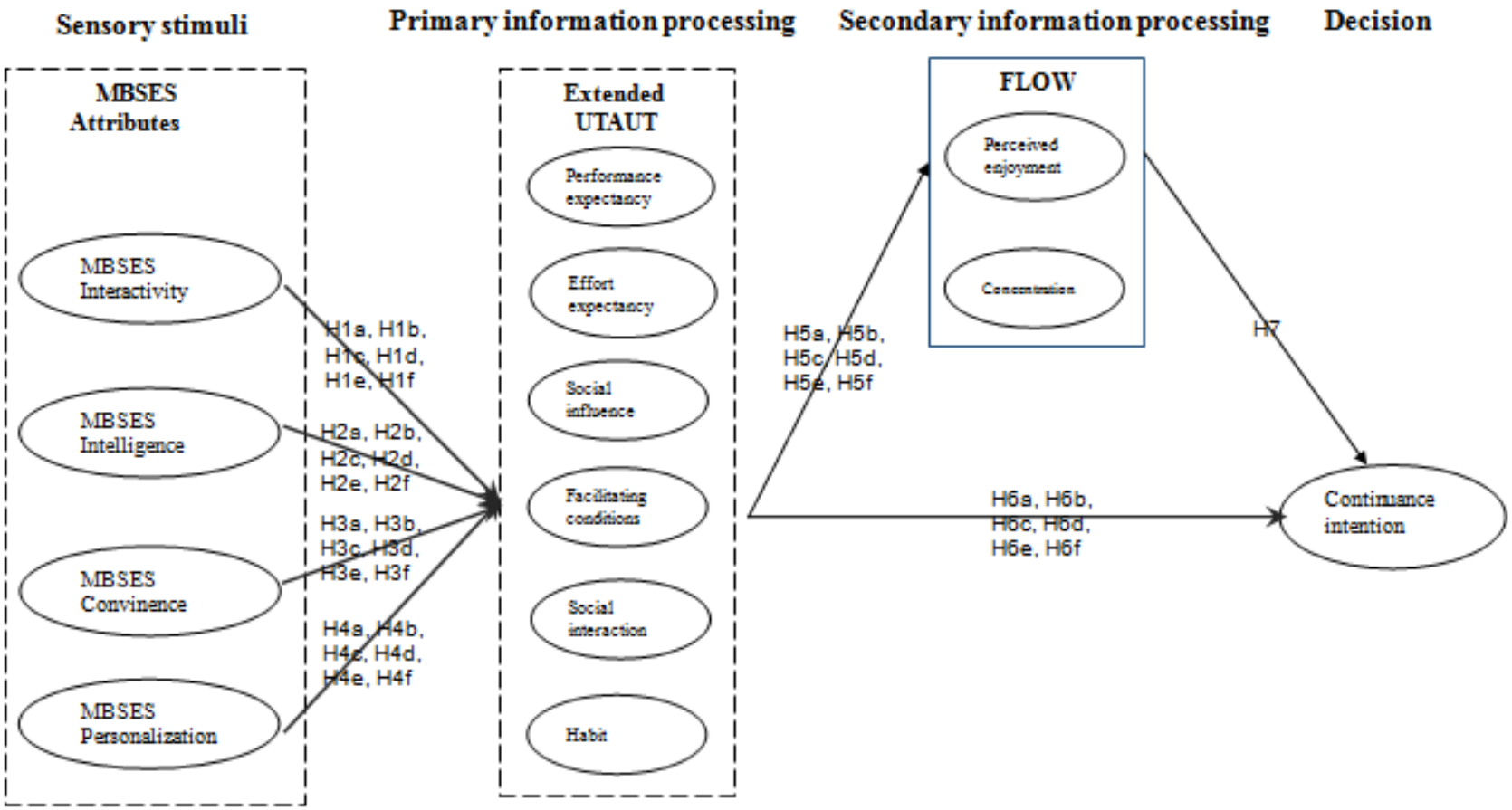
Construct	Adapted scale
Continuance intention Bhattacherjee (2001) Wu and Zhang (2014)	1. My intentions are to continue using Liulishuo AI learning service than to use any alternative means (traditional way). 2. I shall use the Liulishuo AI learning service on a regular basis in the future. 3. I shall frequently use the Liulishuo AI learning service in the future. 4. I shall strongly recommend others to use Liulishuo AI learning service.
Perceived enjoyment Moon and Kim (2001) Van der Heijden (2003)	1. Using Liulishuo can provide more enjoyment than other English learning methods. 2. Using Liulishuo can give me fun for my learning. 3. Using Liulishuo, let me feel pleasure.
Perceived concentration Koufaris (2002)	1. When using Liulishuo AI learning service, I am absorbed intensely in the activity. 2. When using Liulishuo AI learning service, I concentrate fully on the activity. 3. When using Liulishuo AI learning service, I am deeply engrossed in the activity.
Performance expectancy Venkatesh et al. (2003)	1. Using Liulishuo AI learning service increases my productivity. 2. Using Liulishuo AI learning service allows me to learn English effectively. 3. I find that Liulishuo AI learning service is useful.
Effort expectancy Venkatesh et al. (2003)	1. Learning to use Liulishuo AI learning service is easy for me. 2. Skillfully using Liulishuo AI learning service is easy for me. 3. My interaction with Liulishuo AI learning service is clear and understandable.
Social influence Venkatesh et al. (2003)	1. People who influence my English learning behaviour think that I should use Liulishuo. 2. People who are important to me think that I should use Liulishuo. 3. People whose opinions that I value prefer that I use Liulishuo.
Facilitating Conditions Venkatesh et al. (2003)	1. I have the resources necessary to use Liulishuo. 2. Liulishuo is compatible with other technologies I use. 3. I can get help from others when I have difficulties using Liulishuo.
Social Interaction Choi and Kim (2004)	1. Communicating with others is pretty useful for using Liulishuo AI learning service. 2. Liulishuo supports competition and cooperation between users. 3. Liulishuo supports social communities inside and outside the app.
Habit Venkatesh et al. (2012)	1. The use of Liulishuo has become a habit for me. 2. I am addicted to using Liulishuo. 3. I must use Liulishuo.
Intelligence Bartneck et al. (2009)	1. Liulishuo education system is competent. 2. Liulishuo education system is sensible. 3. Liulishuo education system is intelligent.
Convenience Ko et al. (2005)	1. Using the Liulishuo education system enables me to learn English at a time that is convenient for me. 2. I can learn English anywhere with the Liulishuo education system. 3 I find the Liulishuo education system convenient for my learning.
Interactivity Wu (2000)	1. I was in control over the content of Liulishuo system that I wanted to use. 2. I was in control over the pace of my visit to Liulishuo system. 3. Liulishuo system has the ability to respond to my specific questions.
Personalization Ünal et al. (2011); Xu et al. (2008)	1. I feel that Liulishuo AI learning service is tailored to me. 2. I feel that Liulishuo AI learning service is personalized. 3. The Liulishuo AI learning service is personalized to my needs.

4.3.2 Data collection methods

Before the main study, a pilot test was conducted with 102 respondents. After that, a preliminary analysis of the pilot study was conducted, illustrated both content validity and reliability of the data. We found preliminary evidence that the scales were valid and reliable.

This sub-study conducted an online survey by Baidu sample service in China. We received 687 responses to the online survey. As only current users of Liulishuo could respond to questions about their opinions, we removed the respondents with no prior experience of Liulishuo, leaving us with a sample of 501 users. Among them, seven participants who sent incomplete questionnaires were further omitted from the analyses. Therefore, a total of 494 users' responses were considered to be valid for further analysis.

Figure 8. The proposed research model of chapter 4



4.4 Data analysis and results

Partial least square structural equation modelling (PLS-SEM) is chosen to evaluate the research model. Both the measurement model and the structural model are examined using SmartPLS 3.0 with ordinary least squares estimation. Because PLS-SEM is suitable for structural equation models with high complexity (Urbach and Ahlemann, 2010), it is selected for the data analysis of this sub-study.

4.4.1 Descriptive statistics

Table 15 summarizes the demographics of the respondents.

Table 15. Demographic characteristics of the respondents of chapter 4

Item	Type	Frequency	Percentage
Gender	Male	237	48.0%
	Female	257	52.0%
Age	10-18	6	1.2%
	19-25	296	59.9%
	26-45	188	38.1%
	46+	4	0.8%
Educational level	Middle school	21	4.3%
	Undergraduate	426	86.2%
	Postgraduate	47	9.5%
Weekly usage time	1-3 hours	208	42.1%
	4-10 hours	226	45.7%
	More than 10 hours	60	12.2%

Of these 494 participants, 237 were male (48.0%) and 257 were female (52.0%). The majority of respondents were aged between 19 and 45 (98.0%) and were undergraduate or above (95.7%). All respondents had engaged in Liulishuo for more than one hour per week; among them, 57.9% of users had engaged in Liulishuo for more than four hours per week.

4.4.2 Measurement model

We firstly examined the measurement model to evaluate reliability and validity. Tables 16 and table 17 present the measurement model results, including information about reliability, validity, correlations and factor loadings. The internal

consistency reliabilities of multi-item scales modelled with reflective indicators were all higher than 0.70, suggesting that the scales were reliable.

Discriminant validity in this sub-study is evaluated in two steps. First, the Fornell and Larcker (1987) criterion are used to test whether the square root of a construct's AVE is higher than the correlations between this construct and any other construct within the model. In the correlation matrix, if the squared correlations between the constructs do not exceed 0.80, the multicollinearity problem can be ignored for model estimation (Hair et al., 2006). As a result, the average variance extracted (AVE) was higher than 0.60 in all cases and higher than the square of the correlations, thus suggesting discriminant validity. Second, the factor loading of an item on its associated construct should be higher than the loadings of another non-construct item on that construct (e.g., (Venkatesh et al., 2012)). The data analysis shows the result of loadings and cross-loadings supported internal consistency and discriminant validity.

Table 16. Construct reliability and validity of chapter 4

Construct	AVE	CR	Cronba-ch's Alpha	CI	EEX	PEN	FC	HA	PCO	PCV	PEX	PIG	PIT	PPE	SI	SINF
CI		0.866	0.793	**0.786**												
EEX		0.848	0.731	0.628	**0.807**											
PEN	0.689	0.869	0.773	0.718	0.713	**0.83**										
FC	0.674	0.861	0.759	0.703	0.781	0.738	**0.821**									
HA	0.725	0.888	0.811	0.671	0.64	0.742	0.706	**0.852**								
PCO	0.732	0.891	0.817	0.686	0.681	0.762	0.673	0.691	**0.856**							
PCV	0.662	0.855	0.745	0.666	0.683	0.706	0.704	0.521	0.647	**0.814**						
PEX	0.67	0.859	0.753	0.719	0.742	0.755	0.778	0.68	0.706	0.736	**0.819**					
PIG	0.667	0.857	0.75	0.705	0.679	0.747	0.735	0.65	0.716	0.729	0.743	**0.817**				
PIT	0.657	0.852	0.738	0.667	0.758	0.741	0.77	0.678	0.737	0.686	0.767	0.702	**0.81**			
PPE	0.667	0.857	0.75	0.676	0.782	0.744	0.766	0.737	0.709	0.678	0.769	0.723	0.78	**0.817**		
SI	0.629	0.835	0.705	0.658	0.742	0.735	0.788	0.678	0.675	0.678	0.746	0.71	0.725	0.742	**0.793**	
SINF	0.665	0.856	0.748	0.672	0.704	0.745	0.736	0.795	0.718	0.606	0.726	0.687	0.738	0.77	0.719	**0.815**

Notes:
CI=continunance intention; PEX=performance expectancy; EEX=effort expectancy; SINF=social influence; FC=facilitating conditions; SI=social interaction; HA=habit; PIT=perceived interactivity; PIG=intelligence; PCV=convenience; PPE=personalization; PCO=concentration; PEN=perceived enjoyment.

Table 17. PLS loadings and cross-loadings of chapter 4

	CI	EEX	PEN	FC	HA	PCO	PCV	PEX	PIG	PIT	PPE	SI	SINF
CI1	**0.774**	0.469	0.542	0.534	0.544	0.536	0.484	0.527	0.553	0.509	0.53	0.484	0.541
CI2	**0.791**	0.546	0.595	0.576	0.505	0.532	0.57	0.612	0.57	0.548	0.543	0.551	0.529
CI3	**0.799**	0.486	0.582	0.578	0.533	0.573	0.595	0.588	0.58	0.528	0.545	0.556	0.535
CI4	**0.778**	0.47	0.536	0.518	0.529	0.513	0.434	0.528	0.508	0.512	0.506	0.471	0.508
EEX1	0.513	**0.837**	0.582	0.644	0.519	0.557	0.547	0.641	0.54	0.613	0.636	0.653	0.564
EEX2	0.51	**0.776**	0.589	0.597	0.523	0.527	0.561	0.575	0.534	0.613	0.625	0.52	0.564
EEX3	0.497	**0.807**	0.556	0.649	0.507	0.564	0.544	0.579	0.569	0.608	0.632	0.622	0.576
PEN1	0.596	0.636	**0.87**	0.636	0.653	0.653	0.621	0.65	0.651	0.632	0.656	0.637	0.669
PEN2	0.586	0.588	**0.783**	0.582	0.578	0.614	0.576	0.631	0.62	0.589	0.601	0.574	0.573
PEN3	0.607	0.551	**0.835**	0.619	0.613	0.629	0.559	0.598	0.589	0.622	0.594	0.618	0.609
FC1	0.608	0.65	0.643	**0.834**	0.664	0.588	0.57	0.679	0.625	0.629	0.628	0.683	0.643
FC2	0.53	0.658	0.577	**0.82**	0.513	0.509	0.553	0.611	0.588	0.596	0.615	0.604	0.557
FC3	0.589	0.617	0.596	**0.809**	0.555	0.558	0.61	0.623	0.595	0.669	0.642	0.65	0.609
HA1	0.617	0.614	0.688	0.702	**0.853**	0.61	0.55	0.676	0.649	0.636	0.658	0.67	0.704
HA2	0.526	0.536	0.604	0.528	**0.842**	0.579	0.378	0.509	0.48	0.522	0.609	0.53	0.678
HA3	0.567	0.478	0.596	0.561	**0.86**	0.574	0.39	0.541	0.519	0.568	0.611	0.521	0.645
PCO1	0.618	0.621	0.672	0.582	0.613	**0.869**	0.559	0.627	0.638	0.621	0.621	0.614	0.618
PCO2	0.552	0.553	0.642	0.566	0.577	**0.863**	0.557	0.574	0.606	0.617	0.607	0.562	0.602
PCO3	0.59	0.572	0.641	0.58	0.584	**0.834**	0.543	0.611	0.591	0.654	0.592	0.556	0.622
PCV1	0.527	0.547	0.587	0.6	0.458	0.511	**0.798**	0.622	0.591	0.536	0.532	0.568	0.496
PCV2	0.544	0.56	0.58	0.538	0.399	0.496	**0.797**	0.56	0.582	0.545	0.567	0.522	0.461
PCV3	0.555	0.561	0.557	0.579	0.412	0.57	**0.845**	0.612	0.606	0.592	0.557	0.564	0.52
PEX1	0.578	0.623	0.63	0.644	0.579	0.601	0.592	**0.85**	0.602	0.64	0.653	0.645	0.61
PEX2	0.602	0.596	0.612	0.618	0.538	0.557	0.646	**0.786**	0.618	0.636	0.629	0.598	0.593
PEX3	0.585	0.602	0.61	0.648	0.553	0.575	0.567	**0.819**	0.602	0.606	0.605	0.587	0.58
PIG1	0.613	0.606	0.635	0.646	0.557	0.637	0.641	0.66	**0.851**	0.607	0.619	0.654	0.606
PIG2	0.563	0.552	0.601	0.567	0.515	0.572	0.543	0.578	**0.801**	0.535	0.592	0.548	0.556
PIG3	0.548	0.499	0.595	0.585	0.52	0.538	0.599	0.577	**0.797**	0.577	0.56	0.53	0.519
PIT1	0.539	0.625	0.616	0.626	0.556	0.591	0.569	0.646	0.558	**0.828**	0.623	0.595	0.59
PIT2	0.568	0.605	0.609	0.621	0.557	0.628	0.513	0.604	0.571	**0.789**	0.64	0.555	0.596
PIT3	0.517	0.612	0.576	0.625	0.536	0.573	0.584	0.614	0.579	**0.813**	0.635	0.612	0.607
PPE1	0.539	0.658	0.629	0.624	0.666	0.612	0.501	0.646	0.592	0.624	**0.827**	0.612	0.671
PPE2	0.587	0.648	0.624	0.629	0.608	0.585	0.618	0.648	0.631	0.637	**0.806**	0.619	0.616
PPE3	0.53	0.608	0.567	0.623	0.524	0.538	0.544	0.587	0.546	0.652	**0.817**	0.586	0.597
SI1	0.576	0.68	0.663	0.68	0.623	0.617	0.62	0.678	0.639	0.601	0.678	**0.85**	0.653
SI2	0.519	0.585	0.579	0.663	0.52	0.515	0.542	0.597	0.567	0.625	0.57	**0.797**	0.568
SI3	0.463	0.482	0.494	0.519	0.455	0.46	0.435	0.482	0.469	0.493	0.502	**0.726**	0.473
SINF1	0.59	0.611	0.663	0.631	0.65	0.629	0.556	0.684	0.609	0.615	0.665	0.647	**0.831**
SINF2	0.563	0.575	0.6	0.618	0.682	0.564	0.49	0.581	0.553	0.635	0.63	0.581	**0.821**
SINF3	0.485	0.531	0.551	0.547	0.61	0.559	0.428	0.5	0.513	0.552	0.585	0.522	**0.794**

