Computer models as tools for the reflection on ideas: a model for evaluating the thematic consistency of a narrative

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Abstract

This paper describes the Model of Thematic Consistency (MTC). A narrative has thematic consistency when all the events in the plot contribute to progress the conflict in a story or to preserve the coherence of the tale. Thus, the purpose of the MTC is, given a narrative developed by our automatic storyteller or written by a person (in a rigid format), to identify those actions that do not help to achieve a thematic consistency. In this paper we describe the main components of the model, the mechanisms used to analyse a given narrative, and provide an example of the reports produced by our prototype. The results suggest that the prototype is a good first step, and that computers are great tools for the reflexion on ideas.

Introduction

Our research area is the automatic generation of narratives. We have developed a model of creative writing that has been realised as a computer program. By contrast with other similar systems, our storyteller produces stories avoiding the use of statistical models, predefined story-structures or characters and authors' goals. Because the story emerges as a result of content and rhetorical constraints, sometimes it includes some story-actions that do not fulfil any purpose in the tale. As a result, the quality of the generated output suffers.

This condition reminded us of some of the ideas that some experts have expressed about writing. In the introduction on fiction, Clayton wrote that "A scene has to carry the conflict forward, not just be a place where characters talk." (Clayton 1996, p. 18). Later, he states that "… in good dialogue irrelevances are omitted, speech is selected to intensify the focus of the story" (Clayton 1996, p. 24). Edgar Allan Poe wrote that "In the whole composition there should be no word written of which the tendency, direct or indirect, is not to the one pre-established design." (Poe 1847) Thus, although our storyteller is far from developing a plot like a human being does (no computer program can do that), these ideas resonated on us. We believe that it is important to represent (at least partially) the concepts expressed by

Clayton and others, to improve the quality of the outputs of our creative agent. Thus, we asked ourselves the following question: how can a writer identify those situations in a plot that do not contribute to push the conflict forward? Because computers are great tools for the reflection on ideas, we decided to build a computer model to test a hypothesis that might contribute to answer these questions. We employ our computer model of creative writing as a general framework to develop what we refer to as the Model of Thematic Consistency (MTC). A narrative has thematic consistency when all the events in the plot contribute to progress the conflict in a story or to preserve the coherence of the tale. Thus, the purpose of the MTC is to identify those actions that do not help to achieve thematic consistency. The first version of our model does not consider that actions might have other functionalities, e.g., building a specific atmosphere for the reader.

The main contributions of this paper are:

- A detailed description of the different components of the MTC and how they relate to each other (see section Description of the model).
- A description of the mechanisms employed to analyse the thematic consistency of a given narrative (see the section How the model works).
- A detailed example of how the prototype of the MTC works (see the section Generated reports).
- Some final conclusions (see section Discussion).

Description of the model

We start by providing some context. For the development of this project, we employ our model of creative writing (Sharples and Pérez y Pérez 2022, chap. 9; Pérez y Pérez and Sharples 2023, chap. 11). In this model, each time an action is performed, the story-world is updated in any of the following ways: (1) Emotional relations between characters are established or adjusted; (2) conflicts between characters are triggered or deactivated; (3) characters in the story-world modify their location. Because we developed a computer program known as MEXICA (Pérez y Pérez and Sharples 2001) that is an instantiation of this model, we

already have routines capable of analysing the conflicts and emotions between characters in a tale. We use these routines as part of the project reported in this paper. Details of how they work can be found in (Pérez y Pérez 2007).

Now, we define a story as a sequence of actions where conflicts are introduced, developed, and finally sorted out. Thus, as we explained earlier, in the MTC the purpose of performing an action is either to progress a conflict (e.g., if two characters are fighting, the conflict escalates when one kills the other) or to preserve the coherence of the tale (e.g., by inserting early on an action that explains why a conflict arises, in this case, why the murderer hates the victim). As these examples illustrate, to progress a conflict or to preserve the coherence of the narrative involves establishing what we refer to as functional "bindings" between two or more actions. We claim that in a narrative with thematic consistency, all actions must be bounded to at least one other of the actions in the tale. In other words, unbounded actions do not fulfil any purpose in the tale. Those, the main goal of the model is to identify those bindings.

