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Film, Interrupted: Investigating How Mobile Device Notifications Affect Immersion During Movies

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Abstract

Mobile devices are increasingly used while watching video, both as a secondary device and for dedicated viewing. However, devices frequently issue notifications that can interrupt viewing. This study investigated the effect of interruptions from notifications on viewer immersion. Participants watched 10 minutes of a movie without notifications, and 10 minutes while receiving message notifications. There were two participant groups: one watched video on a 30-inch monitor with messages sent to a separate smartphone; while another watched on a smartphone while also receiving messages on it. Viewer immersion was assessed after each condition via questionnaire. We also considered message response times. Results showed that immersion scores were lower when the video was interrupted with notifications, regardless of viewing device. Message response times were fastest when using the phone as a secondary device. Our results suggest that device-driven interruptions should be minimised for an immersive film experience.

Author Keywords

Media multitasking; interruptions; notifications; dual screening; task switching; television; film; video

ACM Classification Keywords

H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction

Watching film and television is a popular digital leisure activity. Recently, there has recently been a shift away from live broadcast TV to on-demand services, such as Netflix, Youtube, and Amazon Video [21]. These allow viewers to watch on a variety of devices, when and wherever they like.

Our mobile devices are often nearby. A downside of this is that users can be overloaded with notifications. Pielot et al. [23] found that people receive 63.5 mobile notifications per day on average. These serve various purposes [26], but are often similar in presentation, making it difficult to assess importance. As a result, people are reluctant to disable them.

Mobile devices are often used as dedicated screen for watching video [21], and as a secondary device while watching TV [12]. Due to this, and the large number notifications received by users, viewing is often accompanied by device-driven notifications. These can lead to interruptions [1, 23], which can in turn lead to distractions [15] and task switching [7]. Prior research into interruptions has been in safety critical settings, where negative effects of interruptions can result in injury. Similarly, interruptions in the workplace — another focus of research — can result in reduced productivity and financial loss. These activities are task-focused, where metrics such as performance levels and error rates are easily measured. The effect of interruptions on the experience of watching film and television has not been well explored, perhaps because viewing video is mostly a passive activity, where these traditional metrics do not apply. In this paper, we overcome this by using immersion as a measure of engagement to determine the effect of notifications.

We also consider the difference between receiving notifications on a secondary device while watching on TV, or on the primary viewing device. Attending to notifications on a secondary device is optional, but may be accompanied by a large visual attention shift, and the very presence of a secondary device can lead to decreased visual attention on the primary device [11]. On the other hand, notifications on the primary viewing device can forcibly interrupt viewing by overlaying distracting content [28]. However, users can address notifications without switching attention between devices. Viewer attention in multi-screen environments has been investigated for ad-hoc companion experiences (e.g. [4, 20]), but not when considering spontaneous interruptions from external sources such messaging notifications.

This study investigates the effect of interruptions on immersion across two emergent viewing paradigms: watching on a large screen with a mobile device present, and watching on a mobile device. We review work on interruptions and notifications, and discuss the implications of our findings.

Related work

Prior work shows that being interrupted can be detrimental to performance in the workplace [10] and in safety critical environments such as piloting a plane [17]. Interruptions can make knowledge workers slower and more error-prone [2]. This is also true when looking specifically at interruptions from email and instant messaging notifications [6], where it has been shown that some workers work longer and more consistently without notifications [15, 19].

Users receive many mobile device notifications in different contexts, especially from messaging services [23, 26]. Mobile notifications differ from desktop ones in a number of ways [26]. Firstly, they have a similar visuals, sounds, and vibrations, regardless of source. Secondly, they provide information about variety of services, so much that it can lead to users being overloaded [5]. Fischer et al. [8] found that users assign differing levels of importance to notifications from different sources, depending on context. When
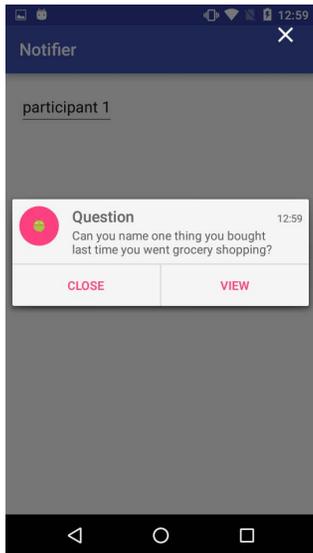
Figure 1: Example notification.

- "What did you eat for breakfast today?"
- "Can you name one thing you bought last time you went grocery shopping?"
- "What are your plans for the weekend?"
- "What was the last restaurant you went to?"
- "If you were to get a new pet, what would it be?"

