

Toward a More Robust Usability concept with Perceived Enjoyment in the context of mobile multimedia service

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Abstract

Mobile multimedia service is relatively new but has quickly dominated people's lives, especially among young people. To explain this popularity, this study applies and modifies the Technology Acceptance Model (TAM) to propose a research model and conduct an empirical study. The goal of study is to examine the role of Perceived Enjoyment (PE) and what determinants can contribute to PE in the context of using mobile multimedia service. The result indicates that PE is influencing on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) and directly Behavior Intention (BI). Aesthetics and flow are key determinants to explain Perceived Enjoyment (PE) in mobile multimedia usage.

Keywords: TAM, Perceived Enjoyment, Mobile multimedia, Aesthetics, Flow, Social Presence.

1. INTRODUCTION

The traditional usability concepts have been dominated by instrumentally motivated ideas of information technology use. Approaches to measure usability have mainly focused on the tasks, the goals, and their efficient accomplishment. However, since new technology such as the invasion of mobile phones into people's daily lives, the complexity of products is increasing and user's expectation becomes challenge with using new technology. According to Manovich [1], interactions with computers and computer-based devices penetrate people's lives outside of work. Especially, the mobile phone is getting attractive to customers with its aesthetic features such as animated icons and sounds, the personalized interfaces, and the various shapes and surface finishes. Also, a mobile phone came to be used for all kinds of non-work activities: entertainment (game, music, video and TV), information searching and social life, because of its multi-functionality and flexibility of its usage. As a result, the emphasis on efficiency and functionality came to be replaced by new criteria such as being friendly, pleasurable, aesthetically pleasing, animated graphics [1]. With this viewpoint, narrow focus on task-related usability was challenged to designers and developers and widened by introducing "emotional usability" [2]. In the emotional usability concept, enjoyment is more related with an important determinant of the adoption of mobile service than the usefulness [3, 4, 5]. This study attempts to investigate aesthetic, flow, and social presence as significant predictors of usability in multimedia use of mobile context, especially in the aspect of Perceived Enjoyment (PE). The model integrates Technology Acceptance Model [6], social presence theory [7], theory of flow [8], and aesthetic. By

investigating the linkage between these three concepts and PE, this study examines considerable predictors for more robust usability of mobile phone usage.

2. PROBLEMS IN TRADITIONAL USABILITY CONCEPT

Traditionally, usability is defined as being:

“...the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environment.” [9]

Effectiveness refers to the extent to which a goal or a task is achieved. Efficiency is about the amount of effort required to accomplish a goal. Satisfaction refers to the level of comfort that a user feels when using a product and to how acceptable a product is to users for achieving their goal [10]. Thus, evaluation of usability has been conducted by having an evaluator to record the data such as time per task, the number and types of errors and user attitudes while users are doing some tasks. Likewise, Nielsen mentioned [11], [12] that usability was the question of how well users could use the functionality and the main goal of the website should make users complete their tasks easily and fast even if there was a need for fun and time to enjoy or relax on the web. As shown above, there are rooms to argue the concept of traditional usability for information technology use. Approaches to measure usability have mainly focused on given tasks and goals, and their efficient and effective accomplishment.

2.1 Effectiveness

In a case of task oriented usability, scoring of effectiveness is arguable in some contexts such as creative production, management, data analysis. Also, it is not clear in the traditional usability concept of how to measure what outcomes are effective for users and, how users and outcomes are related [13]. Also, as new technologies have embedded into the daily lives, the complexity of product is increasing and user's expectations become higher. For example, mobile phone can be simultaneously used while travelling, talking or doing other activities. However, most usability tests assume that the context of a user facing a product would come with the full attention in comfortable environments. In the various contexts, the meaningful outcomes from users could be different from the effectiveness of classic usability [14].

2.2 Efficiency

Efficiency is evaluated by the invested time or effort during completing the given tasks. In other words, interactions between the products and users are evaluated by the time, number of steps, or number of variations from ideal path. Those variables are highly correlated but there are exceptions. For example, there can be a step users spend most of time or just skip not because of the efficiency, but because of past experiences or preferences such as fun or special meaning to users [13]. Usability issues are increasingly demanding and complex and are better considered of as being about consumer experience than ease of use. The new technologies and applications now have more challenge on users' expectations, various types of users, and usages. However, existing usability concepts are unable to handle such an intricate and multifaceted definition. For example, IPTV (Internet Protocol TV) or DiTV (Digital interactive TV) is not just a TV. They attempt to provide interactions between TV and viewers. Existing usability cannot measure how users can best manage those interactions because it just emphasize on the functionality of TV [14]. Also, mobile phone gives challenge to the traditional concept of usability. In addition to the context, existing usability cannot explain why people are so immersed into texting even though numeric keyboard is not effective and efficient as a view of usability. There are needs for understanding users' behaviors based upon user experience integrated with, and beyond functionality [15].

2.3 Satisfaction

The term “satisfaction” in usability is concerned with evading negative feelings rather than producing positive emotions. It indicates that good usability equals the removing of usability flaws

[16]. The concept of “satisfaction” is not enough to cover the human factors for usability. Also, many new technologies are associated with both work and leisure, not just with task-based performance issues. Based upon the user experience with performance, the satisfaction is influenced by preferred user experience, aesthetics of product, intrinsic value to the users [13].

