Storytelling variants based on semiotic relations

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A R T I C L E   I N F O

A B S T R A C T

An intriguing phenomenon in human storytelling – inexhaustible source of inspiration for digital storytelling – is our ability to still recognize a story that the narrator has felt free to change to a considerable extent. However, observing how folktales have appeared and disseminated through different countries along the centuries, we may notice that our favorite stories have evolved no less dramatically in the course of the oral storytelling tradition. In this paper, taking Little Red Riding Hood as example, we review a small number of variants of this universally cherished story, in an attempt to understand how variants emerge. Our study is founded on the classification of types and motifs contained in the Index of Antti Aarne and Stith Thompson, and examines the hypothesis that variants are often the consequence of type interactions, which we propose to characterize in terms of semiotic relations associated with the socalled four master tropes. The paper presents our analysis of the variant-formation phenomenon and describes the implementation of a computational system capable of generating new variants by applying the proposed semiotic relations.

1. Introduction

Since the emergence of the first Interactive Storytelling systems [1,2], several Artificial Intelligence (AI) techniques have been applied for the generation of sequences of narrative events. Also many different visual media (such as 3D graphics [3], videos [4] or illustrations [5]) have been used to dramatize these events. However, the inspiration for all the work in interactive storytelling seems to emerge from narrative theories [6]. And when thinking about narrative theories, in order to formulate and implement narrative generation methods, two highly influential approaches come immediately to mind, both dealing specifically with folktales: Propp's *functions* [7] and the comprehensive classification of types and motifs proposed by Antti Aarne and Stith Thompson [8], known as the *Aarne-Thompson Index* (heretofore simply *Index*).

In a previous work, as part of our **Logtell** project [3,9], we developed prototypes [10,3] that adopted the first approach to compose narrative plots interactively, employing a *plan-generation* algorithm. By formulating the event-producing functions that characterize the chosen genre (folktales, detective stories, etc.) as operations defined by pre-conditions and post-conditions, we made sure that the obtained plots would be in full conformity with the conventions of the genre. Starting from different initial states

and giving to users the power to intervene in the generation process, within the limits of the conventions, we were able to obtain in most cases a fair number of different plots, thereby achieving an encouraging level of variety in plot composition. Indeed, more than once, we posed goals that we thought to be unattainable in the given context, and had the surprise to see the planner find its way along unexpected sequences of events.

Now we propose to invest on a strategy that is based instead on the analysis of already existing stories. Though we shall focus on folktales, an analogous conceptual formulation applies to any genre strictly regulated by conventions and definable in terms of fixed sets of characters and typical events. In all such genres, one should be able to pinpoint the equivalent of Proppian functions, as well as of ubiquitous types and motifs, thus opening the way to the *reuse* of previously identified narrative patterns as an authoring resource. An added incentive to work with folktale variants is the movie industry's current interest in adaptations of folktales for adult audiences, in contrast to old Disney productions.

The present study is based on the concepts of types and motifs of the Aarne-Thompson's *Index*, under whose guidance we explore what the ingenuity of supposedly unschooled narrators has legated. As a case study, we chose to concentrate on folktale type **AT 333**, centered on *The Little Red Riding Hood* and spanning some 58 variants (according to [11]) from which we took a small sample. The paper starts with a comparative survey of these variants, followed by an attempt to understand how folktale variants emerge

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and how this phenomenon could be used to support narrative generation methods in computer environments. The main thrust of the paper is to investigate how such rich diversities of variants of traditional folktales came to be produced, as they were told and retold by successive generations of oral storytellers, hoping that some of their tactics are amenable to automatic or semi-automatic processing. Our objective is to provide the conceptual basis for the development of automatic methods for narrative generation.

In this paper, we use the 1961 version of the Aarne-Thompson's *Index* [8], instead of its second revision [12] or the third and broader revision by Uther [13]. This latter revision is known as the *Aarne-Thompson-Uther Index*. Also we loosely use both notation AT (as in *Aarne-Thompson Index*) and ATU (as in *Aarne-Thompson-Uther Index*). These choices have no further consequences on the results of the current paper, besides being easier to make references to other researchers' studies on fairy tales variants.

Related work is found in the literature of *computational narratology* [6,14] – a new field that examines narratology from the viewpoint of computation and information processing – which offers models and systems based on tale types/motifs that can be used in story generation and/or story comparison. Karsdorp et al. [15] believe that oral transmission of folktales happens through the replication of sequences of motifs. They remark that more work is necessary to cope with all kinds of folktales and develop a system where motifs are considered at different levels of abstraction. Darányi et al. [16] proposed to handle motif strings like chromosome mutations in genetics with operations of insertion/deletion, duplication and transposition. Kawakami et al. [17] covered 23 Japanese texts of Cinderella tales, proposed a motif network model of narrative structure not using the *Index* ("motif" being simply "the most significant action described in the text"), and provided a system to generate variations of Cinderella tales.

Our text is organized as follows. Section 2 presents the two classic variants of type **AT 333** and summarizes some additional variants. Section 3 presents our analysis of the variant-formation phenomenon, with special attention to the interaction among types, explained in terms of semiotic relations. Section 4 describes some ways of employing the semiotic relations to compose new stories. Section 5 presents a computational system capable of generating new variants by applying the proposed semiotic relations. Section 6 contains the concluding remarks. The full texts of the variants mentioned in the paper are available in a separate online document.[1]

2. Variants of type AT 333

In the *Index*, the type of interest, **AT 333**, characteristically named **The Glutton**, is basically described in two major episodes as follows [8, p.125]:

> The wolf or other monster devours human beings until all of them are rescued alive from his belly.
> **Wolf's Feast.** By masking as mother or grandmother the wolf deceives and devours a little girl whom he meets on his way to her grandmother's.
> **Rescue.** The wolf is cut open and his victims rescued alive; his belly is sewed full of stones and he drowns, or he jumps to his death.

2.1. The two classic variants

The first classic variant, *Le Petit Chaperon Rouge* (Little Red Riding Hood), was composed in France in 1697, by Perrault [18], dur-

ing the reign of Louis XIVth. It consists of the first episode alone, so that there is no happy ending, contrary to what children normally expect from nursery fairy tales. The little girl, going through the woods to see her grandmother, is accosted by the wolf who reaches the grandmother's house ahead of her. The wolf kills the grandmother and takes her place in bed. When the girl arrives, she is astonished at the grandmother's large ears, large eyes, etc., until she asks about her huge teeth, whereat the wolf gobbles her up. Following a convention of the genre of admonitory fables, a "moralité" is appended, to the effect that well-bred girls should not listen to strangers, particularly when they pose as "gentle wolves". Fig. 1 shows well-known illustrations made by the famous French artist Gustave Doré (1832–1883) for a 1862 French edition of the Perrault's stories.

The second and more influential classic variant is that of the Grimm brothers (Jacob and Wilhelm), written in German, entitled *Rotkäppchen* (Little Red Cap) [19], first published in 1812. The girl's question about the wolf's teeth is replaced by: "But, grandmother, what a dreadful big mouth you have!" This is a vital change – not being bitten, the victims are gobbled up alive – and so the Grimm variant can encompass the two episodes prescribed for the **AT 333** type. Rescue is effected by a hunter, who finds the wolf sleeping and cuts his belly, allowing girl and grandmother to escape. The wolf, his belly filled with heavy stones fetched by the girl, wakes up, tries to run away and falls dead, unable to carry the weight. As a moral addendum to the happy ending, the girl promises to never again deviate from the path when so ordered by her mother. Having collected the story from two distinct sources, the brothers wrote a single text with a second finale, wherein both female characters show that they had learned from their experience with the villain. A second wolf comes in with similar proposals. The girl warns her grandmother who manages to keep the animal outside, and eventually they cause him to fall from the roof into a trough and be drowned.

2.2. Some other variants

In [11], no less than 58 folktales are examined as belonging to the types **ATU 333** (Little Red Riding Hood) and **ATU 123** (The Wolf and the Kids), which are quite similar types, as explained by Tehrani [11, p. 3]: "First, ATU 333 features a single victim (a group of siblings) who is a human girl, whereas ATU 123 features multiple victims who are animals. Second, in ATU 333 the victim is attacked in her grandmother's house, while in ATU 123 the victims are attacked in their own home." Here we shall merely review seven **AT 333** tales, in addition to the classic ones of the previous section, including a Brazilian tale that is not mentioned by Tehrani [op. cit.].

