# When to Recommend What? A Study on the Role of Contextual Factors in IP-based TV Services

Jing Yuan    Fikret Sivrikaya    Stefan Marx    Frank Hopfgartner

Technische Universität Berlin

Ernst-Reuter-Platz 7, 10587 Berlin, Germany

{jing.yuan, fikret.sivrikaya, stefan.marx, frank.hopfgartner}@dai-labor.de

## Abstract

Today's IP-based TV services commonly strive for personalizing their content offers using complex recommendation systems to match their users' interests. These systems try to capture the relevance of content recommended to a user, which may also depend on many contextual factors such as time, location, or social company. Nevertheless, in most cases, these factors are either omitted or integrated in recommendation systems without a concrete modeling of what different roles each may play on different users' experiences. Do users really care about all of these specific factors? How do those factors interact with or influence each other? Can this interaction be modeled commonly for all users or is it more specific to the user profile? To the best of our knowledge, answers to these questions have not been studied in detail yet. In this paper, we introduce the results of a questionnaire and a focus group discussion to elaborate on the influence of contextual factors on IP-based TV services from the users' point-of-view.

## 1   Introduction

According to a recent survey performed by Point Topic [1], the number of subscribers of IPTV services has

reached 87.2 million globally as of mid-2013. 17 million of these subscribers have been acquired within the last twelve months alone. This success story is due to various factors. First of all, novel techniques for the compression and streaming of multimedia content have been developed. Moreover, the rapid development of fixed and mobile broadband communication technologies resulted in increased availability of bandwidth for the streaming of multimedia content over the web. Apart from these technological advancements, the main reason for the success of IPTV services can be considered as the flexible, dynamic access to content provided via these services. Differing from traditional television channels that broadcast rather static content for all consumers, content provided by IP-based television and Video-on-Demand (VoD) services can be adapted to the individual customer's interests. An important aspect of this adaptation process is the development of appropriate recommendation techniques such as [2, 3, 4].

These personalization techniques strongly depend on understanding users' needs, which is, however, a non-trivial task. Users' needs and interests can change over time and can depend on external contextual factors such as the time, location or company of other people [5]. Various studies (e.g., [6, 7, 8]) have shown that recommender systems can benefit significantly when these contextual factors are incorporated. Given that we are all individuals though, it is not premature to assume that contextual factors are not equally important for all of us. For example, the time of the day might be important for some people, but not so important for others. As far as we know, a detailed analysis of the choice of contextual factors for a recommender has not been studied yet.

With this paper, we intend to shed some light on the role of contextual factors on individual users. The work is divided into two parts. First, we present the outcome of an online questionnaire where we asked

participants about their usage of IP-based TV services. Second, we summarize the results of a focus group discussion where we discussed the results of the questionnaire with various participants of our survey.

The paper is structured as follows. In Section 2, four possible influential contextual factors are proposed, which form the basis of the questionnaire presented and analyzed in Section 3. Section 4 summarizes the participants' opinions in the focus group discussion. Finally, Section 5 concludes the work and outlines future work.

## 2 Contextual Factors

In literature, various contextual factors have been proposed that should be considered when providing recommendations. In the context of this paper, we concentrate on a subset of them, i.e., the most commonly used contextual factors. These include *time*, *location*, *social company* and *external breaking news*, each of which we elaborate next.

**Time** Various researchers (e.g., [9, 10, 11]) focus on time as contextual factor to improve their recommendation algorithms. Although these works suggest that time can be a very strong and thus helpful factor, it remains unclear if this observation is valid for every user in an IP-based TV scenario. For example, freelancers with flexible working hours might not consider time to be a significant factor, while employees on a strict work schedule generally consider it to be highly important. We argue that further investigations are required to study the role of time as contextual factor.

**Location** is another frequently mentioned contextual factor for recommenders [6, 12]. In most cases, location as a contextual factor is considered by following simple matching rules. A concrete approach for building relations between location and content evaluation procedure has not been studied yet. Given the unclear picture of location factor's involvement in personalization and recommendation methods, we consider it to be a relevant factor that need to be investigated further.

