Don't Leave – Combining Sensing Technology and Second Screens to Enhance the User Experience with TV Content

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ABSTRACT

In this paper we explore how the use of sensing technologies can enhance people's experience during perceiving TV content. The work is motivated by an increasing number of sensors (such as Kinect) that find their way into living rooms. Such sensors allow the behavior of viewers to be analyzed, hence providing the opportunity to instantly react to this behavior. The particular idea we explore in our work is how a second screen app triggered by the viewer's behavior can be designed to make them re-engage with the TV content. At the outset of our work we conducted a survey (N=411) to assess viewers' activities while watching TV. Based on the findings we implemented a Kinect-based system to detect these activities and connected it with a playful second screen app. We then conducted a field evaluation (N=20) where we compared (a) four hints to direct users' attention to the second screen app and (b) four types of second screen content requiring different levels of engagement. We conclude with implications for both practitioners and researchers concerned with interactive TV.

Author Keywords

Interactive TV; User Behavior; Kinect; advertisements;

ACM Classification Keywords

H.5.2. User Interfaces: Screen Design; H.5.1. Multimedia Information Systems: Video

INTRODUCTION

TV has come a long way from being a family event for many years to a medium that many people today consume alone [14]. During the last 20 years, the number of people watching alone has doubled. Yet, smart TVs are growing in popularity (over 50% market penetration as of today [8]), indicating that the living room's couch is still the prime spot to watch TV. As of 2015, 73% of the generation X and 55% of millennials are watching TV on a TV [11].

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Figure 1. We address the challenge of re-engaging users as they direct their attention away from TV content, for example to interact with their mobile device or to get something to eat/drink during commercial breaks. We implemented a system that allows such activities to be recognized from Kinect data and to react to them by means of a second screen application. We compare the effectiveness of different visual hints and examine how their degree of engagement impacts on user behavior.

At the same time, our TV viewing behavior changed considerably. On one hand, TV watching is in many cases not constrained anymore to one TV in the living room – rather, people often have TVs also in their bedroom, the kitchen, or even their bathroom – and, on the other hand, the viewer's attention easily shifts away from the screen, not only as people get something to eat or drink during commercial breaks, but mainly as they attend to their mobile devices, for example, reading and replying to instant messages (WhatsApp, etc.).

There is an undisputed need to find ways as to how such changes in behavior can be accounted for. In particular, sensing technologies that are increasingly finding their way into living rooms (for example, Microsoft Kinect or cameras integrated with TVs) create novel opportunities by allowing the current behavior of the viewer to be sensed, analyzed and reacted to. For example, systems could try to direct viewers' attention back to the TV or, as content gets more personalized, to instantly adapt the content to user behavior, such as providing a brief summary of content viewers potentially missed as soon as they direct their attention back to the screen.

In this work, we present a system that allows the behavior of users in front of a TV to be analyzed by means of a Microsoft Kinect. We then show how this information can be exploited in a particular use case, that is a second screen app trying to make the user re-engage with the actual TV content.

In recent years, second screen applications have become a popular means to prevent users from engaging in other activities [2]. According to the MyScreens study [7], 74% of all TV viewers were using a second screen as of 2015. They direct their visual attention to apps about 30% of the time in general [6] and about 90% of the time during commercial breaks. With 47%, the smart phone is the most used second screen, followed by the laptop (38%) and the tablet (20%) [7].

However, previous work showed that second screen apps may draw more of the viewer's attention away from the screen than desired [3, 5, 9, 10]. The reason for this is that much prior work focused on how second screen apps could be better integrated with the TV content rather than putting the user into focus. For example, Schroeter et al. [12] showed how certain content (ads, shows) can be detected in real-time to immediately show fitting content on the second screen. Basapur proposed to synchronize content updates on second screens based on the viewer's social circle [1]. And Weber et al. investigated how to embed notifications with smart TVs [15]. As sensing technologies enables a real-time assessment of user behavior, we can add a new quality to second screens. In contrast to previous work, we detect when viewers direct their attention away from the screen and only then try to re-engage them.