Since several variants do not mention a red hood or a similar piece of clothing as attribute of the protagonist, the conjecture was raised that this was Perrault's invention, later imitated by the Grimm's. However a tale written in Latin by Egbert de Liège in the 11th century, *De puella a lupellis seruata* (About a Girl Saved from Wolf Cubs) [20], arguably prefiguring some characteristics of **AT 333**, features a red tunic that is not merely ornamental but plays a role in the events. The girl had received it as a baptismal gift from her godfather. When she was once captured by a wolf and delivered to its cubs to be eaten, she suffered no harm. The virtue of baptism, visually represented by the red tunic, gave her protection. The cubs, their natural ferocity subdued, gently caressed her head covered by the tunic. The moral lesson, in this case, is consonant with the teaching of the *Bible*.[2]

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[1] http://www-di.inf.puc-rio.br/~furtado/LRRH_texts.pdf.

[2] Daniel VI, 27: He delivereth and rescueth, and he worketh signs and wonders in heaven and in earth, who hath delivered Daniel from the power of the lions.

Fig. 1. Illustrations of *Compère le Loup* by Gustave Doré for the book *Contes* by C. Perrault, in a 1862 French edition. Images reproduced under "fair use" and/or public domain policy.

Whilst in the variants considered so far the girl is presented as naïve, in contrast to the clever villain, the situation is reversed in the *Conte de la Mère-grand* (The Story of Grandmother), collected by folklorist Achille Millien in the French province of Nivernais, circa 1870, and later published by Delarue [21]. In this variant, which some scholars believe to be closer to the primitive oral tradition, the villain is a "bzou", a werewolf. After killing and partly devouring the grandmother's body, he stores some of her flesh and fills a bottle with her blood. When the girl comes in, he directs her to eat and drink from these ghastly remains. Then he tells her to undress and lie down on the bed. Whenever the girl asks where to put each piece of clothing, the answer is always: "Throw it in the fire, my child; you don't need it anymore." In the ensuing dialogue about the peculiar physical attributes of the fake grandmother, when the question about her "big mouth" is asked the bzou gives the conventional reply: "All the better to eat you with, my child!" – but this time the action does not immediately follow the words. What happens instead is that the girl asks permission to go out to relieve herself, which is a ruse whereby she ends up outsmarting the villain and safely going back home.[3] There is a possibility that the oral tale collected in Nivernais dates back long before Perrault penned his tale. In this case, Perrault adapted it for the French court of Louis XIV, eliminating the cannibal drinking and the detailed striptease, although the girl undresses and gets into bed with the wolf [22, p. 587].

An Italian variant published by Italo Calvino, entitled *Il Lupo e le Tre Ragazze* (The Wolf and the Three Girls) [23], adopts the trebling device [7] so common in folktales, making three sisters, one by one, repeat the action of taking victuals to their sick mother. The wolf intercepts each girl but merely demands the food and drink that they carry. The youngest girl, who is the protagonist, throws at the wolf a portion that she had filled with nails. This infuriates the wolf, who hurries to the mother's house to devour her and lay in wait for the girl. After the customary dialogue with the wolf posing as the mother, the animal also swallows the girl. The townspeople observe the wolf coming out, kill him and extract mother and girl alive from his belly. But that is not all, as Calvino admits in an endnote. Having found the text as initially collected by Giambattista Basile, he had deliberately omitted what he thought to be a too gruesome detail ("una progressione troppo truculenta"): after killing the mother, the wolf had made "a door latch cord out of her tendons, a meat pie out of her flesh, and wine out of her blood". Repeating the strange above-described episode of the *Conte de la Mère-grand*, the girl is induced to eat and drink from these remains, with the aggravating circumstance that they belonged to her mother, rather than to a more remotely related grandparent.

Turning to China, one encounters the tale *Lon Po Po* (Grammie Wolf), translated by Young [24], which again features three sisters but, unlike the Western folktale cliché, shows the eldest as protagonist, more experienced and also more resourceful than the others. The mother, here explicitly declared to be a young widow, goes to visit the grandmother on her birthday, and warns Shang, the eldest, not to let anyone inside during her absence. A wolf overhears her words, disguises as an old woman and knocks at the door claiming to be the grandmother. After some hesitation, the girls allow him to enter and, in the dark, since the wolf claims that light hurts his eyes, they go to bed together. Shang, however, lighting a candle for a moment catches a glimpse of the wolf's hairy face. She convinces him to permit her two sisters to go outside under the pretext that one of them is thirsty. And herself is also allowed to go out, promising to fetch some special nuts for "Grammie". Tired of waiting for their return, the wolf leaves the house and finds the three sisters up in a tree. They persuade him to fetch a basket mounted on which they propose to bring him up, in order to pluck with his own hands the delicious nuts. They pull on the rope attached to the basket, but let it go so that the wolf is seriously bruised. And he finally dies when the false attempt is repeated for the third time.

Another Chinese variant features a bear as the villain: *Hsiung chia P'o* (Goldflower and the Bear) [25], translated by Chiang Mi. The crafty protagonist, Goldflower, is once again an elder sister, living with her mother and a brother. The mother leaves them for one day to visit their sick aunt, asking the girl to take care of her brother and call their grandmother to keep them company during the night. The bear knocks at the door, posing as the grandmother. Shortly after he comes in, the girl – in spite of the darkness – ends up disclosing his identity. She manages to lock the boy in another room, and then obeys the bear's request to go to bed at his side. The villain's plan is to eat her at midnight, but she asks to go out to relieve her tummy. As distrustful as the werewolf in the before-mentioned French variant, the bear ties one end of a belt to her hand – an equally useless precaution. Safely outside on top of a tree, Goldflower asks if he would wish to eat some pears, to be plucked with a spear, which the famished beast obligingly goes to fetch in the house. The girl begins with one fruit, but the next thing to be thrown into his widely open gullet is the spear itself. Coming back in the morning, the mother praises the brave little Goldflower.

One variant, published in Portugal by Junqueiro [26], entitled *O Chapelinho Encarnado* (The Little Red Hat), basically follows the Grimm brothers pattern. A curious twist is introduced: instead of luring the girl to pick up wild flowers, the wolf points to her a

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[3] cf. http://expositions.bnf.fr/contes/gros/chaperon/nivers.htm.

number of medicinal herbs, all poisonous plants in reality, and she mistakes him for a doctor. At the end, the initiative of filling the belly of the wolf with stones is attributed not to the girl, but to the hunter, who, after skinning the animal, merrily shares the food and drink brought by the girl with her and her grandmother.

The highly reputed Brazilian folklorist Camara Cascudo included in his collection [27] a variant, O *Chapelinho Vermelho* (The Little Red Hat), which also follows the Grimm brothers pattern. The mother is introduced as a widow and the name of the girl is spelled out: Laura. Although she is known, as the conventional title goes, by a nickname translatable as "Little Red Hat", what she wears every day is a red parasol, given by her mother. One more particularity is that, upon entering her grandmother's house, the girl forgets to close the door, so that finding the door open is what strikes the hunter as suspicious when he approaches the house. The hunter bleeds the wolf with a knife and, noticing his distended belly, proceeds to open it thus saving the two victims. Nothing is said about filling the wolf's belly with stones, the wounds inflicted by the hunter's knife having been enough to kill him. Two prudent lessons are learned: (1) Laura would not forget her mother's recommendation to never deviate from the path, the specific reason given here being that there existed evil beasts in the wood and (2) living alone should no longer be an option for the old woman, who from then on would dwell with her daughter and granddaughter.

3. Comments on the formation of variants

3.1. Classical differences among variants

It is a truism that people tend to introduce personal contributions when retelling a story. There are also cultural time and place circumstances that require adaptations. For example, in the times of Louis XIVth, to be or not to be born from a noble family was still a serious issue. So, in the first written publication of *The Story of Beauty and the Beast* [28], when the prince tells his mother that he is anxious to marry the girl who had just made him recover his human form, the haughty queen is scandalized upon hearing that Belle is merely the daughter of a merchant – a troublesome scene not repeated in any of the later variants. Likewise, in the Arab world the prince would in no way be allowed to meet Cinderella in a ballroom – he falls in love without having ever seen her (cf. "Le Bracelet de Cheville" in the Mardrus translation of *One Thousand and One Nights* [29]).