4.4.3 Structural model

Since the measurement model evaluation provided evidence of reliability and validity, the structural model was subsequently examined to evaluate the hypothesized relationships among the constructs in the research model (Hair et al., 2013). According to the recommendations from Henseler et al. (2012) and Hair et al. (2013), the structural model in this sub-study was evaluated with several measures.

Based on the data analysis, the model explains 72% of the variance for performance expectancy, 68.5% of the variance for effort expectancy, 65.4% of the variance for social influence, 70.4% of the variance for facilitating conditions, 64.7% of the variance for social interaction, and 58.9% of the variance for habit, 75.1% of the variance for flow, and 62.6% of the variance for continuance intention.

Tenenhaus et al. (2005) suggested a global fit measure for PLS-SEM path modelling, which is goodness of fit (GoF) ($0 < GoF < 1$); It can be calculated as the geometric mean of the average value of communality and the average value of R^2. In the PLS path modelling, the value of communality equals to the value of AVE. Therefore, as proposed by Fornell and Larcker (1981), this sub-study thus applies a threshold value of 0.50 for communality. Furthermore, Cohen (1988) proposed the small, medium and large threshold value of the effect sizes for R^2 (small value is 0.02; medium value is 0.13; large value is 0.26). Therefore, substituting the average AVE threshold value of 0.50, and the threshold value of the effect sizes for R^2 in the calculation formula of GoF, the threshold value of GoFsmall=0.1, GoFmedium=0.25, and GoFlarge=0.36 can be calculated. These threshold values can serve as baseline values for validating the PLS-SEM model globally (e.g., (Croasdell et al., 2010; Wetzels et al., 2009)). The GoF value of the model of this sub-study is calculated to be 0.67, which exceeds the threshold value of 0.36 for GoFlarge. As a result, the model of this sub-study performs well according to the baseline values discussed above and indicating that the model provided a good fit for the data.

As H1 predicts, this sub-study found direct positive impacts of interactivity on performance expectancy ($\beta=0.264$, $P<0.001$), effort expectancy ($\beta=0.285$, $P<0.001$), social influence ($\beta=0.287$, $P<0.001$), facilitating conditions ($\beta=0.3$, $P<0.001$), social interaction ($\beta=0.233$, $P<0.001$), and habit ($\beta=0.232$, $P<0.001$).

As H2 predicts, this sub-study found direct positive impacts of intelligence on performance expectancy (β=0.198, P<0.001), social influence (β=0.198, P<0.001), facilitating conditions (β=0.212, P<0.001), social interaction (β=0.216, P<0.001) & habit (β=0.247, P<0.001). But there is no significant direct impact of intelligence on effort expectancy.

As H3 predicts, this sub-study found direct positive impacts of convenience on performance expectancy (β=0.233, P<0.001), effort expectancy (β=0.169, P<0.001), facilitating conditions (β=0.162, P<0.001), social interaction (β=0.161, P<0.001). However, the sub-study found a significant direct negative impact of convenience to habit (β= -0.137, P<0.05). There is no significant direct impact of convenience on social influence.

As H4 predicts, this sub-study found significant direct positive impacts of personalization on performance expectancy (β=0.262, P<0.001), effort expectancy (β= 0.395, P<0.001), social influence (β=0.414, P<0.001), facilitating conditions (β= 0.269, P<0.001), social interaction (β= 0.294, P<0.001), and habit (β= 0.47, P<0.001).

As H5 predicts, this sub-study found significant direct positive impacts of extended UTAUT constructs on flow, including performance expectancy (β=0.239, P<0.001), effort expectancy (β=0.157, P<0.01), social influence (β=0.182, P<0.001), social interaction (β= 0.138, P<0.01), and habit (β= 0.24, P<0.001). But there is no significant direct impact of facilitating conditions on flow.

As H6 predicts, this sub-study found significant direct positive impacts of extended UTAUT constructs on continuance intention including performance expectancy (β=0.233, P<0.001), facilitating conditions (β=0.188, P<0.05), and habit (β=0.121, P<0.05). There is no significant direct impact of effort expectancy, social influence, and social interaction on continuance intention. However, effort expectancy, social influence, and social interaction are found to have a significant positive influence on continuance intention indirectly through the flow.

Last but not least, as H7 predicts, this sub-study found significant direct positive impacts of flow on continuance intention (β=0.332, P<0.001).

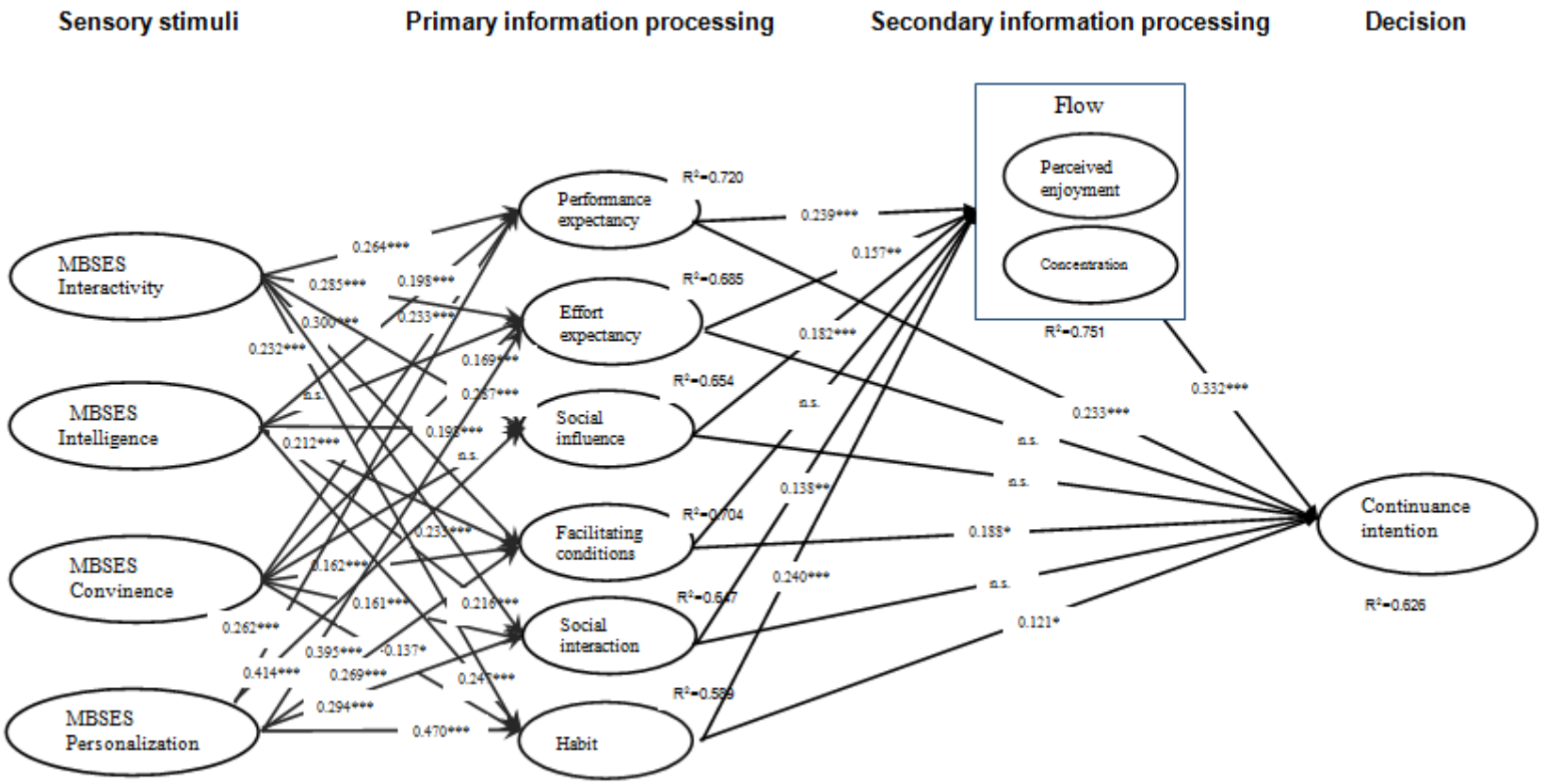
When testing the mediation effect of flow, this sub-study found significant indirect positive impacts of extended UTAUT constructs on continuance intention including performance expectancy (β= 0.079, P<0.001), effort expectancy (β= 0.052, P<0.05), social influence (β= 0.061, P<0.001), social interaction (β= 0.046,

P<0.05), and habit (β=0.08, P<0.001). There is no significant indirect impact of facilitating conditions on continuance intention through the flow construct.

Besides, serial mediation effects are found in this sub-study. To be specific, extended UTAUT constructs and flow mediate the relationships between stimuli constructs and continuance intention.

Figure 9 depicts the structural model. All the results are shown in table 18 and table 19.

Figure 9. The structural model of chapter 4



*Note: ***: p < 0.001, **: p < 0.01, *: p < 0.05. 5,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.*

Table 18. Hypothesis testing of chapter 4

The hypothesis	Path coefficient	P-value	Result
H1a: PIT -> PEX	0.264	***	Yes
H1b: PIT -> EEX	0.285	***	Yes
H1c: PIT -> SINF	0.287	***	Yes
H1d: PIT -> FC	0.3	***	Yes
H1e: PIT -> SI	0.233	***	Yes
H1f: PIT -> HA	0.232	***	Yes
H2a: PIG -> PEX	0.198	***	Yes
H2b: PIG -> EEX	n.s.	n.s.	No
H2c: PIG -> SINF	0.198	***	Yes
H2d: PIG -> FC	0.212	***	Yes
H2e: PIG -> SI	0.216	***	Yes
H2f: PIG -> HA	0.247	***	Yes
H3a: PCV -> PEX	0.233	***	Yes
H3b: PCV-> EEX	0.169	***	Yes
H3c: PCV -> SINF	n.s.	n.s.	No
H3d: PCV -> FC	0.162	***	Yes
H3e: PCV -> SI	0.161	***	Yes
H3f: PCV -> HA	-0.137	*	Yes
H4a: PPE -> PEX	0.262	***	Yes
H4b: PPE -> EEX	0.395	***	Yes
H4c: PPE -> SINF	0.414	***	Yes
H4d: PPE -> FC	0.269	***	Yes
H4e: PPE -> SI	0.294	***	Yes
H4f: PPE -> HA	0.47	***	Yes
H5a: PEX -> FLOW	0.239	***	Yes
H5b: EEX -> FLOW	0.157	**	Yes
H5c: SINF -> FLOW	0.182	***	Yes
H5d: FC -> FLOW	n.s.	n.s.	No
H5e: SI -> FLOW	0.138	**	Yes
H5f: HA -> FLOW	0.24	***	Yes
H6a: PEX -> CI	0.233	***	Yes
H6b: EEX -> CI	n.s.	n.s.	No
H6c: SINF -> CI	n.s.	n.s.	No
H6d: FC -> CI	0.188	*	Yes
H6e: SI -> CI	n.s.	n.s.	No
H6f: HA -> CI	0.121	*	Yes
H7: FLOW -> CI	0.332	***	Yes
PEN <- FLOW	0.936	***	
PCO <- FLOW	0.941	***	

*Note: ***: p < 0.001, **: p < 0.01,*: p < 0.05. 5,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.*

Table 19. Indirect effects of chapter 4

Path	Specific path	Path coefficient	P-value
PEX -> CI		0.079	***
	PEX -> FLOW -> CI	0.079	***
EEX -> CI		0.052	*
	EEX -> FLOW -> CI	0.052	*
FC -> CI		n.s.	n.s.
	FC -> FLOW -> CI	n.s.	n.s.
SINF -> CI		0.061	***
	SINF -> FLOW -> CI	0.061	***
SI -> CI		0.046	*
	SI -> FLOW -> CI	0.046	*
HA -> CI		0.08	***
	HA -> FLOW -> CI	0.08	***
PIT -> CI		0.23	***
	PIT -> EEX -> FLOW -> CI	0.015	*
	PIT -> PEX -> FLOW -> CI	0.021	**
	PIT -> SINF -> FLOW -> CI	0.017	*
	PIT -> FC -> FLOW -> CI	n.s.	n.s.
	PIT -> SI -> FLOW -> CI	0.011	*
	PIT -> HA -> FLOW -> CI	0.018	*
	PIT -> PEX -> CI	0.061	***
	PIT -> EEX -> CI	n.s.	n.s.
	PIT -> SINF -> CI	n.s.	n.s.
	PIT -> FC -> CI	0.056	*
	PIT -> SI -> CI	n.s.	n.s.
	PIT -> HA -> CI	0.028	†
PIT -> FLOW		0.257	***
	PIT -> PEX -> FLOW	0.063	***
	PIT -> EEX -> FLOW	0.045	*
	PIT -> SINF -> FLOW	0.052	**
	PIT -> FC -> FLOW	n.s.	n.s.
	PIT -> SI -> FLOW	0.032	*
	PIT -> HA -> FLOW	0.056	**
PIG -> CI		0.187	***
	PIG -> PEX -> FLOW -> CI	0.016	*
	PIG -> EEX -> FLOW -> CI	n.s.	n.s.
	PIG -> SINF -> FLOW -> CI	0.012	*
	PIG -> FC -> FLOW -> CI	n.s.	n.s.
	PIG -> SI -> FLOW -> CI	0.01	*
	PIG -> HA -> FLOW -> CI	0.02	*
	PIG -> PEX -> CI	0.046	**
	PIG -> EEX -> CI	n.s.	n.s.
	PIG -> SINF -> CI	n.s.	n.s.
	PIG -> FC -> CI	0.04	*
	PIG -> SI -> CI	n.s.	n.s.
	PIG -> HA -> CI	0.03	†