3. Extended Technology Acceptance Model (TAM) for the mobile multimedia

3.1 Mobile Multimedia Services

Even only a decade ago, all mobile services were simple communication-oriented and network-based applications, such as voice calls or SMS messages. However, people have been accustomed by the content-oriented services and various multimedia solutions. 3G, recently including some 4G networks and smart phones with various value-added services are introduced and reaching mass mobile markets. It is widely understood that the emergence of multimedia services has reflective implications in the mobile industry based on the rise of IP-based mobile services [27]. The mobile multimedia services refer to a trend in which mobile services integrate with improving the contextual value through entertainment, information or communication [28, 29, 30]. In this study, all services and applications dealing with graphics, music, game, and video are included in the scope. Also communication oriented functions which relate to multimedia content are in the scope of the study. These include;

- Music/audio players (both offline and streaming)
- Movie/video players (both offline and streaming)
- Photo/image viewers
- Photo functions (Phone camera)
- Blogging applications
- Searching information applications (clients providing access to online information)
- Games
- Multimedia communication (MMS, Bluetooth, IM, email)

3.2 Extended Technology Acceptance Model

Traditional Technology Acceptance Model (TAM) suggests that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of Information Technology (IT) are major determinants of its usage. Davis [6] defined PU as “the degree of which a person believes that using a particular system would enhance his or her job performance,” and PEOU as “the degree of which a person believes that using a particular system would be free of effort.” Also, user’s beliefs or trusts determine the attitude toward actual using the system. Behavioral intentions (BI) to use are determined by these attitudes toward using the system. Finally, BI to use leads to actual system use. With this traditional TAM, PEOU and PU constructs have been considered important criteria in determining the acceptance and use of IT in the past decades (Keil et al., 1995; Malhotra & Galletta, 1999; Moon & Kim, 2001). From the same aspect, the traditional approaches toward improving usability have been focused on ease of use. The Human-Computer Interaction (HCI) research has focused primarily more on technology-centered aspects of usability, such as time complete tasks and the number of errors. These variables are the most fundamental and motivational factors consisting of the TAM. Information system researchers have investigated and agreed that PEOU and PU are valid in predicting the adoption of various information technologies [19, 20, 21, 22, 23, 24].

However, depending on the specific technology context, additional explanatory variables may be needed beyond the ease of use and usefulness constructs. Davis [6] argued that future technology acceptance research needs to address how other variables affect usefulness, ease of use, and user acceptance. Factors which are antecedent of the acceptance of a new IT are vary with the technology characteristics, target users, and context [19]. Especially, mobile phones provide pleasure and usefulness at the same time. In other words, users will expect to get information and enjoyment at anytime and anywhere.

According to Vorderer et al. [25], Perceived Enjoyment (PE) is the core of media entertainment experience, and it can be found in many ways depending on the user's readiness and ability to suspend disbelief to engage. PE has been confirmed that it has an important role in user technology acceptance and has great implications [6]. Also, PE is based on the user experience such as "how the person felt about the experience, what it meant to them, whether it was important to them, and whether it sat comfortably with their other values and goals." [26]. This study would add PE as a significant predictor of behavior intention, and suggest aesthetic, flow, and social presence as additional factors of explaining PE in the mobile multimedia usage. The proposed research model of Extended TAM for this study is shown in Figure 1.

