Enhancing Interactive Television News

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ABSTRACT

A prototype system for interactive television news is described. It supports the full production cycle for interactive news, including assembly of clips into stories and stories into newscasts. A variety of interactive techniques are offered to the viewer. These include expressing likes and dislikes of headlines, skipping out of stories, requesting additional content and selection of stories from a menu. This system was deployed into homes for two weeks using fresh television content. User control events were logged and evaluated to understand interactive viewing behavior.

Author Keywords
Interactive Television; Television News; Network Video;

ACM Classification Keywords
H.5.1 Multimedia Information Systems

INTRODUCTION

This paper describes an interactive television news service that was delivered over the network into the homes of test users. This is the second such trial that we have performed. In the first effort [10] it was clear the people liked and used the interactivity. However, a variety of failings were identified. We completely redesigned the system to address these challenges. In this paper we report our response to earlier insights and the resulting behavior when actually used in homes. We have also redone the production process to exploit the capabilities of internet television.

The system we will describe here provides interactivity in three basic ways:

1. Story-by-story choice of what to watch
2. Ability to skip out of a story at any time
3. Ability to dive deeper into additional material on a particular topic

With a technology such as interactive television, a laboratory experiment is not appropriate. Television is engaged with the way people live. In particular, television news must be fresh in order to realistically engage viewers.

Because of these requirements, in-home deployments of such systems are highly important to user interface design experimentation. In this work, we deployed into 10 homes and logged the viewers' interactive behavior. The results are formative rather than summative but provide important insights into the structure of such interactive systems.

We have pursued two key questions:

1. What software architecture is required to produce an interactive newscast? News is not only interactively consumed but must be realistically produced.
2. What are the interactive usage patterns during viewing? Previously, viewers made little use of the additional material we provided. In this work, we have tried different interaction techniques and produced much higher utilization.

An additional question for interactive television is revenue. We largely ignored this issue. We removed all advertising from our experiments. We did, however, assume that longer viewing time would mean more revenue either in advertising or in subscription shares.

PREVIOUS WORK

There have been a variety of studies that have shown that television and the Internet are converging [5]. Studies show that there is significant consumer interest in more interactive television experiences [11].

News interaction as an algorithm

Informedia [3] pioneered an approach that framed the news experience as an information retrieval problem. Their work was focused on extracting appropriate information from a variety of sources that could be used to retrieve video for user consumption.

Similarly, the MyInfo[13] project used speech recognition, closed captions and features extracted from the video itself to automatically segment a newscast into stories. Based on their recognition algorithms, they would perform web searches to find additional material to augment the story. The user interacts with this system by selecting materials from a play list.

In a similar vein, the MyNewsMyWay[6] project used a profile of viewer interests. The system would then match the profile against news stories to select what was viewed. From the point of view of news producers there is little control of the experience or the story. It is simply a matter of adding tags for the algorithms to exploit. The "News at Seven" project [xx] also provides algorithms for generating the news.

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There are many examples of technologies which automatically or semi-automatically process video to produce an experience that provides a viewer with a choice of what to watch. Image processing and video technology proceedings are full of such papers. We have three problems with this algorithmic approach.

The first is that many of these systems assume that news lives in a historical database as simple video files. Real news is fresh. It is current. It is about what is happening in the world now. That is why it is called the news. Secondly, there is no need for automated segmentation of a newscast. The news is created in segments. It is only assembled as a whole at the last minute when broadcast. Rather than use unreliable recognition problems on assembled newscasts we modified the news production process to capture segmentation at the source. Lastly, the news is a human-to-human experience. Viewers develop para-social relationships with newscasters [4]. It is a process of news professionals gathering, filtering, summarizing and humanizing the facts of the world [1]. Algorithms do not do this well.

Interactive video

The BBC [8] introduced a limited form of interactive video using standard broadcast channels. The Red Button on their remote control allows them to skip among a fixed number of different news feeds.

A notable attempt to move away from algorithms and into a more creative and interactive model is Hyper-Hitchcock [2]. In this system the user is presented with a timeline of the current video. Below the timeline, viewers are shown thumbnails of other linked videos that are related to that portion of the core video. The essential idea is hyperlinking sections of a video to other video. The Hyper-Hitchcock approach is very general in its applicability but not focused specifically on the news experience. It did, however, strongly influence our work.

