A Computer Model for Visual-Daydreaming

Rafael Pérez y Pérez

Ricardo Sosa

Christian Lemâitre

Departamento de Tecnologías de la Información
Universidad Autónoma Metropolitana, Cuajimalpa, México
(rperez@correo.cua.uam.mx)

Departamento de Teoría y Procesos del Diseño
Universidad Autónoma Metropolitana, Cuajimalpa, México
(rsosa@correo.cua.uam.mx)

Departamento de Tecnologías de la Información
Universidad Autónoma Metropolitana, Cuajimalpa, México
(clemaitre@correo.cua.uam.mx)

Abstract

The purpose of our daydreaming model is to represent or "tell" computer generated daydreams employing computational animations. We employ the engagement part of the engagement-reflection model of writing to generate sequences of actions which are then animated employing computers. An important characteristic of our system is that animated characters are represented by non-verbal, non-anthropomorphic and non-zoomorphic visual objects. We refer to this program as the Visual-Daydreamer (V-Daydreamer). This paper reports on our first prototype. It describes some initial experiments that attempt to analyse if the outputs generated by the system are considered as daydreaming narratives by a group of human referees. The results suggest that V-Daydreamer's output corresponds with what most subjects identify as a daydream.

Introduction

Narrative has taken the attention of researchers for centuries and its relevance to cognition has been pointed out by several authors. For example, Eubanks affirms that "the study of narrative is the study of culture" and that "along with metaphor, narrative is one of the most observable ways we conceptualize experience and organize memory" (2004). Turner manifests that narrative is "the fundamental instrument of thought. Rational capacities depend upon it. It is our chief means of looking into the future, of predicting, of planning, and of explaining. It is a literary capacity indispensable to human cognition generally" (Turner 1996). In the literature one finds all types of different studies related with narrative. For example, the relationship between social intelligence and narrative intelligence (Dautenhahn 1999), the relation between play and narrative in children (Ilgaz and Aksu-Koc 2005; Engel 2005), the use of narratives to confirm cases of suspected sexual abuse (Hydén and Överlien 2005), the study of design as narrative (Dillon and Howe 2003), and the study of music as narrative (Levinson 2004).

We are interested in studying how narrative is generated employing computer models. We have developed programs for automatic plot generation (Pérez y Pérez and Sharples 2001; 2004), and studied the role of emotions in computer-generated stories (Pérez y Pérez 2007). In this paper we describe a computer model —based on our previous work—that employs computational animations to visually describe or "tell" computer-generated daydreams. In the following lines we explain why we are interested in daydreaming and what kind of visual narrative we are modelling.

Daydreaming.- Pérez y Pérez (1999) developed a computer model of storytelling known as the engagement-reflection model. It is based on Sharples (1999) account of writing: "An engaged writer is devoting full mental resources to transforming a chain of associated ideas into written text. At some point the writer will stop and bring the current state of the task into conscious attention [reflection], as a mental representation to be explored and transformed". Other authors mention similar ideas. For example, Beardsley (1965/1976) describes two phases that constantly alternate during the creative process. The inventive phase —traditionally known as inspiration— where new ideas are generated; and the selective phase where ideas are accepted or rejected. Daydreaming is the typical example of the engagement or generation phase; we believe it plays an important role during plot generation and deserves to be studied. However, it is hard to find computer models that represent daydreaming during the creative process. An exception is Mueller's DAYDREAMER program (1990). In our earlier work, we concentrated in the interaction between engagement and reflection. Based on this experience, in this paper we focus in developing a computer program that daydreams. We understand daydreaming as a type of narrative; following Singer (1975), daydreaming is a process related to "the unrolling of a sequence of events, memories or creatively constructed images of future events which have varying degrees of probability of taking place". Thus, we define a computer daydreaming as a computer-generated sequence of events where personae interact to progress a narrative; however, although there is a recognizable plot, actions are not necessarily connected in a logical or coherent way. For example, in daydreaming a character may be located on the beach and in the following action she may be lost in the forest. In fiction, it is necessary to explain how this change of location takes place. However, daydreaming might lack such an explanation. That is why this type of narratives is so flexible. An important characteristic of our system is that we do not see daydreaming as a goal oriented activity; in our model they emerge as a result of previous experiences and the interaction between characters.

