Brigham Young University
BYU ScholarsArchive

All Theses and Dissertations

2012-07-13

A General Framework for Interactive Television News

Benjamin Bart Sellers
Brigham Young University - Provo

Follow this and additional works at: https://scholarsarchive.byu.edu/etd

 Part of the Computer Sciences Commons

BYU ScholarsArchive Citation

Sellers, Benjamin Bart, "A General Framework for Interactive Television News" (2012). *All Theses and Dissertations*. 3357.
https://scholarsarchive.byu.edu/etd/3357

This Thesis is brought to you for free and open access by BYU ScholarsArchive. It has been accepted for inclusion in All Theses and Dissertations by an authorized administrator of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.

A General Framework for Interactive Television News

Benjamin Sellers

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

Dan R. Olsen, Jr., Chair
Kevin Seppi
Dennis Ng

Department of Computer Science

Brigham Young University

December 2012

Copyright © 2012 Benjamin Sellers

All Rights Reserved

ABSTRACT

A General Framework for Interactive Television News

Benjamin Sellers
Department of Computer Science, BYU
Master of Science

We design a complete interactive television news system. We develop a news production system that allows for the creation of flexible, content-rich interactive news. This system embraces a general creation process to interactive news that is built on top of a newscast model that evolves from and conforms with the current production newscast model. It allows for content sharing and content reuse. We also create an interactive news viewing system that adapts well to a living room environment. It contains several interactive features designed to give the viewer control and allow them to watch the news when, where, and how they want to. We perform a formative evaluation through a user study and interviews. Our results show that the production system allows fast, quality construction of interactive news. Viewers enjoy the interactivity and control the viewing system provides, but more work needs to be done to improve ease of use. Our system increases extra content visibility and usage over previous studies through additional features, more content, and direct invites to viewers. We also produce and deliver the news over an entire two-week period to a large number of viewers, making it the largest study done according to our knowledge.

Keywords: interactive television news, user interfaces, news production frameworks, news reporting, interactivity, broadcast television, viewing behavior

Table of Contents

1 Introduction 1

1.1 Broadcast Television News 1

1.2 Interactive Television News 5

2 Related Work 10

2.1 Viewer and Provider Susceptibility to Interactive News 10

2.2 Interactive Video News Systems 11

2.3 Automated News Annotation 16

2.4 Live Interactive News 17

2.5 Interactive Documentaries 17

2.6 Other Types of Interactive Television 18

3 System Architecture 19

3.1 Video Ingestion 21

3.2 Interactive Newscast Production 22

3.3 Interactive Newscast Consumption 23

4 Viewing System 25

4.1 No Required Interaction 25

4.2 Navigation Controls 25

4.2.1 Controllers 26

4.2.2 Control Overlay 27

4.2.3 Basic Navigation 28
4.3 Headlines 29
4.4 Drop-down Prompts 31
4.5 Pitches 33
4.6 Playlist Menu 34
4.7 Extra Content Menu and Info Display 35
4.8 Extra Content 38
5 Interactive Newscast Model 40
5.1 Interactive Newscast Elements 40
5.2 Interactive Newscast Creation 42
5.3 Interactive Newscast Delivery 45
6 Production System Implementation 47
7 User Study Production Process 51
7.1 Interactive Newscast Production 51
7.2 Production Content 56
8 Delivered Content 57
9 User Study Viewing Participants 60
10 Viewing Behavior 65
10.1 Sessions 65
10.2 Content Usage 72

10.3 Interactive Feature Evaluation 76

10.3.1 Headlines 76

10.3.2 User Engagement 78

10.3.3 Basic Navigation 79

10.3.4 Extra Content 82

11 Summary and Future Work 91

References 93

Appendix A Post-Study Television Viewer Interviews 96

1 Introduction

Television is an excellent medium for delivering news. Viewers can effortlessly see and understand events going on around them and do so from their living room sofas. Unfortunately, television news is also very limited. The content offered is restricted by broadcast time constraints and the need to appeal to the widest demographic possible. If a viewer is interested in a story, they have no way to learn more from their television. They must turn to other sources such as their computer and the Internet where they can search for more information. By changing the content delivery mechanism from broadcast television to the Internet and creating a television-friendly user interface, an interactive news experience could be created. This news system would then enable news providers to create and deliver flexible, content-rich news that viewers could interactively adapt to their individual schedules, needs, and interests. We present such a system in this work.

1.1 Broadcast Television News

As stated, broadcast television is a common and useful way for individuals to consume news. Television allows viewers to learn about and increase awareness of local and world events and do so in a relaxed environment such as a family or living room. Multiple individuals can be watching the same television at once. Watching television does not require a viewer's full attention, nor does it force interaction upon the viewer. The television interface is a "lean-back" approach where viewers can relax, be entertained and informed, and process information at their leisure.

Unfortunately, television news is also very limited. Broadcast technology restricts the number of deliverable stories and the quantity of content provided. News programs are generally scheduled into a 30 minute broadcast slot where viewers are shown the same content in the same way as

every other viewer. In the process of news production, there are ultimately more stories developed than can fit into this slot, so some newsworthy stories must be cut. This limits the diversity or breadth of content that can be shown. In addition, stories must be short enough that an uninterested viewer will not disengage from the newscast before the next story is presented, limiting the story depth.

Since broadcast technology is receive-only, the ways of tracking television viewer habits and program popularity are limited. Current rating systems [21] rely on some form of self-reporting from a sample of the population every few months. Self-reporting leads to errors and the limited sample makes it difficult to accurately represent the viewing population. These systems also do not track how viewers watch, only what and when they watch. This limited information leads to a less accurate viewer representation; thus, lowering the quality of delivered content.

This receive-only nature also limits the amount of control viewers have over what they are watching. Viewers cannot skip uninteresting content. Viewers cannot ask to learn more about a particular story. Without an external device, such as a digital video recorder, there is no way to view the content at a later time. The only control viewers have is over which channel they are currently watching. There is no interaction between viewers and the content or content providers. There is no direct means to inform the content provider of content quality or a desire for different content. All of this leads to content that may not be interesting to many individual viewers.

These limitations and the near-ubiquity of web-enabled devices are leading to an ever-growing set of individuals who are turning to the web to find and consume news. This is especially true among the younger demographic where 65% of adults 18 to 29 said the Internet was their main source of news [23]. The Internet presents a “lean-forward” approach where viewers are focused

on the task at hand and actively select content that is appropriate or interesting to them. This is generally done on a laptop or desktop computer, but is now expanding to include smartphones and tablets.

The web experience is interactive and viewers have complete control over the content they view. Content is viewed on-demand and is always generally available. Video is mixed in with text and allows more information to be shown than is available with a lean-back approach. Hyperlinks provide access to content related to the current story, giving access to greater depth and breadth. Content providers are also able to track usage data and provide targeted content to the viewer.

The lean-forward approach is powerful, but does not adapt well to a living room setting. The television requires a video-centric system. Web pages contain too much text to be visible or useful from a distance. Televisions are also controlled with a simple remote, while web pages generally require a mouse and keyboard.

What is needed is a system that maintains the lean-back nature of the living room, but takes advantage of the interactivity, content depth and breadth, and flexibility that are found in a web-based approach. The Internet's ability to deliver deep, individualized content in parallel with other users, coupled with a television-friendly user interface, would allow the creation of a quality interactive television news experience. This news system would then enable news providers to create and deliver flexible, content-rich news that viewers could interactively adapt to their individual schedules, needs, and interests.

The following examples show some advantages of an interactive newscast over a traditional newscast:

Example 1

Figure 1: Example of political commentary

News commentators are discussing a criticism of the President made during an earlier interview by one of your state's senators (see Figure 1). During the discussion, they play a ten second clip of the senator's criticism. Not having seen the original interview, you would like to see the comment made in its full context. With an interactive newscast, you could gain immediate access to the interview without losing access to the original discussion.

Example 2

Figure 2: Human interest story about volunteers rehabilitating ferrets

Being a young techie, sports, the weather, and human-interest stories do not appeal to you (see Figure 2). You can find what you want much more quickly on the Internet. News providers and advertisers would love to appeal to you, but you exist in a niche market and they must target the masses. Because interactive news is not limited by broadcast times slots and can deliver a unique

stream to each user, an interactive news system would allow providers to expand their content base and deliver content that is relevant to you. As the viewer, you could also interact with the system seeking content you want while avoiding that which is of no interest.

These and many other opportunities to improve the television news creation process and viewing experience exist once the system has been shifted into the interactive paradigm.

1.2 Interactive Television News

Our goal is not to radically change the basic news viewing experience, but instead to greatly augment and evolve it through interactivity. By augmenting the basic newscast design, we allow users to maintain the basic mental model of what a newscast is which enables them to quickly adjust to our system. We are also able to make use of and build upon current news production practices and systems, increasing adoptability by news providers.

One of the basic requirements for building an interactive news system is understanding the needs of both the news providers and the news consumers. Because interactive television news greatly affects how news is both created and delivered, it is important that both a news production system and viewing system be integrated into the design of a full interactive news system. Most research systems for interactive news seek to automate the annotation and production of interactive news. This is a major weakness of these systems. News providers want control over their content and want to guarantee a quality news experience. Instead of removing the news provider from the interactive news equation, an interactive news system should enable the provider to bring their work into this new medium. In our system, we ensure that the needs of this production and viewing system duality are met.

The viewing interface needs to be easy to learn and manipulate. Prior research has shown that viewers enjoy simple, transparent controls [3,7,13] and that too much interactivity can lead to confusion and disorientation [2]. There will be various types of viewers which the system should support. Passive viewers may not have the time or desire to control the newscast. Casual viewers will want basic control such as skipping uninteresting content or being able to view more of an interview. Exploratory viewers may find something interesting and want to learn as much as they can about a subject. An individual's viewing type may change as the newscast progresses, such as moving from casual to exploratory viewing when the casual viewer comes across a deeply interesting story. The controls should be simple for all and fluid so that individuals can act at their preferred level of interaction and freely move between levels of interaction, while not being overwhelmed with content or having to actively control the system.

To provide story depth and breadth and increase the usefulness of interactivity, the viewing system needs to provide access to additional material beyond the basic newscast. This supplemental content provides access to alternate viewpoints of a story from different stations covering the same story, previous or similar stories that cover the same topic, supplemental content such as interviews and press releases, etc. Making this material available via the viewing interface will increase the individualization possible in the system and provide continuity that cannot be present when having to access a web page for more content.

An interactive television newscast also needs to be easy to produce. The production system should flow with current broadcast news production processes to minimize costs and encourage adoption by major news providers. However, it must also be general enough that it allows for non-traditional news sources such as news aggregators and Internet news sites to take advantage of the technology.

Because we are delivering news based on the individual instead of the demographic, targeted, rich interactive news requires more content. Increasing the content base will ensure that there is enough interesting material to satisfy the needs of all users of the system. To enable this, content reuse and content sharing between providers should be a basic feature of the system. Not only does this ensure that news stations will have access to the necessary content for their newscasts, but it empowers and creates a market for others such as freelance reporters who can create quality, newsworthy content, but do not have the resources necessary to develop and deploy a full newscast of their own.

Because of these requirements, we designed an interactive television viewing system that meets the following needs:

- The interface is easy to learn and manipulate, interactions are simple, and no interactions are required to watch the news (i.e. can be viewed like traditional non-interactive news).
- Viewers have multiple ways to access additional material that provide story depth and breadth.
- Viewers can customize newscast story order and skip uninteresting content.
- Viewers have on-demand access to all newscast content.

Our implementation of this system and how we met these needs can be found in Chapter 4.

These requirements also led us to design an interactive television production system that meets the following needs:

- It supports multiple creation processes including those used in traditional broadcast news as well as possible flows used by news aggregators and online news stations.

- Stories and other content can be created in parallel.
- Content can be reused and shared between stations.
- Additional material can be associated with each story to provide a richer news viewing experience.

The model we designed to meet the needs of this system is discussed in Chapter 5. The actual implementation of this design is discussed in Chapter 6.

Not included in this solution is the commercialization and monetization of such a system. There are many possibilities for interactive commercials and other forms of interactive advertising that are left for future work.

To test the validity of our solution, we implemented our interactive news system. This system can create and deliver a full interactive news experience. It also contains a viewing interface that can be accessed from the television via a set-top box and via the Web. We set up a news production environment for four weeks where we developed interactive newscasts. We used the first two weeks to refine the system and get a content base that could be used to provide additional material to stories. For the final two weeks of the trial, we delivered the interactive newscasts to viewer homes. Chapter 7 describes the interactive newscast production setup and use over the trial, Chapter 8 discusses the content that was generated during the trial that was delivered to the viewers, Chapter 9 describes the users who participated in the viewer study, and Chapter 10 describes the viewing behavior that was observed over the two week study.

In designing, implementing, and testing this system, we hoped to validate our thesis statement that an interactive television news system can be created that enables news providers to create

and deliver flexible, content-rich news that viewers can interactively adapt to their individual schedules, needs, and interests. In doing so, we will perform the following:

- Define the model such a system should be built upon and show the feasibility of our interactive news system design.
- Explore and compare several interactive news features to determine which are the most important and why.
- Increase viewer usage of additional material over previous, comparable studies.
- Gain a better understanding of viewing habits and viewer perception of interactive television news.

Our results show that interactive news can be delivered with only a modest addition to current newsroom workloads (see Chapter 7). They also show that viewers enjoy the interactive news experience and the control they have over that experience. Viewers consistently used interactive features throughout the study. There was also a four times increase in usage of additional material over a previous comparable study. We also found that pitches were the preferred feature used to access extra content. The full details of our viewer study and our observations are found in Chapter 10.

2 Related Work

Consumer demand for interactive content has long been apparent. Recent advancements in data storage, content distribution networks, and the ability to deliver high quality, on-demand video via the Internet have made interactive video a reality. This has led to several forays into the realm of interactive television news. These works include work on interactive viewing interfaces, automated and non-automated news production processes, and other related interactive television research.

2.1 Viewer and Provider Susceptibility to Interactive News

In a recent Pew Research Center study [24], they found that some of the most important qualities in an online news site were access to breaking news, access to related stories, and additional multimedia content. In a study on how viewers perceive future television interaction [8], every suggestion made by the study participants related to on-demand access to information or content interaction. In two other studies [7,16], participants responded positively to simple, interactive newscast demos with navigation features and extra textual information.

The Internet has made it easy to access up-to-the-minute news. It has also led to new forms of media such as blogs, forums, and status feeds. News providers have had to respond accordingly. In two studies on how newsrooms have changed in the digital age [14,20], they found that a large focus has been given to the rapid creation and delivery of news; turnaround times have to be in hours instead of days. Also, there has been a convergence in news media. There are no longer television reporters, online reporters, and newspaper reporters. There are now just reporters who have to make their stories function across multiple forms of media. There has also been increased usage of region targeting and freelance reporters to handle the need for large amounts of content. Two other studies [5,22] show that reporters recognize the importance of interactivity in the

news, but that, in practice, news providers want to be in control of the content that is delivered to the viewer. These studies show that any system developed needs to handle the rapid nature and growing content base of the modern newsroom. Also, such a system would need to maintain news provider control to gain general acceptance.

2.2 Interactive Video News Systems

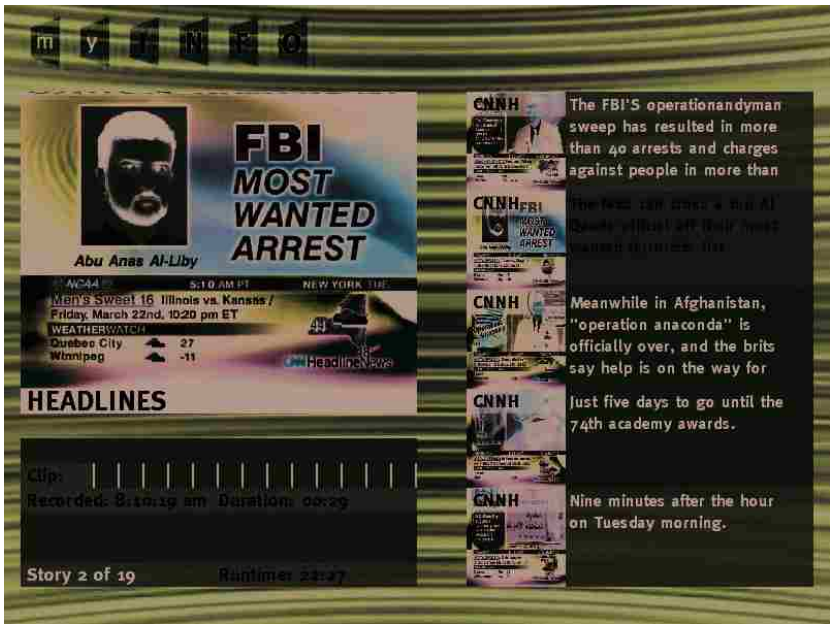

Figure 3: Headline screen of the MyInfo system

There have been several attempts to create an interactive news system that automates the segmentation and annotation of news broadcast video [6,11,12,27]. MyInfo [11,27] is a complete interactive news system with an automated production system. Speech recognition, closed captions, and video features are used to segment the video into stories. This information is then used to query the Web for additional textual information that can augment the story and be displayed to the viewer. This includes things such as story summaries or weather info. MyInfo also contains a viewing interface that is based on a descriptive playlist from which the viewer can select and view stories on-demand (Figure 3). While this system removes any extra workload

from the news providers by automating the production process, automated annotation leads to errors which limit the newscast quality and takes away the control from the news providers. The story depth and quality of additional content is also limited by what can be found on the web by the automated process. While the viewing interface allows on-demand access to stories, it also suffers from too much text and requires the viewer to actively select stories.

Figure 4: Viewing screen of MyNewsMyWay

Several systems have focused on content personalization through search or profiling [4,15,17,18]. The most notable example of these systems is MyNewsMyWay [15]. The system was developed as part of a range of interactive television experiments across several genres [26]. MyNewsMyWay (Figure 4) allows the viewer to set up profiles. These profiles are used to pull content from a pre-annotated set of news stories to create an on-demand newscast. Viewers have the ability to skip stories, extend or shorten their watching time, and view related material. These interactions take place in a television-friendly way. Related material is based on the topics represented by the story. While the system is able to provide breadth through topic-based, related content, there is no way to provide story depth. Profile initialization is cumbersome. Newscast creation by the news provider is also limited to the annotations given to the stories.

Figure 5: Hyper-Hitchcock viewing interface

Some systems [3,10] have used a concept called hypervideo. Hyper-Hitchcock [10] presents this concept with a system that allows the provider to link additional material into a video. A timeline is presented which can be annotated by the provider to supply links to other video. During playback, labels appear showing the viewer that there is more information about what is currently being shown (Figure 5). The viewer can choose to follow the link and view the additional material. This additional material can also be selected from a list below the player. Once the additional material has finished playing, the viewer is returned to the last viewed location within the original video. While Hyper-Hitchcock was not built as a television system, Bunn's television news system [3] uses this concept in the form of drop-down prompts. His experience showed that viewers did not regularly follow these prompts to extra material.

Figure 6: BBC's Red Button

The BBC Red Button (Figure 6) is an interactive news system that is seeing real production use [19]. This system uses digital broadcast technology to deliver several looping news streams as well as additional material to augment the stories. Without any interaction, viewers see a standard news broadcast. By pressing the red button on a specialized remote, viewers gain access to an on-screen menu. Viewers can then access additional textual information about the stories, view statistics, take quizzes, and perform other simple interactions. Viewers also have the ability to switch between several different news feeds. BBC Red Button pushes the limits of what can be done with broadcast technology, but it is still limited in its abilities. While delivering constant news, the looping streams do not provide true on-demand access to video. If a viewer misses a story, they will have to wait for the broadcast to loop back to the story. Also, broadcast technology limits the amount of information that can be transferred and does not allow for video-based extra content. Without additional video material, the depth of the interactive experience and stories is limited.

Figure 7: Providers control the annotation process

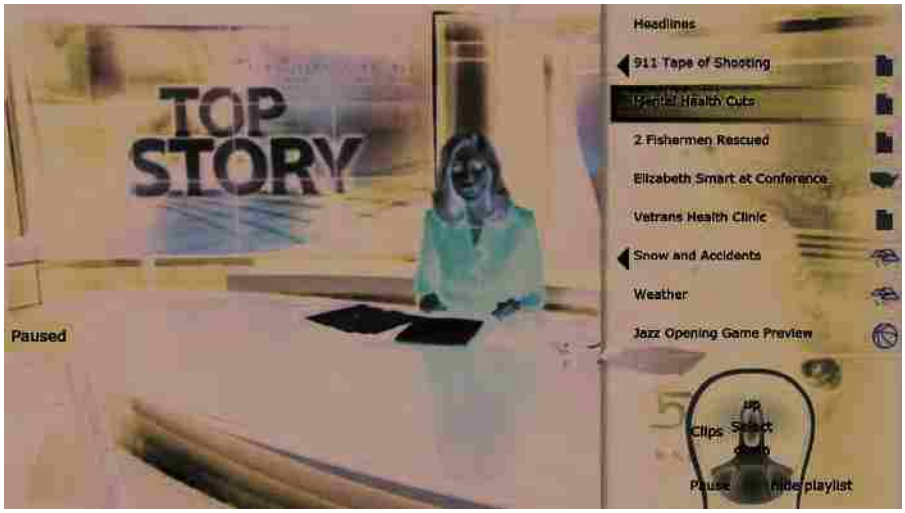

Figure 8: Playback of the interactive newscast

Bunn has developed a web technology-based, interactive news production and consumption system that was tested in a real newsroom environment [3]. This system seeks to augment the current news production process. It also puts the news provider in control of news creation. Providers are able to segment video into stories, assign properties, and link extra content into each story (Figure 7). During playback, viewers can select and view this extra content. Providers can also create headlines that are shown at the beginning of a newscast to weigh viewers'

preferences for the upcoming stories and reorder them accordingly. Viewers are also presented with a playlist and a simple set of controls to navigate through the newscast (Figure 8). While providers have control over the content, the production system design is very restrictive: content must enter the system in a certain way and news production happens linearly (i.e. it is built to empower a single user in newscast creation, limiting its usefulness in large production environments). It has no support for gathering content from historical repositories or third parties, limiting the possible scope of the extra content. Results also have shown that viewers do not regularly access the extra content. Whether this is because of sparseness of content, content quality, or interface issues is unknown. This system is supported by a week-long, in-home user study. Because this system is the true predecessor to our work, we will be able to make comparisons between our results and the results found in their study.

