

# Heating up Interactions in an Agent-Based Simulation to Ensure Narrative Interest

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**Abstract:** Multi-agent systems have become important sources of inspiration for narrative generation systems, with significant growth in solutions based on *story sifting*: identifying the subset of events generated by such a system that is worthy of being told as a story. Existing systems simulate the romantic behaviour of agents based on simple rules that consider models of social norms and relations, and the evolution of affinities between agents. The present paper describes an extension to one such simulation that inserts several sources of conflict between characters to induce more interesting situations that allows the creation of more engaging stories. The system is empirically shown to give rise with much higher scores on metrics for narrative interest.

## 1 INTRODUCTION

One of the challenges of Artificial Intelligence during the last decades has focused on the generation of quality narrative texts. With the development of LLMs, the appearance of the generated texts has improved dramatically, but the quality of the stories created by these models still has much room for improvement. One possible approach to generate interesting stories is to run agent-based simulations to model human behaviour and then pick out of the resulting set of events a subset that constitutes an interesting story. This would be equivalent to simply observing how people behave around us and identifying the particular situations that make for an interesting story. However, in real life the percentage of events that happen around us that is valuable as material for stories is considerably low. If the simulation chosen as object of our study models real human behaviour closely, we may be faced with a similar situation. Human authors more often apply different strategies, either exaggerating or extrapolating beyond the behaviours they do observe in real life, or merging together remarkable fragments of ordinary lives into fictional lives that pack more interest than real humans usually observe.

The present paper explores measures for enriching or tuning an agent-based simulation to ensure that the logs of events that result contain material that may be


valuable to inspire an interesting story. As a relevant case study, the simulation on which we operate follows a set of characters that interact, focusing on the evolution of affinities and romantic relations between them.


## 2 RELATED WORK

Two topics need to be reviewed to inform the work in this paper: existing simulations that contemplate affinities and relations between characters, and efforts to sift through the logs of simulations in search of interesting stories.

### 2.1 Simulations Involving Romance

There have been several computational systems that model situations of affective engagement between characters. Some of them have been developed as interactive fiction applications (Mateas and Stern, 2005; Szilas, 2003), some as models of social interaction (McCoy et al., 2014) to support games (McCoy et al., 2010) or narratives (Porteous et al., 2013a), some as models of emotional response to support training environments (Gratch, 2000), some directly aimed to support the generation of narratives, whether based on evolving affinities between characters (Pérez y Pérez, 1999; Theune et al., 2003; Méndez et al., 2014) or conflict (Ware et al., 2014; Fendt and Young, 2017).

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The Façade system (Mateas and Stern, 2005; Strong and Mateas, 2008) was an interactive narrative in which the participant in a dinner party at a couple's home, gets to participate in the conversations, and partly experiences and partly determines the evolution of tensions between the couple. Façade was a very realistic system based on a pre-determined scripts structured as a set of beats, with the system choosing among them based on the typed contributions by the user. The system modelled the affinities between the characters and relied on elaborate models of how dialogue contributions influenced them.

The IDTENSION system (Szilas, 2003) was also an interactive narrative engine designed to construct interesting behaviour for a set of characters, relying on a model that accounted for character goals, obstacles on their path, and the moral values that sustained them. To attain interest, the system faced characters with potential actions that conflicted with their moral values.

The Comme il Faut (CiF) (McCoy et al., 2014) system was a knowledge-based model of social interactions that attempted to account for the complex interplay between social norms, character desires and cultural background. It considered a micro-theory of friendship and it proposed a set of rules to capture the possible behaviours of characters faced with particular social situations. The Comme il faut system has been used to build the game PromWeek (McCoy et al., 2010; McCoy et al., 2013a; McCoy et al., 2013b), in which players live out the week before the prom and have to achieve a particular set of goals in that time. The game evolved from an initial version focused on the psychological needs of individuals within the social context to a later version that focused on the logic of social statuses and relationships between characters.

The NetworkING (social Network for Interactive Narrative Generation) system (Porteous et al., 2013a; Porteous et al., 2013b; Porteous et al., 2015) was a system for interactive narrative for a medical drama with a cast of doctors, nurses and patients. It relies on a representation of the social relationships between characters as a network, and it has the story evolve as these relations change dramatically over time. The relationships considered are affective (six graded categories: *friend*, *close-friend*, *long-term-close-friend*, *antagonist*, *extreme-antagonist*, *long-term-extreme-antagonist*, *professional-rival*), romantic (five categories with subtle differences: *long-term-partner*, *dating*, *secretly-dating*, *attracted-to*, *romantic-rival*) and a default relationship that covers indifference. A planner is used to determine the actions each character takes, based on and affecting the relationships

between them.