Visual narrative.- From drawings to computer animations, including photographs, sculptures, comics, contemporary dance, and so on, there are several ways of describing a story employing visual components. However, in many of these examples, narratives are supported by verbal, anthropomorphic or zoomorphic elements which help to make sense of characters' roles, emotions, intentions, etc. We are interested in studying the processes and knowledge structures needed to construct a computer program capable of generating coherent narratives employing non-verbal, non-anthropomorphic and non-zoomorphic representations. We refer to this kind of representations as *dry-elements*.

Thus, the purpose of our daydreaming model is to create a program which successfully represents or "tells" computer generated daydreams employing computational animations of dry-elements. We refer to this program as the Visual-Daydreamer (or V-Daydreamer). We select a set of figures from three separate sources to represent our characters: Miro's Les Constellations paintings, Australian aboriginal art, and Mexica's glyphs. Figure 1 illustrates the three different sets of figures employed to represent personae.

This paper reports on our first prototype and describes some initial experiments that attempt to analyse if the outputs generated by the system are considered as daydreams by a group of human referees.

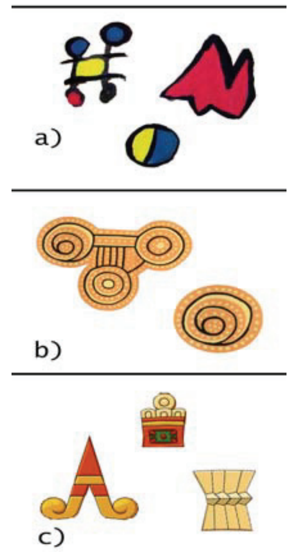

Figure 1: Sets of figures employed to represent personae; a) Miro's Les Constellations paintings, b) Australian aboriginal art, and c) Mexica's glyphs.

Visual-Daydreamer

Gelernter (1994), in his general account of creativity, talks about a continuous spectrum of cognitive activity that ranges from high focus (characterised by analytical thought) to low focus (where the analytical thought gradually disappears and ideas are linked together by emotions). Gelernter claims that creativity boils down to the discovery of new analogies —during low focus— that occur when one thought triggers another one which is related to it by shared emotions. In the same way, Getz and Lubart (Getz and Lubart 2000; Lubart and Getz 1997) claim that the association of concepts is driven by emotions. Two different concepts that share some associated emotions can be linked. That is how metaphors are created. Following these ideas, we claim that the sequences of actions that occur in a daydream are (at least partially) linked through emotions. The core ideas behind our model of daydreaming are:

1) Previous narrative-like experiences are the source of daydreams. We represent such experiences as narratives (sequences of actions made by the researchers) which are provided to the system.

2) One of the essential components in any narrative is the set of emotional links between characters that arouse

from the interaction between them. This set is referred to in this paper as the *emotional context* of the daydream. Thus, at any moment during a narrative there is a specific emotional context.

3) A sequence of actions can be represented as an emotional context that evolves over time. In other words, actions modify the emotional context as the daydream unravels. Therefore, it is possible to establish a connection between emotional contexts and actions performed.

In this way, a daydream is generated when an initial emotional context is provided; the system searches in its previous experiences in memory for similar situations in order to progress the narrative.

Description of the system.

The system works as follows: a visual daydream is formed by an animated sequence of events or actions performed by a set of characters. The current version of the system includes eight possible actions: attack, fight, wound, run away, die, suffer an accident, attempt to steal, cure and reward. Each animated action is supported by a sound (e.g. a fight includes "punch" sounds). In V-Daydreamer all actions performed by characters have associated a set of post conditions. Such post conditions are exclusively comprised by emotional links between characters. For example, if character A *heals* character B, character B develops *gratitude* towards A (an emotional link). If in the following action B *rewards* A, now A develops *gratitude* towards B. So, we have two emotional links between characters A and B. V-Daydreamer employs two types of emotional links: type 1 represents a continuum between *love* (brotherly love) and *hate* and type 2 represents a continuum between *being in love* with (amorous love) and *feeling hatred* towards. For practical reasons, emotions are implemented in discrete terms with a value in the range of -3 to +3. In this way, a narrative might be described as a (some times very complex) net of emotional links between characters that progress over time (Pérez y Pérez 2007). The program performs three main processes: 1) the creation of the knowledge structures in memory; 2) the generation of a sequence of actions; 3) the computational animation of such sequence of actions.

