

Field Study on College Students' Uses and Gratifications of Multitasking Interaction with Multiple Smart Devices

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Abstract. In order to deeply understand college students' multitasking interaction with multiple smart devices, we conducted a field study with the experience sampling method. We tracked 25 college students for 14 days about their multitasking activities and the dynamic characteristics of behavior motivations and feelings from the perspective of Uses and Gratifications. The participants reported their multitasking activities according to the designated format via WeChat. The researchers coded the qualitative data and classified multitasking activities into three types. It was found that multitasking with relevant content on different devices outperformed the other multitasking types in gratifying cognitive need. To the opposite, multitasking with irrelevant content on different devices was found to serve better at gratifying emotional need than the other multitasking types. The implications for designing cross-platform collaborative user experience in the era of smart computing were discussed.

Keywords: Multitasking · Uses and gratifications · Experience sampling · User needs

1 Introduction

1.1 Research Significance and Objective

Benefiting from the development of emerging interactive techniques and computing technology, people are able to interact with multiple smart devices simultaneously and pervasively. It is described that people's life and work are engaged in a smart environment. It is common and popular that a person who owns multiple smart devices such as tablet, smartphone, laptop interacts with these devices in a multitasking way. Based on a survey by Nielsen Company, roughly 40 percent of tablet and smartphone owners in the United States used their devices daily while watching TV [1]. One survey by the Hollywood Reporter showed that 79 % of the respondents said that they always or sometimes visited Facebook while watching TV and 41 % tweeted about the show they were watching and three quarters said that they posted about TV while watching live shows [2]. Another survey focusing on multi-screen users in the US found that in 2011 there were about 34 % of four-screen users, 32 % of three-screen users and 28 % of two-screen users above 18 years old who were prone to using devices such as PC, smartphone and tablet while watching TV. Besides, 47 % of the four-screen users

would vote and purchase online with their mobile devices when seeing promotions on TV [3]. These activities, referred to as “a person’s consumption of more than one item or stream of content at the same time”, are called media multitasking [4].

In contrast to the prevalence of media multitasking, research evidence has confirmed the negative impact of multitasking on individuals’ performance [5], memory [6] and learning abilities [7]. It is surprising that heavy media multitaskers’ ability of task switching is even worse than light media multitaskers’ [4]. If multitasking has such negative impacts, why do people increasingly get involved in multitasking activities? Figuring out the answer to this question can shed light on the causality between multitasking activities and the corresponding motivations, and facilitate designing appropriate interventions to reduce the negative impact of multitasking in the environment surrounded by various media.

As indicated by [8], American teenagers from 8 to 18 years old spend 29 % of the media use time in using two or more media concurrently. It is found that among American young people who engage in media multitasking activities, they devote about a quarter of their media time to more than one medium [9]. Young people tend to have paradoxical experiences of media multitasking, with both positive and negative experience mixed [10]. Hence, in this study we selected young people as the research subjects of multitasking behaviors.

We define both simultaneously conducted activities and switching between activities as multitasking [11]. Further, we focus on multitasking interaction with multiple smart devices including personal computers, tablets and smartphones, as people’s interaction activities with various smart devices have been more and more ubiquitous and fragmented [12]. Researchers have tried to yield the motivations behind people’s multitasking behaviors. The theory of Uses and Gratifications (U&G) is frequently adopted as the framework to examine media choice and the underlying motivation [13]. However, previous studies from the perspective of U&G lack in focus on emerging situations where people interact with multiple smart devices. They concentrate on multitasking combining a media task and a non-media task [13, 14], or merely interruption-driven multitasking [15]. Besides, these studies consider media multitasking just as a whole group of behaviors, without further typology. Hence, it is necessary to investigate the motivations behind individuals’ multitasking behaviors concerning interaction with multiple smart devices, and how different types of multitasking behaviors gratify different user needs.