Our previous experiment

The work reported in this paper is an outgrowth of [10]. In the prior work, a major local news station was recruited and consented to modify their news production processes for one week. The body of the interactive news was a sequence of stories ordered by the headline responses. While watching, the primary control was to skip out of a story early and move on to the next story. In addition, viewers had access to a play list of all of the stories so that they could select what they wanted directly. On stories for which additional material was provided, a label would appear in the upper left corner of the screen indicating the presence of additional material. The viewer could then select to watch this material.

The production system worked well and did not impede the newsroom processes. Reporters were somewhat reluctant to spend much effort on creating the additional material. They were supportive of the experiment but did not see this as part of their job. This resulted in only 21% of the stories having any additional material and some of the material was of low quality.

We deployed computers running our viewer software into 10 homes and recorded their interactive behavior. The interactive viewing mechanism was a success and is reused in this experiment. Users performed some form of news navigation every 79 seconds on average, which indicated a high level of engagement. The most common form of interaction was to skip to the next story.

The use of additional story content was very low. We believed that this was due to:

- relative rarity of additional content,
- low quality of some of the content,
- the label indicating the content was easily missed
- the whole idea of additional content is unexpected

PROJECT STRATEGY

In this project, we wanted to explore new ways to get viewers to watch additional content. Watching extra news content is important not only because we believe it enriches the viewer's experience but for financial reasons. If the primary interactive behavior is for viewers to skip over news content, then the total news viewing time is reduced. In most revenue models, lower viewing time means lower income. Lower viewing time means watching less advertising. In subscription systems, lower viewing time means a smaller share of the subscription income.

In this project we addressed two main issues. The first was to create a deeper, richer and more collaborative model for interactive news production. The second was to increase the amount of additional material that was viewed. To achieve this we wanted to greatly enrich the quantity and kind of additional material. The reporter-generated material is still possible in our new system, but we focused on two other kinds of material: stories from competitive news programs and historical material. Because the video lives on a server, all of the prior news stories can be stored and made available. If a particular dictator is being toppled today, there are probably previous stories on that country and that individual.

Our key production contributions are 1) new sources and styles of interactive content to draw viewers into that content and 2) a more open and collaborative model for acquiring news content for delivery.

SYSTEM ARCHITECTURE

The news production workflow is shown in Figure 1. Video feeds come from a variety of sources including reporters, competitors, contributing newsmakers or others. This reflects more of the way newscasts are currently assembled than the way in which they are presented.

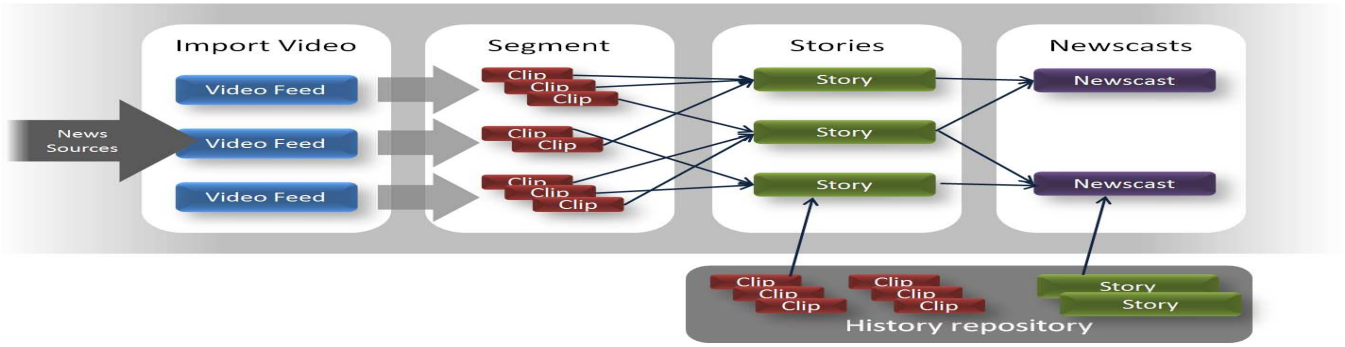

Figure 1 – Newscast production flow

Segmentation

Video feeds are segmented into clips, which consist of a video feed and a start and end point within that feed. Video can be chopped into many clips to be used for a variety of purposes. Clips may also overlap because the video is not actually cut.

