

The Applicability of Greimassian Semiotics to Meaningful Procedural Quest Generation

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Abstract. We present the semiotics of Algirdas J. Greimas as an analytical method that may be useful to the procedural generation of quest narratives in interactive games. We focus on summarizing the tools introduced by Greimas to describe a narrative's meaning, and we explain them using a sample analysis of Monterroso's microstory "The Dinosaur". Finally, we sketch our vision of how these tools can be used in the context of a generative system that could create stories where a deeper meaning is identifiable by players.

Keywords: Semiotics, Procedural Quest Generation, Story Generation.

1 Introduction

Procedural Content Generation (PCG) has long since been used as a feature of digital games, with varying degrees of success. In her historical analysis of PCG, Smith observed that by delegating the creation of game content to computer systems, "any ability for providing meaning in the generated characters or consideration for player experience was lost" [1]. She added that it is "harder to create *meaningful* content or to understand the qualities of generated content in terms of player experience" [1] and highlighted the detrimental effects that using randomness in the generation of encounters, monsters, and items can have on the players' experience of a game.

We believe that Smith's call for meaning refers to the perceived absence of a *theme* in procedurally generated content. This idea of theme corresponds to what Howard called "meaningful action" [2], or an allegorical set of correspondences where game players find statements about the real world by interacting with a fictional world. Thus, we raise the question: How can a procedural quest generator provide such a meaning to its generated stories? To answer it, we turn to the semiotics proposed by Algirdas J. Greimas [3] as a tool that an algorithm might use to generate quests that mimic Howard's meaningful action.

We propose that Greimas's method of analysis offers a compelling precursor for an envisioned quest generation algorithm that prioritizes meaning. We believe this for the following reasons. First, it formally describes the concept of theme as a "relation of various units of the signified distributed throughout the length of the story" [4] that follows concrete, procedural rules. Second, Greimas's equation has been applied as a

method to describe the theme of a complete story and is able to describe and predict thematically relevant events in a story [5]. Third, it presents a model of narrative grammar that focuses on theme [6] as well as a way to establish how actions performed by story actants [7] are related to the story's theme.

2 Related Work

Among the most influential works to discuss the idea of “meaning” within interactive narratives are those of Aarseth [8] and Bogost [9]. Aarseth created a conceptual toolset to understand texts using a function-oriented perspective, and studied them as a machine for the production and consumption of signs. Aarseth's work observes elements of texts and the functions that they serve in the process of communication. The study created a compelling basis for an ontology of the text, but it does not discuss the processes of meaning production at an authorial level. In contrast, Bogost's unit analysis seeks to assist critics in finding the “discrete meaning-making in texts of all kinds.”

Bogost's approach is aimed at the critical study of interactive texts. He makes the claim that critics and creators work with similar tools. In his view, the similarity of these tools teaches us to read both technology-based works and non-technology-based works “from the single perspective of their shared procedurality” [9]. This view supports our position that a detailed analysis of meaning is a precursor of the procedural generation of meaning.

Eladhari applied the semiotics of Algirdas Greimas and others to the study of meaning production in videogames [10]. Eladhari focused her application of Greimas as a “conceptualization that breaks down the parts of a story into force fields that make it possible for the narrative to come into existence” [10]. These “force fields” refer to the devices of meaning production and the contextualization of actions and events. Eladhari further wrote that the analysis of the dynamic elements (actions) and static (characters and settings) helps us observe the semantic syntax which gives a game its meaning. The view is based on Budanekiewicz's syntactic study of action [11], which presupposes the *modal*, i.e., motivating factors such as wants, goals and plans, as an antecedent state of the actualization of actions.

In what is perhaps a more relevant study for interactive computing, Yu et al. [12] use Greimas's actantial model as a tool in computer-based narrative by studying character interactions to classify them ontologically by their relationship to the story's subject. They conclude that continued tests would further evidence the similarity between human and system identifications of characters as subjects, helpers correlate with human identifications. Nonetheless, we find that these studies, originally conceived as tools of analysis, could contribute to interactive narrative design.