Table 1: Questions participants were asked.

presented in a unified manner, users cannot distinguish importance without attending to the notification. Finally, the ubiquity of mobile devices means notifications are nearly always with the user. This can lead to checking habits [22] and compulsive device use, even when it could affect another activity. Indeed, most notifications are responded to within 30 seconds [26]. Regardless of the interruption and frustration sometimes caused, users value notifications [15], and hence disabling them is often not welcomed.

Little research has examined interruptions when watching film and TV. Operationalising video watching experience in order to assess interventions has often relied on ad-hoc methods, such as questionnaires measuring presence [13, 18], the sensation of being physically located in the location presented in the medium. However, as a viewer can be highly engaged without feeling like they are in another location, presence does not entirely encompass the experience of watching film and TV. Rigby et al. [25] turned to gaming research to better define video watching experiences by using the concept of *immersion* as defined by Jennett et al. [16], which describes a high level of engagement when gaming. They suggest that immersion builds over time, and that states of high immersion take longer to return from than low ones. By modifying the Immersive Experience Questionnaire [16], Rigby et al. developed the Immersive Experience Questionnaire for Film and Television (Film IEQ) which can be used to asses the impact of technological interventions, e.g. showing that smaller screens lead to lower immersion than larger ones [25].

Here we present a study to assess the effect of messaging notifications on viewer immersion while watching a movie. Based on prior research, we expect that notification interruptions will reduce immersion across both devices, with immersion further reduced in the phone condition due to the small screen. As states of higher immersion can take longer to recover from than lower ones [16], we expect quicker responses to messages when viewing on the phone.

Method

Participants
29 participants (14 female) were recruited from a university participant pool. Ages ranged between 18 and 52 ($M = 25.1, SD = 7.5$). They were paid \$9.50 for 40 minutes.

Design
A 2×2 (viewing device×interruption) mixed factorial design was used. Viewing device (the between subjects variable) was manipulated by having participants watch content on either a phone or computer monitor. Interruption (the within subjects variable) was manipulated by regularly interrupting the participants with phone notifications in one condition and removing interruptions in the other. Dependent variables were the participants' self-reported immersion, measured using the Film IEQ, and notification response time.

Materials
The experiment took place in a lab, with participants sitting at a desk in a fixed chair. A smart phone with a 4.5-inch screen (held by participants with their arms on the desk) and a 30-inch monitor (placed on the desk approx. 50cm away) connected to a laptop were used to play the clips. Participants freely chose an unseen movie they wanted to watch from Netflix using the laptop, the first 20 minutes of which was split into two 10-minute clips. Three participants chose *Kung Fu Panda 2*, two chose *Ride Along*, two chose *Maleficent*. Remaining participants chose something unique. Audio was played through desktop speakers.

A messaging app delivered the notifications, consisting of a pop-up, sound, and vibration (See Fig. 1). Each asked a simple question (see Table 1), and the order was shuffled.
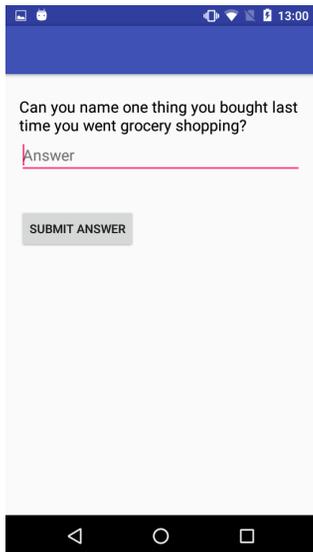
1. To what extent did the movie/show/clip hold your attention?
2. To what extent did you feel you were focused on the movie/show/clip?
3. How much effort did you put into watching the movie/show/clip?
4. Did you feel you were trying your best to follow the events of the movie/show/clip?
5. To what extent did you lose track of time?
6. To what extent did you feel consciously aware of being in the real world whilst watching?
7. To what extent did you forget about your everyday concerns?
8. To what extent were you aware of yourself in your surroundings?*
9. To what extent did you notice events taking place around you?*
10. To what extent could you picture yourself in the scene of the events shown in the movie/show/clip?
11. To what extent did you feel separated from your real-world environment?
12. To what extent did you feel that the movie/show/clip was something you were experiencing, rather than something you were just watching?
13. To what extent was your sense of being in the environment shown in the movie/show/clip stronger than your sense of being in the real world?
14. To what extent did you find the concepts and themes of the movie/show/clip challenging?
15. Were there any times when you just wanted to give up watching?*
16. To what extent did you feel motivated to keep on watching?
17. To what extent were the concepts & themes easy to understand?*
18. To what extent did you feel you were making progress towards understanding what was happening, and what you thought might happen at the end?
19. How well do you think you understood what happened?
20. To what extent did you feel emotionally attached to the content?
21. To what extent were you interested in seeing how the events in the movie/show/clip would progress?
22. Were you in suspense about how the events would unfold?
23. At any point did you find yourself become so involved that you wanted to speak to the movie/show/clip directly?
24. How much did you enjoy the cinematography, graphics & imagery?
25. How much did you enjoy watching the movie/show/clip?
26. When it was over, were you disappointed to have to stop watching?
27. Would you like to watch more of this, or similar, in the future?

