

A Framework for Playable Social Dialogue

Mike Treanor, Josh McCoy, and Anne Sullivan

American University
{treanor, jam, sullivan}@american.edu

Abstract

Non-player characters in games generally lack believability and deep interactivity. The AI system Ensemble begins to tackle this by modeling social state and behaviors for game characters. With previous versions of Ensemble, the player initiates social exchanges and the system generates the dialogue and outcome and displays them in their entirety. In this paper we present an extension to Ensemble comprised of a model of playable social dialogue called social practices. Social practices increase the playability of character interactions and add interactivity at each stage of dialogue. Additionally, this work enables a more modular form of authoring to support the additional complexity.

Introduction

Non-player characters (NPCs) in computer games often take the role of simple automaton: delving from statically authored content and following branching dialog trees in most cases. While some commercial games such as *Shin Megami Tensei: Persona 4* (Atlus 2008) and *Elder Scrolls V: Skyrim* (Studios 2011) have worked to add some depth to NPC's interactions with the player and in-world believability, there is still much room for improvement in creating more interactive and meaningful social dialogue.

The situation is compounded as adding complexity to the NPC's interactions increases the authorial burden due to the increasing branches within their dialog trees. This leads to difficulty in creating and supporting interesting characters within the game.

The AI system implementation of a playable social model *Ensemble* (formerly known as *Comme il Faut*) (McCoy et al. 2014) was used in both *Prom Week* (McCoy et al. 2013) and *Mismanor* (Sullivan et al. 2012). Ensemble was created as a first pass at increasing the capabilities of NPC AI by deeply representing the social state of the game world as well as the social models of behavior in the NPCs. Players choose a social interaction such as *Flirt* or *Small Talk*, and Ensemble uses the social models to compute the reaction of the NPC as well as the outcome and performance of the entire social interaction.

This solution sidestepped the dialog tree complexity by having the entire social interaction conversation generated and shown at once as a mini cut-scene. However, in a more traditional game setting in which dialogue trees are employed, the complexity issue remains. Additionally, this implementation only allows interaction at the level of choosing which social interaction to initiate, but no interactivity within the social interaction itself.

Our work uses the social models found in Ensemble as a base and adds lower-level interaction to increase the player's social impact in the decision and choice making within the social interactions.

To accomplish this we extend the social models found in Ensemble, creating a model of social practices that are playable at the level of lines of dialogue. Instead of choosing a social interaction and watching the entire interaction play out, the player and NPC take turns choosing actions at each stage of the social practice until its conclusion.

To support this from an authoring perspective, the dialogue is no longer written for specific characters, but can instead be retargeted to many NPCs. This departs from the standard tree structure of dialogue and allows for a deeper generative space and more believable characters. It also allows the AI system to reason at the level of action-to-action consistency and coherence within the procedural space to prevent moment-to-moment character amnesia that can be common in dialog-tree driven systems.

In this paper we present details on the social practice model and how it enables interactions at the level of character dialogue. This system enables interactions that are playable as the characters (both player and NPC) have choices for each unit of performance that impact game state. Finally, we present an example of a social practice and discuss the proof of concept visual novel we are creating using this system as well as future work.

Related Work

While successful computer role-playing games like *Elder Scrolls V: Skyrim* provide engaging experiences with beautifully realized worlds, pre-authored dialogue trees dominate the story and social worlds of AAA games. The *Persona* series is one of the few examples of games released

by AAA studios to allow player choice to impact the story. For instance, *Shin Megami Tensei: Persona 4* featured a system of social links between characters that can be modified when the player takes certain actions. The effect player actions have on the social links between characters is set ahead of time by the author.

Some independent and academic games allow players to have more meaningful interactions and impact the social aspects of their story worlds. *Prom Week*, *Faade* (Mateas and Stern 2005) and *Blood and Laurels* (Short 2014) each allow for a larger range of possible player interactions that have meaningful impact on the story world. As a consequence, these games have progressed social interaction systems past the pervasive dialogue tree representation, but do not break the social interactions down to a more granular level.