Szilas used elements of structuralism, including Greimas's canonical narrative schemata in his study of the narrative act. He described this act as “a type of meta-action in which the embedded action is one of the core actions of the story” and stated that such acts “constitute the main sequence (or plot) in the story” [13]. His system, IDtension [14] [15], works by organizing concrete actions through generated meta-actions. Szila's contribution to the formalization of what Chatman refers to as the “content/form” of stories is invaluable. However, we argue that a formal process through which Szilas's

narrative acts can be filtered to reflect what Chatman calls “the codes of the author’s society” which determine the “content/substance” of the story. [16]

The focus on the “content/form” that Szilas proposed has been shown to have limitations. For example, Riedl and Young’s IPOCL focuses on two attributes of narratives that they considered to be relatively universal: “the logical causal progression of plot and character believability” [17]. The project found that the generator was unable to communicate comedy and tragedy given the inability to produce narrative structures where a character failed to achieve one of its goals.

To address this issue, Shirvani and Ware drew on the Ortony, Clore and Collins model of emotions to constrain possible actions and add variety to possible plots [18] and “ensure that agents only act in ways that they expect to contribute to achieving their goals” [19]. The model works by explaining such actions, enabling a system-user communication of character personality traits, by which they judge the characters to be more relatable [19]. Similarly, the CONAN engine “seeks to produce novel and coherent quests in a videogame context by having NPCs make plans to solve their goals in accordance with their preferences” [20]. CONAN presents each NPC as a planning problem, which computes a quest by imposing a point cost to the possible actions characters can take.

We find that the above-mentioned models do not address the lack of an overarching theme in stories: understandable characters with consistent emotions and motivations do not necessarily make stories with a central thematic message. These are made instead via “correspondence” or allegory, which Howard presents as central for the design of meaningful action [2], and which we believe Greimas has formalized, based on the work of Propp.

The goal of having a theme in computer-authored narrative has led many authors to adopt narratological structures such as the ones described by Propp [21] and Campbell [22] or a combination of both. One such system used Case Based Reasoning to generate stories by following a principle of “story fragment interchangeability” [23]. To exemplify this modularity, we can look at Burstenev’s Overall Story Arc, in which “a designer can make sure that a narrative [...] follows the simple rules of the ‘Heroes Journey’ [sic] and can quickly set a skeleton framework to the game which can then be populated with more clearly defined level design” [24].

However, Propp’s generative model has proved more popular. Examples of its use include *Minstrel Remixed* [23], a reconstruction of the Turner 1993 original [25]; Grabson, Spierling and Braun’s *GEIST* [26], Ogata’s plot generator module [27], and Gervás’s *ProtoPropp* system [28]. Despite their successes as technical constructions, using Propp for narrative generation has not been without critique. Sjöström points out that game stories that adhere to Propp’s structure do not offer players a significant range of choice in what happens in a story and notes that in such cases “the narrative sequence must always be complete and the player may therefore not fail” [29], an issue reminiscent of the shortcomings that Riedl and Young identified in IPOCL [17].

Perhaps more significantly, Gervás later wrote of Propp’s morphology that “the brevity in which this generative procedure is described in Propp’s book inevitably leaves many things unsaid and a large number of open problems”. One of them is an apparent difficulty to identify functions that allow stories to end in a satisfactory manner; another is the difficulty in recognizing dependencies between non-consecutive story events [30].

These approaches attempt to add meaning to stories by arranging a sequence of events following a restrictive formula which only allows permutations at critical points, while the rest is determined with constrained randomness. This allows only for limited variations within the same narrative structure, and do not present particularly meaningful opportunities to engage with a thematic message more than once. To this end, we propose the further study of Greimassian semiotics.

3 Greimassian Semiotics and a Sample Analysis

This paper proposes using the model presented in Greimas’s “On Meaning” [3] as a narrative morphology to generate quests in which:

1. Events and characters seem connected to a story message or theme.
2. Different ways for players to advance are recognized and responded to accordingly.
3. Story structures are malleable, so the system can alter them to suit player actions.