Stories and newscasts

Clips are then assembled into stories and stories are assembled into newscasts. The assembly of stories and newscasts are where newscasters exert their creative influence. They can add clips from their own video feeds and juxtaposition various viewpoints when creating a coherent story. The collection of stories into newscasts creates a particular view of today's world.

If the video feed and clip databases are generally available under suitable revenue sharing terms, it now becomes possible for a newscaster to have no news reporting staff at all. A possible newscaster role would be to select and interpret from material made available by others. News based on a large (possibly national or international) news repository rather than video tape and broadcast channels can radically change the way television news is crafted. This contributory model for assembling the news is sharply different from our previous newscast-centric approach.

The contributory model also supports freelance reporters who follow particular interests or regions. They can make contributions to the database of stories from which newscasters can select what they will show and what they will emphasize.

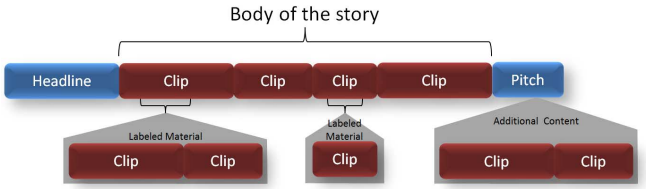

Figure 2 – News story structure

Figure 2 shows the basic structure of a story. The body of the story is composed of a sequence of clips to be played one right after the other. The presence of clips is invisible to the viewer. It just feels like one story. However, to the production team, the assembly from clips is a basic production technique that is currently used in professional news organizations. At the beginning of a story is an optional headline clip. This is played (typically at the beginning of the newscast) to advertise the story and solicit interest. This mirrors the "tease tracks" of most professional newscasts.

There are an optional number of labeled segments that can be attached to a story. The label is descriptive text that is shown to the viewer to invite them to watch some additional material. The label is associated with a time range in the story. The additional material is a sequence of clips. These labels form prompts for the viewer to select additional material.

At the end of the story is an optional pitch clip. The pitch clip is a short segment of video that invites the viewer to watch some additional material. This is new for this system. It mirrors what one sees in many newscasts today where the news anchors will describe additional material and tell viewers that they can reach this material at the news station's web-site. One of our hypotheses was that actively inviting viewers to watch the new material would be more effective than an unobtrusive label.

A story is essentially a data structure which can be created by the production software and traversed by the viewer software.

NEWS PRODUCTION

Our news production tools are web-based with the video stored in the cloud. We used Windows Azure [7] to provide the streaming service. Production of the news is relatively straightforward. Video feeds are uploaded from various sources and transcoded for streaming. At the time of upload, metadata is entered describing the feed's source and subject matter. From there three interleaved processes are used to assemble a news cast.

- Feeds are cut into clips
- Clips are assembled into stories

• Stories are assembled into newscasts

Though Figure 1 shows a sequential process, real news production is asynchronous and iterative. Production of a coherent story may require the adjustment of clip length as well as the acquisition of other material. Production of a particular newscast may require simplifying, extending or creating new stories to fit the overall structure of a particular newscast. Assembly of basic story elements might be followed by news anchors recording introductions and connective commentary to stitch a story together.

Story construction is timeline based. Clips are dropped into the timeline in the order they should appear. This is the most creative part of the news production process. This is where the raw material is formed into a cohesive story.

Headlines

For a given newscast, you only want a subset of the stories to appear in the headlines. If the headlines take too long, the viewer becomes bored with lots of headlines and no solid information. This creative choice is exerted by deciding which stories should have headline clips.