Other differences among variants may result from the level of education of the oral storytellers, affecting how spontaneous they are, and the attitude of the collectors who may either prefer to reproduce exactly what they hear or introduce corrections and rational explanations while omitting indecorous or gruesome scenes. On the storyteller's part, however, this tendency is often attenuated by an instinctive pact with the audience – with children, in special – in favor of faithful repetition, preferably employing the very same words. Indeed the genre of folktales is strongly marked by *conventions* which, to a remarkable extent, remain the same in different times and places. The folklorist Albert Lord called *tension of essences* the compulsion that drives all singers (i.e. traditional oral storytellers) to strictly enforce such conventions [30, p. 98]:

"In our investigation of composition by theme this hidden tension of essences must be taken into consideration. We are apparently dealing here with a strong force that keeps certain themes together. It is deeply imbedded in the tradition; the singer probably imbibes it intuitively at a very early stage of his career. It pervades his material and the tradition. He avoids violating the group of themes by omitting any of its members. [We shall see] that he will even go so far as to substitute some-

thing similar if he finds that for one reason or another he cannot use one of the elements in its usual form."

The notion of tension of essences may perhaps help explaining not only the total permanence of some variants within the frontiers of a type, but also the emergence of transgressive variants, which absorb features pertaining to other types, sometimes even provoking a sensation of strangeness. When an oral storyteller feels the urge "to substitute something similar" in a story, the chosen "something" should, as an effect of the tension-of-essences forceful compulsion, still belong to the folktale genre – but what if the storyteller's repertoire comprises more than one folktale type? As happens with many classifications, the frontiers between the types in the *Index* are often blurred, to the point that one or more motifs can be shared and some stories may well be classified in more than one type. So a viable hypothesis can be advanced that some variants did originate through, so to speak, a *type-contamination* phenomenon.

In this paper, contamination has the meaning of interactions between types or between oral and literary traditions. This connotation is different from the usual meaning of contamination, at least from two points of view. Firstly, it is different from the outdated concept of contamination resulting from the idea of "oral tradition as corruption" that changes more pure or genuine fairy tales. This outdated concept has its origins in early thoughts by Antti Aarne when he was building the first version of what became the Aarne-Thompson-Uther index, as explained by Vaz da Silva [31]:

"... each tale type was defined on the basis of a particular set of motifs. But folktales actually shuffle motifs continuously, displaying ever-new variants. Therefore, discrepancies became apparent between preset tale types and protean folktales. Aarne attempted to resolve such discrepancies by postulating that "originally" every motif was part of one tale exclusively, so that motif mix-ups are due to latter borrowings between tales. He thought such borrowings result from corruption due to imperfect oral transmission. The rationale is as follows: Since oral tradition is based on memory, which is intrinsically faulty, new variants of tales become increasingly corrupted. As tellers forget motifs, materials from other stories tiptoe in. Therefore, contamination results from corruption, which is endemic in oral tradition."

Secondly, our understanding of contamination does not consider the usual contraposition between literary and oral fairy tales, where the later are the real, pure, genuine, or uncontaminated fairy tales. In opposition to this, we understand contamination as an evolution of content, which emerges from type interactions independently of the style (oral or literary). Although we are not concerned with the flow direction of style interactions, we believe that literary versions of fairy tales (e.g. Perrault and the Grimms) are based on oral folktales, rather than vice versa. At least this is the case of "Little Red Riding Hood", as found in [32]. Moreover, oral traditions probably originated long before the emergence of the literature record. Indeed, Graça da Silva et al. [33] showed that the tale "The Smith and the Devil" dates back 6000 years to the very beginning of the Bronze Age. Tehrani et al. [32] and Graça da Silva et al. [op. cit.] consider that folktales evolve through similar processes as biological species (such as variation, selection, and inheritance) and, then, they apply phylogenetic analysis to folktales. Data for their study come from the category of "Tales of Magic" (ATU 300 – ATU 749) of the *Aarne-Thompson-Uther Index*. More than finding a tree of evolution for a specific folktale, Graça da Silva et al. [op. cit.] cast light into the question about the origins of the Proto-Indo-European language speakers (suggesting that these people lived at the very beginning of the Bronze Age). However, in the present paper, we focus neither on finding ancestors of

Table 1
Semiotic relations.

Semiotic relation	Meaning	Operator	Type relationship	Trope
Syntagmatic	Connection	And	*complements*	Metonymy
Paradigmatic	Similarity	Or	*analogously replaces*	Metaphor
Meronymic	Unfolding	Part-whole	*unveals elements of*	Synecdoche
Antithetic	Opposition	Not	*is in opposition to*	Irony

specific folktales nor on applying flow-based procedures (such as genetic-based processes) to story generation. In this paper we focus on the task of finding logical mechanisms in type contamination that can work as driving forces of the evolution of storytelling variants.

3.2. Semiotic relations

We propose to study type interactions as a possible factor in the genesis of variants. We shall characterize the interactions that may occur among types, also involving motifs, by way of *semiotic relations*, taking an approach we applied before to the conceptual modeling of both literary genres and business information systems [9,34,35]. We distinguish four kinds of semiotic relations (Table 1), associated with the so-called *four master tropes* [36,37], whose significance has been cogently stressed by a literary theory scholar, Jonathan Culler, who regards them "as a system, indeed *the* system, by which the mind comes to grasp the world conceptually in language" [38, p. 72]. For the ideas and for the nomenclature in Table 1, we are mainly indebted to the pioneering semiotic studies of de Saussure [39].

The next sections illustrate the meaning of each of the four semiotic relations (Table 1), as applied to the derivation of folktale type variants stemming from AT 333.

3.2.1. Syntagmatic relation with type AT 123

As mentioned at the beginning of Section 2, the *Index* describes type **AT 333** as comprising two episodes, namely **Wolf's Feast** and **Rescue**, but the classic Perrault variant does not proceed beyond the end of the first episode. As a consequence, one is led to assume that the **Rescue** episode is not essential to characterize **AT 333**. On the other hand, the situation created by **Wolf's Feast** is a long distance away from the happy-ending that is commonly expected in nursery fairy tales. A continuation in consonance with the **Rescue** episode, exactly as described in the *Index*, is suggested by **AT 123: The Wolf and the Kids**, a type pertaining to the group of **Animal Tales**, which contains the key motif **F913: Victims rescued from swallower's belly**.

The connection (syntagmatic relation) whereby **AT 123** *complements* **AT 333** is explicitly declared in the *Index* by "cf." cross-references [8, p. 50, p. 125]. Moreover the Grimm brothers variant, which has the two episodes, is often put side by side with another story equally collected by them, *The Wolf and the Seven Little Kids* [19], clearly of type **AT 123**.

Still it must be noted that several of the variants reported here do not follow the Grimm pattern in the **Rescue** episode. They diverge with respect to the outcome, which, as seen, may involve the death of the girl, or her rescue after being devoured, or even her being totally preserved from the villain's attempts either by miraculous protection or by her successful ruses.

3.2.2. Paradigmatic relation with type AT 311B∗

For the Grimm variant, as also for those that follow its pattern (e.g. the Italian and the two Portuguese variants in Section 2.2), certain correspondences or analogies can be traced with variants of type **AT 311B**∗: **The Singing Bag**, which is immensely popular in Africa and known outside that continent mainly in Spain and

Brazil (probably by travelling there via slaves, as conjectured by Swart [40]). This type is present in 9 traditions (Central African, Spanish (Catalan), Brazilian, Cuban, Portuguese, Gypsy, Egyptian, Iraqi, Russian), according to the search tool for the geographic distribution of types developed by Artem Kozmin (1976–2013).[4] A striking example of this type is another story collected in Brazil by Cascudo [27], *A Menina dos Brincos de Ouro* (The Girl with Golden Earrings). Here the villain is neither an animal nor a werewolf; he is a very ugly old man, still with a fearsome aspect but no more than human. The golden earrings, a gift from her mother, serve as the girl's characteristic attribute and have a function in the plot. As will be noted in the summary below, the villain's bag becomes the wolf's belly of the Grimm variant, and what is done to the bag mirrors the act of cutting the belly and filling it with stones. In this sense, the **AT 311B**∗ variant *analogously replaces* the Grimm variant.

