Investigating Director Agents' Decision Making in Interactive Narrative: A Wizard-of-Oz Study

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ABSTRACT
Interactive narrative planning offers significant potential for creating engaging narrative experiences that are tailored to individual users. Orchestrating all of the events in a storyworld to create optimal user experiences calls for effective narrative decision-making. A key requirement of this endeavor is understanding the role that different knowledge sources play in narrative decision making. To investigate knowledge sources for interactive narrative, a corpus was collected in a Wizard-of-Oz (WOZ) study conducted with a narrative-centered learning environment. With narrative planning and natural language dialogue functionalities provided by wizards, the data from the WOZ study offers insight into the knowledge sources involved in narrative decision making and suggests how these knowledge sources can be effectively utilized by a narrative planner to create engaging interactive narratives.

Categories and Subject Descriptors
H.5.1 [**Multimedia Information Systems**]: Artificial, augmented, and virtual realities; K.3.1 [**Computer Uses in Education**]: Computer-assisted instruction.

General Terms
Design, Experimentation.

Keywords
Interactive narrative, Wizard-of-Oz, Narrative-centered learning environments.

1. INTRODUCTION
Recent years have seen significant growth in research on interactive narrative planning [2][8][14][15][16][19] for both entertainment and education applications [1][10][13][20]. By taking advantage of narrative's inherent structure, interactive narrative planning seeks to create engaging and effective narrative experiences that are tailored to individual users. Although a broad range of computational models of narrative have been investigated, a common metaphor is the notion of a director agent or drama manager [3][22] working behind the scenes to direct a cast of believable characters and storyworld events to build coherent narrative structures while integrating the user's interactions in real time.

Director agents for interactive narrative planning craft global story arcs utilizing a set of *plot points* [3] representing a partial order of significant story events and a set of *director actions* that reconfigure the storyworld in an effort to guide users through an intended narrative. To create engaging user experiences, director agents must determine the most effective sequence of plot points and director actions to perform while balancing character believability, plot coherence, and author aesthetics. To sequence a set of plot points, a director agent might employ a search mechanism and an evaluation function encoding key features of the narrative, such as author aesthetics, agency, thought flow, and location flow [15]. Using the evaluation function to rank the potential plot point sequences, the director agent can select the next plot point on which to focus the story. Once selected, the director agent can utilize its set of director actions to guide the story to the selected plot point, e.g., directing a character to perform an action in the environment.

To develop a clear understanding of the knowledge sources that inform interactive narrative planning, we conducted a Wizard-of-Oz study with thirty-three participants using a narrative-centered learning environment. In the study, users assumed the role of a medical detective solving a science mystery while the wizard provided director agent functionalities for the system. Throughout the study, detailed trace data was collected for all wizard decision making and all user navigation and manipulation activities within the virtual environment. One of the wizard's tools was a mechanism for controlling the behavior and creating the spoken dialogue for one of the story's main characters, and the conversations between the wizard and user were recorded. The resulting corpus of trace data and recordings provides a rich source of information for studying interactive narrative planning.

This paper presents the Wizard-of-Oz interactive narrative study. It is structured as follows. Section 2 provides background and related work on interactive narrative planning. Section 3 reviews narrative decision-making and introduces key knowledge sources used in effective narrative decision-making. The CRYSTAL ISLAND Learning Environment, the extensions to it that support its Wizard of Oz functionalities, and the study design and procedure are described in Section 4. Section 5 discusses the findings, and

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Section 6 offers concluding remarks and suggests directions for future work.

2. BACKGROUND

Narrative experiences are both compelling and pervasive. Cognitive scientists have long recognized narrative's foundational role in problem solving [7], and narrative occupies a privileged position in models of reading comprehension [9] and film theory [5]. Increasingly, interactive applications in entertainment [13], education [1][12][17][20], and training [10] are leveraging narrative to create engaging experiences in rich virtual storyworlds. There has also been a long tradition of using scripted sequences of activities to create interactive narrative for education and entertainment applications. In these scripted environments, events are either completely linear or ordered in a pre-determined branching structure [6], but the tree-like representations of interactive narrative limits the level of interactivity and tailoring provided by the system to individual users.