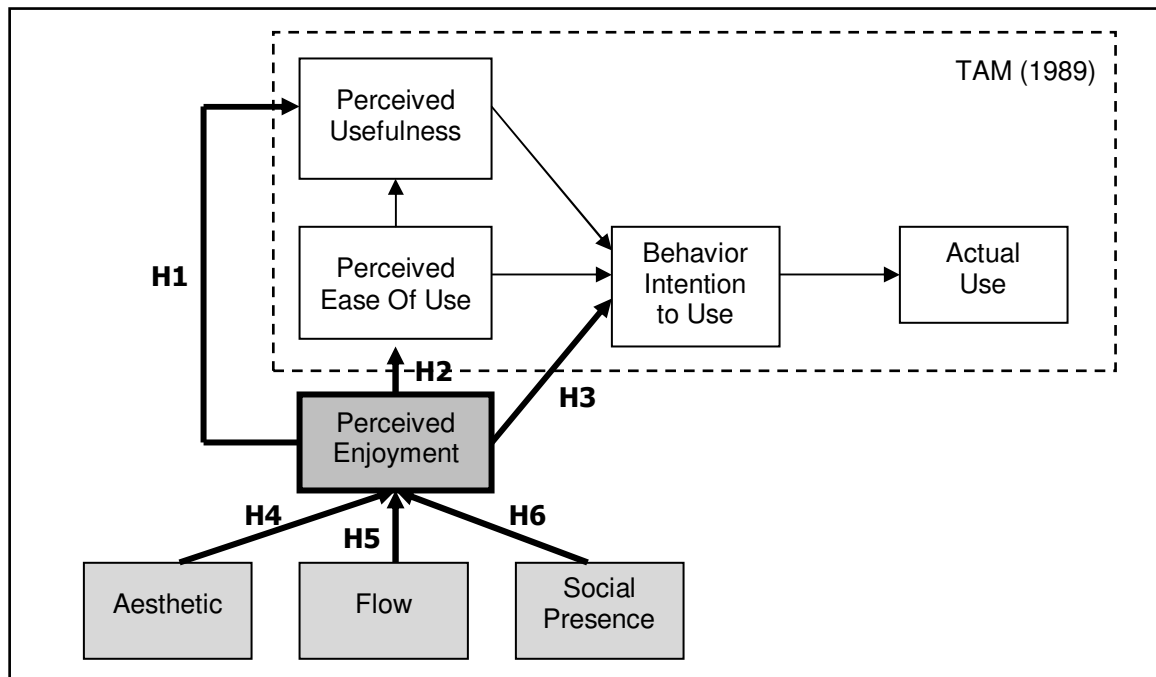


FIGURE 1: Proposed research model of Extended TAM for the mobile multimedia services.

3.3 Perceived Enjoyment (PE) → Perceived Usefulness (PU)

PE is defined as "the extent to which the activity of using computers is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" [31]. PE is referred to as an intrinsic motivation variable such as the doing of an activity for satisfactions rather than for some outcomes or results. In contrast, extrinsic motivation, such as PU is a construct that measures how user's productivity and effectiveness have been improved by using the product [32]. Davis et al [31] found that usefulness and enjoyment were significant determinants of behavioral intention. However, the effect of enjoyment on perceived usefulness was relatively unexamined [33].

People with a pleasurable perception of the enjoyment from using the product are more likely to perceive it useful [8, 34]. Also, Agarwal and Karahanna [35] found a multi-dimensional construct called "cognitive absorption," a state of involvement with software, had a significant influence on PU. High cognitive absorption status which makes high impact on PU is enjoyment. Assuming other things being equal, the more enjoyable a product is the more useful a product can be perceived. Furthermore, the purpose of mobile multimedia service includes pleasure and enjoyment such as music, photo, movie, or even game. It means that PE would affect positively on PU in mobile multimedia services. To verify the facts, following hypotheses is addressed.

H1: PE has a significant positive effect on PU in the context of mobile multimedia services.

3.4 Perceived Enjoyment (PE) → Perceived Ease Of Use (PEOU)

PEOU is defined as “the degree to which a person believes that using a particular system would be free of effort” [6]. Also, PE has been conceptualized as an antecedent of PEOU (PE→PEOU) [33, 36, 37]. Previous literature revealed that the causal direction between PE and PEOU had been proposed and confirmed (Table 1). Studies using this direction usually referred to the technology acceptance model (TAM) with the justification that PE makes users underestimate the difficulty with using the technologies, because they enjoy the process itself and do not perceive it to be difficult [36]. Also, positive affective emotion makes users perceive themselves as having generous time to complete a task and it actually reduces the perception of workload related with using the technologies [33, 35]. Also, Huang et al. [38] examined that PE has a positive impact on PEOU in the context of mobile learning. Thus, the study proposes the following hypothesis:

H2: PE has a significant positive effect on PEOU in the context of mobile multimedia services.

PE → PEOU			
Article	Model	Context	Findings
[35]	Extended TAM	Web	PE is one dimension of Cognitive Absorption (CA); CA has a significant impact on PEOU.
[36]	TAM	Online help desk, multimedia system for property management	PE influenced PU via PEOU, without assessing its direct effect on PU over and above PEOU. PE's impacts on PEOU increase along with increasing experience.
[37]	TAM & motivational model	Virtual Workplace	PE does not have direct impacts on BI. Instead, its effects are fully mediated by PU and PEOU.
[33]	Extended TAM	Web-based class management system	PE has significant effects on PEOU and PU.
[45]	Expectation-Confirmation Model (ECM)	IT product/service	Users' PE of IT is positively related to their PEOU of IT.
[102]	TAM	Virtual work place	PE has a significant impact PEOU in game-based training.

TABLE 1: Review of the existing literature on the causal relationship between PE and PEOU.

3.5 Perceived Enjoyment (PE) → Behavior Intention (BI)

Enjoyment is significant not only in offline settings such as shopping [39, 40], but also in online contexts [41]. Prior research suggested that enjoyment directly affected the BI of online customers [42]. For example, in the research of online consumer behavior, Koufaris [43] found that shopping enjoyment played a critical role in predicting consumer intention to return to an online store. Also, Li et al. [44] found that users who perceived the use of IM (Instant Messaging) as enjoyable were more likely to intend to continue using it. For the IT product and services, users' PE had a significant effect on user's intention to use [45]. In the online gaming context, one important motive for playing online games was to seek pleasure or enjoyment; players who experienced enjoyment and the emotional response of pleasure were more likely to be motivated to play more [46, 47, 48]. Prior research also showed that enjoyment could indirectly impact BI through other variables. For example, Venkatesh [36] examined factors of PEOU and found that PE significantly impacted on BI to use information technology through PEOU. Accordingly, the following hypothesis is addressed:

H3: PE affects BI in the context of mobile multimedia services

3.6 Aesthetic → Perceived Enjoyment (PE)

Interface design is increasingly important as both information and entertainment websites in order to compete for rapidly increased and complicated customers [49]. The sensory experience of the website can also determine whether a user stays, shops or revisits [50, 51]. Especially, online retail shopping sites have suggested to include both utilitarian and hedonic dimensions and vendors can create aesthetically rich shopping environments to provide enjoyment to customers. Like the examples of online shipping environment, the aesthetics is considered to make the positive emotions and lead a more favorable judgment towards a system or technical products in HCI research [52, 53]. Also, according to Postrel [54], aesthetics has intrinsic value above and beyond their functional values, and it satisfies users' needs and motivates them. Users want to achieve not only certain well-defined goals, but also involve the sense of affective responses [55, 56, 57].