PIG -> FLOW		0.19	***
	PIG -> PEX -> FLOW	0.047	**
	PIG -> EEX -> FLOW	n.s.	n.s.
	PIG -> SINF -> FLOW	0.036	**
	PIG -> FC -> FLOW	n.s.	n.s.
	PIG -> SI -> FLOW	0.03	*
	PIG -> HA -> FLOW	0.059	**
PCV -> CI		0.086	**
	PCV -> PEX -> FLOW -> CI	0.018	**
	PCV -> EEX -> FLOW -> CI	0.009	*
	PCV -> SINF -> FLOW -> CI	n.s.	n.s.
	PCV -> FC -> FLOW -> CI	n.s.	n.s.
	PCV -> SI -> FLOW -> CI	0.007	*
	PCV -> HA -> FLOW -> CI	-0.011	*
	PCV -> PEX -> CI	0.054	**
	PCV -> EEX -> CI	n.s.	n.s.
	PCV -> SINF -> CI	n.s.	n.s.
	PCV -> FC -> CI	0.031	†
	PCV -> SI -> CI	n.s.	n.s.
	PCV -> HA -> CI	-0.017	†
PCV -> FLOW		0.074	*
	PCV -> PEX -> FLOW	0.056	***
	PCV -> EEX -> FLOW	0.026	*
	PCV -> SINF -> FLOW	n.s.	n.s.
	PCV -> FC -> FLOW	n.s.	n.s.
	PCV -> SI -> FLOW	0.022	*
	PCV -> HA -> FLOW	-0.033	*
PPE -> CI		0.287	***
	PPE -> PEX -> FLOW -> CI	0.021	**
	PPE -> EEX -> FLOW -> CI	0.021	*
	PPE -> SINF -> FLOW -> CI	0.025	**
	PPE -> FC -> FLOW -> CI	n.s.	n.s.
	PPE -> SI -> FLOW -> CI	0.013	*
	PPE -> HA -> FLOW -> CI	0.037	***
	PPE -> PEX -> CI	0.061	**
	PPE -> EEX -> CI	n.s.	n.s.
	PPE -> SINF -> CI	n.s.	n.s.
	PPE -> FC -> CI	0.051	*
	PPE -> SI -> CI	n.s.	n.s.
	PPE -> HA -> CI	0.057	*
PPE -> FLOW		0.361	***
	PPE -> PEX -> FLOW	0.063	***
	PPE -> EEX -> FLOW	0.062	**
	PPE -> SINF -> FLOW	0.075	***
	PPE -> FC -> FLOW	n.s.	n.s.
	PPE -> SI -> FLOW	0.041	*
	PPE -> HA -> FLOW	0.112	***

*Note: ***: p < 0.001, **: p < 0.01,*: p < 0.05. †:p<0.10 . 5,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.*

4.5 Discussions and conclusions

4.5.1 Discussions

As this sub-study predicted, the data analysis results indicate that interactivity positively influences performance expectancy and effort expectancy. This finding is consistent with prior literature (e.g., (Abbad et al., 2009)). Besides, it also positively influences social interaction; this is consistent with previous literature (e.g., (Auter, 1992)). Furthermore, through logical reasoning and empirical analysis, this sub-study also found interactivity positively impact social influence, facilitating conditions, and habit, which is a discovery and has not previously been explored to the best of our knowledge. This sub-study suggests that interactivity refers to the MBSES technology's ability to enable users (learners) to interact, get involved with, and control over the educational content more easily. MBSES provides users with the most interactive type of educational information technology available, where an individual user can control over her/his manipulation by natural language understanding. As the data analysis result suggests, this sub-study illustrates that the MBSES interactivity positively enhances all six extended UTAUT factors.

Based on logical reasoning and empirical analysis, the results indicate that intelligence positively influences five extended UTAUT factors, including performance expectancy, social influence, facilitating conditions, social interaction and habit, which is a new discovery and has not previously been explored to the best of our knowledge. Somewhat surprisingly, the effect of intelligence on effort expectancy is not significant. A reasonable explanation might be that in MBSES, intelligence refers to the sensibility, competency, and smartness of MBSES system, compared with the traditional non-smart education service, the MBSES intelligence technology is currently technologically advanced for users. Hence, it mainly affects the performance expectancy of users rather than the effort expectancy.

As this sub-study predicted, the results indicate that convenience positively impacts on performance expectancy and effort expectancy. This finding is consistent with prior literature (e.g., (Teo et al., 2014)). Besides, it positively influences facilitating conditions; this is consistent with previous research (e.g., (Krishnaraju et al., 2016; Vinodh and Mathew, 2012)). Furthermore, it positively impacts on social interaction, and this is consistent with prior literature (e.g., (Carmel et al., 2009)). Moreover, it negatively impacts on habit, which is

unexpectedly inconsistent with previous research (e.g., (Pan and Yan, 2012)); their study indicated the impact of convenience on habit was positive. This sub-study argues that, in the MBSES context, users can learn anytime, anywhere using a convenient MBSES information technology, which could affect the formation of users' fixed learning habits. Somewhat surprisingly, the effect of convenience on social influence is not significant. A possible explanation is that people who are essential to users consider convenience attribute of MBSES as a relatively unimportant factor, which will be less likely to suggest users MBSES because of the convenience attribute.

As this sub-study predicted, the empirical results indicate that personalization positively impacts on performance expectancy, which is consistent with prior literature (e.g., (Chau and Lai, 2003; Liang et al., 2012)). Besides, it positively influences effort expectancy, which is consistent with previous research (e.g., (Ahmad and Al-Zu'bi, 2011; Beninger, 1987; Mathew and Stone, 2003; Wang et al., 2017)). Furthermore, through logical reasoning and empirical analysis, this sub-study also found personalization positively impact on social influence, which is a new finding and has not previously been explored to the best of our knowledge. Moreover, personalization positively influences facilitating conditions, which is consistent with prior literature (e.g., (Krishnaraju et al., 2016; Vinodh and Mathew, 2012)). Additionally, it positively impacts social interaction, which is consistent with previous research (e.g., (Carmel et al., 2009)). Lastly, it positively impacts habit, which is consistent with prior literature (e.g., (Pan and Yan, 2012)).

As this sub-study predicted, the results indicate that extended UTAUT constructs, including performance expectancy, facilitating conditions, can directly and positively influence the continuance intention. This finding is consistent with previous literature (e.g., (Venkatesh et al., 2003; Venkatesh et al., 2012)). Besides, habit directly and positively impacts continuance intention, which is consistent with prior literature (e.g., (Venkatesh et al., 2012)). However, the results in this sub-study indicate that effort expectancy, social influence, and social interaction do not directly influence continuance intention. Instead, they affect the continuance intention indirectly and positively via the flow.

The indirect and positive influence of social interaction on continuance intention via flow can be supported by prior literature. For example, social interaction has been found to impact on the flow experience (Kim et al., 2005).

Sweetser and Wyeth (2005) suggested that social interaction makes users more deeply immersed in the online game. Lazzaro (2004) indicated that a large part of user enjoyment comes from interaction. Pilke (2004) proposed that during the use of information technology, the interaction can prompt users to enter a flow state. Choi and Kim (2004) also suggested that people will experience the flow state if they can interact with other people effectively. This result can also be explained by self-presentation theory: In MBSES, social interaction features enable a user to build her/his desired self-image (Animesh et al., 2001). According to self-presentation theory (Goffman, 1959), users have a social self-image. They want to project their social self-image among other users, so they are motivated to use related information systems to fulfil this demand. With the user's engagement in social self-impression, the user enjoys herself/himself and reaches the state of losing self-consciousness, thus entering the flow state (Wang et al., 2007).

Social influence refers to the degree to which an individual user feels that people who are important to them, believe they should use information technology. The effect of social influence on flow can also be interpreted like social interaction; that is, users are more likely to concentrate and have a flow state with other important people's social influence. Therefore, social interaction and social influence impact the continuance intention indirectly and positively via the flow. Additionally, based on the fact that MBSES system can be accessed easily with a friendly interface, this makes MBSES very easy to use. As a result, if the degree of ease related to using MBSES is high, it can improve efficiency for users and can also bring pleasure to enter a flow state. Therefore, effort expectancy influences the continuance intention indirectly and positively via the flow.

As this sub-study predicted, the results indicate that performance expectancy and effort expectancy directly and positively impact on flow, which is consistent with prior literature (e.g., (Liu et al., 2016)). Besides, social interaction directly and positively impacts on flow, which is consistent with prior literature (e.g., (Choi and Kim, 2004; Kim et al., 2005)). Besides, by logical reasoning and empirical analysis, the results indicate that social influence and habit directly and positively impact on flow, which is a discovery and has not previously been explored to the best of our knowledge. Somewhat surprisingly, the effect of facilitating conditions on flow is not significant, which is inconsistent with (Liu et al., 2016). A reasonable explanation might be that in MBSES, facilitating conditions means the degree a

user believes they have adequate supporting technical knowledge and resources to use MBSES. However, it is a relatively unimportant factor for the user's concentration and enjoyment in the context of MBSES. Thus, it influences the user's continuance intention directly and positively, rather than the flow construct.

In addition, as this sub-study predicted, the results indicate that flow can directly and positively influence on the user's continuance intention. This finding is consistent with prior literature (e.g., (Hsu and Lu, 2003; Lee and Tsai, 2010; Rettie, 2001)).

Serial mediation effects are found in the model of this sub-study. To be specific, extended UTAUT factors and flow factors mediate the relationships between stimuli and continuance intention. The findings of extended UTAUT factors and flow as mediators are consistent with the prior literature (e.g., (Liu et al., 2016; McLean and Wilson, 2019; Wong et al., 2015; Yao and Cao, 2017)). Therefore, in the context of MBSES, this sub-study confirmed that extended UTAUT factors and flow factors serve as crucial mediating variables in the model based on the information processing framework.

4.5.2 Theoretical contributions

The research of the user behaviour in mobile-based smart education service is in its infancy. This sub-study advances our theoretical understanding of smart service user's decision stage, based on the integration with stimuli, UTAUT and flow. Taking the MBSES's technical attributes as stimuli, extended UTAUT as primary information processing, flow state as secondary information processing, and continuance intention as a decision, this sub-study thus explores the relationships among the constructs and their influences towards MBSES usage.

This sub-study identifies the role of MBSES attributes and defines such attributes, namely MBSES interactivity, MBSES intelligence, MBSES convenience, and MBESE personalization. Specifically, this sub-study identifies the MBSES attributes driving continuance intention through the extended UTAUT constructs and flow constructs. By doing so, this sub-study thus illustrates the user's information processing process towards MBSES usage.

This sub-study combines theoretical and empirical research based on the information processing framework. The theoretical basis of this sub-study is also

rooted in the technology diffusion theory - UTAUT (Venkatesh, 2003). Smart education has been around for some time. Because of the lack of a smart education service system that can become popular on a large scale, the promotion of smart education in the user market was progressed slowly until the emergence of new MBSES technology like Liulishuo. In order to explain the mobile-based smart education service user behaviour, this sub-study proposes an extended UTAUT, which covers the factors of internal user evaluation in the context of MBSES. In addition, this sub-study also introduces the flow construct as a mediator to understand user's behavioural intention towards MBSES better.

Consequently, significant theoretical contributions were made. First, this sub-study combines the knowledge from neuroscience with information processing to explain the user's information processing process, takes the extended UTAUT as primary information processing and flow as secondary information processing, and thus develops information processing theory. Second, to explain smart service users' psychological and behavioural mechanism, this sub-study incorporates stimuli constructs as antecedents to the extended UTAUT. Third, to explain the user's behavioural intention, this sub-study adapts flow construct as a partial mediator between UTAUT and continuance intention. Fourth, this sub-study furthers the generalizability of UTAUT by adding social interaction and habit as additional constructs. As a result, the above theoretical integration and extension promote the generalizability of the theory under the context of smart service and therefore is an indispensable step in the development of the theory (Alvesson and Kärreman, 2007; Johns, 2006).

4.5.3 Practical implications

Many of the findings in this sub-study provide practical guidance for smart education practitioners. This sub-study confirmed that compared with the application of other non-smart devices for learning activities, MBSES is featured by more natural interactivity, more convenient technology, more personalized recommendations, and more advanced intelligence. Therefore, from the perspective of the service design, these MBSES attributes including interactivity, intelligence, convenience, and personalization are the key to the success of smart

education service, and those smart features are also applicable in other smart service sectors.

This sub-study suggests that extended UTAUT factors (performance expectancy, effort expectancy, social influence, facilitating conditions, social interaction, and habit) and flow factors (perceived enjoyment and concentration) are crucial mediators between stimuli and behavioural intention. This finding is helpful for MBSES practitioners as well as practitioners from other service sectors to understand smart service user's decision stage and thus better meet user needs and enhance their user experience.

Last but not least, this sub-study will be helpful for the exploration of the causes of smart service usage from the perspective of information processing and help individual users to understand and improve their behaviour in the decision stage, which can be used to manage better their own smart service usage, such as learning.

4.5.4 Conclusions

This sub-study is conducted to understand the smart education service user's decision stage. This theoretical framework combined four streams in the literature; it integrated MBSES attributes as stimuli, extended UTAUT, and flow in an information processing framework. It investigated the effects of technological attributes (intelligence, convenience, interactivity, personalization) of mobile-based smart education service on users' primary information processing (performance expectancy, effort expectancy, social influence, facilitating conditions, social interaction, and habit), subsequently on flow constructs (perceived enjoyment and concentration) as secondary processing, and finally on their behavioural intention as a decision. This sub-study also investigated the serial mediation effects among the constructs, and thus acquired in-depth of understanding user's psychological and behavioural decision stage towards smart education service usage.

4.5.5 Limitations and future research directions

The limitations of this sub-study are primarily reflected in two aspects: First, the sample size is relatively small compared with a large number of MBSES users. Second, this sub-study is a cross-sectional study, which can only study a social phenomenon at a specific time and space.

To further enhance the applicability of the theory in this sub-study as well as further facilitate an in-depth understanding of user's behaviour in smart service, it would be meaningful to study other smart service sectors and compare with this research context. It would also be beneficial using experimental research methods to get a deeper understanding of the user's decision stage regarding smart service.

Chapter 5
Understanding smart service user's gratifications based on U&G theory

The extended abstract of understanding the user's gratification stage by studying U&G theory has been published in *ICServ2020 Conference Proceedings.*

5.1 Research background

This sub-study employs the uses and gratifications (U&G) framework to explore various specific gratifications in affecting users' continuance intention concerning the gratification stage of the smart education service. It applies a quantitative research approach using survey data from the users who used a mobile-based smart education service.

The U&G theory (Katz et al., 1973) has been applied to various new media and services based on new communication technologies. For example, the Internet (Stafford et al., 2004), SNS (Liu et al., 2016), online video (Khan, 2017), online games (Wu et al., 2010; Li et al., 2015)), instant messaging (Gan and Li, 2017) and mobile education (Aburub and Alnawas, 2019). As a type of smart service, based on mobile educational services application, mobile-based smart education allows users access to computer-mediated and self-access educational services. Therefore, the U&G theory can be applied to online mobile-based smart education, because it is relevant to the internet, the new media, and the information system (IS).

