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# Emotion as an Indicator for Future Interruptive Notification Experiences

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**Abstract**

This paper explores the relationship between emotion and the notification experience. We found a strong relationship between the user emotions used to describe interruptive notification experiences and whether the users wanted similar interruptive notifications again in the future. Participants were likely to want similar future interruptive notifications if they described their interruptive notification experiences using positive words. They were likely to not want similar future interruptive notifications if they described their interruptive notification experiences using negative words. The implications for the use of this knowledge in the design of intelligent systems and potential for future work are also discussed.

**Keywords**

Context; Emotion; Interruption; Notification

**ACM Classification Keywords**

H.5.m [Information Interfaces and Presentation]:  
Miscellaneous;

**General Terms**

Design; Experimentation; Human Factors

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## Introduction

Thanks to affordable personal computing devices and a ubiquitous Internet connection we are living in an increasingly active information environment. As this information environment becomes more active and rich, the demands on our attention increase. There is a need for services that help us maintain awareness of new and updated information while managing the effects interruptions have on our attention.

Interruption is the method of forcefully switching attention from one piece of information to another. Notifications are a type of information alerts that informs the user of an event or update. Interruptive notifications are notifications that draw the user's attention in order to inform him of the new event or information, such as a new chat message from a friend. The nature of these message displays is interruptive because the system must grab the user's attention in order to deliver the information. Many events and services rely on interruptive notifications to deliver information updates to the user in a timely manner.

While interruptive notifications serve an important role in an active information environment, they can also be a source of user distraction, annoyance, and dissatisfaction. The design of interruptive notifications presents a challenge because these services must deliver information to the user while balancing the costs of interrupting the user with the benefits of information awareness. As more of our information moves to online and distributed services that are dynamically and frequently updated, the importance of awareness of these updates and the need for better interruptive notification management increases.

## Related Work

Most of the HCI research in interruptions and notifications has looked at the empirical effects of interruptions on the user during the task cycle and the usability of interruptive notification software. Little work has been done to understand the context of the interruption or notification, such as under what conditions a user would want to be interrupted.

### *When to Interrupt Users*

Knowing when to interrupt the user within a task cycle has been the focus of most interruption literature. Interrupting a task has been shown to cause a number of negative effects such as decreased task performance [7, 16], increased perceived task difficulty [3, 8], and a reduced quality of the user experience [1, 3, 11]. Most research agrees that the best time to interrupt a user is between tasks and sub-tasks [1, 2, 3, 7].

### *How to Interrupt Users*

Notification system behavior rules and interface features have been proposed based on the interruption research to help reduce the negative effects of interruptions on users. Details of the notification user interface that affect usability include how information is presented in the notification [4, 15], the position and animation of the notification [11, 15], the ability to interact with the notification [4, 15], and the configurability of the notification system [4].

### *Why Interrupt Users*

User performance is a traditional measurement used in empirical interruptions and notifications research; however, by itself is insufficient for understanding the context of user interruption. Usability engineering has linked user performance and preference [17] but

relevant interruption research has shown no link between user performance and preference [6]. Also, link has been demonstrated between type of interruption and user performance—reducing the value of studying user performance for design insight [10].

Ultimately, software behavior and interface design depends on the context of the user’s task and other contextual features [1, 16], but there is limited research in this area. The literature has shown that the content of the notification message [2], sources of the notification [18], urgency of the notification [19], and value of the notification [19] are indicators for notifications users may want. However, factors such as these are difficult to define because of their contextual nature. While many researchers have provided anecdotal comments that support the importance of examining context, the literature does not provide an in-depth understanding of how contextual factors impact interruptive notifications.

#### *Role of Emotion in Interruption and Notification*

Emotion is an important aspect of the user experience and influences how users understand, interpret, experience, and interact with technology [5, 9]. However, emotion can be difficult to study because it is context dependent. There is no single method that is best for studying emotion and the best method is often determined by the scope of the study and type of data desired [13, 14]. In [18] we found significant link between positive emotional experiences and interruptive notifications from social sources.

In this paper we examine the relationship between the emotional experience of interruptive notifications and users wanting similar future notifications.

## **Methodology**

An online study was conducted using Amazon Mechanical Turk (AMT). Participation in the study was limited to participants in the United States to help control for English language skills, and was limited to participants who at least a 95% Human Intelligence Task (HIT) approval rating to ensure quality participation.

The study instrument was a web-based form that asked participants to describe a recent interruptive notification experience through a combination of open-ended (text) and closed-ended (selection or scale) questions about the details of their experiences:

- Describe a recent notification experience (Q1—Q6)
- Did you [feel that you needed to] take action or respond to the notification? (Q7 & Q8)
- Rate the notification based on the following qualities and choose the most important quality: Important, Interesting, Urgent, Useful, Valuable (Q9 & Q10)
- Would you want notifications like the one you received in the future? (Q11)
- Using one word, how would you describe the notification? (Q12)
- Participant demographics (Q13—Q15)

Each study part was conducted over three rounds of AMT studies until 20 responses that met the instruction goals were collected. Separating the studies into multiple rounds is a recommended strategy for AMT studies because newer studies requiring fewer responses tend to have better response rates than older studies requiring many responses.