1.2 Related Work

Theory of Uses and Gratifications. The theory of U&G was first adopted in mass communication research in the 1940s, and it was later systematically organized and proposed by Katz et al. [16] in 1973. According to the basic assumptions in U&G, audience are active and their media use behaviors are goal oriented, meaning that audience have the initiative in linking need gratification and media choice, but not the media. Since audience vary in their need gratifications, media that differ (or are similar) in attributes are more likely to serve different (similar) needs. This theory successfully explains audience’s behaviors to adopt traditional mass media such as television,

broadcasting, newspaper, books and movies [16] and it is also used to explain how people are motivated to consume new media like social media [17] or online games [18].

In U&G, needs and gratifications are two core concepts. Needs are “the combined product of psychological dispositions, sociological factors, and environmental conditions” [19] which motivate media uses. Gratifications are the “perceived fulfillment” [20] of the needs through media uses. Needs, uses and gratifications are mutually influenced. Needs drive multitasking media uses and media uses generate gratifications. Multitasking uses may deliver none of, some or all of the gratifications sought and those gratifications obtained in turn can influence user needs. User gratifications are determined by what needs exist and how the needs are fulfilled by multitasking uses. What’s more, needs, uses and gratifications have dynamic reciprocal causality, meaning that needs, uses and gratifications provide feedback for subsequent needs, uses and gratifications [14].

Typology of User Needs. Previous studies accumulated various typologies of user needs in media multitasking. Katz et al. [16] raised a classification of media-related needs. Their classification scheme consists of three facets including mode, connection and referent. Mode includes: (1) to strengthen; (2) to weaken; (3) to acquire. Connection includes: (1) information, knowledge, understanding; (2) gratification, emotional experience; (3) credibility, confidence, stability, status; (4) contact. Referent includes: (1) self; (2) family; (3) friends; (4) state, society; (5) tradition, culture; (6) world; (7) others, negative reference group. Each possible and reasonable product of the items in the three facets form a type of user needs, such as to strengthen the understanding with my friends or to strengthen my confidence in the society. Under this scheme, considering the real media-consuming situations, Katz et al. [16] formed five meaningful user needs. Later on in this field, there were many typologies classifying user needs of media-consuming behaviors in different situations. They are summarized in Table 1.

U&G and Media Multitasking. One conclusion concerning media multitasking and U&G is that media multitasking is “emotionally satisfying but cognitively unproductive” [13]. It indicates that people conduct media multitasking activities motivated by their cognitive needs, but media multitasking actually cannot bring them improved efficiency. However, emotional gratifications are obtained despite not being actively sought. Thus, people will form the circle of continuous media multitasking.

The conclusion made by Wang and Tchernev [13] is largely based on multitasking with media and non-media activities mixed. However, it warrants questioning whether all media multitasking activities can gratify emotional needs but not cognitive needs. Zhang and Zhang [22] find that the relationship between need gratifications and multitasking behaviors is influenced by situational factors. Specifically, convenience needs are strong predictors of work-related type of computer multitasking, but not interaction type of multitasking like communication with IM while playing online games. Jeong et al. [24] state that in multitasking with media and non-media activities mixed, media use is usually the secondary activity. This pattern has important influence on media effect, or the gratifications brought by media use. However, in the era of multitasking with smart devices, users’ multiple tasks can be all related to media. Users’ needs and gratifications should be studied in caution with different multitasking types into consideration.

Table 1. Typology of user needs in different media-consuming situations

Source	User needs	Situation
[16]	<ul style="list-style-type: none"> • Cognitive needs to strengthen information, knowledge and understanding • Affective needs to strengthen aesthetic, pleasurable and emotional experience • Integrative needs to strengthen credibility, confidence, stability and status • Integrative needs to contact with others • Escaping or tension-release needs 	Mass media use
[13, 14]	<ul style="list-style-type: none"> • Emotional needs • Cognitive needs • Social needs • Habitual needs 	Media and non-media mixed multi-tasking activities; social media and other media use
[21]	<ul style="list-style-type: none"> • Recognition needs to establish personal identity, gain respect, build confidence and publicize expertise • Cognitive needs • Social needs • Entertainment needs 	User-generated content on the Internet
[22]	<ul style="list-style-type: none"> • Convenient/easy/instant • Control/habitual • Social/affective/relaxation 	Multitasking with computers
[23]	<ul style="list-style-type: none"> • Information processing • Enjoyment experience 	Media multitasking