CONTRIBUTION STATEMENT

The contribution of this work is threefold. First, we conducted a *survey* (N=411) to obtain an understanding of viewers' activities while watching TV. Second, we then implemented a Kinect-based *system* that is able to detect these activities in real time. Third, we *showcase* how a second screen app can benefit from this knowledge. We report on the implementation of the app and present results from a field study (N=20) in which we deployed our system in users' homes. We compared (a) the ability of different visual triggers to re-engage viewers, as well as (b) various types of content that require different levels of engagement.

Our findings are relevant for researchers and practitioners working on interactive TV systems that take viewers' behavior into account in general, as well as for designers of second screen apps which aim to re-engage viewers in particular.

OBJECTIVE AND METHODOLOGY

The main objective of our work is to understand how viewers' behavior while perceiving TV content can be determined and how this knowledge be used for different purposes, including but not limited to enhancing the viewing experience as well as increasing exposure of content by making viewers re-engage as they turn away attention. As a result, both viewers as well as content providers can benefit from this approach. With our work we hope to support research primarily concerned with the considerable change in TV viewing behavior over the past decades and how to account for it.

Our research consists of multiple steps. At the outset, we conducted a survey with the main goal of understanding how people watch TV today and, in particular, in which activities they engage while doing so. From this we obtained a broad set of activities, which we aimed to detect in the second step. Therefore, we implemented a system, capable of determining the viewers' activities by means of a Microsoft Kinect. The third and final step of our research was to demonstrate how the ability to determine a viewer's behavior can be exploited. While our use case here is a second screen app that tries to re-engage users as they shift their attention away from the screen by means of interactive content, we would like to stress, that there are many more use cases that can benefit from this approach, some of which are discussed in the future work section at the end of this paper.

ONLINE SURVEY: UNDERSTANDING VIEWER BEHAVIOR

At the outset of our work we conducted an online survey to assess user behavior while watching TV and using second screens. The survey contained 36 questions grouped into four categories (demographics, second screen usage, behavior while watching TV, behavior during commercial breaks).

Recruiting

We recruited participants through University mailing lists and in social media groups. Three 30 Euro Amazon vouchers were raffled among all participants. During two weeks, 557 persons participated in the survey – 411 surveys were completed until the end and considered for further analyses.

Results

Participants (42% female) had a mean age of 27 years (range: 13-68). Most were students (67.9%) and employees (13.2%).

The majority of participants (75.7%) aged 14 to 49 stated to *watch TV alone* occasionally to very often. Participants also watch TV with their partner (56.7%), with their family (46.1%) and with their friends (31.3%).

Among participants aged 14 to 29, 79.1% of male and 85.0% of female participants use a *second screen* while watching TV. With 84.8% the smartphone is the most popular device among both genders, followed by laptop (74.3%) and tablet (32.6%). A Mann-Whitney U test shows that participants using a second screen spend significantly more time watching TV than participants who do not (+37 minutes on weekdays, +67 minutes on weekends), $U = 7683.00$, $p = 0.001$, $r = -0.16$.

Usage of second screen apps is highest during a commercial break (74%). Regarding which apps were used, the younger generation (aged 14 to 29, N=267) prefers communication with friends while consumers over 30 years (N=64) favor surfing the internet and searching for general information.

Almost every second participant (47.2%) stated to play on the smartphone – mainly for pastime (95.4%), because it is fun to play (91.2%), and because they like competing with friends (33.0%). Top-ranked apps are quiz and knowledge games played by 70% of all participants, followed by brain games (60%),strategic games (49%), and skill games (46%).

During a commercial, most participants stated to use their second device (86.3%), followed by switching to another TV channel but switching back (85.4%) or doing other things not related to the TV or second screen (82.8%). Participants not using a second screen mainly do things unrelated to the TV program (73.2%), followed by switching to another TV channel but switching back (62.49%) and switching to another TV channel and not switching back (42.9%).