Creation of knowledge structures

The system employs a text file provided by the user with a set of narratives —known as the Previous Histories— as input to create its knowledge structures in memory. The process works as follows. V-Daydreamer analyses each action in each of the previous stories: it takes action 1 in the previous story 1, triggers its post conditions and records the results in a structure known as the Emotional Context (we refer to the content of the Emotional Context at this moment as context 1); then it takes action 2 in the previous story 1, triggers its post conditions and updates the Emotional Context (we refer to the content of the Emotional Context at this moment as context 2); and so on. The system copies into memory the content of each of the contexts generated during the analysis of the previous stories to create a set of new structures known as atoms. In this way, context 1 is employed to build atom I, context 2 is employed to build atom II, and so on. Then, the system associates to each atom the following action in the narrative. That is, Atom I (created from context 1) is associated to action 2; Atom II (created from context 2) is associated to action 3; and so on (see figure 2).

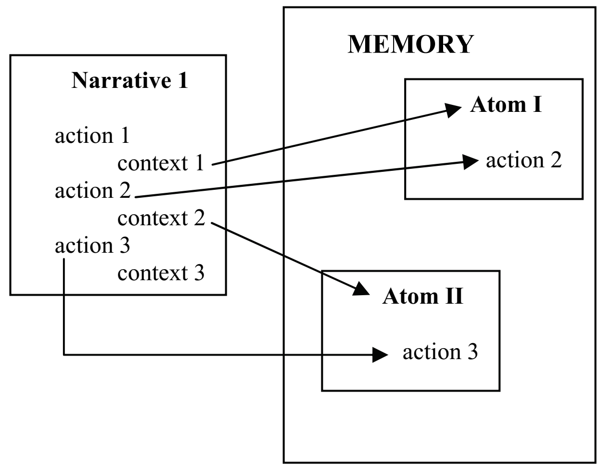

Figure 2. An example of how atoms are created in memory.

The system resets the Emotional Context and repeats the same process for each of the previous stories. Thus, it is possible that the Emotional Context has the same content in two different previous stories, and therefore the system might try to create two atoms alike. If two identical atoms are generated, e.g. atom 1 and atom 2, the system copies the associated action of atom 2 to atom 1 and destroys atom 2. In this way, one atom can have several actions associated. For example, if the content of the atom I and atom II is character A loves character B, and atom I has associated the action A proposes B, and atom II has associated the action A buys flowers for B, atom II is deleted and both actions are associated to atom I. Once the knowledge structures are created, the system can daydream.

Generation of a sequence of actions

The process to generate a sequence of actions starts when the user gives an initial action. The system triggers all its post conditions and an Emotional Context is formed. This Context is employed as cue to probe memory in order to match an atom alike or similar to it. The system includes a parameter to establish a percentage of similarity between the Emotional Context and the atoms. If all matched atoms are 100% similar to the Emotional Context (i.e. they are alike), the system is just reproducing a previous story; if all matched atoms are 50% similar to the Emotional Context, the system is generating a completely novel narrative although coherence is not guaranteed. Thus, it is necessary to find a balance. The system retrieves from memory all the actions associated to the matched atom, one action is selected at random, its post conditions are triggered updating the Emotional Context and the cycle starts again (see figure 3).

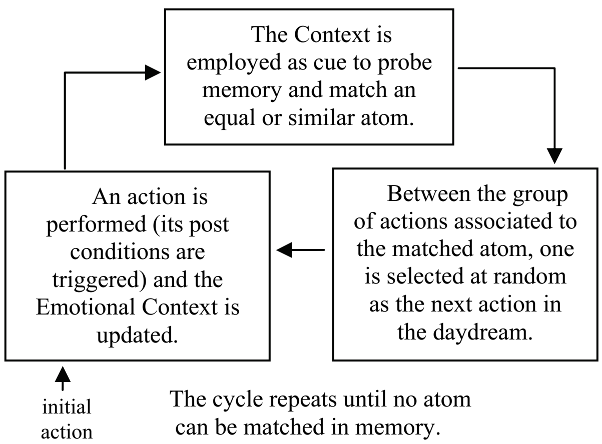

Figure 3. The engagement cycle.

