

# Toward Recombinant Dialogue in Interactive Narrative

James Ryan, Marilyn Walker, and Noah Wardrip-Fruin

Center for Games and Playable Media  
University of California, Santa Cruz  
{jor, maw, nwf}@soe.ucsc.edu

## Abstract

*Prom Week* is a social-simulation videogame driven by the artificial intelligence engine *Comme il Faut* (*CiF*). In each level of the game, the player selects social interactions between characters in an effort to achieve socially oriented goals. These social interactions are enacted with hand-authored natural-language dialogue exchanges, called *instantiations*, which also serve to render the underlying social considerations propelling the narrative at hand. While *CiF*'s merit is in its capacity to richly model a social space, constraints rooted in authorial burden hinder *Prom Week*'s ability to fully render *CiF*'s rich social representations. What is needed is more instantiations, specifically instantiations that can render uncommon or complex game states with greater fidelity. We propose a technique to procedurally generate new, felicitous instantiations by recombination of dialogue segments from existing instantiations that are annotated, using the story-encoding tool SCHEHERAZADE, for their transmissions about the story world and their various dependencies.

## Introduction

*Comme il Faut* (*CiF*) is a social artificial intelligence engine that is designed to underlie interactive narrative experiences in which the player's primary affordances are social interactions with or between characters (McCoy et al. 2011b). *CiF*'s major demonstration is *Prom Week*, a social-simulation videogame set in a high school in the week leading up to prom (McCoy et al. 2011a). In each level, players of the game are tasked with causing certain social outcomes to be realized before the titular prom concludes the week. These outcomes may be for two characters to begin dating or to become friends, for example, and are achieved by selecting social interactions, like *flirting* or *bragging*, that are initiated by one character and directed toward another. The set of interactions available to the player at any point is determined by computation over the state of the story world.

Once a particular interaction, or *social exchange*, and initiating character, or *initiator*, are selected by the player, *CiF* reasons over several thousand social considerations to decide whether the recipient of the exchange, called the *responder*, will accept or reject it. This computation is then

repeated to choose an *instantiation* of that exchange to play out. An instantiation is an enactment of a social exchange through five to ten lines of hand-authored dialogue between its participants, coupled with expressive character animation.

Beyond communicating how the social exchange plays out and how its outcome changes the story world, an instantiation also serves to render the underlying social considerations that made that social exchange an available interaction between the initiator and the responder in the first place, as well as the social considerations that influenced the responder to either accept or reject the exchange. For instance, if the player decides for a character to initiate an *Ask out* social exchange with a responder who is an ex whom the initiator had cheated on and for these reasons rejects the exchange, the instantiation that is enacted should convey these pivotal considerations with its dialogue.

Due to authorial burden, however, many combinations of social considerations do not have instantiations that can fully render them, and in these cases a more generic instantiation that comes closest to doing so will be enacted. When this happens, it works to conceal much of *CiF*'s social computation from the player. This problem could be at least partly alleviated by the authoring of more instantiations, which would increase the coverage of game states that *Prom Week* can render, and more specific instantiations, which would increase the game's fidelity in rendering complex game states.

In this paper, we propose a technique for procedurally authoring new instantiations by recombination of dialogue from existing instantiations that are annotated, using the story-encoding tool SCHEHERAZADE, for their transmissions about the story world and their various dependencies.

## Problem Formulation

Once a *Prom Week* player has selected a social exchange and the responder of that exchange has decided whether to accept or reject it, *CiF* enacts the most *salient* instantiation of that exchange. The salience of a potential instantiation can be thought of as the fidelity with which it renders the social considerations that made that exchange available to the player and also the considerations that determined whether the responder would accept or reject it. Every instantiation has a set of preconditions about the story world that must hold in order for that instantiation to be enacted. These pre-

conditions are social considerations in the form of predicates representing facts about the story world, such as *Initiator is nerdy*, *Initiator has a crush on responder*, or *Responder did something taboo during the current playthrough*. The more salient an instantiation is, the more preconditions it has, and thus the more specificity it has in terms of what it is rendering about the state of the world.

As more salient instantiations render more about the story world, they in turn are better poised to render how the player's actions have affected that world. But as the salience of an instantiation increases, the likelihood of it being enacted decreases. This is simply because more salient instantiations have more preconditions on them, and the more preconditions that must hold in order for an instantiation to be enacted, the less likely it is that that instantiation will actually be enacted. Because of this, the composition of dialogue for very salient instantiations would represent misspent human authoring time and effort. As such, *Prom Week*'s instantiations understandably are typically not of high salience.