Smart education combines AI and education. It integrates various technologies that can adapt to different user's needs and activate the education process (Abdel-Basset et al., 2018). Smart education is user-centred in nature; its adaptation of product functions according to users' needs is crucial for users' experience towards smart education (Smart Learning Institute of Beijing Normal University, 2019). It aims to provide personalised education service anywhere and anytime (Bajaj and Sharma, 2018). By smart education, users can access personalised and seamless education service through internet-enabled smart devices (Zhu et al., 2016).

As a type of smart education, mobile-based smart education service (MBSES), represented by Liulishuo, is gradually maturing in China. As a user-centric service integrated the artificial intelligence system with an innovative, user-friendly mobile interface, Liulishuo provided personalized English education service to over 120 million registered users (Liulishuo.com, 2020). However, faced with competitive pressure from many other English education apps, Liulishuo must retain the existing users. As researchers indicated, retaining users by studying their continuance intention is an important issue (Bhattacherjee, 2001).

U&G research has applied to various mediums based on computer-mediated communication and has some adaptations to the research of different new mediums. But when studying MBSES, these adaptations are incomplete, and important new gratifications for smart education have not yet been determined. Besides, existing research lacks an understanding of what gratifications and to what extent different gratifications influence the continuance intention to use a smart education service. To address the research gap, this sub-study employs the U&G theory as the research framework to explore the influence of different gratifications on smart education users' continuance intention.

5.2 Research construct and hypothesis formulation

5.2.1 Research construct

To derive the five types of gratification in this sub-study, different theories are considered, including motivation theories, hedonic theory, diffusion of innovation theory, self-determination theory and learning theory. Based on the review of past literature and different theories, this sub-study concluded that there are five gratifications each composed of formative factors: Technology gratification is composed of perceived intelligence (Bartneck et al., 2009) and convenience (Ko et al., 2005) factors. Hedonic gratification is composed of perceived enjoyment (Ryan and Deci, 2000) and concentration (Koufaris, 2002) factors. Status (Venkatesh and Brown, 2001) is the factor that fulfils users' social gratification. Achievement (Wu et al., 2010) is the factor that satisfies users' utilitarian gratification. Education is the factor that fulfils users' content gratification (Stafford

et al., 2004). Table 20 shows the research construct in this sub-study.

Table 20. Research construct

Gratification	Construct	Theory	Definition in this research context
Technology gratification	Perceived intelligence	Motivation theories	The extent to which using Liulishuo is perceived to be smart.
	Convenience	Motivation theories	The extent to which using Liulishuo is perceived to be convenient.
Hedonic gratification	Perceived enjoyment	Hedonic theory, Motivation theories	The extent to which using Liulishuo is perceived to be enjoyable.
	Concentration	Hedonic theory	The degree to which using Liulishuo makes an individual concentrate.
Social gratification	Status	Diffusion of innovations theory	The degree to which using Liulishuo improves an individual's status.
Utilitarian gratification	Achievement	Self-determination theory	The degree to which using Liulishuo improves an individual's progress.
Content gratification	Education	Learning theory	The extent to which using Liulishuo is helpful in terms of education, information, knowledge, learning and research.

5.2.2 Hypothesis formulation

Continuance intention is one of the major behavioural outcomes in terms of IS post-adoption (Bhattacherjee, 2001). The definition of continuance intention in this sub-study is the likelihood a user will continue using Liulishuo for a long time.

Intelligence in this sub-study means that Liulishuo's smart education system can constantly store memory through self-learning (Ritter et al., 2011). The smartness and intelligence that Liulishuo's smart education system possessed are evaluated by users (Lee et al., 2007). About the technical standard for user consideration, Liulishuo's smart education system should meet user's technical gratification of perceived intelligence. Previous studies have empirically proved that user's perceived intelligence can positively impact on user's behavioural intention (Dong et al., 2017).

Convenience means how easy it is for users to obtain what they need by using the system (Chou et al., 2004). Convenience value means the value completing a task quickly, efficiently and easily (Larivière et al., 2013). This is a major motivation for Internet usage (Flanagin and Metzger, 2001). In the service-based research context, the existing literature has identified and discussed several dimensions of convenience (e.g., (Berry et al., 2002)). Convenience was empirically validated as the most potent motivation towards the usage of mobile media (Leung and Wei, 2000). Thus,

H1. Perceived intelligence is positively associated with the continuance intention towards MBSES.

H2. Convenience is positively associated with the continuance intention towards MBSES.

Perceived enjoyment is considered one of the primary motivations affecting medium usage (Ryan and Deci, 2000). Previous literature has empirically proved that users are more inclined to continue to use the system if they perceive the usage process as an enjoyable, pleasant experience (Gallego et al., 2016). Additionally, users who are in a flow state are concentrate on their activities first (Koufaris, 2002). User's enjoyment of medium usage results from a flow

experience (Sherry, 2010). Prior studies found that concentration can promote their usage of e-learning (Lee, 2010). Thus,

H3. Perceived enjoyment is positively associated with the continuance intention towards MBSES.

H4. Concentration is positively associated with the continuance intention towards MBSES.

User's social gratification is derived from their elevation in status using Liulishuo's smart education system. Innovation literature suggests that the desire to gain status is an essential reason for IS adoption (Rogers, 1995). Thus,

H5. Status is positively associated with the continuance intention towards MBSES.

Achievement refers to using Liulishuo's smart education system to gain English skill, progressing in a game clearance, points accumulation, and competing with others (Ryan and Deci, 2000). User's achievement was empirically validated as a motivation to predict their continuance intention (Wu et al., 2010). Thus,

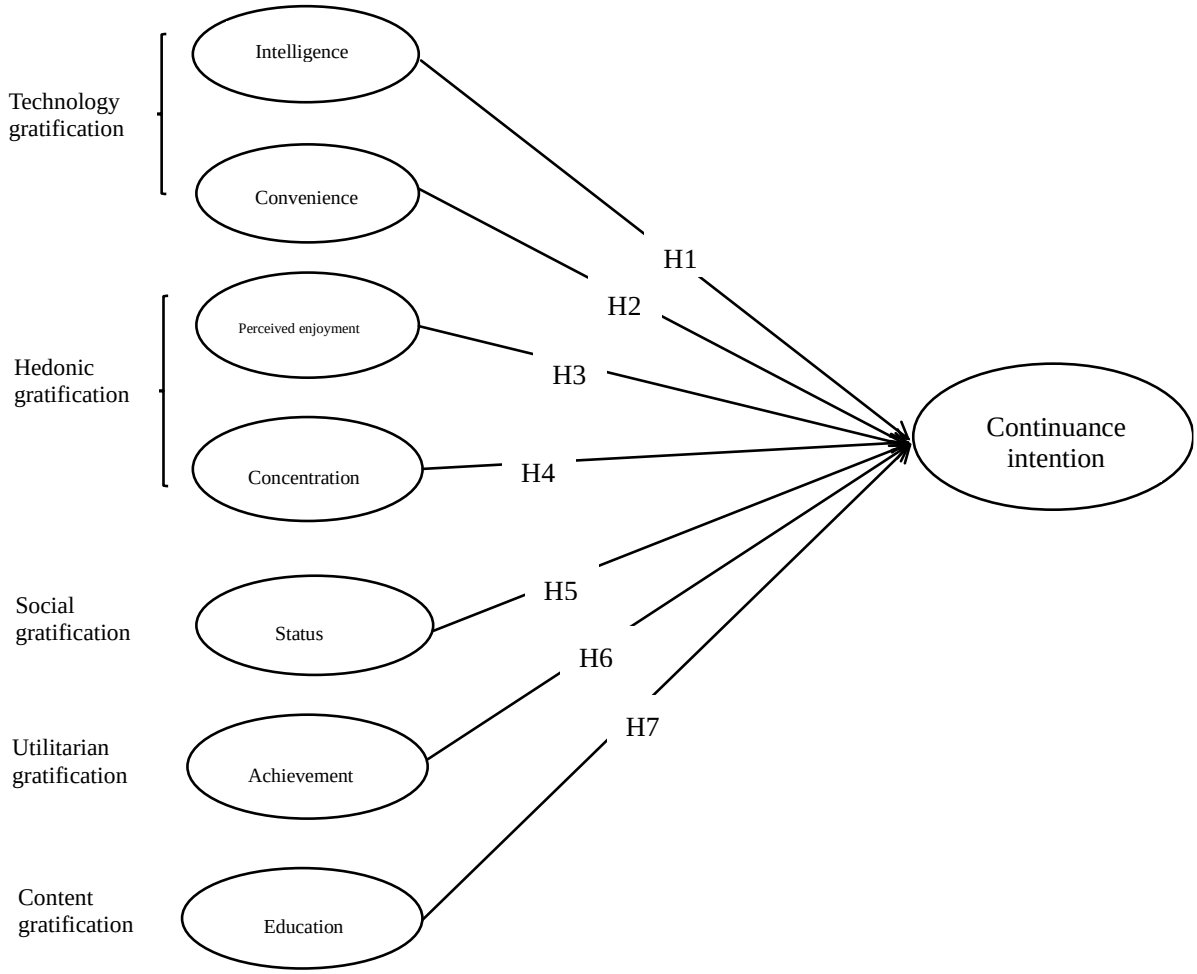
H6. Achievement is positively associated with the continuance intention towards MBSES.

User's content gratification is represented by the education they obtained using Liulishuo's smart education system. Content gratification concerns the information carried by the media, and it is the fulfilment of user's information expectation (Cutler and Danowski, 1980). With the introduction of the light social mechanism and the presence of nearly 100 elites in the field of English culture and education, Liulishuo upgraded from oral learning to pan English culture learning. The prior study empirically validated that content gratification can promote user's online media usage (Stafford et al., 2004). As a smart education system, users' education obtained using Liulishuo can very likely promote their continuance intention. Thus,

H7. Education is positively associated with the continuance intention towards MBSES.

Figure 10 depicts the research model of chapter 5.

Figure 10. Research model of chapter 5



5.3 Research method and data

5.3.1 Measurement development

This sub-study employs a quantitative research approach using survey data. Participants in this sub-study are users who have used Liulishuo. All the measurement scales were adapted from past literature: Perceived intelligence (Bartneck et al., 2009); Convenience (Ko et al., 2005); Perceived enjoyment (Moon and Kim, 2001; van der Heijden, 2003;); Concentration (Koufaris, 2002); Status (Venkatesh and Brown, 2001); Achievement (Wu et al., 2010); Education (Stafford et al., 2004); Continuance intention (Bhattacherjee, 2001) and adjusted to the context of mobile-based smart education service. All measurement items are measured using a seven-point Likert scale. Table 21 shows the measurement items.

Table 21. Measurement items

Construct	Adapted scale
Continuance intention Bhattacherjee (2001) Wu and Zhang (2014)	1. My intentions are to continue using Liulishuo AI learning service than to use any alternative means (traditional way). 2. I will use the Liulishuo AI learning service on a regular basis in the future. 3. I will frequently use the Liulishuo AI learning service in the future. 4. I will strongly recommend others to use Liulishuo AI learning service. 5. I intend to continue using Liulishuo AI learning service in the future.
Perceived intelligence Bartneck et al. (2009)	1. Liulishuo education system is competent. 2. Liulishuo education system is sensible. 3. Liulishuo education system is intelligent.
Perceived convenience Ko et al. (2005)	1. I can learn English anywhere with the use of Liulishuo education system. 2. I find the Liulishuo education system convenient for my learning. 3. Liulishuo education system is convenient to use.
Perceived enjoyment Moon and Kim (2001) van der Heijden (2003)	1. Using Liulishuo can give more enjoyment than other English learning methods. 2. Using Liulishuo, let me feel pleasure. 3. When using Liulishuo, I do not realize the time elapsed.
Perceived concentration Koufaris (2002)	1. When using Liulishuo AI learning service, my attention is focused on the activity. 2. When using Liulishuo AI learning service, I concentrate fully on the activity. 3. When using Liulishuo AI learning service, I am deeply engrossed in the activity.
Status Venkatesh and Brown (2001)	1. The new AI app Liulishuo enables me to talk about what my friends talk about. 2. The new AI app Liulishuo allows me to share content with my friends. 3. The new AI app Liulishuo makes me like the leading generation.
Achievement Wu et al. (2010)	1. I use Liulishuo to achieve a higher level. 2. I use Liulishuo to have a better command of English than other users. 3. I use Liulishuo to score more, which gives me a higher status than other users of the app.
Education Stafford et al. (2004)	1. I got a good English education by using Liulishuo. 2. I got useful information about English learning using Liulishuo. 3. I have acquired a lot of English knowledge using Liulishuo. 4. My English learning has improved by using Liulishuo.

5.3.2 Data collection methods

The online questionnaire survey is hosted by Baidu sample service with a simple random sampling procedure. The data collection cycle lasted about 30 days in China. Finally, a total of 495 users' responses were considered to be valid for further analyses. Before the main study, a pilot test was conducted, which was not included in the main survey. We found preliminary evidence that the measurement

scales were valid and reliable.

5.4 Data analysis and results

PLS-SEM can be used to explain the relationships among independent variables, dependent variables, mediators, and moderators. PLS-SEM is more suitable for the data analysis of this sub-study. Compared to CB-SEM, PLS-SEM has fewer identification issues and is more robust (e.g., (Hair et al., 2011)). This sub-study applied PLS-SEM to test the model because this sub-study has a relatively large number of variables; this increases the model complexity. Under this circumstance, PLS-SEM is capable of proving the relationships in the model of this sub-study (Chin et al., 2003).

5.4.1. Descriptive statistics

Table 22 summarizes the demographics of the respondents.

Table 22. Demographic characteristics of respondents of chapter 5

Item	Type	Frequency	Percentage
Gender	Male	238	48.1%
	Female	257	51.9%
Age	10-18	6	1.2%
	19-25	297	60.0%
	26-45	188	38.0%
	46+	4	0.8%
Educational level	Middle school	21	4.2%
	Undergraduate	426	86.1%
	Postgraduate	48	9.7%
Weekly usage time	1-3 hours	208	42%
	4-10 hours	227	45.9%
	More than 10 hours	60	12.1%

The participation of the survey in this sub-study was voluntary. A total of 495 usable questionnaires were obtained. Among these respondents, 48.1% were male, and 51.9% were female. Most of the respondents (98%) were between 19 and 45 years old. In addition, 95.8% of the respondents were undergraduate or above.

5.4.2 Measurement model

Chin (2010) suggested that the first step of a research model evaluation is to examine the reliability and validity of the measurement scales applied in each construct by analyzing the measurement model results. Therefore, using the SmartPLS 3.0 version, this sub-study first examined the measurement model to evaluate the validity and reliability before testing the structural model.

The psychometric properties of the constructs in this sub-study were assessed by calculating the Cronbach's alpha reliability coefficient (e.g., (Nunnally and Bernstein, 1994), in table 24). The empirical study results indicate that the five dimensions of the gratification concept shown in table 24 are identifiable and distinguishable.

In this sub-study, all constructs exhibit adequate internal consistency reliability as the Cronbach's alpha coefficient values exceed the threshold value of 0.70. The average variance extracted (AVE) is higher than the threshold value of 0.50. As a result, all the remaining constructs in this sub-study show good internal consistency reliability. These results are shown in tables 24.