Table 2: Film IEQ items. Negatively scored items marked with *.

Figure 2: Answer submission screen.

After pressing the view button, participants gave their answer (see Fig. 2). The app recorded the time taken to reply, as well as the responses. Before the experiment, participants completed a demographic questionnaire.

After each condition the Film IEQ was completed [25] to measure immersion. This consisted of 27 questions (see Table 2) answered using 7-point likert scales, giving total immersion scores between 27 and 189. There are four constituent subscales measuring the factors of involvement (Q5, 7, 11, 12, 13, 14, 20, 22, and 23) captivation (Q1, 2, 3, 4, 15, 16, 21, 24, 25, 26, and 27), comprehension (Q14, 17, 18, and 19), and real-world dissociation (Q6, 8 and 9).

Procedure
Participants were first seated and briefed. They then read an information sheet and signed a consent form, asked any questions they had, and completed a demographic questionnaire. All participants were given a smart phone and told they may receive a notification containing a message which they should respond to, which they were shown how to do. They then chose a movie from the Netflix catalogue, and depending on their assigned viewing device they watched the first 10 minutes on either the phone or monitor then completed the Film IEQ. They watched the next 10 minutes on the same device and completed another Film IEQ. During one clip, participants received notifications on the smart phone which asked them simple questions. This was counterbalanced to control for order effects.

In the notification condition, participants watched uninterrupted for 5 minutes, then were asked a question every minute for 5 minutes. This left an uninterrupted minute of viewing before the clip ended. Participants responded

Factor	F	p
Within subjects (interruption)		
Involvement	6.537	.016
Captivation	.005	.947
Comprehen.	.999	.326
Real-world dissoc.	8.627	.007
Between subjects (device)		
Involvement	.726	.402
Captivation	.049	.826
Comprehen.	3.929	.058
Real-world dissoc.	.284	.598

Table 3: Factorial ANOVA results for subscales, showing within subjects (interruption) effects and between subjects (viewing device) effects. $df = 1, 27$.

using the phone's on-screen keyboard. Both the order of whether participants received notifications and the order of the questions were counterbalanced to control for order effects. The study ended when both clips had been watched.

Results

Immersion was calculated by summing all Film IEQ answers, with Qs 8, 9, 15, and 17 negated. Scores for our data ranged from 80 to 160 ($M = 127.62, SD = 17.47$).

A factorial ANOVA was conducted to compare the main effects of the presence of interruptions and viewing device, and the interaction effect between interruptions and viewing device, on immersion. Mean immersion scores were lower in the notification condition ($M = 124.9, SD = 17.99$) than in the uninterrupted condition ($M = 130.34, SD = 16.8$). Statistical analysis showed a significant main effect of interruptions on immersion score, $F(1, 27) = 6.66, p = .016, \eta_p^2 = 1.98$. Mean immersion scores were slightly lower in the phone condition ($M = 126.79, SD = 16.3$) than in the monitor condition ($M = 128.4, SD = 18.74$). There was no significant main effect of viewing device on immersion scores, $F(1, 27) = .067, p = .797, \eta_p^2 = .002$. There was no significant interaction between the viewing device and the presence of interruptions on immersion scores, $F(1, 27) = .1, p = .754, \eta_p^2 = .004$.

The Film IEQ subscales were analysed. Results are shown in Table 3. For within subjects effects there was a significant main effect of interruptions on involvement, $F(1, 27) = 6.57, p = .016, \eta_p^2 = .196$, and real-world dissociation, $F(1, 27) = 8.627, p = .007, \eta_p^2 = .242$. There was no effect of interruptions on captivation or comprehension, $p > .05$. For between subjects effects, there was no significant main effect of viewing device on involvement, captivation, comprehension, or real-world dissociation, $p > .05$.