Heijden [58] proposed a new concept, "Perceived Attractiveness," for the TAM model in the Internet context. It was defined as "the degree to which a person believes that the website is aesthetically pleasing to the eye." He found empirical support that perceived attractiveness of the website did influence PU, PE, and PEOU [58]. Cyr et al. [3] also found that design aesthetics had a significant impact on PU, PEOU, and PE in the mobile commerce context. Also, the design aesthetics may have a larger relative impact on PE than on PU and PEOU. In this study, we draw on research on visual aesthetics and apply this work in the specific context of the mobile multimedia services. We expect that perceived visual aesthetics of the mobile interface would impact PE. Therefore, the following hypothesis is addressed.

H4: Aesthetic affects PE in the context of mobile multimedia services.

3.7 Flow → Perceived Enjoyment (PE)

Flow is a concept originally suggested in the 1970s [59, 60, 61] to explain the pleasure found by immersion in everyday activities. According to Csikszentmihalyi [62], the enjoyment was realized by artists when they were immersed in the creative act. Also, Hsu & Lu [63] found when people were in flow, they shifted into a common mode of experience and they became absorbed in their activities. In other words, it is felt when "...instead of being buffeted by anonymous forces, we do feel in control of our own fate. ...we feel a sense of exhilaration, a deep sense of enjoyment." In order to reach this state of optimal experience: "There must be a goal in a symbolic domain; there have to be rules, a goal, and a way of obtaining feedback." Users must be able to concentrate and interact with the opportunities at a level corresponding with their skills [8, 64]. Csikszentmihalyi [65] outlined nine dimensions of flow:

- Clear goals
- Immediate feedback
- Personal skills meet with challenges
- Merger of action and awareness
- Concentration on the task
- Control
- A loss of self-consciousness
- An altered sense of time
- Experience which becomes autotelic (self-contained goal experience)

Recently, flow has also been studied in the context of information technologies and recommended as a useful attribute in understanding consumer behavior [43, 66, 67, 68, 69, 70]. Also, some of the emotional and cognitive components used in flow research have values of intrinsic enjoyment, perceived control, and concentration/attention focus [71]. For many people, finding a moment of flow can be when they are doing things that they enjoy and excel at. In studies of games, Jones [16] reported that certain games made people so absorbed and concentrated that they could not stop playing. Also, Herz [72] found the intense captivation while people were playing a computer game. It is not just about play and competition. It is associated

with the intense feelings of engagement that the game can stimulate and engender deep feelings the player. This type of devotion makes game to be perceived as a total package. It is not just the graphics, sounds, and other multimedia attributes. It is about how those attributes help, support, and give life to a domain that makes possible anything which has no counterpart in the physical world [64]. Like this example, flow theory has been applied to the game and well explained how the game captured the fun and entertainment motivation of users. According to Lu et al. [73], people were often in the state of flow when they used IM service. Also, when users log into an IM platform, they not only want to communicate with others, but also look for fun and try to obtain a flow experience. Therefore, the study hypothesizes:

H5: Flow positively affects PE in the context of mobile multimedia services.

3.8 Social Presence → Perceived Enjoyment (PE)

Social presence is defined as “being together with another” that a medium allows users to experience others like being psychologically present [74, 75]. Social presence theory considers social presence as an intrinsic component in a communication medium [7]. Some researchers emphasized on the psychological connection. They regarded social presence as concerned with “warmth.” Encouraging a sense of human warmth and sociability can be achieved by providing actual interaction with other humans such as virtual communities or chats, or by instilling the imagination of interacting with other humans such as human audio and video, intelligent agent, or greeting with human touch [76]. Also, to stimulate the interaction with other humans through the medium, some researchers characterized the social presence of a medium as its capability to transmit information about non-verbal cues such as facial expressions and gesture [7]. Like this, both verbal and nonverbal cues contributed to social presence [77, 78], and the choice of communication medium was found impacting immediacy of social presence significantly [78, 79]. Recent studies [80, 81, 82, 83, 84, 85] addressed the importance of mobile telephone use in stimulating socially linked. The ability to communicate with anyone, anytime, and anywhere is the most fundamental value of telecommunication applications.

Mobile communication technologies provide easy ways of strengthening social bonds among friends, and even with strangers through functional and expressive management [85, 86]. The mobile communication has successfully moved people’s communication patterns into a “social network- based paradigm,” where people socially connected and interacted based on mutual trust, rather than being controlled by their physical location, mood or their appearance [85, 87]. For example, text-based IMs (Instant Message) allow users to express their emotional states by commenting their status or using emoticons which increase social presence. Also, people can use mobile phone anywhere, and they can find out other people’s location status easily. More recently GPS (Global Positioning System) applications help to find nearby members of their social networks, leading to a physical meetings. Moreover, device status (on/off) might signal to others’ availability and willingness to communicate [88]. Like this, the mobile system can enable users to integrate simulated social actors into their social network as easily as real social actors. As a result, mobile systems produce high social presence, and social presence mediates social interaction.