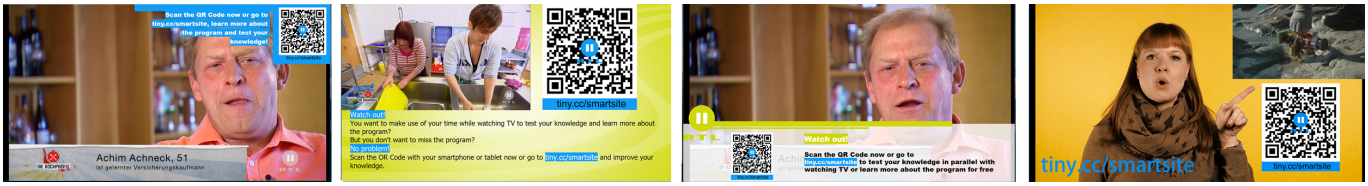

Figure 2. Hints in the study: we used three textual hints (bandage, slider, split screen) and a spoken tutorial. Each hint provided a brief description of the second screen app as well as a QR code and a URL for accessing the content.

Feedback from participants showed that non TV related activities during a commercial break include doing the household (41.8%), going to the bathroom (46.2%) getting something to drink or do some cooking (53.6%). Very few learned, read, called somebody, or listened to music (<5%).

People using a second screen keep in touch with friends through social media (63.4%), read or write emails (27.1%) play games (17.9%) or browse the internet for general information (14.4%). Only few people call somebody, work or learn, do online-shopping or listen to music.

Summary

Through the survey we identified a list of activities that ought to be recognized as interactive TV systems should react to viewer behavior. This includes (1) leaning forward to grab a phone, (2) looking away from the TV (e.g., to the phone), and (3) standing up to get something to eat/drink. As will be described in the following sections we used these activities as requirements for our behavior analysis tool.

In addition, we learned that the use of smartphones as second screen is particularly popular and that the majority of people favor playful apps. Hence, we focus our investigation on a use case including a playful second screen app.

VIEWER BEHAVIOR ANALYSIS & SECOND SCREEN APP

To investigate how TV can benefit from real-time knowledge on user behavior in the future, we first implemented a *behavior recognition* component that allows to detect when users shift their attention away from the screen by using a Microsoft Kinect. Our simple recognizer can determine the following behaviors: looking right/left/up/down, standing up, leaning forward/backward, grabbing something with the left/right hand, and looking at a smart device. Head direction and leaning forward/backward can be inferred from a comparison of the viewer's head angles, standing up is available from the Kinect SDK, and a custom implementation was used to recognize the other behaviors. The recognition was implemented in C#.

The second component we built allows for *embedding different hints with TV content* that are triggered as one of the aforementioned types of behavior is recognized. Note, that in general each behavior could trigger a different action. Triggers differ with regard to the amount of presented information, how information is presented, and where it is presented (see Figure 2). For the purpose of our work we implemented four triggers: in the *bandage* a hint is shown at the bottom of the screen in a distinct area overlaying the TV content. The *slider* is shown in the top-right corner of the screen with shorter text. For the *split screen* the TV content is scaled down and shown in the top-left corner. Hints are shown below the video. In contrast to the other triggers, in the *tutorial* information about the second screen app is presented by a speaker. Content is continued to be shown in the top-right corner of the screen. In the context of our work, we use the hints to make users aware of a second screen app. All hints depict a QR code as well as the URL to the second screen app. Hints are shown for 20 seconds.

The third component is a *second screen app*. This app enhances TV content [4] by showing information or questions that are synchronized and closely related with the TV program. Information can consist of different types of media, in our case text and images. Questions have different answer options and a time constraint. After having answered a question, the correct answer is displayed to the user. All questions, answering options and timestamps are received from a database. The application is realized with HTML5, CSS, JavaScript and responsive design. Figure 3 shows the different content types of the second screen app.

USER STUDY

The system described above forms the basis for a user study in which we investigated how people could be re-engaged with TV content by responding to their behavior. In particular, we were interested in 1) comparing different hints, as well as in 2) understanding design considerations for second screen apps used while watching TV. We decided to conduct a field study in participants' homes to ensure more natural behavior than under lab conditions. For example, this allowed participants to go to the toilet or to grab food – at home they are more likely to really stand up and leave the TV than in the lab.