Finally, response times between receiving notifications and submitting answers were analysed. Mean response time across the 5 answered questions was computed for each participant, and these were analysed using an independent samples t-test to compare the phone and monitor groups. The results showed that the monitor group had significantly faster response times (14.46s, $SD = 4.62$) than the phone group (19.12s, $SD = 6.38$), $t(26) = 0.36, p = .036$.

Discussion

Our main finding was that mobile message notifications during a movie lead to lower immersion scores, regardless of viewing device. This agrees with prior work showing that interruptions are detrimental in other environments, e.g. safety-critical and workplace settings. This has implications for the viewer, because it shows that constant mobile device interruptions may result in a reduced viewing experience. Interruptions have been shown to affect emotional state and feelings of annoyance [2, 29], and so may result in frustration. This also has implications for content producers, who risk reduced engagement, or even losing their audience, if viewers become disinterested due to frequent interruptions.

One solution is to simply disable notifications, but we know that users value the awareness they provide [15], and may even add to the viewing experience (e.g. discussing shows with friends). With this in mind, these findings reinforce the case for greater management of notifications. This could be performed manually at operating system level, or through use of intelligent notification management systems such as that suggested by Iqbal and Bailey [14], which suggest delivering notifications at breakpoints in a task. For office-based tasks break points are frequent and identifiable (e.g., switching between documents); this is not the case for film and television, where it is not clear where breaks points lie. Consider a three-hour movie: should notifications be dis-

abled for the entirety of the movie, or collected and batch-released at intervals? More intelligent approaches could also be taken, e.g. a smart watch might detect user movement to deliver interruptions when they are fidgety, which has been linked to lower immersion [3]. Electronic programme guides could be used to establish start and finish times of TV programmes, or a notification manager could detect cinematic cuts. While some previous work has examined managing attention for multi-screen TV settings [20], this has focused of specially designed companion experiences and do not account for spontaneous interruptions.

Somewhat unexpectedly, immersion scores were not found to be significantly lower when watching on the phone. This is inconsistent with the results of a previous study showing that smaller screens were found to lead to reduced immersion [25]. This was possibly because the previous study used a within subjects design where each participant watched on all devices [25], and could therefore directly compare screen sizes. While not statistically significant, mean immersion scores were lower for the phone group than the monitor group across both interruption conditions.

Message response times showed that participants watching on the monitor responded to messages faster than those watching on the phone. This may be because the content was automatically paused when the notification appeared when watching on the phone, but was not when watching on the monitor. This perhaps meant participants felt less pressured to respond as they were not missing the movie.

A limitation of this study is the messaging task, as in reality notifications come from various sources [5]. Also, the questions may not have required much thought to answer, and participants may have been aware they were answering a computer. Messages from friends may result in even more time using the phone, e.g. when involved in a conversation.

Another limitation is the lab setting, which could be seen as unsuitable for studying living room behaviour. This feeds into a wider discussion about experimental control versus ecological validity when considering research methods in this domain. A number of methods have been used when looking at device usage while watching television, each with pros and cons. Researchers have often relied on self reporting from participants such as surveys [9, 24], diary studies [9, 24, 27], and interviews [27]. These can be effective in ascertaining general practices, but can be unsuitable for developing a fine-grained understanding of specific behaviours. One solution is to conduct situated studies (e.g [12]), but the living room environment presents a number of challenges [4], such difficulties with data collection, experimental setup in a non-controlled environment, and monitoring attention over multiple screens. On the other hand, controlled experiments can be less resource-intensive to conduct and allow for a detailed understanding of very specific behaviours. We suggest that there is no panacea for this problem, and that incorporating a number of complimentary methods can allow us to develop a balanced understanding when conducting research in this domain.

As in similar studies (e.g. [25]) participants selecting stimuli could present a lack of control. While it is possible to expose participants to the same stimuli, the immersion measure is partially based on personal interest. We hoped that participant choice would maximise potential immersion.

Conclusion

This study investigated how interruptions from messaging notifications affect immersion during a movie. We found that interruptions resulted in significantly lower immersion whether watching on a large monitor or a phone. This suggests that viewers wishing to have an immersive viewing experience should minimise interruptions, perhaps by dis-

abling some notifications on their mobile devices, or simply by turning their devices off if watching on a TV. Results suggest that content producers wishing to incorporate second screen content should be mindful of this, and not interrupt the viewer when they wish for them be fully immersed.

Future work could investigate notification management strategies — both user strategies (e.g. disabling notifications), and through technological solutions to assess when to deliver notifications. Further work could vary interruption pattern and type, such as making participants complete fewer tasks that take more time (e.g. watching a short video, or playing a game) to better represent the different interruptions that users receive. Also, conducting the study in a living room setting could strengthen ecological validity.

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