In this study, we aimed to investigate whether different types of media multitasking differ in gratifying users' different types of needs, especially the two types of needs: emotional needs and cognitive needs. The former one is related to relaxation and entertainment while the latter one is related to productivity, convenience and efficiency. Hence, the two core research questions were:

Research question I: Which type of media multitasking has the advantage of gratifying users' emotional needs?

Research question II: Which type of media multitasking has the advantage of gratifying users' cognitive needs?

2 Method

In order to deeply understand young people's needs and gratifications concerning media multitasking, we conducted a field study among college students. We adopted an experience sampling method to track their daily media multitasking activities and their dynamic state of needs and gratifications. Experience sampling is an effective method

to gain insight into what people are experiencing during a particular period and it has been used a lot in the study concerning multitasking [13, 25, 26].

We recruited 25 college students in a 14-day experience sampling ethnographic study. All the participants owned at least 3 types of smart devices including a personal computer, a smartphone and a tablet computer. They all had the habit of multitasking interaction with multiple smart devices. During the study period, each participant received one message via WeChat at fixed time to remind him/her to report media multitasking activities in the past four hours. One experimenter sent messages three times at 12:30, 16:00 and 22:00. Upon receiving the message, the participant should reply in 1.5 h, otherwise the reply would be regarded invalid. They were also allowed to actively report their media multitasking activities anytime they were willing to. Each report of media multitasking should contain information on location, people involved, devices, content on each device, motivations and feelings. If a participant left out a particular detail, the experimenter would send a message asking for supplement. Before the formal field study, the experimenter gave participants instructions in a training section about how to reply to messages to report. In the training section, the experimenter also provided two examples as the report templates. One template is as follows:

*I by myself (**people**) used my computer (**device**) to watch The Voice of China (**content**) in my dorm (**location**), meanwhile used my smartphone (**device**) to tweet about the singers' performance (**content**) because it is very interesting (**motivation**). Then I was very happy to communicate with my buddies (**feeling**).*

After the 14-day field study, each participant filled in a questionnaire about demographic information. We provided three options of electronic devices as the incentive: a set of wireless keyboard and mouse, a mobile power and a Bluetooth earphone. Participants reported their choice at the end of the questionnaire.

Since most data were qualitative, they were coded into frequency of each type of gratifications. We categorized multitasking activities into three types. The first type (called type A) indicated those multitasking activities in which there were data communications between different devices. The second type (called type B) indicated those multitasking activities in which there was no data communication between devices but the content on different devices was relevant. The third type (called type C) indicated those multitasking activities in which there was no data communication between devices and the content on different devices had no relevancy. Based on the typology of user needs in Table 1, we chose cognitive need, emotional need, information need, social need and recognition need as the types of user gratifications in the analysis.

For each item of report, the researcher first recognized its multitasking type and added the frequency value of the corresponding gratifications by one point if the participant reported that his/her need was gratified. Then the points for all the five types of user gratifications were summed up. The ratios of the five types of gratifications were calculated by dividing the sums for each type of gratifications by the total frequency points. ANOVA was used to analyze the relationship between the ratio of the corresponding gratifications and multitasking types.

3 Results

3.1 Descriptive Statistics

Among the 25 participants, 14 (56.0 %) were males and 11 (44.0 %) were females. The average age was 21.8 (SD = 2.0). The education level of the sample was: 11 undergraduate students (44.0 %), 7 master students (28.0 %) and 7 PhD students (28.0 %).

Their experience of smart device use is shown in Table 2. It can be seen that most of them had a rich experience of using smart devices including computers, tablets and smartphones. As screened in the recruitment phase, participants all had the habit of multitasking interaction with multiple smart devices.