2.3 Automated News Annotation

As mentioned earlier, there has been much work done in attempting to automate the segmentation and annotation of news broadcast video for interactive newscast creation [6,11,12,27]. These systems use speech recognition, closed captions, image processing, and other features to segment video into individual stories and determine their content. We believe that such work in unnecessary for interactive television news production because news providers already create most of this information while creating a news broadcast. Modern newsroom software, such as Avid iNews [1], creates and maintains this type of information during news production. News anchor scripts are already digitized and context switches, controlled by the producer, can be tracked and used to determine story breaks. Connecting into existing newsroom systems or even manual annotation by newsroom staff should be sufficient to gather all necessary information about the news video content. This should enable complete control by the

news providers over how their content is taken into the interactive paradigm without imposing unnecessary burdens upon newsroom staff.

2.4 Live Interactive News

Another approach to interactive television is through live interaction. In this type of system, viewers can directly influence the viewing experience as it happens. When applied to news, reporters can receive comments and questions from viewers that can direct where the reporter will take the news story. Van Every [9] proposes such a system that allows reporters to receive questions from viewers. The reporter can then direct these questions at the person being interviewed. This approach has several weaknesses. Only a limited number of viewer questions can be directed at the interviewee because of time constraints. Viewers are also directly influenced in what they watch by other viewers, limiting individualization of the newscast. Also, viewers can only participate if they are watching the live broadcast.

2.5 Interactive Documentaries

One type of story that can be found occasionally in news broadcasts is the documentary. A documentary is a long-form story that can present an issue more as a complete narrative, rather than an informational blurb. The length and depth possible in a documentary allows for new opportunities of interactivity. Such work has been done with the recently developed system Flexible Storylines [25]. This system allows the creation and consumption of interactive documentaries. Viewers begin with access to a base story. Throughout the story, viewers are given the choice between staying in the current story and branching off to a longer, deeper version of the upcoming content. Once the branch has completed, the viewer is returned to the main story with a lead-in to give context and a smooth transition. The idea is viewers will always

be given a smooth, unbroken chain of video that tells the story at hand, no matter what path or paths viewers choose.

Flexible Storylines gives great insight into applying interactivity to individual narratives and can greatly enhance the viewing experience. However, we are interested into applying interactivity to a newscast, which is a large set of stories. While many stories may be able to benefit from this depth of interactivity, to limit our scope and the tractability of our user study we do not apply this type of interactivity to our design.

2.6 Other Types of Interactive Television

Much work has been done and continues to be done in the realm of interactive television. We do not want to discuss interactive television in general, but want to instead focus on interactive television as applied to news. However, Jensen [13] provides a brief history of interactive television. In it, he notes that one of the weaknesses of prior approaches is the lack of useful interactive features over current broadcast television. His paper can be a starting point into research done with other types of interactive television.

In summary, while much work has been done in the development of an interactive news system, none of the systems developed so far give users an easy-to-use, content-rich television interface along with a system that meets the needs of news providers and the demands of a modern newsroom environment.

3 System Architecture

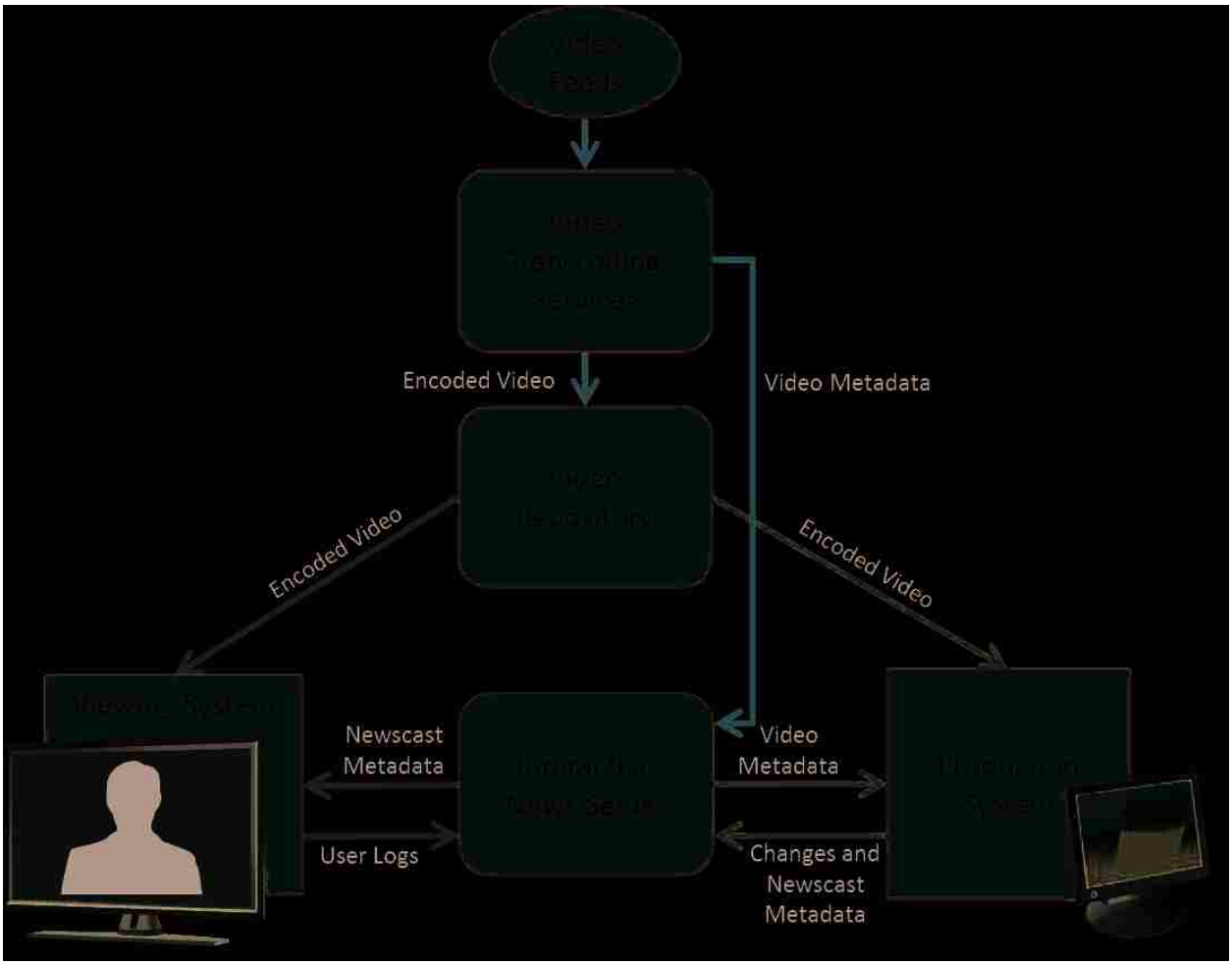

Figure 9: Overview of the full system architecture

In support of our thesis, we must show the feasibility of creating a complete interactive television news system that delivers an easy-to-use, content-rich experience to viewers and also accommodates the needs of news providers and news creation. We have created an overall architecture that meets the needs of this system (see Figure 9). This system consists of several subsystems that are needed to deliver the complete experience. The components necessary for this system include the following:

- **Video Feeds** – These are the raw video data that exist outside the system. Generally, this raw video would come from the reporters and be generated using external tools such as the Avid iNews system [1]. Other sources can include pre-recorded broadcasts, eyewitness recordings, etc.
- **Video Transcoding Services** – These consist of any services necessary to convert the video feeds to an adaptive streaming format usable by our system. These services also move the encoded video into the Video Repository and sends relevant metadata about the video to the Interactive News Server.
- **Video Repository** – A location that has ample storage space to host the encoded video and also has the technology necessary to correctly send the video to viewing and production systems. Optimally, this repository is accessible via a content distribution network (CDN), which provides higher bandwidth and reduced data latency to improve the seamless viewing experience.
- **Interactive News Server** – The server that maintains and provides access to the video and newscast metadata.
- **Production System** – The interface and client-side services that enable interactive newscast creation. All changes and updates are sent to the Interactive News Server.
- **Viewing System** – The interface and client-side services that enable interactive newscast viewing and usage log creation.

With all of these components in place, we can now divide the system into three separate processes: video ingestion, interactive newscast production, and interactive newscast consumption. This system assumes that the raw video is already available.

3.1 Video Ingestion

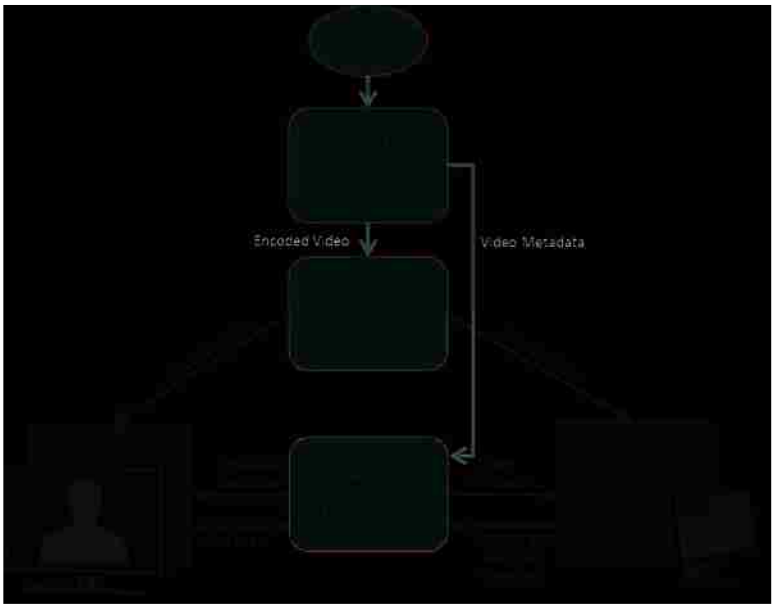

Figure 10: Components and connections that comprise the video ingestion process

The first process is the ingestion of the raw video feeds into the system (see Figure 10). Raw video must first be encoded into an adaptive streaming format recognizable by our system using the Video Transcoding Services. These services must also be able to move this video to the Video Repository that the interactive news system uses as a central store for the video. Metadata from the encoding and transfer process are sent to the Interactive News Server so that it can be accessed later. If metadata generated by reporters in creating the stories using external tools is available, that information can also be sent to the Interactive News Server to simplify and shorten the production process.

3.2 Interactive Newscast Production

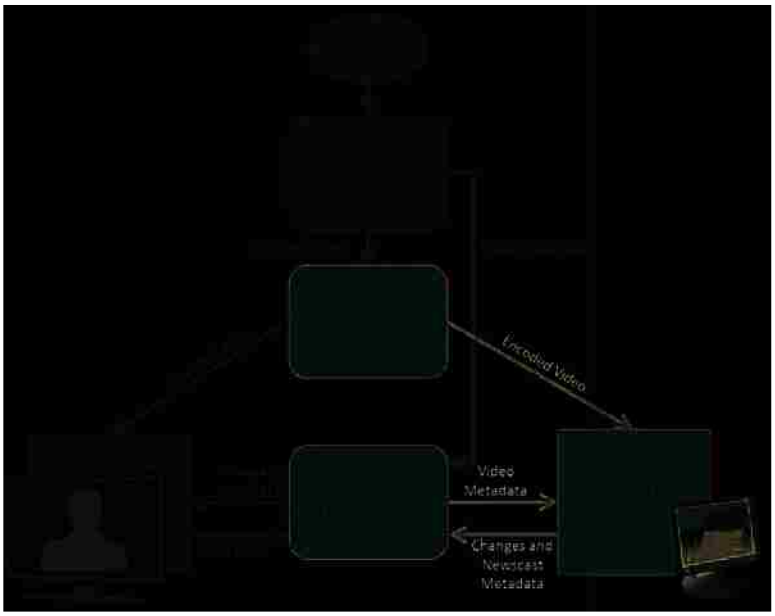

Figure 11: Components and connections that comprise the interactive newscast production process

Once the encoded video and related metadata are made available within the system, interactive newscast production takes the forefront (see Figure 11). Video and its related metadata can be taken, edited, and augmented by news providers in the Production System to create a set of stories that can be used in the production of an interactive newscast. News providers are then able to combine these stories and other stories that have previously been created to create an interactive newscast. All of the relevant metadata is then transmitted back to the server. The data model we designed to support this system will be discussed in Chapter 5, while the actual implementation of the Production System will be discussed in Chapter 6.

3.3 Interactive Newscast Consumption

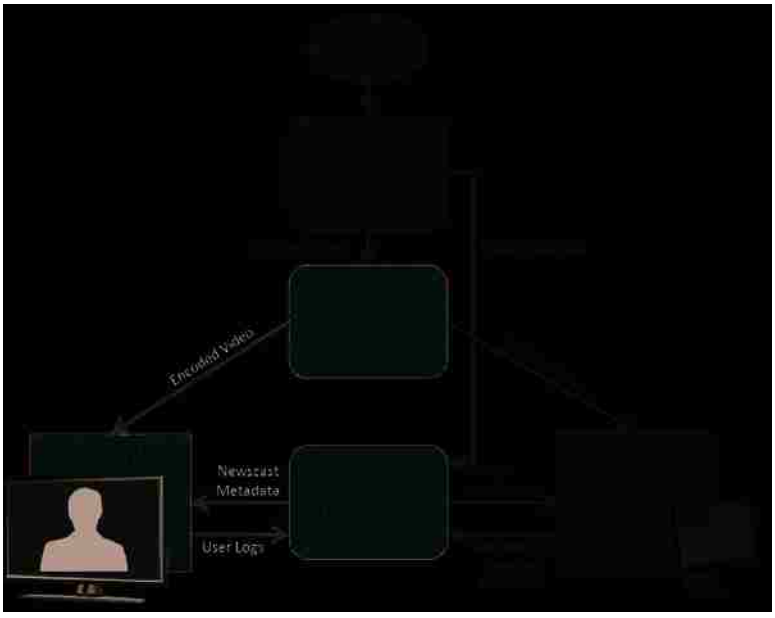

Figure 12: Components and connections that comprise the interactive newscast consumption process

Once an interactive newscast has been created, it can be made available for consumption by the viewers (see Figure 12). All of the interaction by the viewer takes place within the Viewing System. When the viewer selects a newscast, all relevant metadata necessary to play the newscast is obtained from the Interactive News Server. Video is then displayed to the viewer according to the newscast metadata and the viewer's interactions. The viewer's actions and content choices are also logged so that the experience can be later improved. The Viewing System interface will be described in detail in Chapter 4.

In summary, we have created an overall architecture that meets the requirements of our flexible interactive news system as defined in our thesis statement. This architecture is able to handle the needs of both news production and consumption. Once the raw video has been ingested into the system, the metadata surrounding the video and the newscasts can be created and modified. The Production System will enable creation of this metadata, while the Viewing System will interpret

the metadata and present the interactive newscast to the viewer. The following three chapters will discuss the Viewing System, Production System, and the interactive data model that will make interactive news possible.

4 Viewing System

The news viewing system consists of the viewing interface and the services that support it. The viewing interface is the component with which the viewers watch and interact with the interactive newscast. By knowing the components that go into this interface, we can understand what the newscast model should look like as well as what should go into the production system to enable the creation of this experience. In this chapter, we will discuss the various features that are included in this interface and how they add value to our system. By including several features, we give the viewer more control and flexibility in how they interact with the system, a basic premise we described in our thesis statement.

4.1 No Required Interaction

To become a true replacement to broadcast television news, the interactive news interface needs to be able to present news as if there were no interactive controls available. Our interface is able to do so. Once a newscast has started, stories will play one right after another until newscast completion. By allowing the system to function without interactivity, we maintain the ability to have a full lean-back experience. This also gives those who cannot currently interact, such as a parent caring for his or her child or someone cooking dinner, the freedom to enjoy the news according to their own schedule and abilities. Even when interactive options are presented directly to the viewer, if the viewer chooses not to interact with the system, the newscast will continue playing on its current path.

4.2 Navigation Controls

The news viewing system needs interactive controls. These controls allow the viewer to navigate through the stories in the newscast as well as access the other interactive features that are present in the system. We chose a physical controller that meets the needs of this system. We augmented

the physical controller with an on-screen representation showing the available commands. We also provided a set of basic navigation techniques that allow the viewer to navigate easily through the newscast.

4.2.1 Controllers

A basic component of any interactive system is the input devices used to manipulate it. We want an input device that is simple, easy to learn and use, and flexible. We also want to provide an efficient way for viewers to learn how to manipulate the interface.

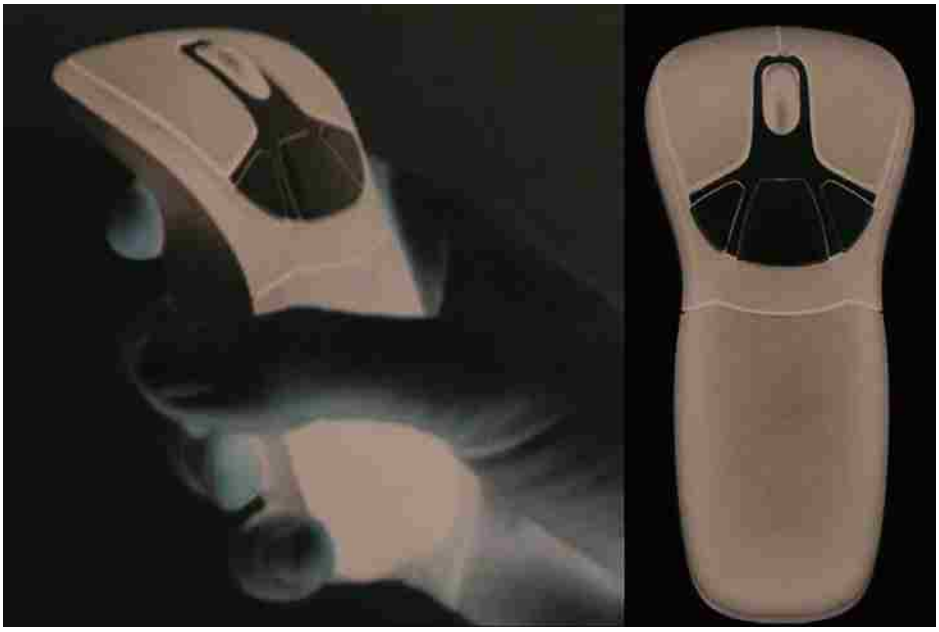

Figure 13: Remote control used in our implementation

For our in-home television study, we opted for a simple remote identical to the one used in Bunn's study [3] as shown in Figure 13. With only five front buttons, a back trigger button, and a mouse wheel, this remote embodies the simplicity that should exist within an interactive television newscast. Unlike Bunn's study, we did not use the tilt-based gestures possible with the built-in gyroscope because they are hard to describe visually using the control overlay and tended to confuse the viewers.

In our study, we delivered newscasts to both televisions and web browsers. Because only those with television setups had access to the specialized remote control, it was important that our system could also work with desktop and laptop setups. Without modifying the visual interface available to the viewer, we added key bindings that mapped interactions to the keyboard. While this provided a workable experience to web browser viewers, we learned that just as standard desktop or laptop interfaces are not ideal for the television, television interfaces are not ideal for a standard desktop or laptop experience. While web browser viewers enjoyed the system and the flexibility it provided, several complained about the difficulty of learning the keyboard setup. Modifying the interface to work as a standard point-and-click browser experience for web browser viewers would have been a better fit.

4.2.2 Control Overlay

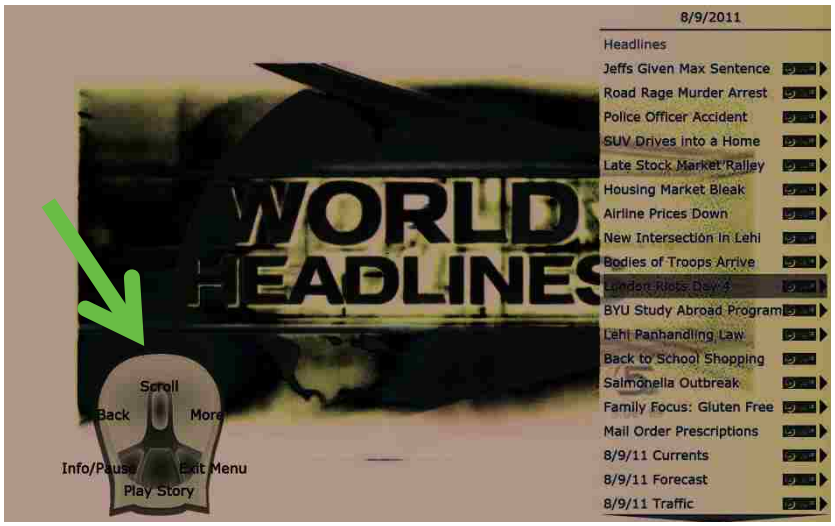

Figure 14: Control overlay for television viewers

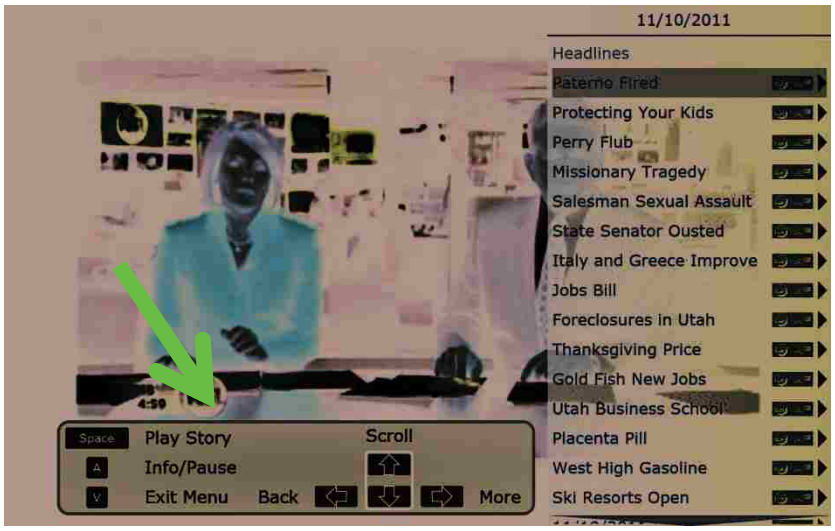

Figure 15: Control overlay for web browser viewers

For both television and web browser viewers, we provide a control overlay that displays the currently available actions to the viewer (see Figure 14 and Figure 15). To ease the learning process, the overlays were built to give a fairly accurate representation of the actual input devices. To maximize screen real estate, these overlays begin hidden, but can be brought up by the user at any time by clicking the remote's back trigger button or by moving the computer's mouse pointer. They are then hidden again after several seconds. The available controls change based on the viewer's actions and the current state of the viewing interface. By giving viewers constant, optional access to the controls, any novice should be able to quickly learn the system without encumbering viewers familiar with the system.

