What might an action do? Toward a Grounded view of Actions in Interactive Storytelling

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Abstract. Interaction is central to interactive narrative experiences, but our understanding of player actions remains relatively shallow. Recent works have widened our view of what an action might do, but we still lack a way to identify, compare, and discover different kinds of action that an interactive narrative's player might perform. In this work, we present a way to model the interaction that occurs in an interactive narrative process, offering a common ground upon which many kinds of action can be distinguished, including kinds that might never have been used. We demonstrate our method on *The Ice-Bound Concordance*, an interactive narrative system that offers complex actions.

1 Introduction

The capacity for a player or audience to interact is a defining feature of Interactive Narrative media, but the common concept of a player *action* remains relatively narrow. From the perspective of interactive narrative design [4], an action is often viewed as a player's performance of a choice that they made, where their choice can affect the immediate progression of their unfolding narrative experience. The popularity of this view is apparent from the widespread use of directed graphs to summarize how a narrative experience might progress, in both literature and practice. In such a graph, each node represents a segment of narrative content, each directed edge represents a temporal ordering between its connected nodes, and each outgoing edge from a node represents an action that can progress the experience forward in time toward the target node. ...but is this all that an action might do?

Prior analyses have demonstrated that various notions of player actions have been used as parts of successful interactive narrative systems. These include *narrative rewinding* as discussed by Kleinman et al. [3] as well as *narrative sculpting*, *social navigation*, *generation*, *storywrighting*, *negotiation*, and *administration*, as discussed by Reed [9]. While these analyses offer useful examples of different activities that players can engage in as part of a narrative experience, they do not attempt to ground our understanding of what different kinds of action are afforded by an interactive narrative system. We aim to do so in this work.

Before proceeding, we must be careful to define "kind of action" – i.e., how should one recognize that two given actions are different kinds of action, in the

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way that we desire in this work? We derive our definition from the nature of one of the player activities that Reed discovered in his work: narrative sculpting [9]. Unlike the common notion of an action being something that changes the narrative world, narrative sculpting changes the structure of how any narrative experience can progress. In other words, narrative sculpting differs from the typical notion of a player action in that it changes a different aspect of the interactive narrative process [4]. Following this idea, we identify different *kinds of action* as those that change different aspects of an interactive narrative process.

Obtaining a grounded understanding of interactive narrative actions is important for three reasons. First, it can offer a new conceptual tool for interactive narrative design, empowering designers to carefully consider a variety of ways in which they could leverage interaction in their work. Second, it can offer a useful lens for interactive narrative analysis, allowing scholars to systematically catalog and categorize player actions in a more structured and nuanced way. Third, an initial grounded understanding can help researchers explore and discover new kinds of player actions, toward improving our shared knowledge over time. Our research challenge can thus be formulated as follows: We seek a way to model interaction in the context of Interactive Narrative that allows us to identify, compare, and discover different kinds of action that players might perform.

In this paper, we propose a new way to consider and understand player actions in an interactive narrative system. Compared to prior work, our method offers two key advantages. First, it is *flexible*. We have successfully reframed all of the notions of player actions that we mentioned above using a shared set of elements, though space limitations permit us to discuss only narrative sculpting in detail. This allows us to directly compare different kinds of actions on a common theoretical ground. Second, it is *generative*. Starting from a set of elements that model interaction in a "simple" interactive narrative system, the designer/analyst can recursively extend the model through a structured analysis. By the structure of this analysis (which we describe in Section 4), each new extension reveals a unique kind of action to consider. The set of possible models is infinite, but the extension process ends when the designer/analyst decides that no new extension is needed. As a result, exploring the set of possible models might allow a researcher to discover kinds of action that have never before been used. We suggest some potential candidates later on.

2 Related Work

In his recent dissertation [9], Reed explored the potential for action in the context of interactive narrative design. His analysis was informed by his knowledge and experience as an established creator of interactive narrative systems, and it was supported by an array of theoretical work spanning interactive narrative, narratology, and the study of both digital and analog games. Reed summarized his findings in terms of three modes of interactive narrative that differ from the common traversal of directed graphs: Sculptural Fiction, Social Simulation, and Collaborative Storygames. Sculptural Fiction gives a single player some actions

that are typically reserved for a narrative designer, as they must pick and choose between elements of narrative content to *build* a directed graph (e.g., *The Ice-Bound Concordance* [10]). Social Simulation asks its player to learn to navigate a simulation of social behaviour across a cast of non-player characters (e.g., *Prom Week* [6]). Finally, Reed posited that players of Collaborative Storygames (e.g., *Dungeons & Dragons* [2]) tend to spend their time on four core activities: *generation* (creating new narrative content), *storywrighting* (assembling content in a coherent or satisfying way), *negotiation* (resolving conflicts between players), and *administration* (interpreting and carrying out rules). As an analysis of how players might act in interactive narratives, Reed's work succeeds in extracting several player activities that can help broaden our view. At the same time, it does little to help us understand or identify different kinds of action in relation to one another, or as part of a larger whole. We aim to remedy that in this work.