One day the girl went out to bring water from a fountain. Having removed her earrings to wash herself, she forgot to pick them up before returning. Afraid to be reprimanded by her mother, she walked again to the fountain, where she was caught by the villain and sewed inside a bag. The man intended to use her to make a living. At each house that he visited, he advertised the magic bag, which would sing when he menaced to strike it with his staff. Everywhere people gave him money, until he came inadvertently to the girl's house, where her voice was recognized. He was invited to eat and drink, which he did in excess and fell asleep, whereat the bag was opened to free the girl and then filled with excrement. At the next house visited, the singing bag failed to work; beaten with the staff, it ruptured spilling its contents.

3.2.3. Meronymic relation with type AT 437

In *The Story of Grandmother* by Delarue [21] (Section 2.2 above), the paths taken by the girl and the werewolf to reach the old lady's house are called, respectively, the Path of Needles and the Paths of Pins. And, strangely enough, while walking along her chosen path, the little girl "enjoyed herself picking up needles". At first one might try to classify these needles under motif R135, which covers different objects serving to mark a path, either as a clue to help finding the way, like the white pebbles in the tale of *Hansel and Gretel* [19], or as a lure leading to a trap, like the silver objects resembling fried grains of rice in *A Parrot Called Hiraman* [41]. But none of these explanations is applicable here: on the one hand, the little girl knew perfectly well the way to her grandmother's house, and, on the other hand, the wolf had no need to attract her to a place whereto she was going on her own accord. So, except for this brief and puzzling mention, these objects remain as meaningless details, having no participation in the story. There are variants in which the girl prefers the path of pins instead of the path of needles. For Delaure, these paths of pins and needles are puerile details, which were dropped in Perrault's version for this very reason [42]. But for other authors, the references to needles and pins are explained by the ethnographic context found in small French villages, in which sewing and seamstresses are closely related to women and marriage. In this context, needles seem to signify the sexuality of an older woman or a girl looking for a husband and pins seem to be a symbol of puberty [42,22].

Browsing through the *Index*, we see that needles and pins are often treated as wondrous objects (motifs **D1181: Magic Needle** and **D1182: Magic Pin**). And traversing the *Index* hierarchy upwards, from motifs to types, we find them playing a fundamental role in type **AT 437: The Needle Prince** (also named **The Supplanted Bride**), described as follows [8, p. 140]: "The maiden finds a seemingly dead prince whose body is covered with pins and needles and begins to remove them . . .". Those motifs are thus *expanded* into a full narrative in **AT 437**. Furthermore, through a contamination process, elements of **AT 437** tales can be part of **AT 333** variants. In this case, we can say that AT 437 *unveils elements of* **AT 333**.

Especially relevant to the present discussion is an **AT 437** variant from Afghanistan, entitled *The Seventy-Year-Old Corpse*, reported by Dorson [43], which has several elements in common with "The Story of Grandmother" – although it is a tale full of typical Afghan traditions, such as girls marrying far older men, concubines, and religious references. In this tale, the girl (called "the old man's daughter") lives alone with her old father, who takes her to visit her aunt. We are told that, instead of meeting the aunt, the girl finds a seventy year old corpse covered with needles, destined to revive if someone would pick the needles from his body. The girl is deceived by a concubine, whom the girl naively trusts. The concubine marries the "corpse" and the girl becomes his concubine. At the end, the girl puts herself in an oven, covers the top, tells the whole story to the "corpse", and plans to kill herself. But the "corpse" opens the top of the oven and takes her out. After this, the "corpse" punishes the misleading wife with a terrible death, covers her skull with silver and turns it into a cup to drink water, and marries the old man's daughter. The common elements are many, such as a journey to the home of a relative, needles, deceptive behaviors, sexuality, the victim being saved from a confined space, and a dreadful drinking glass. In this Afghan tale, no further news are heard about the girl's old father, whom she had left waiting for a drink of water in the middle of the desert. One is tempted to say that Bruno Bettelheim, the famous child psychologist, would regard this participation of two old males, the father and the daunting corpse (or, similarly, the wolf and the hunter), as an uncannily explicit confirmation of the presence – in two different forms – of the paternal figure, in an "externalization of overwhelming oedipal feelings, and . . . in his protective and rescuing function" [44, p. 178].

3.2.4. Antithetic relation with type AT 449

In *The Story of Grandmother* we watch the strange scene of the girl eating and drinking from her grandmother's remains, punctuated by the acid comment of a little cat: "A slut is she who eats the flesh and drinks the blood of her grandmother!". The scene has no consequence in the plot, and in fact it is clearly inconsistent with the role of the girl in type **AT 333**. It would sound natural, however, in a type *in opposition to* **AT 333**, such as A**T 449: The Tsar's Dog**, wherein the roles of victim and villain are totally reversed. The female villain of the most often cited variant of type **AT 449**, *The Story of Sidi Nouman* (cf. Andrew Lang's translation in *Arabian Nights Entertainment*), is a person who eats corpses (and, in fact, the type **AT 449** contains the motif **G20**: **Ghouls**). In opposition, the cannibalistic scene in *The Story of Grandmother* has the effect of assimilating the victim girl to a ghoul.

No matter what learned explanation a critic may devise, a ghoulish Little Red Riding Hood surely goes too far beyond the limits of **AT 333**. In this paper, we claim that peculiar variants might result from contamination by an extraneous type, and this appears to be one of those cases. We may risk the hypothesis that the anonymous storyteller, responsible for interpolating this cannibalistic scene, borrowed it as a fragment taken from a totally different story, very likely of type **AT 449**, which was suddenly brought to memory. This hypothesis presupposes that the repertoire of some storytellers might comprehend more than one type of story.

No less intriguing in *The Story of Grandmother* is the subsequent undressing scene, with the villain (a werewolf, as we may recall) telling the girl to destroy each piece of clothing: "Throw it in the fire, my child; you don't need it anymore." This, too, turns out to be inconsequential in the plot, but it was a major concern in the werewolf historical chronicles and fictions of the Middle Ages [45,46]. In 1521, the Inquisitor-General for the diocese of Besançon heard a case involving a certain Pierre Bourget [45]. He confessed under duress that, by smearing his body with a salve given by a demon, he became a wolf, but "the metamorphosis could not take place with him unless he were stark naked". And to recover his form he would "beat a retreat to his clothes, and smear himself again". In another chronicle [45], a man called Gilles Garnier (died in 1573), under the form of a wolf, kills a young girl and, inspired with conjugal affection, brings her flesh home for his wife Apolline. So, did the werewolf in *The Story of Grandmother* intend to transform the girl into a being of his species? Surely the anonymous author did not mean that, but, leaving aside the norms of **AT 333**, the idea would not appear to be so far-fetched.

In line with the werewolf traditions in the Middle Age and also illustrating **AT 449**, there are two medieval lays (short narrative poems) that deserve our attention. They are both about noble knights with the ability to transform themselves into wolves. In the two narratives, they are betrayed by their villainous wives, intent on permanently preventing their resuming the human form. In Marie de France's lay of *Bisclavret* [47] – an old Breton word signifying "werewolf" – the woman accomplishes this effect by stealing from a hiding place the man's clothes, which he needed to put on again to undo the transformation. In the other story, the anonymous lay of *Melion* [48], after a magic ring is applied to break the enchantment, the man feels tempted to punish the woman by inflicting upon her the same metamorphosis.