4.2.3 Basic Navigation

The core interactions of our system are based on the idea of casual viewing. Any interaction that happens at this level requires a single click or selection. While the interaction may modify the flow of the newscast, the newscast will continue playing on its new path to completion without any further interaction.

One set of casual viewing options that is always available is the ability to skip forward and backward throughout the stories in the newscast. If a viewer finds a story uninteresting, a single button click is a low-cognition action that equates to “show me something new”. The ability to replay a story or go backwards in the newscast allows viewers to access missed content with a single click. The viewers are also given the ability to pause and resume the newscast at any time.

4.3 Headlines

As part of the evolution from broadcast news to interactive news, our newscast system includes headlines similar to those found in Bunn’s work [3]. In a traditional newscast, introductory video clips or headlines are shown throughout the newscast’s time block. These headlines are used to tease major stories and maintain viewer interest with the hope of interesting content coming later in the newscast. However, in our interactive newscast, headlines are not only used to tease major stories, but also allow for upfront newscast customization.

Figure 16: Example of a headline with the optional control overlay

Figure 17: Example headline overlay

The first thing viewers see when they begin interactive newscast playback is a short series of video clips or headlines introducing some of the stories that will be shown in the newscast (see Figure 16). These headlines are accompanied by an overlay that shows the name of story being introduced as well as a visual showing that the currently playing clip is a headline (see Figure 17). While the headline is playing, viewers are able to rate or express their interest level in a story. The story playlist that is presented to the viewer will be rearranged based on the viewer's ratings. The possible ratings include the following:

- **Interested** – The view can express interest in a story by giving the story a "thumbs up". This is done using a single click on the remote or keyboard. Stories that receive a positive interest level will be brought forward in the playlist, so that they will be the first stories that the viewer watches.
- **Not Interested** – The viewer can express a lack of interest or a disinterest in a story by giving the "thumbs down". This is also done using a single click on the remote or keyboard. Stories that receive a negative interest level will be sent to the end of the playlist. This moves the least interesting content to the end of the newscast; however, this material is still available for access by the viewer at any time.
- **No Selection** – If a selection is not made by the viewer, then there will be no reordering of the story within the playlist. The newscast will continue forward regardless.

This ability to view headlines and rate stories informs viewers of the upcoming content and gives them the ability to do a preliminary reordering of the newscast playlist. By bringing the most interesting stories to the beginning, viewers are able to watch more of the content they want to watch sooner. By moving the least interesting stories to the end instead of removing them from the newscast, the stories are still available to the viewer if they are still interested in the newscast when they arrive at the stories within the playlist, which happened often in practice. From our study, we also learned that some viewers used the stories moved to the end of the playlist as a marker or signal for when they were approaching the end of the newscast. They liked knowing the newscast was reaching its conclusion.

4.4 Drop-down Prompts

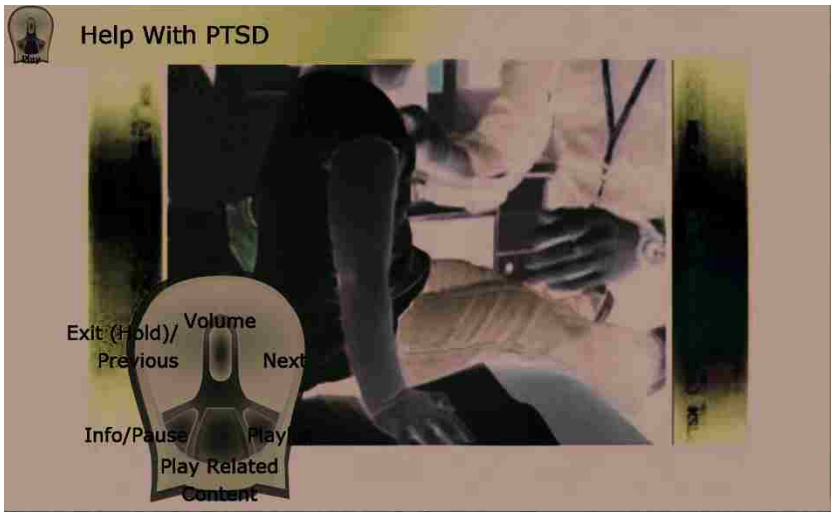

Figure 18: Example of a drop-down prompt with the optional control overlay

Once viewers are actually watching a story, there needs to be methods to direct them to additional material beyond that which is presented in the base newscast. This material can include additional interviews, other stations' coverage of the same story, etc. One method we include in our system is the drop-down prompt (see Figure 18). This is the preferred method of

accessing extra content in Bunn's system [3]. The drop-down prompt takes advantage of the hypervideo technique found in Hyper-Hitchcock [10].

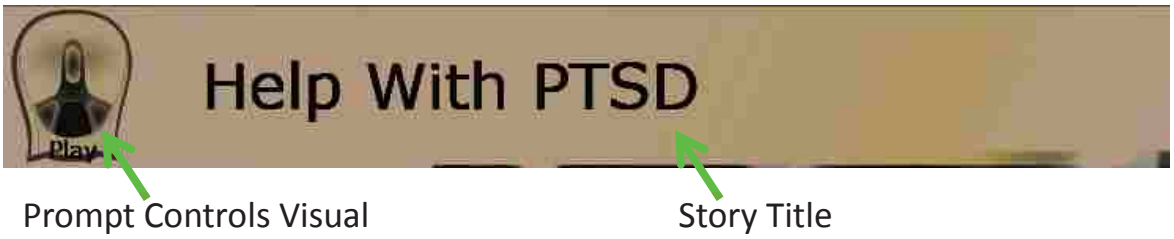

Figure 19: Example drop-down prompt

During story playback and when additional material is available for viewing, an overlay is shown at the top of the screen. This overlay contains the title of the additional material that is currently accessible as well as a visual showing that the overlay represents a prompt (see Figure 19). If viewers make the selection to view the extra content, the currently playing story is paused and the selected content is then presented to the viewer. Once the additional material has finished playing or if the viewer chooses to end the additional material early, the viewer is returned to the previous spot within the base newscast and playback resumes.

The drop-down prompt provides an easy and unobtrusive way to introduce viewers to and access additional material. However, it is a very passive way to get viewers to watch additional material. There is no direct invite. Results from both Bunn's study [3] and ours show that the prompt is not a favorable way to access extra content. In post-interviews, the reasons given by viewers included that they sometimes did not see it or, if they did, that they did not want to interrupt the story that was currently playing. Comparing actual usage of the different methods of accessing extra content in our system confirms this behavior. Pitches were a much more used source of extra content.

4.5 Pitches

Another change from the traditional newscast is the interactive pitch. Many times in a traditional newscast, a pitch is given at the end of the story by the news anchor. This pitch invites viewers to visit the news provider's website or view a later newscast to gain access to additional material about the currently running story. Because we are not limited by broadcast technology, we not only invite the viewer to seek additional material in our interactive pitches, but we give them immediate access to that material.

In our interactive system, pitches may be shown at the end of a story. These pitches include a video clip that introduces viewers to additional material and then invites them to access it. This additional material could include one or more stories. If the viewer chooses to access the additional material, the newscast is paused and the viewer is immediately taken to the additional material. The viewer can skip individual pieces of additional material or all of them at any time. Once the viewer has chosen to exit the additional material or there is no more additional material to view, the viewer is taken back to the main newscast and playback resumes.

Figure 20: Example of the generic pitch overlay that is accompanied by an audio invite

Because of resource constraints, our study's implementation of the pitch only includes a set of generic pitches that consist of a static image and an audio invite directing the viewer to access the additional material as in the example in Figure 20. Study results show that interactive pitches are a much more effective method of providing access to additional material compared to prompts. These results are given in Chapter 10.

4.6 Playlist Menu

Figure 21: Example of playlist menu

Because a newscast is basically a playlist of stories, it makes sense to provide a way to visualize this playlist and allow for complete on-demand access. We call this interface item the playlist menu and is similar to the one found in Bunn's system [3]. An example of this playlist menu is found in Figure 21.

Even though the playlist menu requires more interaction, it is extremely simple to interact with. With a single click, the viewer can be taken to the playlist menu. Once there, they are presented with a list of all the stories in the newscast. The viewer can scroll up and down and make selections. Once a viewer has selected a story, the current story is replaced with the selected

story and newscast playback resumes. Stories that have already been watched by the viewer are deemphasized. Accessing the playlist menu does not stop newscast playback. After several seconds without any interaction, the playlist menu will disappear, minimizing the amount of necessary interactions.

The playlist menu is a simple, effective means to allow viewers to know the contents of the newscast and select exactly the content they want. Its simplicity moved us to extend it to support our next features, the extra content menu and info display.

4.7 Extra Content Menu and Info Display

Figure 22: Example of the extra content menu accessed off the playlist menu

For those who are exploratory viewers, we need to provide a way for them to be able to access all additional available material related to the stories at hand. Our solution was to provide an extension of the playlist menu called the extra content menu (see Figure 22). As an extension, it can be accessed off of the playlist menu.

Accessing the extra content menu is fairly simple. Next to each story in the playlist menu, there is an arrow showing whether there is additional material associated with that story. If the viewer

highlights the story, they have the option to navigate into the extra content menu for that story. This extra content menu contains all stories added by the news provider that are associated with the base story. It also contains a historical content entry that provides access to all previous material that shares a topic with the currently selected story. Stories in this menu can be selected and played in a new video overlay, pausing the main newscast. Once the story has finished or the viewer chooses to end the story, the viewing system returns to its prior state and newscast playback resumes. Items found in the extra content menu can also have extra content associated with them, allowing for a deep menu and selection system along with the ability to provide access to a lot of additional material. The viewer can navigate backward and forward though the menu hierarchy and can exit it completely at any time. If the viewer does not interact with the menu for several seconds, the menu will disappear automatically.

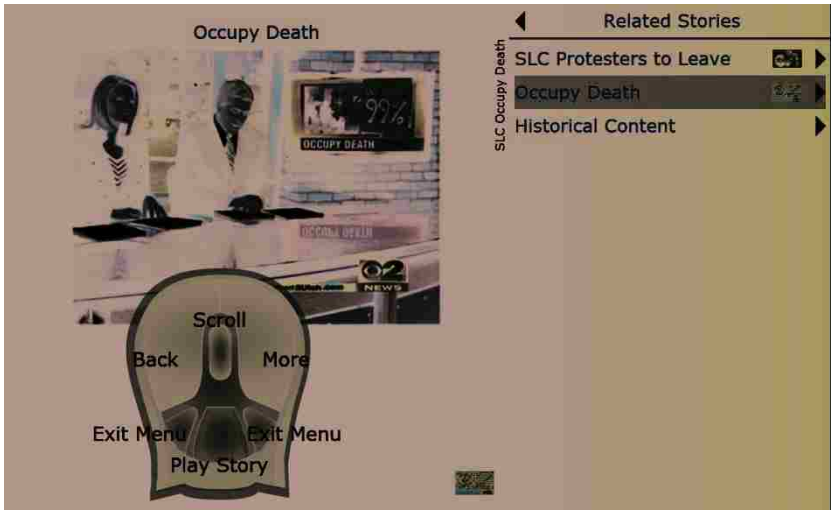

Figure 23: Example of the extra content menu and the info display

Because navigating the extra content menus may be confusing with the newscast playing in the background and to ensure that viewers do not miss important newscast content, we take advantage of the ability to pause the newscast to present the viewer with the extra content menu along with an informational display (see Figure 23). The informational display can provide

additional information that describes the highlighted story within the menu. Any stories played while in this mode will play within a video overlay that appears upon selection. This includes stories found in the base newscast. The viewing system will return back to the same place within the menu after story completion. The info display mode will not return to regular newscast playback without further interaction. Once the viewer has chosen to exit the info display mode, the viewer is returned to the original location within the newscast and playback of the base newscast resumes.

Figure 24: Example of the base newscast stories being displayed as extra content along with the info menu

Allowing access to the base newscast from the info display mode (see Figure 24) allowed for some interesting behavior from a small subset of viewers. These viewers entered immediately into this mode and then proceeded to watch the newscast completely through the menu. That means that when one story finished, the viewer would have to actively select the next story they wanted to watch. This created a much more lean-forward experience for these viewers.

Even though the menu system requires a more lean-forward approach, we feel that it is a necessary inclusion to give the viewer full access to potentially interesting material. It also does

not interfere with the overall experience, nor the more casual interface features discussed earlier. Because it does not encumber the interface, it is a useful and valid additional resource to our news viewing system.

4.8 Extra Content

One of our primary goals is to deliver newscasts with a content-rich experience. By including a substantial amount of additional material alongside the base newscast, we ensure that we will be able to provide both topic breadth as well as story depth.

We have identified several types of extra content that deal with interactive news:

- **Alternative Viewpoints** – For a given story, this is any story whose content covers the same as the original, but from a different viewpoint. This typically consists of stories done by competing stations. An example would be two stations covering the same celebrity trial on the same day, each with its own take on the issue at hand.
- **Story Related Material** – This includes any material that is directly related to the current story. If a story includes a partial interview, a clip showing the full interview could be story related material. If the story was about children and the common cold, a stock video describing ways to keep your child from getting sick at school could also be story related material.
- **Topic Related Material** – This is any material that not directly related to the story, but rather the general topic that the story represents. For example, if the main story was about a Veterans Day celebration, a story about a veterans' awards ceremony would be topic related material.

- **Historical Material** – This is previous material that is not currently news, but is related to the story at hand. Many stories, such as a story about a high profile trial or a war, can take place over days, weeks, months, or even years. All of these previous stories may have contextual information valuable to the viewer. For the purposes of our study, we define all previous content that shares the same topic as the current story as historical material.

Drop-down prompts, pitches, and the extra content menu are the various methods that we include for accessing this additional material.

All of these features included in our viewing system provide a quality interactive experience for viewers and are packaged in a television-friendly interface. In support of our thesis, this allows viewers to interactively adapt the news to their individual schedules, needs, and interests. Viewers have a simple set of optional navigation controls. Headlines provide upfront newscast customization. Prompts and pitches give easy access to additional material that provides story depth. The playlist and extra content menu provide on-demand access to all content available in the system, giving the viewer access to content depth and breadth. By providing and testing these various features with a large body of additional material, we can begin to understand which features are truly important in an interactive news system.

5 Interactive Newscast Model

Now that we know the features that we need to support and how it should look to the viewer, we can discuss the interactive model that will be used to create this experience. In support of our thesis, the model must meet the needs of our viewing system, but also make it easy to create interactive news. This chapter introduces a generic model and production process that can be followed to create interactive television news.

5.1 Interactive Newscast Elements

We will first define the basic elements that make up our interactive newscast model:

- **Video Feed –** An encoded video feed stored in the Video Repository and its associated metadata.
- **Clip** – An element that represents a start and end location within a video feed; essentially, a chunk of consecutive video within the video feed. When a video feed is created, a default clip the length of the video feed is also created.
- **Story –** An ordered collection of one or more clips that will form a single, coherent story on playback and the associated metadata. Beyond the collection of clips, there are several important pieces of metadata:
    - **Topic** – Describes the general category or running story under which this story falls. This is used to automatically generate a Historical Content item at the end of the extra content menu. Stories in the Historical Content will be ordered in reverse-chronological order.
    - **Headline Clip** – An optional clip that can be used to help create the initial set of headlines at the beginning of the newscast.

    - **Pitch Clip** – An optional clip that can be used to create a video pitch at the end of a story.
    - **Extra Content** – An ordered list of additional stories, related to the current story, which should be included at the base level of the extra content menu. The Historical Content option in the extra content menu will be automatically generated based on the topic.
    - **Content to Pitch** – The ordered list of content that will be shown to the viewer if they choose to follow the pitch.
    - **Prompts** – A list of start and end times along with references to pieces of extra content that will be shown should the viewer choose to follow the prompt. The prompt text is taken from the story title.
- **Newscast** – An ordered collection of one or more stories and the associated metadata.

These four elements can be used to fully describe an interactive newscast that news providers can create and the viewing system can interpret to deliver the interactive experience to the viewer.

5.2 Interactive Newscast Creation

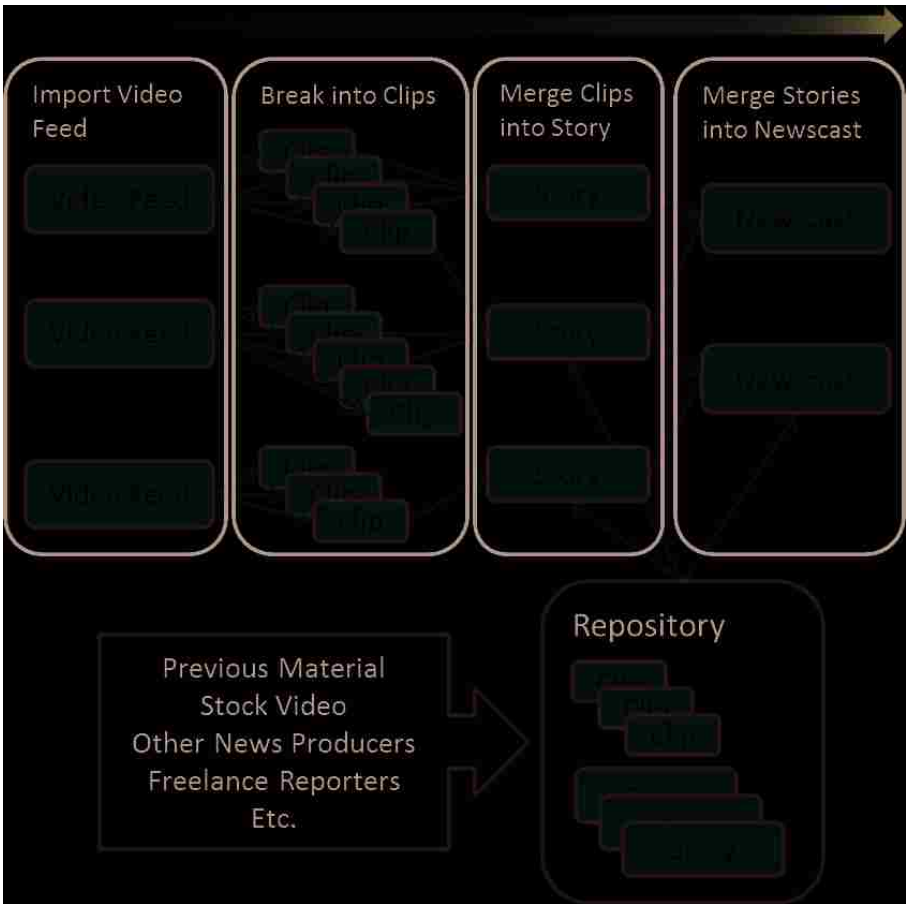

Figure 25: General newscast creation process

We must now discuss how video feeds are transformed into an interactive newscast. This process is shown in Figure 25 and is broken up into four steps:

- **Imported Video Feed Creation** – This includes everything found in the video ingestion process described in Section 3.1. Metadata can also be modified after a video feed has been imported into the system.
- **Clip Creation** – Either using metadata brought in from newsroom systems or by manual annotations, video feeds are divided up into clips. These clips become the base units used

in interactive newscast production. All clips created are stored in a central repository accessible from the Interactive News Server.

- **Story Creation –** Using metadata brought in from newsroom systems and by manual annotations, a story object is created. This story object contains all of the metadata necessary to describe the story to the interactive system. Clips can be taken from the central repository and combined to create the video segments that compose the story. Optionally, clips can be taken and used to define a headline and pitch clip. Extra content stories can also be associated with the story object and a collection of prompts can be created. All stories that are created are also stored in a central repository accessible from the Interactive News Server.
- **Newscast Creation** –Story objects can be taken from the central repository and combined to create the actual newscast.

This content creation process is significantly different to that found in Bunn's work [3]. Unlike Bunn's work, there is no special designation for headline feeds, extra content feeds, and newscast feeds; all video coming into the system is treated the same. This means that clips can be used and reused throughout the newscast as the provider sees fit. Clips and stories are even stored for reuse in later productions. This allows for a much more open flow of video resources and liberates news providers to create interactive newscasts as they see fit, while maintaining a general flow that matches what is found in traditional news production.

While we present newscast creation as a somewhat linear process in Figure 25, our general newscast model actually enables parallel content creation. Because newscasts are a container for a set of stories and stories are a container for a set of clips, all relevant metadata can actually be added to newscasts and stories even before the video feeds are ingested into the system. This

includes all of the extra content that is to be associated with the stories. Once video feeds have been imported and divided into clips, the clips can then finally be added to the stories. Stories can be created in parallel and video feed segmentation can be done in parallel for the different video feeds being imported. This can allow reporters to maintain complete ownership over a story even after it has entered into the interactive realm. They can handle metadata creation and the content that will ultimately become part of their story. Parallelization also speeds up production time. This open process should give full freedom to providers as they manage the needs of a full news production.

Because all material, past and present, created by the various providers is available from the central repository, we ensure that there is plenty of content available for newscast creators to work with. Because content is available from other news providers, alternate viewpoints can be made available and news aggregation can occur. Because, potentially, anyone can import video feeds into the system and create clips and stories, freelance reporters have a medium in which they can share their content with major news providers.