The Émile system (Gratch, 2000) was also an interactive system that relied on a model of affective response to situations, in this case applied to simulation for military training and pedagogical agents. Agents in the system monitor the environment and periodically update a model of their emotional state, which is taken into account when determining their behaviour. The model for Emile considers significant psychological theories of emotional appraisal. However, it stops short of considering issues of romantic attachment between characters.

The MEXICA system (Pérez y Pérez, 1999) generated short sequential narratives about the Mexicas, ancient inhabitants of Mexico City. To do this it relied on a representation of the affinities and tensions between characters, which are used to drive the construction of the story based on knowledge structures that capture examples of evolution of affinities and tensions over existing prior stories.

The Virtual Storyteller system (Theune et al., 2003) was a multi-agent system designed to generate short fairy tales. It has an underlying storyworld in which agents interact to achieve goals. In so doing they experience emotions, which affect their subsequent actions. To ensure the resulting storyworld includes material useful for telling stories about it, two different mechanisms are overlaid on agent simulation: (1) the actions of agents are constrained by a model of plot (to ensure that stories are consistent) and (2) a special director agent is added to guide the actions of the other agents towards a well-structured plot. The director agent can intervene in the simulation in one of three ways: by inserting new characters or objects into the story world, by infusing characters with new goals, by blocking actions that a character intends to do. The Virtual Storyteller was built as a multi-agent framework running on JADE (Java Agent Development Environment (Bellifemine et al., 2005)).

Further systems that rely on elaborate models of agent behaviour rely on conflict between agents, modelled as clashes between agents plans modelled explicitly by means of planners. One such system was the Glaive system (Ware et al., 2014), which informed an interactive game where the user would come up with a plan to carry out a simple task and then the system would attempt to find ways of thwarting that plan. A similar mechanism was employed by the IRIS system (Fendt and Young, 2017) which constructed plots featuring conflict by iterating over a cycle in an original plan for the protagonist was built, then come up with countermeasures that would thwart the plan so that the protagonist would need to replan. The IRIS

system relied on a belief desire intention (BDI) model of the protagonist. However, none of these systems based on planning considers situations of romantic interest.

Charade (Méndez et al., 2016) is a multi-agent simulation (also based on JADE (Bellifemine et al., 2005)) driven by a model of interpersonal affinities between characters and how they evolve over time. The system represents affinities on a scale of *foe*, *indifferent*, *friend* and *mate*. The system explicitly considers situations of romantic interest between pairs of characters, and models how affinities between them evolve based on how they respond to proposals for joint activities. A set of rules governs how agents behave based on their standing set of affinities and how these affinities change based on character behaviour. A simulation is run with 15 agents who do not all know each other. Each agent may or may not have a partner, a small set of friends (between 2 and 4) and may or may not have any enemies (1 or 2 at the start). Interactions are driven by affinities between characters, and also act upon them. Probability of interaction is highest for partners, lower for friends, and lowest for enemies. Acceptance of proposals raises affinity between the characters, rejections and inactivity lower it. The result is a log of interactions and evolutions of affinity levels which are subsequently used to generate episodes within a narrative (Concepción et al., 2018).

Affinities between two agents A and B are directed, so what A feels for B may differ from what B feels for A. They are represented on a scale between 0 and 100, with 0 representing strong dislike and 100 representing passionate love. The Charade system considers a classification of relations between agents in terms of the affinities between them: *foe* affinity between 0 and 40, *neutral* affinity between 40 and 60, *friend* affinity between 60 and 80 and *mate* affinity between 80 and 100.

The type of relation that holds between two agents determines the subset of activities that they may consider together.

Each agent contributes to the general evolution of the simulation by: (a) proactively proposing interactions to other agents or reacting to proposals received, and (b) by registering changes in affinity towards other agents in response to proposals or reactions. The behaviour of agents is informed by the affinities between them, and it also has the potential to alter the affinities between them.

## 2.2 Story Sifting

The idea of generating narrative by telling about selected subsets of events arising from an agent-based simulation evolved over time into a research line specifically focused on modelling this process of selection of interesting events to tell. This research line has come to be known as *story sifting*. The term was proposed in James Ryan's PhD thesis (Ryan, 2018) as the task of curating interesting narratives out of the logs for simulations, usually agent-based. Many of the early approaches to this task relied on procedures for trawling through the available events in search for subsequences that satisfy patterns of plot known to be interesting (Kreminski et al., 2019; Kreminski et al., 2021).