Greimas’s model attempts to explain how the human mind constructs complex cultural objects [5], starting with simple elements and following a constrained trajectory. In this section, we will outline this process with an example analysis to introduce the terms and conceptual tools used by Greimas. This will clarify our discussion section, which explains how these tools might help an algorithm assemble meaningful computer game quests.

Describing Greimassian semiotics is best done with examples. Greimas worked with myths and folktales, whereas Budnikiewicz [11] worked with West’s *Miss Lonelyhearts* (a US literature classic), and Hébert [31] worked with biblical stories, Greek classics, and fairy tales. In our sample analysis, we work with Monterroso’s microstory “The Dinosaur”; which we will use as a running example throughout the text. The story, quoted in its entirety is: “Cuando despertó, el dinosaurio seguía allí” [32]. Grossman translated it as: “When he awoke, the dinosaur was still there” [33]. However, we will not use this translation given that it ignores the null-subject quality of the original. Instead, we will work with a more technical (though perhaps less appealing) translation:

Table 1. Technical translation of Monterroso’s “The Dinosaur”.

Cuando	despertó	,	el dinosaurio	seguía allí.
When	he/she/it awoke	,	the dinosaur	remained there.

According to Greimas, the construction of this “meaningfulness” is a compound process with three structured stages. The first is the *deep structure*, which “accounts for the achronic apprehension of the signification of all stories that could possibly be generated by a given semantic micro universe” [6]. The second structured stage is *surface structure*, which uses the elements described in the deep structure to define the characters, actions, happenings, and settings that are susceptible to manifestation by means of a *semiotic grammar*. The *structure of manifestation* is the third stage of the process. It produces the text that is visible to interactors. This last stage is beyond the scope of this

paper, as it would only be observable in a finished game. It is nonetheless useful to be aware of, as we use it as the starting point of the example analyses that follow.

Our translation in Table 1 attempts to reflect word by word the manifest structure that Monterroso published in 1959. As the process of translation shows, the ideas: (1) someone awakes, and (2) they realize a dinosaur remains at a known place; are independent of the manifest structure used (such as the original text, or our translation or Monterroso's original). Greimas describes the surface structure as a stage in which actants (anthropomorphized performers) and their actions follow a syntax to create a meaningful story. By contrast, the deep structure (which he also called *elementary morphology*) describes the thematic significance of story actions or happenings.

3.1 The Deep Structure

There are two events in Monterroso's story: the act of awakening and the act of remaining. Because these actions are the only elements of the text that evidence the presence of a meaningful sentiment in the story, we identify them as *elementary concepts* of the story. Elementary concepts are the basic units of meaning from which a story is drawn, and form the basis of Greimas's taxonomic model to study the deep structure.

Greimas proposes that the events carried out by actants are arranged syntactically to communicate meaning, and that they do so by proposing elementary concepts in an oppositional relation. Monterroso's microstory has only two elementary concepts to contrast: (a) awareness, asserted by the awakening of the implied someone or something and (b) presence, implied by the fact that the dinosaur remains. In our analysis, the word "awareness" refers to the active function of perceiving Monterroso's story world, and "presence" refers to the passive function of being there or being perceivable in the story world. Figure 1 shows the elementary concepts in Monterroso's story as part of Greimas' *semiotic square*, which shows ten different ways in which meaningful events, characters and settings can occur or exist in a story world. Each elementary concept corresponds to a corner, edge, or diagonal of the semiotic square.

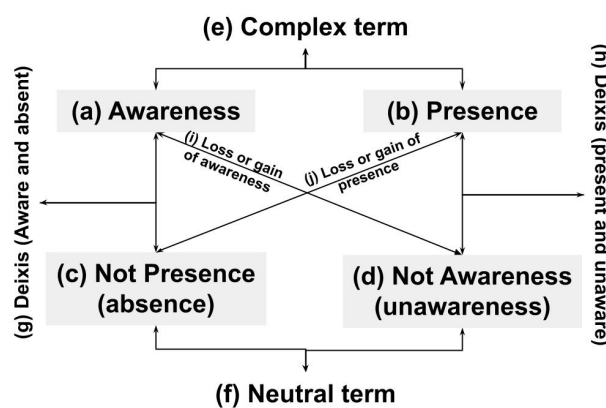


Fig. 1. Greimas' semiotic square, used to analyze Monterroso's "The Dinosaur".