Also at play here is the authoring bottleneck, whose constraint on interactive narrative is well known (Mateas 2007), and which becomes especially constrictive when a game's primary means of rendering its state is natural language. Indeed, other social-simulation systems have altogether eschewed fully realized character dialogue by instead relying on expressive abstractions of language, e.g. *Storytron* with its Deikto words (Crawford 2008) and the Simlish of *Sims 3* (Electronic Arts 2009).

In this case, authorial burden has worked to limit the number of instantiations hand-authored for *Prom Week*. This limitedness of the full set of instantiations in turn limits coverage, in terms of what can be rendered, of the possible social spaces afforded by *CiF*, the multitude of which is largely the selling point of the system. Indeed, certain combinations of things true about the story world in a particular playthrough may not be privileged to have an instantiation of the player's chosen social exchange for which all, most, or even any of those things are preconditions. When there is no instantiation with the matching preconditions, a more generic one is chosen, meaning that meaningful aspects of the story world will at times not be rendered to the player.

While *CiF*'s merit is in its capacity to richly represent a social space and in the multitude of possible social spaces that it can represent, these constraints on rendering work to conceal these strengths – and this way lies the *Tale-Spin effect* (Wardrip-Fruin 2009).

So, what can be done? We propose a technique that would generate many new instantiations for *Prom Week* – thus expanding the coverage of states that can be rendered – of which many would be highly salient – thus increasing the fidelity with which states can be rendered. This, we propose, would be done by procedural recombination of annotated segments of existing instantiations into new instantiations that satisfy specified constraints.

## Related Work

Prior work has explored repurposing natural-language text for a number of applications, including interactive tutoring (McGreal 2004, Shen et al. 2003), pedagogical simulation

(Gaffney, Dagger, and Wade 2007), story generation (Swanson and Gordon 2008), chatbots (Carpenter 2011), and spoken dialogue systems (Shibata, Nishiguchi, and Tomiura 2009; Bessho, Harada, and Kuniyoshi 2012). Other related work has involved expressive natural language generation for interactive narrative (e.g. Walker et al. 2011), including by the use of SCHEHERAZADE (Rishes et al. 2013), but we are not aware of any work on procedural authoring of dialogue by recombination.

## Proposed Methods

Part of the motivation for developing *CiF* was the desire for a system that could reuse and recombine social considerations and social exchanges in interactive narratives (McCoy et al. 2011b). While instantiations are reusable in the sense that they may be enacted at any given time as a partial rendering of various possible world states, they are not currently recombinable. The smallest unit of dialogue in *Prom Week* is the full exchange, and the lines of dialogue composing an exchange are inextricable from one another, in that the system cannot decompose the exchange or reason about its components in any way.

We believe that new instantiations with precondition sets not found in *Prom Week*'s current suite of instantiations could be composed procedurally by recombining lines of dialogue from existing instantiations. To do this, the system would have to reason about individual lines of dialogue, specifically about what they transmit about the story world and what their dependencies are.

## Transmission and Dependence

To compose an instantiation with preconditions  $x$ ,  $y$ , and  $z$ , what is needed is at least one line of dialogue that transmits the content of  $x$ , one that transmits the content of  $y$ , and one that transmits the content of  $z$ . However, for obvious reasons, dialogue is not so easily recombinable. To ensure that recombinant dialogue exchanges are well formed, each line's dependencies must be met. The dependencies that a line of dialogue has are all the things that must be in context for the line not to be a non-sequitur. We have identified two types of dependencies, which we specify by the type of thing that is depended on:

1. **Speech act of a preceding line.** A line with this type of dependence may, for instance, be an affirmative answer, in which case the line is a non-sequitur if it is not preceded by a yes/no question.
2. **Lexical feature of a preceding line.** Usually this means that a line of dialogue's phrasing is a play on a preceding line's phrasing, as illustrated in this example sequence from *Prom Week*:

**Initiator:** Great Scott! I calculated there was only a pi-times-e-squared-to-one chance this tactic would succeed!

**Responder:** You had me a 'pie'. Let's go to the bakery, sweetie.

Because the dependence is strictly on a preceding line, a line with the third type of dependency can only be reused if the specific line that is depended on is also reused and precedes it in the recombinant dialogue.