Carstensdottir [1] recently sought to model interaction in an Interactive Narrative context, defining both the Progression Model and Progression Maps as highly granular ways to represent any specific opportunity to progress through an interactive narrative experience. This work is complementary to what we present in this paper, as we have a different goal. While Carstensdottir sought to enable detailed analyses of how players understand and reason about the narrative world based on the observations that they perceive, we seek to enable new perspectives on the kinds of actions that players might be given to perform.

3 Defining an Interactive Process

Our approach relies on a particular notion of an interactive process. We define it first as a general construct and then explain it in the context of Interactive Narrative, yielding a match with Koenitz's definition of an *interactive narrative process* [4]. An *interactive process* is a collection of six data elements and three functions, as shown in Fig. 1. *Data* describes information and *functions* produce data when given other data as input. The data and functions are as follows:

- A **target object** identifies the object that can be changed by interacting in the process (e.g., a narrative world);
- a **set of actors** defines which players may act upon and/or observe the target object by participating in this process;
- an **initial state** defines how the target object should be at the start of any actor's experience;
- a **set of possible states** defines every way in which the target object might be (e.g., at different times in a narrative experience);
- a **set of possible observations** defines every observation that an actor might receive about the target object;
- a **set of possible actions** defines every action that an actor might perform to change the target object;
- an **observation function** determines what each actor should observe (given the set of possible observations) based on the target object's current state;

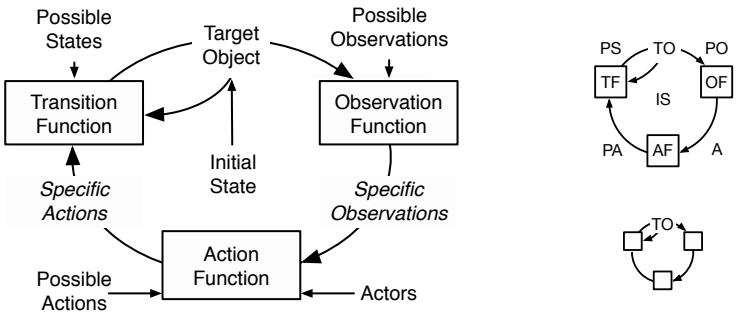

Fig. 1. Left: A diagram of an interactive process. Boxes show functions and arrows show the flow of data. Large arrows show the interactive loop. Italics show ephemeral elements for clarity. Right: Minified versions of the diagram that appear in later figures.

- an **action function** determines a possible action for each actor to perform based on the observation that each actor received (this represents the joint effect of all of the actors, who might or might not collaborate); and
- a **transition function** determines how a vector of all actor actions (one from each actor) should be used to transition the target object from its current state to a new state (given the set of possible states).

Koenitz stated that an interactive narrative process is defined and shaped by the actions that players perform and the opportunities that an interactive narrative system provides [4]. He further defined an interactive narrative system as a collection of all of the elements that can be used to produce interactive narrative experiences (including executable code, art assets, and the computing hardware in which they are situated) [4].

We propose that our definition of interactive process can serve well for modelling the interactive narrative process that Koenitz described, as choosing the target object to be a narrative's world yields a model that (i) provides opportunities to players via observations of the narrative world and (ii) gives them the ability to act to change it. We further propose that this model can also describe any interactive narrative process that considers a player action as something that progresses between nodes in a directed graph, which we discussed in Section 1. Specifically, when the target object is the story's narrative world, each node of the directed graph is a state of the narrative world, each outgoing edge is a possible player action, and each incoming edge describes how the narrative world transitions between states on the basis of a chosen action. The observation function allows the state to change in ways that the player might not observe.

Function Execution. Each function in an interactive process must be *executed*, meaning that a computer or one or more people must do some work to produce the function's output data. By considering execution in this flexible way, we ensure that we can represent interactive processes that are fully analog (e.g., *Dungeons & Dragons* [2]), fully digital (e.g., *Sheldon County* [11]), or

combinations of both. Following the tradition of Artificial Intelligence research, we use the term *agent* to refer generally to an entity that can perceive some input and act to produce some output. Thus, each function is executed by one or more agents. For example, the action function is executed by the process's actors, while the transition and observation functions might be executed by a computer (e.g., in *Skyrim* [5]) or by the process's actors (e.g., in *Fiasco* [7]).