Examples

The following lines show two examples of outputs generated by the system.

*** Daydreaming 1:
A Attempted to steal B
B attacks A
B wounds A
C cures A
B wounds A
C cures A
B wounds A
C cures A
B wounds A
C cures A
B wounds A
C cures A
…

A, B and C represent characters that will be substituted by dry-elements during the animation phase. In this example one can observe that the system produces a loop of two actions. The daydream describes a character A that attempts to mug B; B responds by attacking and then hurting A. So far, the sequence of events seems coherent. Then, a third character C —whose relation with A is never established— appears in the narrative and cures A. Next, B attacks and wounds A again and this sequence of actions is repeated over and over again. Why did C cured A? Were they friends? Was C a good fellow that just tried to help? Or was C a sadistic character that cures A just in order to watch how B hurts it again? These questions are never answered during the narrative (as we might expect in daydream). The loop emerges because the system does not have enough previous experiences to find different ways to continue the narrative. The second example generated by the system is:

*** Daydreaming 2:
A attacks B
B fights with A
A wounds B
A runs away
B dies

In this case, there is no explanation of why character A attacks B. Once A wounds B, character A runs away instead of making B prisoner (or something alike). Things are not clear, as we expect from a daydream. Nevertheless, there is a recognisable plot and it is possible to observe how characters' interactions advance the narrative (c.f. computer models of narratives where the plot is predefined by the authors).

Computational animations

The next step is to represent the generated sequence of actions as a computational animation. Figure 1 shows the group of visual objects that we use to represent characters. The current version of V-Daydreamer employs a set of predefined animations to illustrate each possible event. For example, the action A *fights* B is implemented as follows: two visual objects representing characters are placed in proximity; then, they "bounce" against each other (each time they hit each other a short "punch" sound is triggered) and signs of deformation or damage in both figures become visible (see figure 4). (It is a laborious work to describe all implemented actions in V-Daydreamer; if the reader is interested in watching some of these animations please contact the authors). In this way, in V-Daydreamer, animations are produced by piecing together a group of actions.

Figure 4. Representation of the action *A fights with B*.

Experiments

A pilot study was conducted to assess V-Daydreamer's outputs. 13 subjects participated in the experiment. The study consisted in the evaluation of three animations. We followed these steps. First, three sequences of actions were generated: the first was generated by V-Daydreamer; the second is a brief story produced by MEXICA, a computer program that generates short stories (Pérez y Pérez and Sharples 2001); the third one was pieced together by human researchers joining actions and characters arbitrarily (see figure 5c). The three sequences of events were processed by the animation module of V-Daydreamer. Each of these three animations employed one set of characters from figure 1. Finally, we designed and applied a questionnaire to perform the evaluation.

a) narrative # 1
A attacks B
B fights with A
A wounds B
A runs away
B dies

b) narrative #2
B suffers an accident
C cures B
B rewards C

c) narrative #3
A rewards B
B dies
A runs away
B fights with C
C cures B
A attacks C
C runs away

Figure 5. The three narratives employed in the experiment; a) was generated by the V-Daydreamer, b) was generated by MEXICA and c) was created by humans. A, B and C represent characters.

Procedure

Experiments were conducted in person, usually in a computer lab with subjects seating in front of a computer and wearing earphones. Subjects were advised that the test lasted between 15 and 20 minutes and that it was divided in three sections. Subjects were asked to finish the first part of the questionnaire before heading to the following sections.

In part 1, subjects observed the first animation on a computer screen; if necessary, they could watch it again. Then, they were asked to write down a description of what the animation suggested or brought to their minds. Each subject had blank sheets of paper available to complete this task. We repeated the same process for animations two and three.

In part 2, subjects were asked to evaluate each animation for narrative flow and coherence, narrative structure and personal preference. Five discrete values were available for evaluation ranging from "very poor" to "very good".

In part 3 of the questionnaire, subjects were asked to classify each animation according to the following options: a full story, a daydream narrative, a non-sense narrative, or other (specify). Subjects were also asked to rank the three animations according to their personal preference by simply ordering them from best to worst.