Another antithetic relation can be found between **AT 333** and its variant **AT 333A**. Although **AT 333A** refers to a specific story "Cattarinetta", it may represent all variants of the Italian "Cattarinetta" tale, including "Uncle Wolf" [23]. Can indeed the Uncle Wolf story, for instance, be classified as a variant of type **AT 333: The Glutton**? The trouble is that here the girl is the first to reveal herself as the "glutton". She does not resist the temptation to eat and drink all that her mother was sending to Uncle Wolf in return for the loan of a skillet, offering him instead an ugly mess composed of donkey manure, dirty water, and lime. He is not deceived and threatens her: "Tonight I'm coming to eat you!". The wolf sneaks into the house, repeatedly announcing where he is at each moment until reaching the girl's room and eating her. This closing episode, in which a supernatural visitor terrorizes the main character with continuously increasing threats, is a frightening ghost-like sequence proper of another type: **AT 366: The Man from the Gallows** (also referred to as "A Corpse Claims Its Property", with several variants found in http://www.pitt.edu/~dash/type0366.html tale). In this paper, we consider "Uncle Wolf" as a variant of **AT 366** and having an antithetic relation with **AT 333**. It is interesting to notice how the "Uncle Wolf" story ends with a weird kind of moral: "So Uncle Wolf always eats greedy little girls"

3.3. An insight into type combinations

In the preceding discussion we purported to show how types can be semiotically related, and argued that such relations constitute a factor to be accounted for in the emergence of variants. We should add that types may be combined in various ways to yield more complex types, whose attractiveness is heightened by the occurrence of unexpected changes. Indeed Aristotle's *Poetics*[5]

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[5] http://www.gutenberg.org/files/1974/1974-h/1974-h.htm.

distinguishes simple and complex plots, characterizing the latter by *recognition* (αναγνορισισ) and *reversal* (περιπειεια). Differently from reversal, recognition does not imply that the world changed, but that the beliefs of the characters about themselves and the current facts were altered.

In particular, could a legitimate folktale promote the union of a monster and a girl? Could we conciliate type **AT 333** (where the werewolf is a villain) with the antithetically related medieval lays of type **AT 449** (where the werewolf is the victim)? Such conciliations of opposites are treated under the topic of *blending* [49], often requiring creative adaptations. A solution is given by type **AT 425C: Beauty and the Beast**. At first the Beast is shown as the villain, claiming the life of the merchant or else of one of his daughters: "Go and see if there's one among them who has enough courage and love for you to sacrifice herself to save your life" [28, p. 159] – but then the Beast proves to be the victim of an enchantment. Later, coming to sense his true inner nature (an event of recognition, as in Aristotle), Belle makes him human again by manifesting her love (motif **D735-1: Disenchanting of animal by being kissed by woman**). So, it is as human beings that they join. Fig. 2 places in contrast naive girl and amorous young lady face-to-face with the monster, reproducing illustrations by Walter Crane (1845–1915).

Alternatively, we might combine **AT 333** and **AT 449** by pursuing, until some sort of outcome emerges, the anomalous passages of *The Story of Grandmother*, and allowing the protagonists to join in a non-human form. The werewolf feeds the girl with human flesh of his victim, expecting that she would transform herself like he did (as *Melion* for a moment thought to cast the curse upon his wife), thereby assuming a shape that she would keep forever once her clothes were destroyed (recall the concern of Pierre Bourget to "beat a retreat to his clothes", and the knight's need to get back his clothes in *Bisclavret*). At the end, the two werewolves would marry and live happily forever after, as a variant of an admittedly misbegotten new type (with, perhaps, a modern appeal, since it would also include among its variants the story of the happy vampires Edward and Bella in the *Twilight Saga*.[6])

4. Exploring ways of composing new stories

New stories often emerge through an adaptation of one or more old stories: this is a most common strategy among even the best professional authors, though surely not easy to trace in its complex ramifications, as eloquently expressed by the late poststructuralist theoretician Barthes [50, p. 39]:

> Any text is a new tissue of past citations. Bits of code, formulae, rhythmic models, fragments of social languages, etc., pass into the text and are redistributed within it, for there is always language before and around the text. Intertextuality, the condition of any text whatsoever, cannot, of course, be reduced to a problem of sources or influences; the intertext is a general field of anonymous formulae whose origin can scarcely ever be located; of unconscious or automatic quotations, given without quotation marks.

A simple way of employing this "reuse strategy" is to follow the paths pointed by the semiotic relations. Suppose that, having looked at variants of type **AT 333**, the author decides to compose a plot on more or less *similar* lines. Then it is expedient to adapt one of those variants, or to look for a variant of some paradigmatically related type, such as **AT 311B∗**.

If the plot has not gone beyond the villainy episode yet, just telling that some monstrous animal swallowed the victim, the author may search for a way to *connect* this episode with a rescue episode.

The syntagmatic relation of **AT 333** with **AT 123** suggests a possible compatible continuation, which can be derived after accessing some **AT 123** variant.

In the folktale classification hierarchy, moving down from a type to the meronymically related motifs allows to present the plot in *detail* (whereas moving up allows *summarization*). To relieve the mother's concern with the risks that the girl may run in her solitary trip to grandmother's house, one may borrow motif **E761: Life-token** which occurs under, among others, type **AT 303: The Twins or Blood-Brothers**. More specifically, looking at *The Gold Children* of the Grimm brothers [19], the author will learn about golden lilies that remain fresh while the child is in health, but will wither or even perish as a warning that this is no longer so. The plot could then be enriched with this detail, to the effect that the child, before leaving, delivers to the mother a flower that fades if she is in danger.

Turning now to antithetic relations, let us look more closely at Aristotle's already mentioned notion of *reversal*, as a characteristic of complex plots, defined by him as "a change by which the action veers round to its *opposite*, subject always to our rule of probability or necessity".[7] Accordingly, having first selected the happy-ending Chinese *Lon Po Po* and the two-part Grimm variant, the author may want to have in continuation some unexpected turn of events. And the inspiration may come from a type in antithetic relation to **AT 333**, such as type **AT 449**, which portrays the monster as victim and the female character as villain. But suppose the author likes the idea of rehabilitating the monster, but is not prepared to treat the nice little girl as villain. Bringing in one more type, say **AT 425C** mentioned at the end of the previous section, a tentative plot might begin to form: (1) the girl is attacked by the wolf and outsmarts him (as in *Lon Po Po*); (2) learns that the (were)wolf is actually a man enchanted by some evil woman (*Bisclavret*); (3) encounters the wolf again (second part of *Little Red Cap* of the Grimm brothers); and (4) by kissing the monster transforms him back into a handsome young prince and they get married and live happily ever after (*The Story of Beauty and the Beast*).

Notice that, to put together fragments from different stories, our imaginary author would have to do several adaptations in order to conciliate conflicting situations. This is the nontrivial *blending* process [49], mentioned in Section 4.2. Thus, the victim of the wolf in (1) and the enchantress that would have earlier operated the cruel metamorphosis in (2) must be different characters. On the contrary, the wolves in (1) and (3) represent one and the same character, to be in turn duly conflated with the werewolf in (2) and with the unspecified monster (the Beast) in (4). But one difficulty still remains: an infant girl getting married? The passage of time comes in as a convenient solution, if it is explained that several years went by between phases (1) and (2). In the meanwhile the girl grew up, and hence she who redeemed and married the prince was at this point a tall young lady – and so, indeed, the paired images of Fig. 2 above end up serving to illustrate this amateurish, hopefully not too contrived, 'multitype' new story.

A thoroughly professional – and modern – antithetic adaptation of the **AT 410: Sleeping Beauty** type gave us the movie misleadingly entitled *Maleficent*,[8] which transgresses the conventions of the fairy tales genre by allowing the witch that lays a curse on the child (motif **F316**) to disenchant her by a (motherly) loving kiss (motif **D735**), after the proverbial Prince Charming's failed attempt. Today, regrettably, genre is too often left aside for pragmatic considerations that have nothing to do with the desire to innovate. The producers of the film *Star Trek Beyond*, so it is reported, having rejected a version of the proposed script as being "a little bit too Star Trek-y",
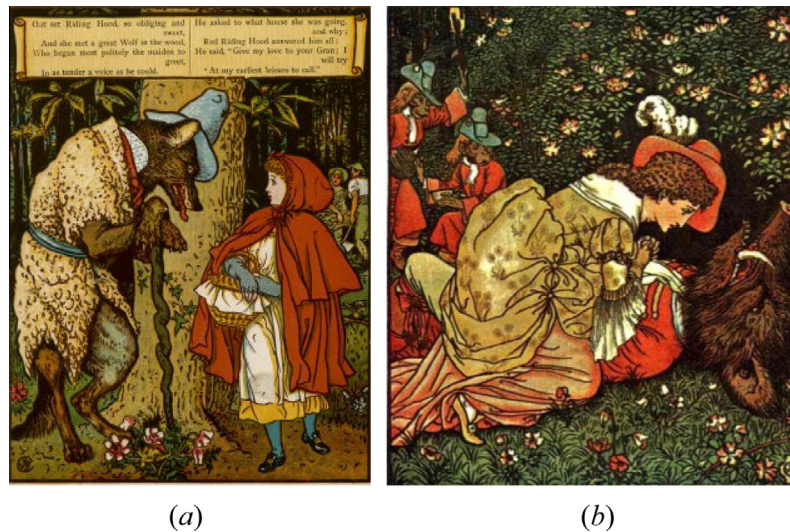

Fig. 2. Monster as a villain in (a) *Petit Chaperon Rouge et le Loup* (illustration by W. Crane, 1875, reproduced under "fair use" and/or public domain policy) and as a victim in (b) *la Belle et la Bête* (illustration by W. Crane, 1901, freely available for scholarly and academic publication under OASC by The Metropolitan Museum, http://www.metmuseum.org/art/collection).

would have asked the writers to "make a western or a thriller or a heist movie, then populate that with Star Trek characters so it's more inclusive to an audience that might be a little bit reticent".[9]

In the present paper we limited our attention to the genre of folktales, as characterized by the *Index*, because of their geographic universality and temporal permanence. However, to conclude this section, it is appropriate to add a brief reference to the use of resources not provided by the *Index*, an aspect of authorship that is *not* in the scope of the paper.