Several artificial intelligence systems provide stronger playable models of the social spaces. Some of these systems provide the foundation for such experiences: *FAtiMA* (Dias and Paiva 2005) is an agent-based architecture behind *FearNot!* (R. S. Aylett et al. 2005) and *ORIENT* (R. Aylett et al. 2009). *Bilat* (Kim, Jr, and Durlach 2009) was built on *PsychSim* (Marsella, Pynadath, and Read 2004) and Ensemble is the underpinning for *Prom Week* and *Mismanor*. Similarly, the system Praxis (Evans 2013), with its authoring language *Prompter* is behind *Blood and Laurels*. These systems all work towards a similar goal as our work, but we are presenting a deeper interactive model of social practices.

The work in this paper allows for deeper playability in dialogue interactions as seen in the mentioned AI systems while keeping the end performances coherent like those of pre-authored dialogue trees of computer role-playing games.

Social Practices

As social practices and similar concepts are broad and multifaceted, several games and systems use related concepts and terminology (Evans 2011; Schank and Abelson 1977; “The Sims Studio” 2009). In this work, a social practice is defined as a normative pattern of social interaction that captures the nuances that result from the individual agent’s situation in the social state. In Ensemble, the particular path through an instance of a social practice is not strongly pre-authored; instead the path is generated. Rather than adhering to a static branching tree structure, or a state machine with transition rules, a sophisticated selection mechanism is used to determine an agent’s response to the previous action and current social state. This mechanism is driven both by the structure of the practice as well as a model of socio-cultural norms of the story world.

Social practices are made up of linked *stages*, each with a selection of *actions*. There is also a collection of special stages called *event stages* that can be triggered by special circumstances. Each action is realized by a character *performance*.

The generated path through a social practice is based on *scoring actions* and *microtheories* and the scores are calculated based on the *social state*. Every action *evolves the social state* and some actions may cause *triggers* to happen. This continues until the *end of a practice* has been reached.

These concepts are all described in more detail below and shown in Figure 1 above.

Social State

A symbolic representation of aspects of the social world relevant to the story, referred to as social state, is central to reasoning done by Ensemble. The social state for a story world modeled by the system is bounded by an abstract representation known as a social schema. The social schema may describe things such as possible relationship types (e.g. friendship and romance), possible moods (e.g. angry and sad), and possible character attributes (e.g. humble and outgoing). As explained in the Scoring Actions and Microtheories section below, Ensemble’s reasoning process often results in determining if units of social state are true or false. Some examples of social state units are “character X is friends with character Y” and “if Y has more than 50 trust for Z”.

Stages

A social practice is made up of a series of linked stages in which two participants take turns being the active character. Stages are comprised of a set of actions that contain a character performance (generally a line of dialogue, animation, or visualization) as well as updates to the social record. Every action of a stage is authored to conceptually represent the same aspect of a practice (e.g. a stage “reciprocate compliment” could contain several actions where participants reciprocate the complement in different manners). The stages are linked together under the constraints of a directed acyclic graph (DAG). Stages that can be used to start the practice are called entry stages.

The social practice is initiated by one of the participants. To do this, the participant is presented a choice of actions from any of the entry stages to initiate the social practice and the selected action is realized via a performance. For example in Figure 1, the initiating participant can choose from actions A or B from the left entry stage, and actions C or D from the right entry stage. After choosing an action (in our example the initiating participant chooses action B), the social state is modified to reflect the effects of the chosen action.