The Model contemplates four types of bindings: those related to common-sense knowledge (represented as action's preconditions and post conditions), those that establish emotional relationships between friends and family members (known as loving-characters), those that trigger conflicts between characters (known as inferred conflicts), and those that cause two characters to be in the same place so they can interact with each other (known as Positional).

Once bindings are identified, actions that share similar features are grouped. Groups represent sequences of actions that describe a particular situation. The MTC establishes that all groups in a tale must be connected or "chained" to another group. The following elaborates all these ideas.

Common-sense bindings.
In MEXICA, each action has an associated set of preconditions and postconditions, which represent common sense knowledge. Preconditions represent requirements to execute the action, and post conditions represent the consequences of executing the action. These can be of two types: social and logical. The preconditions of the social type represent common-sense knowledge which is determined by a given social context. For example, in a classist society, the precondition for two characters to marry may be that such characters belong to the same socioeconomic stratum. The preconditions of the logical type represent common-sense knowledge which is not determined by social contexts. For example, the logical precondition for character A to heal character B's wounds is that character B is injured.

In the same way, social-type post conditions are determined by social contexts, and logical-type post conditions do not depend on such contexts. For example, the consequences of a character killing another can be social - society rejects these types of acts - and logical - the character is dead. Post conditions are not optional, that is, each time an action is performed there are always consequences that involve at least one of the characters participating in the deed.

In MEXICA, post conditions establish or modify emotional links and conflicts between the characters participating in the action.

When the post conditions of one action fully satisfy the preconditions of another action, we say that those actions are connected by a common-sense knowledge binding. When the post conditions of one action partially satisfy the preconditions of another action, we say that those actions are partially connected by common-sense knowledge binding.

Special case of post conditions: loving-characters.
In the previous paragraph it was explained that post conditions include at least one of the characters participating in the deed. It is also possible to include in the post conditions characters that do not participate in the action, known as loving-characters.

When during the development of a plot two characters establish a strong positive emotional relationship between them, they become loving-characters. For instance, the consequences of the action "Mary and Juan were friends since childhood" is to build a strong friendship between them; i.e., to establish two loving-characters. Thus, loving-characters typically represent friends or family members.

MEXICA allows including loving-characters as post conditions, even when such characters do not participate in the deed. For instance, the post conditions of the action "Margarito insults Mary" include that the Mary gets angry with Margarito (a negative emotional link), and that all her loving-characters (e.g. Juan) also develop an animosity against this man (a negative emotional link).

Given that in MEXICA the relationships between characters emerge as the narrative develops, every time an action is executed the system verifies the story-context to determine the current loving-characters.

Within the framework of the MTC, loving-characters produce bindings that have unique characteristics that I now explain.

Loving-characters bindings and contextual bindings.
In the following example, when Juan notices Margarito's rude attitude towards Kate, he reacts angrily and this causes him to rebuke Margarito.

1. Kate and Juan were friends since childhood.
2. Margarito insulted Kate.
3. Juan rebuked Margarito.

In this case, the action of rebuking (action 3) is bounded to the action where Juan gets angry because Margarito insults his friend (action 2). But action 2 is in turn bounded to the action that establishes the friendship between Kate and Juan (action 1). That is, if Juan and Kate were not friends (loving-

characters), Juan would not have gotten angry with Margarito for the way he treated Kate (action 2) and, therefore, he would not have rebuked him (action 3). In this way, the function of action 1 is to create loving-characters, while the function of action 2 is to trigger a negative emotional link from Juan towards Margarito, which explains Juan's behaviour in action 3.

The binding between actions 1 and 2 is known as loving-character, while the binding between actions 2 and 3 is known as contextual.