The application of evolutionary solutions for sifting interesting stories about romantic entanglements (Gervás and Méndez, 2023) from the Charade agent-based simulation (Méndez et al., 2016) operated by developing a set of metric on relative narrative interest from the point of view of romance to a selection of events made over a log of a system run. The described algorithm was shown to achieve relatively good scores on those metrics, but the overall values were seen to be restricted by the level of interest achieved by the simulation. Runs of the system were shown to have a relative variation of affinities between agents at the start but eventually converge to rather low values of affinity between all couples taking part in the simulation. Although this may appear to be realistic in terms of modelling personal experience of individuals (Alsawalqa, 2019), it leads to stories that are not as interesting as we could have hoped.

We therefore consider that the agent-based simulation might produce more interesting material for subsequent selection aimed at obtaining interesting narratives if the behaviour of agents could somehow be tweaked towards situation more interesting from the point of view of narrative. To inform such a task, we consider candidate theories that might provide clues as to what situations among romantic partners may lead to interesting narratives.

## 3 UPGRADING THE NARRATIVE INTEREST OF A SIMULATION

The starting point for the work described in this paper is the Charade system reported in section 2.1 (Méndez et al., 2016). The simulation is made up of 3 types of agents that allow the development of the interactions necessary to simulate an environment of romantic relationships between the characters: The Logger Agent

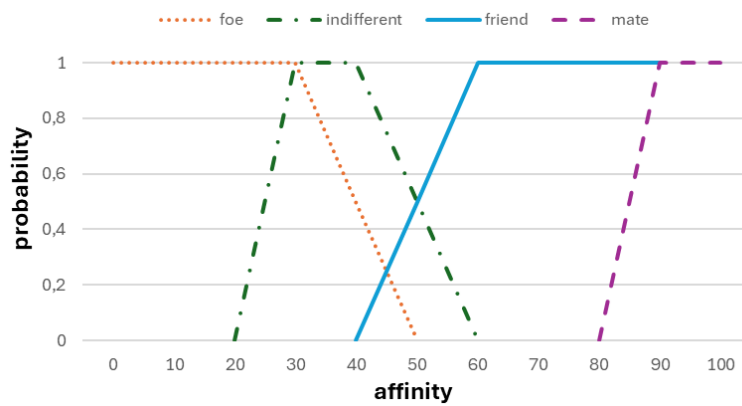


Figure 1: Transition of affinities between characters.

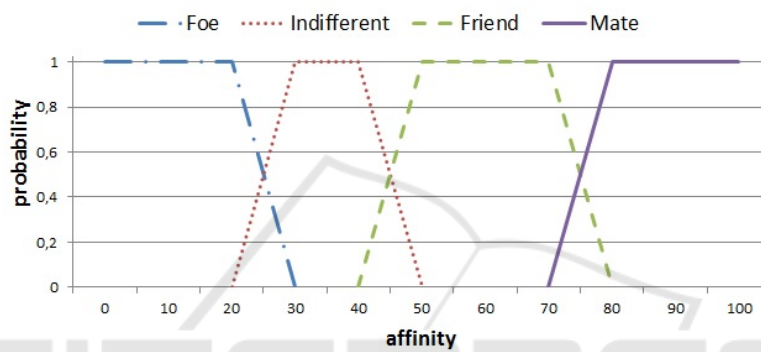


Figure 2: Original transition of affinities between characters.

allows collecting all the events triggered by the rest of the agents and filtering and formatting those that are of interest to build the simulation log that is used to generate the stories; the Director Agent is in charge of loading the initial situation of the simulation and creating all the characters that will intervene in it; and the Character Agents, one for each character in the plot, whose responsibility is to interpret the state of the relationships with the other characters and decide how to interact with them in order to develop the plot of the story. In turn, these characters are endowed with a series of behaviors that are executed in a cyclical manner that allow them to send messages to each other and react to the messages they receive depending on the relationship they have with the character sending the message.

A preliminary analysis of the logs generated by the original simulation shows that of the 23 bidirectional relationships between the 15 characters existing in the initial situation of the simulation, most of them decay into a relationship of indifference between them, which leaves the state of the simulation in a fairly stable situation but which, in narrative terms, quickly ends up being of no interest. This analysis is confirmed by the subsequent results described in (Gervás and Méndez, 2023) where it can be seen

that the story sifting process on the simulation logs manages to obtain a few interesting events that allow to extract an attractive narrative from the simulation logs.

From this starting point, four sources of conflict have been introduced into the simulation to make it more dynamic and increase the likelihood of creating situations that make the narrative more interesting.