TV and Second Screen App Content

For the study, we worked together with a national German TV station, who provided us with 60 minutes of professionally produced video content. Thus we increased the ecologic validity of our data. The program consisted of a cooking show and was interlaced with three 7-minute commercial blocks.

For the second screen app, we designed four different types of content. Hereby we followed Schulmeister's classification of interactivity levels of multimodal learning systems [13]. In particular, we distinguished non-interactive content and interactive content requiring different levels of engagement. The content took the form of background information or questions, all of which were related to the TV program (Figure 3).

Background Information in the form of short text provides additional information on the program. Such information could tell participants how many people are usually involved in shooting an episode of the cooking show (such as several authors, camera-men make-up artists, designers, editors, and cutters.)

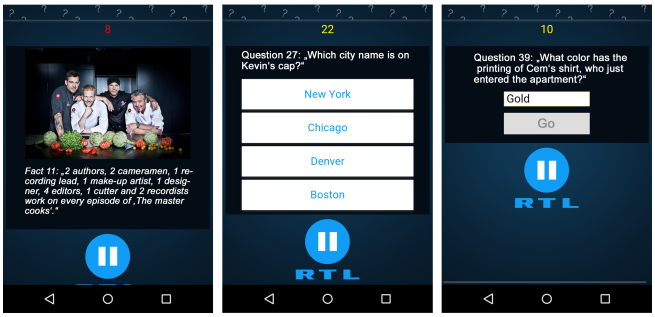

Figure 3. Second screen app content: information, yes/no question (not depicted), questions with four answer options, question with text input.

Yes/No Questions are also related to the current content. For example, users were asked whether or not they could imagine using a particular tool one of the cooks was using during the show for preparing their meals.

Multiple Choice Questions provide users multiple answer options, for example 'Which city name is on Kevin's (one of the cooks) cap? – New York, Chicago, Denver, or Boston?'.

Open Question require users to freely type text, hence requiring the highest level of engagement. An example question asked users on the color of one of the people's shirts.

Study Design

The study followed a repeated measures design with two independent variables – hints and required level of engagement. *Hints* capture the attention of the audience. We compared four hints described before: bandage, slider, tutorial, split screen. As a baseline we used a push notification sent to the participant's smart phone. *Engagement* was also compared on four levels, as described before: in addition to static program information (low engagement) we compared yes/no questions (moderate engagement), questions that included multiple, more complex answering options (high), and finally questions requiring free text (very high) (Figure 3).

As dependent variables we collected (1) number and duration of different activities; (2) number and duration of app use beyond the second screen app; (3) number, type and time of appearance of hints; (4) number of answered questions per question type; (5) when the second screen app was opened.

Setting & Procedure

Participants watched TV at home, sitting on a couch or chair in front of the TV screen with a small table being placed between seating and TV screen. The Kinect was placed right below the TV screen to capture the scene and participant. A laptop with the Kinect program was attached to the TV. Participants could place their smart phone or something to eat or drink on the table. We used the TV and second screen app content as described above.

As the researchers arrived at the participants' home they would first explain the purpose of the study. In particular we told them that a second screen app was to be tested during the study but not that the hints were triggered through their behavior. The second screen app was installed on the participant's phone. Furthermore, we told them that images would occasionally be taken by the Kinect but that they would have the opportunity to look through these immediately after the study and decide which to delete. After being instructed to watch TV in an accustomed manner, they signed a consent form.

After the instructions, participants were left alone and watched one hour of the pre-cut TV program. Afterwards the technical setting was removed while the participant was browsing through and potentially deleting pictures taken by the Kinect.

Then, participants answered a questionnaire. The questionnaire assessed the opinion of the participant on the second screen app and its content. In particular we wanted them to rate the following statements on a 4-Point Likert scale[1]: 'I would be motivated to use the second screen app again.' 'Perceiving the background information required a lot of effort. Responding to the {yes/no questions | multiple-choice questions | open questions} required a lot of effort.' 'Using the {yes/no questions | multiple-choice questions | open questions} was fun.' Furthermore, we asked them whether they considered the TV program to be attractive. Finally, we provided statements on the displayed hints: 'The {bandage | slides | split screen | tutorial | push notification} was easy to understand.' 'The {bandage | slides | split screen | tutorial | push notification} motivated me to use the second screen app.' 'The {bandage | slides | split screen | tutorial | push notification} was disturbing.' In addition, we conducted semi-structure interviews, assessing whether participants noted that the second screen app reacted to their behavior, whether they preferred accessing the second screen app using QR code or the URL, and asking them how our system could be further improved. Finally, each participant received a 15 Euro gift voucher.