A promising alternative to pre-defined branching structures is interactive narrative planning in which stories are dynamically crafted in response to users' actions. Interactive narrative planning has been the subject of increasing interest, and recent work in the narrative technologies community has explored a wide range of issues for interactive storytelling. Techniques have been developed for tightly coupling plot creation and character behavior in dialogue-oriented interactive stories [13], for monitoring users' actions to determine if they are threatening the plot and, if so, either accommodating the new development or intervening [11][18]. Search-based approaches utilize an evaluation function encoding author aesthetics to guide narrative planning [15][22], while reinforcement learning has been used to learn policies to guide narrative action selection [16], and Targeted Trajectory Distribution Markov Decision Processes (TTD-MDP) have been employed to enhance replayability [4][19]. Other narrative planners have taken decision-theoretic approaches to narrative management [14][21].

3. NARRATIVE DECISION-MAKING

Narrative is a complex phenomenon, and interactive narrative is becoming increasingly sophisticated. Interactive narrative decision-making must be carried out while considering three principle knowledge sources: narrative objectives, storyworld state, and user state [14]. In an interactive narrative environment, the director agent continuously monitors and seeks to achieve its *narrative objectives* to ensure that steady progress is made through the plot (plot progress) and that global coherence is maintained (narrative flow) so that the story does not seem disjoint as a result of non-motivated actions occurring. Its *storyworld state* knowledge includes information about which plot points are currently active (plot focus), as well as basic knowledge of the storyworld and characters (physical state), e.g., the characters' goals, behaviors, and current locations. Its *user state* represents knowledge about the user's current goals, her beliefs about the storyworld, and experiential attributes, such as engagement, which are inferred from her actions in the storytelling environment. In our investigation of narrative decision-making we use the following knowledge sources adapted from Mott and Lester [14]:

- *Plot Progress*: Models the storyworld's plot graph, a representation of temporal relations that hold between significant storyworld events; identifies which elements in the plot graph are waiting, ready, or completed.
- *Narrative Flow*: Models thought flow (coherence of actions to support a particular goal, e.g., searching a room after being asked to do so), location flow (coherence of actions within spatial constraints of the storyworld, e.g., discovering multiple physical clues within the same room, one after another), and pacing associated with plot point completion.
- *Plot Focus*: Models the plot points that are currently active to which (it appears to the director agent) the user is currently attending.
- *Physical State*: Models the current location of the user and characters in the storyworld, and models the user's activity level as indicated by her character's interactions with objects and characters in the storyworld.
- *User Goals and Beliefs*: Models the user's knowledge about the salient facts of the story that she has learned through interactions with the environment and other characters, as well as her plot progress and focus (see above).
- *User Experiential State*: Models the user's independence (as indicated by how much manipulation the director agent has performed) and her affective state.

The role each of these knowledge sources plays in interactive narrative decision-making is examined in Section 5. The discussion is illustrated with findings from the Wizard-of-Oz study.

4. WIZARD OF OZ STUDY

To investigate interactive narrative decision-making, a Wizard of Oz study was conducted with a customized version of the CRYSTAL ISLAND narrative-centered learning environment [20]. After introducing CRYSTAL ISLAND, we describe the custom episode created for this study along with the Wizard-of-Oz functionalities introduced into the environment. We then present the study design and wizard protocol.

4.1 CRYSTAL ISLAND

CRYSTAL ISLAND is a narrative-centered learning environment developed for middle school students for the domain of eighth-grade microbiology. It is built with Valve Corporation's Source™ engine, the technology behind Half Life® 2 and other critically-acclaimed games. CRYSTAL ISLAND features a science mystery set on a recently discovered tropical island where a research station has been established to study the island's unique flora and fauna. Within the story, the user plays the role of the protagonist attempting to discover the identity and source of an infectious disease plaguing the research station. Throughout the mystery, the user is free to explore the world and interact with other characters while forming questions, generating hypotheses, collecting data, and testing hypotheses. The user can pick up and manipulate objects, view posters, operate lab equipment, and talk with non-player characters to gather clues about the source of the disease. During the course of solving the mystery, the user completes an in-game diagnosis worksheet to organize her thoughts regarding the patients' symptoms, the likelihood of potential diseases (based on their expected symptoms, incubation period, and transmission source), and her final diagnosis. Upon completing the diagnosis worksheet, the user verifies its contents with the camp nurse and develops a treatment plan for the sickened CRYSTAL ISLAND researchers.