Discriminant validity in this sub-study is evaluated in two steps. First, all items loaded on to the corresponding latent variable and all items exhibit loadings higher than the threshold value of 0.70. The factor loading of an item on its associated construct should be higher than the loading of any other non-construct item on that construct (e.g., (Venkatesh et al., 2012)). The cross-loading matrix of this sub-study indicates that no cross-loading that exceeds the column and with-in row loadings; as a result, the measurement model of this sub-study demonstrates significant convergent validity. Table 23 presents the PLS loadings and cross-loadings.

Second, the Fornell and Larcker (1987) criterion are applied to test whether the square root of a construct's AVE is higher than the correlations between this construct and any other construct within the model of this sub-study. Hair et al. (2006) suggested that in the correlation matrix, if the squared correlations between the constructs do not exceed 0.80, the multicollinearity problem can be ignored for model estimation. Table 24 shows the result of this analysis and presents the latent variable correlation matrix with the AVE on the diagonal. Therefore, this sub-study concludes that the measurement model demonstrates good discriminant validity and meets the Fornell and Larcker (1987) standards.

Table 23. PLS loadings and cross-loadings of chapter 5

Construct		CI	PIG	PCV	PEN	PCO	ST	ACH	EDU
Continuance intention	CI1	**0.755**	0.544	0.456	0.515	0.506	0.503	0.502	0.494
	CI2	**0.782**	0.566	0.548	0.554	0.561	0.53	0.572	0.591
	CI3	**0.8**	0.576	0.565	0.562	0.55	0.532	0.563	0.603
	CI4	**0.749**	0.504	0.439	0.523	0.519	0.557	0.505	0.498
	CI5	**0.758**	0.535	0.533	0.54	0.522	0.495	0.531	0.549
Perceived intelligence	PIG1	0.643	**0.847**	0.598	0.614	0.626	0.57	0.618	0.689
	PIG2	0.609	**0.801**	0.539	0.581	0.621	0.544	0.561	0.568
	PIG3	0.548	**0.802**	0.567	0.562	0.571	0.563	0.558	0.618
Perceived convenience	PCV1	0.532	0.582	**0.853**	0.526	0.553	0.493	0.54	0.591
	PCV2	0.551	0.606	**0.82**	0.542	0.604	0.509	0.589	0.652
	PCV3	0.494	0.467	**0.718**	0.553	0.54	0.502	0.448	0.497
Perceived enjoyment	PEN1	0.665	0.65	0.597	**0.87**	0.64	0.619	0.612	0.649
	PEN2	0.602	0.589	0.545	**0.841**	0.652	0.633	0.6	0.615
	PEN3	0.562	0.531	0.52	**0.759**	0.617	0.642	0.519	0.544
Perceived concentration	PCO1	0.6	0.651	0.608	0.624	**0.812**	0.591	0.572	0.663
	PCO2	0.594	0.606	0.578	0.66	**0.82**	0.613	0.566	0.574
	PCO3	0.57	0.591	0.576	0.633	**0.855**	0.632	0.584	0.597
Status	ST1	0.566	0.567	0.485	0.605	0.595	**0.841**	0.552	0.561
	ST2	0.579	0.598	0.554	0.663	0.645	**0.813**	0.563	0.607
	ST3	0.59	0.534	0.512	0.625	0.592	**0.828**	0.571	0.516
Achievement	ACH1	0.593	0.619	0.518	0.625	0.575	0.58	**0.818**	0.678
	ACH2	0.513	0.572	0.557	0.538	0.551	0.503	**0.745**	0.613
	ACH3	0.549	0.561	0.497	0.598	0.563	0.579	**0.816**	0.53
Education	EDU1	0.674	0.682	0.549	0.633	0.591	0.562	0.577	**0.808**
	EDU2	0.587	0.598	0.586	0.546	0.571	0.53	0.565	**0.765**
	EDU3	0.573	0.569	0.55	0.576	0.567	0.494	0.55	**0.779**
	EDU4	0.573	0.561	0.618	0.55	0.592	0.547	0.553	**0.794**

Table 24. Construct reliability and validity of chapter 5

Construct	AVE	CR	Cronbac-h's Alpha	CI	PIG	PCV	PEN	PCO	ST	ACH	EDU
CI	0.591	0.879	0.827	**0.769**							
PIG	0.667	0.857	0.75	0.71	**0.817**						
PCV	0.638	0.84	0.716	0.663	0.696	**0.799**					
PEN	0.68	0.864	0.763	0.701	0.718	0.673	**0.825**				
PCO	0.687	0.868	0.772	0.692	0.742	0.708	0.771	**0.829**			
ST	0.684	0.867	0.769	0.68	0.685	0.625	0.763	0.738	**0.827**		
ACH	0.63	0.836	0.706	0.697	0.736	0.658	0.741	0.709	0.699	**0.794**	
EDU	0.619	0.867	0.795	0.713	0.767	0.732	0.733	0.737	0.678	0.766	**0.787**

Notes:
CI=continunance intention; PIG=intelligence; PCV=convenience; PEN=perceived enjoyment; PCO=concentration; ST=status; ACH=achievement; EDU=education.

5.4.3 Structural model

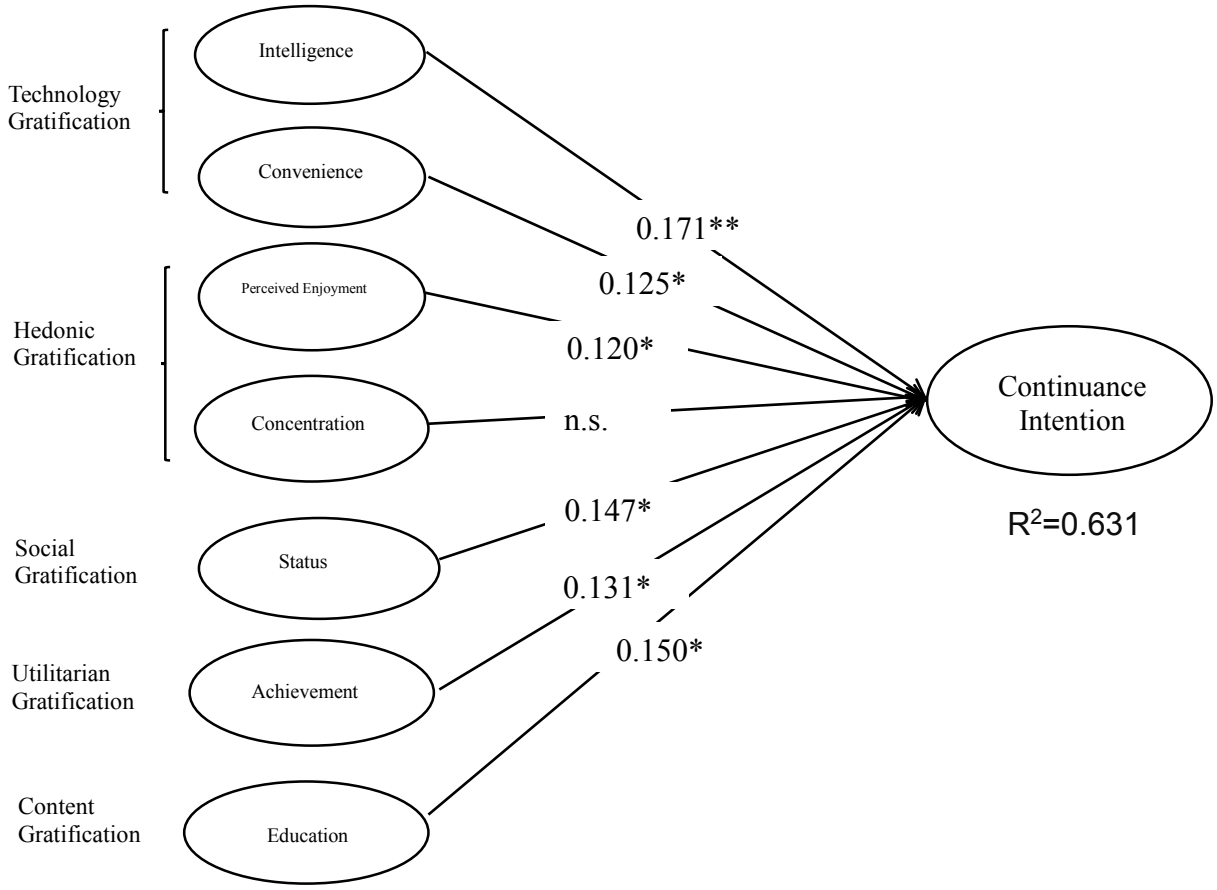
Tenenhaus et al. (2005) suggested a global fit measure for PLS-SEM path modelling, which is goodness of fit (GoF) (0 < GoF < 1); it can be calculated as the geometric mean of the average value of communality and the average value of R^2. In the PLS path modelling, the value of communality equals to the value of AVE. Therefore, as proposed by Fornell and Larcker (1981), this sub-study thus applies a threshold value of 0.50 for communality. Furthermore, Cohen (1988) proposed the small, medium and large threshold value of the effect sizes for R^2 (small value is 0.02; medium value is 0.13; large value is 0.26). Therefore, substituting the average AVE threshold value of 0.50, and the threshold value of the effect sizes for R^2 in the calculation formula of GoF, the threshold value of GoFsmall=0.1, GoFmedium=0.25, and GoFlarge=0.36 can be calculated. These threshold values can serve as baseline values for validating the PLS-SEM model globally (e.g., (Croasdell et al., 2010; Wetzels et al., 2009)). The GoF value of the model in this sub-study is calculated to be 0.64, which exceeds the threshold value of 0.36 for GoFlarge. As a result, the model of this sub-study performs well according to the baseline values discussed above and indicating that the model provided a good fit for the data. Consequently, the model of this sub-study explains 63.1% of the variance for continuance intention.

The estimated standardized structural coefficients for the hypothesized relationships between constructs and their significance level are shown in table 25.

The results indicate that all hypothesized relationships are supported except H4. It shows that continuance intention is influenced by intelligence (β=0.171, P<0.01), convenience (β=0.125, P<0.05), perceived enjoyment (β=0.12, P<0.05), status(β=0.147, P<0.05), achievement (β=0.131, P<0.05) and education (β=0.15, P<0.05). However, concentration does not have a significant impact on continuance intention. As a result, the structural model analysis results empirically indicate the sequence of the importance of different gratifications affecting on continuance intention towards mobile-based smart education service.

Figure 11 depicts the structural model.

Figure 11. Structural model of chapter 5



*Note: **: p < 0.01, *: p < 0.05. 5,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.*

Table 25. Hypothesis testing of chapter 5

The hypothesis	Path coefficient	STDEV	T-value	P-value	Result
H1: PIG -> CI	0.171	0.065	2.611	**	Yes
H2: PCV -> CI	0.125	0.055	2.257	*	Yes
H3: PEN -> CI	0.12	0.06	2.001	*	Yes
H4: PCO -> CI	n.s.	n.s.	n.s.	n.s.	No
H5: ST -> CI	0.147	0.066	2.206	*	Yes
H6: ACH -> CI	0.131	0.063	2.071	*	Yes
H7: EDU -> CI	0.15	0.074	2.015	*	Yes

*Note: **: $p < 0.01$, *: $p < 0.05$. 5,000 bootstrap samples were used for the bias-corrected bootstrap 95% confidence intervals.*

5.5 Discussions and conclusions

5.5.1 Discussions

Building on the U&G framework, this sub-study identified five major types of user gratifications toward MBSES continuance intention, each composed of various reflective factors. This sub-study discusses every type of gratification according to their order of importance. The empirical results of the relationship between each gratification and continuance intention are discussed next to how they support or contradict the literature. The reason for the findings is explained correspondingly.

This sub-study takes Liulishuo as a typical research object to study MBSES. The empirical results show that all five types of gratifications have significant impacts on Liulishuo users' continuance intention: Technology gratification (intelligence, convenience), Hedonic gratification (perceived enjoyment), and Social gratification (status), Utilitarian gratification (achievement), Content gratification (education).

Technology gratification (intelligence) is found to be the most important motivator determining the continuance intention to use Liulishuo. This is consistent with the findings of Gulvady (2009) regarding blogging; Gan and Li (2017) regarding Wechat. The intelligence of Liulishuo reflects competence, sensibility, and intelligence to Liulishuo users. A high degree of intelligence indicates that users can use Liulishuo to learn more efficiently and effectively, close to that of a human personal teacher. For example, Liulishuo users can be graded with their performance and are accurately pointed out where the problem is; this can effectively and efficiently improve the user's English level. The intelligence gratification obtained in Liulishuo usage further motivates individuals' intention to continue using Liulishuo. Besides, convenience as a technology gratification factor can also positively impact on the continuance intention to use Liulishuo. This finding is consistent with the findings of Ko et al. (2005) regarding the Internet; Haridakis and Hanson (2009) regarding YouTube.

Consistent with prior findings regarding Facebook (Hsu et al., 2015) and virtual social worlds (Mantymaki and Riemer, 2014), hedonic gratification (perceived enjoyment) was found to have a powerful influence on Liulishuo users' continuance intention. Users perceive the usage of Liulishuo as enjoyable and pleasant when

learning English with it. The gratification of the perceived enjoyment can fulfil Liulishuo users' need for hedonic gratification, thus leading to their intention to continue using Liulishuo. Unexpectedly, concentration was found to have no significant effect on the continuance intention to use Liulishuo. The possible reason for that can result from the fact that users may treat concentration as a less important factor when using Liulishuo.

As this sub-study predicted, social gratification (status) is found to have significant effects on Liulishuo users' continuance intention. This finding is consistent with prior findings regarding personal computers (Venkatesh and Brown, 2001). This sub-study thus shows that Liulishuo could be used as a platform for social reasons, such as gaining status.

Furthermore, utilitarian gratification (achievement) is found to impact the continuance intention to use Liulishuo significantly. The result is consistent with previous studies regarding social network games (Li et al., 2015). This sub-study thus indicates that Liulishuo could be used as a platform for utilitarian reasons, such as attaining achievement.

Last but not least, as this sub-study expected, content gratification (education) is found to impact on the continuance intention to use Liulishuo significantly. The result is consistent with previous studies regarding the Internet (Stafford et al., 2004). This sub-study suggests that as a mobile education platform, Liulishuo could provide users with education value as a content gratification.

5.5.2 Conclusion and implications

This sub-study contributes to the understanding of user's gratification stage concerning smart services by identifying the specific gratifications concerning smart education service. By doing so, it expands the scope and generalizability of U&G theory to the smart education service context. By studying the relationships between different types of gratifications and continuance intention, the knowledge gained can facilitate a better understanding of user's gratification stage in the context of mobile-based smart education services.

It is worth mentioning that there is no specific research construct for exploring technology gratification in terms of the smartness of an AI information system. This sub-study found that intelligence as a technology gratification has the most

substantial impact on motivating Liulishuo users' continuance intention. Previous IS literature employing the U&G theory has mainly focused on social, utilitarian and hedonic gratifications, and revealed their effects on IS user behaviour. Less attention has been paid to the impact of technology gratification. The findings of this sub-study extend the use of U&G theory in IS literature by considering the role of a new type of technology gratification factor (perceived intelligence), and it also deepens our understanding of the factors influencing IS continuance behaviour. Therefore, this sub-study contributes to the literature by adding and empirically proving perceived intelligence is an essential construct in the user's technology gratification for predicting continuance intention. We also confirmed that the technology gratification of convenience has positive effects on the continuance intention to use Liulishuo.