Additionally, some lines of dialogue, notably questions, may have a forward dependence in that they necessitate some sort of resolution by a subsequent line. This follows the notion of *discourse obligations*, which is well known in dialogue systems research (Traum and Allen 1994).

Having this preliminary typology of dependencies, and knowing the full set of *CiF* preconditions that we may hope to convey in new instantiations, we now show that we can annotate existing lines of dialogue for this information in order to facilitate procedural recombination.

## Annotation

We propose to use the story-encoding tool SCHEHERAZADE (Elson and McKeown 2007) to annotate hand-authored lines of *Prom Week* dialogue for their transmissions about the story world and for their dependencies. The following recombinant instantiation, though not authored automatically, was constructed manually by reference to SCHEHERAZADE annotations of the three instantiations that it is culled from.

## A Recombinant Instantiation

Figure 1 shows a dialogue exchange for a new instantiation that was composed by recombination of three existing instantiations. It is for an ACCEPT outcome of the social exchange *Pick-up line* and has the preconditions *Initiator is nerdy*, *Initiator used to date responder*, and *Responder cheated on initiator*. We operationalize these items as things that must be conveyed in the recombinant instantiation, i.e., its dialogue must render what these preconditions specify about the story world and must also communicate the identity of the social exchange as well as its ACCEPT outcome. A formulation of our planned combinatorial procedure, by which recombinant instantiations will be authored, is beyond the scope of this paper, but it will reason about recombination in the way that we do in the remainder of this section.

The first line is from a *Pick-up line* instantiation in which the initiator is nerdy, and it transmits that fact, thus satisfying the first targeted precondition. As a pick-up line, it also communicates the identity of the social exchange. The second line comes from an *Ask out* instantiation and transmits that the responder cheated on the initiator, which entails that the two characters used to date, thus satisfying the two remaining targeted preconditions. This line depends on a preceding line having the speech act *Initiator asks out responder*, but the first line satisfies this dependency, so it can be used. The ACCEPT outcome still has not been communicated by any dialogue, so the instantiation cannot end here even though the target preconditions have been rendered. Further, there is a forward-moving dependency from the second line in that it commands a response. The third line comes from the same *Ask out* instantiation as the second line, strengthens the rendering of the latter two targeted preconditions, and has its dependencies met. Finally, the last three lines

Figure 1: A new highly salient instantiation culled from three existing instantiations, as indicated by color.

**Initiator:** What's your sine? It must be pi/2, because you're the 1.

**Responder:** What? Seriously? I cheated on you, Initiator.

**Initiator:** It doesn't matter! We all make mistakes! Please, take me back!

**Responder:** I don't know, Initiator... I might break your heart again.

**Initiator:** If it's you, Responder... I don't mind.

**Responder:** Alright...

come from a different *Ask out* instantiation and serve to further strengthen rendering of the targeted preconditions, but moreover to communicate the ACCEPT outcome. The final line has no forward dependence, so the instantiation can end with it.

## Future Work

Our ongoing work is to annotate a large number of *Prom Week* instantiations with SCHEHERAZADE and to implement a combinatorial procedure that will query a database of annotated dialogue to build recombinant instantiations with targeted preconditions. From here, we can build a version of *Prom Week* that has both hand-authored and recombinant instantiations and then test whether the latter stand out. Beyond this, we may seek to explore automatically generating annotations for dialogue exchanges, as such a technique could be used to harvest new dialogue from the web or other media. Ultimately, we envision this work informing development of an authoring tool for recombinable dialogue.

## Conclusion

In this paper, we proposed a method for procedural authoring of recombinant dialogue exchanges for the game *Prom Week*, which would improve both the game's coverage and fidelity in rendering the rich social representations generated by its underlying artificial intelligence engine, *Comme il Faut*. In order to do such recombination, we believe that the system will need to reason about lines of dialogue in terms of what they transmit about the story world and what dependencies must be met in order for them to fit into new contexts. We intend to annotate existing dialogue exchanges with the story-encoding tool SCHEHERAZADE in order to capture this information. Finally, we will implement a combinatorial procedure that queries these annotations in order to extract and recombine lines of dialogue into new exchanges that satisfy targeted constraints. We believe our method will be generalizable to any narrative systems that use dialogue to render aspects of their story worlds.

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