4.2 CRYSTAL ISLAND: Wizard-of-Oz Version

For the study reported in this paper, a custom episode of CRYSTAL ISLAND (Figure 1) was created featuring a companion agent, who assists the user in solving the mystery, rich natural language dialogue between the user and companion agent, and approximately 35 minutes of interaction time. This episode features six characters Alyx Reid (player), Kim Lee (camp nurse and companion agent), Bryce Reid (lead scientist), Ford Patterson (zoologist), Audrey Newsome (botanist), Quentin Nash (camp cook), and Al Cunningham (camp foreman). The user plays the role of Alyx Reid visiting her father, Bryce, who serves as the research station's lead scientist.

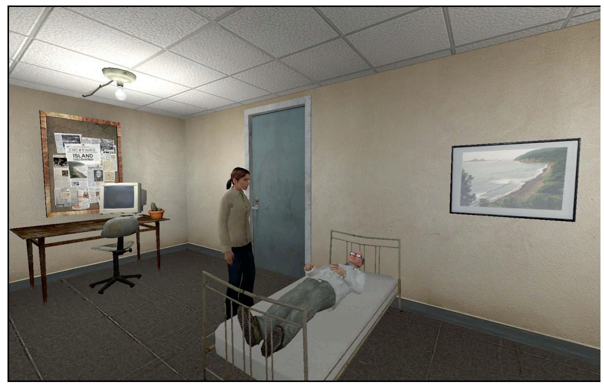
Alyx has arrived at CRYSTAL ISLAND to visit her father whom she has not seen for a while. As she approaches the dock, she hears news that her father has fallen ill from Al, the camp foreman. Al tells her that Audrey, Ford, and her father were out on an expedition gathering specimens. Their expedition was scheduled to last for two days; however, they failed to return to the camp on time. Al found this very unusual since they were known to adhere closely to schedule. Fearful for their safety, Al led a search team to locate them. After two days of searching, the research team discovered that the expedition team had fallen ill on the south side of the island. It appears the group lost their way, became ill, and could not make it back to the camp. They are in the infirmary and are being attended to by the camp's nurse. Upon hearing the news, Alyx goes to the infirmary to see her father and his colleagues. Kim, the camp's nurse, informs her that their condition is not good. Her father seems to be much worse than the others. Kim is baffled by the illness and does not know what could have caused it. She asks Alyx to help her identify the disease and its source.

In this episode, the user takes control of her character upon arriving at the camp's infirmary, which is housed in the same building as the laboratory. All of the user's interactions, as she works with the camp nurse, occur within the confines of the infirmary and laboratory. A typical scenario has the user learning about the scientific method (Figure 1a), examining patients to learn about their symptoms (Figure 1b), learning about infectious diseases by reading books (Figure 1c), testing food items to find out which ones are contaminated (Figure 1d), convincing the camp nurse of a diagnosis, and finally treating the sickened research team members for their illness. Figure 2 depicts a plot graph [3] of this CRYSTAL ISLAND episode.

4.3 Wizard-of-Oz Functionalities

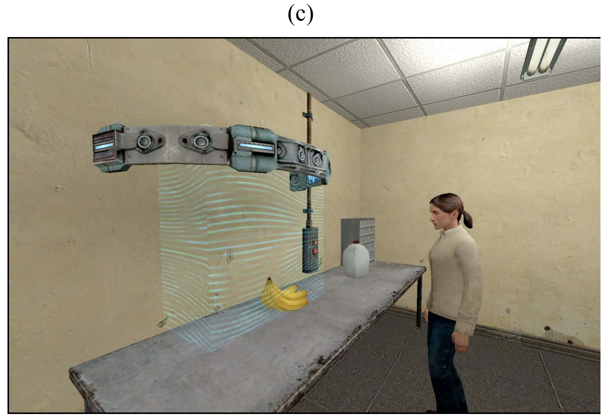
To investigate narrative decision-making, CRYSTAL ISLAND was extended to include Wizard of Oz functionalities. In this WOZ-enabled version of CRYSTAL ISLAND, a wizard provides the narrative planning functionalities, including spoken natural language dialogue for the character of the camp nurse. Playing the role of the camp nurse, the wizard works collaboratively with the user to solve the science mystery. Together in the virtual environment they carry on rich conversations using voice chat and observe one another's actions while engaging in problem-solving activities (Figure 3). In addition to directing the navigation, spoken communication, and manipulation behaviors of the nurse's character in the virtual environment, the wizard guides the user's inquiry activities and controls the progression of the story. To