We expected the following results:
- subjects would be able to describe the core events that constitute narratives #1 and #2, and would report narrative #3 as confusing.
- animations #1 and #2 would get a higher score in narrative coherence and structure than animation #3.
- subjects would prefer animation #1 and #2 over #3.
- subjects would classify animation #1 as a daydream, animation #2 as a story, and animation #3 as non-sense.

Results

In the first part of the questionnaire, animation #1 —generated by V-Daydreamer— included the following sequence of actions: A *attacks* B, B *fights with* A, A *wounds* B, A *runs away,* B *dies*. The following lines show subjects' descriptions of animation #1 (all subject's comments are free translations from Spanish made by the authors): "Violence", "extreme violence", "it upsets me, murder, no values, dead, blood", "for me it is obvious that two things are fighting and one ends the life of the other", "it suggests a persecution and a murder", "this is a fight between two strange animals or bugs. One attacks the other until it wounds and kills the second one", "a street fight", "a 'sphere' destroyed by a red crests", "what started as a game ended as a cruel slaughter", "a persecution between two objects; it ends with the death of one of them". Most of these descriptions matched the original content of the plot generated by V-Daydreamer: two characters fought and one killed the other.

Animation #2 —a brief story generated by MEXICA— included the following sequence of actions: B *suffers an accident*, C *cures* B, B *rewards* C. The following lines show subjects description of animation #2: "peace", "luck", "game ball", "love", "it seems to me that a symbol —linked with the female uterus— gives life to an inanimate object from the mineral realm, and then it goes back to its origins", "the rescuer of my wounds", "the image suggests association of ideas", "a stranger attacks and wounds a boy. His mother arrives and heals him. The boy and his mom go home safely." "water, magic, restoration, fixing, coming back with the Creator", "it communicates tenderness. I see a kid that hurts himself with a rock and his mother comes and cuddles him", "a noisy 'rock' that drips a red liquid", "in this [narrative] the death is a sacrifice, that is, someone goes voluntarily to her death", "a rock that wounds in the head of an object, and as a consequence it is dying". Animation #2 seemed to bring to subjects' minds ideas which did not reflect the content of the original plot (e.g. a sacrifice, a noisy rock); the core aspects of the original narrative (character B having an accident and character C healing B) were explicitly mentioned by 5 subjects.

Animation #3 —generated by humans— included the following sequence of actions: A *rewards* B, B *dies*, A *runs away*, B *fights with* C, C *cures* B, A *attacks* C, C *runs away*. The following lines show subjects' descriptions of animation #3: "pre-Hispanicism that lives and dies with blood", "competence, the stronger wins", "this image is similar to the first one. However, the drawings [the visual images] make me think of the Spanish conquest", "the possibility of power and nevertheless the destruction of everything", "terror", "persecution", "aggression", "two Mexican indigenous fighting. The first wounds the second but before he dies a third indigenous arrives and takes the heart of the wounded one. The first fighter wants revenge and challenges the third one. But the third indigenous is very strong and intimidates the first one", "pain, dead", "I see two lovers, someone arrives and kills one of the lovers. The other one wants revenge and kills the murderer", "betrayal: the murder is the result of a love triangle", "it does not make sense to me". It was interesting to observe how this apparently meaningless sequence of actions triggered (in some cases very elaborated) narratives. For three subjects the visual representations, i.e. the Mexica's glyphs, influenced the content of the narrative (pre-Hispanic associations). This situation was clearly captured in subject's descriptions.

The second part of the questionnaire evaluated coherence, structure and preference. Regarding narrative coherence, the first two animations were ranked as "good" or "very good" by a majority of subjects, whilst none evaluated their coherence as "very poor". Figure 6 shows these results: white bars correspond to the coherence of animation #1, black bars to the coherence of animation #2, and dashed bars that of animation #3. The coherence of animation #3 (pieced together by the researchers) shows a high variance. The vertical axis plots number of responses by subjects, and the horizontal axis plots the five discrete values ranging from "very poor" to "very good".

The assessment of narrative structure shows that animation #1 was not perceived as "very poor" by any subject, but a large disagreement prevails in all other categories. However, animation #2 clearly marks a positive tendency towards "good" narrative structure. Finally, animation #3 was perceived with a high variance across all possible values, weighted towards "very good". Figure 7 shows these results: white bars represent the narrative structure of animation #1, black bars that of animation #2, and dashed bars that of animation #3. The vertical axis plots number of responses by subjects, and the horizontal axis the five discrete values ranging from "very poor" to "very good".