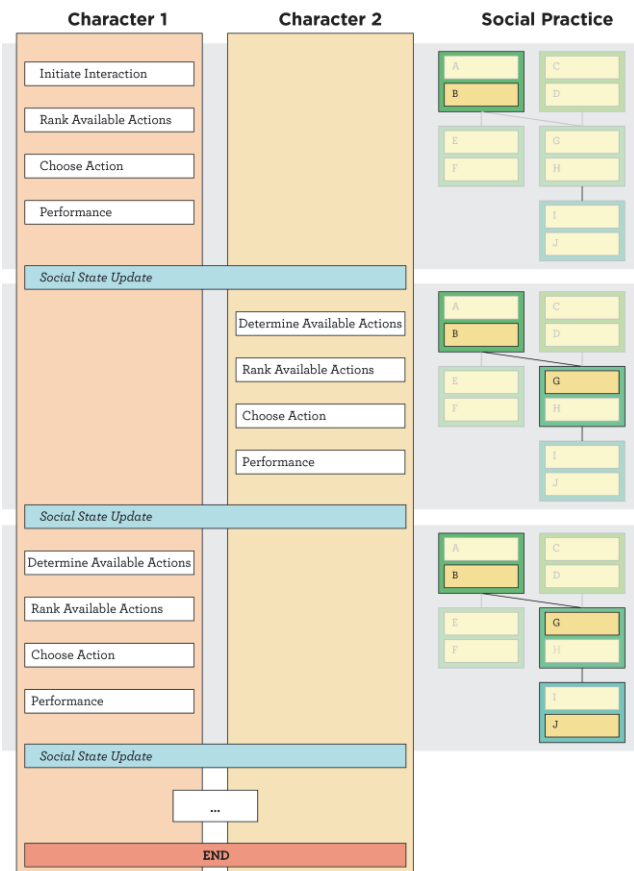


Figure 1: A diagram of the way two characters take turns moving through a social practice. An abstract social practice is shown along the right displaying the actions that were chosen within each stage. The "Social State Update" markers denote the end of an action.

The other participant is then presented a list of actions based on the linked stages from the current stage of the social practice. In Figure 1, the second participant would be offered a choice of actions E, F, G, or H which are the actions from stages linked from the stage that action B is part of. When a non-playable character is the active participant, the action is chosen using a selection mechanism that is described below in the Scoring Actions section.

Actions

Each stage consists of a set of actions that are authored to express an agent's intent (see the Microtheories section below). When an action is taken, a performance is given and the social state is modified to reflect the agent's response via the action's effect. Examples of social state changes are "record that X was rude to Y" or "raise the trust between X and Y by 5."

The game engine carries out the actions, so they consist of procedures that enact performances appropriate for the game that will realize them. Actions' performances typically consist of the dialogue, animation, or visualization the game needs to express to the player that the action has occurred. After an action's effect is applied to the social state, all actions contained within each of the linked stages are scored and the highest ranked is selected (and so on).

Event Stages

In addition to the linked stages, at every choice point a collection of event stages and their actions are considered. These stages are used to catch situations that fall outside of a normative social pattern. For example, if two agents are bitter rivals, an effect stage of rejection could be authored to perform that the responding agent dislikes the initiating agent and ends the practice early.

Scoring Actions and Microtheories

Transitions between stages are determined by considering all of the possible actions in the linked stages, and choosing the stage that contains the action with the highest scoring volition. Scoring is achieved by summing three values: the *practice-specific bias*, the *microtheory rules* tied to the action's intent, and the action's particular *influence rules*.

The practice-specific bias is how the normative flow between actions is introduced. It is a weight that represents the situation of two agents that don't have any particular social relationship and determines the most routine path through a practice. For example, a practice-specific bias may be introduced in a "How're you doing?" social practice where agents almost always respond with "Good! How're you doing?"

Microtheories are collections of *influence rules* that apply across practices. An influence rule is made up of a left and right hand side. The left hand side is a conjunction of queries about the social state. The right hand side is a weight that should be accumulated to that intent's score should the rule evaluate as true. Microtheories are often the most pertinent factor in choosing an action as they encode the socio-cultural commonsense of the agents. From an authoring perspective, microtheories allow authors to not need to consider wide ranges of social common sense when creating practices.

As an example, a microtheory rule might define an agent's intent to be "friendly." An example influence rule in the friendly microtheory is "if X was nice to Y in the last 8 turns, add 2 to X's volition to express the friendly intent to Y." In other words, "If someone has been nice to you recently, you will be 2 more likely to be friendly to them." Each action in a social practice is tagged with one of these intents and the accumulation of the scores of these

rules provide the microtheories score that is added to an action's weight.

An action's influence rules take the same form as the microtheory rules described above, except the weights are only relevant while scoring the action they are associated with.

Evolving the Social State

In Ensemble, every action evolves the social state. This may be recording that "X has been nice to Y at time 7" or that "Y is 'disgusted with' X." It can also be something more complex such as "Y's friendship towards X has gone up by 4 and Y is happy." These changes to the social state change the way that future practices will play out for the agents involved, as well as any other agents that are related in the social state.