Limitations

We are aware of several limitations of our study. Many homes have more than one TV (for example, in the living room, the bedroom, the kitchen, and even the bathroom). In this work we focused exclusively on TVs located in the living room. Future work could look into how user tracking could be realized for other locations, how user behavior is different, and which opportunities arise from the ability to track viewers across multiple TVs. Furthermore, our results may have been influenced by a novelty effect. Yet, we expect this to be minimal, since it was not apparent to participants that hints were triggered through their behavior and we were not primarily interested in how often the approach triggers a response from the participants. Then, participants' behavior may have been influenced by their awareness of being recorded via Kinect. Yet, we tried to minimize any potential bias by telling participants in the beginning about the opportunity to delete images immediately after the study. Finally, we only focused on single user interaction. Future work could take the interplay between second screen apps and multiple users into account.

Results

A total of 20 participants (iPhone and Android users) recruited through University mailing lists and from social networks took part in the study. On average, participants were 24.4 years (age range 15-46, 12 female). Eleven participants were students.

[1]We chose a 4-Point scale to minimize the central tendency bias.

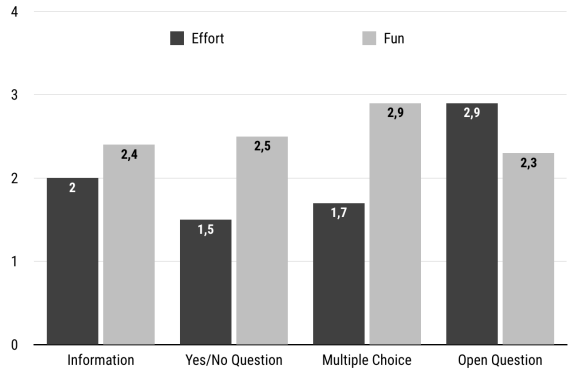

Figure 4. User rating of the second screen app content: Open questions were perceived to require more effort compared to the other types of content. Users liked multiple choice questions due to their high fun factor.

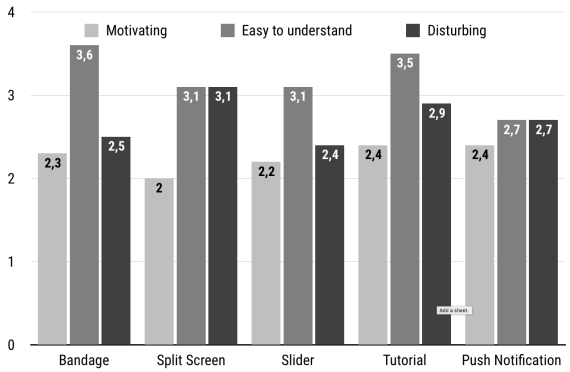

Figure 5. User rating of the hints: Bandage and tutorial were most easy to understand. Slider and bandage were perceived as least disturbing. Hints were perceived similarly with regard to motivation.

Detection Accuracy

Manual inspection revealed that in 264 of 304 cases, the behavior of participants was recognized correctly (87%). The remaining cases were a result of body postures being misinterpreted, mainly due to participants being positioned in a way such that the skeleton could not be detected properly.

Second Screen Application Usage

On average, participants with Android phones used the second screen app (N=13, M=1369.62 s, SD=272.72) longer than other applications (N=13, M=1045.38 s, SD=273.71) on the smartphone. Note, that this data cannot be logged on iPhones.

65% of the participants preferred the QR code compared to the URL. For seven participants it was very easy and for four it was rather easy to scan the QR code from the TV screen.