The assessment of personal liking shows a clearer picture: subjects tended to evaluate negatively animation #1, positively animation #2, and were rather neutral about animation #3. Figure 8 shows these results: white bars represent personal liking of animation #1, black bars that of animation #2, and dashed bars that of animation #3. The vertical axis plots number of responses by subjects, and the horizontal axis the five discrete values ranging from "very poor" to "very good".

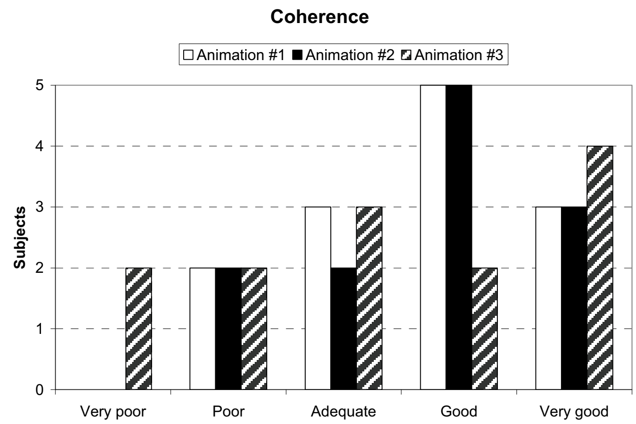

Figure 6. Evaluation of the coherence.

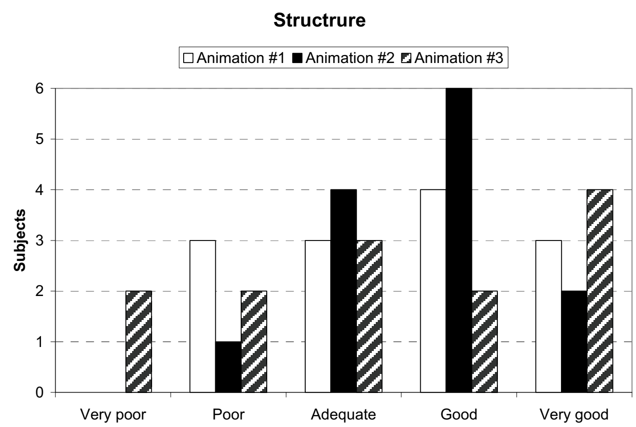

Figure 7. Evaluation of the narrative structure.

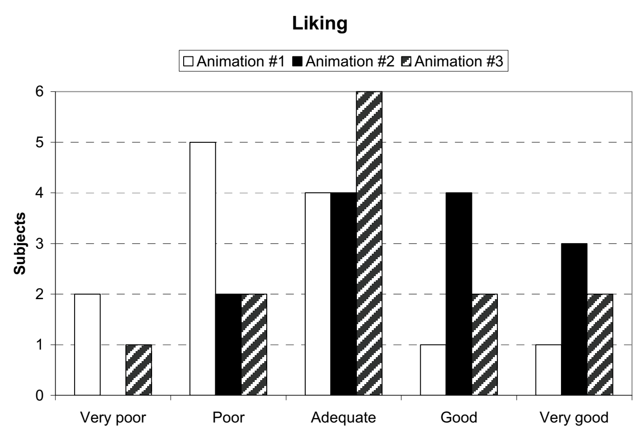

Figure 8. Evaluation of personal liking

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In its last section the study shows a high degree of consensus across subjects' classifications of the three animations: "full story", "daydream", "non-sense narrative" or "other (specify)". With significant agreement, subjects classified animation # 1 as a daydream, animation #2 as a full story, whilst animation #3 again showed high disagreement. Figure 9 shows these results: white bars represent the classification of animation #1, black bars that of animation #2, and dashed bars that of animation #3. The vertical axis plots number of responses by subjects, and the horizontal axis shows the four discrete values of "full story", "daydream", "non-sense narrative" or "other (specify)".