Loving-characters bindings are coupled to contextual bindings, i.e., the former is a requirement to establish the latter. If an action that creates loving-characters appears in the plot, but this is not later used to create a contextual binding, then, there is no point in creating the loving-characters. A contextual binding always triggers an emotional reaction or conflict between characters. Thus, a contextual binding might partially or fully satisfy the preconditions of another action.

Inferred conflicts bindings.
In MEXICA, conflicts between characters arise as the story unravels. There is a group of conflicts, known as inferred, which are activated automatically when the following conditions are met:
- A character hates and loves another character at the same time (known as clashing emotions).
- When two characters are in love with a third character (known as love competition).
- When a character hates another character and both are located in the same place (known as potential danger).

The required conditions for triggering an inferred conflict typically arises as a result of performing two actions. For example, to trigger a Love competition, first character A must fall in love with character B; subsequently, character C must fall in love with the same character B. When the second action takes place, MEXICA triggers the conflict. So, these two actions are bounded by an inferred tension.

Positional bounds.
In MEXICA, all characters participating in an action must be located in the same place within the story world. When this requirement is not fulfilled, one of the characters needs to be moved to the same location of the other actor. Thus, the action that changes the position of one of the characters, and the first action where those characters interact (after this change), have a positional binding.
Table 1 summarizes the types of bindings in the MTC.

Creation of groups.
The MTC arranges actions intro groups. Each group represents a specific situation in the plot. Groups are built as follows. Two bounded actions have continuity when one of them follows the other. In other words, continuity occurs when the action performed at time=t (At) and the action

performed at time=t+1 (At+1) are bounded. A sequence of two or more actions that have continuity forms a group. When the continuity of a sequence of actions is broken, then two or more groups are created. However, sometimes groups with one element are created. This happens when a single action has no bindings neither with the previous deed nor with the following deed. In this way, a group might include one or several elements.

Type of Bindings	Description
Common-sense binding	They can partially or fully satisfy the common-sense preconditions of another action.
Loving-characters binding	They are a requirement to build a contextual bond.
Contextual binding	They can partially or fully satisfy the common-sense preconditions of another action.
Inferred conflicts binding	They establish the necessary conditions to trigger inferred conflicts.
Positional binding	They satisfy the requirement that characters must be in the same location to interact.

Table 1. Types of bounds in the MTC.

When actions in different groups are bounded, we say that those groups are chained. Let us imagine that we have two groups named as I and II, and that action A belongs to group I (represented as A[I]) while action B belongs to group II (represented as B[II]). Group I is chained to group II when action A in group I has a binding with action B in group II (A[I] -> B[II]).

A narrative that includes unchained groups makes a bad story because the events that occur in the unchained group are not related to the other events in the plot. The number of bindings that chain two groups is known as the strength of the chain. The higher the value of the strength of the chain, the better coupled those groups are.

We can conclude that:
- Groups are made up of sequences of continuous actions that are bounded to each other.
- In a story that only has one group, events occur in a linear manner. By linear I mean that action 1 leads to action 2, which leads to action 3, and so on until the end of the story.
- A narrative with unchained groups produces a bad story because there are groups of actions that have no bindings with each other.

How the model works

This is an example of a plot whose thematic consistency must be evaluated. The actions are numbered for easy identification.

1. Ernest is introduced in the story.
2. John is introduced in the story.
3. Ernest was in love with Kate.
4. John was in love with the Kate.
5. Kate was in love with the Walter.
6. Ernest got jealous of Walter because Kate gave him lots of attention.
7. Ernest killed Walter.
8. Kate attacked Ernest.
9. Ernest wounded Kate.
10. John attacked Ernest.
11. John fought against Ernest
12. John killed Ernest.
13. John cured Kate.
14. John exiled John.

Table 2 shows the preconditions and postconditions for each of the actions in this example. Figure 1, known as the Thematic Consistency Map (TC-Map), shows the bindings between actions, and how the groups are chained (the curious reader can use table 2 to verify the bindings in figure 1).