Triggers

Triggers capture social state changes that exist outside of social practices. A trigger's primary purpose is to capture third party effects (i.e. social state changes with agents who are not part of a social practice). For example, where an agent who has a monogamous romantic relationship may be able to engage romantically with an agent in the context of a "Flirt" social practice, a trigger will capture that the agent is engaging in norm violating behavior.

Triggers capture social state changes that should occur, but which do not have to do with the particular social practice that is taking place. These changes often take the form of the consequences of actions that cascade through the social world.

Performance

Each action is realized in a game via its performance. The particular form that a performance may take is game specific, though a common example may simply be a line of dialogue, an animation, and a sound effect. In the current implementation, the line of dialogue uses a template-based NLG system to replace names, pronouns, history references and more.

Additionally, each action is able to provide a custom performance based on what path through the practice has led to the performance. However, a default performance can be provided should the author not want to create a custom performance.

Ending a Practice

A practice is complete once there are no further linked stages in the current stage of the action that was performed (and thus no actions are available to consider).

Authoring

Although the primary contribution of this work is making a smaller scale of character interaction playable, social practices provide advantages to the author. Authoring for standard computer role-playing games is already difficult; adding another level of abstraction makes the cognitive load hard to handle. In the case of social practices, we chose to use a DAG as a primary mode of representation. This provides both structure (to use as a creative constraint) and a visual metaphor to the authoring process.

In previous versions of Ensemble, the system provided the ability to retarget and parameterize performances – made up of a small number of dramatic beats – based on the context of the game and the characters involved. In comparison, the actions in social practices are performed at the granularity of lines of dialogue, which can be aggregated into beats. This allows a potentially large number of beats to come from fewer actions.

Behavior trees are a common structure used in contemporary games, but they suffer from exponential growth when adding complexity. The basis of this growth is due to the many dependencies in the tree structure that serve as hard constraints. In contrast, in our implementation of Ensemble, the NPCs choose paths through the DAG of stages based on soft constraints (i.e. influence rules and microtheories). Therefore, the impact of dependencies in the authoring process is greatly reduced. This allows the author to add, remove, and modify authored content with minimized impact on the rest of the social model.

Example

We are currently applying social practices in a visual novel style game prototype. In this game, the player engages with an unknown culture and attempts to navigate through social interactions with the NPCs. We are able to encode the alien culture as a set of microtheory rules and the player initiates and moves through social practices with the NPCs.

As an example to help illustrate our work, we present the social practice "Compliment" as seen in Figure 2. Compliment has two entry stages: Insincere Compliment and Sincere Compliment. Insincere Compliment has two actions: Backhanded Compliment and Flatter. Sincere Compliment also has two actions: Friendly Compliment and Romantic Compliment.

When the player interacts with an NPC and chooses the Compliment social practice, they are presented with the four actions from the two entry stages, as long as the preconditions for the actions are met. For instance, the romantic compliment action has a prerequisite that the initiator and responder of the action are over 18 years of age. For this example, the player chooses the "Backhanded Com-