This sub-study revealed that content gratification as education has the second most significant positive effect on the continuance intention to use Liulishuo. Besides, this sub-study shows that the hedonic gratification of perceived enjoyment, the social gratification of status, the utilitarian gratification of achievement has positive effects on the continuance intention to use Liulishuo, while the hedonic gratification of concentration does not. The findings of this sub-study indicate that a variety of factors constructs the gratifications towards MBSES usage, and different factors will play different roles in fulfilling the user's gratifications.

Many of the findings can offer practical guidance on how to retain existing Liulishuo users in China by fulfilling users' needs of specific gratifications in the gratification stage. Some gratifications could get practitioners' attention in designing of the future product.

This sub-study highlights the salient role of the technology gratification of intelligence and convenience in impacting on MBSES users' continuance intention. Thus, MBSES service providers should ensure that users can access their services on the mobile-based smart education platform of Liulishuo with more intelligent, more convenient ways.

Besides, this sub-study discovered that the content gratification of education is the second dominant factor motivating Liulishuo users' continuance intention. The result suggests that MBSES service providers should improve their services to make the mobile-based smart education platform of Liulishuo more educative.

Furthermore, this sub-study finds that the hedonic gratification of perceived enjoyment, the social gratification of status, the utilitarian gratification of achievement are important factors motivating Liulishuo users' continuance intention in the gratification stage. Therefore, MBSES service providers should improve the corresponding features and functions of the mobile-based smart education platform Liulishuo, to help users obtain their gratifications for perceived enjoyment, status, and achievement in the gratification stage.

This sub-study has the following limitations. First, this sub-study primarily collected data in China, and the findings can be more generalized if we also use samples from a developed country. Second, the sample size of this sub-study is relatively small. The larger sample size is recommended in future studies.

Chapter 6
Research conclusions and insights

This chapter concludes the dissertation by taking up the research questions, as stated in the introduction. Chapter 6.1 provides a summary of results and critically reflects the research questions regarding the findings of this dissertation, in chapter 6.2 the theoretical and managerial contributions are discussed, and chapter 6.3 completes the dissertation with its limitations and an outlook into further research.

6.1 Summary of the results

The research of this dissertation was guided by the following research questions:

Q1: How to define the user's internal psychological decision-making process across the pre-acceptance, acceptance and post-acceptance stages of the smart service system?

The three service consumption stages of pre-purchase, purchase and post-purchase in the classical consumer behaviour theory (e.g., Peter and Olson, 2009), reflected in the field of information services, is three consumption stages of pre-acceptance, acceptance and post-acceptance (e.g., (Fichman, 2001; Hameed et al., 2012)); reflected in the service marketer's market development process as "pre-service, service, and post-service" (e.g., (Rosenbaum et al., 2016)); Accordingly, the user’s internal psychological process for the external manifestation of the service consumption stage is "perception - decision - gratification".

The theoretical integration of technology diffusion theory and U&G theory, is proved to enable a systematic and holistic understanding of the user’s internal psychological decision-making process towards smart service system. After three empirical studies, this dissertation confirms that the three-stage behavioural framework as user’s internal psychological process is reasonable.

Q2: In the user's internal psychological process, what factors of a smart service system are different from other information technology service system that affect the user's pre-acceptance, acceptance and post-acceptance?

This dissertation suggests that the following dimensions are the biggest difference between smart services and non-smart information technology services. They are: (1) Smart service is personalised in nature; (2) Smart service can achieve flexible co-creation with smooth service experience; (3) Smart service is highly interactive, it enables natural two-way communication; (4) Smart service is characterized by intelligence; (5) Smart service is characterized by service convenience. The effect of these smart dimensions on users' behavioural intention is empirically proved.

Q3: What are the different factors considered by users regarding the pre-acceptance, acceptance and post-acceptance, and how are the factors change dynamically in these three consumption stages?

After three systematic empirical studies of the three stages, this dissertation finds that with the deepening of users' involvement in information technology services, the factors considered by users will change, from considering rational factors to considering both rational factors and emotional factors. The user first makes a rational judgment by considering the homogeneous, basic and functional factors in the perception stage. In the decision stage, the user begins to add some emotional considerations based on rational factors. In the gratification stage, after the usage of the smart service system, the user tends to think beyond the basic functionality by considering more differentiated emotional factors.

6.2 Research implications

6.2.1 Theoretical contributions

Contribution of the three-stage behavioural framework

This dissertation contributes to the literature on user decision-making models by systematically and holistically developing and analysing a smart service user's three-stage behavioural framework of "perception - decision - gratification". This dynamic three-stage behavioural framework describes the internal psychological decision-making process of the three corresponding service consumption stages of pre-acceptance, acceptance and post-acceptance. It is the latest development of consumer decision-making model in the contemporary smart service context.

Based on the three consumer consumption stages of pre-purchase, purchase, and post-purchase in the classical consumer behaviour literature, this dissertation proposes a three-stage behavioural framework of "perception - decision - gratification". At the same time, this dissertation unifies three-stage behavioural framework with pre-acceptance, acceptance and post-acceptance of information technology service consumption stage and three stages of "pre-service, service and post-service" of the market development process. This synthesis of extant knowledge regarding user's internal psychological process, service marketer's marketing development process, user's information technology service acceptance stage, consumer's service consumption process, especially the synthesis of the first two perspectives, answers the early call of market orientation (e.g., (Kohli and Jaworski, 1990)), as they suggest that market orientation refers to marketer identifies the needs of consumers and provides corresponding products/services that satisfy those consumers. This synthesis thus provides an in-depth understanding of the user's service consumption. It enables marketers to meet users with corresponding needs in each stage of the service consumption process.

This three-stage behavioural framework enhances a holistic and systematic understanding of smart service user's internal psychological mechanism in terms of smart service system pre-acceptance, acceptance and post-acceptance. It thus offers new holistic theoretical insights for practitioners to design and implement smart service systems successfully. It also provides a theoretical basis for a

practical testing framework that can predict smart service user’s usage and satisfaction; as a result, it enables smart service system practitioners to evaluate the smart service systems across the acceptance and post-acceptance stages.

It offers holistic and systematic theoretical understanding for users to improve their own behaviour across the pre-acceptance, acceptance and post-acceptance. This three-stage behavioural framework can also provide a theoretical reference in terms of the user’s internal psychological decision-making mechanism for other service systems, rather than information technology service system.

This dissertation suggests that the smart service user's internal psychological process is a dynamic process, rather than a linear process. As a result, by proposing the three-stage behavioural framework, this dissertation believes there are certain overlaps in the three stages of the smart service user's internal psychological decision-making process. The three-stage behavioural model supposes that, in the perception stage and decision stage, users cannot fully recognise their own needs and clarify their own problem recognition. In the decision stage, the user's already recognised needs and cleared problem recognition are met. In the gratification stage, user's incompletely satisfying needs, and problem recognition will become prioritised needs and problems. At the same time, in this gratification stage, the user begins to recognise potential deep psychological needs and new problem recognition, and thus entering a new psychological cycle of the decision-making process. Smart service can make it easier for users to recognize new problems and needs so that users can be better satisfied.

This three-stage behavioural framework as the internal psychological reflection of the three information technology service consumption stage (pre-acceptance, acceptance and post-acceptance) confirms that, with the deepening of users' involvement in information technology services, the factors considered by users will change. It finds that the transformation of user’s considerations is manifested as: from considering rational factors to considering both rational factors and emotional factors. Specifically, it suggests that the user first makes a rational judgment by considering the homogeneous, basic and functional factors in the perception stage; In the decision stage, on the basis of rational factors, the user starts to consider some emotional factors based on social and psychological perspectives; In the gratification stage, after the usage of the smart service system,

the user tends to consider more differentiated emotional factors; specifically, users pay more attention to whether their social and psychological expectations are gratified. Therefore, it allows us to have a holistic and dynamic understanding of the user experience across user's smart service system acceptance and post-acceptance, with both rational and emotional factors covered. To the best of our knowledge, this is a novel contribution to the research on the information technology service user behaviour.

This dissertation also contributes to the smart service literature and enhances our theoretical understanding towards smart service, by identifying and proving the new smart dimensions of smart service perceived by users across the three user's internal psychological stages, compared to the non-smart information technology service.

Last but not least, the three-stage behavioural framework of "perception - decision - gratification" allows us to have a holistic and systematic understanding of the user experience across user's smart service system pre-acceptance, acceptance and post-acceptance.

Contribution to technology diffusion theory and U&G theory

Previously, technology diffusion theory including TAM and UTAUT, consider user's technology pre-acceptance and acceptance as a static process in one single model. This dissertation thus considers technology diffusion theory including TAM, UTAUT, as consumer decision-making process models to explain the user's dynamic internal psychological process across the pre-acceptance and acceptance stage. This dissertation applies the U&G framework to explain the gratification of consumers in the post-acceptance stage. The integration provides solid theoretical support for user's three-stage behavioural framework of "perception - decision - gratification" for a systematic and holistic understanding of the user's internal psychological mechanism.

Technology diffusion theory, including TAM and UTAUT, is a theory that can reliably predict user information technology service acceptance. U&G provides a more complete understanding of user acceptance behaviour from the perspective of explaining different types of user satisfaction after use. The theoretical integration of these two theories are of great significance: first, it provides us with

the opportunity to extend the boundary conditions of a single theoretical genealogy and holistically explain user's smart service system acceptance and post-acceptance; second, using the theory originally from computer-mediated communication to study smart service systems can broaden the horizons of academics who usually use an information system perspective to analyse smart service systems; it thus combines the theoretical advantages of the management information system field and the communication field, thus providing academics and practitioners with an interdisciplinary perspective to study user acceptance and post-acceptance behaviour as a whole.

This dissertation extends the generalizability of U&G which was primarily applied in communication research, to the smart service system/information system; as a carrier of information dissemination, information system belongs to computer-mediated medium in a broad sense. Therefore, the extension of the generalizability is sufficiently reasonable in theory. It also clearly relates the U&G theory to the post-acceptance research of the information system. This connection is also theoretically reasonable, for U&G theory solves user's gratifications with expectations after using a specific medium (e.g., (Ruggiero, 2000)).

Contribution of the three sub-studies

The three sub-studies have the following three contributions explicitly:

1. The first sub-study contributes to understanding the user's perception stage by identifying and studying user's smart service belief factors based on the integration with TAM. Specifically: First, based on active audience theory, this sub-study proposes the concept of a smart media audience-type user, to explain the perceptual and behavioural characteristics of consumers in smart media content services. Second, by identifying smart service belief factors, exploring the relationships between smart service belief factors and user's attitude toward behaviour, and analyzing intention to purchase, the knowledge gained will facilitate a better understanding of user's perception stage towards smart service. Third, by incorporating three smart service belief factors into TAM, this sub-study has expanded the overall theoretical network related to technology use and have furthered the generalizability of TAM. Fourth, by taking user experience type as an original moderator, this sub-study demonstrates how to convert ad-supported

users into new paid subscribers, while keeping existing subscribers, by fulfilling their smart service requirements, from a CEM perspective. In summary, based on this sub-study, we gained insights into smart service system user's perception stage.

2, The second sub-study contributes to understanding user's decision stage based on the integration of stimuli, UTAUT and flow, from an information-processing perspective. Specifically, this sub-study makes four critical contributions. First, this sub-study combines the knowledge from neuroscience with information processing to explain the user's decision stage, takes the extended UTAUT as primary information processing and flow as secondary information processing, and thus develops information processing theory. Second, to explain smart service users' psychological and behavioural mechanism, this sub-study incorporates stimuli constructs as antecedents to the extended UTAUT. Third, to explain their continuance intention, this sub-study adapts flow theory as a partial mediator between UTAUT and behavioural intention. Fourth, this sub-study furthers the generalizability of UTAUT by adding social interaction and habit as additional constructs. In summary, based on this sub-study, we gained insights into smart service system user's decision stage.

3, The third sub-study contributes to understanding user's gratification stage based on U&G theory. Specifically: First, this sub-study derives five types of user gratification based on five theories, including motivation theories, hedonic theory, diffusion of innovation theory, self-determination theory and learning theory. Second, by studying the relationships between different types of gratifications and continuance intention, this sub-study expands the scope and generalizability of U&G theory. Third, this sub-study firstly uses an intelligence construct to explore user's technology gratification concerning smart service and empirically demonstrated the validity of this construct. In summary, based on this sub-study, we gained insights into user's gratification stage in smart service consumption.

6.2.2 Practical implications

For smart service practitioners, by providing a deeper understanding of the mechanism of the information technology service user' internal psychological decision-making process, the formulation of new knowledge in this dissertation is

helpful for practitioners to promote the market development. For example, practitioners can allocate resources to adjust factors that affect user perception and decision during the smart service pre-acceptance and acceptance stage and factors that affect user gratification/satisfaction in the smart service system post-acceptance stage, as this can optimize customer conversion rate and retention rate to improve their profits. Besides, it could help practitioners to get a more in-depth understanding of the user's psychological mechanism in each stage of the three-stage behavioural framework and thus serve users better in the market development process. Furthermore, the understanding of the new different dimensions of smart service perceived by users, compared to the non-smart information technology service, would provide an essential reference for practitioners when designing future smart service products and smart service systems. Lastly, the three-stage behavioural framework allows smart service practitioners to manage customer experience systematically and holistically across smart service system pre-acceptance, acceptance and post-acceptance.

This dissertation can benefit smart service users in terms of the exploration of the causes of smart service usage from the perspective of personal psychology. This dissertation allows users to consider which behaviours are reasonable and which are unreasonable when using smart service systems. Therefore, it can help individual users to understand and improve their own behaviour towards smart service system.

6.3 Limitations and future research directions

The limitations of this dissertation can provide future paths of research, and they are listed below.

First, the data used in this dissertation is geographically limited to China. On the one hand, this can limit exposure to cultural distortion of the research. On the other hand, it could limit exposure to economic distortion by researching a developing country. Second, because of the length of this dissertation, smart media and smart education are selected as two typical research objects. Third, this dissertation does not separately study the user's perception in the pre-acceptance stage. In order to better understand the user's perception and their influence on acceptance decision, the first sub-study puts pre-acceptance and acceptance

together; similarly, when studying the user's decision stage, this dissertation also studies the factors that affect the user's decision. This research approach is supported by the classical technology diffusion theory approach. Last but not least, it is very complex to explain the change of smart dimension considered by users in three behavioural stages, as it is a continuous dynamic process. Therefore, in this dissertation, we did not design to analyze this continuous dynamic process, which is the limitation of this dissertation. Again, for similar reasons, there is no comparative study on the strength of non-smart factors perceived by users in the smart service system and non-smart service system, which constitutes another limitation of this dissertation.

Future research can empirically explore other types of smart services with samples from other western developed countries. They can use a multi-stage survey, or multi-stage experiment to study the dynamic change of smart factors in the three behavioural stages, and to compare the strength of non-smart factors perceived by users in the smart service system and non-smart service system, in the three behavioural stages, for a more complete understanding of smart service user behaviour.

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Appendix 1

Survey to investigate user's opinions toward AI-powered smart TV usage

I am a PhD student from the School of Business Administration, Kobe University, and I am doing this survey to investigate user's opinions toward AI-powered smart TV watching. This research is purely academic and will not be used for any commercial purpose. I would be very grateful for your participation in this research.

Note: AI TVs have added AI functions such as voice interaction functions and smart recommendation functions to the original smart TVs. The representative brands include TCL, Skyworth, Hair, LG, Sony, Samsung, and many others.

If you have not used an AI TV before, please do not answer it.