Action	Precondition	Post condition
A was in love with B	None	A is in love with B (A develops an emotional link of intensity +3 and type 2 towards B)
A got jealous of B because C (gave him attention)	A feels a strong attraction towards C (A has an emotional link of intensity +2 and type 2 towards C). C likes B (C has an emotional link of intensity +1 and any type towards B).	A strongly dislikes B (A develops an emotional link of intensity -2 and type 1 towards B)
A killed B	A strongly dislikes B (A has an emotional link of intensity -2 and any type towards B)	B is dead (the tension Actor dead is activated). All the characters linked to B hate A (Each character linked to B develops an emotional link of intensity -3 and type 1 towards A)
A attacked B	A strongly dislikes B (A has an emotional link of intensity -2 and any type towards B)	The life of character B is at risk (the tension life at risk is activated for character B). B hates A (B develops an emotional link of intensity -3 and type 1 towards A)
A wounded B	A strongly dislikes B (A has an emotional link of intensity -2 and any type towards B)	All the characters linked to B hate A (Each character linked to B develops an emotional link of intensity -3 and type 1 towards A) The health of character B is at risk (the tension health at risk is activated for character B). B hates A (B develops an emotional link of intensity -3 and type 1 towards A) All the characters linked to B hate A (Each character linked to B develops an emotional link of intensity -3 and type 1 towards A)
A fought against B	A and B strongly dislikes each other (A has an emotional link of intensity -2 and any type towards B; B has an emotional link of intensity -2 and any type towards A)	The life of characters A and B is at risk (the tension life at risk is activated for both characters). A and B hate each other B (A develops an emotional link of intensity -3 and type 1 towards A and B develops an emotional link of intensity -3 and type 1 towards A)
A cured B	B is injured or ill (The tension health at risk of B is active)	B recuperates its health (the tensions health at risk is deactivated) B is very grateful towards A (B develops an emotional link of intensity +3 and type 5 towards A).
A exiled itself	A strongly dislikes itself (A has an emotional link of intensity -2 and any type towards A)	A feels very upset with himself (A develops an emotional link of intensity -3 and type 5 towards A).

Table 2. Preconditions and post conditions of story-actions.

The numbered circles in the TC-Map in figure 1 represent the actions in the plot. Bindings are represented as arrows in different types and colours (see the top of figure 1). In the case of the Common-sense and Contextual bindings, the arrows point to those actions whose preconditions are partially satisfied (represented as dashed arrows) or fully satisfied (represented as continuous arrows) by the current action. In the case of the Loving-character bindings, the arrow starts in an action that creates the loving-characters and points to the action that triggers the emotional reaction

of one of the loving-characters. In the case of the Inferred conflict bindings, the arrow stars in an action that set the conditions for a conflict, and points to the action that triggers the conflict. In the case of the Positional bindings, the arrow starts in the action that locates two characters in the same position, and points to the first action where those characters interact after being located in the same place. Groups are represented as rectangles with Roman numerals.

In our example, the TC-Map in figure 1 shows that the story is divided into four groups: group I includes actions 1 to 4, group II includes actions 5 to 12, group III includes action 13, and group IV includes action 14. The following examines the information in the TC-Map, and complements it with some comments about the events in the plot.