According to Biocca et al. [75], the most telecommunication bandwidth, such as internet and mobile, was used to gain satisfying, and productive access to others’ thoughts, emotions, and presence of humans, because humans are social beings. Also, Heeter [89] found that users felt enjoyment more when they felt a stronger social presence in the context of a virtual reality entertainment system. With the same reason, the social presence was found consistently associated with enjoyment or fun [90]. However, there is little research about the relationship between social presence and enjoyment [90, 91]. Therefore, the study hypothesizes:

H6: Social presence positively affects PE in the context of mobile multimedia services.

4. RESEARCH METHOD

4.1 Respondents and Procedure

College students are an important population in studying mobile phone usage because they are not only familiar with cutting edge technology but also very excited to maximize mobile phones in daily lives. There were more than 262 million wireless mobile phone subscribers, representing 84 percent of the US population in June 2008, according to the Cellular Telecommunications and Internet Association [92], that is up 35 percent from 194 million in June 2005 and nearly three times more than the 97 million wireless subscribers in June 2000. In 2008, Harris Interactive reported that 9 out of 10 U.S. College Students own a mobile phone [93].

The M:Metrics report [94] found that employed college students are 42 percent more likely to use mobile email than the typical subscriber, 23 percent more than full-time workers. Working students download mobile games and personalize content on their phones twice as often as do other users. Many studies have shown that cell phone usage was subject to functional expansion, because users gradually changed habits and learned to apply the new technologies for a growing concerns and purposes in a wide range of situations [95].

A Web-based survey was employed for data collection. Undergraduate students at a large Mid-Western university participated in this study in exchange for extra credits. The survey has been conducted online (<http://www.supersurvey.com>) during nearly two weeks from November 18th to December, 1st. Total number of data collected was 148 and we used data from 129 respondents for this research after dropping useless data. However, among valid sample of 129, 16% of sample reported that they had a mobile phone without multimedia functions, yielding a total sample size of 108. The demographics indicated that there were more female (70%) than male (30%), consistent with the composition of the class. The average age of participants was 21 ($SD=1.33$).

4.2 Operational Measures

Measures were adopted from previous research and modified to fit the context of this research. All measurements are shown in Table 2. As for Flow construct, nine questions were adopted from previous related research [96]. In the original study, Chou & Ting [96] categorized flow into five groups; concentration, playfulness, time distortion, telepresence, and exploratory behavior. 1-2 items in each category have been selected for this study.

Constructs	Measure Items (7-point multi-item scales from <i>Strongly disagree</i> to <i>Strongly agree</i>)	Sources
Perceived Enjoyment (PE)	<ul style="list-style-type: none"> ▪ I found using mobile multimedia services entertaining ▪ I found using mobile multimedia services pleasant ▪ I found using mobile multimedia services is exciting ▪ I found using mobile multimedia service is fun ▪ I found using mobile multimedia service is enjoyable. 	[58, 97, 98]
Perceived Ease of Use (PEOU)	<ul style="list-style-type: none"> ▪ It will be impossible to use mobile multimedia services without expert help ▪ Learning to use mobile multimedia services is easy for me ▪ It is difficult to learn how to use mobile multimedia services ▪ I find it easy to use mobile multimedia services to do what I want it to do ▪ It takes too long a time to learn to use mobile multimedia services ▪ It is easy to remember how to use mobile multimedia services ▪ Using mobile multimedia services requires a lot of mental effort ▪ My interaction with mobile multimedia services is clear and understandable ▪ It is easy for me to become skilful at using mobile 	[63, 97]

	multimedia services	
Perceived Usefulness (PU)	<ul style="list-style-type: none"> ▪ Using mobile multimedia services improves my task quality ▪ Using mobile multimedia services improves the performance of my tasks ▪ Using mobile multimedia services supports the critical part of my tasks ▪ Using mobile multimedia services enables me to accomplish tasks more quickly ▪ Using mobile multimedia services increases my task productivity ▪ Using mobile multimedia services enables me to have more accurate information ▪ Using mobile multimedia services enables me to access a lot of information ▪ Using mobile multimedia services enables me to access the newest information ▪ Using mobile multimedia services enables me to acquire high quality Information 	[63]
Behavior Intention(BI)	<ul style="list-style-type: none"> ▪ I will use mobile multimedia services on a regular basis in the future ▪ I will frequently use mobile multimedia services in the future ▪ I will use mobile multimedia services during the coming month ▪ I would spend money to mobile multimedia 	[63, 99, 100]
Aesthetic	<ul style="list-style-type: none"> ▪ The screen design (i.e. colors, boxes, menus, etc) for mobile multimedia services is attractive ▪ The interface for mobile multimedia services looks professionally designed ▪ The graphics mobile multimedia services are meaningful ▪ The overall look and feel of the interface for mobile multimedia services is visually appealing 	[3]
Flow	<ul style="list-style-type: none"> ▪ I am always totally fascinated with the game when using mobile multimedia services ▪ I am always absolutely focused on the game when using mobile multimedia services ▪ I experience the highest exciting when using mobile multimedia services ▪ I experience the highest satisfaction when using mobile multimedia services ▪ Time goes by very quickly when using mobile multimedia services ▪ I tend to forget where I am when using mobile multimedia services ▪ Mobile multimedia services provide me endless surprising behavior experiences ▪ I burned with curiosity when using mobile multimedia services ▪ Using mobile multimedia services make me feel like exploring a new world 	[96] (selected)
Social Presence	<ul style="list-style-type: none"> ▪ There is a sense of human contact in the mobile multimedia services ▪ There is a sense of personalness in the mobile multimedia services ▪ There is a sense of sociability in the mobile multimedia services ▪ There is a sense of human warmth in the mobile multimedia services ▪ There is a sense of human sensitivity in the mobile multimedia services 	[101]