An Interactive Narrative Process. As an illustrative example, consider how an interactive narrative process (i.e., an interactive process with a narrative world as its target object) can be used to model the first Choose Your Own Adventure novel, *The Cave of Time* [8]. The target object is the narrative world of *The Cave of Time*, meaning the fictional place in which the story happens, along with every object and character in it. The set of actors includes only a single player. The initial state includes the player's character standing just outside a mysterious cave in a place called Snake Canyon. The set of possible states is defined by the 86 reachable sections of the book, each of which is a different state. Each section is reached by performing an action from the set of possible actions, which each direct the reader to turn to a particular page of the book. Each possible observation corresponds to the printed text (and sometimes a drawing) that appears in each section of the book. The observation function is executed by the player; they must manipulate the book in a way that allows them to perceive the contents of each section (e.g., by holding it open and upright). The player executes the action function at the end of each (non-terminal) section by choosing one of the printed actions to perform. Finally, the player also executes the transition function; given the current state (e.g., the fifth section) they turn pages to reach the section given by the action's text (e.g., "turn to page 46"), and thereby transition the narrative world to a new state.

Thinking generally, an interactive process is useful for modelling interaction because it represents a way for an actor to affect change – i.e., the process's target object can be changed by executing its action function (subject to the transition function). As we will see in Section 4, this capacity to represent acted change is what will allow us to consider different kinds of player actions in an interactive narrative process.

4 A Method for Modelling Interaction

We now propose a method for modelling interaction in an interactive narrative process, toward highlighting its capacity to identify and distinguish between different kinds of player actions.

At a high level, our method begins with a base model of an interactive narrative process (specifically, an interactive process from Section 3 with a narrative world as its target object) and then grows into a more complete model through a recursive sequence of steps. Each step examines one of the elements (data or function) of the interactive process and prompts the designer/analyst to answer a specific question: *Should (or can) any agent change that element?* If the answer is "no", then nothing further is done and another element of the process

is examined in the next step (until no element remains unexamined). If the answer is "yes", then the model must grow, adding a *new* interactive process with a particular target object: the element for which the designer/analyst just answered "yes". The designer/analyst must define the elements of this new process (including which agents execute its functions), and then for each element ask *Should (or can) any agent change that element?* This is why the examination is recursive: with each answer of "yes", the model must grow again, creating a new interactive process with its own elements to examine. The model will be complete once every element of each of its processes have been examined, which will occur once the designer/analyst chooses to answer "no" for every remaining, unexamined element. The depth of detail included in each element's definition can be chosen to satisfy the designer/analyst's aims.

4.1 Modelling Interaction in The Ice-Bound Concordance

We demonstrate our method by modelling player interaction in *The Ice-Bound Concordance* [10]. This example is challenging because *Concordance*'s story contains multiple layers [9] as well as an example of sculptural fiction (recall Section 2). The outermost layer concerns the player's interaction with KRIS, a computational simulacrum of long-dead author Kristopher Holmquist. Each inner layer concerns Holmquist's incomplete account of the story of a unique group of people, where each group once inhabited different levels of a sinking polar research base. The player's task is to work with KRIS to complete each of the group's stories. This task is enabled via Reed's notion of sculptural fiction, wherein the player dynamically alters the structure of each inner story (including both themes and occurrences) until they reach a structure that they desire.

To address *Concordance*'s multi-layered nature, we begin with a base model comprised of several interactive narrative processes: one for the outer layer's story and one for each inner layer's story (Figure 2). Each process's target object is set to the narrative world of its associated story, while the initial states, sets of possible states, and sets of possible observations are set based on the potential content of each story. The set of actors contains the player for every process, but the set of possible actions remains empty for every process except that of the outer layer's story. This is because the outer layer's narrative world is the only one upon which the player can directly act. All transition and observation functions are executed by the computer that runs *Concordance*, and the action functions are all executed by the player, though there is nothing to do in all but the outer layer's process. Keeping the player as an actor in the inner stories' processes is important because it models the player's ability to observe (by reading) the events of each inner story.