**Social company** Users' acceptance of social company during IP-based TV service usage has been identified in literature (e.g., [13, 14]). In a social context, functionalities such as exchanging thoughts on TV programs or recommending each other interesting TV content are very common amongst users. Social context can provide users an opportunity to evade the filtering bubble, which guides users to their own preferred directions, thus leading to large amount of hidden content. Nevertheless, it can not easily be assumed that social company is important for every consumer of IP-based TV services. In this paper, we include social networks, which are a more detectable social factor, into the discussion range to observe users' attitudes towards social company.

**External breaking news** may be treated not only as a content type for recommendation, but also as a contextual factor. Studies in [15, 16] make use of trending topics on microblogs to mine real-time hot news. In IP-based TV services, external breaking news might be quite relevant for the consumer's choice on programs beyond news, and thus worthy of being studied as a contextual factor. For example, a famous singer's death may arouse users' interests in his old music videos or concerts, apart from the news of his death itself.

In order to study the role of these contextual factors for individual users, we performed a user survey where we asked participants to answer specific questions on five-point likert scale, multiple choice or radio. Moreover, we organized a focus group session where we discussed the role of these factors with different types of IP-based TV content consumers.

## 3 User Study Questionnaire

In our design of the user questionnaire, we focused on the four specific contextual factors for IP-based TV recommendations introduced in the previous section. At the beginning of the questionnaire, we gave users a description of our "IP-based TV service" concept, which covers not just IPTV through set-top boxes, but also WebTV and web-based mobile apps. In this section we share some of the statistical results of the survey, through which we try to provide a clearer picture of the contextual factors' influence from the users' perspective.

### 3.1 Respondents' Basic Info

The online questionnaire remained in effect throughout the month of August 2013, with a total of 51 respondents. The demographic information of the questionnaire respondents is listed in Table 1. All respondents are digital natives, i.e. were born after the start of the digital age (around 1960); so their understandings of legacy TV (terrestrial, cable, satellite) and IP-based TV services are clear. Most participants are either employees or students at our university. In terms of their place of birth and residence, Asians and Europeans form the two largest groups of our respondents. This coincides with the survey result from Point Topic [1], which shows that Asia and Europe are the two biggest markets for IP-based TV content with 48.7%

and 36.6% market share of the worldwide IPTV subscribers, respectively. Given these similarities, we argue that our participants form a subset of the main target groups for such services.

Table 1: Questionnaire Demographic Info

| Question | Options | N | % |
|---|---|---|---|
| Gender | Female | 15 | 29.4 |
| | Male | 35 | 68.6 |
| | N/A | 1 | 2.0 |
| Age | 15~20 | 1 | 2.0 |
| | 20~30 | 38 | 74.5 |
| | 30~40 | 12 | 23.5 |
| Profession | Employee | 19 | 37.3 |
| | Freelancer | 2 | 3.9 |
| | Teacher | 2 | 3.9 |
| | Student | 26 | 51.0 |
| | other | 2 | 3.9 |
| Place of Birth | Europe | 17 | 33.3 |
| | Asia | 33 | 64.7 |
| | N/A | 1 | 2.0 |

Table 2 represents TV usage habits of the respondents. We first observe that a large majority consumes IP-based TV services much more than traditional TV, with more than half of the participants spending at least five times more time on IP-based TV services than on normal TV. Moreover, 86.3% (19.6%+25.5%+41.2%) report that they have been using IP-based TV services for over two years. These statistics confirm that the respondents to the questionnaire represent experienced IP-based TV service users, possessing the required reference value for our survey.