One important system restriction that must be made to this system is that only those who create a piece of content can actually modify that content. News providers will want to maintain control over how their content is presented. While we do nothing to enforce content sharing policies, one can assume that such policies would have to exist in a commercial implementation.

Another important feature is that this process does not interfere with or change how reporters do their reporting. Reporters can gather information and create their story in the traditional manner. The only difference is that, when they have finished that process, they export the story into the

interactive news system. By not interfering with the reporters work, we are able to present a new news creation and delivery medium without any changes for a large portion of newsroom staff.

This simple, general interactive newscast production flow allows us to create an interactive newscast that contains the features necessary for an easy-to-use, content-rich interactive experience. This process enables news providers and does not radically change the overall model of traditional newscast production. Much of the potential additional work can be mitigated by including methods for bringing current newsroom system metadata into our system.

5.3 Interactive Newscast Delivery

Once all of the pieces have been assembled and a newscast is finalized, the newscast object can then be delivered to the viewing system. From the newscast object, the viewing system will construct the interactive newscast by first requesting all of the relevant metadata for the various newscast elements (stories, clips, etc.). The majority of playable components are simple collections. The base newscast stories can be loaded and played sequentially. When a menu is to be shown, the relevant collection can be loaded into that menu. There are a few components, however, which require a further explanation.

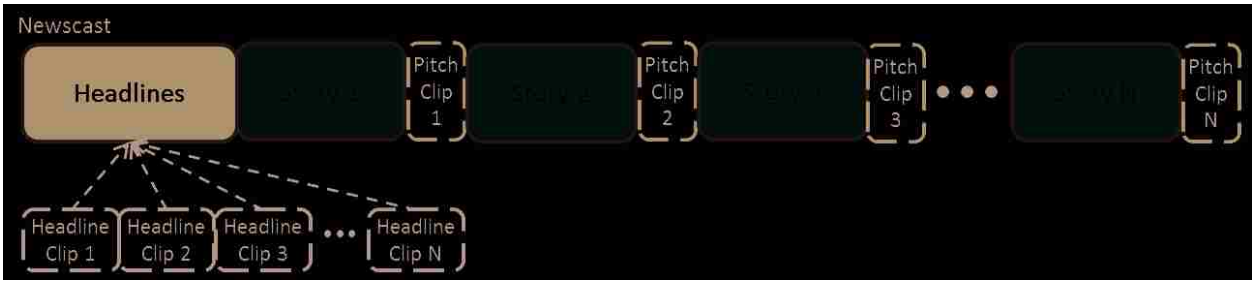

Figure 26: Example newscast with headlines and pitches included

Several of the stories within the newscast may have a headline clip associated with them. These headlines are shown at the beginning of the newscast. In our implementation, we gather the

various headline clips and combine them into their own special story that we insert at the beginning of the newscast (see Figure 26). In playback and menus, the headlines are treated like any other story. The only difference is included markers that tell the system that a currently playing clip is a headline. These markers also know the newscast story that is associated with the clip.

Many stories may also have a pitch clip associated with them. Once a story has finished playing and if a pitch clip is present, it is shown to the viewer (see Figure 26). Because we do not want to burden viewers with a pitch after every story, we limited the amount of pitches we associated with stories.

Knowing what features our system needs to support, we have been able to develop a simple, flexible model that enables parallel content creation, includes several interactive features, and is easily adaptable to the traditional newsroom. In doing so, we have created a model that meets the needs of the flexible interactive news system that we defined at the outset. With this understanding, we are finally able to create an implementation of the production system which we used in our user study.

6 Production System Implementation

With the understanding of how all of the pieces go together, we need an interface implementation that allows for rich content creation based on our model. We did not have access to an actual newsroom and its production system data during our study. We therefore built a system based on complete manual creation of the interactive newscast. This system is just one possible implementation that shows the viability of our model and that the creation of a flexible interactive news production tool without undue burden to current newsroom processes is feasible. This chapter discusses our implementation of the production system.

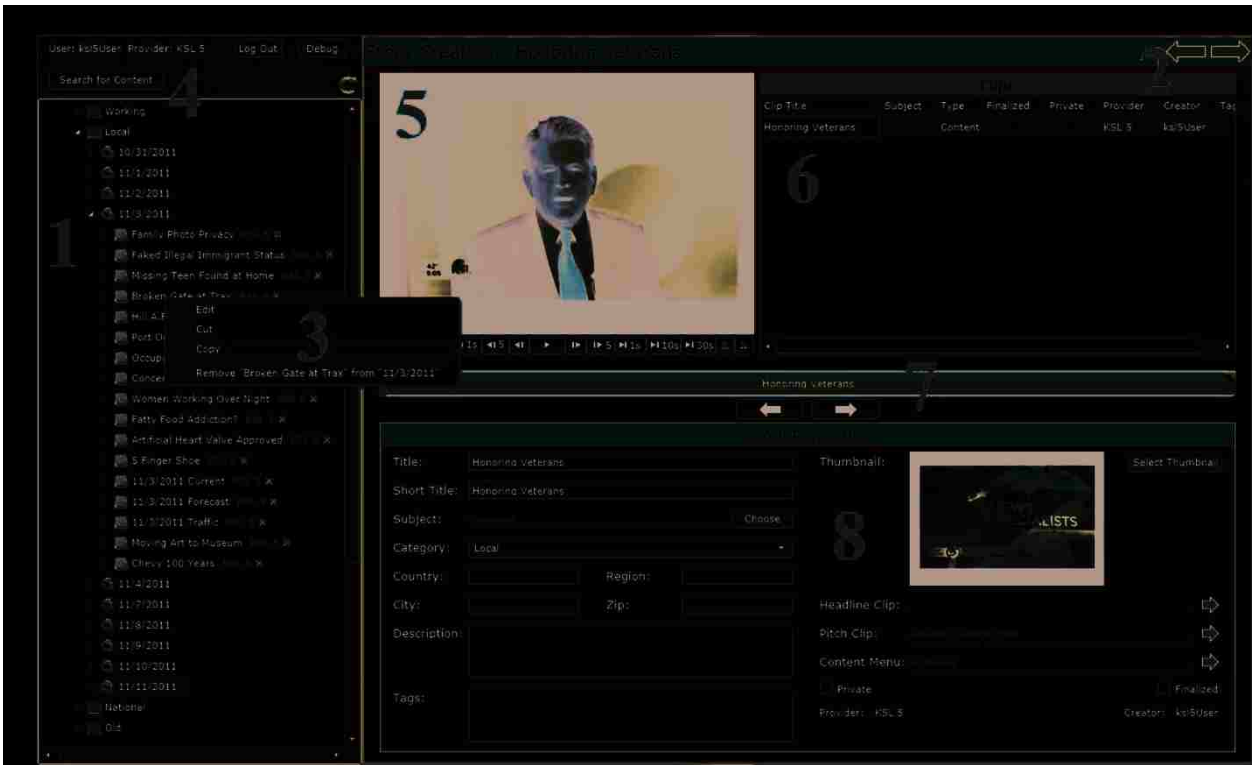

Figure 27: Example screen from our production system interface

Because we are drawing content from multiple sources and are allowing for parallel content creation, we need an interface that pushes flexible navigation as well as content accessibility. New content needs to be creatable and both old and new content need ways of being edited.

These features are found in our system. We describe these features using an example screen from our implementation found in Figure 27:

1) **Navigation Pane** – The left side of the interface is occupied by a directory-style navigation pane. Here content can be accessed, moved, and created. When content is accessed, it is displayed on the right side of the interface in an editor that takes up the majority of the screen real estate.
2) **Back Button** – A back button is provided to quickly go to previously accessed content without using the navigation pane. This is especially important for top-down workflows where newscast creators access the newscast, then a story within the newscast, perform edits, and then want to return to the newscast to access the next story without searching for the newscast or following story in the navigation pane.
3) **Context Menu** – A right click on items in the navigation pane brings up a context menu that provides options based on the clicked object and the content currently in the editor. Using this, providers can create new content and add selected content to the current editor item (e.g. adding a clip to a story).
4) **Search** – We implement basic search functionality to enable providers to find any content that is available in the system.
5) **Video Player** – A simple video player that contains navigation controls and plays back the video associated with the item displayed in the editor.
6) **Collection Content –** Most items contain a list of the clips or stories that make up the playable content items contained in the current editor item. This list can be used for both information and navigation, taking the newscast creator to the content upon selection.

7) **Timeline** – This is another view of the collection content. Here content can be reordered and the user can go directly to a location within the timeline. When annotating a video feeds to break it up into clips, the user interact with the timeline to decide where breaks should occur.
8) **Properties Editor** – Every piece of content has a properties box where users can edit the various pieces of metadata associated with the current object.

The production interface is much more complicated than the viewing interface and requires some learning. This is not a problem. Whereas the viewing interface needs to be immediately intuitive to consumers, users of the production interface can be trained as they would be with any other system in their work environment.

One thing we found during testing of the production interface is that users treat newscast creation as a filling out a specific newscast object rather than a bringing together several pieces to form a newscast. Our initial production flow had users creating content in the order of the newscast model: users create clips, then create stories for those clips and associate those clips with the correct stories, then create newscasts for those stories and associate those stories with the correct newscast. This turned out to be backwards from the expected behavior. Users first wanted to create a newscast, create a set of stories directly in the newscast, add the metadata, and finally add the clips. We tweaked our interface to better enable this flow.

Our goal was to create a production system that amply met the needs of our interactive production workflow and was implementable in a reasonable amount of time. While there are many possible features that could be included on top of what we implemented in our system, our implementation presents a straightforward, easy-to-use, time-efficient method for interactive

newscast creation that fully met the needs of our four week user trial. This helps prove the feasibility of flexible interactive news creation in support of our thesis statement. How this system was used in the trial will be discussed in the next chapter.

7 User Study Production Process

We wanted to perform a user study that could test the validity of both our viewing and production systems. Because we did not have access to an actual newsroom for this study, we decided to draw our news content from what was available on broadcast television. Because we wanted the content to still be considered news when delivered to viewers, we sought to minimize the delay between when the news was first broadcast and when the interactive newscast went live to only a few hours. This chapter discusses the procedures we followed and content we worked with in the production process to deliver interactive news to our viewers. These procedures support our claim that interactive news can be created and delivered in a timely manner without undue burden to the traditional newsroom. We also note where this process could be improved given access to commercial and newsroom systems.

7.1 Interactive Newscast Production

Because we have chosen to evolve and augment television news, the majority of the components necessary to make a successful interactive newscast are already present in a standard news broadcast. We were able to pull introductory teases and headlines from the broadcast and use them to help create our headline clips that would be used to generate the headlines at the beginning of our interactive newscast. We were able to make use of all the individual stories found in the broadcast. We also created a set of generic pitches that we could use based on the extra content that we were pitching.

The main problem was getting sources of extra content beyond the broadcast. We decided that we would derive the majority of our extra content from other stations and news broadcasts that were happening around the same time as our main newscast. This allowed us to provide alternate viewpoints and topic related stories to augment the stories in our base newscast. We also

performed several weeks of news production before our actual study to ensure a good historical content base. With all of these sources, we were able to provide an ample supply of extra content to our main stories.

We decided to use the half-hour 5 PM newscasts from three local stations (KUTV 2, ABC 4, and KSL 5) along with their national affiliates' half-hour newscasts (CBS Evening, ABC World, and NBC Nightly) that followed. We chose the 5 PM news to ensure we could deliver the interactive newscast to viewers by a reasonable hour that same evening. We also decided to include hour-long newscasts from two national news stations (CNN Newsroom and Fox News' America Live). We also decided that the local KSL 5 newscast would be the main newscast that would be presented as an interactive newscast to our viewers. The content from the others newscasts would be used to provide extra content to our interactive newscast.

Because we did not have access to newsroom systems, we had to do all annotations by hand. This included creating descriptive metadata, segmenting video feeds into clips, and creating the interactive stories and newscasts. We employed three individuals to help develop the interactive news so that the different stations' newscasts could be worked on in parallel. We also had a communications graduate student, familiar with broadcast news production, to act as producer and manage the overall creation of the interactive newscast. We employed these individuals over a four week period. The first two weeks were used as training to get the users familiar with the system as well as to develop a historical content base. The second two weeks were the actual trial where news was delivered to viewers. We used news broadcasts and created interactive newscasts only on the weekdays during our four weeks of newscast production.

The two national station newscasts were annotated earlier in the day as they became available. The local stations' and their national affiliates' newscasts were treated in a time-sensitive manner. The sooner we could get the news to viewers, the fresher it would be. Because of this, we developed a strict schedule that would allow us to deliver the full interactive newscast by 8 PM the same evening (a three hour time delay).The following is the schedule we were able to follow each weekday during our two week trial:

- 5:00 PM
    - Begin recording local news broadcasts.
    - Begin interactive newscast creation for local news broadcasts.
- 5:30 PM
    - Finish recording local news broadcasts.
    - Begin recording national news broadcasts.
    - Begin video ingestion of local news broadcast feeds.
    - Begin interactive newscast creation for national news broadcasts.
- 6:00 PM
    - Finish recording national news broadcasts
    - Begin video ingestion of national news broadcast feeds.
    - For the deliverable interactive newscast, add all extra content annotations.
- 6:00 PM – 7:30 PM
    - Video ingestion finishes for the individual feeds
    - As feeds become available in the production system, perform video feed annotation and break the feeds into clips.

    - After video feed annotation is completed, add created clips to their respective stories.
- 7:30 PM – 8:00 PM
    - Finalize deliverables and make interactive newscast live for viewing in the viewing system.

As shown in the schedule, our first limitation was that the news broadcast had to be fully recorded before we could begin video ingestion. Video ingestion also took about an hour to complete for each half-hour of video. We had multiple systems handling the encoding so that this would not be a bottleneck. While these were limitation for our trial system, a commercial system could ingest video in near real-time using new adaptive streaming encoders and better hardware. This would reduce the committed time to this process to almost nothing. Ingestion can also begin as soon as reporters submit their video, which would be well before broadcast.

Even though we could not pull metadata from newsroom systems, we were still able to add the required metadata in real time as the news broadcast was being watched by our production system users. This step could also disappear with the ability to pull metadata from current newsroom systems.

After all the relevant metadata had been added to the available stories, our news producer was able to add all the metadata necessary to include the extra content in the newscast. This process was generally all completed before even a single video feed had finished encoding. This is the only step that provides metadata unique to an interactive newscast and would, therefore, probably be a required step in a commercial system.

Once broadcast video feeds had been ingested into the system, they could be annotated and broken up into clips. Clips were created to represent the various stories and headlines available in the feed. These clips were then associated with their respective stories to complete the interactive stories. Commercials, lead-ins, and other non-story video were moved into clips that were marked as "Dead Time" so that they would not be mistaken for legitimate content for our interactive newscast.

Once all content had been created and the clips had been associated, the newscast was marked as finalized. This allowed the newscast to become available on viewers' systems. Following this process, we were able to deliver our interactive newscast in a timely manner that maintained the relevancy of the content being delivered, unlike many other research systems that take a repository of stale content and seek to build a system around that.

We learned several things in the process of creating interactive news. First, when producing professional-looking content it is important to create a style guide. As we created news in during the first two-weeks, it was a rocky process of figuring out such things as how dates should be formatted or standards for titles, descriptions, etc.

Another issue is the training of those who are employed to do newscast creation. One of the three employed was familiar with news production processes. The quality of his work (naming, finding story breaks, etc.) was noticeably greater than that of the others.

Initially, we were not consistently pitching the same extra content that was also found in the drop-down prompts. About halfway through the final two weeks, we realized that prompts were not getting much attention from viewers. We then ensured that all remaining pitches additionally

pitched the content found in the prompts to make sure viewers would have access to that content during newscast playback.

Overall and even with our limited resources, the newscast creation process went smoothly. There were no major issues that we needed to consider or rework. This enabled us to deliver a consistent, quality experience over the final two weeks of the study. Tying into commercial newsroom and video encoding systems could only shorten the process and improve the experience.

7.2 Production Content

During the several weeks we were producing interactive content, we made use of a lot broadcast material. The sheer amount of fresh content used and created makes this a unique and important study. This chapter discusses the overall content used in this study.

In the weeks preceding the two-week in-home study, over 1000 stories were developed from the broadcast newscasts. These stories were used as an initial historical base accessible by their topic.

During the actual two-week study, 978 stories were developed from the broadcast newscasts. These stories were broken up into 206 different topics. Including the historical content base, this led to 288 different topics overall.

In summary and in support our of thesis statement, we were able to create interactive news along with its supporting extra content in a timely, efficient manner using our production system implementation, even without access to newsroom systems. It was easy to learn, even for those who had no prior news production experience. It allowed for the creation of flexible, content-rich interactive news that we were then able to deliver to our viewers.

8 Delivered Content

Even though we worked with around 2000 stories, only a portion of that was actually delivered to the viewers. Content that was actually delivered was based off KSL's 5 PM newscast that we fully converted into an interactive newscast. This chapter discusses the content that was actually delivered to the viewers.

In total, we delivered ten newscasts over the two-week period. We delivered the newscasts Monday through Friday each week (10/31/2011-11/4/2011 and 11/7/2011-11/11/2011). The last five delivered newscasts were made available for viewing at all times, including on the weekends. Making newscasts available for multiple days allowed viewers who missed watching a newscast to have the opportunity to catch up. Only providing five saved newscasts means we can still provide a week's worth of news, without cluttering the interface with older, staler newscasts from previous weeks. Since we ran the study through the second weekend, every newscast was available for at least the next two days following delivery.

Newscast Statistics	Min	Max	Average	StdDev
Newscast Length (minutes)	17.1	25.3	20.2	2.08
Number of Stories per Newscast	14	22	17.1	2.47
Number of Headlines per Newscast	2	5	3.5	0.85
Number of Pitches per Newscast	2	10	6.4	2.37

Table 1: Statistics of the ten newscasts delivered to viewers during the study

Table 1 contains general data about the ten newscasts that were delivered during the study. The length is the combination of the length of contained stories. It does not include commercials, lead-ins, and other such material classified as "Dead Time." The KSL newscasts contained more stories on average than any other station's newscast, leading to shorter stories on average. Twenty percent of stories delivered had an associated headline and were available for reordering

at the beginning of the newscast. Thirty-seven percent of stories were followed by an added pitch promoting additional material.

Story Statistics	Min	Max	Average	StdDev
Length (seconds)	13	399	71	57.44
Number of Prompts per Story	0	4	0.40	0.74
Number of Non-Historical Extra Content per Story	0	7	1.18	1.62
Number of Historical Extra Content per Story	0	138	25.26	34.26

Table 2: Statistics of base stories available in the ten newscasts used during the study

Table 2 contains the general data about the base stories present in the ten interactive newscasts. For clarification, at the base level on the extra content menu for a story, extra content included related material and alternative viewpoints. These are found in the table as non-historical extra content. Also in the extra content menu was a "Historical Content" element that viewers could go into and view the related historical material. This material found within the "Historical Content" element is labeled in the table as historical extra content.

In total, there were 171 base stories produced and used during the study. There were 72 topics covered across the stories. The most common topics were weather, transportation, and health and wellness. Twenty-seven percent of stories had prompts. Fifty percent of stories had non-historical extra content while ninety-two percent of stories had historical extra content. This led to 95% of stories having some form of extra content and 47% having both. By comparison, only 21.5% of stories in Bunn's study [3] had extra content. By providing extra content across the vast majority of our stories, we allow viewers to always assume there is extra material available. We hoped this would allow for more familiarity with the idea of extra content and increase its usage.

Because historical extra content is drawn from all previously delivered material, there was an every growing amount of it. More important was the amount of non-historical extra content that

we were able to include. There were 201 pieces of non-historical extra content used across the ten newscasts. These were divided into 76 pieces of topic related content and 125 alternate viewpoints. By comparison, Bunn's study [3] included 29 pieces of extra content across seven newscasts. Another difference was that Bunn's content consisted of story related content that was provided by the actual news station they were working with.

In summary, we were able to deliver a content-rich interactive experience. Compared to previous attempts, our study included significant amounts of extra content. This gives a better metric of how viewers use extra content. It also lasted a full two weeks, allowing us to see how the system was used over time. This will help us prove that our system actually allows us to create and deliver flexible, content-rich interactive news as described in our thesis statement. Now that we understand the content that was delivered to viewers, we need to understand the viewers that participated in the study.

9 User Study Viewing Participants

To test the validity of our system, we wanted to get as many viewers as possible to participate in our user study. Our main goal was to deploy it in several viewers' homes using small set-top boxes connected to their television. Because we could only deploy the television setup into a small number of homes, we decided to also allow viewers to access the system via a web browser to increase the number of viewers. This chapter discusses the viewers who were involved in the study.

As participants for the in-home television trial, we wanted individuals who were interested in news and, therefore, would be more likely to use the system, were fairly local, had the technology necessary to support and maximize the experience of an in-home setup, and were willing to participate. To aid us in choosing these individuals, we created a survey. This survey included tests for basic demographics, affinity for news, quality of their home internet connection, and willingness to participate in the study. We made this study available via email and social networks, reaching upwards of 2000 people.

In total, there were 377 people who took the survey. Of those, 128 people were eligible (over 18), agreed to participate, and shared their contact information. From these 128, we chose 10 individuals to participate using the in-home, television setup. We also made the newscasts available via a web browser to the entire 128.

Each set-top box came with a hard-coded identifier so we could distinguish them from the other viewers. When web browser users ran the viewing system for the first time, it would set up a unique identifier on their system so we could track their usage over time.

During the study, emails were sent out every weekday by 8 PM to remind trial participants that a new newscast was available and encourage them to watch the newscast according to their own schedule. Because viewers watched news according to their own schedule and needs, not all viewers watched every day. Some viewers did not watch any interactive newscasts.

Of the 10 television viewers, a total of 8 actually watched an interactive newscast during the study. There were 7 viewers during the first week and 8 viewers the second week, leading to 1 new viewer in the second week and 7 viewers watching during both weeks. Of the 128 potential web browser viewers, a total of 36 watched an interactive newscast. There were 31 viewers during the first week and 18 viewers the second week, leading to five new viewers in the second week and 13 viewers watching during both weeks. From post-interviews, we know at least one television viewer also watched the news via a web browser.