### 3.1 Customising Reaction Thresholds to Maximize Interest

The first step in achieving greater dynamics in the relationships between characters has been to empirically modify the thresholds for switching from one type of affinity to another. The values that have shown to be most promising, as shown in Figure 1, substantially modify those of the original simulation (see Figure 2), introducing a greater overlap and a more gradual transition between them, making it possible for changes between affinities to occur more frequently.

As can be seen by comparing both figures, an attempt has been made to have a greater overlap between the different affinities, so that the change from one to the other is not so predictable and there is even the possibility on occasions of skipping intermediate

states, such as the possible change from foe to friend or vice versa. Mate-type relationships used to be too stable and took away interest from the stories, so their amplitude has been reduced and, as will be explained later, the range of actions that make it possible for a couple to break up and change their status to one of the other affinities has been widened. This causes that, with the change of affinity, the actions performed by the characters have a greater variety and that these, in turn, cause a greater impact on the variation of the affinities.

### 3.2 Adapting Criteria to Prioritize Reactions to Other Characters

The second change that has been introduced over the initial simulation is the criterion used by each character to decide whether to make a proposal to another character or to accept or reject one of these proposals from another character. In the initial simulation, this decision was made by setting a probability threshold and generating a random number. If the generated number exceeds the threshold, then the proposal is launched or the received proposal is accepted; otherwise, the proposal is not made or the received proposal is rejected, with consequent modifications between the affinities of the characters.

As a new source for conflict, the thresholds for deciding to react have been slightly modified to allow for more interactions between characters. The most relevant changes that have been made are:

- In the original simulation, the interactions between friend characters outnumbered by far the rest of the interactions (about 90% of the interactions took place between friends). The probability to initiate or accept friend interactions has been lowered from 0.7 to 0.4, so that less interactions among friends take place and there is a higher chance that other kinds of interactions take place.
- The probability of accepting a mate proposal has been increased from 0.4 to 0.7, so that more proposals are accepted and, as a consequence, more break-ups with previous mates take place and more transitions from mate to foe can occur, giving rise to more dramatic events to take place.
- The probability of getting angry after a break-up has increased from 0.4 to 0.6. This, together with the previous change, make it possible for more couples (but not too many) to dissolve in an unfriendly manner, which in turn provides a higher number of dramatic changes that may create more engaging situations.

- In the first version of the simulation, interactions with friends and mates were prioritized, so interactions with indifferent characters were almost nonexistent. The probability to interact with these characters has increased from 0.4 to 0.7, so that the chance to meet new characters or interact with a wider range of them is now higher, therefore making it possible to interfere in other character's lives.
- The probability to interact with a foe has been decreased from 0.4 to 0.2. Previously, it was less probable to relax the affinities between two foes, so once two characters started being foes, their affinity state rarely changed. This, in some occasions, made the relationships between characters to get stuck and turned the simulation into an uninteresting succession of foe events. With this change, foe relations tend to evolve towards an indifferent state that make it possible for foe characters to turn into friends or, eventually, form a new couple.

In addition, the probability on which the decision of whether to interact with another character is based in the enhanced version is now computed as the product between the value of the random number generated and the affinity with the character with which one interacts, so that the probability of interacting with characters with which one has a higher affinity increases, while the probability of interacting with those with which one has a lower affinity decreases.

### 3.3 Monitoring and Intervention to Avoid Stabilization

The third source of conflict that has been introduced in the simulation, and the main one, is the intentionality of the characters when deciding with which other characters they interact and with what objective this interaction is carried out. For this purpose, the Director Agent of the simulation has been provided with the capacity to supervise the evolution of the affinities between the different characters in the simulation. This allows, on the one hand, to detect when the actions taking place in the simulation begin to lose interest because they remain in too stable values. At that moment, the Director Agent selects a character and instructs it to increase the probability of interacting with another character in order to modify its degree of affinity with that character.

The monitoring and intervention of the Director Agent is carried out in three steps in order to avoid the stabilization of the relationships between characters:

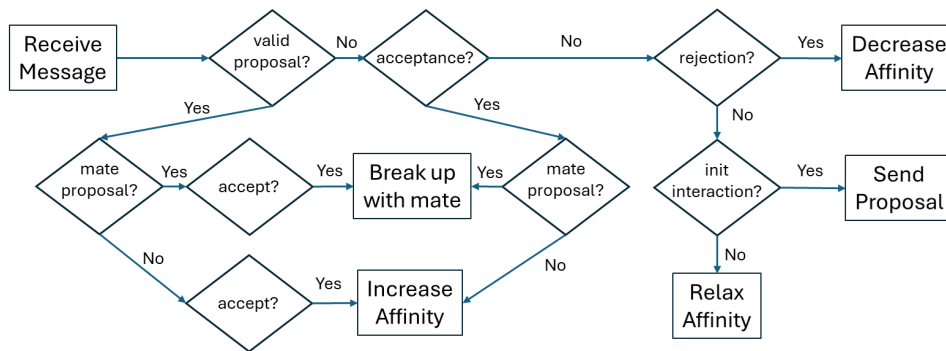


Figure 3: Flow diagram of the Friend Protocol in the enhanced simulation, showing the new possibility of switching from the preceding partners to a friend with which affinity has reached a sufficiently high value.