In any analysis, the choice of (a) and (b) is subjective but relies on the observation of constant values proposed by the main character's actions and the challenges they overcome. (a) and (b) are subset to (e), the complex term, which represents the meaningful message of any story. In the case of "The Dinosaur," we see (e) manifest in any number of subjective meanings that one could assign to Monterroso's contrast between awareness and presence, such as the opinions a reader can have about the meaning of the story, or the ways in which a film maker might re-tell "The Dinosaur." The neutral term, (f), indicates the limitations of the story, which can be understood as the things that the author(s) did not mean to communicate. As stories become more complex, (e) and (f) may not be as evident as they are in our example story. Greimas includes contradictory terms (c) and (d) as neutralizing operators that are subset to (f), so that $a + d = 0$ and $b + c = 0$. In the case of "The Dinosaur" it is simple to find a word that encompasses $d = -a = \textit{unawareness}$ but this is not always required; (d) could remain as *non-awareness*. Contrary terms are calculated as follows:

$$d = -a \qquad c = -b \qquad (1)$$

(g) and (h) are called *deixes* by Greimas. They refer to a micro-ontology of actants (including characters, settings, and events) determined by their relationship to the elementary concepts of a given story. In "The Dinosaur", we might classify actants as belonging to the set (g) because they cause or bring about awareness or absence. On the other hand, actants organized in (h) will cause or bring to attention the concept either presence or unawareness in opposition to the actants in set (g). Although these are not discussed here at length, deixes (g) and (h) form the basis of Greimas' actantial model, where (g) includes helpers and opponents and (h) includes senders and receivers.

(i) and (j) are the transformative functions. Greimas originally expressed these as oriented syntactic operations, in the forms $f(a) = a \rightarrow d$ or $f(d) = d \rightarrow a$ and conversely $f(b) = b \rightarrow c$ or $f(c) = c \rightarrow b$ [6]. These describe the possible actions that actants (g) and (h) can perform to propose either of the elementary concepts at a particular point of story time. We depart from Greimas toward adding more mathematical meaning to the notation. We give (a) a value of 1 when our main character is aware. We can therefore understand a function (i) such as "*he/she/it awoke*", as follows:

$$a_{n+1} = \max(\min(a_n + ut_n, 1), -1) \qquad (2)$$

This equation represents (i) in Figure 1, and describes the process by which our person in (g) awakens, or gains awareness, going from a moment where they are unaware and towards a moment when they are aware. For example, we can say that at the moment of awakening, a_0 has a value of -1 and the story segment *he/she/it awoke* adds a contribution value $ut_0 = 2$. The result is $a_1 = 1$, indicating that our character is now aware, changing the state of the meaningful variables of Monterroso's story.

This narrative unit creates a full transformation from (d=1) unawareness to (a=1) awareness. It is therefore a *simple* narrative unit, consisting of one function (i), that is, one narrative utterance. More complex narratives follow a similar process, although the transformative functions (either (i) or (j)) follow a more gradual value change, and therefore consist of several narrative units. These units may be *declarative* (assigning or restating values of our elementary concepts) or *transformative* (carrying out transformative functions which an author can manipulate to create distinct dramatic effects).

Narrative Units and Narrative Utterances. Greimas describes a *narrative unit* as a “syntagmatic [meaningfully arranged] series of narrative utterances” [6], while a *narrative utterance* is a function through which an author attributes significance to the actants of a story. These concepts allow us to describe story events as consecutive operative functions that alter the value of elementary concepts for a given actant.