Section 1: Basic information

1. Have you used an AI-powered smart TV?

☐ Yes
☐ No

2. Are you a paid-subscriber of Smart TV?

☐ Yes
☐ No

3. How many hours do you spend using AI TV every week recently? (Includes all-time using AI TV in a week)

☐ Less than 1 hour
☐ 1-3 hour
☐ 3-6 hour
☐ 6-10 hour
☐ 10-20 hour
☐ 20-40 hour
☐ More than 40 hour

Section 2: Opinions toward AI-powered smart TV

Please indicate your opinions towards the following items. Point 1 means strongly disagree, point 2 means very disagree, point 3 means fairly disagree, point 4 means neutral, point 5 means fairly agree, point 6 means very agree, point 7 means strongly agree.

1. It is likely that I will purchase the AI TV content services within the next 6 months.	1	2	3	4	5	6	7
2. Given the chance, I intend to purchase the AI TV content service.	1	2	3	4	5	6	7
3. I recommend my family and friends to purchase the AI TV content service.	1	2	3	4	5	6	7
4. Using the AI TV is a good idea.	1	2	3	4	5	6	7
5. Using the AI TV is a wise idea.	1	2	3	4	5	6	7
6. I like the idea of using the AI TV.	1	2	3	4	5	6	7
7. Using AI TV is pleasant.	1	2	3	4	5	6	7
8. I have a positive impression toward using AI TV.	1	2	3	4	5	6	7
9. AI TV enables two-way communication.	1	2	3	4	5	6	7
10. AI TV enables concurrent communication.	1	2	3	4	5	6	7
11. AI TV is interactive.	1	2	3	4	5	6	7
12. AI TV is interpersonal.	1	2	3	4	5	6	7
13. AI TV enables conversation.	1	2	3	4	5	6	7
14. I feel that AI TV content service recommendations are tailored to my interests.	1	2	3	4	5	6	7
15. I feel that AI TV content service recommendations are personalized.	1	2	3	4	5	6	7
16. I feel that AI TV content service is personalized for my use.	1	2	3	4	5	6	7
17. I feel that AI TV content service recommendations are delivered in a timely way.	1	2	3	4	5	6	7
18. I feel comfortable co-creating content (including comments) on AI TV.	1	2	3	4	5	6	7
19. The setting of the AI TV allows me to effectively co-create content.	1	2	3	4	5	6	7
20. My AI TV using experience was enhanced because of my content co-creation activity.	1	2	3	4	5	6	7
21. I found that learning to operate AI TV is easy.	1	2	3	4	5	6	7
22. The operation of AI TV is clear and understandable.	1	2	3	4	5	6	7
23. Operating AI TV does not require a lot of my mental effort.	1	2	3	4	5	6	7
24. Using the AI TV makes “TV watching” more convenient.	1	2	3	4	5	6	7

25. Using the AI TV can enhance the effectiveness of "TV watching."	1	2	3	4	5	6	7
26. Using the AI TV can assist my life.	1	2	3	4	5	6	7

Section 3: Personal information

1. What is your gender?

☐ Male
☐ Female

2. Which age group do you belong to?

☐ 18-25
☐ 26-35
☐ 36-45
☐ 46-55
☐ 56-65
☐ 65+

3. What is your monthly income? (RMB: Yuan)

☐ 3000-
☐ 3001----5000
☐ 5001----10000
☐ 10001----20000
☐ 20000+

Thank you very much for your co-operation !

调查用户对人工智能电视使用的看法

我是神户大学经营学研究科的博士生，此问卷的目的在于调查用户对人工智能电视收看的看法。 此问卷将不会占用您很多时间，您的宝贵意见和反馈将对我们的研究起到非常重要的作用，为此我们真诚地感谢您的支持。您的所有答案将会被匿名处理， 而且此问卷仅作为学习研究用，不会用于任何商业用途，请放心作答。

注：人工智能电视是在原有的智能电视基础上，增加了语音交互功能和智能推荐功能等 AI 功能。人工智能电视的代表品牌有 TCL，创维，海尔，LG，索尼，三星等等诸多国内外品牌。

如果您没有使用过人工智能电视，请您务必不要回答。

第一部分：使用情况

1. 您是否使用过人工智能电视？
   - ☐ 是
   - ☐ 否

2. 您是智能电视的付费会员吗？
   - ☐ 是
   - ☐ 否

3. 您平均每周用人工智能电视多长时间？(一周所有用人工智能电视的时间都包括在里面）
   - ☐ 少于 1 小时
   - ☐ 在 1 小时和 3 小时之间
   - ☐ 在 3 小时和 6 小时之间
   - ☐ 在 6 小时和 10 小时之间
   - ☐ 在 10 小时和 20 小时之间

☐ 在 20 小时和 40 小时之间

☐ 40 小时以上

第二部分：对人工智能电视使用的看法

请根据您的实际情况选择最符合的项，1 代表非常不同意，7 代表非常同意，4 代表中立。1-7 程度逐渐加强。

1. 我可能会在未来 6 个月内购买人工智能电视内容服务。	1	2	3	4	5	6	7
2. 如果有机会，我想要购买人工智能电视内容服务。	1	2	3	4	5	6	7
3. 我建议我的亲朋好友购买人工智能电视内容服务。	1	2	3	4	5	6	7
4. 看人工智能电视是个好主意。.	1	2	3	4	5	6	7
5. 看人工智能电视是一个明智的想法。	1	2	3	4	5	6	7
6. 我喜欢看人工智能电视的想法。	1	2	3	4	5	6	7
7. 看人工智能电视是令人愉快的。	1	2	3	4	5	6	7
8. 我对观看人工智能电视持积极的看法。	1	2	3	4	5	6	7
9. 人工智能电视支持双向交流。	1	2	3	4	5	6	7
10. 人工智能电视支持同步交流。	1	2	3	4	5	6	7
11. 人工智能电视是互动的。	1	2	3	4	5	6	7
12. 人工智能电视支持人际交往。	1	2	3	4	5	6	7
13. 人工智能电视支持人机对话。	1	2	3	4	5	6	7
14. 我觉得人工智能电视节目推荐是为我量身定做的。	1	2	3	4	5	6	7
15. 我觉得人工智能电视节目推荐是个性化的。	1	2	3	4	5	6	7
16. 我觉得人工智能电视内容服务是为我的观看而个性化的。	1	2	3	4	5	6	7
17. 我觉得人工智能电视节目推荐能够及时提供。	1	2	3	4	5	6	7
18. 在人工智能电视上参与节目的评论和创作等让我觉得很舒服。	1	2	3	4	5	6	7
19. 人工智能电视的环境让我能有效地共同创作节目(包括评论等)。	1	2	3	4	5	6	7

20. 我的内容共同创作活动(包括评论等)增强了我的观看体验。	1	2	3	4	5	6	7
21. 学习操作人工智能电视对我来说很容易。	1	2	3	4	5	6	7
22. 人工智能电视的操作方式是清楚且可以理解的。	1	2	3	4	5	6	7
23. 我在使用人工智能电视时不需花费太多精力。	1	2	3	4	5	6	7
24. 人工智能电视让“看电视” 变的更方便了。	1	2	3	4	5	6	7
25. 人工智能电视可以提高我“看电视”的效率。	1	2	3	4	5	6	7
26. 用人工智能电视可以提高我的生活质量。	1	2	3	4	5	6	7

第三部分：基本信息

1. 您的性别是？
   - ☐ 男性
   - ☐ 女性

2. 您所处的年龄段是？
   - ☐ 18-25
   - ☐ 26-35
   - ☐ 36-45
   - ☐ 46-55
   - ☐ 56-65
   - ☐ 65+

3. 您的月收入是？（人民币：元）
   - ☐ 3000-
   - ☐ 3001----5000
   - ☐ 5001----10000
   - ☐ 10001----20000
   - ☐ 20000+

对您的帮助表示衷心的感谢！

Appendix 2

Survey to investigate user's opinions toward Liulishuo's usage (From an information-processing perspective)

I am a PhD student from the School of Business Administration, Kobe University, and I am doing this survey to investigate user's opinions toward Liulishuo's AI education system. This research is purely academic and will not be used for any commercial purpose. I would be very grateful for your participation in this research.

As a mobile English learning APP, Liulishuo is based on artificial intelligence technology, providing users with personalized and efficient English learning experience.

Note: If you have not used Liulishuo before, please do not answer it.

Section 1: Basic information

1. Have you used Liulishuo?

☐ Yes
☐ No

2. Have you paid for Liulishuo?

☐ Yes
☐ No

3. How many hours do you spend using Liulishuo every week recently?

☐ Less than 1 hour
☐ 1-3 hour
☐ 3-6 hour
☐ 6-10 hour
☐ 10-20 hour
☐ 20-40 hour
☐ More than 40 hour

Section 2: Opinions toward Liulishuo's usage

Please indicate your opinions towards the following items. Point 1 means strongly disagree, point 2 means very disagree, point 3 means fairly disagree, point 4 means neutral, point 5 means fairly agree, point 6 means very agree, point 7 means strongly agree.

1. My intentions are to continue using Liulishuo AI learning service than to use any alternative means (traditional way).	1	2	3	4	5	6	7
2. I shall use the Liulishuo AI learning service on a regular basis in the future.	1	2	3	4	5	6	7
3. I shall frequently use the Liulishuo AI learning service in the future.	1	2	3	4	5	6	7
4. I shall strongly recommend others to use Liulishuo AI learning service.	1	2	3	4	5	6	7
5. Using Liulishuo can provide more enjoyment than other English learning methods.	1	2	3	4	5	6	7
6. Using Liulishuo can give me fun for my learning.	1	2	3	4	5	6	7
7. Using Liulishuo, let me feel pleasure.	1	2	3	4	5	6	7
8. When using Liulishuo AI learning service, I am absorbed intensely in the activity.	1	2	3	4	5	6	7
9. When using Liulishuo AI learning service, I concentrate fully on the activity.	1	2	3	4	5	6	7
10. When using Liulishuo AI learning service, I am deeply engrossed in the activity.	1	2	3	4	5	6	7
11. Using Liulishuo AI learning service increases my productivity.	1	2	3	4	5	6	7
12. Using Liulishuo AI learning service allows me to learn English effectively.	1	2	3	4	5	6	7
13. I find that Liulishuo AI learning service is useful.	1	2	3	4	5	6	7
14. Learning to use Liulishuo AI learning service is easy for me.	1	2	3	4	5	6	7
15. Skillfully using Liulishuo AI learning service is easy for me.	1	2	3	4	5	6	7
16. My interaction with Liulishuo AI learning service is clear and understandable.	1	2	3	4	5	6	7
17. People who influence my English learning behaviour think that I should use Liulishuo.	1	2	3	4	5	6	7
18. People who are important to me think that I should use Liulishuo.	1	2	3	4	5	6	7
19. People whose opinions that I value prefer that I use Liulishuo.	1	2	3	4	5	6	7
20. I have the resources necessary to use Liulishuo.	1	2	3	4	5	6	7
21. Liulishuo is compatible with other technologies I use.	1	2	3	4	5	6	7

22. I can get help from others when I have difficulties using Liulishuo.	1	2	3	4	5	6	7
23. Communicating with others is pretty useful for using Liulishuo AI learning service.	1	2	3	4	5	6	7
24. Liulishuo supports competition and cooperation between users.	1	2	3	4	5	6	7
25. Liulishuo supports social communities inside and outside the app.	1	2	3	4	5	6	7
26. The use of Liulishuo has become a habit for me.	1	2	3	4	5	6	7
27. I am addicted to using Liulishuo.	1	2	3	4	5	6	7
28. I must use Liulishuo.	1	2	3	4	5	6	7
29. Liulishuo education system is competent.	1	2	3	4	5	6	7
30. Liulishuo education system is sensible.	1	2	3	4	5	6	7
31. Liulishuo education system is intelligent.	1	2	3	4	5	6	7
32. Using the Liulishuo education system enables me to learn English at a time that is convenient for me.	1	2	3	4	5	6	7
33. I can learn English anywhere with the Liulishuo education system.	1	2	3	4	5	6	7
34. I find the Liulishuo education system convenient for my learning.	1	2	3	4	5	6	7
35. I was in control over the content of Liulishuo system that I wanted to use.	1	2	3	4	5	6	7
36. I was in control over the pace of my visit to Liulishuo system.	1	2	3	4	5	6	7
37. Liulishuo system has the ability to respond to my specific questions	1	2	3	4	5	6	7
38. I feel that Liulishuo AI learning service is tailored to me.	1	2	3	4	5	6	7
39. I feel that Liulishuo AI learning service is personalized.	1	2	3	4	5	6	7
40. The Liulishuo AI learning service is personalized to my needs.	1	2	3	4	5	6	7

Section 3: Personal information

1. What is your gender?

- ☐ Male
- ☐ Female

2. Which age group do you belong to?

- ☐ 18-25
- ☐ 26-35
- ☐ 36-45
- ☐ 46-55
- ☐ 56-65
- ☐ 65+

3. What is your educational level?

- ☐ High school education or below
- ☐ Bachelor's degree or college diploma
- ☐ Master's degree
- ☐ PhD degree or above

Thank you very much for your co-operation !

调查用户对英语流利说智能服务的看法（基于信息处理理论）

我是一名管理学在读博士生，此问卷的目的在于调查用户对英语流利说智能服务系统的看法。 此问卷将不会占用您很多时间，您的宝贵意见和反馈将对我们的研究起到非常重要的作用，为此我们真诚地感谢您的支持。您的所有答案将会被匿名处理，而且此问卷仅作为学习研究用，不会用于任何商业用途，请放心作答。

作为一款移动端英语学习软件，英语流利说 APP 基于人工智能技术，为用户提供个性化、高效率的英语学习体验。如果您没有使用过英语流利说 APP，请您务必不要回答。

第一部分：使用情况

1. 您是否使用过英语流利说 APP？
   - ☐ 是
   - ☐ 否

2. 您是（或曾经是）英语流利说 APP 的付费用户吗？
   - ☐ 是
   - ☐ 否

3. 您平均每周用英语流利说 APP 多长时间？(一周所有用英语流利说 APP 的时间都包括在里面）
   - ☐ 少于 1 小时
   - ☐ 在 1 小时和 3 小时之间
   - ☐ 在 3 小时和 6 小时之间
   - ☐ 在 6 小时和 10 小时之间
   - ☐ 在 10 小时和 20 小时之间
   - ☐ 在 20 小时和 40 小时之间

□ 40 小时以上

第二部分：对英语流利说智能服务的看法

请根据您的实际情况选择最符合的项，1 代表非常不同意，7 代表非常同意，4 代表中立。1-7 程度逐渐加强。

1. 我将继续使用流利说智能学习服务，而不选择其它替代方式(如传统的英语学习 APP)。	1	2	3	4	5	6	7
2. 我将会定期使用流利说智能学习服务。	1	2	3	4	5	6	7
3. 我将会经常使用流利说智能学习服务。	1	2	3	4	5	6	7
4. 我强烈建议其他人使用流利说智能学习服务。	1	2	3	4	5	6	7
5. 与其他英语学习方法相比，使用流利说可以带来更多的快乐。	1	2	3	4	5	6	7
6. 使用流利说可以给我富有乐趣的学习体验。	1	2	3	4	5	6	7
7. 使用流利说让我感到愉悦。	1	2	3	4	5	6	7
8. 在使用流利说智能学习服务时，我强烈地专注于学习。	1	2	3	4	5	6	7
9. 在使用流利说智能学习服务时，我会完全地全神贯注于学习。	1	2	3	4	5	6	7
10. 使用流利说智能学习服务时，我对学习深深地投入。	1	2	3	4	5	6	7
11. 使用流利说智能学习服务提高了我的学习效率。	1	2	3	4	5	6	7
12. 使用流利说智能学习服务使我能够更快地完成学习任务。	1	2	3	4	5	6	7
13. 我发现流利说智能学习服务是有用的。	1	2	3	4	5	6	7
14. 学习使用流利说智能学习服务系统对我来说是容易的。	1	2	3	4	5	6	7
15. 熟练使用流利说智能学习服务系统对我来说是容易的。	1	2	3	4	5	6	7
16. 我与流利说智能学习服务系统之间的互动是清晰易懂的。	1	2	3	4	5	6	7