Because of the open nature of the system, we cannot tie specific survey results to individual web browser viewers. However, we are able to provide demographic information for the 128 eligible participants who were contacted and encouraged to participate. This full set of survey results for the 128 is found in the tables that follow in this chapter.

In Table 3, we see that the majority (78%) of those willing to participate were between the ages of 18-24. Participants were fairly evenly divided on gender (see Table 4). 45% of respondents said they access news 2-6 hours a week while 25% said they access news more than 6 hours (see Table 6), leading to a view that respondents are consuming news for a significant portion of their day. In Table 8, we see that respondents are getting their news from a variety of sources, but that the lion's share of content is being accessed via the Web. Part of this could be attributed to a significant portion of respondents who are doing their news gathering at work (see Table 9)

where access to television, newspaper, and radio would be limited. Finally, respondents seem to do their news gathering in the early morning and late evening (see Table 10).

Age	# Responses	%
18-24	35	27
25-34	65	51
35-44	10	8
45-54	12	9
55-64	5	4
65+	1	1

Table 3: What is your age?

Sex	# Responses	%
Male	60	47
Female	65	51
No Response	3	2

Table 4: What is your sex?

Ethnicity	# Responses	%
African American	0	0
Asian	1	1
Hispanic	5	4
White	120	94
Other	2	2

Table 5: What is your ethnicity?

# of People in Home	# Responses	%
1	5	4
2	33	26
3	36	28
4	25	20
5	10	8
6+	19	15

Table 6: How many people live in your home?

Type of News Consumer	# Responses	%
Light (0-2 hours a week)	38	30
Average (2-6 hours a week)	57	45

Heavy (6+ hours a week)	32	25
No Response	1	1

Table 7: What type of news consumer would you consider yourself?

Interest in News Type	Very Interested	Interested	Neutral	Disinterested	Very Disinterested	No Response
Local	39	60	21	7	1	0
National	50	64	12	1	0	1
World	32	74	21	0	0	1
Political	38	48	30	7	3	2
Business	15	43	46	17	5	2
Sports	33	26	22	27	18	2
Weather	28	47	38	6	7	2

Table 8: How interested are you in these types of news information?

News Sources	0-1 hours	2-3 hours	4-5 hours	5-6 hours	7+ hours	No Response
Television	80	33	7	2	3	3
Radio	81	31	8	5	2	1
Newspaper	100	18	4	2	0	4
Internet	38	38	21	19	12	0

Table 9: How much of your news information do you get from these different media types?

Location	0-1 hours	2-3 hours	4-5 hours	5-6 hours	7+ hours	No Response
Home	42	52	17	6	6	5
Work	67	22	10	5	11	13
School	80	13	4	2	0	29
Car	73	38	4	1	2	10

Table 10: Where are you when you consume your news information?

When	# Responses	%
12 am – 6 am	5	4
6 am – 9 am	33	26
9 am – 12 pm	19	15
12 pm – 4 pm	19	15
4 pm – 6 pm	7	5
6 pm – 7 pm	9	7

7 pm – 8 pm	5	4
8 pm – 9 pm	4	3
9 pm – 10 pm	14	11
10 pm – 11 pm	10	8
11 pm – 12 am	2	2
No Response	1	1

Table 11: What time of day do you consume most of your news information?

Motivation	Very Motivating	Motivating	Neutral	Unmotivating	Very Unmotivating	No Response
Education	48	65	12	1	1	1
Social Awareness	50	65	9	3	1	0
Curiosity	42	70	13	2	0	1
Entertainment	15	61	35	11	3	3
Escape	4	24	52	32	13	3
Boredom	9	25	51	26	15	2

Table 12: What motivates you to consume news information?

Expectations of News	# Expected	# Unexpected	No Response
Fair	110	16	2
Honest	121	7	0
Complete	104	24	0
Transparent	82	42	4
Entertaining	60	64	4
Factual	122	6	0

Table 13: What do you expect from your news information?

Our goal was to gather a significant number of participants to use our viewing system as well as a quality set of viewers who could participate using the in-home system. Through our survey, we were able to accomplish these goals fairly well. In hindsight, we should have provided methods for attaching survey results to those who actually used the system. All in all, we were able to gather enough viewers to allow for a significant user trial. The results from this trial are discussed in the next chapter.

10 Viewing Behavior

As part of the two-week user study, we implemented logging features within our viewing system so that we could learn how viewers used our system. We also followed the two-week trial with in-person interviews of our television users to understand their direct reactions to the system. The complete transcript of these interviews is found in Appendix A . These interviews were accompanied by an email follow-up survey that was available for all users to provide their feedback. This chapter discusses the results and formative evaluations made based on the gathered viewer data. These results show that our design allowed us to create an interactive television news system that viewers enjoyed and allowed them to adapt the news to their individual schedules, needs, and interests, which is what we set out to prove.

10.1 Sessions

Before analyzing the data, we divided viewers' usage up into sessions. We define a session as the time from when a viewer begins watching a newscast to the time they exit that newscast. This means that if viewers pause the newscast and then come back later to finish the newscast, it will all be treated as one session. This also means that multiple sessions can happen, one right after another, for any particular viewer if they decide to watch multiple newscasts in one sitting. This behavior occurred when viewers were catching up on older material.

		Week 1	Week 2	Overall
Number of Sessions	TV	22	39	61
	Web Browser	51	45	96

Table 14: Breakdown of the number of sessions watched during the study

Within the session data, we wanted to remove session and story views that were false starts. Therefore, we removed all session data for sessions that had less than one minute of content viewed. We also did not count stories as being viewed if they were viewed for less than 1.5

seconds (e.g. a viewer navigating by clicking next, next, next, previous in rapid succession should not have the intermittent stories counted as viewed). These very short views do not generally leave enough time to learn what the current story is about, so it should be safe to assume that these were accidental views. After this cleanup, we were left with a total of 157 sessions (see Table 14). Bunn had a total of 44 sessions in his study [3].

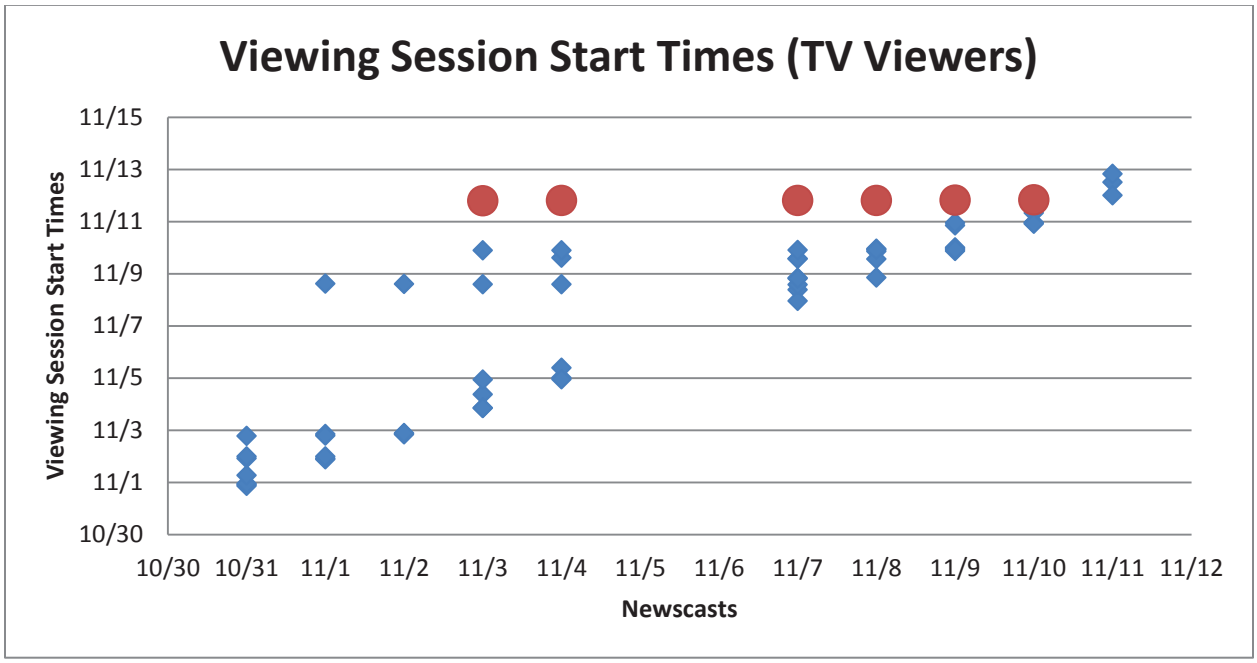

Figure 28: Viewing session start times for each newscast (TV Viewers) (emphasizes a viewer who watched multiple newscasts in a single sitting)

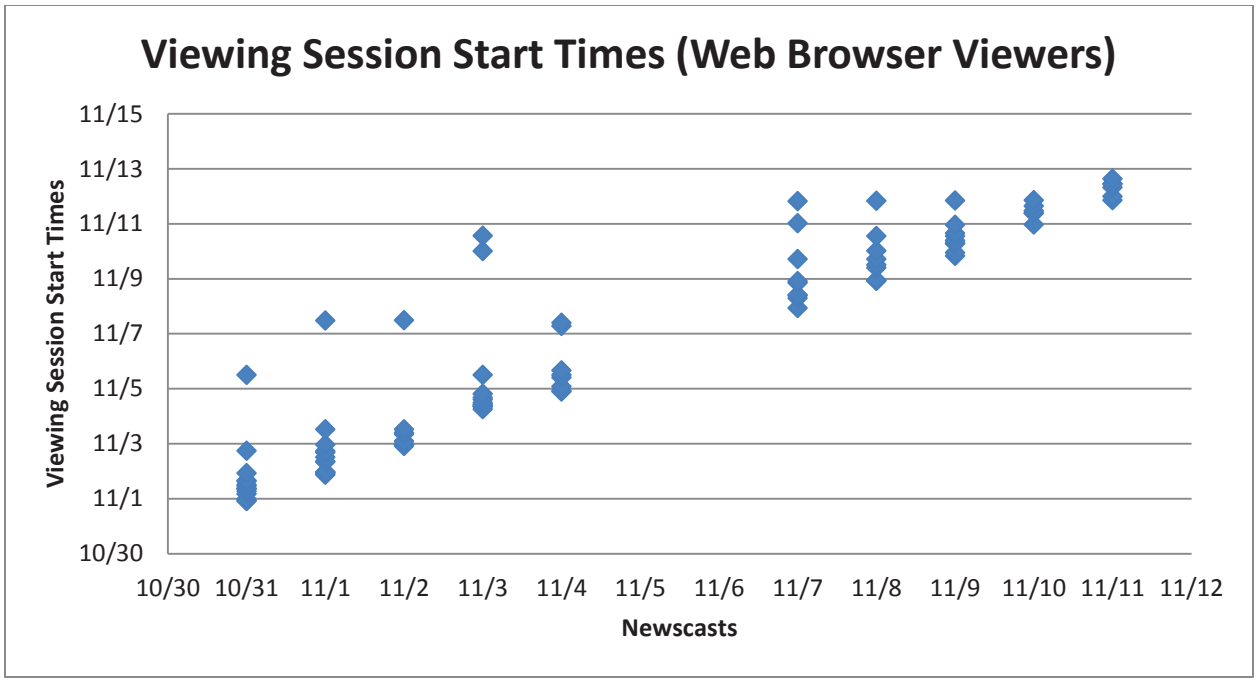

Figure 29: Viewing session start times for each newscast (Web Browser Viewers)

Figure 28 and Figure 29 show the session start times over the two-week study for television and web browser viewers respectively. We see that most sessions began shortly after the respective newscast became available. For television viewers, 59% of sessions began within the first 24 hours of newscast availability; for web browser viewers, 76%. However, we also see that a large share of sessions began later; even days after the respective newscast became available.

	Min	Max	Average	StdDev
TV	0.06	190.92	35.19	48.26
Web Browser	0.03	161.65	23.69	31.33

Table 15: Time after newscast availability before being watched in the session (in hours)

Table 15 confirms this by showing that the average time after newscasts availability before being watched in the session was over 35 hours and 23 hours for television and web browser viewers respectively. At least part of this behavior can be explained in Figure 28. Highlighted are six sessions covering six different newscasts all viewed by the same viewer within a relatively short period of time. From post-interviews, we found that some viewers may have not watched the

news for several days, and so watched content from several newscasts in a row to catch up and ensure they had not missed anything in the previous several days. This was a behavior practiced by both television and web browser viewers. Our assumption was that viewers would think this past news too stale to be worth viewing. This seems to not be the case. This may be encouraged by the fact that, since viewers have control, they can choose what feels fresh; there isn't a great fear in looking at several-day-old news because they can skip out-of-date stories or stories they are already familiar with at will. Some viewers commented on this fact that they didn't have to sit through several hours of news to catch up; they could just watch the parts they wanted.

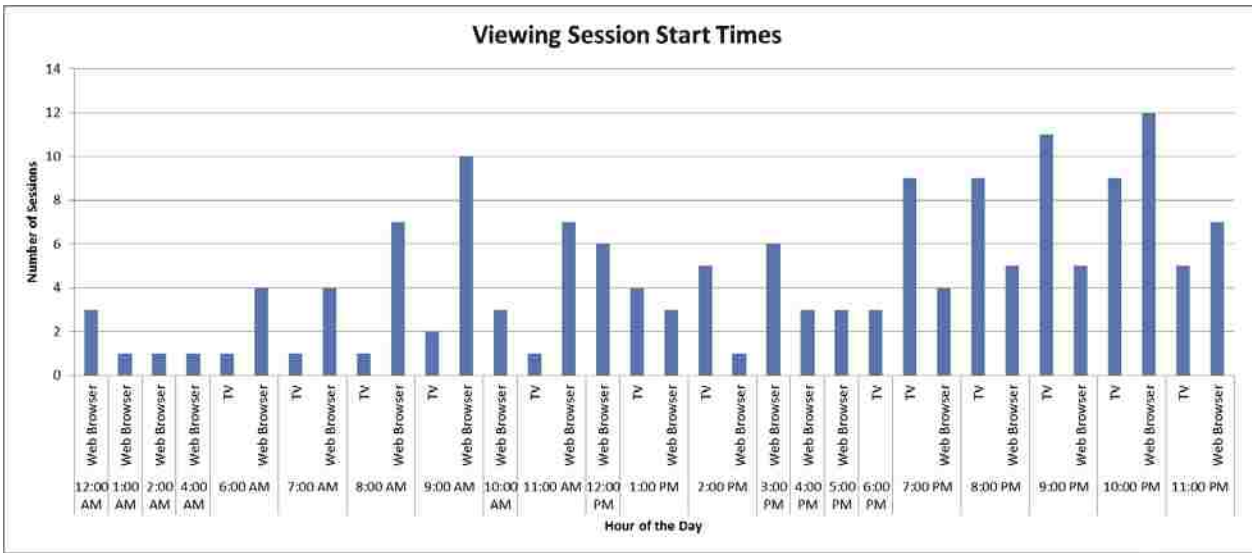

Figure 30: Histogram of session start times over the two week study

Figure 30 shows the hourly breakdown of session start times for both television and web browser viewers. This is presented with the understanding that newscasts were made available starting at 8:00 PM the night they were produced. We see that television viewers generally watched in the evening. Web browser viewers also watched at night, but there were a fair number who watched in the morning, most likely when they checked their email and saw that the newscast was available. Truly, web browser viewers watched throughout the day, most likely because of

constant availability (i.e. they likely always had their computer with them). All of this shows that viewers enjoy being able to consume news according to their own schedule.

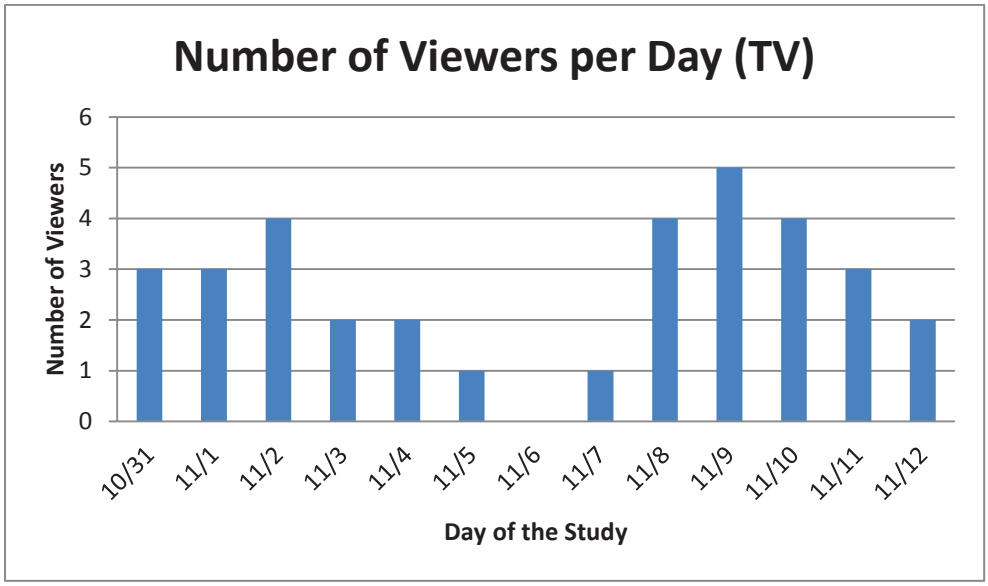

Figure 31: Number of viewers per day (TV)

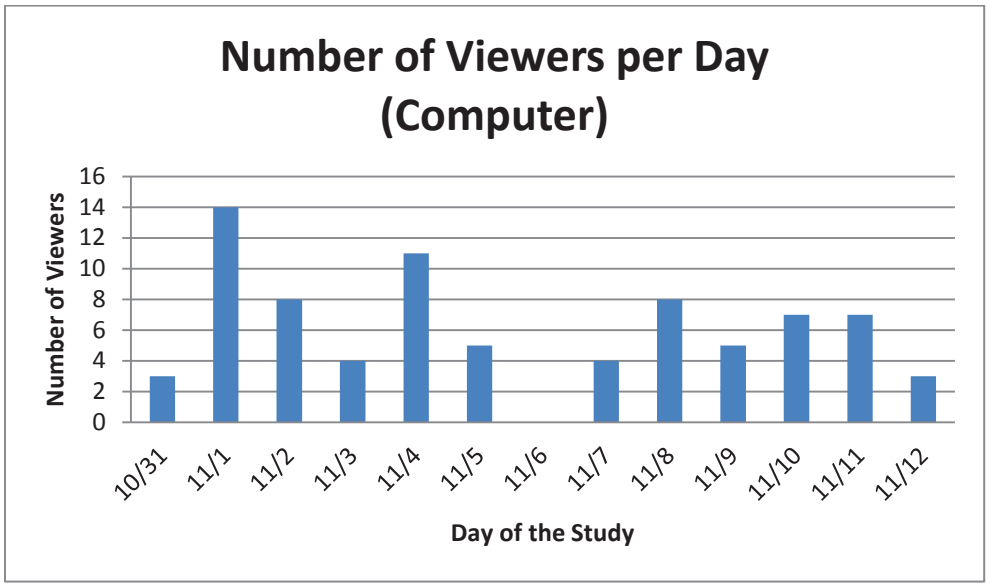

Figure 32: Number of viewers per day (Web Browser)

Figure 31 and Figure 32 describe the number of viewers that watched at least one session during any specific day of the study. From these figures, we see that web browser usage dropped off

over time while television usage actually spiked during the second week of the study. No news was watched by any viewer on the two Sundays that were available during the study.

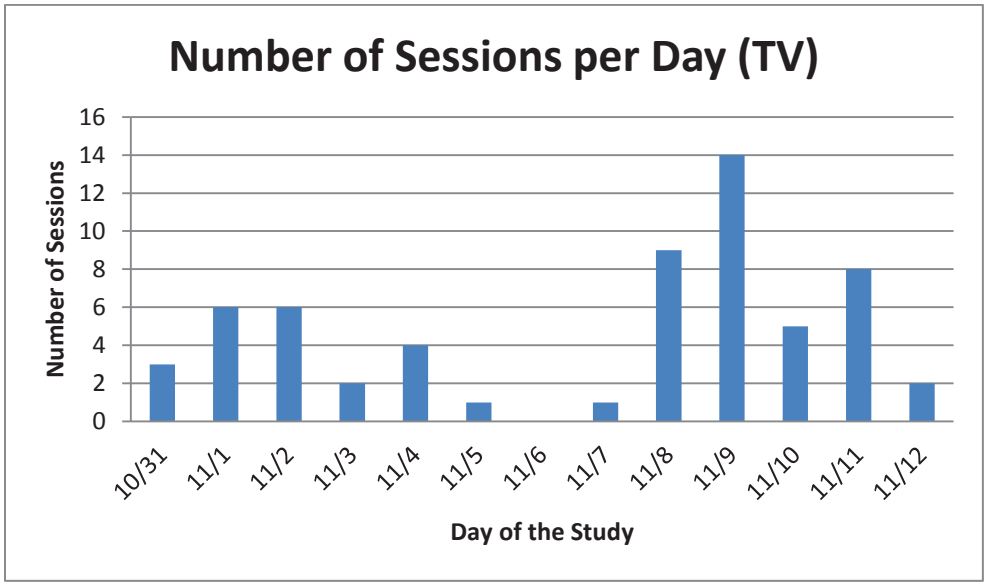

Figure 33: Number of sessions per day by television viewers

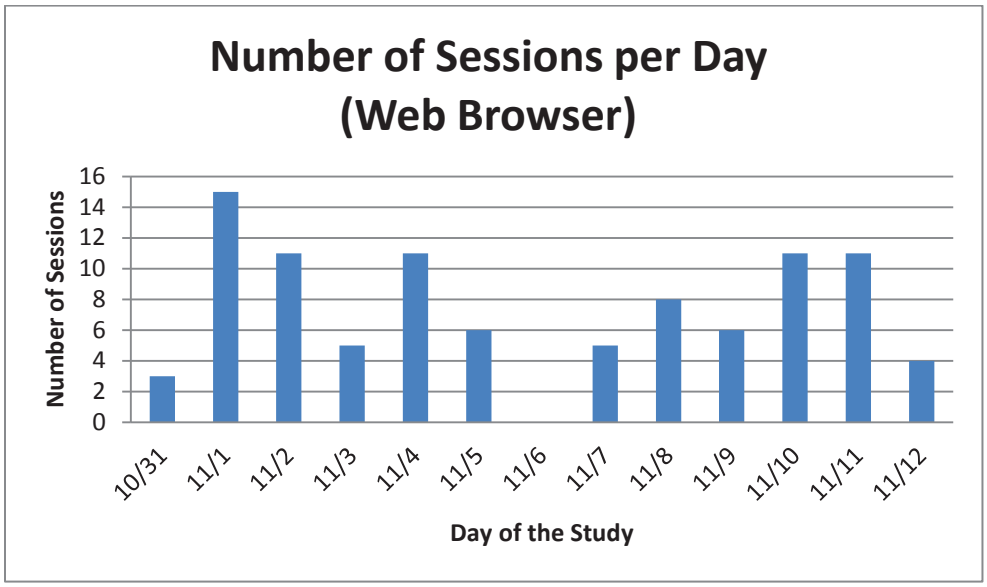

Figure 34: Number of sessions per day by web browser viewers

Figure 33 and Figure 34 show the number of sessions that were watched per day. As stated earlier, there were several viewers who watched more than one newscast in a single day. This

lead to peaks in the second week for television viewers as they were trying to catch up on news missed from the previous week, leading to 14 sessions being watched with a total of 5 television viewers watching that day.