Firstly, it must be recognized that new types and motifs can arise whenever new genres appear. This is the case, for example, of Arthurian romances of chivalry, which flourished in the Middle Ages from the 12th century on, and had their types and motifs duly registered in modern indices [53,54]. Even though the Arthurian genre is traditionally considered to be an outgrowth of heroic folktales, inter-genre borrowings did require adaptations. For instance, to explain the surname of Lancelot (of the Lake), the anonymous authors of the *Lancelot-Grail* cyclic romances tell that soon after his birth he was carried off into a lake by a fairy, who raised him there [56, p. 9]. Living under water is acceptable for protagonists of **Tales of Magic** (**AT 300-749**), as in the lay of *Tydorel* [48], but not for the worthy but no more than human knights of the Round Table, a narrative conflict that was quickly dismissed on page 12 – the lake was an illusion, an enchantment that covered a valley full of splendid houses: "The whole estate was so hidden that no one could ever find it, for the apparent lake so masked it that it could not be seen".

Part, or sometimes the whole, of what is original in a new story can, as claimed in the Barthes quotation at the beginning of this section, simply be the "new tissue" that puts together fragments of "past citations", but obviously true authorship cannot be discounted. Writers of genius can inaugurate a genre, introducing new types, motifs and patterns that eventually become collective property. It can be claimed that detective stories founded on minute observation and deduction originate from the writings of Edgar Allan Poe, as Arthur Conan Doyle, one of his many highly successful followers, generously acknowledged [58, p. 323]: "Each [of Poe's] stories] is a root from which a whole literature has developed . . . .

Where was the detective story until Poe breathed the breath of life into it?". And yet, even when true originality is encountered, plausible links with past stories ought to be cited, in this case with the Persian tale of *The Three Princes of Serendip*[10] (type **AT 655A: The Strayed Camel and the Clever Deductions**, containing motif **J1661.1: Deductions from Observation**), reprised in Voltaire's *Zadig*, which led Horace Walpole to coin the notion of *serendipity*, currently of great interest for the research community.[11]

But everyday life can also be a source of motifs, which become fashionable and may later be ruled out from usage. Taking a synchronic view of culture, Hans Ulrich Gumbrecht surveyed what was current in 1926; about the widespread craze for boxing, he mentioned a few of the [55, p. 45]: ". . . many motifs that surface whenever boxing is treated in newspapers or in literary texts – motifs such as the modern metropolis, crime, ocean liners, drinking, treacherous black companions, and trouncings in early fights". Technology (in reality or in science fiction) is a particularly fertile source of motifs, as when[12] "Bond is implanted with a microchip that helps MI6 keep track of Bond's whereabouts; it also monitors Bond's vital signs which are transmitted back to MI6 for analysis". But here we must beware: this is just one more instance of the ubiquitous **E761: Life-token** motif, mentioned earlier in this section (cell phone signals being yet another less sophisticated instance).

Finally, James Bond himself brings us back to our Little Red Riding Hood guiding example when, in *Thunderball*,[13] in a clear allusion to the time-honoured folktale, the donjuanesque 007 agent poses once more as one of those "gentle wolves" of Perrault's "moralité" (cf. Section 2.1):

Bond: My dear, uncooperative Domino.
Domino: How do you know that? How do you know my friends call me Domino?
Bond: It's on the bracelet on your ankle.
Domino: So. . . what sharp little eyes you've got.
Bond: Wait 'til you get to my teeth.

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9 https://www.theguardian.com/culture/2015/may/19/simon-pegg-criticises-dumbing-down-of-cinema.

10 https://it.wikisource.org/wiki/Peregrinaggio_di_tre_giovani_figliuoli_del_re_di_Serendipp.
11 https://en.wikipedia.org/wiki/Serendipity.
12 https://en.wikipedia.org/wiki/List_of_James_Bond_gadgets.
13 http://www.imdb.com/title/tt0059800/quotes.

5. Exploring variants in computer-generated stories

The previous section explored ways of generating new stories – some ways are simple and others are nontrivial processes leading to complex stories. In this section, we propose a system that easily generates simple stories based on semiotic relations. More complex stories require, especially when the conciliation of conflicting situations is needed, a future extension of the proposed system towards a full-fledged authoring tool.

To build such tool, we plan to utilize several modules already operational as part of our **Logtell** project [3,9]. A critical feature is the ability to check consistency by verifying whether all preconditions of each narrative *event* (cf. this notion in Section 5.1 below) are fulfilled before its occurrence. Indeed, without a module to perform this function automatically, errors can pass unnoticed by visual inspection even in relatively short stories (cf. story 4 in Section 5.3.1).

In fairness, it must be admitted that certain more subtle aspects would not easily be automated. Besides *plot* and *character* as fundamental aspects of narratives, Jonathan Culler adduced the notion of *theme*, signifying [57, p. 224] "the name we give to the forms of unity we can discern in the text or to the ways we succeed in making various codes come together and cohere". In other words, we should be able to discover and express in a few words [57, p. 228–9] "what the work is 'really about'" in a story generated by the tool, similarly to Elsevier's guideline to reviewers,[14] calling them to summarize in a single paragraph what an academic work has to contribute.

Thus a *thematic coherence* requirement must be imposed, to exclude stories composed of loosely knit assortments of events that lack purpose or significance. Also, to be judged acceptable, the theme of the story must contain [57, p. 175] "at least implicitly, potential riches which make it worthy of attention". For this and for any other aspects that seem to resist full automation at the present state of the art, the solution is to resort to *user interaction*, a major asset of the **Logtell** project [3].

The starting point of our development strategy is to explore, in a computer environment, the variants of folktale types, which are kept in a *library of typical plans*. Our system, written in *C#*, does plan-recognition over variants of a given type (e.g. **AT 333**), and is capable of generating new variants by applying the proposed semiotic relations (*connectivity*, *similarity*, *unfolding*, and *opposition*) over related types (e.g. **AT 123**, **AT 311B∗**, **AT 437**, **AT 449**). Plan-recognition involves matching a number of actions against a pre-assembled repertoire of plot patterns (cf. [51,34]).

The *source code* of our system is available at: http://www.icad.puc-rio.br/~logtell/storytelling-variants/.

5.1. Basic definitions

An event is denoted by an atomic formula, which can contain variables (denoted by a string beginning with an upper-case letter, as in Prolog notation), constants, and function symbols. Variables can be replaced by constants (e.g., Grandmother by uncle, Mother by father, and Little Red Cap by john) or even by other variables (e.g. Grandmother by Aunt).

A *plan* is a sequence of *events*, which are consistent with all kinds of restrictions (e.g., temporal), and an *episode* is simple a label.