Table 2. Participants' smart device use experience (N = 25)

Item	N	Mean	SD
Computer use time length (years)		10.7	4.0
4–6	2		
6–10	12		
11–15	7		
15–18	4		
Tablet use time length (years)		2.1	1.2
<1	3		
1–2	12		
3–4	10		
Smartphone use time length (years)		3.2	1.2
<3	9		
3–4	14		
5–7	2		
Computer use frequency (hours per day)		7.1	3.8
<6	11		
6–9	6		
10–12	6		
13–15	2		
Tablet use frequency (hours per day)		1.2	1.6
<.5	3		
.5–1	17		
>1	5		
Smartphone use frequency (hours per day)		4.5	4.9
<2	6		
2–4	13		
5–8	1		
>8	5		

The ratios of gratifications among three multitasking types are shown in Table 3. It can be found that cognitive need of type B tended to be better gratified than that of the

other two types, and that emotional need of type C tended to be better gratified than that of the other two types. These two differences were further tested via ANOVA in the next sub-section. As for the other three types of user needs, the data fluctuated too much among individuals and the differences between different types of multitasking were not obvious.

Table 3. Ratios of gratifications among three multitasking types (percentage)

User needs	Type A		Type B		Type C	
	Mean	SD	Mean	SD	Mean	SD
Cognitive need	15.14	27.24	52.63	38.09	21.90	19.10
Emotional need	9.59	23.84	14.25	28.82	38.20	20.90
Information need	4.00	20.00	8.27	14.19	3.72	6.56
Social need	1.33	5.20	11.64	23.77	6.68	9.50
Recognition need	19.74	37.09	7.99	21.62	2.06	3.33

3.2 Variance Analysis

The results of ANOVA test of multitasking types for cognitive need and emotional need are shown in Table 4. It can be seen that there exist significant differences between different types of multitasking concerning either cognitive need or emotional need. Pairwise comparisons between types of multitasking for the two needs are shown in Fig. 1. Participants' cognitive need was significantly more gratified when they conducted the second type of multitasking activities than when they conducted the other two types of multitasking activities. The first and the third types of multitasking did not differ in gratifying participants' cognitive need.

Table 4. ANOVA test of multitasking types for cognitive need and emotional need

Variables	<i>df</i>	<i>F</i>	<i>p</i>	Partial η^2	Cohen's f^2
Cognitive need	2	13.599	<.001	.362	.567
Emotional need	2	14.576	<.001	.378	.608

In order to investigate if the two needs differ in the extent of being gratified within each type of multitasking, we conducted the ANOVA test of cognitive need and emotional need within each type of multitasking, the result of which is shown in Table 5. At the significant level of 0.05, the two needs showed significant differences in the extent of being gratified within type B and type C. Type B had the advantage of gratifying cognitive need over emotional need, while the situation for type C was the opposite.

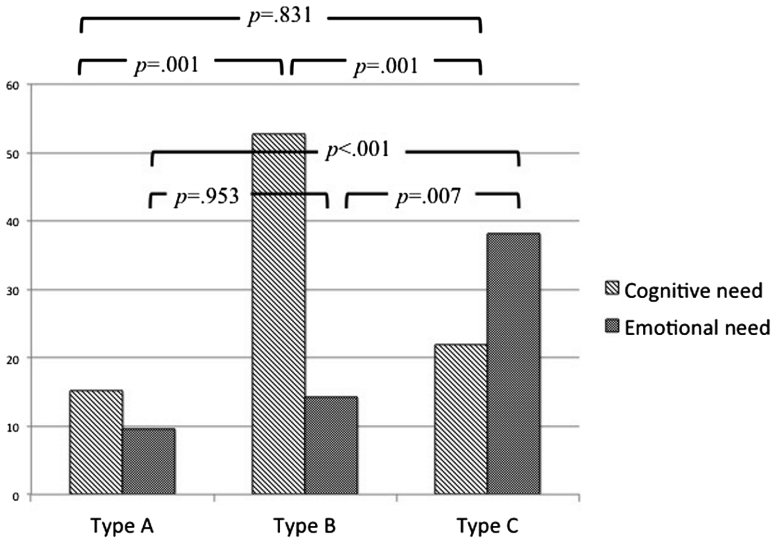


Fig. 1. Pairwise comparison between types of multitasking for cognitive need and emotional need.