(a)



(b)

(c)



(d)

Figure 1. CRYSTAL ISLAND from nurse's perspective

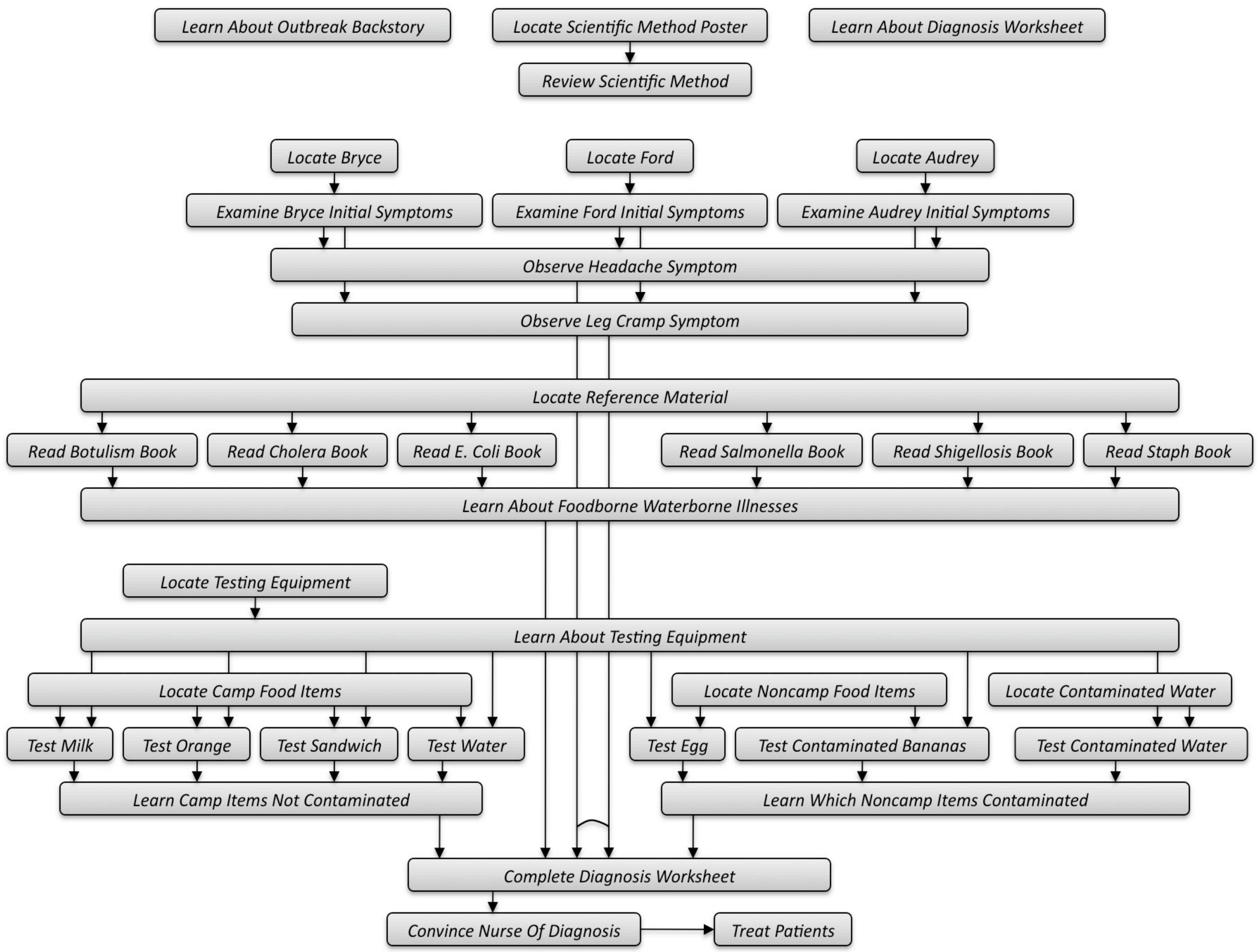


Figure 2. Plot Graph for Crystal Island: Wizard-of-Oz Version

support these activities, the wizard's display includes detailed information regarding the user's activities in the environment (e.g., reading books, testing objects, updating the diagnosis worksheet) as well as access to a narrative dashboard (Figure 4). The *narrative dashboard* enables the wizard to initiate key narrative decisions in the environment (e.g., introducing new patient symptoms, having a non-player character bring in additional items for testing) analogous to a director agent.