Perception of the Second Screen App & Content

Figure 4 shows the average rating for the second screen content. Overall, participants rated the second screen app to be fun to use (Mdn=3). Looking more closely at the results, we found the questions to be perceived more fun (Mdn=3) compared to the information (Mdn=2). With regard to the required effort, the open question was perceived as rather demanding (Mdn=3), whereas all other questions as well as the information were perceived as rather undemanding (Mdn=2). We found a significant correlation between the effort for answering a question and the fun factor for that type of question, R=-0.29, p <0.05. The higher the effort, the lower the fun factor was rated.

People who used the the second screen app more often than other apps (Mdn=3) rated the watched TV program significantly more attractive than participants who in the majority of cases used other apps (Mdn=1), U=6.00, s, r=-0.63.

Response to Hints

During the study none of the participants realised that the hints were triggered by their behavior. Neither did they consider them to be particularly disruptive. Being debriefed afterwards, two participants mentioned that they found it creepy that the system was capable of detecting their activities.

Following Geerts et al. who found discoverability to be crucial for second screen apps [5], each hint was accompanied by a short sound. 30% of participants stated that they didn't notice this sound whereas 45% fully agreed that the sound gained their attention. Visual inspection of the images revealed, that some of them, though they stated not to have noticed the sound, raised their head from looking at the smartphone and watched the screen. This suggests that the sound is an effective way to attract attention while not being too disturbing.

We were furthermore interested in how quickly participants responded to the hints. Hence, we looked at all cases, where a hint was shown for the first time. Participants who were shown the split screen as the first hint were fastest to open the second screen app (N=4, M= 83.5 s, SE=27.45 s). Slightly slower were the participants who were first shown the bandage (N=3, M=307.67 s, SE=58.46 s) and the slider (N=4, M=311.75 s, SE=26.07 s). Time was measured from when the hint was first displayed until the second screen app was opened first.

Figure 5 depicts the average ratings for the different hints. We did not find strong differences with regard to how *motivating* the hints were. Participants found the bandage and tutorial most easy to *understand* (Mdn=4), followed by split screen and slider (Mdn=3). As expected, push notifications were ranked lowest. Concerning *disturbance*, all hints that strongly affected the TV content (split screen, tutorial) as well as push notification were rated as rather disturbing (Mdn=3) whereas bandage and slider were rated as less disturbing (Mdn=2).

Influence on User Behavior

We reviewed the video material and log files to gather insights into people's behavior during a commercial break. Whereas 18 people watched the first block of commercials, only 12 did so for the third block. Likewise, also the number of people using the second screen app decreased between the first and third block of commercials. The second break was used by participants mainly to stand up and get something to eat or drink, whereas this was not the case for blocks one and three.

We observed several occasions (17) where participants used the second screen app during watching the program and continued using it during the break. In five cases, usage even lasted throughout the entire break into the next program. During all breaks about the same number of participants used the second screen to surf the internet while the number of persons who used our app increased each break. Continued use even in a break suggests that viewers were more engaged with the TV content than if they had left the room.

Qualitative Feedback

Two persons found the second screen app to be distracting while watching TV and two persons would have liked the information hints to be displayed longer. Four participants would have liked shorter time intervals between two questions.

DISCUSSION & LESSONS LEARNED

Our findings are relevant for both researchers and practitioners aiming at exploiting knowledge on user behavior in general as well as for using second screen apps that are strongly linked with the TV program in particular.

Assessment of User Behavior

Our work demonstrates that an assessment of viewers' behavior is a promising means to enhance the way we will watch TV in the future. From a technical perspective, we found that with *off-the-shelf devices* such an assessment is possible with high accuracy (in our case, behavior was correctly identified in 89% of all cases). As such devices are available in many viewers' homes or could be easily integrated in consumer TVs, we envision such approaches to find wider application in the near future. Challenges may arise from situations, such as users walking around while watching TV (e.g., as screens are located in the kitchen) or watching while lying in bed.