Labeled extra content

One of our hypotheses was that the rarity and novelty of additional content led to low usage in our previous experiments. Because there was so little additional content, people may have just not expected it to be there and may not have been aware of it. For some additional content, we envision a future system where newscast owners and news story creators share revenue. The newscast owner can fill out their offerings with the viewpoints of others at little cost to themselves. This makes their offering much bigger and richer with only a little editing effort.

For a news creator, having their story included in someone else's newscast, even that of a competitor, provides new viewers and new revenue at little additional effort to themselves. Historical content is easily added from the story database of previous newscasts.

To add labeled content, clips or other stories are assembled into the body of the supplementary segment. The supplement is given a textual label and then placed on a time period in the main story's timeline.

One of the challenges faced by those assembling a newscast is locating clips that should be included. There are many services for such searching. Wagner, et. al. [12] provide some interesting insights into how to find stories that provide context. We have focused on assembling the interactive experience.

Pitches

Because of our previous deployment's failure to entice viewers into additional material, we revisited the structure of our interactive television newscasts. Many newscast stories include an invitation for viewers to seek more information by going to the station's web site. This is a cumbersome idea, but it seems to work for many newscasters.

Our innovation in this system was to embed the pitch for additional content into the structure of the story. Every story can have a pitch at the end with some additional content attached. The viewer need only click the control to immediately see the additional content. Our hypothesis was that such explicit invitations would draw viewers into the additional invitation.

THE VIEWING EXPERIENCE

In prior experiments, users responded that they preferred a one-handed controller rather than two-handed for a more relaxed experience. For our prototype viewing software we used a wireless mouse like that shown in figure 3. We did not use the mouse capabilities, only the buttons.

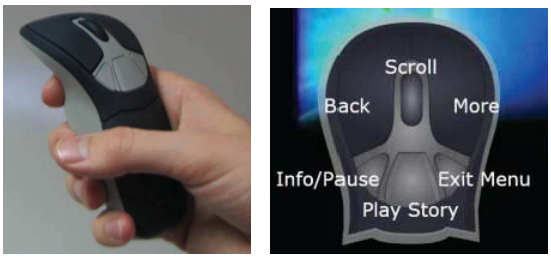

Figure 3 - Interactive Controller

One of the problems with the interactive news is that there are many more options than fit into a simple controller and new viewers have little idea how to get the behavior they want. Also shown in figure 3 is a technique we call *control overlays*, which we had used previously with great success. When the viewer pulls the trigger with their forefinger, an overlay like that shown in figure 3 appears on the screen. The overlay looks similar to the controller, making the mapping intuitive. It is easy for a viewer to pull the trigger; stay focused on the screen and hit the desired button without looking at the controller. In our experience, users learn the controls rapidly and stop using the overlay assistance. As the interactive context shifts we keep analogous functions on the same buttons. Once viewers were told about the trigger, we had no need to give further instruction. Subjects regularly used all of the controls with no help video or other instruction aids.

Newscast headlines

The first form of interaction is when headline clips are being presented. While watching a headline the viewer sees the title and icon. If they pull the overlay trigger they will also see the control overlay shown at the bottom. The icon is a visual reminder of expected actions, with the overlay providing more clarity about what the left and right button will do. A viewer can "like" or "dislike" a story or not act at all. Viewer's actions on headlines are used to reorder the

stories by pulling "liked" stories to the front of the playlist and pushing "disliked" stories to the end. This headline presentation is built dynamically from the newscast's list of stories and the stories that have headline clips.

In-story interaction

After the headlines, the newscast stories are played in order as determined from the viewer's headline preferences. If there is additional material, the title and icon is shown in the upper left. The icon in the upper left also shows the button that will play this content.

Playlist interaction

Another button shows a playlist menu. This shows a list of all of the stories in the newscast. The viewer can scroll through this list and pick particular stories to watch. We specifically included this form of interaction to test viewer preferences. We wanted to see if they would use the more sequential controls like "next" and "previous" or would browse a list for selecting specific stories. Many stories have additional content associated with them. Selecting the additional content brings up an additional menu like that shown in figure 4. These are links to other stories and to historical content from previous newscasts. These links are added manually when producing the interactive newscast. This position of the historical content in the playlist menu impacted some of the results that we report in the next section. Unlike our previous deployment that only provided additional content on a very few stories, we were able to provide additional materials on virtually every story. Many stories had multiple supplements available through the playlist as shown in figure 4.