Table 2: Respondents Basic Usage Info

| Question | Options | N | % |
|---|---|---|---|
| Watching Duration Proportion (Normal TV: IP-based TV service) | 5+:1 | 6 | 11.8 |
| | 4:1 | 3 | 5.9 |
| | 2:1 | 1 | 2.0 |
| | 1:1 | 3 | 5.9 |
| | 1:2 | 4 | 7.8 |
| | 1:4 | 8 | 15.7 |
| | 1:5+ | 26 | 51.0 |
| How many hours per day do you use IP-based TV services? | 0-1 hours | 30 | 58.8 |
| | 1-3 hours | 17 | 33.3 |
| | 3-5 hours | 4 | 7.8 |
| How long have you been using IP-based TV services? | Never | 1 | 2.0 |
| | < 6 months | 4 | 7.8 |
| | 1 year | 2 | 3.9 |
| | 2-3 years | 10 | 19.6 |
| | 3-5 years | 13 | 25.5 |
| | > 5 years | 21 | 41.2 |
| Prefered IP-based TV services | Set-top box IPTV | 15 | 29.4 |
| | WebTV / Internet TV | 43 | 84.3 |
| | TV Apps or softwares | 16 | 31.4 |

## 3.2 Context Influence on Content Selection

The first question that we analyze in the questionnaire tries to capture the temporal changes in users' interests for specific types of content: *"What kind of programs would you prefer watching a) in the morning, b) during a break at daily work, c) in the evening and d) on weekends?"* As presented in Figure 1, twelve basic genres of TV content were listed as choices for each of the four categorical time periods. In line with the intuitive reasoning, we observe the following trends: i) weather report and daily news seem to be favorable choices in the morning or during a break at work, when people usually spend much less time watching TV; ii) similarly, during a break at work, those relatively short TV content such as daily news, sport, music and entertainment content are usually consumed; iii) users' preference in the evening and on weekends show very similar behavior, with the comparatively longer programs such as movies, TV series and documentaries outweighing other content types. Despite of the resemblances to some TV company strategies, users' intuitive choices still make these trends worthy of being referred to when recommending, especially for VoD services.
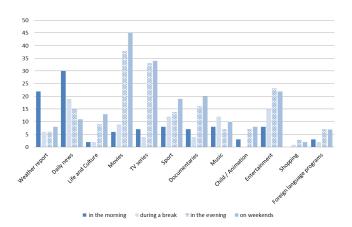


Figure 1: Users' Choices on Program Categories

The next question that we cover is on the user's direct opinion on a more limited set of recommendation types given to them in a set of changing contexts regarding time and location: *"Consider three types of content recommendations provided to you at the same time (habitual content at this time, breaking news or events happening just now, friends' instant suggestions). In each of the contexts (at home in the morning; at work hours during a break; at home in the evening; on weekends), which of those recommended contents are you most likely to choose for watching?"* As depicted in Figure 2, the users seem to be much more interested in hearing about breaking news and events during work hours or in the morning at home, similar to the earlier question's result. Conversely, the habitual content or friends' suggestions become much more favorable in the evening or on weekends. In other

words, the influence of contextual factors as breaking news and social company on users' preference may change with alterations in certain contexts as time and location.

In addition to supporting the existence of contextual factors' influence on TV content selection or recommendations, which can be turned out from the first question's result, the second question's result also provides an interesting insight on contextual factors' mutual influence, when we consider the breaking news and social effects as contextual factors.
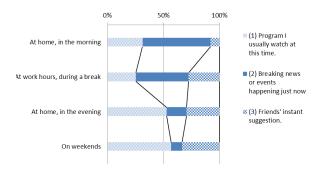


Figure 2: Contextual Factors' Influence on Recommendation Type

## 3.3 Users' Perspective on the Importance of Contextual Factors

Aiming to study the importance of these contextual factors from the individual users' points of view, we posed the following question: "*How important is each of the following factors regarding their influence on your own (subjective) choice of TV programs recommended?*" Participants were then asked to assess the importance of the four factors (*Time*, *Location*, *Social company* and *External breaking events*), in addition to the option of using their standard user profile (based on daily viewing habits). The assessment was based on a five-point likert scale, ranging from "*1-Not important, 2-Somewhat important, 3-Can't decide, 4-Important, 5-Very important*".