1. **Supervision:** the Director Agent is informed about all the interactions between each existing pair of characters - initially, not all characters know each other, so the number of monitored relationships depends on the initial configuration of the simulation and the number of new characters that are met while the simulation runs - and takes note of all the changes in the affinities. Since affinities increase with interactions and slowly decrease with the lack of them (or the other way in the case of foes), it is usually the case that the affinity values fluctuate between the limits of an affinity level (e.g. friends) for a long period without anything exciting happening. To avoid this, the Director Agent identifies long series of events or periods of time where the affinity level does not change. Currently, experimental values are set to 20 interactions or 30 seconds of execution time.
2. **Selection:** once the described situations are detected, the Director Agent has to select what pair of characters to act on and where to drive their relationship. In order to do this, the Director Agent checks the state of the simulation in order to know how many affinity relations of each kind currently exist in the simulation and selects the largest one. Then, among all the relationships that have been identified as candidates to be modified, it selects the most stable one in order to act on it.
3. **Action:** once the pair of characters have been identified, the Director Agent informs both of them that they have to modify their interaction criteria until their affinity changes in the following way:
  - they have to stop to select randomly what character to interact with and they have to focus on the specific character they have to change the affinity level
  - the probability value to interact with that character or to accept interactions with that charac-

ter is decreased to 0.1, so that possible interactions are almost nonexistent

- alternatively, if the two characters were close friends and there are no other restrictions (such as gender or sexual preferences, which are taken into account for each character), then the characters are driven towards trying to become mates and break up with their current couples, which automatically generates the possibly interesting sources of conflict (i.e. two break-ups and a new couple)
- if the existing relation was of indifference, the characters are driven to change it to friends or foes, depending on how many relationships of each kind there are in the simulation

### 3.4 Increased Affinity with Others Leading to Couple Break up

The interaction protocol of two characters that are friends has been modified so that, once a sufficiently high affinity value is reached between two friends, the simulation now allows a change of partner between the characters to occur. To this end, when one character decides that the level of affinity with another is sufficiently high, he sends him a proposal to become his partner. If the other character accepts, each of the two informs their previous partner that they are breaking off their relationship, lowering their affinity level with them and forming a new partner. In turn, each of the previous partners decide how much they decrease their affinity with the partner who has broken the relationship, and can change this affinity to the level of friend, indifferent or foe. Figure 3 shows the flow diagram for the enhanced behaviour.

An example of such an interaction extracted from the log of one of the simulations can be seen below:

```
Clark PROPOSE friend_visit_botanical_garden Mary
Mary ACCEPT-PROPOSAL friend_visit_botanical_garden Clark
```

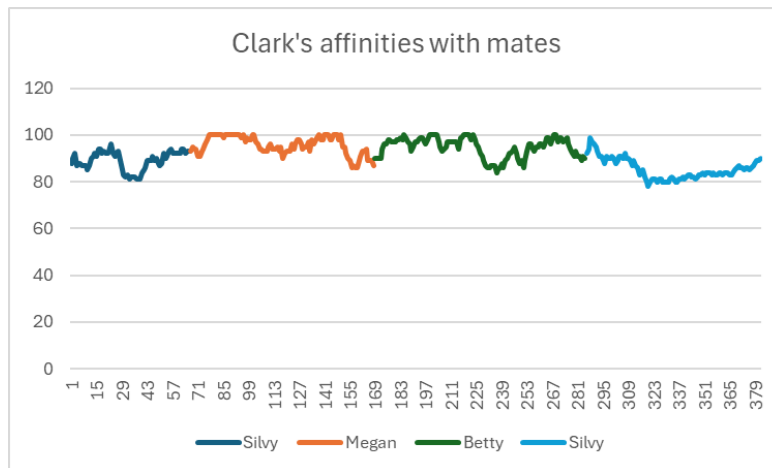


Figure 4: Evolution of the affinities between Clark and his mates.