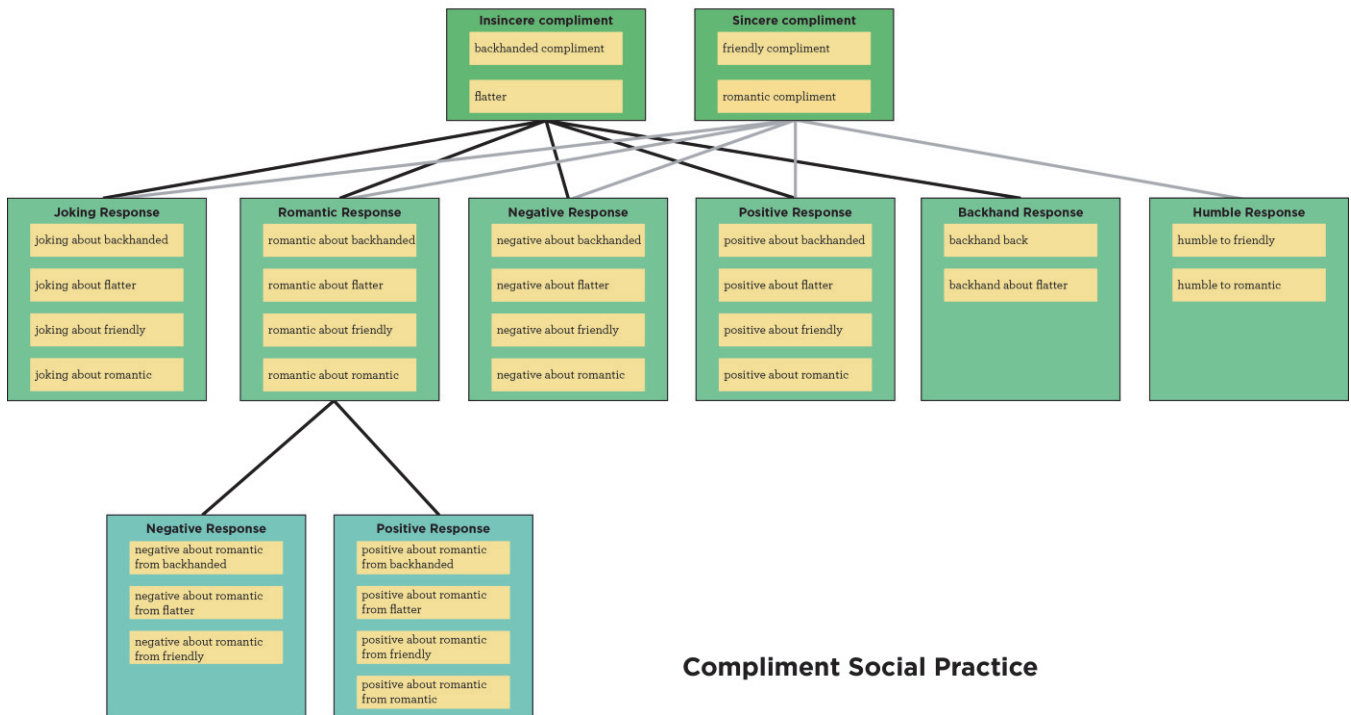


Figure 2: The compliment social practice. Each stage is shown in a shade of green, and actions within stages are shown in yellow. Each stage may be linked to a further stage. The player or NPC chooses actions from the linked stages based on their current stage.

pliment” action and the performance is realized by the dialogue line: “I wish I was confident enough to wear something like that.”

Ensemble then calculates the response for the NPC. Given the list of possible reactions, Ensemble first checks the preconditions to see which actions are available given the current social state. From the remaining actions, microtheories for all the intents represented are calculated and the action with the highest weight is chosen. In this example, the NPC has a low friendship towards the player and therefore chooses the “Backhanded Response”. The NPC responds with “Thanks! I had no idea you knew anything about fashion.” Screenshots of this interaction can be seen in Figure 3, below.

This interchange shows the power of the performance trees. Without them, the dialogue had to remain very generic as a “Backhanded Response” could be given for any of the four initial actions, “Backhanded Compliment”, “Flatter”, “Friendly Compliment”, and “Romantic Compliment.” With only one dialogue option to answer all four of those possibilities, the dialogue was not nearly as interesting as we’d hoped. Performance trees provided the solution to this and, as this example shows, allows for much more tightly coupled dialogue between the player and NPC.

Once a response has been given, the effects are calculated. In this example, because the player has a high humor

value, they appreciate the witty banter and their respect for the NPC actually goes up. However, the NPC has a low trust for the player and saying something insincere strengthens those feelings, so the NPC’s trust and friendship towards the player both go down.

From here, the social practice is over and another practice can be chosen. If the NPC had chosen the romantic response, the player would be able to choose their reaction to the romantic response, effects would be calculated, and the practice would continue until the end state was reached.

Discussion

The details on the social practice model and how it enables playable interactions at the level of character dialogue were detailed in this paper. An example of a social practice was explored to illustrate the expressive range and capabilities of social practices in Ensemble.

Because social practices are designed to be retargetable, the particular way that the practice will unfold reflects the individual NPC’s state as well as the player’s social history. We are finding that this modularity is very useful for scaling. For example, once the “Small Talk” practice is completed, the practice can be applied between the player and any other NPC.