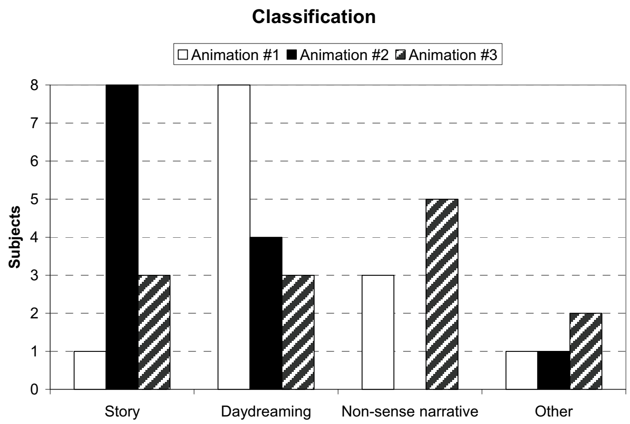

Figure 9. Classification of the animations.

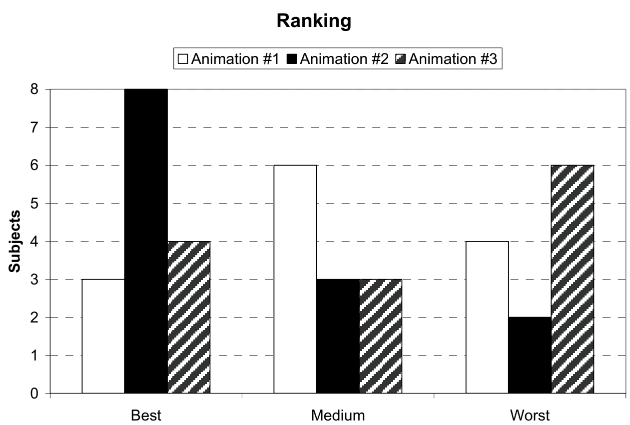

Figure 10. Ranking of the animations.

Finally, subjects ranked the three animations according to their personal preference by simply ordering them from best to worst. We expected a positive correlation between this ranking and the personal liking addressed earlier. This was the case for animation #2, which clearly is a favourite amongst subjects. However, the difference between animations #1 and #3 is not sufficiently clear in this study. Figure 10 shows these results: white bars represent the ranking of animation #1, black bars that of animation #2, and dashed bars that of animation #3. The vertical axis plots number of responses by subjects, and the horizontal axis shows their ranking order.

Discussion

In its first part, the test shows a large variance of subjective interpretations. Most subjects not only describe the figures on screen and their movements, but they also attribute anthropomorphic and zoomorphic characteristics to describe the sequences of actions displayed on screen. For instance, subjects associate characters with situations like love triangles, violence, fight between humans, human sacrifices, good vs. evil, etc. The majority of subjects' descriptions of narrative #1 correspond to the core elements found in the original plot in the animation generated by V-Daydreamer. These results suggest that, at least for this exercise, subjects are able to produce a more accurate account of a computer-based daydream than the animation introduced by the researchers (animation #3), which received a large variance of interpretations. In this respect, the results of animation #2 are not clear.

As expected, most subjects classify the computational animations either as a daydream or as a story, whilst they classify the third animation as non-sense narrative. These results seem to suggest that V-Daydreamer's output corresponds with what most subjects identify as a daydream. In addition, computational animations exhibit a slightly higher coherence and better narrative structure than that introduced by the researchers. In this way, it makes sense that animation #1 did not obtain the highest ranks in coherence and structure, since daydreams might lack these characteristics. Most subjects find narrative #1 (the daydream) extremely violent. Probably that affects its evaluation in the ranking and liking categories (figures 8 and 10).

Against our expectations, most subjects provide several seemingly coherent descriptions of the third animation. These results suggest that subjects may appreciate the ambiguity of the third animation, which was originally intended as an arbitrary sequence of actions. This has been also examined in the context of evaluating novel ideas in the diffusion of innovations, suggesting that more complex, ambiguous, and controversial ideas are likely to generate richer and more varied interpretations (Sosa and Gero 2004). If required, V-Daydreamer could be modified to purposefully generate such types of daydreams.

This document reports on our first attempt to generate an application based on our previous research on computer models of writing. V-daydreamer generates daydream-like narratives based on the engagement part of the engagement & reflection (E&R) computer model for plot generation. We believe that the E&R model of writing characterises important aspects of the creative process of storytelling.

Our first results suggest that we are on the right direction. However, much more work is required.

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