Table 5. ANOVA test of cognitive need and emotional need within each multitasking type

Variables	df	F	p	Partial η^2	Cohen's f^2
Type A	1	.578	.455	.024	.025
Type B	1	10.954	.003	.313	.456
Type C	1	7.652	.011	.242	.319

4 Discussion

The core finding of this study is that multitasking activities are not necessarily “emotionally satisfying but cognitively unproductive” [13]. Whether a certain user need is gratified or not may depend on the multitasking type, to be specific, whether the content on each device has relevancy. Relevant content on different devices can improve the collaborative works and activities, resulting in higher perceived productivity and higher perceived efficiency. A typical use scenario is as depicted by the following report:

[No. 8, female] *“I forgot to print out the lecture slides, so I used the laptop to do my homework and referred to the lecture slides on the iPad in my dormitory. I felt it very convenient.”*

To the opposite, irrelevant content on different devices can aggravate the interruptions caused by multitasking, resulting in lower perceived productivity, as described in the words below:

[No. 24, female] *"I was in my lab searching for some literature, while I received text messages on my mobile phone. I had to reply to it. The coming messages disturbed my work and I felt very anxious."*

In this case, her social need was gratified while the negative effect was the reduced productivity. A more extreme example to gratify emotional need in the third type of multitasking is as follows:

[No. 23, male] *"I was in my dormitory watching the cartoon Initial D on my computer. Since the plot of the cartoon was very slow, I meanwhile read the book On Top of Tides on the tablet. I felt it very comfortable and I didn't miss either."*

The finding can provide implications for designing collaborative applications or services based on multiple platforms. In the era of smart computing, the collaboration and communication between devices are becoming more and more popular. For application designers, the goal should be enhancing the whole user experience provided, but rather user experience on a single device. Thus, the content relevancy on different devices is not ignorable. Reducing the interruptions between devices and maximally improving the cooperation and consistency between devices are beyond all doubt beneficial for providing excellent whole user experience across platforms. From the results of the study, we can see that multitasking activities with data communication between devices are still insufficient for gratifying either cognitive need or emotional need. The fact that type B multitasking outperforms type A multitasking implies that humans are still better at coordinating and managing different devices than technology itself. In other words, humans are smarter at choosing the work for each device in a multitasking setting. In this direction, more research needs to be done to exploit the capacity of each device and explore the possible collaborative work patterns for multitasking contexts.

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References

1. Nielsen. http://blog.nielsen.com/nielsenwire/online_mobile/40-of-tablet-and-smartphone-owners-use-them-while-watching-tv/
2. Hollywood Reporter. <http://www.hollywoodreporter.com/gallery/facebook-twitter-social-media-study-302273-3>
3. iResearch. <http://wireless.iresearch.cn/88/20120719/177001.shtml>
4. Ophir, E., Nass, C., Wagner, A.D.: Cognitive control in media multitaskers. *Proc. Nat. Acad. Sci. U.S.A.* **106**, 15583–15587 (2009)
5. Bowman, L.L., Levine, L.E., Waite, B.M., Gendron, M.: Can students really multitask? An experimental study of instant messaging while reading. *Comput. Educ.* **54**, 927–931 (2010)
6. Van Winsum, W., de Waard, D., Brookhuis, K.A.: Lane change manoeuvres and safety margins. *Transp. Res. Part F: Psychol. Behav.* **2**, 139–149 (1999)
7. Wei, F.-Y.F., Wang, Y.K., Fass, W.: An experimental study of online chatting and notetaking techniques on college students' cognitive learning from a lecture. *Comput. Hum. Behav.* **34**, 148–156 (2014)