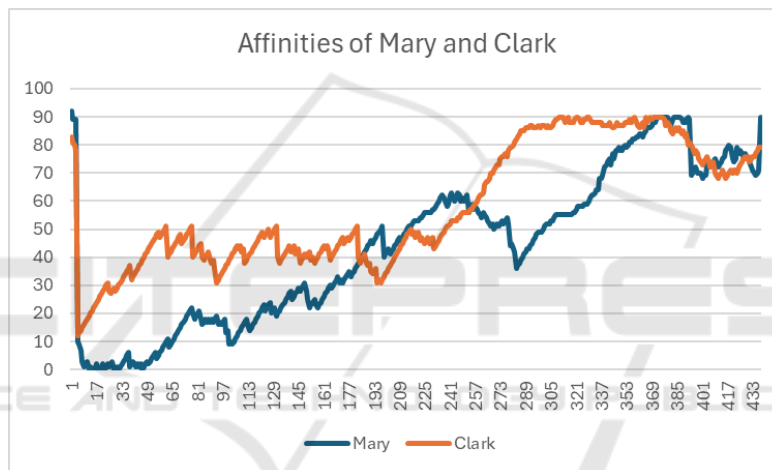


Figure 5: Evolution of the affinities between characters Mary and Clark.

```

Mary CHANGE affinity_with Clark 70-->71
Clark CHANGE affinity_with Mary 88-->90
[...]
Clark PROPOSE mate_proposal Mary
Mary ACCEPT-PROPOSAL mate_proposal Clark
Mary CHANGE affinity_with Clark 71-->90
Clark CHANGE affinity_with Mary 90-->90
Clark INFORM mate_break_up Betty
Mary INFORM mate_break_up John
Betty CHANGE affinity_with Clark 92-->15
John CHANGE affinity_with Mary 87-->62
    
```

As shown in Figure 4, this new behavior makes it possible for various changes between existing couples to occur throughout the simulation, which was not previously possible. This, in turn, results in that the relationship between two characters can vary drastically, as can be seen in Figure 5, where, as a consequence of a change of partner of one of the characters, both change the value of their affinity to be considered enemies. The relationship between these two charac-

ters evolves in a parallel, but asymmetrical manner, until eventually they both become friends again.

### 3.5 Neural Rendering of Selected Behaviour

The ultimate goal is the ability to create stories from what happens in the simulation. As we have seen with the recent development of Large Language Models (LLMs), these models are capable of generating high quality text, but it is more complex to be able to control what these systems generate. This has become especially apparent in the case of story generation, where narrative richness and consistency in generating stories of a certain size has not yet produced the results that can be seen in other areas. On the other hand, in the area of story generation, as shown in section 2.1, significant progress has been made in generating stories with great narrative richness, although

the quality of the final text, in most cases, was quite poor.

In the case at hand, we have combined the output generated by our simulation with an LLM, namely ChatGPT-4o<sup>1</sup>, to generate a story whose development can be driven in a way by the simulation output and simultaneously presented in text format with a rich narrative. A sample prompt we have used for this generation is

I am going to provide you with the log of a simulation and I need you to transform it into a short story. The requirements for the story are:

- \* Write a brief introduction to the story
- \* Set the story in some scenario extracted from the log
- \* Use only the characters and events from the log

This is the log:

<log>

An example with the log shown above is as follows:

In the heart of the bustling city, nestled amidst towering skyscrapers, lay the serene Riverside Botanical Garden. A peaceful oasis where vibrant blossoms and the soothing rustle of leaves created a haven away from the urban noise. It was here, on a warm spring afternoon, that Clark found himself standing by the entrance, his heart racing with a mix of anticipation and hope.

"Mary," Clark began, his voice steady but soft, "would you like to visit the Botanical Garden with me today?"

Mary's eyes lit up at the suggestion, and she responded with a warm smile. "Of course, Clark. I'd love to," she replied, accepting his invitation. The two friends strolled down the meandering paths, surrounded by bursts of color from the blooming flowers. As they wandered through the fragrant air, their bond deepened. For Mary, her affection for Clark grew just a little stronger, her feelings blooming like the roses around them. Clark, too, felt the pull of a stronger connection, and his heart swelled with affection.

Suddenly, a quiet moment by the koi pond turned into something much more meaningful. Clark took a deep breath and turned to Mary. "Mary," he said earnestly, "will you be more than just my friend?" His voice was sincere, hopeful, and full of vulnerability.

Mary paused, her gaze meeting his, and her heart swirled with emotions as she gave a gentle nod. "Yes, Clark. I will," she whispered, sealing their newfound commitment. The garden around them seemed to glow even brighter as their love blossomed in unison. Their connection was no longer just a friendship but something richer and deeper. In that magical moment, Mary's affection surged, reaching the same height as Clark's. Their hearts were fully in sync.