- The function of actions 1 and 2 is to introduce some characters into the story, so they do not include preconditions or post conditions. They are known as special actions and are marked with asterisks in figure 1. Although they are not bounded to any other action, they are considered part of group I.
- Action 3 sets the necessary conditions to trigger in action 4 a love competition conflict, and in action 8 a clashing emotion conflict. In this way, actions 3 and 4, and actions 3 and 8, have inferred tension bindings. Let us explain the same situation in terms of the deeds in the plot. Action 3 describes that Ernest falls in love with Kate. Because in action 4 John also falls in love with the same woman, a love competition is triggered. And because in action 8 Kate attacks Ernest then, at that moment, Ernest loves and hates Kate, producing a clashing emotion conflict between them.
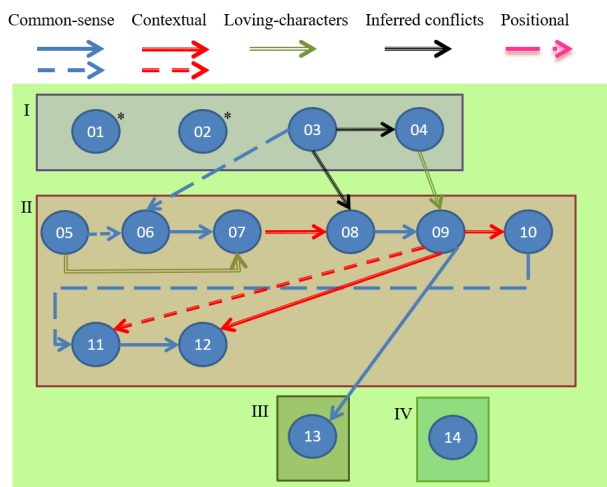

Figure 1. A Thematic Consistency Map of example 1.

- Each of actions 3 and 5 partially fulfil the common-sense preconditions of action 6. In this way, action 3 is bounded to three different actions. Let us analyse this situation in the plot. In action 3 Ernest falls in love with Kate, and in action 5 Kate falls in love with Walter. Based on table 2, both actions are necessary to satisfy the preconditions of action 6, where Ernest gets really jealous of Walter.
- Action 9 also plays an important role in the plot because it is bounded to four different actions: it fully satisfies the preconditions of actions 10, 12 and 13, and it partially satisfies the preconditions of action 11. Analysing the plot one can observe that in action 9 Ernest wounds Kate. Because John is already in love with Kate (action 4), Ernest's attack produces a negative emotional reaction in John that explains why he attacks (action 10), fights (action 11) and finally kills Ernest (action 12). Also, action 9 explains why John heals Kate's wounds (action 13).
- Each of actions 9 and 10 partially satisfies action 11 (see table 2). Thus, actions 9 and 11 have a contextual binding, while actions 10 and 11 have a common-sense binding.
- Each of actions 9 and 11 fully satisfied the preconditions of action 12 (see table 2). Thus, any of them would have been enough to give meaning to action 12.
- The actions 4 and 9 have a loving-characters binding, which gives rise to three contextual bindings between action 9 and actions 10, 11 and 12. Thus, the loving-characters binding proves essential for the story. In other words, John's love for Kate supports a core part of the tale.
- Action 14 is an unbounded action. Therefore, it does not contribute in any way to the progress of the story.

An analysis of the groups in figure 1 shows that:
- The strength of the chain between groups I and II is 3 because action 3 is bounded to actions 6 and 8, and action 4 is bounded to action 9.
- The strength of the chain between groups II and III is 1 because action 9 is bounded to actions 13.
- Group IV only includes the unbounded action 14. Thus, this action does not fulfil any function in the narrative and therefore it must be eliminated from the story.

Generated reports

The MTC model has been instantiated as a prototype that is part of our narrative generator. So, it can evaluate the thematic consistency of a narrative generated by our

storyteller, or a narrative written by a human (as long as it is written in the rigid format required by our program).

The prototype produces a detailed report that describes each of the steps performed during the analysis of a narrative. For reason of space, here we only present the final part of the report. This is divided in three parts. The first lists those actions that do not fulfil any purpose in the tale. The second prints the plot, highlights the main sections of the tale and indicates those actions that need to be deleted. Any group that has more than three actions (this number can be modified by the user) is considered as one of the main sections of the story. And the third part suggest a final version of the story based on the analysis of the thematic consistency. Because our storyteller is not a language model, it uses templates to realize that final version.

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The story requires to be modified. The following
actions need to be eliminated because they do not
have a function in the narrative:
     -> John exiled John.