Figure 3 depicts the distribution of the respondents' ratings. Intuitively, scores for each factor's importance are relatively evenly distributed in the five-point likert scale. Considering the average score for each factor's importance (*Daily Viewing Habit*: 2.78, *Time*: 2.98, *Location*: 3.39, *Social company*: 3.25 and *External breaking events*: 3.29), location is viewed among respondents as the one factor having slightly more influence than others on TV content selection, although there is no clear winner. Obviously, there is no evident preference for any specific contextual factor from a general view. When analyzing the sample standard
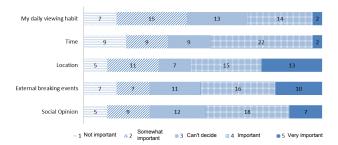


Figure 3: Users' Scoring Distribution on Contextual Factors' Importance

deviation for each of the factor's ratings (*Daily viewing habit*: 1.12, *Time*: 1.22, *Location*: 1.34, *Social company*: 1.20 and *External breaking event*: 1.32), we observe the largest variation also for *Location*, although the difference among the four factors are again not so significant. These spread distributions (according to Chebyshev's rule, there will be at least 3/4 of the data within 2 standard deviations of the mean and at least 8/9 of the data within 3 standard deviations of the mean) illustrate that there is no strong and unified tendency towards the valued importance of specific contextual factors. Moreover, it seems that the contextual factors' influences are valued differently by the users, and that there is no specific contextual factor that is equally important for everyone. This further supports the existence of individual difference when considering the importance of specific contextual factors, which differs from the usual overall consistent treatment of them.

We then compute the Pearson Correlation Coefficient for each pair of the given factors based on respondents' ratings, as given in Figure 4. The fact that the correlation between any two factors turns out to be quite weak indicates that a user's interpretation of each factor's influence level may be independent on their evaluation of the other factors.
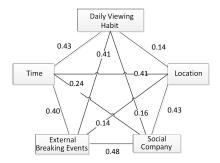


Figure 4: Pearson Correlation Coefficient of Different Pair of Factors

## 3.4 Subjective Responses

We also provided two free-text style opinion questions in the questionnaire to gain additional user insight on the assessment of IP-based TV services and contextual factors.

> *Q1: From your point of view, what features should a perfect IP-based TV service offer?*

> *Q2: What other contextual factors may influence your decision to follow a certain program on IP-based TV services?*

Even though these questions did not have any prescribed options for the answers, the responses have shown some natural clustering around a few concepts.

For *Q1*, several respondents explicitly referred to the contextual factors *External breaking news and events* and *Social company* as requirements for an ideal IP-based TV service. In addition, more variety in content, less advertisement, free of charge service, and a clear and fast UI were also suggested. Responses to *Q2* supplemented influential contextual factors with some inspiring comments. Some claimed that the status of "busy or not" would play a central role in users' preferred type and length of TV content, and others suggested *mood* as an independent contextual factor. As implicit factors though, "busy or not" and "mood" can not be so easily detected from existing datasets. Therefore, any clue that can help deduce users' such status would be quite valuable. Some respondents also indicated that the quality of TV programs is of importance. Comprehensive factors such as players, guests, theme were all referred to as quality evaluation indicators on programs, which are already well studied and integrated in most recommendation systems.

# 4 Focus Group Discussion

In order to further find out users' personal usage experiences and remedy their unavoidable misunderstandings of objective questions, we invited participants of our questionnaire to join a focus group discussion. Eight respondents were able to participate in the discussion session. In this section, we label these participants as *P1* to *P8* to share some of their valuable ideas.

## 4.1 Discussion on Contextual Factors

Considering the main purpose of the work in this paper, participants' opinions on contextual factors were undoubtedly the main focus group discussion.