In addition to the wizard functionalities, the narrative environment was modified to focus on the rich interactions between the user and wizard as well as to reduce the time spent navigating the environment. This was accomplished by confining the scenario to a single building housing both the camp's infirmary and laboratory. Within this environment the user and wizard gain access to all of the materials needed to solve the science mystery (e.g., sickened researchers, background books and posters, potential sources of the disease, lab equipment). The scenario, user and wizard controls, and wizard display were refined throughout a series of pilot studies with college students prior to the study reported in this paper.

To illustrate the behavior of the WOZ-enabled CRYSTAL ISLAND environment, consider the following scenario. A user has been collaborating with the nurse character, whose behaviors are planned and executed by the wizard. The user has learned that an infectious disease is an illness that can be transmitted from one organism to another, often through food or water. Under guidance of the nurse, the user has examined the patients' symptoms and run lab tests on food items. Through this exploration, the user has come to believe that the source of the illness is a waterborne disease and that it is likely cholera or shigellosis. Although she believes cholera is more likely, she is unable to arrive at a final diagnosis. Through her conversation with the nurse character, "Yeah, hum, well, they both can come from water, but cholera is mostly water, I believe," the wizard determines that the user is having difficulty ruling out shigellosis and decides that this is an opportune moment to provide a hint. The wizard uses the narrative dashboard and enables the *Observe Leg Cramp Symptom* plot point, which results in one of the patients moaning loudly in the infirmary. The user examines the patient and informs the wizard, "He has leg cramps. That means it is cholera." The wizard asks the user to update her diagnosis worksheet with her new

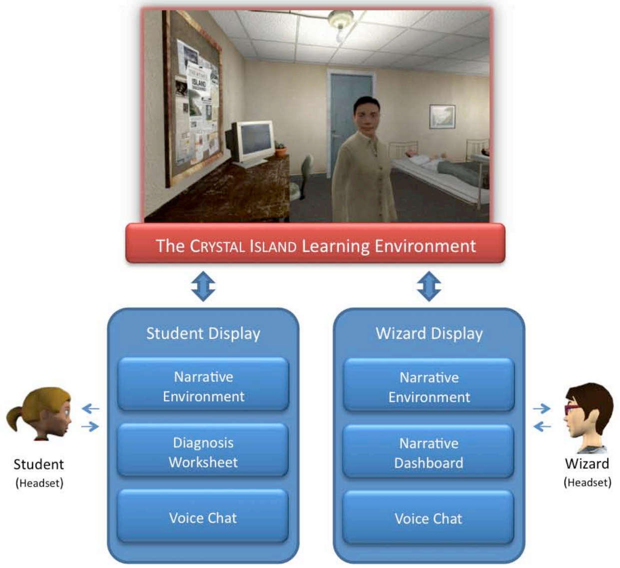


Figure 3. WOZ-Enabled CRYSTAL ISLAND

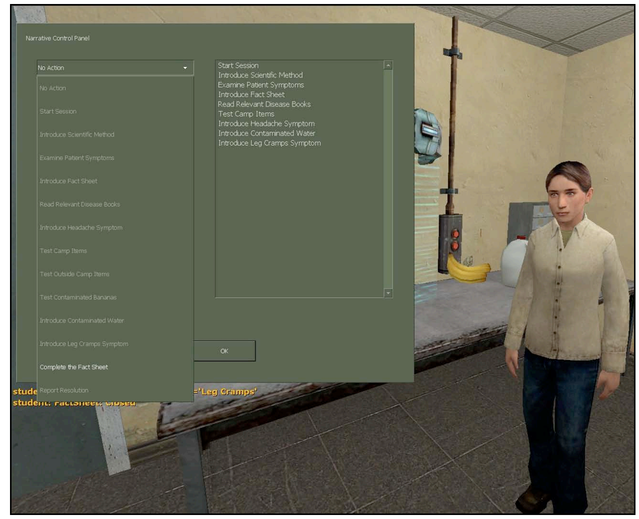


Figure 4. Narrative Dashboard

hypothesis and explain why she believes this. The user then provides a detailed explanation justifying her diagnosis, and the story concludes with the nurse treating the patients for cholera.