17. 对我英语学习行为起到影响作用的人认为我应该用流利说。	1	2	3	4	5	6	7
18. 对我重要的人认为我应该用流利说。	1	2	3	4	5	6	7
19. 那些我重视意见的人更倾向于我使用流利说。	1	2	3	4	5	6	7
20. 我有使用流利说所需的资源。	1	2	3	4	5	6	7
21. 流利说与我使用的其他技术设备兼容。	1	2	3	4	5	6	7
22. 当我使用流利说有困难时，我可以从别人那里得到帮助。	1	2	3	4	5	6	7
23. 与他人交流对于流利说智能学习服务很有用。	1	2	3	4	5	6	7
24. 流利说支持用户之间的竞争与合作。	1	2	3	4	5	6	7
25. 流利说支持 APP 线上线下的社交社区。	1	2	3	4	5	6	7
26. 使用流利说已经成为我的一种习惯。	1	2	3	4	5	6	7
27. 我沉迷于使用流利说。	1	2	3	4	5	6	7
28. 我必须使用流利说。	1	2	3	4	5	6	7
29. 流利说智能学习服务系统是胜任的。	1	2	3	4	5	6	7
30. 流利说智能学习服务系统是能感觉到用户的。	1	2	3	4	5	6	7
31. 流利说智能学习服务系统是智能的。	1	2	3	4	5	6	7
32. 使用流利说智能学习服务系统，让我在方便的时候学习英语。	1	2	3	4	5	6	7
33. 使用流利说智能学习服务系统. 让我可以在任何地方学习英语。	1	2	3	4	5	6	7
34. 使用流利说智能学习服务系统，给我的英语学习带来了便利。	1	2	3	4	5	6	7
35. 我能掌控我想使用的流利说内容。	1	2	3	4	5	6	7
36. 我能控制我访问流利说系统的节奏。	1	2	3	4	5	6	7
37. 流利说系统有能力快速有效地回应我的具体问题。	1	2	3	4	5	6	7
38. 我觉得流利说智能学习服务是为我量身定做的。	1	2	3	4	5	6	7
39. 我觉得流利说智能学习服务是个性化的。	1	2	3	4	5	6	7
40. 我觉得流利说智能学习服务是为我的需求个性化的。	1	2	3	4	5	6	7

第三部分：基本信息

1. 您的性别是？
   - ☐ 男性
   - ☐ 女性

2. 您所处的年龄段是？
   - ☐ 10-18
   - ☐ 19-25
   - ☐ 26-45
   - ☐ 46-65
   - ☐ 65+

3. 您的学历是？
   - ☐ 高中及以下学历
   - ☐ 专科或本科
   - ☐ 硕士
   - ☐ 博士及以上

对您的帮助表示衷心的感谢！

Appendix 3

Survey to investigate user's opinions toward Liulishuo's uses & gratifications

I am a PhD student from the School of Business Administration, Kobe University, and I am doing this survey to investigate user's opinions toward Liulishuo's AI education system. This research is purely academic and will not be used for any commercial purpose. I would be very grateful for your participation in this research.

As a mobile English learning APP, Liulishuo is based on artificial intelligence technology, providing users with personalized and efficient English learning experience.

Note: If you have not used Liulishuo before, please do not answer it.

Section 1: Basic information

1. Have you used Liulishuo?

☐ Yes
☐ No

2. Have you paid for Liulishuo?

☐ Yes
☐ No

3. How many hours do you spend using Liulishuo every week recently?

☐ Less than 1 hour
☐ 1-3 hour
☐ 3-6 hour
☐ 6-10 hour
☐ 10-20 hour
☐ 20-40 hour
☐ More than 40 hour

Section 2: Opinions toward Liulishuo's uses & gratifications

Please indicate your opinions towards the following items. Point 1 means strongly disagree, point 2 means very disagree, point 3 means fairly disagree, point 4 means neutral, point 5 means fairly agree, point 6 means very agree, point 7 means strongly agree.

1. My intentions are to continue using Liulishuo AI learning service than to use any alternative means (traditional way).	1	2	3	4	5	6	7
2. I will use the Liulishuo AI learning service on a regular basis in the future.	1	2	3	4	5	6	7
3. I will frequently use the Liulishuo AI learning service in the future.	1	2	3	4	5	6	7
4. I will strongly recommend others to use Liulishuo AI learning service.	1	2	3	4	5	6	7
5. I intend to continue using Liulishuo AI learning service in future.	1	2	3	4	5	6	7
6. Liulishuo education system is competent.	1	2	3	4	5	6	7
7. Liulishuo education system is sensible.	1	2	3	4	5	6	7
8. Liulishuo education system is intelligent.	1	2	3	4	5	6	7
9. I can learn English anywhere with the use of Liulishuo education system.	1	2	3	4	5	6	7
10. I find the Liulishuo education system convenient for my learning.	1	2	3	4	5	6	7
11. Liulishuo education system is convenient to use.	1	2	3	4	5	6	7
12. Using Liulishuo can give more enjoyment than other English learning methods.	1	2	3	4	5	6	7
13. Using Liulishuo, let me feel pleasure.	1	2	3	4	5	6	7
14. When using Liulishuo, I do not realize the time elapsed.	1	2	3	4	5	6	7
15. When using Liulishuo AI learning service, my attention is focused on the activity.	1	2	3	4	5	6	7
16. When using Liulishuo AI learning service, I concentrate fully on the activity.	1	2	3	4	5	6	7
17. When using Liulishuo AI learning service, I am deeply engrossed in the activity.	1	2	3	4	5	6	7
18. The new AI app Liulishuo enables me to talk about what my friends talk about.	1	2	3	4	5	6	7
19. The new AI app Liulishuo allows me to share content with my friends.	1	2	3	4	5	6	7
20. The new AI app Liulishuo makes me like the leading generation.	1	2	3	4	5	6	7
21. I use Liulishuo to achieve a higher level.	1	2	3	4	5	6	7

22. I use Liulishuo to have a better command of English than other users.	1	2	3	4	5	6	7
23. I use Liulishuo to score more, which give me a higher position than other users of the app.	1	2	3	4	5	6	7
24. I got a good English education by using Liulishuo.	1	2	3	4	5	6	7
25. I got useful information about English learning using Liulishuo.	1	2	3	4	5	6	7
26. I have acquired a lot of English knowledge using Liulishuo.	1	2	3	4	5	6	7
27. My English learning has improved by using Liulishuo.	1	2	3	4	5	6	7

Section 3: Personal information

1. What is your gender?

- ☐ Male
- ☐ Female

2. Which age group do you belong to?

- ☐ 18-25
- ☐ 26-35
- ☐ 36-45
- ☐ 46-55
- ☐ 56-65
- ☐ 65+

3. What is your educational level?

- ☐ High school education or below
- ☐ Bachelor's degree or college diploma
- ☐ Master's degree
- ☐ PhD degree or above

Thank you very much for your co-operation !

调查用户对英语流利说智能服务使用与满足的看法

我是一名管理学在读博士生，此问卷的目的在于调查用户对英语流利说智能服务系统的看法。 此问卷将不会占用您很多时间，您的宝贵意见和反馈将对我们的研究起到非常重要的作用，为此我们真诚地感谢您的支持。您的所有答案将会被匿名处理，而且此问卷仅作为学习研究用，不会用于任何商业用途，请放心作答。

作为一款移动端英语学习软件，英语流利说 APP 基于人工智能技术. 为用户提供个性化、高效率的英语学习体验。如果您没有使用过英语流利说 APP，请您务必不要回答。

第一部分：使用情况

1. 您是否使用过英语流利说 APP？
   - ☐ 是
   - ☐ 否

2. 您是（或曾经是）英语流利说 APP 的付费用户吗？
   - ☐ 是
   - ☐ 否

3. 您平均每周用英语流利说 APP 多长时间？(一周所有用英语流利说 APP 的时间都包括在里面）
   - ☐ 少于 1 小时
   - ☐ 在 1 小时和 3 小时之间
   - ☐ 在 3 小时和 6 小时之间
   - ☐ 在 6 小时和 10 小时之间
   - ☐ 在 10 小时和 20 小时之间
   - ☐ 在 20 小时和 40 小时之间

□ 40 小时以上

第二部分：对英语流利说智能服务使用与满足的看法

请根据您的实际情况选择最符合的项，1 代表非常不同意，7 代表非常同意，4 代表中立。1-7 程度逐渐加强。

1.我将继续使用流利说智能学习服务，而不选择其它替代方式(如传统的英语学习 APP)。	1	2	3	4	5	6	7
2.我将会定期使用流利说智能学习服务。	1	2	3	4	5	6	7
3.我将会经常使用流利说智能学习服务。	1	2	3	4	5	6	7
4.我强烈建议其他人使用流利说智能学习服务。	1	2	3	4	5	6	7
5.我打算将来继续使用流利说智能学习服务。	1	2	3	4	5	6	7
6.流利说智能学习服务系统是胜任的。	1	2	3	4	5	6	7
7.流利说智能学习服务系统是能感觉到用户的。	1	2	3	4	5	6	7
8.流利说智能学习服务系统是智能的。	1	2	3	4	5	6	7
9.使用流利说智能学习服务系统，让我可以在任何地方学习英语。	1	2	3	4	5	6	7
10.我觉得流利说智能学习服务系统让我的英语学习很方便。	1	2	3	4	5	6	7
11.使用流利说智能学习服务系统，给我的英语学习带来了便利。	1	2	3	4	5	6	7
12. 与其他英语学习方法相比，使用流利说可以带来更多的快乐。	1	2	3	4	5	6	7
13. 使用流利说让我感到愉悦。	1	2	3	4	5	6	7
14. 在使用流利说的时候，我没有意识到时间的流逝。	1	2	3	4	5	6	7
15. 在使用流利说智能学习服务时，我的注意力集中在学习上。	1	2	3	4	5	6	7
16.在使用流利说智能学习服务时，我会完全地全神贯注于学习。	1	2	3	4	5	6	7
17.使用流利说智能学习服务时，我对学习深深地投入。	1	2	3	4	5	6	7

18.使用流利说让我可以谈论我的朋友们谈论的话题。	1	2	3	4	5	6	7
19.使用流利说让我可以与我的朋友分享内容。	1	2	3	4	5	6	7
20.新的人工智能 APP 流利说让我觉得自己是领先的一代人。	1	2	3	4	5	6	7
21.我用流利说达到了更高的水平。	1	2	3	4	5	6	7
22.我使用流利说是为了拥有比其他用户更强的英语能力。	1	2	3	4	5	6	7
23.我在流利说里分数更高 ,这让我的地位比其他流利说用户高。	1	2	3	4	5	6	7
24.通过使用流利说，我得到了很好的英语教育。	1	2	3	4	5	6	7
25.通过使用流利说，我得到了关于英语学习的有用信息。	1	2	3	4	5	6	7
26.我用流利说学到了很多英语知识。	1	2	3	4	5	6	7
27.使用流利说对我的英语学习有促进作用。	1	2	3	4	5	6	7

第三部分：基本信息

1. 您的性别是？
   - ☐ 男性
   - ☐ 女性

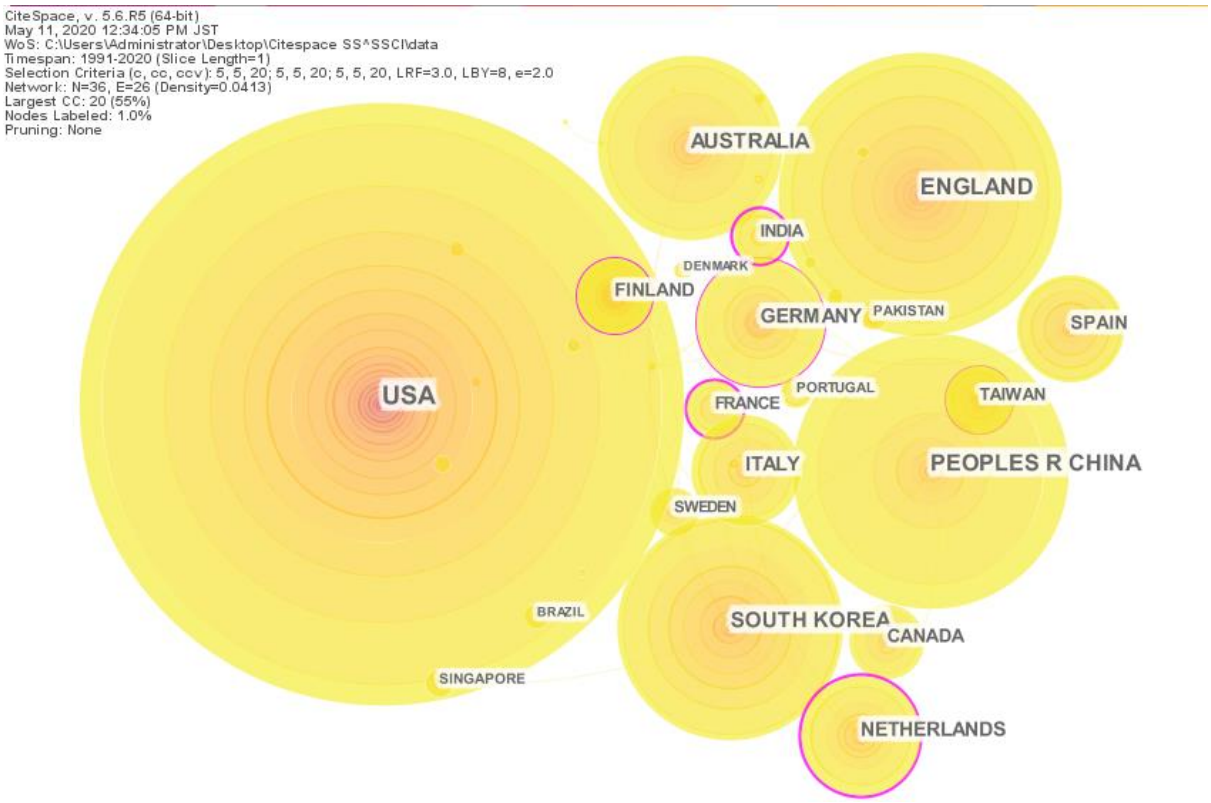
2. 您所处的年龄段是？
   - ☐ 10-18
   - ☐ 19-25
   - ☐ 26-45
   - ☐ 46-65
   - ☐ 65+

3. 您的学历是？
   - ☐ 高中及以下学历
   - ☐ 专科或本科
   - ☐ 硕士
   - ☐ 博士及以上

对您的帮助表示衷心的感谢！

Appendix 4

Smart services literature in social sciences citation index (SSCI) by country/region in 1990-2020



Note: All 2057 SSCI papers with a time span of 1990-2020 and a time division of one year. Keyword, author, and institute are selected as the analysis objects, respectively. When setting the threshold value, this dissertation adopts three operation modes, namely, top n (n = 30), top n% (n = 10%) and threshold interpolation (C. CC. CCV = 5.5.20).

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