Yet, every new beginning brings change. Knowing what they had to do, Clark and Mary exchanged difficult messages to their former partners. Clark informed Betty of their separation, while Mary had a similar conversation with John. As the news traveled, old affinities shifted like autumn leaves falling from branches: Betty's bond with Clark crumbled, and John's connection to Mary dimmed, leaving behind memories of what once was.

And so, amidst the blossoms and the whispering leaves of the Riverside Botanical Garden, a new chapter began for Clark and Mary, a story of love born from friendship, growing ever stronger beneath the open sky.

The example presented above shows how the text rendering recounts the basic changes between the affections of the characters that result from the simulation model, while adding a significant amount of detail on the particular scenes that lead to the different changes in affinity. This is considered a valuable combination of the advantages of the technologies for agent-based simulation and neural text generation.

## 4 DISCUSSION

The enhanced simulation proposed in this paper can be discussed in terms of the advantages it introduces and in terms of how it compares with previous work on related topics.

### 4.1 Advantages of the Enhanced Simulation

The enhanced simulation, by construction, now avoids important shortcomings of the original simulation.

Of the modifications introduced in the enhanced simulation, not all respond to the same motivation.

Some of the changes may be considered as improvements that make the simulation more realistic. The preference for interacting with characters towards which one has stronger affinity, or the possibility of dissolving an ongoing romantic relationship when the affinity with a third party increases beyond a given threshold, both fall under this category.

Other changes can be considered departures from real behaviour as observed in human couples, and they would correspond more to the type of intervention that an author inspired by real life events but desiring richer situations might apply in powering up the situations in her story. The adaptation of reaction thresholds to obtain richer interactions, or the monitoring by the Director Agent of stable situations that may lead to direct interventions on the probability of characters interacting would correspond to this second category.

Table 1 shows data from different runs of the simulations grouped by the version of the simulation used (the first four stories were generated with the original simulation, while the last four were generated with the version described in this paper) and sorted by simulation length. The PROPOSE, ACCEPT and REJECT rows refer to interactions between mates, friends and indifferents, while the INFORM row shows interactions between foes. The *break-ups* row shows the number of break-ups that oc-

<sup>1</sup><https://openai.com/index/hello-gpt-4o/>



Table 1: Simulation data sorted by simulation length. The first 4 stories have been generated using the original simulation, while the last 4 stories include the modifications described in this paper. Column *n* shows the number of interactions of each kind, while column *%* shows the percentage that each type of interaction represents out of the total number of interactions.

	story0		story1		story2		story3		story4		story5		story6		story7	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
PROPOSE	317	46,14	667	49,44	1011	24,71	1074	13,78	7976	64,57	8988	48,37	9545	58,36	10585	54,97
ACCEPT	151	21,98	375	27,80	420	10,27	448	5,75	2230	18,05	4064	21,87	3356	20,52	3641	18,91
REJECT	125	18,20	245	18,16	282	6,89	282	3,62	1733	14,03	3346	18,01	2730	16,69	2770	14,39
INFORM	94	13,68	62	4,60	2378	58,13	5992	76,86	414	3,35	2184	11,75	725	4,43	2260	11,74
break-ups	6		7		7		6		7		11		14		17	
affinity changes	652	1,59	1309	1,80	3789	1,12	7458	1,06	11117	1,33	14162	1,27	17546	1,71	24093	1,88

cur, and the *affinity changes* row shows the number of affinity changes over the total number of interactions.

As shown in the table, using the original simulation, as the simulation time increases the percentage of interactions between mates, friends and indifferent characters tends to decrease, while the number of interactions between foes increases notably. On the contrary, in the stories generated with the simulation described in this contribution, it can be observed how the interactions between couples, friends and indifferent people are more numerous and remain more stable, fluctuating around 60%, while the interactions between foes fluctuate around 8%.

This has an effect on the number of affinity changes, which in the case of the original simulation tends to decrease as the length of the simulation increases while in the case of the new simulation it tends to double the number of interactions. The latter data points to a greater tendency to meet new characters over the course of the simulation and to relax affinities with those characters with whom one character interacts less. In the case of the initial simulation, this effect did not occur because the break-ups between characters led to an increase in interactions between enemies, which can be appreciated in the increase in INFORM-type interactions.

Finally, the row relating to break-ups shows how in the original simulation all or almost all the existing couples (initially 7) break up due to lack of interest between the members of the couple, while no new couples are created. In the case of the new simulation, although the number of break-ups is not very high, the creation of new couples is a fact that, in due course, gives rise to new break-ups, so that in the subsequent story sifting process it is possible to select events that provide greater interest to the final story.