Having defined a base model for *Concordance*, we can now recursively examine its elements to (potentially) grow the model, asking whether or not each of them can be changed by any agent. The answer is "no" except for the transition function of each inner story's process. The answers for these elements are "yes" because of the work that sculptural fiction entails – the player must be able to alter the structure of how a narrative experience can unfold, and this structure is

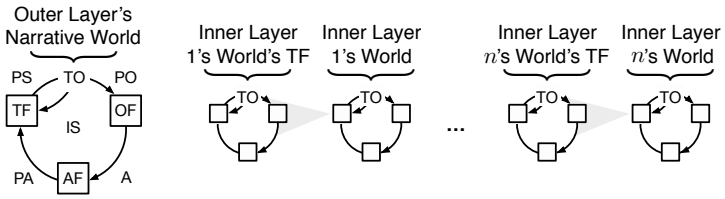

Fig. 2. Our complete model of *The Ice-Bound Concordance* [10]. See Fig. 1 for details.

precisely what each process's transition function represents. For each inner story process, the effect on the model is thus as follows. The model grows by the addition of one new interactive process whose target object is the transition function of the inner story's process. The remaining elements of each such process are defined by *Concordance*'s designers, and together they describe every possible story structure, how the player can observe and edit that structure, and what rules exist to shape how the editing proceeds (via the new process's transition function). To finish the analysis, we complete the recursive step, asking whether each of the elements in the newly created processes can be changed by the player. As every answer is "no", the examination ends and the model is complete.

The result is a model with $2n+1$ interactive processes, where n is the number of inner stories that *Concordance* contains: one for the outer layer story, and two for each inner layer story (one that allows the player to observe the story, and another that allows the player to modify that story's structure; Figure 2). This model confirms that Reed's notion of *narrative sculpting* is indeed a different kind of action from traversing an edge in a directed graph to affect a narrative world; instead of affecting the state of a narrative world, narrative sculpting affects the transition function that governs how a narrative world can proceed.

4.2 Limitations of the Method

Two of the notions of player actions that we noted in Section 1 posed a challenge for our model: *narrative rewinding* and *social navigation*.

Narrative Rewinding. As discussed by Kleinman et al. [3], narrative rewinding allows a player to revisit parts of the narrative world as though they were travelling back in time, providing opportunities to alter prior decisions and choose different actions. As Kleinman et al. show in their work, being able to rewind is different from the typical way that player actions traverse a directed graph. Typical traversals involve starting at one node and then visiting nodes that are progressively further (more nodes away) from the starting point. Meanwhile, directed graphs that allow rewinding must also contain edges that allow traversals that progress to nodes that are closer to the starting point.

In terms of our modelling method, narrative rewinding can be found in the base interactive narrative process that targets a narrative's world: by choosing particular actions via the action function, a player can cause the state of the

world to change in a way that revisits a previously visited state. Although we can successfully identify narrative rewinding as an activity within one of our models, there are no two models that can distinguish between processes that allow or do not allow the narrative to be rewound. This highlights that our stated notion of what distinguishes between different "kinds of action" is only one of perhaps several dimensions along which actions can be usefully distinguished.

Social Navigation. Reed identified Social Games as a mode of interactive narrative that is distinct from navigating a directed graph to change a narrative world [9]. We refer to this notion of an action as *social navigation*, as the player must understand, reason about, and manipulate a simulated web of social relationships between a cast of non-player characters (NPCs; e.g., in *Prom Week* [6]). When we use our method to model interaction in a Social Game, the result is a model with two interactive processes: the base process targeting the narrative world, and a second process targeting the action function of the narrative world. This second process is created because each of the NPCs is an AI agent that can modify its own behaviour by changing the base process's action function. While the player of a Social Game generally cannot *directly* influence the behaviour of any NPC, they can *indirectly* influence such behaviours by acting in the narrative world. Our current modelling method does not distinguish between "changing the narrative world" and "changing the narrative world to affect how another actor changes the action function" as different kinds of action, but we hope to explore this as part of our future work.

5 Discussion and Future Work

In this work, we presented and demonstrated a new way to model how players can interact in an Interactive Narrative context. Contrary to prior work, our method can distinguish between various kinds of action on the basis of which aspects of an interactive narrative process they are able to change. This notion of how actions can differ represents a significant generalization from prior work, as it unifies several known kinds of action under a common representation and further supports the discovery of new kinds of action through the method we described. To imagine some of kinds of action that are potentially new, consider a connected set of three interactive processes: one is the base interactive narrative process, the second process targets an element of the first process, and the third process targets an element of the second process. With nine potential targets to choose from in each of the first and second processes, this leads to $81+9+1 = 91$ different kinds of action that such a model could allow. For example, a sneaky *Dungeons & Dragons* [2] player might creatively edit the Game Master's rule book before a game begins, thereby changing the set of possible states that are allowed during character creation and allowing them to create a character (as part of the story's initial state) that runs counter to the official rules.

We hope that the generative nature of our method will be used to explore this new space of possible actions, toward further diversifying the kinds of actions that players can perform in interactive narrative experiences.

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