A *story* is basically a sequence of plans organized by episodes. More precisely, a *story* is a sequence $s = (ep_1, P_1), (ep_2, P_2), \ldots, (ep_m, P_m)$, where ep_i is an episode and P_i is a plan, for each $i \in [1, m]$. For instance, the story "Little Red Cap",

which is a variant of type AT 333 – Little Red Riding Hood, can be defined by the following sequences:

Episode 1: `Wolf's Feast`
　Plan 1: `give(Grandmother, red velvet cap, Little Red Cap), ask_to_take(Mother, Little Red Cap, cake and wine, Grandmother), go(Little Red Cap, the woods), meet(Little Red Cap, Wolf), go(Wolf, house (Grandmother)), eat(Wolf, Grandmother), disguise (Wolf, Grandmother), lay_down(Wolf, bed(Grandmother)), go(Little Red Cap, house (Grandmother)), delivery(Little Red Cap, cake and wine), question (Little Red Cap, Wolf), eat(Wolf, Little Red Cap), sleep(Wolf)`
Episode 2: `Rescue`
　Plan 2: `go(Hunter, house (Grandmother)), cut(Hunter, Wolf, axe), jump_out_of(Little Red Cap, Wolf), jump_out_of(Grandmother, Wolf), die(Wolf)`

In terms of the *Index*, a tale type is a pair $t = (E, V)$, where $E = \{ep_1, ep_2, \ldots, ep_{ne}\}$ is a set of episodes and $V = \{V_1, V_2, \ldots, V_n\}$ is a possibly empty set of stories, called *story variants*. For instance, type AT 333 – Little Red Riding Hood has 2 episodes ("Wolf's Feast" and "Rescue") and may have 3 variants: "Little Red Riding Hood", "Little Red Cap", and "The Story of Grandmother". In this case, we have:

$$V_i = (ep_1, P_1^i), (ep_2, P_2^i), \ldots, (ep_{ne}, P_{ne}^i), \quad i = 1, n$$

Some story variants may have one or more empty episodes (e.g., Perault's variant of AT 333 has the first episode only, while the Grimm brothers' variant has two episodes).

The definition of a story variant is extended to a triple $V_i = (n_i, s_i, a_i)$, where n_i is the *variant name*, s_i is a story, called the *variant story*, and a_i is a set of *actors*, which are quadruples of the form (N, T, A, R), where N is the *actor name*, T is the *actor type* and is either "character" or "object", A is a set of *actor attributes*, and R is a set of *actor roles*. For example, we may define the following story variant:

```
V₂ = (Little Red Cap,
    < (Wolf's Feast, plan1), (Rescue, plan2) >,
    {(Wolf, character, {glutton}, {villain}),
     (Little Red Cap, character, {gentle}, {victim 1 }),
     (Grandmother, character, {}, {victim 2 }),
     (Hunter, character, {}, {hero}),
     (Grandmother's home, object, {}, {feast place})
```

where the Wolf is a glutton villain; Little Red Cap is a gentle victim; Grandmother is a victim; Hunter is a hero; and grandmother's home serves is a feast place.

The *library of typical plans* of a given tale type k is a set $L_k = \{V_1^k, V_2^k, \ldots, V_{n_k}^k\}$, where n_k is the number of variants of tale type k and $V_i^k = (n_i^k, s_i^k, a_i^k)$ is a story variant, for each $i \in [1, n_k]$. For the sake of simplicity, in the rest of this paper, we remove the index k from most of the equations, when the tale type is clear from the context. Moreover, we freely write $L_k^{P_i}$ to denote any instantiated plan extracted from L_k. We tested our prototype with a database consisting of 5 tale types, a maximum of 3 variants per tale type, and a maximum of two episodes in each variant. In the prototype, each library L_k is specified in a separate XML file.

Tale types are associated with motifs through a *library of typical motifs*. Let $M = \{M_1, M_2, \ldots, M_{mt}\}$ be a set of mt motifs, where each motif is defined, in line with the *Index*, by a tuple $M_i = (id_i, n_i, gE_i, tT_i)$, where id_i is the *motif identification*, n_i is the

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motif name, gE_i is a sequence of *generic events* that characterize the occurrence of M_i in a variant, and tT_i is a set of types associated with the motif. For instance, we may define the following a library of typical motifs (we recall that upper-case letters denote variables, i.e., generic "roles, characters, or objects"):

```
M₁ = (D1181 ,"Magic Needle.",
    < pick(Character,needles,Place) >,
    {AT437(TheSupplanted Bride)})
M₂ = (F913 ,"Victims rescued from swallower's belly.",
    < cut(Hero,Villain,Tool),
      jump_out_of(Victim,Villain >) >,
    {AT333(Little Red Riding Hood),
     AT123(The Wolf and the Kids),
     AT450(Little Brother and Little Sister),
     AT700(Tom Thumb),AT 1889(Man Swallowed by Fish)})
```

where in F913, the generic events are a hero cutting the villain's belly with a tool (such as scissors or axe) and the victim escaping from the villain by jumping out of his entrails; `Hero`, `Villain` and `Victim` are actor roles defined as variables, and `needles` is a constant. In our prototype, the library M is specified in a single XML file.

5.2. Plan recognition

Let k be a specific tale type and T be a partial plan expressed as a sequence of events given by the user. The system finds some plans $L_k^{P_i}$ in the library L_k that are consistent with T, using a plan recognition algorithm. During the searching process, the arguments of the events in L_k are instantiated. For example, with the input

$$T = \{give(Anne, ring, Little\ Ring\ Girl), ask\_to\_take$$
$$(Marie, Little\ Ring\ Girl, tea, Anne), eat(Joe, Little\ Ring\ Girl)\}$$

the following stories are generated:

Story 1: give(Anne, ring, Little Ring Girl), ask_to_take(Marie, Little Ring Girl, tea, Anne), go(Little Ring Girl, the woods), meet(Little Ring Girl, Joe), go(Joe, Grandmother's house), eat(Joe, Anne), disguise(Joe, Anne), lay_down(Joe, Grandmother's bed), go(Little Ring Girl, Grandmother's house), delivery(Little Ring Girl, tea), question(Little Ring Girl, Joe), eat(Joe, Little Ring Girl), sleep(Joe), go(Hunter, Grandmother's house), cut(Hunter, Joe, axe), jump_out_of(Little Ring Girl, Joe), jump_out_of(Anne, Joe), die(Joe).

Story 2: give(Anne, ring, Little Ring Girl), ask_to_take(Marie, Little Ring Girl, tea, Anne), go(Little Ring Girl, the woods), meet(Little Ring Girl, Joe), go(Joe, Grandmother's house), eat(Joe, Anne), disguise(Joe, Anne), lay_down(Joe, Grandmother's bed), go(Little Ring Girl, Grandmother's house), lay_down(Little Ring Girl, Grandmother's bed), delivery(Little Ring Girl, tea), question(Little Ring Girl, Joe), eat(Joe, Little Ring Girl).

which correspond, respectively, to the Grimm and Perrault **AT 333** variants, rephrased to display the names of characters and objects given by the user.

Our plan recognition algorithm employs a tree structure, which we call *generalized plan suffix tree*. Based on the *suffix tree* commonly used for string pattern matching [52], this *trie*-like data structure contains all suffixes p_j of each plan in L_k. If a plan $L_k^{P_i}$
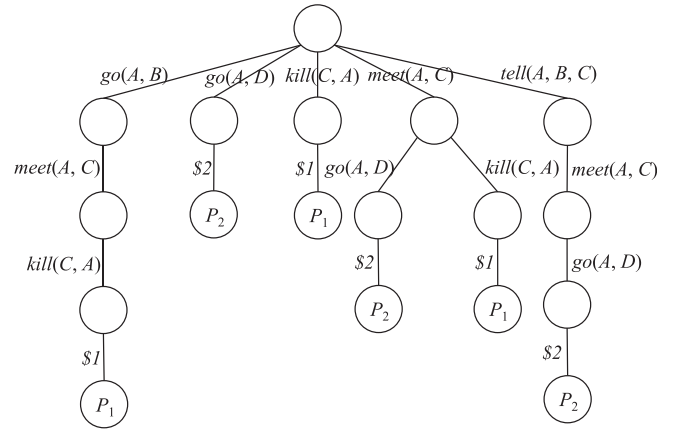

Fig. 3. Generalized plan suffix tree for $P_1 = \{go(A,B),\ meet(A,C),\ kill(C,A)\}$ and $P_2 = \{tell(A,B,C),\ meet(A,C),\ go(A,D)\}$.

has a sequence of events $p = e_1 e_2, \ldots, e_j, \ldots, e_N$, then $p_j = e_j e_{j+1}, \ldots, e_N$ is the suffix of p that starts at position j (we dropped the indexes i and L_k of the expressions p and p_j for the sake of simplicity). In a generalized plan suffix tree S, edges are labeled with the parameterized plan events that belong to each suffix p_j and the leaves point to the complete plans ending in p_j. Each suffix is padded with a terminal symbol $\$i$ that uniquely signals the complete plan in the leaf node. Fig. 3 shows an example of the generalized plan suffix tree generated for the plan sequences $P_1 = \{go(A,B),\ meet(A,C),\ kill(C,A)\}$ and $P_2 = \{tell(A,B,C),\ meet(A,C),\ go(A,D)\}$.