From a viewers' perspective there is a clear need to investigate *acceptance* of such a technology, since recording Kinect data in viewers' homes may be considered a severe invasion of privacy. In contrast to the use of microphones (for example, Amazon Alexa[2]) or cameras (as in many of Samsung's current TV models) which easily allow users to be identified and conversations to be tracked, we use skeleton data only which is neither buffered nor stored. Yet, viewers' privacy concerns need to be understood and taken seriously as such technologies find their way into our homes. Whereas some participants found the technology 'creepy', others seemed not to bother. Yet, the question remains to which degree users understand that an analysis of data from the Kinect's depth camera could be ultimately used to not only track behavior but to also identify people (for example, among other family members).

Beyond acceptance, there is also a need to investigate how much *control* viewers would want to have as their behavior is recorded and which *incentives or benefits* they would consider appropriate. Apart from the use case explored in this work, we envision that adaptations of (personalized) content that takes into account what users are currently doing and supports them in re-engaging could further leverage the potential of this approach.

Using Second Screen Apps to Re-engage Viewers

Our findings center around four important aspects: discoverability, disturbance, motivation, and ease of use.

One major challenge seems to be how to *introduce the second screen app*. The tutorial was both motivating and easy-to-understand. Furthermore, it led to users opening the second screen application quickly and was remembered well after the study. In particular the fact that no text had to be read on the screen seemed to facilitate participants' willingness to access the app. In contrast, the bandage was perceived to be less *disturbing*, yet understandable. We conclude, that to introduce the second screen app, a tutorial is clearly advisable. Once users saw the tutorial, less disturbing hints could be used – yet a balance needs to be striven between too subtle hints that are potentially overlooked and too prominent hints. To then access the app, participants preferred the QR code compared to the URL. Yet, to not exclude people without an installed QR code scanner, it is advisable to show both options. It turned out that displaying the QR code for 30 seconds was a good choice.

We found that no hint stood out with regard to motivating the use of the app. This may well be a result of the study situation, since users knew the app was under investigation. Future work should more closely investigate means to increase viewers' *motivation* to use the app, for example through benefits such as the opportunity to download the current sound track.

Our second screen app, in particular the questions, was well received by participants due to its *fun* factor and its ability to increase the attractiveness of the TV program. At the same time, perceived *effort* is crucial: free text answers required a lot of effort and were hence perceived to be less fun compared to the other types of questions. Participants also liked the informative text. Our findings suggest that second screen applications should offer a mixture of interactive and non-interactive content. For answers in quizzes, immediate feedback should be provided. The time between two content pieces should not be too long (e.g., max. 30 seconds), since else viewers are likely to again direct their attention away.

CONCLUSION AND FUTURE WORK

In this paper we showed how future interactive TV applications could make use of knowledge on TV viewers' behavior. In particular, we demonstrated how to leverage this knowledge to re-engage viewers in front of the TV by means of a second screen app. Our findings revealed that the way hints are presented impacts on how quickly users access the second screen app, and how understandable and motivating the concept is. Furthermore, we found that whereas too engaging tasks should be avoided, people liked a mixtures of content requiring different levels of engagement.

We see a lot of opportunities for future research, including a long-term deployment and evaluation of the system as well as an extension to multi-device and multi-user scenarios. Furthermore, additional sensors could be included (for example, physiological sensors) to obtain more fine-grained information not only on the viewers' behavior but also on their state (Where do they focus their attention? Which content did they perceive? What is their current emotion?). This, finally, provides opportunities for further use cases and applications that adapt to the viewers and their context. As a result, the TV watching experience could be further enhanced. For example, systems could adjust the presentation of content in a way, such that important information (e.g., news a viewer is particularly interested in) is presented in phases of high attention. Or content could be better tailored to the viewers' behavior, such as pausing content as they temporarily engage in other activities or providing a brief summary of what happened in a plot or during a sports events as users briefly left the TV.