4.4 Study Design and Procedure

In the study, more than twenty hours of trace data were collected using the WOZ-enabled CRYSTAL ISLAND environment. The trace data includes detailed logs of all the user and wizard actions (e.g., navigation, manipulation, and decision making) within the environment as well as audio and video recordings of their conversation.

4.4.1 Wizard Protocol

To improve the consistency of the wizards' narrative planning and natural language dialogue activities, a protocol was iteratively developed and refined through a series of pilot studies. The resulting protocol included a high-level procedure for the wizard to follow (e.g., introduce yourself as the camp nurse, describe the patient situation to the user, review the scientific method with the user), a set of interaction guidelines (e.g., collaboratively work with the user to solve the mystery, organize the users activities around the scientific method, act as a senior peer to the user, have users explain their conclusions and ensure they are logical and consistent with the available data, engage the users in constant face-to-face inquiry dialogue), and a set of narrative guidelines (e.g., overall story structure, appropriate contexts for narrative decisions, ordering constrains, be cognizant of the elapsed time to ensure the session completes in a timely manner).

Prior to the study with the eighth grade students, each wizard was trained on the CRYSTAL ISLAND microbiology curriculum and the materials that would be provided to students during the study. The wizard training also included information on key concepts from the CRYSTAL ISLAND curriculum and the protocol to follow. After carefully reviewing the materials over the course of a week and having any of their questions answered, the wizards participated in at least three (and up to four) training sessions with college students. After each training session, a researcher performed an "after action review" with the wizard to discuss his or her interactions with the students and adherence to the wizard protocol.

4.4.2 Participants

The study participants were 33 eighth-grade students (15 males and 18 females) from a public school ranging in age from 13 to 15 (M = 13.79, SD = 0.65). Approximately 3% of the students were American Indian or Alaska Native, 3% were Asian, 24% were Black or African American, 9% were Hispanic or Latino, 55% were Caucasian, and 6% were of other races. Two wizards assisted with the study, one male and one female. Each session involved a single wizard and a single student. The student and wizard were physically located in different rooms throughout the session.

4.4.3 Procedure

When users arrived at the study room, they were greeted by a researcher and instructed to review a set of CRYSTAL ISLAND handouts, including information on the CRYSTAL ISLAND back-story, task description, characters, and controls. Upon completing their review of the handouts, the researcher provided further direction to the users on the use of the keyboard and mouse controls. The researcher then informed the users that they would be collaborating with another human-controlled character, the camp nurse, in the environment to solve the science mystery. Users were asked to communicate with the camp nurse throughout their sessions. Finally, the researcher answered any questions from the users, informed them that the sessions were being videotaped, instructed them to put on their headsets and position their microphones, and asked them to direct all future communication to the camp nurse. The researcher remained in the room with the user for the duration of their session. The CRYSTAL ISLAND session concluded once the user and wizard arrived at a treatment plan for the sickened researcher. The users' sessions lasted no more than sixty minutes (M = 38, SD = 5.15).

5. FINDINGS AND DISCUSSION

To explore the role knowledge sources play in the decision-making process of the wizards while carrying out their narrative planning activities, a qualitative analysis of the sessions was conducted. The usage of each of the knowledge sources is illustrated in the discussion below with examples taken from the corpus collected during the study.

5.1 Plot Progress

To demonstrate the use of plot progress knowledge, consider the following interaction. The wizard introduces the back-story and asks the user for her assistance, "Alyx, it's up to us to determine the cause of the illness. Can you help me?" Following the introduction, the wizard suggests that the scientific method would be a useful approach to solve the mystery, "I think we could use the scientific method for our investigation. Are you familiar with the scientific method?" and leads the user over to where a poster about the scientific method is hanging. The wizard suggests, "There is a poster behind you. Let's take a look at that." The wizard and user discuss the contents of the poster, "The first step of the scientific method is to…."