8. Rideout, V.J., Foehr, U.G., Roberts, D.F.: *Generation M2: Media in the Lives of 8-to 18-Year-Olds*. Kaiser Family Foundation, Menlo Park (2010)
9. Foehr, U.G.: *Media Multitasking Among American Youth: Prevalence Predictors and Pairings*. Kaiser Family Foundation, Menlo Park (2006)
10. Bardhi, F., Rohm, A.J., Sultan, F.: Tuning in and tuning out: media multitasking among young consumers. *J. Consum. Behav.* **9**, 316–332 (2010)
11. Circella, G., Mokhtarian, P.L., Poff, L.K.: A conceptual typology of multitasking behavior and polychronicity preferences. *Electron. Int. J. Time Use Res.* **9**, 59–107 (2012)
12. eMarketer. <http://www.emarketer.com/Article/UK-More-Screens-Mean-More-Fragmented-Viewing-Behavior/1009708>
13. Wang, Z., Tchernev, J.M.: The “myth” of media multitasking: reciprocal dynamics of media multitasking, personal needs, and gratifications. *J. Commun.* **62**, 493–513 (2012)
14. Wang, Z., Tchernev, J.M., Solloway, T.: A dynamic longitudinal examination of social media use, needs, and gratifications among college students. *Comput. Hum. Behav.* **28**, 1829–1839 (2012)
15. Rosen, L.D., Carrier, L.M., Cheever, N.A.: Facebook and texting made me do it: media-induced task-switching while studying. *Comput. Hum. Behav.* **29**, 948–958 (2013)
16. Katz, E., Haas, H., Gurevitch, M.: On the use of the mass media for important things. *Am. Sociol. Rev.* **38**, 164–181 (1973)
17. Quan-Haase, A., Young, A.L.: Uses and gratifications of social media: a comparison of facebook and instant messaging. *Bull. Sci. Technol. Soc.* **30**, 350–361 (2010)
18. Chang, B.-H., Lee, S.-E., Kim, B.-S.: Exploring factors affecting the adoption and continuance of online games among college students in South Korea integrating uses and gratification and diffusion of innovation approaches. *New Media Soc.* **8**, 295–319 (2006)
19. Katz, E., Blumler, J.G., Gurevitch, M.: Uses and gratifications research. *Public Opin. Q.* **37**, 509–523 (1973)
20. Palmgreen, P.: Uses and gratifications: a theoretical perspective. In: *Communication Yearbook*, vol. 8, pp. 20–55 (1984)
21. Leung, L.: User-generated content on the internet: an examination of gratifications, civic engagement and psychological empowerment. *New Media Soc.* **11**, 1327–1347 (2009)
22. Zhang, W., Zhang, L.: Explicating multitasking with computers: gratifications and situations. *Comput. Hum. Behav.* **28**, 1883–1891 (2012)
23. Jeong, S.-H., Fishbein, M.: Predictors of multitasking with media: media factors and audience factors. *Media Psychol.* **10**, 364–384 (2007)
24. Jeong, S.-H., Hwang, Y., Fishbein, M.: Effects of exposure to sexual content in the media on adolescent sexual behaviors: the moderating role of multitasking with media. *Media Psychol.* **13**, 222–242 (2010)
25. Mark, G., Iqbal, S.T., Czerwinski, M., Johns, P.: Bored Mondays and focused afternoons: the rhythm of attention and online activity in the workplace. In: *The 32nd Annual ACM Conference on Human Factors in Computing Systems*, pp. 3025–3034. ACM, New York (2014)
26. Mark, G., Iqbal, S., Czerwinski, M., Johns, P.: Capturing the mood: facebook and face-to-face encounters in the workplace. In: *The 17th ACM Conference on Computer Supported Cooperative Work and Social Computing*, pp. 1082–1094. ACM, New York (2014)