Figure 4 – Additional content from playlist

Pitches

At the end of some stories there can be a video clip inviting viewers to view additional material on the story just completed. A simple click takes the viewer into the additional material from which they can return to the main newscast at any time. We did not have access to news anchor talent to record these pitches. Instead we used a generic pitch clip recorded by a student from the news and communications department. We were concerned our generic prerecorded pitches would reduce their effectiveness. As will be seen in the experimental data, this was not a problem.

DEPLOYMENT

The study of how people use interactive television news is particularly problematic because it is news. The content must be fresh and relevant in order to get any understanding of viewer behavior. The use of news cannot be effectively studied in a laboratory setting because the way people consume their news is very much tied up in how they live their personal lives.

In-home deployments of technology are expensive and cumbersome to carry out. Of necessity, they have a small number of viewers. The result is that the data collected is more formative than summative. Interactive television is in its infancy. We are trying to understand broad directions that can guide more extensive, commercial deployments that will yield more definitive data.

For this trial, we delivered 10 newscasts over a two week period (Monday-Friday). Viewers were provided with the current day's newscast and an archive of the previous 4 newscasts. We kept the archive short so as to not clutter the user interface. Television screen space is a scarce resource. There were two parts to this experiment: 1) the production of an interactive newscast and 2) the in-home viewing of that experience.

News production

Our interactive newscasts were driven by the 5PM news broadcast of KSL television. For several weeks before our trial we recorded the news and chopped it into clips. This formed the basis for our historical content. When we started the trial, we had a historical base of over 1,000 stories. For each story in the newscast, we were able to provide an average of 25 historical stories that were related. This is far richer than what was done in [10]. We chose to create clips from an actual newscast so that our content would be fresh and identical to existing newscasts.

Each night we recorded the KSL news broadcast, converted it to digital form and segmented it into clips and stories. We removed all commercials and all promotions of other television content. The result was that each newscast had between 17 and 25 minutes of news content. Each newscast had between 14 and 22 separate stories. For additional content we used stories from other news channels that provided alternative viewpoints. In our previous study, we provided additional content for 21% of the stories. In this study, 95% of all stories had additional related content.

For the headline clips we used the tease promotions that all television newscasts include. News organizations will frequently promote a story before going to commercial in order to encourage viewers to stay on the channel. We extracted these clips from the newscast and used them for our headline clips. Every newscast had an average of 3.5 headline clips.

Our pitch clips were constructed using still images and voice-overs recorded by students from our university's broadcast communications department. Every newscast had an average of 6.4 pitch clips to invite viewers into additional material.

Production process

Our production process involved recording newscasts from broadcast television. These were digitized and passed to 3 student production assistants who segmented the clips and assembled the stories. A graduate student from broadcast communications served as the producer for our interactive newscasts. None of these production people were from technical fields of study. We wanted to see if non-technical staff could produce interactive news using our tools, without technical training.

We ran news production for two weeks before the in-home trials so that the production team could practice and refine their processes. We found that the tools were easy to learn. What was difficult for the production staff was to understand the structure of an interactive newscast. It took some time to refine the process of collecting, finding and assembling material into a credible interactive form. Nothing in their previous training had taught them how to think about interactivity in the news. The good news is that after the initial two weeks, the process worked smoothly every night. Two weeks of training seems like a small cost. We are confident that these processes would be easy to teach within a standard broadcast communications curriculum.

Each night the process began with the 5PM broadcast. We delivered an interactive newscast by 8PM. We did not actually need the full three hours but we wanted to promise our viewers a specific availability time that we knew we could meet. 8PM is also a better time for a more focused interactive experience than 5PM.

The primary cause of production delay was the time required to digitize, upload and convert the video. We know from prior work that this time can be sharply reduced by more specialized equipment than we had available.