A downside to this approach is that completing a robust practice is a significant undertaking and involves a



Figure 3: Screenshots showing the player initiating a Backhanded Compliment, and the NPC choosing a Backhanded Response.

fair deal of abstract reasoning and imagination. Future work will involve investigating authorship and creating guidelines for exploring the space of a social practice.

As of now, a practice must be taken to completion before another practice can be initiated. This does not reflect real social interaction and is a limitation of the current system. Further work will explore allowing agents to be engaged in several longer-term practices simultaneously.

Because both NPCs and players are treated equally, the player's role in a social practice has the potential to be problematic with respect to player modeling. The actions available to a player is limited to those authored in the social practice. This can create a rift between the player's interpretation of their interactions and the interpretation imposed by the social practice. In settings where players represent themselves in the story world, this rift is pronounced. In settings where the player assumes the role of a character, the imposed interpretation is more interesting and may even be desirable as it enforces the social norms of the story world on the player. All of the interpretations, rituals, and assumptions that come with being a denizen of the story world are levied on the player's character by the NPCs driven by Ensemble and can further immerse the player in the experience.

Additional future work consists of furthering the games that are built to use this system. Currently several research systems exist that use social practices, including the proof of concept visual novel described above. However, they are still in development. These systems will be used to test this implementation of playable social dialogue through the creation of playable experiences which will then undergo user studies.

References

- Atlus. 2008. "Shin Megami Tensei: Persona 4." <http://www.atlus.com/persona4/>.
- Aylett, R S et al. 2005. "FearNot!: An Experiment in Emergent Narrative." In *Proceedings of the Fifth International Conference on Intelligent Virtual Agents*, eds. Themis Panayiotopoulos et al. Springer Berlin Heidelberg, 305–16.
- Aylett, Ruth, Natalie Vannini, Elisabeth Andre, and Ana Paiva. 2009. "But That Was in Another Country: Agents and Intercultural Empathy." *AAMAS '09: Proc. of The 8th International Conference on Autonomous Agents and Multiagent Systems*: 329–36. <http://dl.acm.org/citation.cfm?id=1558058>.
- Dias, João, and Ana Paiva. 2005. "Feeling and Reasoning: A Computational Model for Emotional Characters." In *EPIA*, Lecture Notes in Computer Science, eds. C Bento, A Cardoso, and G Dias. Springer, 127–40.
- Evans, Richard. 2011. "Using Exclusion Logic to Model Social Practices." *Agents for Games and Simulations II*: 163–78. <http://www.springerlink.com/index/W2675776V4411H58.pdf> (May 5, 2011).
- . 2013. "Introducing PRAXIS: A Statically-Typed Logic-Programming Language for Modelling Social Practices." <http://www.cs.ox.ac.uk/seminars/841.html>.
- Kim, JM, RW Hill Jr, and PJ Durlach. 2009. "BiLAT: A Game-Based Environment for Practicing Negotiation in a Cultural Context." *International Journal of Artificial Intelligence in Education*. 19(3): 289–308.
- Marsella, Stacy, David Pynadath, and Stephen Read. 2004. "PsychSim: Agent-Based Modeling of Social Interactions and Influence." In *Proceedings of the International Conference on Cognitive Modeling*, Pittsburg.

Mateas, Michael, and Andrew Stern. 2005. "Structuring Content in the Façade Interactive Drama Architecture." In *Artificial Intelligence and Interactive Digital Entertainment (AIIDE 2005)*, Marina del Rey, CA.

McCoy, Joshua et al. 2013. "Prom Week : Designing Past the Game / Story Dilemma." In *Proceedings of Foundations of Digital Games (FDG 2013)*,.

———. 2014. "Social Story Worlds with Comme Il Faut." *Computational Intelligence and AI in Games, IEEE Transactions on* 6(2): 97–112.

Schank, Roger, and Robert Abelson. 1977. *Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures*. L. Erlbaum Associates.

Short, Emily. 2014. "Blood and Laurels."

Studios, Bethesda Game. 2011. "The Elder Scrolls V: Skyrim."

Sullivan, Anne, April Grow, Michael Mateas, and Noah Wardrip-Fruin. 2012. "The Design of Mismenor: Creating a Playable Quest-Based Story Game." In *Proceedings of the International Conference on the Foundations of Digital Games*, ACM, 180–87.

"The Sims Studio." 2009. "The Sims 3."