In “The Dinosaur”, consider the first statement (A) *When he/she/it awoke*. We assign our actant in (g) *he/she/it*, by relationship of implication, a value of awareness (a) equal to -1. In our analysis, this value indicates that the actant is unaware. In general, the value 1 indicates that an actant (in either (g) or (h)) is defined by an elementary concept (a) or (b). A value of -1 indicates the actant is defined by the contrary concept. We therefore understand the narrative utterance *he/she/it awoke* as an instance of Eq.2 where the initial awareness (a) of our actant in (g) has an initial value of -1 (it is not aware) and a resulting value of 1 (it is aware).

Because “The Dinosaur” is a very short story, narrative units and narrative utterances are indiscernible in context. The contrast between them can be seen more easily in the context of two adaptations:

(Y) *“He came back from an uneasy slumber. Slowly, he opened his eyes and began to rise as he yawned lazily. He didn’t immediately scan the room, but when he did; the dinosaur remained there.”*

(Z) *“He came to slowly. He opened his eyes and began to rise tentatively. The wound in his eye made it difficult for him to look around, so he treated it as best he could. When he was done, he saw that the dinosaur remained there.*

In adaptation (Y), the act of waking up takes 5 distinct actions, whereas in (A), it takes only one. The individual actions in (Y) are considered narrative utterances, which comprise the general act (and narrative unit) of awakening. Table 2 compares the three adaptations, showing that the fluctuation of value (a) as difference narrative utterances add a contribution value following Eq.2. to compute a new value of (a) of our actant in (g), the main character who awakens.

Table 2. Narrative Units contrasted with Narrative Utterances.

		Utterance number (n)	(a _n) Starting value	ut _n	Computation	(a _{n+1}) End value
A	$i_g = d \rightarrow a$	1	-1	2	$a_0 = -1 + 2$	1
		1	-1	0,4	$a_1 = -1 + 0,4$	-0,6
Y	$i_g = d \rightarrow a$	2	-0,6	0,4	$a_2 = -0,6 + 0,4$	-0,2
		3	-0,2	0,4	$a_3 = -0,2 + 0,4$	0,2
		4	0,2	0,4	$a_4 = 0,2 + 0,4$	0,6
		5	0,6	0,4	$a_5 = -0,6 + 0,4$	1
Z	$i_g = d \rightarrow a$	1	-1	0,4	$a_1 = -1 + 0,4$	-0,6
		2	-0,6	0,3	$a_2 = -0,6 + 0,3$	-0,3
		3	-0,3	0,3	$a_3 = -0,3 + 0,3$	0
		4	0	0,6	$a_4 = -0 + 0,6$	0,6
		5	0,6	-0,3	$a_5 = 0,6 - 0,3$	0,3
		6	0,3	0,3	$a_6 = 0,3 + 0,3$	0,6
		7	0,6	0,4	$a_7 = -0,6 + 0,4$	1

We begin Table 2 by dividing it in three sections, corresponding to our analyzed statements. We then present the narrative unit type describing the act of awakening as a function of our actant in (g) going along axis (i) in the semiotic square (see Figure 1) by having its current (a) value (-1, indicating the subject is unaware) fluctuate towards our desired (a) value (1, indicating the subject is aware). We represent the fluctuation with the addition of variable (ut_n), to which we attribute a value representing the degree in which a given utterance (with number n) contributes to the value of (a). Variable (ut_n) has an arbitrary value that describes the contribution an utterance makes to the value with which we describe an actant. Longer narrative units will contain more functions with lower values of (ut_n). In (A) the act of awakening takes one narrative utterance, and therefore (ut_1) “when he awoke” has its maximum value (2) when the new value of (a) is calculated. To contrast this, in (Y), we observe a more gradual awakening, and therefore (ut_n) has lower values that happen in sequence. Note that every utterance in (Y) has a value in the positive axis, and are therefore *conjunctive functions*, that is, they modify the value of (a) so that it fluctuates towards our desired value.