Home deployments

Our equipment and staffing required that we limit our trial to 10 homes. We sent out a survey through email and social network contacts reaching over 2,000 people in our geographic area. Of these, 128 met our criteria of being older than 18 (we were not interested in children's news) and willing to participate. Most of those we contacted were not willing to participate. From these 128 we chose 10 that had good internet connections in their home, were easily accessible for hardware installations and reported an active interest in television news. To simulate a set-top box with appropriate software we used a Dell Studio or a Mac Mini depending on the kinds of connections available on their television. This was connected to their primary television.

A summary of the viewer data that we collected is shown in figure 5. Out of the 10 installations, 8 actually watched the news. During the first week, 7 watched and 8 watched during the second week. Though the other 2 agreed to watch and accepted an installation, they never turned it on. Every day of the 10-day trial, we sent emails to each participant, reminding them of the availability of the news at 8PM.

Homes deployed	10	
Days of news	10	
Sessions watched	96	
View minutes per newscast	10.5	52%
View minutes of additional content	1.4	
Stories with additional content		95%
Pitches activated		55%
Prompts activated		23%
Pitches per newscast	6.4	
Playlist selections		22%
Headlines per newscast	3.5	
Headlines rated		84%
PlayNext selection		77%
PlayPrevious selection		8%
Playlist selection		15%

Figure 5 – Summary of data collected

Because our interactive newscast uses HTTP-based protocols, it is easy for us to track and log all interactivity on a per-home basis. We segmented the log data into sessions. A session lasted from the time a viewer started a particular newscast until they left that newscast. We discarded any session of less than 1 minute of viewing. We assumed that such viewing was some kind of a false start rather than actual viewing. During the first week we logged 51 sessions and during the second week we logged 45.

Figure 6 shows the dates of the various newscasts (x axis) and the times when those newscasts were actually viewed (y axis). There is a mark for every unique session. Marks on the diagonal show normal viewing just as the news is available. However, a large amount of the viewing is much later than the actual availability. There is a very strong pattern of viewers watching news when it is convenient for them rather than on schedule. This is true even when the news is more than a day old. Of particular interest are the horizontal patterns. These are people watching several newscasts at the same time. The red dots are one individual watching a lot of news (much of it a week old) at the same time. The average session was viewed 35 hours after its

original production. There is a clear pattern of finding a convenient time and then "getting caught up." A possible alternative interpretation of the data is that viewers felt guilty about not watching as they agreed. Post experiment interviews supported the "getting caught up" interpretation. This may be encouraged by the fact that they can readily skip news that they are already aware of, spending catch up time only on what they truly missed.

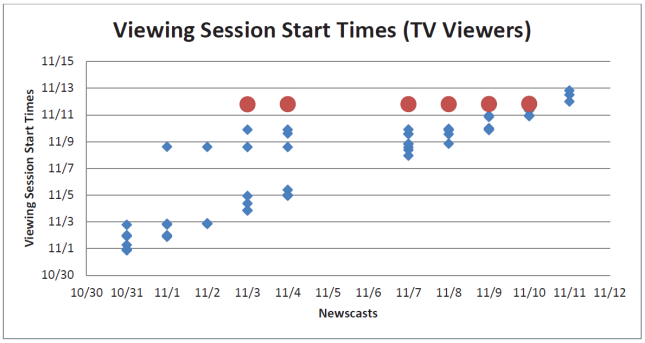

Figure 6 – Viewing times

Viewing time

Of key importance to news agencies is the time that viewers will spend watching. If giving the viewer control means that they watch less, there is potentially less advertising revenue. The average combined length of the base stories of our interactive newscasts was 20 minutes. Out of this time, viewers watched an average of 9.11 minutes. This is less than half. We knew that viewers would skip over uninteresting stories and we hoped to make that up by enticing them to watch extra content. On average they watched 1.41 minutes of extra content per session for a total viewing time of 10.52 minutes per session or 52%. This is not good news for advertising-based revenue. This is mitigated in three ways: 1) advertising can be more targeted to individual viewers and thus command higher prices or 2) traditional television news consumption is not a continuous behavior, or 3) interaction creates a more focused viewer experience as will be discussed in the next section.

On the level of an individual story, viewers watched an average of 62% of the story. People are watching enough to get the essence of the story and then regularly making the decision to move on.