TABLE 2: Measure Items of main constructs

All items were scored on a 7-point Likert scale ranging from 1, strongly disagree, to 7, strongly agree. For measuring the mobile multimedia usage, respondents choose one of given answers from 1-3 times in a month to more than 4 times in a day and top three favorite features of mobile phone.

4.3 Data Analysis

PLS (Partial Least Squares) method is adopted to test the hypotheses and analyze data. PLS can provide not only the examinations of all paths in the proposed model (structure model), but also supplementary analyses with underlying items (measurement model). Éthier et al [103] mentioned that PLS is more prediction-oriented than other Structural Equation Model (SEM) tools. Also, PLS has the benefit with relatively small sample size [104]. Chin [104] recommends "rule of 10" guideline for PLS users: at least 10 cases per measured variable for the larger of (1) the largest latent factor block, or (2) the dependent variable with the largest number of incoming causal arrows in the model. In this research model, the second condition yields a minimum sample size required of 90, which is well exceeded by given sample size of 108.

The SmartPLS 2.0 software (<http://www.smartpls.de>) was used to analyze the measurement, structural model and SPSS17 was used to test construct validity and reliability.

5. RESULTS

26% of the respondents reported that they used mobile multimedia service 1-3 times in a month, while another 25% said that they used it more than 4 times in a day. There is a distinctly divided two groups to use mobile multimedia services. It is shown in Figure 2.

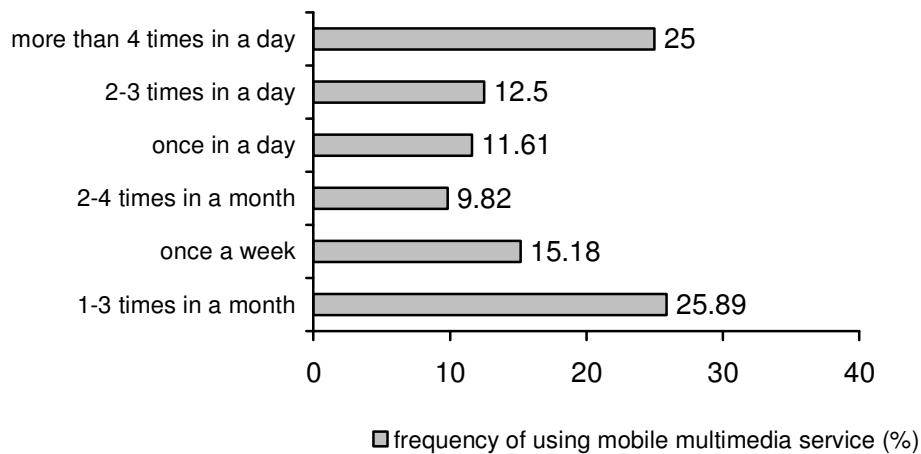


FIGURE 2: Frequency of using mobile multimedia service

The most popular mobile multimedia services were; phone camera (63.8%), photo image viewer (60.7%), MMS (Multimedia Messaging Service) and e-mails (52.7%) and music/audio players (50.9%). On the contrary, 3.6% of respondents reported to use blogging with their mobile phones (Figure 3).