In (Y), the inclusion of narrative utterance 5 “The wound in his eye made it difficult to look around” is a *disjunctive function*, where variable (ut_5) has a value in the negative range, causing the value of (a) to fluctuate towards its value at ut_0 . This potentially describes a story in which the elementary concept (a) has a more interesting development, where characters must overcome obstacles, or encounter opponents or situations that propose (a)’s contrasting value (d).

Figure 2 shows the values of elementary concept (a) in our three versions of “The Dinosaur”. The three narrative units are superimposed in the same chart, where the vertical axis reflects the value of (a) awareness, and the horizontal axis represents the number of utterances in each unit.

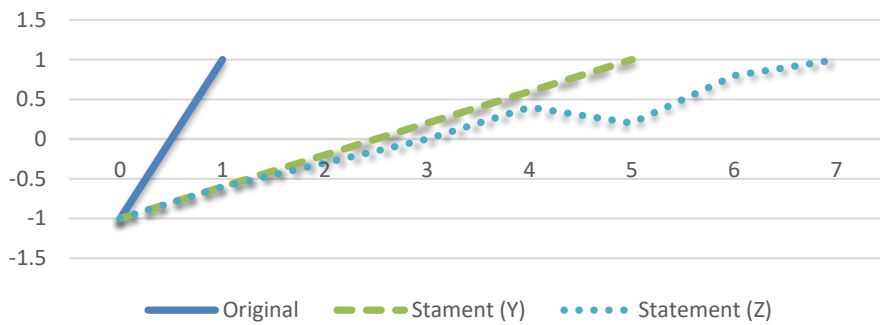


Fig. 2. Contrast of the value of (a) awareness in different renditions of “The Dinosaur”

From this comparison we present the following conclusions. First, narratives can be understood as the sequence of narrative utterances which arise from both stated and inferred narrative units. Second, narrative units are transformations of the story world, represented by the value fluctuation of elementary concepts to their contrary values (1, -1), and these can be experienced in chains of sequential narrative units that have varying lengths. Furthermore, a narrative unit describes the way in which actants

(characters or settings classified in deixies (g) or (h)) perform functions (i) or (j) causing the values of elementary concepts to fluctuate.

3.2 The Surface Structure

In our discussion of narrative units and utterances, we have presented how the actions and happenings of a story can be represented as thematic operations. The sequential listing of these operations (expressed in the terms of the deep structure) constitutes a representation of the surface structure. We do this by listing narrative units (Nu_n) in sequence, where the integer n indicates their logical progression. We assign the number 0 to the narrative unit in which the reader enters the story (e.g., when he/she/it awakens in “The Dinosaur”). By relationship of implication, some narrative units are inferred to have happened before this moment, and thus count along negative values of n .

Table 3 shows the surface structure of “The Dinosaur”, where we present the manifest discourse as evidence of our identification of meaning from left to right. We proceed to assign a number to each narrative unit that we identify, starting from the furthest that can be logically inferred towards the last one indicated by the manifest discourse. We continue by providing information on its “type,” which describes the thematic operation it performs in terms of the deep structure. Next, we present each unit’s function and assign values to variables. We conclude by providing an interpretation using natural language to exemplify the meaning of the abstract operations that we work with.

Table 3. The surface structure of “The Dinosaur”

Manifest Discourse	Narrative Unit	Narrative Unit Type	Functions & Values	Interpretation
None, but implied by (B)	Nu_{-3}	a, b $c = -b$ $d = -a$	$a = 1$ $b = 1$ $c = -1$ $d = -1$	Person (g) is aware of the presence of the dinosaur in (h).
	Nu_{-2}	$a \rightarrow d$ $ut = -2$	$a_g = a_g + ut_1$	Person (g) goes from state: aware to state: unaware
(A) When he/she/it awoke	Nu_{-1}	a, b $c = -b$ $d = -a$	$a = -1$ $b = 1$ $c = -1$ $d = 1$	Person (g) is unaware.
	Nu_0	$d \rightarrow a$ $ut = 2$	$a_g = a_g + ut_1$	Person (g) goes from state: unaware to state: aware
(B) the dinosaur remained there	Nu_1	<i>ability:</i> $b \rightarrow c$ $ut = -2$	<i>ability:</i> $b_h = b_h + ut_1$	Person is aware that the state of the dinosaur in (h) can change from present to absent.
	Nu_2	a, b $c = -b$ $d = -a$	$a = 1$ $b = 1$ $c = -1$ $d = -1$	Person becomes aware of the dinosaur’s (h) state: present