## 4.2 Comparison with Prior Work

The Façade system (Mateas and Stern, 2005; Strong and Mateas, 2008) differs from the solution presented in this paper in that it relied on pre-determined scripts.

The Virtual Storyteller system (Theune et al., 2003) uses a model of plot to constrain the actions of characters. The system described in this paper differs from these in that it contemplates a basic set of actions that can be combined freely to develop complex behaviours.

The Émile system (Gratch, 2000) operates at a lower level of representation of relationships, more concerned with emotional appraisal. The Glaive (Ware et al., 2014) and IRIS (Fendt and Young, 2017) systems focus on conflict at the level of the actions that character want to undertake, but these actions in general do not involve romantic attachments between the characters. The system described in this paper operates at a higher level of abstraction, considering romantic attachments between characters and the social interactions that may lead to such attachments.

The IDTENSION system (Szilas, 2003) focused on conflict between actions desired by the characters and the moral values they aspire to uphold. The Comme il Faut (CiF) (McCoy et al., 2014) system evolved from an earlier focus on the psychological needs of individuals onto the logic of social statuses and relationships between characters. The simulation described focuses on romantic relations and it does not consider conflicting plans, moral values, psychological needs or social status.

The MEXICA system (Pérez y Pérez, 1999) relies on a system for representing affinities between characters, and it drives the construction of its stories by a set of tensions computed over these affinities. Tensions arise when characters have conflicting values of affinity to other characters (one character hates and loves another, or two characters love the same character). The system described in this work does not yet allow us to reflect that type of conflict, although what it does allow us to reproduce with the new sources of conflict are situations in which, when a couple breaks up through the intermediation of a third person, the characters who have been abandoned have the possibility of reacting to the breakup in three different ways: by downgrading their affinity to the level of friendship and trying to win back their former part-

ner, as can be seen in Figure 4; by adopting a position of indifference; or by displaying a hostile and hateful attitude and executing actions that reflect this.

The NetworkING (social Network for Interactive Narrative Generation) system does include romantic relationships between characters as well as a number of other possible relations between them, such as friendship, antagonism or professional rivalry. The actions of the characters are determined by a planner that takes into account the network of relations in which the characters participates. In contrast, the actions of the characters in the simulation described in this paper are determined by stochastic process that operate on the values of affinities between them. This has been an explicit decision made because, as can be seen in the analyzed literature (e.g. (Laclaustra et al., 2014)) and in our own experience developing story-generating systems (e.g. (Gervás et al., 2019)), the use of systems based on rules or planners generally leads to solutions that tend to always generate the same story or a very reduced set of them, since the variability introduced by these solutions is usually small. In our case, it has been decided to use pseudo-random decisions to ensure that the variety of situations that can arise is as wide as possible, since the subsequent story-sifting process on the log generated allows us, from among all of them, to select those that are most interesting depending on the parameters that are set at any given time. In addition, although apparently the representation of the types of relationships possible in our system is poorer than the one used in NetworkING, it seems that the categories used in that system are closed categories. In our case the affinity values, although discrete, simulate to be continuous in comparison, the transitions between categories are more diffuse and smooth and, above all, the representation of the affinities used in our system is designed to make the affinities efficient to calculate, since our simulation, not being interactive, unlike Networking, performs many more interactions between characters per second and needs the calculations of the new values of the affinities to be performed efficiently.

## 5 CONCLUSIONS

This paper has shown how four mechanisms have been successfully introduced to inject conflict into an agent-based simulation used to create romantic stories based on the affinity variations that occur between characters when they interact with each other. These four mechanisms have been the modification of the interaction thresholds between characters to achieve more affinity variations between them; the introduc-

tion of intentionality in the characters when deciding which character to interact with and what type of interaction to initiate with them; the possibility of having the Director Agent directly modify the probability of interaction between characters to avoid stagnation into uninteresting situations; and an extension in the agents' behavior that allows them to search for a new partner even at the cost of breaking up with their own partner and having their new partner break up with their previous partner as well.

There is still room for improvement in the story generation system described in this work. As lines of future work, the following courses of action are proposed. First, we intend to enrich the representation of the relationships between characters, introducing relationships and interactions between more than two characters and representing the affinities between them so that contradictory interests may arise (having a partner with whom one has a low affinity or that a romantic interest arises with a character one hates). Secondly, it is proposed to introduce the possibility of the characters interpreting the existing relationships between other characters, giving the possibility of misunderstandings or misinterpretations based on what one character tells another. Finally, it is also intended to provide the characters with a more complex model of personality and emotions, so that each character can react differently from another to the same situation, and that this does not depend solely on the generation of a random value as in the current system.

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