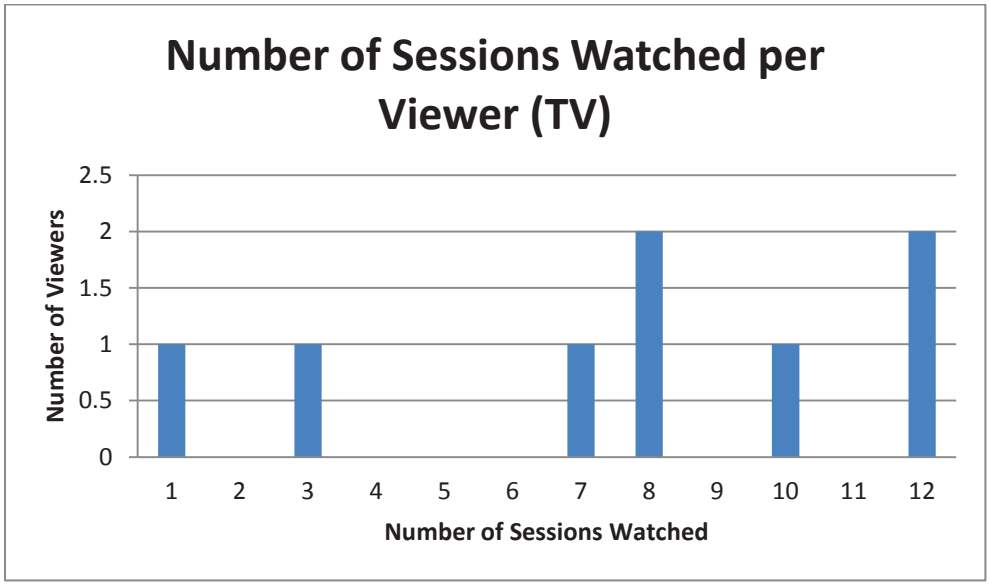

Figure 35: Histogram of the number of sessions watched by each television viewer

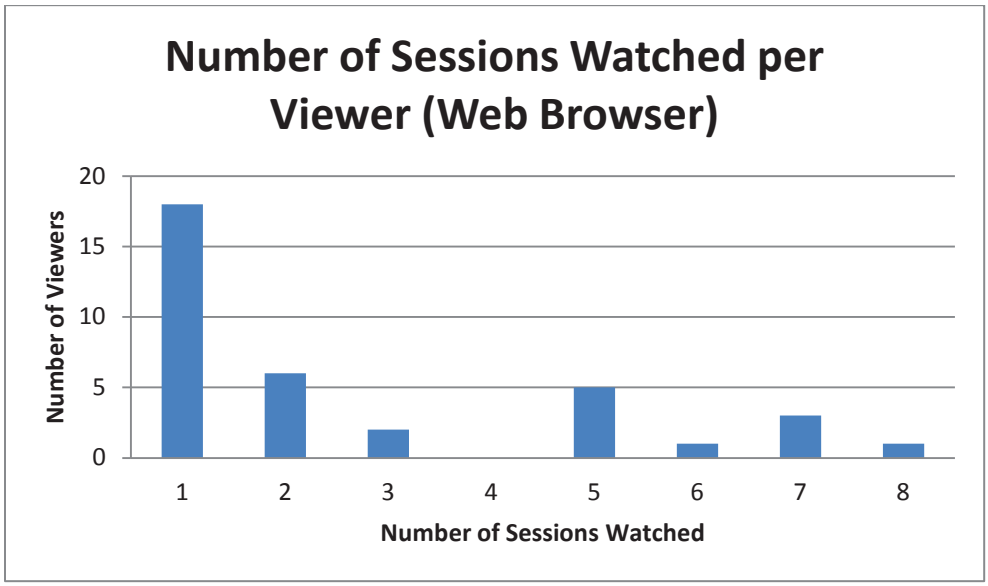

Figure 36: Histogram of the number of sessions watched by each web browser viewer

Figure 35 and Figure 36 present a breakdown of the number of sessions watched by each user of the viewing system. From these charts, we see that the majority of web browser viewers only watched a single session. This implies that most viewers seemed to just be interested in trying the system out. Because we did not set up a system in their home, there was less commitment to use it. It could also imply that the interface available to web browser viewers did not encourage viewing. As stated earlier, post-survey results showed that web browser viewers had a harder time in general adapting to the system as it was not built on a point-and-click methodology. We also see that most television viewers watched the majority of available newscasts. Some viewers reentered a newscast, which began a new session; some happened consecutively, but others did not. This could also be caused multiple individuals in a household using the system. Because of this, we maintained them all as unique sessions. This lead to the possibility of viewing more sessions than there were available newscasts, such as the two television viewers who watched 12 sessions when only 10 unique newscasts were available.

The greatest insight from this data is that viewers used the system in their own way, according to their own needs, interests, and schedules. We had a wide variety of viewing behavior. Some viewers watched the news religiously as it became available. Others waited several days before watching the news again, possibly catching up on the previous newscasts. Others tried out the system, but did not take it throughout the study. Now that we understand how viewers interacted with the newscasts as a whole, we can seek to understand how they interacted with the content available in those newscasts.

10.2 Content Usage

The interactive newscast format has the ability to greatly change how viewers watch content and how much they actually watch. This section discusses the actual amount of content watched. We

can use this information to gauge viewer interest in the available stories. All of the following results show the overall results as well as results for week one and two. This allows us to view the overall behavior as well as how it changes over time, so we can discount some of the novelty of the system.

Per Session Averages (TV Viewers)	Week 1	Week 2	Overall
Base Story Content Watched (minutes)	9.44	8.92	9.11
Ratio of Base Story Content Watched to Newscast Length	50%	43%	45%
Extra Content Watched (minutes)	1.84	1.16	1.41
Total Content Watched (minutes)	11.28	10.09	10.52
Ratio of Total Content Watched to Newscast Length	59%	48%	52%
Session Length (minutes)	13.46	12.00	12.53
Ratio of Session Length to Newscast Length	71%	58%	63%

Table 16: Content usage per session averages (TV Viewers)

Per Session Averages (Web Browser Viewers)	Week 1	Week 2	Overall
Base Story Content Watched (minutes)	7.03	8.32	7.64
Ratio of Base Story Content Watched to Newscast Length	36%	40%	38%
Extra Content Watched (minutes)	0.37	0.69	0.52
Total Content Watched (minutes)	7.40	9.01	8.16
Ratio of Total Content Watched to Newscast Length	38%	43%	41%
Session Length (minutes)	9.73	11.55	10.58
Ratio of Session Length to Newscast Length	50%	55%	53%

Table 17: Content usage per session averages (Web Browser Viewers)

Table 16 and Table 17 give us an understanding of the actual time spent in a session and watching the content within. Taking into account only the base stories available in the interactive newscast (mirroring the actual stories found in the news broadcast), television and web browser viewers watched about 45% and 38% of available content respectively. If we include watched extra content and compare against the original newscast length, those numbers increase by 7% and 3% respectively. This is not as large of an increase as we would have hoped, but is at least partly affected by the quality of content we could offer as additional material. Finally, if we compare the full session length (including headlines, accessing the info menu, pitches, etc.) to

the base newscast time we see that television and web browser viewers spent 63% and 53% of the base newscast time in the session respectively. We removed any interactivity gaps greater than an hour (e.g. if they paused during the session and left the session running overnight). We include this to compare against the results from Bunn's study where the ratio of session time to newscast length was 80% [3]. Several of the sessions in Bunn's study lasted longer than 100% of the newscast length. This does not make sense considering that they had minimal extra content and it wasn't well used. They may be including these interactivity gaps which we removed. In the end, the actual amount of content watched is a better indicator of usage. While our results show that this number is about 50% of the base newscast length on average, the majority of this is quality time in which the viewer involved and interacting with the newscast.

Per Session Averages (TV Viewers)	Week 1	Week 2	Overall
Base Stories Started	14.21	12.95	13.75
Base Stories Completed	6.55	6.59	6.57
Extra Content Started	2.55	1.41	1.82
Extra Content Completed	1.41	0.49	0.82
Percent Base Stories Completed	49%	46%	47%
Percent Extra Content Completed	60%	34%	45%

Table 18: Story completion averages (TV Viewers)

Per Session Averages (Web Browser Viewers)	Week 1	Week 2	Overall
Base Stories Started	11.94	12.11	12.02
Base Stories Completed	4.49	5.89	5.15
Extra Content Started	0.47	1.07	0.75
Extra Content Completed	0.22	0.64	0.42
Percent Base Stories Completed	37%	50%	43%
Percent Extra Content Completed	42%	61%	51%

Table 19: Story completion averages (Web Browser Viewers)

Beyond understanding how much content viewers watched, we wanted to understand how much of the individual stories they watched. These numbers can help us gauge interest in the provided stories and can be useful in developing more interesting content. Table 18 and Table 19 show

that, of the stories that viewers began watching, viewers completed about 45-50% of the stories they started. This applies both to the base stories as well as stories viewed in the extra content.

Per Session Averages (TV Viewers)	Week 1	Week 2	Overall
Average Time Before Exiting Story per Session (seconds)	45.58	37.76	40.63
Average Ratio of Exit Time to Story Length	64%	61%	62%
Average Time Before Exiting Extra Content per Session (seconds)	43.28	57.03	51.19
Average Ratio of Exit Time to Extra Content Length per Session	74%	59%	65%

Table 20: Loss of interest averages (TV Viewers)

Per Session Averages (Web Browser Viewers)	Week 1	Week 2	Overall
Average Time Before Exiting Story per Session (seconds)	41.00	48.94	44.63
Average Ratio of Exit Time to Story Length	53%	64%	58%
Average Time Before Exiting Extra Content per Session (seconds)	49.03	40.93	44.87
Average Ratio of Exit Time to Extra Content Length per Session	63%	70%	67%

Table 21: Loss of interest averages (Web Browser Viewers)

Table 20 and Table 21 show that viewers made it over 60% of the way through a story on average before exiting. If we remove stories that actually made it to completion, this percentage drops to about 30%. This shows that if viewers are not interested in a story, they will exit fairly early and move on to more interesting content.

We see that viewers did not watch all the content that was available in the interactive newscast. This is to be expected as not all content will be interesting to all viewers. Notwithstanding this, we are able to see what content they are and are not interested in. Time spent watching the interactive newscasts is quality time as they are involved with the content and are not generally passive in their viewing habits as will be shown in the next section.

10.3 Interactive Feature Evaluation

In addition to the amount of content viewed, we also evaluate our interactive news system with regards to interactivity and its individual features. This includes headlines, user engagement, basic navigation features, extra content features, and the overall attitude of viewers toward the system.

10.3.1 Headlines

	Week 1	Week 2	Overall
TV	86%	82%	84%
Web Browser	88%	73%	81%

Table 22: Percentage of total sessions where the viewer rated at least one headline

The first interactive feature that viewers had access to when the newscast began was the headline menu. In Table 22, we see that headline stories were rated by television and web browser viewers in 84% and 81% of the sessions overall respectively. This means that in 16% to 19% of the newscasts watched the user did not rate any of the headlines. This compares to Bunn's study [3] where the headlines were reportedly used during 70% of the sessions. While there is some drop-off in the second week, the headlines are a heavily used feature that enables user control and content customization.

Story Ratings (TV Viewers)	Week 1	Week 2	Overall
Rated Positively	43%	35%	38%
Rated Negatively	23%	14%	17%
No Rating	34%	51%	45%

Table 23: Ratings given to stories available via the headlines (TV Viewers)

Story Ratings (Web Browser Viewers)	Week 1	Week 2	Overall
Rated Positively	19%	25%	22%
Rated Negatively	36%	31%	33%
No Rating	45%	44%	45%

Table 24: Ratings given to stories available via the headlines (Web Browser Viewers)

While the ratings feature was used in over 80% of the sessions, 55% of stories made available in the headlines actually received a rating. Table 23 and Table 24 show how stories made available in the headlines were actually rated by viewers. Overall, television viewers rated stories presented in headlines in a positive matter. Web browser viewers seem to be more negative in their assessment of the content. Part of this negative assessment could be attributed to bias related to the viewing interface. The left mouse button was tied to the negative rating control. Because headlines are the first thing viewers see, viewers attempting to use point-and-click to manipulate the interface would accidentally rate stories negatively. Another possible explanation is that viewers in the lean-forward mindset would be more prone to skip borderline interesting content, seeking only that which is most interesting to them.

Viewer perceptions of the headlines were positive overall. Some viewers liked the fact that it did not include every possible story (they did not want five minutes of headlines), while others would have liked to see all stories up front. Another desired behavior was that, once a rating was made, the system would immediately skip to the next headline instead of finishing playing the current one. Another wished that he had the ability to disable the headlines and he felt the ability to skip stories and use the playlist navigation was sufficient.

Headline menu usage led to several different behaviors. One viewer stated they liked the idea of a headline so they could see what they knew what they wanted to watch first, and then use the playlist to seek out other interesting content. Another viewer used the negatively rated stories as a marker that let them know the newscast was coming to a close. Almost all enjoyed the customization and control that the headlines provided.

10.3.2 User Engagement

Once the viewer has passed the headlines, they are presented with the actual newscast. From here, they have full navigation capabilities and can access stories in a variety of ways. Because we are tracking the viewer's interactions, we can see the frequency of interaction. In this section, we look at how active viewers were in using interactive features.

For our purposes, we define a content choice as any action performed by the viewer that begins or ends content playback.

	Week 1	Week 2	Overall
TV	100%	100%	100%
Web Browser	94%	89%	92%

Table 25: Percentage of total sessions where the viewer actively made at least one content choice

Table 25 shows how many of the total sessions viewers actively interacted and switched the currently playing content. The results show that viewers almost always use interactive content features at least once per session.

	Week 1	Week 2	Overall
TV	63	54	57
Web Browser	45	59	52

Table 26: Average time between content choices (in seconds) (TV and Web Browser Viewers)

	Day 1-3	Day 4+	Overall
Bunn's Study	74	82	79

Table 27: Average time between content choices (in seconds) (Bunn's Study)

Table 26 goes even further and shows that television and web browser viewers are making active content choices at least once a minute on average. This compares to Bunn's study [3] where content selections were made every 79 seconds on average (see Table 27). The more frequent

interactions with our system could potentially be explained by the increased methods of accessing new material.

These results show that viewers are involved in the newscast, which means they are actively engaged with the content presented. Gauging actual viewer participation is something that cannot be done with traditional broadcast news.

10.3.3 Basic Navigation

As stated, we provide several features that allow the viewer to change the flow of the base newscast. In this section, we look at how viewers used these features.

We provide three actions that allow the viewer to modify the flow of the base newscast:

- **Play Next** – The currently playing story in the base newscast is skipped immediately and the next available story in the base newscast begins playing.
- **Play Previous** – The currently playing story in the base newscast is ended immediately and the preceding story in the base newscast begins playing.
- **Play from Playlist** – Upon selection of a story from the playlist, the currently playing story ends immediately and the selected story within the base newscast begins playing.

	Week 1	Week 2	Overall
TV	91%	97%	95%
Web Browser	92%	80%	86%

Table 28: Percentage of total sessions where the viewer performed at least one basic navigation action

Table 28 shows how many of the total sessions viewers performed at least one of these actions. Basic navigation features were used in the vast majority of sessions.

Method of Interaction (TV Viewers)	Week 1	Week 2	Overall
Play Next	77%	72%	74%

Play Previous	55%	33%	41%
Play from Playlist	59%	46%	51%

Table 29: Percentage of total sessions where the user actively changed the currently playing base story (TV Viewers)

Method of Interaction (Web Browser Viewers)	Week 1	Week 2	Overall
Play Next	71%	60%	66%
Play Previous	75%	60%	68%
Play from Playlist	22%	36%	28%

Table 30: Percentage of total sessions where the user actively changed the currently playing base story (Web Browser Viewers)

Table 29 and Table 30 show the number of sessions in which viewers used basic navigation features at least once over the total number of sessions. The Play Next action was used in 74% of television sessions and 66% of web browser sessions, making it the most popular form of interaction across sessions overall. The playlist feature appears to not be as accessible for web browser viewers, having only been used in 28% of web browser sessions compared to 51% of television sessions. This emphasizes the need for a point-and-click interface or other method to activate the menu in the web browser. Playlist usage is also low compared to the results stated by Bunn [6] where the playlist was used in 78% of total sessions.

Method of Interaction(TV Viewers)	Week 1	Week 2	Overall
Play Next	70%	80%	77%
Play Previous	13%	6%	8%
Play from Playlist	18%	14%	15%

Table 31: Number of times each basic navigation action was used over all basic navigation actions performed (TV Viewers)

Method of Interaction (Web Browser Viewers)	Week 1	Week 2	Overall
Play Next	67%	67%	67%
Play Previous	28%	19%	24%
Play from Playlist	5%	14%	9%

Table 32: Number of times each basic navigation action was used over all basic navigation actions performed (Web Browser Viewers)

Method of Interaction (Bunn's Study)	Day 1-3	Day 4+
Play Next	38%	41%
Play Previous	36%	33%

Play from Playlist	26%	26%

Table 33: Number of times each basic navigation action was used over all basic navigation actions performed (Bunn's study)

Table 31 and Table 32 show the number of times each basic navigation action was performed over the total number of basic navigation actions performed. Play Previous suffers the same problems as Rate Negatively from the headlines for web browser viewers. Play Previous was tied to the left mouse button, biasing this result when viewers tried clicking on the interface. In any case, Play Next is by far the most commonly used feature. It was also the most commonly used feature in Bunn's study [6] at 41% of basic navigation actions performed (see Table 33). Our results show Play Previous having a minor role relative to Play Next. This is different than the results found in Bunn's study where Play Previous usage was 33%. However, we expect Play Previous to play a minor role as the need to return to previous content should only occur if a viewer has accidentally passed over an interesting story. Either way, Play Previous is a useful feature that does not complicate the interface and can easily be included in any interactive news system.

From viewer responses, viewers used the Play Next action to skip uninteresting content or move on once they felt they understood the current story. The ability to pick what they watched and skip uninteresting content was a consistently mentioned important feature for viewers. One viewer stated he watched a story until had enough information and then skipped to the next story. Another called this feature "refreshing" compared to current news watching. While not mentioned as often, the playlist was considered by some their favorite feature. One viewer said that after watching the positively rated stories, he would then go the playlist and seek out specific stories that seemed interesting based on the title. These comments confirm the positive responses found in Bunn's study [6].

The interactions to navigate the base newscast are very important to viewers. They give the viewer control over their viewing experience. The results found strengthen and support those found in Bunn's study [6] and these features should be considered for inclusion in any future interactive news system.

10.3.4 Extra Content

Finally, we evaluate how viewers used the extra content features of the system. There are several methods for accessing additional material. Our hope was that increasing access to extra content through new means of interaction and the ubiquity of that content would greatly increase its usage. We also hoped to learn which methods of serving extra content worked best.

In our study, we provided access to three main types of additional material: alternative story viewpoints taken from other news stations, topic related content that is current information on issues similar to the current story, and historical content that is previously aired material related to the current story.

We provide four ways through which viewers can access this additional material:

- **Prompt** – A drop-down overlay that appears during story playback when additional material is available for viewing. Upon selection, the currently playing story is paused and the additional material is then presented to the viewer. Once the additional material has finished playing or if the viewer chooses to end the additional material early, the viewer is returned to the previous spot within the base newscast and playback resumes.
- **Pitch** – An end-of-story video clip that introduces viewers to additional material and then invites them to access it immediately. Upon selection, the currently playing story is paused and the additional material is then presented to the viewer. If multiple stories are

pitched, they will be shown in sequence. Once the additional material has finished playing or if the viewer chooses to end the additional material early, the viewer is returned to the previous spot within the base newscast and playback resumes.

- **Playlist Content Menu** – An add-on to the playlist menu that allows viewers to select additional material for viewing. While navigating the playlist content menu, the base newscast continues playing. Upon selection, the currently playing story is paused and the additional material is then presented to the viewer. Once the additional material has finished playing or if the viewer chooses to end the additional material early, the viewer is returned to the previous spot within the base newscast and playback resumes.
- **Info Content Menu** – An add-on to the playlist menu that allows viewers to select additional material for viewing. The base newscast is paused during navigation and replaced with an info screen that describes the current story highlighted within the menu. Upon selection, the additional material is then presented to the viewer. Once the additional material has finished playing or if the viewer chooses to end the additional material early, the viewer is returned to the info content menu and allowed to make another selection.

Both the prompt and a form of the playlist content menu existed within Bunn's system [6]. By providing the pitch, richer content menus, and providing every story with additional material, we have managed to increase the usage of extra content.