In this example, the *Learn About Outbreak Backstory* plot point has just been completed and the wizard realizes that many plot points are currently ready; however, based on the study protocol, reviewing the scientific method with the user is important. Correspondingly, the *Locate Scientific Method Poster* plot point is ready and can be achieved by moving over to the poster and indicating its location to the user. Once this plot point is completed the *Review Scientific Method* plot point becomes ready since it depends on the *Locate Scientific Method Poster* plot point. Through the user and wizard's dialogue interaction regarding the poster, the *Review Scientific Method* plot point is completed. This interaction illustrates how a director agent might take plot progress (i.e., the plot graph and its current state) into account while making its narrative decisions.

5.2 Narrative Flow

Taking thought and location flow into account during narrative decision-making is critical for crafting coherent narratives. To illustrate the use of narrative flow, consider the following interaction. The user has learned that several research team members have fallen ill and she should work with the camp nurse to identify the cause of the illness. The wizard has decided that it is time to start examining the patients' symptoms and suggests, "Let's go ahead and start examining patients. We'll start with your father Bryce." The wizard moves toward Bryce and asks the user to examine him. After the user listens to Bryce describe his symptoms, she discusses them with the wizard. When the wizard sees that the user has recorded Bryce's symptoms on the diagnosis worksheet, she moves over to Ford's nearby bed and the user follows. The user examines Ford to learn about his symptoms and records his information on the diagnosis worksheet as well. The wizard then decides to lead the user to the final patient and suggests, "Let's examine Audrey as well." The wizard and user move across the infirmary to Audrey's bed. Upon arriving, the user examines Audrey and records her symptoms on the diagnosis worksheet. At this point, the user knows all of the initial patient symptoms, so the wizard decides that learning about infectious diseases would advance the story. The wizard asks, "Do you know of any type of illness that can cause these symptoms?" The user replies, "No, not at all," and the wizard responds, "Ok, I am not sure either, so I think we should go and read some disease reference books."

In this example, the wizard is taking location and thought flow into account while making narrative planning decisions. Because the patients are all located in the infirmary, examining one after the other contributes to both location and thought flow. From the perspective of the plot graph, the wizard hints at *Locate Bryce* by moving over to Bryce's bed followed by hinting to achieve the *Examine Bryce Initial Symptoms* plot point. Next the wizard moves towards Ford to hint at *Locate Ford* and *Examine Ford Initial Symptoms*. Since Audrey is on the other side of the infirmary behind the user, the wizard provides verbal and nonverbal hints to *Locate Audrey* and *Examine Audrey Initial Symptoms*. Because a reasonable course of action after identifying the symptoms is to learn which diseases are relevant, the wizard decides to achieve the *Locate Reference Material* plot point to continue the investigation.

5.3 Plot Focus

Knowing which plot points the user is currently attending to provides valuable information during narrative decision-making. Consider the following interaction. The user is reading the book on cholera and realizes that one of its symptoms is a headache. Since the patients have not complained about a headache, the user is considering cholera to be less likely. Recognizing the user's conclusion, the wizard decides it would be an opportune time to have the patients complain about having a headache. Although one of the patients calls out for assistance, the user has moved on to reading the book on salmonella. In this case, the wizard notices that the user is attending to another plot point but decides that it is important for the user to learn the new information about the headache symptom, so the wizard has the character say, "I hear the patients in the other room. I'll go check on them." The wizard examines the patient in the infirmary and reporting the results back to the user says, "The patients are complaining about having a headache."

In this example, the wizard is using her knowledge of which plot point the user is focused on to determine whether she will achieve the *Observe Headache Symptom* plot point instead of hinting about it. Because the user is in the process of achieving the *Read Salmonella Book* plot point, the wizard does not want to disrupt her; however, the wizard determines that getting the user to reconsider cholera as a potential disease is important and should not wait. The wizard therefore decides to activate the plot point.

5.4 Physical State

The physical state of the storyworld provides a key source of information for decision-making. Physical actions within the storyworld often indicate when a plot point has been achieved. For example, the narrative dashboard displays a user activity log that provides details regarding actions the user performed in the world. In the case of reading a book, the wizard was notified each time the user opened a book as well as when the book was closed. Armed with this information, the wizard knew when to transition to subsequent plot points. Information about the location of characters within the world is likewise useful for decision-making. In one session, the wizard was guiding the student to locate Bryce and examine his symptoms. Although they successfully navigated to Bryce's bed, the user did not proceed to examine him. After noticing that the user was experiencing difficulty controlling her character, the wizard provided a hint to the user about how to examine Bryce. In this case, the wizard provided a hint to the user to complete the *Examine Bryce Initial Symptoms* plot point.