Emotion	Similar Future Notifications				X <sup>2</sup> df(p)	Cramer's V r(p)
	Always	Sometimes	Never	Total		
Positive	30	27	1	58	32.238 2(.000)	.598(.000)
Negative	2	17	13	32		
Total	32	44	14	90		

**Table 1:** OWR Emotion (Positive, Negative) X Wanting Similar Future Notifications (Always, Sometimes, Never)

*One-Word Response*

One-Word-Response (OWR) is a word association technique that is a short, direct question that requests the participant to respond with a single word. Word association is an elicitation technique that aims to get an immediate reaction rather than a thought-out response. OWR differs from other survey question types in that it is a simple question with a simple response and requires no deliberation to respond to. The OWR in this study (Q12) was worded, "Using one word, how would you describe the notification?"

*Emotion Coding*

Analysis of emotion was a post-hoc comparison and an emotional baseline was not collected. OWR emotion was coded based on an emotional dictionary that defined the positive or negative tone of the emotion [12]. OWRs were coded either *positive* for words with a positive emotional tone, *negative* for words with a negative emotional tone, or *descriptive* for words that had no emotional tone and simply described the experience.

*Data Quality*

A total of 139 responses were collected and 17 responses were discarded because the participants did not follow instructions. A total of 122 valid responses were available for analysis. Ninety responses wanting similar future notifications (Q11) contained OWRs with positive or negative emotional words.

Emotion	Similar Future Notifications			FET (p)	Phi r(p)
	Always	Never	Total		
Positive	30	1	31	(.000)	.850(.000)
Negative	2	13	15		
Total	32	14	46		

**Table 2:** OWR Emotion (Positive, Negative) X Wanting Similar Future Notifications (Always, Never)

**Results**

We explored the relationship between the emotional tone of the One Word Response (OWR) used to describe the interruptive notification experience (Q12 code) and wanting similar future notifications (Q11).

A two-sided Chi-Square test of Independence and a Cramer's V correlation showed a moderate and significant relationship between the emotional tone of the OWR (Positive, Negative) used to describe the interruptive notification experience and wanting similar future notifications (Always, Sometimes, Never) (X<sup>2</sup> df=2, p=.000; Cramer's V r(90)=.598, p=.000; Table 1).

A Fisher's Exact Test and a Phi correlation of only *Always* and *Never* responses showed a strong and significant relationship between emotional tone of the OWR used to describe the interruptive notification experience and wanting similar future notifications (FET: p=.000; Phi: r(46)=.850, p=.000; Table 2).

There was a strong link between the emotional tone of how the experience was described and wanting similar future notifications. Participants were very likely to want similar future interruptive notifications if they described the experiences with positive emotional words and were very likely to not want similar future interruptive notifications if they described the experiences with negative emotional words.

Participants' follow up responses (Why or Why not?) for wanting similar future notifications (Q11) supported the relationship between emotion and *Always* or *Never* wanting similar future interruptive notifications:

*"It is important that my virus protection is up to date"* Q11:Always, Q12:Positive

*"[the notification] is annoying and slows down my computer"* Q11:Never, Q12:Negative

Participants who responded with *Sometimes* wanting similar future notifications had mixed responses:

*"I would like the ability to turn [notifications] off when needed"* Q11:Sometimes, Q12:Positive

*"[Notifications] might be important, but I don't want to be spammed"* Q11:Sometimes, Q12:Negative

Although we have shown that emotional tone has a very strong relationship with wanting similar future notifications, the *Sometimes* responses indicate additional contextual factors contribute to what a desirable interruptive notification may be. The influence of additional contextual factors in the interruptive notification experience is consistent with what was found of the relationship between emotion and social interruptive notifications [18].

### Conclusions

This work in progress found a strong relationship between the emotional experience of an interruptive notification and wanting similar future interruptive notifications. Participants who described their

interruptive notification experiences with positive words were likely to want similar future notifications and those who used negative words were likely to not want similar future notifications. Further study of the differences in notifications that users have a positive experience compared to notifications users have a negative experience will provide insights to factors that contribute to interruptive notifications users want.

This work also confirms previous work that found a relationship between the emotional experience of an interruptive notification and if the notification came from a social source [18]. Understanding the relationships between rich contextual factors in the interruptive notification experience will help us design better interruptive systems. Studying additional factors will help build a contextual model of the interruptive notification user experience. Knowledge of the relationships between emotion and notification socialness and wanting future notifications are first steps towards contributing to this model.

### Implications for Research & Design

There is a clear link between the emotional experience and interruptive notification experience. While more work in this area is needed, this research already provides insight for research and design. Research implications include using methods that measure emotional experience as a way to study interruptive notifications or other types of experiences. Design implications include creating a system that can measure user emotion and is able to customize future interruptive notification behavior based on how users respond to similar notifications.

As we better understand the relationships between emotion, desirable notifications, notification socialness, and other interruptive notification factors we will be able to implicitly infer relationships through contextual knowledge in the environment.

#### Limitations

This study was broad and exploratory in nature and was not designed to capture contextual factors in depth. Emotion was an emergent factor and we were unable to measure an emotional baseline. Without a baseline to establish ground truth, we are limited in how far our analysis can be generalized.

#### Future Work

An in-depth multi-method field study of interruptive notifications is planned to gain a deeper understanding of the relationships between contextual factors that affect the interruptive notification user experience.

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