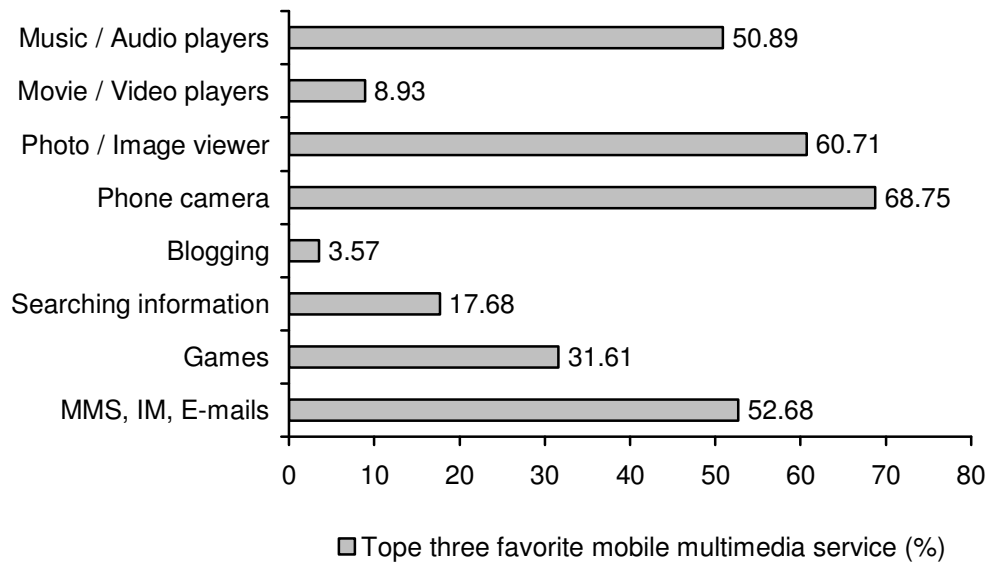


FIGURE 3: Top three favorite mobile multimedia services

Table 3 shows Cronbach’s α in each measurement. All composite reliability values range from .857 to .943, which were above .80. It shows that the construct reliability of our measurement model is acceptable.

Measurement	N of items	Cronbach α
Perceived Enjoyment	5	.943
Perceived Ease Of Use	9	.907
Perceived Usefulness	9	.929
Behavior Intention	4	.857
Aesthetic	4	.907
Flow	9	.909
Social Presence	5	.893

TABLE3: Cronbach’s α in Measurement

Table 4 shows a matrix of Pearson’s Product-moment Correlation Coefficients. The relationships between Perceived Ease Of Use (PEOU) and Perceived Usefulness (PU) ($p=.155$), PEOU and flow ($-.027$) and SP ($-.108$) are not significant. Also there is no significant relationship between social presence and aesthetic ($p=.157$) at the .05 level of significance.

		PE	PEOU	PU	BI	AES	FLOW	SP
PE	Pearson Correlation	1						
	Sig. (1-tailed)							
	N	108						
PEOU	Pearson Correlation	.379**	1					
	Sig. (1-tailed)	.000						
	N	108	108					
PU	Pearson Correlation	.598**	.155	1				
	Sig. (1-tailed)	.000	.055					
	N	108	108	108				
BI	Pearson Correlation	.555**	.376**	.573**	1			
	Sig. (1-tailed)	.000	.000	.000				
	N	108	108	108	108			
AES	Pearson Correlation	.344**	.447**	.352**	.364**	1		
	Sig. (1-tailed)	.000	.000	.000	.000			
	N	108	108	108	108	108		
FLOW	Pearson Correlation	.319**	-.027	.442**	.362**	.308**	1	
	Sig. (1-tailed)	.000	.392	.000	.000	.001		
	N	108	108	108	108	108	108	
SP	Pearson Correlation	.212*	-.108	.229**	.193*	.157	.548**	1
	Sig. (1-tailed)	.014	.134	.009	.022	.052	.000	
	N	108	108	108	108	108	108	108

** . Correlation is significant at the 0.01 level (1-tailed)

* . Correlation is significant at the 0.05 level (1-tailed)

TABLE4: Pearson's Product-moment Correlation Coefficients

Primarily, the proposed research model demonstrates high explanatory power, shown in Figure 4. The final path coefficient shows that the research model explains 48% of BI. The R-square of the Behavioral Intention (BI) from: Perceived Usefulness (PU) is .45; Perceived Ease Of Use (PEOU) is .34. The final result shows that all three determinants, PU, PEOU and PE significantly affect BI in mobile multimedia use.

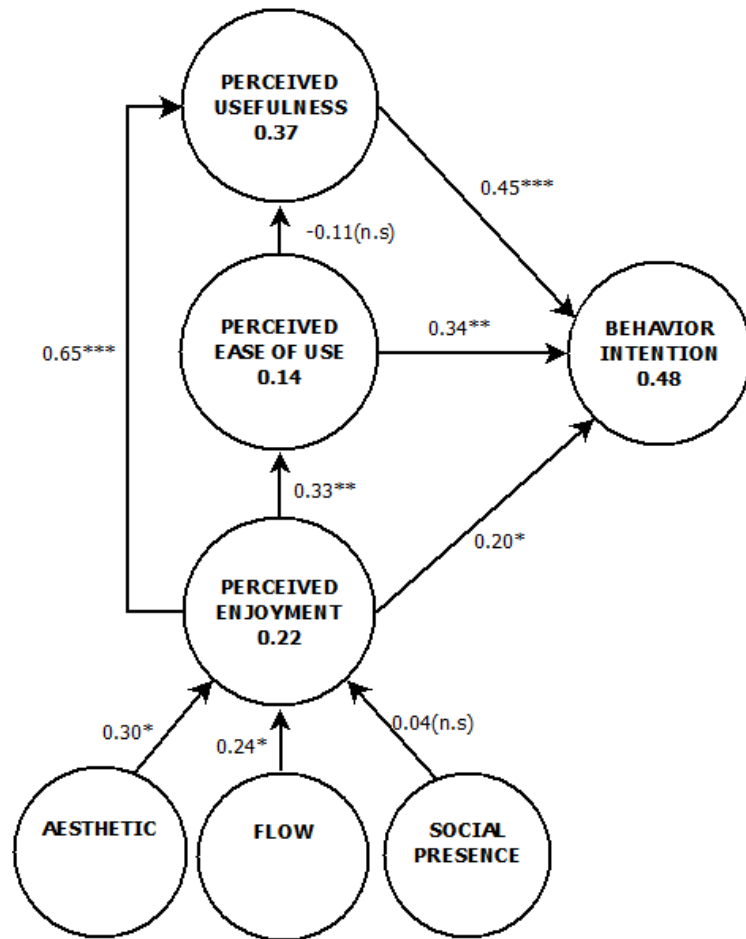


FIGURE 4: PLS results of the structural model

As for three given predictors towards PE, aesthetic and flow also show significant effects with 30% and 24% respectively. However, the PLS result does not show the significant effect of social presence as a predictor of PE and probable reasons will be discussed.