5.5 User Goals and Beliefs

Taking the users goals and beliefs into account while making narrative decisions is crucial for adapting to individual users. To illustrate this dependence, consider the following interaction. After examining the patients and reading the reference materials, the user has acquired new knowledge about infectious diseases. However, she has not successfully demonstrated a clear understanding that some diseases are waterborne while others are foodborne. To ensure the user understands this concept, the wizard explains to her that some of the diseases are transmitted via water while others are transmitted by food. In this case, the wizard is achieving the *Learn Foodborne Waterborne Illnesses* plot point. Working with another user in a similar situation, the wizard believes that the user has an accurate understanding of foodborne and waterborne diseases and decided to transition to the *Locate Testing Equipment* plot point to begin collecting data.

5.6 User Experiential State

Affect plays an important role in narrative decision-making. In one of the sessions, the user has come to believe that the source of the illness is a waterborne disease and that it is likely either cholera or shigellosis. Although the user believes cholera is more likely, she is unable to reach a final diagnosis. The wizard sees that the user understands the difference between the two diseases but is unable to rule out shigellosis. Realizing that the user is becoming frustrated based on their conversation, the wizard decides to use the narrative dashboard to inflict leg cramps on one of the patients, resulting in Bryce moaning loudly in the infirmary. The wizard and user navigate to the infirmary and examine Bryce who is now complaining about leg cramps. The user exclaims with excitement, “That means it is cholera.”

In this example, the wizard takes the user’s affective state into account when deciding on an opportune moment to execute a director action hinting at the *Observe Leg Cramp Symptom* plot point before the users loses interests or becomes discouraged. For a highly interactive environment such as the one used in the study, taking the user’s affective state into account while making narrative decisions is important if the system is to properly adapt to the user and create a dramatic experience for them.

6. CONCLUSION AND FUTURE WORK

Interactive narrative planning offers significant potential for crafting engaging story-based experiences that are tailored to individual users. Identifying the role that knowledge sources play in narrative decision making is critically important for creating optimal narrative experiences for users. In a Wizard of Oz study conducted with a narrative-centered learning environment, it was found that wizards rely on many different sources of knowledge for their narrative decision making. The study suggests that interactive narrative planners should take a holistic view of decision making or risk losing the benefits of the synergistic interplay of knowledge sources available to them.

Each of the knowledge sources is important for director agents to make effective decisions. Director agents must carefully consider the state of the narrative and where it is heading (plot progress) in their decision-making processes. Director agents must understand detailed information about their plot graphs so that they can take narrative flow into account. They must be able to reason about activities from a spatial perspective, and they should consider the user’s current plot activity while making their decisions. Director agents must understand the context and state of the storyworld where their decisions are being carried out. Much data is afforded to director agents by observing the event streams of actions in the virtual environment, a key source of information that should not be ignored. Director agents must utilize a model of the users’ goals and beliefs so that they can properly scaffold their activities in the environment. Further, because narrative and affect are inextricably intertwined, director agents must take users’ affective state into account while making their decisions. A compelling hypothesis suggested by the study is that director agents capable of taking each of these knowledge sources into account may derive benefits to narrative planning in a superaddative fashion.

The study represents a first step towards understanding human-level narrative decision making. A key direction for future work is investigating how director agents should respond to unexpected user interactions, yet still create a rich coherent narrative. In the study, wizards effectively used natural language dialogue to guide users when unexpected behaviors were encountered. Imbuing characters with sophisticated natural language dialogue capabilities offers a means for guiding users through stories, so devising adaptive models of narrative-centered interactive dialogue is a promising line of investigation. Another potentially fruitful direction is developing more effective models of affect understanding and affect generation for interactive narrative systems. Equipping narrative planners with the ability to reason about users’ affective states could provide more sophisticated human-centered inferential capabilities that could serve as the foundation for the next generation of interactive narrative technologies. Finally, another area of future work is to investigate a broader range of wizard interactions. Although the wizards in this study received the same training and instructions, they had different interaction styles. One was observed to be more in tune with users’ affective states while making decisions; the other wizard appeared to better understand users’ interactive capabilities within the environment. Conducting studies with large numbers of wizards will likely yield additional insight into effective narrative decision making.

7. ACKNOWLEDGMENTS

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