The reader enters the story during Nu_0 , when the subject of the story becomes awake, and readers await more information. Manifest statement (A), however, indicates Nu_{-1} , a non-manifest moment in which the subject was unaware. By the word “remained” used in (B), we can infer Nu_{-3} , a previous moment in time where the subject was aware and the dinosaur was present, as well as a function that occurs during Nu_{-2} , where the subject somehow became unaware. Following (B) we understand that the subject somehow becomes aware of the dinosaur during Nu_2 . But again, the word “remained” indicates that the subject expects in Nu_1 that the dinosaur would be absent.

Nu_1 is a virtual function. According to Greimas, actants “possess a virtuality of the particular doing that will make them able to accomplish [a value] transfer operation” [6]. Virtuality occurs in four modes that Greimas identifies. The first three are knowledge, ability, and want, which are prerequisites of the fourth mode, performance, the actualization of a function. In “The Dinosaur,” all narrative units other than (Nu_1), which is a statement of virtuality, are performances.

This analysis of “The Dinosaur” exemplifies three kinds of statements that can be made. The first is *descriptive statements* (see Nu_{-3} , Nu_{-1} and Nu_2). These are important because they represent a recalculation of the elementary concept’s value and present a view of the current world state. The second is *function statements*, which describe state transformations (see Nu_{-2} and Nu_0), where actants belonging to (g) or (h) conduct operations by altering the value of elementary concepts (a, b, c and d). The third is *virtual statements*, which can be subjectivized by either the author or the reader to enrich the meaning even further during the telling or re-telling of a story.

3.3 The Investment of Meaning

In Table 2, we presented and analyzed the types of narrative units that can occur in a story by enlisting the resources employed by Monterroso to communicate “The Dinosaur.” In it we observed we have a single virtual narrative unit, Nu_1 , which communicates the dinosaur’s ability to become absent. It is here that we turn back to the fact that the original story gives readers little manifest evidence to discern its true meaning. Although we instinctively appreciate that the dinosaur can become absent, as most things are, Monterroso does not fully express the virtuality of the value transformation of the variable (b) presence. The following information is missing:

1. Whether the dinosaur wants to become absent.
2. Whether the subject wants the dinosaur to become absent.
3. Whether the dinosaur knows how to leave.
4. Whether the subject knows how to make the dinosaur become absent.
5. Whether the subject has the ability make the dinosaur become absent.

These unknowns represent questions that are answered by readers and interpreters. When they write that the story suggests that “our intellectual slumber prevents us from exacting social change” [34] Ramírez and Toledo identify the dinosaur as an allegorical figure that represents political authority and assumes that the subject (a figure representing society) wishes it to become absent. On the other hand, Aguilar’s cinematographic adaptation of “The Dinosaur” [35] manifests all the narrative units presented in

Table 2 by creating characters, including a drug dealer called “The Dinosaur”, a young man who purchases drugs, and drugs that cause the young man’s unawareness.

The pronounced differences between Ramírez and Toledo’s and Aguilar’s interpretations can be explained by referring to the process that Greimas calls “*investment*” [7]. This process defines characters that propose the elementary concepts of the narrative at the level of the *aesthetic* (with characters and settings), the *virtual* (defining wants, knowledge and abilities) and finally the *moral* (subjective interpretations).