This narrative has 2 main sections:

 --> Ernest is introduced in the story.
|    John is introduced in the story.
|    Ernest was in love with Kate.
 --> John was in love with the Kate.
 --> Kate was in love with the Walter.
|    Ernest got jealous of Walter because Kate gave
him lots of attention.
|    Ernest killed Walter.
|    Kate attacked Ernest.
|    Ernest wounded Kate.
|    John attacked Ernest.
|    John fought against Ernest.
 --> John killed Ernest.
     John cured Kate.
     John exiled John.
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                Final story suggested
                         I
Ernest thought the desert heat was scorching.
That day the sun was beating down so John took
refuge in a shadow.
Ernest was in love with Kate.
John was in love with Kate.

                        II
Kate was in love with Walter.
Ernest realized that Kate was interested in Walter.
So, he got really jealous of Walter!
Ernest took a dagger and cut Walter 's throat.
Angry, Kate attacked Ernest.
With all his strength, Ernest hurt Kate.
John struck Ernest furiously.
In only a moment, John and Ernest were punching
furiously at each other.
Without mercy, John took Ernest's life.

                        III
John went to find some medicinal plants and cured
Kate. She was lucky.
                    The end.
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Here is another example.

1. The priest is introduced in the story.
2. The prince went to the lake
3. The prince had an accident.
4. The priest found by accident the prince.
5. The priest realised that the prince had an accident.
6. The priest cured the prince.
7. The prince went to the palace.
8. The fisherman mugged the priest.
9. The prince realised that the fisherman mugged the priest.
10. The prince looked for the fisherman.
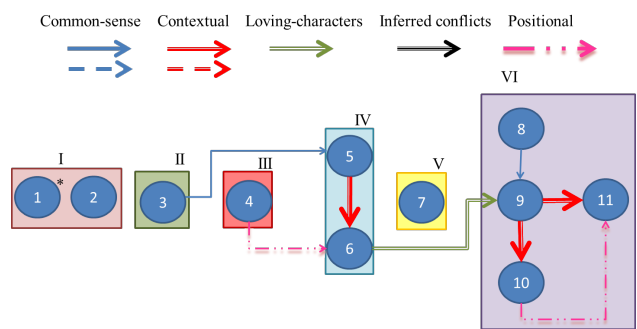11. The prince made the fisherman a prisoner.

Figure 2. A Thematic Consistency Map of example 2.

The TC-Map in figure 2 shows that groups I and V are unchained; therefore, actions 1, 2 and 7 must be eliminated. There is a positional binding between actions 4 and 6. Thus, the role of action 4 is locate the priest in the same place as the prince. The loving-characters binding between actions 6 and 9 explains the reaction of the prince towards the fisherman.