### 4.1.1 Time and Location vs. "Busy or Not"

Contextual factors of time and location were always referred together. Participant 3 (*P3*) started by comparing them as follows: "Location means more than timing in my case. I only watch program through internet at home. Whenever in the office, I'll be busy with my work and won't open any TV related applications." Along the same lines, *P1* expressed his view as: "Whether I'm working or on vacation will result differently on my willingness to accept recommendations. For me, time of the day, day of the week can regularly determine my status of busy or not and thereby drive my choices." *P6* shared a different perspective from her own experience: "Whenever it is or wherever I am, if I am using IP-based TV services for recreation, it means I have time and will enjoy the content I'm interested in; so both time and location factors won't influence that much."

Concluding from these statements, we argue that "busy or not" might be a decisive factor for users' choices when watching TV content, while the directly measurable contextual factors time and location are less important but might be clues to figure out users' status of "busy or not".

### 4.1.2 Comments on Social Company

When the topic moved on to *social company*, *P2* and *P8* have shown strong interest by expressing that it is always a great experience to exchange thoughts with friends on the programs of common interest, and that they always get great suggestions from friends. *P2* mentioned the more concrete case of watching soccer games while discussing and sharing opinions with friends. Yet, on the totally opposite side, *P3* complained, "I really hate being bothered by others; I just would like to be immersed in my own interested programs alone." These statements illustrate that content categories and occasions should be carefully considered when providing social-based recommendation.

### 4.1.3 Being Cautious with Breaking News and Events

As to the newly proposed contextual factor of breaking news and events, *P8* stated, "I feel disturbed when small windows pop-up to remind me of some so-called 'news', unless they are really appealing to me." *P7* supported this with: "I routinely view news from the news websites; I don't think it's necessary to get recommendation from a TV application with respect to news again." Just as the participants warned, TV recommenders should be extra cautious in the way they select and notify their users of breaking news and events. Otherwise the recommendation could be more annoying than appealing, no matter how important it is.

## 4.2 Other Points of Discussion

Aside from the intended discussion on proposed contextual factors, there were other points initiated by participants.

### 4.2.1 Users' Sensitivity to Content Quality

Opinions on popularity and quality of TV content, as appeared in subjective responses of the questionnaire, were proposed again in the focus group. *P4* stated, "Popularity is a useful reference when I choose TV content, while it won't work sometimes since content's popularity can't directly determine its quality." *P2* continued, "I also found that some so-called popular TV content are pushed in front of us only due to commercial reasons rather than users' preference." Apparently, users are more sensitive to TV content's quality now than ever before, and they won't be satisfied with just the popularity statistics. Thus distinguishing high quality content would be quite an important aspect for recommenders.

### 4.2.2 Bookmarking also Implies Success for Recommendations

Another unexpected acquirement from the focus group was users' supplementary view on recommender's effectiveness. *P1* said, "When I don't have time to watch TV content that was correctly recommended, I'll bookmark it and watch it later on." *P2* commented similarly: "I also have the same habit of bookmarking pages when I use WebTV; it is quite convenient." Evidently, apart from users' instant positive reaction to recommendations, such as clicking or watching duration, the behavior of bookmarking can also be a representative indicator for a recommender's success.

## 5 Conclusion and Future Work

In this paper, we analyzed the role of common contextual factors that are usually applied to recommend content to users of IP-based TV services. We addressed this question from the perspective of the consumers, i.e., we asked for their opinions in an online questionnaire and a succeeding focus group discussion. We conclude from our samples that i) contextual factors' influence and their interplay indeed exist; ii) users' attitudes toward contextual factors' influence are individually different, which refutes traditional contextual factors' treatments of modeling them separately or incorporating them equally on every individual. At the same time, users' new suggestions on contextual factors such as "busy or not" and mood, their advanced cognition of TV content's quality and their taboos of being interrupted by dull recommendations are all factors that should be studied further.

In accordance with the guides and insights turned out by this paper, our next step is to design and develop a context-adaptive recommender system for our own IP-based TV service that incorporates these factors.

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