Contrasting these two interpretations shows us that the aesthetic investment and the virtual investment need not remain the same for a deeper message to be communicated. The stories remain recognizable as adaptations of “The Dinosaur” because they follow the same message of contrast. We present this message in Eq. 3.

$$i: \text{changes in awareness} \neq j: \text{changes in presence} \quad (3)$$

4 Proposed Application to Quest Generation

Our application of Greimassian semiotics to interactive narrative design begins with the conception that meaningful stories have messages generated by the contrasting relationship of two elementary concepts as shown in the semiotic square (Fig. 1). We have highlighted four different tools as relevant to interactive story design: (i) A model of the message and the process of investment; (ii) A representation of narrative units that describe actions and states in terms of numerical values attributed to elementary concepts of the semiotic square; (iii) A description of narrative unit types at the author level by their function, including the descriptive, the virtual, and the functional; and (iv) A description of the component parts of narrative units and narrative utterances, including a demonstration of how they can present modular variations without compromising the story’s message.

Having studied these conceptual tools, we argue that a generative system might rely on them to direct happenings, present optional events to users, and provide players with quest plots where they may select a role to play and that they can invest with a moral message. We now sketch the operation of a system that follows these principles.

1. Given an elementary concept (such as *need*), select an appropriate contrasting concept (such as *greed*) and select a target message. This could be achieved with a library of elementary concepts and common contrasts in other stories or quests.
2. Build the story space by identifying possible functions related to the target message and identify actants (characters, objects, and settings), and assign them as proponents of a particular elementary concept (e.g., a farmer who needs medicine; *need*, an alchemist that sells medicine at a ridiculous price; *greed*).
3. Identify logical narrative units for a quest arc (player must identify the needy farmer, get medicine, present medicine), e.g., through narrative planning processes like Shivani & Ware’s [19] or Breault, Ouellet and Davies’s [20].
4. Identify possible narrative utterances (e.g., ways for the player to acknowledge the need, the greed, and their causes, ways to relieve the need or to participate in the

greed, and ways in which actants might respond to such actions) and assign contribution values to each (ut_n).

5. Use the identified utterances to generate narrative units, extending those units that might provide interesting developments. For example, the number of narrative utterances in “get medicine” could be extended by introducing an actant with the directive “steal medicine.” This expansion requires a library of different narrative units with associated contribution values.
6. As the story unfolds, identify player actions that might allow them to propose elementary concepts. Should the player get the medicine, they might either give it and relieve the need, or sell it to a farmer at a better price than the alchemist.
7. At the conclusion of the story, restate the significance of the player’s actions in the story world, presenting or evidencing the contrasting terms of the story by comparing the initial world state and end world state, as well as presenting the system’s understanding of the character’s role of the generated story.

5 Conclusions and Future Work

In this work, we explained how the analytical tools of Algirdas J. Greimas can be used to create and communicate the general meaning of a story through action, and we sketched how a theoretical system might use those tools to generate stories.

Greimas’s work was conceived primarily to analyze stories – not generate them. Therefore, applying several of the tools that we discussed will require inferring additional precision (toward enabling computation) beyond what Greimas explicitly states. Furthermore, several of the steps of the system we have sketched will be non-trivial to automate completely, and thus the support of a substantial body of authored and annotated content will be required. Finding a viable balance between authoring and automation remains as future work. In the meantime, we hope that our summary of Greimas’s tools can support further work that seeks to produce interactive narratives that convey a message – be they hand-authored, generated, or some combination of the two.

Looking forward, it would be useful to analyze more works of literature, both traditional and interactive, with the goal of describing the dramatic resources that human authors have used to communicate their messages through action. This is because more complex stories will contain more than one message, or the message might not be as simple as it is in Monterroso’s “The Dinosaur.” We theorize that observing different messages with this methodology will allow our theoretical system to produce more complex stories with the use of a library of contrasting elementary concepts.

Another benefit further analysis of stories would be the appreciation of narrative utterance design. This would allow us to better understand the relationship between a narrative unit’s emotional effect and the value fluctuation of the ut_n variable we introduced to measure each utterance’s contribution to the value of our elementary concepts. We suspect that works within particular story genres (such as comedy, tragedy or suspense) will present similar patterns in how the values of elementary concepts fluctuate across their narrative utterances.

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