This is the report generated by the system:

```
The story requires to be modified. The following
actions need to be eliminated because they do not
have a function in the narrative:
     -> The priest is introduced in the story.
     -> The prince went to the lake.
     -> The prince went to the palace.

This narrative has 1 main section:

    The priest is introduced in the story.
    The prince went to the lake
    The prince had an accident.
    The priest found by accident the prince.
    The priest realised that the prince had an
accident.
    The priest cured the prince.
    The prince went to the palace.
--> The fisherman mugged the priest.
|   The prince realised that the fisherman mugged
the priest.
|   The prince looked for the fisherman.
--> The prince made the fisherman a prisoner.
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                     Final story suggested
                                I
An old tree fell, injuring the prince badly.
Unexpectedly, the priest came across the prince.
He could not believe it!
The  priest  realized  that  the  prince  had  an
accident.
The priest used the magic plant to cure the prince.
He was grateful!

                               II
When no one was looking, the fisherman mugged the
priest.
The prince realized that the fisherman mugged the
priest.
This was enough! The prince went to look for the
fisherman in order to confront him.
The  prince  put  the  fisherman  into  jail.  The
fisherman  could  not  hide  how  much  he  loathed
prince.
                          The end
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Discussion

The creative process has two clear phases, nicely explained by Beardsley:

> Though there are no universal *stages* of the creative process, there are two clearly marked *phases*, which constantly alternate throughout. They involve an interplay between conscious and preconscious activities. There is the *inventive* phase, traditionally called *inspiration*, in which new ideas formed in the preconscious and appear in consciousness. And there is the *selective* phase, which is nothing more than criticism, in which the conscious chooses or rejects the new idea after perceiving its relationships to what has already tentatively been adopted. (Beardsley 1965, cit. in Rothenberg & Hausman 1976, pp.308-309)

Following Beardsley, to represent in computer terms the creative process it is necessary to develop an agent that not only can generate novel material but also it can perform a process of criticism. Our research on computational creativity is founded on this idea. We have worked to improve in MEXICA the ability of criticism, i.e., the ability to select or reject a "new idea after perceiving its relationships to what has already tentatively been adopted." The Model of Thematic Consistency (MTC) is an important step in that direction. Inspired by the accounts of experts about writing, we came about with the following research question: how can an automatic writer identify those events in a plot that do not help to push the conflict forward? To contribute to find an answer to this question we developed the MTC. This model provided us with a context to reflect on this problem and to find possible ways to solve it.

The MTC establishes five possible ways in which actions are useful to progress a conflict and to keep the coherence in a tale. We represent these functionalities as five different types of bindings between actions: Common-sense bindings, Loving-characters bindings, Contextual bindings, Inferred conflicts bindings and Positional bindings.

Where do these bindings come from? MEXICA is a long-term project. It is based on different theories about how human beings write. These theories provided a theoretical framework for the development of our computational model of the writing process, of which MEXICA is an instantiation. All the bindings used in this work are directly related to the architecture of the cognitive model of the system, and its abilities to generate narratives. Thus, the infrastructure created over these years has been essential to develop new ideas, such as the MTC, that contribute to a better understanding of the creative process. As MEXICA improves, new bindings will be included.

The MTC and its prototype have allowed us to study the dynamic of the phenomenon we are representing. For instance, we have learnt how loving-characters bindings might play a fundamental role in the unravelling of conflicts, and how they are only useful when connected to Contextual-bindings.

The model has also served to clarify some misconceptions. Intuitively, one might think that if all actions' preconditions are fulfilled then all actions must contribute to the progress of the plot. The MTC shows that this idea is incorrect. The scope and functionality of preconditions change from system to system (for a discussion see Pérez y Pérez 2019). In our case, preconditions represent basic social and logical common-sense knowledge. Thus, it is possible to have a narrative where all preconditions are satisfied but nevertheless some of the actions form unchained groups. That is, we have actions that are not useful for the unravelling of plot.

As part of the model, we also developed the Thematic-Consistency Map. Because this map allows visualising all the bindings and chained groups at once, it is a useful tool for the analysis of narratives.

In this way, the MTC describes mechanisms that allow a creative agent to identify those deeds that are not useful for the narrative. We also contemplate other potential uses of the prototype. For instance, because the MTC represents social common-sense knowledge, our prototype allows studying how different social contexts might affect our perception of the functionality of actions with a narrative. These types of systems could also be useful to support students in developing skills for the criticism of narratives.

In a more general comment, the MTC shows that our model of creative writing can be expanded. There are many interesting aspects related to story generation which have not been represented computationally. It is clear the necessity of finding new ways to produce narratives

automatically, that go beyond of techniques such as problem solving, genetic algorithms, and recently deep neural networks.

The mechanisms involved in the way we humans write harmonious narratives are much more complex than those represented by our systems. The study of what I refer to as *Automatic Story Coherence* (ASCO), i.e., the study of how to represent in computational terms those methods and knowledge structures necessary for the production of texts that humans classify as coherent, is relevant for computational creativity (Pérez y Pérez 2023). In this paper I present a model that aims to contribute to understand better how to develop coherent narratives that avoids unnecessary actions. This is a step in that direction.

Computer models are phantastic tools for the reflection on ideas. They are great to test our hypothesis, to challenge our rooted thoughts, and to produce new ways to see world. Let's not forget this.

Acknowledgements

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