Interactive features

Our deployment included a number of interactive features. By logging behavior on the server, we are able to measure the usage of those features. Of all headlines presented, viewers interactively rated 84% of them. This was a very popular feature. It gave viewers a quick way to decide what they wanted to watch. In this study, viewers were more than twice as likely to rate a headline positively than negatively. On average our viewers exerted some interactive choice during every single newscast. They are definitely interactively engaged. On average, they activated one or more of the choice options every 57 seconds. In our earlier study, this was every 79 seconds. In this latest deployment, there were many more content options available than before.

Anecdotal reports from our news partners indicate that much of traditional television news consumption does not involve actually sitting in front of the television. People frequently wander around and do other things. In this deployment the high rate of interactivity indicates viewers that are heavily engaged rather than wandering off leaving the television playing but unwatched.

There are three basic navigation controls: PlayNext, PlayPrevious and Playlist. These were used in 95% of the sessions watched. For an average session PlayNext was used 77% of the time, PlayPrevious 8% and Playlist 15%. Clearly the most popular control was to skip to the next story. The use of PlayPrevious was down from the 33% of our previous study (we have no explanation). The use of the Playlist was also down significantly from the 26% of the previous study.

Extra content

For the commercial reasons that we have described, we were very interested in boosting viewer's use of extra content. Our key changes were to provide much more extra content and to directly pitch the extra content as part of the newscast. In our previous study, there were 0.32 views of extra content per session. In this study there were 1.23 extra content views per session. This is much better performance.

To better understand what made the difference we logged three ways in which a viewer might choose additional content. Pitches, where a specific video invitation is included at the end of a story accounted for 55% of the selections. This feature did not appear in our prior study. Prompts, in the upper left of the screen, accounted for 23% of the choices. Prompts were the primary extra content mechanism in our previous study. Playlist menu selections accounted for 22%.

We divided the logs into week 1 and week 2 to see if there were changes in behavior as viewers gained experience with the viewing interface. During week 2, pitches moved up to 72% of the choices with the menu dropping to 6%. It is quite clear that viewers like to be invited to view additional material rather than a more passive offering that they can select. We are convinced that the introduction of pitches along with the larger amount of available material led to the increased usage of extra content.

Interview feedback from viewers showed that the quality of the additional content is still an issue. Because we were not producing any content but rather scavenging it from existing sources we were using video for other than its original purpose. The comments indicate that viewers want deeper analysis of a story when they chose the additional content. This would require a very different level of

professional production involvement than either of our two studies has been able to accomplish.

Historical content

We were disappointed to find that only 10% of the additional content came from our historical content. We had hypothesized that viewers would want deeper background on stories. We believe that part of the problem was that historical content was rather deep in the playlist menu system and simply got lost.

However, viewing patterns showed an interest in historical content, just not in the way we had hypothesized. Figure 6 shows when various newscasts were viewed. There is a very strong pattern of viewers wanting to catch up on newscasts they had missed even though this was no longer current news. This area needs more exploration.

CONCLUSIONS

News production was easy to learn and it was easy to produce complex interactive newscasts using non-computer science news people. We have again confirmed the popularity of interacting with the news and the use of headline like/dislike choices as a means of tailoring the newscast. Skipping out of a story also remains popular.

We have demonstrated new sources for additional content to augment stories of interest to a particular viewer. We have also shown that specific invitations to watch are the most effective means for drawing viewers in. Post-trial interviews also indicated that viewers did not like the way that following a prompt to additional story material would interrupt the main story. They liked their additional material at the end of the story, as with the pitches. This is also helpful guidance of future implementations.

Even with the extra content, viewers are watching news for less total time. The extra content viewed does not make up for the amount of content that viewers skip over. This is balanced, however, by the fact that viewers are continuously, interactively engaged. They are watching less time, but they are focused on the news rather than wandering around doing other things. We have no idea whether this balances out the prospective impact on advertising.

It is also clear that although our attempts at prototyping an interactive news experience have been successful, viewers want more carefully developed interactive material. In our own production process, we found ourselves developing new work models to handle the more dynamic structure. There is an interesting future of viewer engagement with their news that is ahead of us.

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