[2]http://alexa.amazon.com

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REFERENCES

1. Santosh Basapur, Hiren Mandalia, Shirley Chaysinh, Young Lee, Narayanan Venkitaraman, and Crysta Metcalf. 2012. FANFEEDS: Evaluation of Socially Generated Information Feed on Second Screen As a TV Show Companion. In *Proceedings of the 10th European Conference on Interactive Tv and Video (EuroiTV '12)*. ACM, New York, NY, USA, 87–96. DOI: http://dx.doi.org/10.1145/2325616.2325636
2. E. D'heer C. Courtois. Second Screen Applications and Tablet Users : Constellation , Awareness, Experience , and Interest. In *Proceedings of the 10th European Conference on Interactive Tv and Video*.
3. J. Castillo. 2013. The Rise of the Second Screen: Zeebox, GetGlue, Viggle, and More. StreamingMedia. (2013). http://www.streamingmedia.com/Articles/Editorial/Featured-Articles/The-Rise-of-the-Second-Screen\-Zeebox-GetGlue-Viggle-and-More-89008.aspx
4. Pablo Cesar, Dick CA Bulterman, and AJ Jansen. 2008. Usages of the secondary screen in an interactive television environment: Control, enrich, share, and transfer television content. In *European Conference on Interactive Television*. Springer, 168–177.
5. David Geerts, Rinze Leenheer, Dirk De Grooff, Joost Negenman, and Susanne Heijstraten. 2014. In Front of and Behind the Second Screen: Viewer and Producer Perspectives on a Companion App. In *Proceedings of the 2014 ACM International Conference on Interactive Experiences for TV and Online Video (TVX '14)*. ACM, New York, NY, USA, 95–102. DOI: http://dx.doi.org/10.1145/2602299.2602312
6. Michael E. Holmes, Sheree Josephson, and Ryan E. Carney. 2012. Visual Attention to Television Programs with a Second-screen Application. In *Proceedings of the Symposium on Eye Tracking Research and Applications (ETRA '12)*. ACM, New York, NY, USA, 397–400. DOI: http://dx.doi.org/10.1145/2168556.2168646
7. initiative. 2015. My Screen 2014/02. initiativeMedia. (February 2015). http://www.initiative-media.de/initiative-studie-my-screens-ii-zur-parallelnutzung\-von-tv-und-zweitbildschirmen/
8. Michelle Jones. 2016. How Netflix Is Changing Our TV-Watching Behaviors. ValueWalk. (June 2016). http://www.valuewalk.com/2015/06/how-netflix-is-changing-our-tv-watching-behaviors/
9. Jan Kallenbach, Silja Narhi, and Pirkko Oittinen. 2007. Effects of Extra Information on TV Viewers' Visual Attention, Message Processing Ability, and Cognitive Workload. *Comput. Entertain.* 5, 2, Article 8 (April 2007). DOI:http://dx.doi.org/10.1145/1279540.1279548
10. Timothy Neate, Matt Jones, and Michael Evans. 2015. Mediating Attention for Second Screen Companion Content. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, USA, 3103–3106. DOI: http://dx.doi.org/10.1145/2702123.2702278
11. Lara O'Reilly. 2015. Most Young People Say They Have Stopped Watching TV. BusinessInsider. (Jan 2015). http://www.businessinsider.com/forrester-video-and-tv-consumption-report-2015-1?IR=T
12. A. Schroeter. 2015. So vernetzen Sie TV-Werbung effizient mit dem Second Screen. W&V. (April 2015). http://www.wuv.de/medien/so_vernetzen_sie_tv_werbung_effizient_mit_dem_second_screen
13. Rolf Schulmeister. 2005. Interaktivitaet in Multimedia-Anwendungen. (2005). https://www.e-teaching.org/didaktik/gestaltung/interaktiv/InteraktivitaetSchulmeister.pdf
14. Flint Stephens. 2016. Women or men, young or old: Who really watches the most TV. KTAR News. (May 2016). http://ktar.com/story/724853/women-or-men-young\-or-old-who-really-watches-the-most-tv/
15. Dominik Weber, Sven Mayer, Alexandra Voit, Rodrigo Ventura Fierro, and Niels Henze. 2016. Design Guidelines for Notifications on Smart TVs. In *Proceedings of the ACM International Conference on Interactive Experiences for TV and Online Video (TVX '16)*. ACM, New York, NY, USA, 13–24. DOI: http://dx.doi.org/10.1145/2932206.2932212