	Week 1	Week 2	Overall
TV	1.77	0.92	1.23
Web Browser	0.57	0.51	0.54

Table 34: Average number of extra content views per session

There were a total of 127 extra content views (75 television views and 52 web browser views). This leads to an average of 1.23 television extra content views and 0.54 web browser extra content views per session (see Table 34). For television viewers, this is almost a four times increase over Bunn's study [6] where there was an average of .32 extra content views per session. This shows that our initial goal to increase extra content usage through more content and additional interactive features seems to be met. There were also several stories from the base newscast, stories that were not extra content, that were accessed in an on-demand manner from the info content menu. These are not considered as part of the 127 extra content views.

	Week 1	Week 2	Overall
TV	82%	62%	69%
Web Browser	37%	38%	38%

Table 35: Percentage of total sessions where the viewer viewed at least one piece of additional material

Table 35 shows in how many of the total sessions viewers accessed and watched at least one piece of additional material. As an add-on to our system, we expect extra content to be used less often than basic navigation features. However, extra content was still used in the majority of sessions for television viewers and over a third of the sessions for web browser viewers, making it a well-used feature.

Extra Content Source (TV Viewers)	Week 1	Week 2	Overall
Pitch	38%	72%	55%
Prompt	23%	22%	23%
Playlist Content Menu	10%	0%	5%
Info Content Menu	28%	6%	17%

Table 36: Percentage of extra content stories accessed using the specific feature (TV Viewers)

Extra Content Source (Web Browser Viewers)	Week 1	Week 2	Overall
Pitch	59%	57%	58%
Prompt	10%	13%	12%
Playlist Content Menu	24%	22%	23%
Info Content Menu	7%	9%	8%

Table 37: Percentage of extra content stories accessed using the specific feature (Web Browser Viewers)

All four of the extra content features were used by viewers to access extra content. Table 36 and Table 37 show the number of extra content stories access using a specific feature over the total number of extra content views. The majority of extra content was accessed via the pitch. The fact that the pitch is a direct invite to viewers to access additional material and that multiple extra content pieces are shown with a single selection help explain why so much content was viewed via the pitch.

Extra Content Types (TV Viewers)	Week 1	Week 2	Overall
Alternate Viewpoint	62%	69%	65%
Topic Related Content	21%	31%	25%
Historical	18%	0%	9%

Table 38: Percentage of views of the specific extra content type (TV Viewers)

Extra Content Types (Web Browser Viewers)	Week 1	Week 2	Overall
Alternate Viewpoint	72%	61%	67%
Topic Related Content	24%	22%	23%
Historical	3%	17%	10%

Table 39: Percentage of views of the specific extra content type (Web Browser Viewers)

Table 38 and Table 39 show how much each type of additional material was viewed. All four extra content features were used to deliver alternate viewpoints and topic related content. Only the playlist and info content menus were used to deliver historical content. Accessing historical content also required navigating deeper into the menu system. This helps explain why so little historical content was viewed even though it was technically the most common type of extra content delivered (averaging 25.26 pieces of historical content to 1.18 pieces of non-historical extra content available per story). Viewers may have also associated historical with stale, lessening the desire to explore that content. Of the non-historical extra content delivered, 62% was alternate viewpoints and 38% was topic related content. This helps explain the difference in viewing percentages for these two types of content.

Extra Content Source (TV Viewers)	Week 1	Week 2	Overall
Pitch	50%	46%	48%
Prompt	36%	15%	23%
Playlist Content Menu	5%	0%	2%
Info Content Menu	27%	13%	18%

Table 40: Percentage of total sessions where the extra content features were used (TV Viewers)

Extra Content Source (Web Browser Viewers)	Week 1	Week 2	Overall
Pitch	25%	24%	25%
Prompt	6%	7%	6%
Playlist Content Menu	8%	4%	6%
Info Content Menu	8%	16%	11%

Table 41: Percentage of total sessions where the extra content features were used (Web Browser Viewers)

Table 40 and Table 41 show the number of sessions where specific extra content features were used over the total number of sessions. Being used in 48% of television sessions and 25% of web browser sessions, the end-of-story pitch was by far the most used extra content feature in the system. The prompt and info content menu saw significant usage in television viewer sessions, being used in one-fifth of those sessions. In web browser sessions, only the info content menu also saw significant usage being used in 11% of total sessions.

Per Session Averages (TV Viewers)	Week 1	Week 2	Overall
% of Pitches Taken	31%	32%	32%
% of Prompts Taken	20%	3%	9%

Table 42: Number of times TV viewers chose to view extra content over the total number of opportunities for the viewer to access extra content using the specific feature (pitch or prompt)

Per Session Averages (Web Browser Viewers)	Week 1	Week 2	Overall
% of Pitches Taken	22%	12%	17%
% of Prompts Taken	2%	1%	1%

Table 43: Number of times web browser viewers chose to view extra content over the total number of opportunities for the viewer to access extra content using the specific feature (pitch or prompt)

The popularity of pitches over drop-down prompts is most telling in Table 42 and Table 43. These tables show the number of times viewers chose to view extra content via the pitch or prompt over the total number of times they had the opportunity to access content using that

specific feature. Of the pitches presented during the sessions, viewers chose to view the associated extra content about 32% of the time for television viewers and 17% for web browser viewers. Prompt usage started high for television viewers, but fell off dramatically the second week (from 20% to 3%). We attribute this to viewers learning over time which features they preferred. Prompts were rarely ever used by web browser viewers to access extra content. Therefore, of the drop-down prompts presented during the sessions, viewers chose to access the extra content about 9% of the time for television viewers and 1% for web browser viewers. In post-interviews, viewers provided several reasons for not using the prompts. The most common were that they either did not see the prompt or they did not want to interrupt the currently playing story. Because the pitch appeared at the end of the story and was an explicit invite to the viewer to access additional material, it did not suffer from these problems. All of this leads us to believe that viewers prefer a direct invite to additional material.

Distinct Extra Content Sources (TV Viewers)	Week 1	Week 2	Overall
0	18%	36%	30%
1	55%	54%	54%
2+	27%	10%	16%

Table 44: Percentage of sessions where the specified number of distinct extra content features was used (TV Viewers)

Distinct Extra Content Sources (Web Browser Viewers)	Week 1	Week 2	Overall
0	59%	51%	55%
1	35%	47%	41%
2+	6%	2%	4%

Table 45: Percentage of sessions where the specified number of distinct extra content features was used (Web Browser Viewers)

While pitches were the most used feature, viewers did use multiple ways to access extra content as shown in Table 44 and Table 45. These tables show the number of sessions where the specified number of extra content features was used at least once over the total number of

sessions. In the majority of television sessions (70%) at least one method of accessing additional material was used. For web browser sessions, extra content was used in just under half the sessions (45%). Using more than one method to access additional material in a single session was performed in a smaller percentage of sessions (16% for television and 4% for web browser). No one used more than three of the four available features in a single session. Over time, viewers used less features on average. We attribute this to viewers growing accustomed to the system and determining what features work best for them.

One of the major requests for improvement from viewers was regarding the quality of the additional material. Viewers appreciated the ability to view alternate viewpoints (the bulk of our extra content), but they sought more analysis and content that delved deeper into the current story. One user said they didn't want to "watch the same newscast with a different anchor that is 98% similar." Several viewers commented on enjoying the national extra content which they considered to give more analysis, whereas the local news they considered more factual. Overall, the increased usage of extra content over previous systems shows that viewers do want additional material and will make use of it if it is pertinent and interesting to them, especially if they are explicitly prompted to do so.

	Interactive Feature (TV Viewers)	Week 1	Week 2	Overall
Headlines	Rate Headline Positively	12%	10%	11%
	Rate Headline Negatively	6%	4%	5%
Basic Navigation	Play Next	43%	61%	54%
	Play Previous	8%	5%	6%
	Play from Playlist	11%	10%	11%
Extra Content	Pitch	6%	6%	6%
	Prompt	4%	2%	2%
	Playlist Content Menu	2%	0%	1%
	Info Content Menu	9%	3%	5%

Table 46: Number of times each action was used over the total number of actions performed (TV Viewers)

	Interactive Feature (Web Browser Viewers)	Week 1	Week 2	Overall
Headlines	Rate Headline Positively	5%	8%	6%
	Rate Headline Negatively	10%	10%	10%
Basic Navigation	Play Next	53%	49%	51%
	Play Previous	22%	14%	19%
	Play from Playlist	4%	10%	7%
Extra Content	Pitch	3%	3%	3%
	Prompt	1%	1%	1%
	Playlist Content Menu	1%	1%	1%
	Info Content Menu	1%	5%	3%

Table 47: Number of times each action was used over the total number of actions performed (Web Browser Viewers)

Finally, we look at all actions performed during newscast playback together. Table 46 and Table 47 show the number of times an action was performed over the total number of actions performed using the viewing interface. Basic navigation features were the most commonly used features. Extra content features, being an addition to the base newscast, saw the least amount of usage. Basic navigation features allow viewers to skip uninteresting content and go directly to interesting stories, causing the viewer to watch less news than is found in the basic newscast. Extra content features allow the viewer to go beyond the basic newscast to deeper content. Any time spent watching additional material increases viewer watch time and allows viewing session lengths to go beyond the length of the basic newscast. While results show that this is currently not the case, improving the set of extra content features and the available additional material could make this a reality. This would mean a greater experience for viewers and more opportunities to monetize on viewer usage for news providers.

In summary, viewers enjoyed using our interactive television viewing system. Viewers want control over their viewing experience. They want to adapt the news to their individual schedules, needs, and interests. The constant newscast availability, headlines, and navigation controls make this possible. By providing multiple access points to the additional material, we are able to

ensure viewers a content-rich experience. In other words, we allowed viewers to interactively adapt the news to their individual schedules, needs, and interests, reaching the final goal defined by our thesis statement. More work should be done on features that invite viewers to access additional material. Further trials need to include deeper content to ensure that viewers are getting more relevant content so that features can be tested at a greater depth.

11 Summary and Future Work

We have designed a complete interactive television news system that meets the requirements laid out in our thesis statement. We have developed a news production system that allows for the creation of flexible, content-rich interactive news. This system embraces a general creation process to interactive news that is built on top of a newscast model that evolves from and conforms with the current production newscast model. It also allows for content sharing and content reuse. We have also created an interactive news viewing system that adapts well to a lean-back environment. It contains several interactive features designed to give the viewer control and allow them to watch the news when, where, and how they want to.

We have also validated our design with a formative evaluation which includes a user study and interviews. We have shown that the production system allows fast, quality construction of interactive news that can only improve with access to newsroom resources. We have learned that viewers enjoy the viewing system features, but more work must be done to improve ease of use for both television and web browser viewers. We have increased extra content visibility and usage over previous studies through additional features, more content, and direct invites to viewers. We also produced and delivered the news over an entire two-week period to a large number of viewers, making it the largest study done according to our knowledge.

Future work could look at more features, beyond the pitch, that actively invite the viewer to participate. This could include integration with Flexible Storylines [25] and replacing the drop-down prompt in favor of their method for creating flexible, richer stories. Work could also be done to include other forms of additional material such as photos and social media commentary. The system could also be augmented using machine learning techniques to suggest additional material to providers and viewers. Such technique could also be used to automatically deliver

headlines and pitches that would be most likely to drive the viewer to additional material and create a truly personalized experience.

This work also builds on the assumption that interactive news is an add-on to the traditional newsroom. It augments existing systems and minimizes the necessary changes needed. Reporting and story creation remain the same. Eventually, interactive television news could take the forefront. This could lead to new types of reporting and other changes to the news creation process that can maximize the advantages of interactivity. News can move from a block of stories to a continuous stream where stories are delivered as soon as they are produced. Work should be done to see what interactive television news could be if the standard newsroom paradigm was left behind.

Work could also be done on the commercialization and monetization of such a system. As stated earlier, there are many possibilities for interactive commercials and other forms of interactive advertising that would help an interactive news system see adoption in the marketplace.

In summary, this work empowers both television news viewers and providers. Providers can create and deliver a richer news experience with flexibility and minimal effort, while multiple content sources provide access to necessary material. Viewers have access to richer and more material in a way that is both television-friendly and flexible. It takes the traditionally passive television medium and empowers individuals giving them complete control over their viewing experience.

References

1. Avid Technology. Avid iNews NRCS. http://www.avid.com/products/iNews/index.asp.

2. Bucy, E. The Interactivity Paradox: Closer to the News But Confused. *Annual Meeting of the International Communication Association*, (2003).

3. Bunn, D. Interactive Television News. 2010. http://hdl.lib.byu.edu/1877/etd3397.

4. Bywater, J., Bourguet, M., Kazai, G., Lalmas, M., and Pearmain, A. Scalable and Personalised Broadcast Service. *Proceedings of the European Conference on Interactive Television: Enhancing the Experience*, (2004).

5. Domingo, D. Interactivity in the Daily Routines of Online Newsrooms: Dealing with an Uncomfortable Myth. *Journal of Computer-Mediated Communication 13*, 3 (2008), 680-704.

6. Dowman, M., Tablan, V., Ursu, C., Cunningham, H., and Popov, B. Semantically Enhanced Television News through Web and Video Integration. *Proceedings of the Workshop on Multimedia and the Semantic Web at the European Semantic Web Conference*, (2005).

7. Elberse, A. Consumer Acceptance of Interactive News in the Netherlands. *The Harvard International Journal of Press/Politics 3*, 4 (1998), 62-83.

8. Eronen, L. User Centered Research for Interactive Television. *Proceedings of the European Conference on Interactive Television: From Viewers to Actors*, (2003), 5-12.

9. Van Every, S. Interactive Tele-Journalism: A System for Low Cost, Live, Interactive News Television Production. *Proceedings of the 12th Annual ACM International Conference on Multimedia*, ACM Press (2004), 170-171.

10. Girgensohn, A., Wilcox, L., Shipman, F., and Bly, S. Designing Affordances for the Navigation of Detail-on-Demand Hypervideo. *Proceedings of the Working Conference on Advanced Visual Interfaces*, (2004), 290-297.

11. Haas, N., Bolle, R., Dimitrova, N., Janevski, A., and Zimmerman, J. Personalized News through Content Augmentation and Profiling. *Proceedings of the IEEE International Conference on Image Processing*, (2002), 9-12.

12. Hauptmann, A.G. and Witbrock, M.J. Informedia: News-on-Demand Multimedia Information Acquisition and Retrieval. In *Intelligent Multimedia Information Retrieval*. AAAI Press, 1997, 213-239.

13. Jensen, J.F. Interactive Television: New Genres, New Format, New Content. *Proceedings of the Second Australasian Conference on Interactive Entertainment*, Creativity & Cognition Studios Press (2005), 89-96.

14. Klinenberg, E. Convergence: News Production in a Digital Age. *The ANNALS of the American Academy of Political and Social Science 597*, 1 (2005), 48-64.

15. Larsson, H., Lindstedt, I., Löwgren, J., Reimer, B., and Topgaard, R. From Time-Shift to Shape-Shift: Towards Nonlinear Production and Consumption of News. *Proceedings of the 6th European Conference on Changing Television Environments*, Springer-Verlag (2008), 30-39.

16. Li, F.C., Gupta, A., Sanocki, E., He, L.-wei, and Rui, Y. Browsing Digital Video. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2000), 169-176.

17. Manzato, M., Coimbra, D., and Goularte, R. An Enhanced Content Selection Mechanism for Personalization of Video News Programmes. *Multimedia Systems 17*, 1 (2010), 1-16.

18. Merialdo, B., Lee, K.T., Luparello, D., and Roudaire, J. Automatic Construction of Personalized TV News Programs. *Proceedings of the Seventh ACM International Conference on Multimedia*, ACM (1999), 323-331.

19. Merryman, R. and Wootton, C. Interactive Television News – The Beginning of the UK Revolution. *Proceedings of the National Association of Broadcasters Broadcast Engineering Conference*, (2003), 183-196.

20. Mitchelstein, E. and Boczkowski, P.J. Between Tradition and Change: A Review of Recent Research on Online News Production. *Journalism 10*, 5 (2009), 562-586.

21. Nielsen. Nielsen Company. http://nielsen.com/us/en.html.

22. Paulussen, S. Online News Production in Flanders: How Flemish Online Journalists Perceive and Explore the Internet's Potential. *Journal of Computer-Mediated Communication 9*, 4 (2004), 00.

23. Pew Research Center's Project for Excellence in Journalism. *State of the News Media*. 2011.

24. Purcell, K., Rainie, L., Mitchell, A., Rosenstiel, T., and Olmstead, K. *Understanding the Participatory News Consumer*. 2010.

25. Romashka, I.D. Flexible Storylines. 2011. http://hdl.lib.byu.edu/1877/etd4439.

26. Williams, D., Kegel, I., Ursu, M., Pals, N., and Leurdijk, A. Experiments with the Production of ShapeShifting Media: Summary Findings from the Project NM2 (New

Millennium, New Media). In *Lecture Notes in Computer Science*. Springer Berlin Heidelberg, 2007, 153-166.

27. Zimmerman, J., Dimitrova, N., Agnihotri, L., Janevski, A., and Nikolovska, L. Interface Design for MyInfo: A Personal News Demonstrator Combining Web and TV Content. *Proceedings of the International Federation for Information Processing TC13 Conference on Human-Computer Interaction*, (2003), 41-48.

Appendix A Post-Study Television Viewer Interviews

This appendix contains the transcription of post-interviews given to available television viewers after the trial was complete. Questions were asked by an interviewer, while answers were given by the viewers.

User 15

Question: How often were you able to use the system?

Answer: It was not every day. I wasn't home as often as I thought I would be. It was nice to be able to go back and catch up, and I always started with the latest first and then worked my way up to the most current.

Question: What were some of the things that jumped out to you from the very beginning?

Answer: I liked that I didn't have to go through all the crap. Just hit the stories. That was nice for me.

Question: What do you mean the crap?

Answer: I really don't like the jabbering of the anchors. I ended up going through all of the stories anyway. But sometimes I'd shift the order around. Whatever I was in the mood for, but then I would say "Now what was this other story?" There were a few that I didn't go to because I knew I didn't care about it.

Question: What were some of the stories that you didn't care about?

Answer: I don't even remember what it is now. There were some political things that… I'm not a big political person. I would rather someone I know tell me about it. I don't want to watch it or see it. Not in my home. I was really grateful that I didn't have to sit through sports. I do not care for it. I think there was one on breastfeeding, and I thought "I don't care about that now. That time is gone."

Question: What were some of the features that you enjoyed using? You mentioned jumping around in the news.

Answer: I liked that I could go to other stations and see what they had to say.

Question: How often did you find yourself doing that?

Answer: I didn't do it as much as I thought I would. I'm generally content with one, but if there's a story that really excited me then I would, "yeah, let's see what someone else had to say. And see if it was different." And there were some that… they were a little different and I thought that was interesting. And so I found myself asking "so why did they say this and these guys didn't?"

Question: When you jumped around in the newscast did you find yourself using the menu to do that?

Answer: I went to the menu and would look at the highlights and then make my selection from there.

Question: Did you find yourself using the extra content like the historical background?

Answer: I did the historical content once or twice but found that I really didn't care about that.

Question: Did you like the headlines menu?

Answer: Yes!

Question: Would you make any changes to how that system worked?

Answer: No.

Question: Would you like to have a headline for every story?

Answer: I would rather use the menu on the side.

Question: Do you like the way the newscast re-prioritizes things?

Answer: Yes.

Question: So if you had the ability to re-prioritize inside the menu, you would use that?

Answer: To me it's just easier to go through it. What I really liked was that when I did miss a day I could go back and catch up with all of the news quickly. I didn't have to sit through 3 hours of news. I liked that a lot.

Question: Did you use the prompts and pitches?

Answer: I used the pitches. During the story I just didn't think about it. I was involved in what was going on in the story and didn't want to interrupt it.

Question: How did you feel about the controls? Were they easy?

Answer: The first day it was set up I had to call my son and say, "Now what was I supposed to do again?" But my kids don't generally let me play with the remotes. But after he reminded me, whew… I was good to go. It was very easy and I liked that. I like easy.

Question: Any other comments questions?

Answer: I really enjoyed it because it was just the stories; it wasn't all the other stuff that I don't care about.

Question: You don't care about relationship with the news team?

Answer: Nope. I just want the information.

Question: If this system was available regularly would you use it?

Answer: I would watch the news a lot more because it's quick and easy and I can get to what I want and walk away. I'm generally okay without TV because I know the people at work are going to talk about things and I'll get everything I need from them. But I also know it's their opinion, but that's how the news is anyway.

Question: Do you gather much news online?

Answer: If someone tells me to look at something specifically then I'll go, but I don't generally

search it out. If I heard someone talking about something during the day, a lot of the time I was excited to get home and go right to that story. I didn't have to wait a few hours to hear about it. I could go directly to it.

Question: Did you watch much of the national coverage?

Answer: Not so much.

Question: Thanks

Answer: No problem. Like I said, it was easy to use. I hear about people who "TiVo" things and I think, "What a pain". But this was there ready and I could just do what I wanted.

User 4

Question: What stuck out to you first about this system? What did you like or dislike?

Answer: I was pretty easy to do, and it was just right there. It was convenient.

Question: What was easy, the controls?

Answer: Yeah. It was clear and easy to navigate and figure out what was going on.

Question: How many newscasts did you watch?

Answer: I watched about 4 or 5.

Question: Was that on day multiple newscasts or one four different days?

Answer: It was four different days with that day's newscast.

Question: What did you like about the system?

Answer: It was cool to be able to use the system, but most of the time I just look things up online. So having this on top of that was just another thing to do, ya know? I'm not a huge TV person.

Question: So online would you choose to use this system over your current habits?

Answer: Yeah. Definitely I would choose this over going to multiple sites and looking. I'm all about the easiest way to access the information. I would have watched it a lot more, because like I said, I do all of my catching up while I'm at work.

Question: What did you think about the headlines menu?

Answer: I didn't really care much about the thumbs up thumbs down. I don't think it mattered that much. But the benefit of machine learning based on those entries would be awesome. That would make a lot of sense.