Hypothesis	From	To	Beta	t-Value	p-Value	Sig	Status
H1	PE	PU	0.65	7.42	0.0000	***	Supported
H2	PE	BI	0.20	1.98	0.0251	*	Supported
H3	PE	PEOU	0.33	3.58	0.0003	**	Supported
H4	Aesthetic	PE	0.30	2.51	0.0007	*	Supported
H5	Flow	PE	0.24	2.14	0.0173	*	Supported
H6	Social Presence	PE	0.04	0.47	0.3197	-	n.s

*p<0.5, **p<0.001, ***p<0.0001 (1-tailed)

TABLE 5: Result of hypotheses

The result of all hypotheses is listed in Table 5. The result showed that all hypotheses were supported except H6. Reviewing the results above, two sets of conclusions can largely be drawn. First, PE was positively associated with PU ($\beta = 0.65$; $p < 0.001$) and PEOU ($\beta = 0.33$; $p < 0.05$). Especially, PE had a strong association with PU. There was a relatively weak relationship between PE and BI and it can be assumed that PE had an effect through PU and PEOU toward BI, rather than direct effect on BI. One probable reason for this weak association of PE and BI is because of the diversity of mobile multimedia services. For instance, an activity to search information does not provide much perceived enjoyment, contrary to listening music or mobile blogging. Also, there seems to be moderating effect of PE. Hill and Troshani [105] studied Adoption of Personalization Mobile Services with young Australians and they also found that PE and PU were considered as important determinants of adoption in personalized ringtones. This is consistent with previous studies in the mobile information and entertainment services [106, 107]. Hill and Troshani [105] also suggested that mobile service adoption may vary depending on the type of services.

Second, aesthetics ($\beta = 0.30$; $p\text{-value} < 0.1$) and flow ($\beta = 0.24$; $p\text{-value} < 0.05$) show strong supports to explain PE. In the same context with why PE has a weak association with BI, social presence (SP) may have the same issues of types of mobile multimedia services. For instance, using SMS or emails requires higher SP, however taking self-photos with mobile phone is not related to social presence. All dependences of this study are based on the recent-used mobile multimedia services. Therefore there might be differences to explain PE, based on types of mobile multimedia services.

6. LIMITATIONS AND FUTURE RESEARCH

Limitations of this research provide the foundations for further studies to improve our understandings of the role of enjoyment and its determinants. Limitations may require cautious interpretations of this study. This study focuses on only a subset of possible determinants of mobile multimedia usage. However, mobile multimedia services are relatively lacking in consensus of its wide definitions and understandings. Also, there are wide variations of mobile multimedia services and it is hard to be covered by one criteria. As the result of this study shows, there might be more careful categorization for types of services.

This study employs only undergraduate student sample at a large Mid-Western university and the sample of this study cannot be generalized beyond its age group or its region. Furthermore, the female sample is three times larger than male group in this study and this also can lead different results when adopting other population. The self-reported recall measures of using mobile multimedia services also may be limitation of the present study. According to Pepper, Holmes, and Popovich (2004), direct observations can be more accurate measure than self-reports because people tend to underestimate their usage.

Findings of this study support most of hypotheses about the role of Perceived Enjoyment (PE) in mobile multimedia use. PE has an effect on Perceived Usefulness (PU), Perceived Ease Of Use (PEOU) and directly Behavior Intention (BI), even though the relationship with BI is relatively weak. Therefore, further research need to deeply examine the role of PE. PE may or may not be a dominant variable but moderating variable, and it may also depend on the context of use, types of services, motivation or situation.

The relationship between PE and aesthetics, flow and social presence should be further investigated. Even though, this study shows little relationship between them, there might be unobserved and overlooked indicators. Further research needs to examine alternative measures for aesthetics, flow and social presence with a specific context of use. Particularly for flow, as mentioned previously, this item includes multi-dimensions such as concentration, playfulness,

time distortion, telepresence, and exploratory behavior [96]. Hence, it should be more clearly defined which sub-category is the optimal for measuring mobile multimedia services.

Additionally, mobile multimedia services are very diverse. The activity to take a photo using phone camera (i.e., self photo taking) is different from sending e-mails. There is little room for social presence when listening music or watching videos. Therefore, measuring social presence should be defined in activities with others. Hence, further research should consider the genres of mobile multimedia services. It also remains uncertain whether the relationships are unobserved. For instance, gender difference was observed. However, it cannot be further developed because the numbers of male respondents were relatively small. There were also possibilities of the relationship between mobile multimedia services and frequency of use. Therefore, further research is needed for these issues.

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