Question: Did you use the pitches or prompts?

Answer: I didn't use them, but if I had more time I probably would have.

Question: So did you watch any of the extra content?

Answer: Sometimes you are just curious and want to know if there's anything that really is interesting. So I would check it out a little bit, but not that often. The things that are interesting just depend on the day and your mood. If there's a big story going on you kind of want to know all about it. I get that way. I'm kind of compulsive. So if there's something that someone is interested in they want to go and find all of the details they can about it. Even if there are 10 stories some people are going to read all of them because they think there might be some new information that they haven't heard. Like when the tsunami hit Japan, I have family in Japan. All I did was watch stuff constantly. My cousin and I were watching CNN all day, all night and all day. But at the same time I was pulling up stories online.

Question: Would you have preferred to start with national or local news?

Answer: I would have been more interested if it started with a national newscast and then went more local. I go to CNN almost every day, but don't go to KSL unless I'm going to the classifieds.

Question: Any final comments or questions?

Answer: It was cool to have and had I been home more I'm sure I would have used it. And I like the idea that you can go to a site and watch the same way. One suggesting is having a profile like Hulu that will remember what you've watched from the computer to your TV so that things are linked. Track the news that you've seen and pick up right where you left off.

User 13

Question: What are the things you liked and didn't like?

Answer: I liked the fact that I could speed through the things that I didn't want to watch. And I liked that I could see different stations stories real easily. That way I could find a lot of coverage of something if I was interested, I could do it quickly. Things I didn't like, sometimes it would only give me the option of prioritizing three or four stories and then I would have to jump around to find the rest.

Question: Would you like to see a preview of everything in the news?

Answer: Yeah because then I could just do a thumbs up on everything that I wanted to see and that way I know what I'm going to see. Because for me, I would do it for the first three and then I'd get to the rest of it and I would question whether or not I really wanted to see that story. Maybe if there was a list of all of the stories at the beginning and set your priorities.

Question: Like the headlines menu?

Answer: Yeah, I like being able to say "yeah I want to watch that one."

Question: What were the stories that you were interested in enough for extra content?

Answer: I think typically the stories that I asked for more information on, were the national stories; politics, debates, or Occupy Wall Street. If there was an interesting local spin then I

would generally look to see what CNN or FOX News said about it.

Question: Did you like the national coverage?

Answer: Yeah because then you could see the same story, but see what they were saying nationally.

Question: Would you prefer a newscast that starts with national or local news?

Answer: For TV I like the local first because I go to CNN or FOX News during the day on the Internet. So what I like about this is I could see the local and then if it was something I was interested in I could click to the national. I don't typically watch a lot of news on TV so it was nice to see the local stories that I don't usually get otherwise.

Question: If this system were offered online would you choose to use it?

Answer: I would probably use it more often because we just don't watch TV that often because I'm always online. So I could just jump on, being at school or something.

Question: So did you find yourself watching more local news this way?

Answer: I think so. The thing about local news sometimes is, if it's a slow night the stories are just whatever they can find, and sometimes I just don't care. But sometimes I remember thinking, there was a chemistry student that was making some gas or something from the leftovers from his Chinese food, and that story was, I remember thinking that was really interesting. And had I not had this system we never would have seen that story. So because we saw the little tidbit we watched that story and thought it was pretty cool. But some of the local stories I wasn't interested in at all.

Question: Did you use of the actual menu to access extra content?

Answer: Sometimes, but every once and a while I found myself getting totally lost. So usually I would just use the next and previous buttons.

Question: Did you use the prompts?

Answer: I think I did once or twice. If I was interested in the story I might want to get more, but I never used the extra material if I was already bored with the story.

Question: How about the pitches?

Answer: If I was using it every day and I really knew how to use the clicker, I would probably like the one at the top because that way it doesn't interrupt the story. You can just look and see if you want more. The pitch was easy to understand, but the more comfortable I became with the clicker the more I would probably use the prompts.

Questions: How were the controls? Were they easy to understand?

Answer: They were pretty easy. I figured out a trick and would use it like a mouse instead of a normal controller. But I thought it was pretty easy, especially if you used it like a mouse. It was nice because if I messed up and went too far forward, I could always go back.

Question: Any other comments or suggestions?

Answer: I really like having the national coverage because if I ever clicked more and it was just another local station I figured they would just say the same thing so I would skip that, but I like having the national that I could click and sometimes get some analysis

User 9

Question: How often did you watch the newscast?

Answer: Pretty much every night.

Question: What did you like/dislike?

Answer: My husband actually really enjoyed it. It's just nice being able to go through and pick what you want to watch. I mean, the things that I would change are things that you don't have

control over yet, like having more content, different channels. Just having more broadcasts to choose from. But, the way you set it up so that you see all of the headlines first, I really like that.

Question: So would you extend the headlines menu to preview everything?

Answer: I was thinking about that, but then would you have to sit and just watch headlines for 5 minutes and then decide what you want to watch?

Question: Yeah

Answer: I was thinking about that, I would like to see a preview of each thing, but I would prefer it in menu form where I could just read over them real quick and see if I want to see it because I don't want to sit and watch a headlines menu for 5 minutes.

Question: Did you use the menu to navigate as well?

Answer: Yeah. I used the menu more.

Question: Did you use the prompts to access extra content?

Answer: Yeah I really liked that. If it was an interesting story I wanted to see how other stations presented it to see if there was information that I was missing, and then going on because there was CNN and other coverage on there too.

Question: How about the pitch?

Answer: You know what? I used the pitch more, at the end when you had something.

Question: Which did you prefer?

Answer: I preferred it at the end. It was just easier

Question: Was it a question of interrupting what you were watching?

Answer: Yeah. If I'm watching something I want to finish it and then go on.

Question: What if you could use the prompt but delay it until after the story was over?

Answer: I don't care. Either way it's easy.

Question: What did you think of the controls themselves?

Answer: They were easy to follow. After the first day or two I didn't even need to look at the control menu.

Question: What other developments would you like to have seen?

Answer: It would be cool to be able to go and look at newspaper articles about that story as well. I'd like to be able to read the story as well.

Question: Did you use the national coverage?

Answer: I didn't watch it much.

Question: Would you prefer to start with local or national news?

Answer: I think most people would like the local. I know I like reading local and then going nationally. I'm thinking about the whole occupy wall street thing, finding out what's happening in Salt Lake and then going to the other cities to see what's happening.

Question: Would a multiple source newscast be jarring?

Answer: Yeah. But that's for me, because I'd like to see what one channel for each. However, I don't know if that's the same, I don't know if my husband would think that way. Like, he might like to see the three different ways together. I like seeing what one station does with their newscast and then seeing what someone else does.

Question: So you think that seeing the unique stories combined into one newscast would be jarring?

Answer: Yeah, I think that would be jarring. I think that switching to a new person talking, but I don't know. It would be jarring for me because I like the consistency. But Matt, my husband, really wouldn't care. Is that the goal, to have one ginormous newscast?

Question: I would love to see that.

Answer: It would be interesting to watch. I would have to see it to know if I'd like it.

Question: Doing the news in this new way would mean there's no need for anchors or transmitters, so you'd save money there. You could use that money to hire more reporters which would give you better coverage with a larger and more interactive newscast. Each story would be individually delivered by the reporter that did the story.

Answer: But would they present it like anchors at a desk?

Question: They could, or they could do it at a green-screen.

Answer: I would think that would be, having someone sit down and have the official feel of an anchor and then changing every 5 seconds would be kind of annoying, but if you get rid of the anchor and just have the reporter show their story then that's not that bad.

Question: Any final comments?

Answer: It was really cool. My husband kept commenting, because we don't have cable, how cool it was that we could still watch the news using just the Internet.

User 11

Question: What were some of the first things that stuck out to you? What were the things you liked and disliked?

Answer: I liked being able to pick what I watched. I mean the nightly news cast tries to do the thing where they hook you. They always leave the cool story for the end. It's super obnoxious. You never know when to watch it to see what you want to see. So that was my favorite part, just being able to pick what I saw, when.

Question: How did you go about picking what you were going to watch?

Answer: Well I always watched the headlines menu where you can put thumbs up, thumbs

down. So I would thumbs up the ones that I was interested in. Then...

Question: Did you thumbs down much?

Answer: Not very often. The one thing I thumbs down a lot was, I noticed you broke up the weather so, I usually wanted to watch the forecast but what you had linked do was the currents. So once I realized what was happening I would thumbs down that just about every time. But besides that I rarely used the thumbs down. Mostly I would thumbs up the things that I was interested in. Then, once I got through the stories that I had selected, I would bring up the playlist and go through the titles watching the ones that looked interesting to me.

Question: Would you appreciate an extended headlines menu?

Answer: I didn't get annoyed, but I think if it were longer I would have gotten annoyed. Usually the news, I feel like the headlines, they're pretty good at picking what's going to catch peoples' attention. So generally speaking, I "thumbs up" quite a few things which ended up being beneficial, because sometimes there were things that the title wouldn't have grabbed my attention. I actually did like having that. But I think a preview of every single one of them would have driven me crazy. Because, like I said, I want to skip to what I'm interested in.

Question: Did you find yourself skipping stories once they'd started?

Answer: Yeah I did that a few times.

Question: How did you feel about the controls?

Answer: I didn't pull up the menu too often. The ones that I used regularly were pretty obvious, but the mouse itself was a little awkward to use. I mean, I'd push buttons I didn't intend to push. Sometimes while I was holding it my thumb would push the "left click" and sometimes it would hit the "trigger", which is the help one if I remember right. So if I'm not looking for help it's kind of obnoxious because after a while I didn't need the help anymore and it was blocking the

story. It's a little too easy to get to the help.

Question: Would you like to see the thumbs up and down option in menu itself?

Answer: I don't really care if it's in the right order in the menu, because by that time if I see one that looks interesting I click on it and I watch it and then I can keep going after that.

Question: Did you use the pitch or the prompt more?

Answer: I preferred the banner across the top. The thing at the end bothered me until I realized that I could skip it. I didn't realize it would skip out of it so for a while I had to listen to that whole recording while I was thinking, "Ok, I'm not going to watch extra content on this story." I didn't use either of them all that often. Part of the advantage of the system is that I can go through fast. There were one or two stories that I was interested enough in that I wanted to see extra content. But I think those times it actually didn't have the automatic option. I mean, there's still a way to get to related content, but it didn't end up being as related as I was hoping. It was other political news, but it wasn't really about that particular story. Most of the time I was content with what I got and I didn't really feel the need to go watch something else. But that banner across the top was certainly nice when I was intrigued.

Question: Introduced to things that you wouldn't have watched otherwise?

Answer: Yeah, I don't really read local news in general, so there was a lot of local stuff that was going on that I didn't have any idea about. The Supreme Court case about the crosses in Utah, that's fascinating to me. I didn't even know there was a case going on about that until I saw on the news that they had already ruled. And that's one of the times that I used the extra content.

Question: Would you like to see local or national extra content?

Answer: It depends on the story. That story I probably would have liked to see more local coverage. Had it been a story on Herman Cain, I probably would have wanted to see what ABC

or CNN had to say about it.

Question: What additions would you have made to the extra content?

Answer: Mostly I would have looked for a little more analysis. I mean, I see a story, and on the nightly news you just get the facts and, I like to read and listen to what people think about that. I'm interested in a panel that's talking about it. So I think I'd be more likely to look at added content if I felt like it was going to be that sort of thing instead of seeing another station reporting the same facts. I'm going to see someone going a little deeper into what it means for the state, what it means for the country, whatever.

Question: Do you think we should tease the panel or analysis type stories?

Answer: Yeah I think that would have been more intriguing. And I think I may have used it more if I had experimented with it more. I didn't realize there was a lot of FOX and CNN on there and it kind of surprises me to hear you say that. So that probably shows that I didn't use it all that often. Maybe if I had used it more. I mean, I knew they were there, but I didn't get the feeling that it was really fleshed out, if that makes sense. A couple of times, when I was looking for extra content, I got a little bit lost in the menu.

Question: What do you think about the way the menu structure works?

Answer: I would ideally want to see, so you click "I want to see related content" and then a list of stations that tells the same story. Or... I'm trying to remember what it is. I hardly used that feature. Maybe just come up with a way to reduce the number of menus, especially since I don't have a mouse and I'm trying to remember what back is, and suddenly now some of the functions on the mouse that I haven't been using, I need to be able to use. I just got kind of buried in the menus. Eventually I just got so frustrated that I just wanted to go back and finish the original story and move on.

Question: Do you prefer it starting with local news and going to national, or the other way around?

Answer: I really like it local to national because, when I have a limited amount of time to read the news during the day so I end up mostly reading New York Times and national sorts of things. But I really liked a way to be able to get some local news in a relaxed way. I like watching the local news because you can kick back and you get this feel of and I got the same feel but I was able to skip through it faster so I didn't have to spend the whole, however long the local news is to watch it. So, I actually spent more time consuming national news but I really liked having a local news outlet.

Question: What are the different sources of news that you use?

Answer: Yeah, I prefer to use the Internet and newspaper of national news, but TV for local. Especially that national news on TV now is so sensationalized that I don't pay much attention to what FOX and CNN are saying anymore. I look at newspapers and I feel that the local news, since it's only an hour at night is more trustworthy.

Question: Any final comments or suggestions?

Answer: It would be nice to have it all work from a remote rather than a mouse. But that's probably something that would be pretty hard to do in a study like this. And then, just like I said, I feel like I would have used that extra content more if there was some simple way to use it right at first, and then if you wanted to get into the historical content and other deeper things you could learn about it and figure out how to get there, but if there was some really easy way to say, "these three stations reported on it." That way I recognize the three stations, and I know which one is going to talk about what, I can just pick.

User 3

Question: What were some of the things that stuck out at the beginning? What did you like and dislike?

Answer: I really like the idea of just being able to skip over the stuff that I just didn't care about. I'm not a guy who watches the weather. I'm just not. So that would come on and I would just say, "I don't care. Next." And it was just refreshing to be able to skip stuff that I just had no interest in. Things I didn't like. It was a real learning curve with the mouse. With the controls, because the controls changed depending on what view you were in and so you need to remember what view you were in. So that was a bit of a learning curve with that. Things that I would change? That's a good question. Do you guys have plans to incorporate more local news so that you could select the source that you view first?

Question: Yeah that would definitely be one of the things that would be incorporated.

Answer: Because, it was channel 5 news? It's great, but the more articles you could have, the more it would help out. It would be really nice to select the different stations. Like, "Here's today's news. Would you like to watch it from this channel, this channel, or this channel?"

Question: Why do you want that functionality?

Answer: I guess just for the breadth of the news consumption. Just in case some stations covered stories that others hadn't.

Question: So had we included the unique stories from the other stations?

Answer: Oh yeah!

Question: Would it have been jarring to see a change in anchor?

Answer: Absolutely not! Not for me anyway. For me I don't care. I don't care so much about the anchor; I just care about the information. And a lot of the time they end up passing it off to so

and so live at the screen. I don't know that person, so it may as well be anybody. So yeah, having the unique stories to feel like I have covered my bases, I know everything that anyone had seen on the news and can talk intelligently about. When my father-in-law says, "Did you see that on FOX News?" I can say, "Yeah." Because I don't watch just channel 5, I watch everything.

Question: What, besides weather, did you skip?

Answer: I don't think there is anything specifically that I would skip, in terms of category. It would just depend on the day. I'm trying to think of things that I did skip over. Twilight! But honestly I wouldn't say that there were any topics that I just consistently skipped over besides weather.

Question: What did you think about the headlines menu?

Answer: I enjoyed the functionality. I enjoyed the preview. If I really wanted to keep that I would say that as soon as I make a selection immediately move to the next. Don't require people to watch all of the preview if they've already made a selection. The whole concept of being able to skip the stuff I didn't like at any time, I wanted that to translate over to the headlines menu. That was nice to just get a bearing. It was also nice to see, when I started consistently seeing the things that I had thumbed down, I knew I was getting toward the end. And in my mind I knew, Oh, I'm getting to the end. Because there is really no other indication to say, "You are 75% of the way through this newscast." So for me that was kind of a nice way to put a book end on it and know I'm approaching the end.

Question: So you still found yourself watching the stories you had thumbed down?

Answer: Yeah, as weird as that sounds.

Question: That's part of what I personally was predicting would happen.

Answer: It's true. When you just shuffle the order and prioritize you end up watching just about

everything anyway, except for the weather. Ha ha.

Question: So with those adjustments to the headlines menu, would you want a preview of everything?

Answer: It took me a couple of days to figure out that you were only headlining a few, and that there were more stories that you weren't prioritizing right at the beginning. And then that made sense to me that you weren't headlining everything. That would be impossible. Well, I guess you could do that. I probably would have enjoyed having everything headlined right at the beginning, shuffle everything around, and then start the newscast. Either that or no headlines, and just start. I think the rearranging a few and then skipping through what you don't like of the rest was a little disjointed.

Question: Did you use the extra content from other stations?

Answer: I did use that and mostly for the reason that we talked about. I was interested to see what other people had to say about this topic.

Question: Was it the other locals or the national?

Answer: It was both. I tended to pay more attention to the national coverage, and I would usually watch the entire local clip and then skip to the national coverage and get the pieces that I wanted. As soon as I felt like I had gotten enough I would just skip to the next. Which is a different point... was there any way to fast forward?

Question: There wasn't.

Answer: I didn't think so. That would be nice. Double speed or something, a way to get past the parts of a story that you may have already heard from one of the other views of that story, so that you can see if they have something original to say without watching the entire clip. Because you also don't know how long the clips are. Sometimes I was curious to know, is this 5 minutes, 10

minutes, what kind of investment am I making here?

Question: How do you access the extra content? Prompt, pitch, or via the menu?

Answer: I tended to use the pitch at the end of the story because I wanted to watch the local clip from start to finish. And then based on that make the decision as to whether or not I wanted to watch more. Rarely did I, in the middle of the story, jump out. Because I didn't know what the story was necessarily and I wanted to get the whole scoop. And when you came out of that you just went right back to where you came from, and I would have forgotten what they previously said. The story was kind of broken in half that way. I didn't use the menu to get to the extra content. Most of my other coverage came from your pitch.

Question: If there were a delay in the viewing of the prompt, would you be more likely to use that option?

Answer: Oh yes! I don't want to interrupt the story that I'm watching, and if I change my mind about watching that extra piece than I can always skip out of it.

Question: How were the controls?

Answer: I would say it took me about 2-3 days to be able to navigate without having to pull up the menu. And the biggest learning curve for me was trying to figure out how to get back to the list of the days, that it was a long "left click". I remember I spent about 5 minutes trying to figure that out. So I was trying to think about whether or not there was a simpler way to make the controls, and I think it's a good job for what you have. For the limited number of buttons that you have and the device that you're using, I really think it's just a matter of learning how to use it and when.

Question: So not using the menu, you didn't watch much of the historical context?

Answer: You're right, and that was a conscious choice. I felt like, for me personally, for the time

that I spend watching the news, I am not so interested in the historical aspect of things. I'm more interested in what's happening now. If I had more time to devote to the news, I would probably be interested to how it correlates to previous stories, although I did watch a few. I think it was about cops. No, one that got me interested was teachers having sex with their students. Don't ask why that interested me but looking through, I was like, "Oh my gosh. There is so much historical content it's disturbing." And so that was interesting, because it was more of a visual statistic for me. "This happens more than I thought it did." I think the type of consumer I am, I'm just more interested in what's happening right now.

Question: Any comments or suggestions? Other functionality you'd like to see?

Answer: Other news sources, fast forward, headlining the whole thing or not at all... That's a really good question. I don't know if there's a way to include, and this is just me thinking out loud here, but some kind of user interaction, different users interacting with each other.

Question: What kind would you like to see?

Answer: Maybe when you pull it up, it's tagged to your Facebook account and you see, "These friends put these stories at the top of their newscast." "These people were interested in this." Just to add a more "there are other people watching this. I'm not alone in watching the news." You might even be able to say "I'm really interested in what Trent is watching. So always show me what Trent does with his cue." Now I have no real basis on which to recommend that but there you go.

Question: Would you be interested in seeing full interviews or press conferences?

Answer: Yeah! Especially for sports! Yeah, if there's a story on the game and there's a link to the full press conference, take me to it.

Question: Would you prefer to start with local or national news?

Answer: Personally I would prefer to start national and then drill down to local news. Now that being said, the thing that I liked about this, on my tablet and computer I do a lot with checking the national news. I don't get a lot of local information. So it was nice to kind of not be force fed, but have just the option of getting local news, but I did still prefer national coverage. So it might be nice to say, "Here's your national coverage. Here are you headlines, rearrange them." And mixed in there is some local coverage. Some way to mix the two would be nice.

User 8

Question: What did you think about the system as a whole?

Answer: It gave us the nice ability to view the news in the amount of time we had.

Question: What did you like the most?

Answer: The ability to skip stories because anything "rape" related, or those kind of stories, we could just skip.

Question: Is there anything you didn't like about the system?

Answer: There were a couple control issues. I don't know what the intended behavior was, but I usually only got three teasers or pre-story things and yet there was lots more that would continue, so it would have been nice to see and select more at the beginning of the newscast. I don't know if that was a bug, or intended, but we generally only saw about three stories.

Question: What do you think about the idea of including more headlines at the beginning?

Answer: I like the preview and being able to arrange my newscast from there. I mean we generally went to the end of the newscast just skipping around, so it worked just fine, but I think I would like to see more of a preview at the beginning.

Question: Did you use the extra content?

Answer: Pretty much only when it was advertised to us. I think I tried it one or two other times, but either there wasn't exactly related content, and so I didn't view anything there. I think there were past things that were semi-related, but when things were advertised as other stations stories, or...

Question: Did you use the pitch or the prompt more often?

Answer: I think one time we used the prompt during the story, but we used mostly the pitch.

Question: Why?

Answer: I don't think we noticed the prompt actually.

Question: What would you add if you could build the system?

Answer: Probably, a little area that is dedicated to "this is what you're seeing" and "this is what's up next". That way you can keep a frame of reference and know what's coming up next so you can keep track. But it was nice being able to pull up the list for basically that same thing. Overall it was excellent. The controls were simple enough and yeah, it was good.