The process of searching for plans that match a given partial plan T, expressed as a sequence of input terms, is straightforward: starting from the root node, the algorithm sequentially matches T against the parameterized plan events on the edges of the tree (obeying the sequential order of the plan but not necessarily containing the full consecutive order), instantiating the event variables and proceeding until all input terms are matched and a leaf node is reached. If more solutions are requested, a *backtracking* procedure tries to find alternative paths matching T. The search process produces a set of complete plans $G = \{g_1, g_2, \ldots\}$, with the event variables instantiated with the values appearing in the input partial plan or, for events not present in the partial plan, with the default values defined in the library. Here, G is a better notation than $L_k^{P_i}$. Also, we denote by $g_i^{L_k}$, the tale type of g_i.

After generating G through plan-recognition, the system tries to apply the semiotic relations (involving *connection*, *similarity*, *unfolding*, and *opposition*) to each complete plan $g_i \in G$ to generate new variants of the same or different types. When instantiating one such variant v_i, the event variables of v_i are instantiated according to the characters and objects that play important roles in the baseline story g_i. Characters playing roles in g_i that also exist in v_i assume the same role in the variant. For roles that only exist in v_i, the user is asked to name the characters who would fulfil such roles.

5.3. Applying semiotic relations

This section illustrates the processes of applying semiotic relations over a library of tale types using the following types and stories: **AT 333** (*Little Red Riding Hood*, *Little Red Cap*, and *The Story of Grandmother*); **AT 123** (*The Wolf and the Seven Young Kids*); **AT 311B∗** (*The Girl with Gold Earrings*); **AT 366** (*Uncle Wolf*); and **AT 437** (*The Seventy-Year-Old Corpse*).

5.3.1. Syntagmatic relation (connection)

The syntagmatic relation is applied when a variant g_i misses at least one of the episodes described by its type $g_i^{L_k}$. The process of

applying the relation consists of finding episodes in variants of the same or different types that could be used to *complement* g_i. We say that a variant c_i is *compatible* with g_i iff: (1) c_i contains the episodes missing from g_i and (2) $g_i^{L_k}$ and $c_i^{L_k}$ have at least one motif M_k in common. The episodes extracted from c_i are introduced in the new variant v_i according to the order of episodes established by $g_i^{L_k}$, using the rules for instantiating event variables previously described.

For example, by applying the syntagmatic relation over Perrault **AT 333** variant (Story 2, mentioned above), the stories below are generated. Notice that Story 4, marked with an asterisk, contains an illegal sub-sequence that initially escaped the present authors' attention,[15] but that a consistency-checking module (cf. the second paragraph of the introductory part of Section 5) would reject: a precondition to any action by a character is that the character must be currently active, whereas a post-condition of being gulped by the villain is that the victim becomes not active.

Story 3: give(Anne, ring, Little Ring Girl), ask_to_take(Marie, Little Ring Girl, tea, Anne), go(Little Ring Girl, the woods), meet(Little Ring Girl, Joe), go(Joe, Grandmother's house), eat(Joe, Anne), disguise(Joe, Anne), lay_down(Joe, Grandmother's bed), go(Little Ring Girl, Grandmother's house), delivery (Little Ring Girl, tea), lay_down(Little Ring Girl, Grandmother's bed), question(Little Ring Girl, Joe), eat(Joe, Little Ring Girl), go(Hunter, Grandmother's house), cut(Hunter, Joe, axe), jump_out_of (Little Ring Girl, Joe), jump_out_of(Anne, Joe), die (Joe).

* Story 4: give(Anne, ring, Little Ring Girl), ask_to_take(Marie, Little Ring Girl, tea, Anne), go (Little Ring Girl, the woods), meet(Little Ring Girl, Joe), go(Joe, Grandmother's house), eat(Joe, Anne), disguise(Joe, Anne), lay_down(Joe, Grandmother's bed), go(Little Ring Girl, Grandmother's house), delivery(Little Ring Girl, tea), lay_down(Little Ring Girl, Grandmother's bed), question(Little Ring Girl, Joe), **eat(Joe, Little Ring Girl), fool(Little Ring Girl, Joe),** go(Little Ring Girl, Mother's house), go(Joe, Mother's house).

Story 5: give(Anne, ring, Little Ring Girl), ask_to_take(Marie, Little Ring Girl, tea, Anne), go(Little Ring Girl, the woods), meet(Little Ring Girl, Joe), go(Joe, Grandmother's house), eat(Joe, Anne), disguise(Joe, Anne), lay_down(Joe, Grandmother's bed), go(Little Ring Girl, Grandmother's house), delivery (Little Ring Girl, tea), lay_down(Little Ring Girl, Grandmother's bed), question(Little Ring Girl, Joe), eat(Joe, Little Ring Girl), go(Marie, Grandmother's house), cut(Marie, Joe, scissors), jump_out_of(Little Ring Girl, Joe), fill_with(Marie, Joe, stones), die(Joe).

All the stories generated by the syntagmatic relation correspond to the Perrault **AT 333** variant complemented with rescue acts extracted from different stories. That is: Story 3 incorporates the rescue act from the Grimm brothers **AT 333** variant; Story 4 includes the rescue act extracted from *The Story of Grandmother* (**AT 333**); and Story 5 is complemented with the rescue act from the *The Wolf and the Seven Young Kids* (**AT 123**).

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[15] We are thankful to one of the reviewers who, having detected the inconsistency, stressed the need to watch for problematic stories, even more so when a considerable number of tale types and variants are utilized in the automatic generation process.

5.3.2. Paradigmatic relation (similarity)

The paradigmatic relation automatically holds between each pair of variants of the same type. That is, they are similar to each other to the extent that they have been classified as belonging to the same type. Here, we extend the characterization of paradigmatic relations to variants of different types. The process of applying the paradigmatic relation over a variant g_i consists of finding variants of different types with a certain degree of *similarity* with g_i. The degree of similarity between g_i and another variant c_i is determined by function $sim(g_i, c_i)$, which computes the sum of the weights of all *similarity factors* ($simf_k(g_i, c_i)$) that hold between the variants:

$$sim(g_i, c_i) = \sum_{k=1}^{n} simf_k(g_i, c_i)^{weight_k}[simf_k(g_i, c_i) = 1]$$

where [.] is the Iverson bracket notation, that is, $[P] = 1$ iff P is true, and 0 otherwise.

For instance, $simf_k(g_i, c_i)$ has $weight_k$ of 0.5 and is true iff: (1) $g_i^{L_k}$ and $c_i^{L_k}$ have at least one motif M_k in common; and (2) both c_i and g_i have a sequence of at least α important events in common (in this paper we call α "degree of commonality"). An event is "important" if it belongs to a set of events that are supposed to have more impact in the stories. This set is specified by the user of the system. In the current version of our prototype, we consider that all the events are important, except the "*go*" events. The constant α determines the number of events that g_i and c_i must have in common, so that $simf_i(g_i, c_i)$ holds between the variants. In addition to the similarity factor based on the sequence of events, several other factors can be used to improve the precision when defining the similarity between two variants, such as the characters' attributes, characters' roles, and objects' functions.

When $sim(g_i, c_i) \geqslant \beta$, then c_i is instantiated as a variant of g_i using the rules for instantiating event variables previously described. The constant β determines the degree of similarity that variants must have to be considered similar, which we call "minimum degree of similarity". The values of the parameters (weights, α, and β) used in the similarity assessment are specified by the user of the system, based on his/her judgment and purposes. In principle, by varying these values, the user can produce different variants. However, we have not tested these values extensively.

By applying the paradigmatic relation over the Grimm brothers **AT 333** variant (Story 1) and considering the minimum degree of similarity $\beta = 0.5$ and the minimum degree of commonality $\alpha = 3$, the following stories are generated:

Story 6: give(Marie, gold earrings, Little Ring Girl), go(Little Ring Girl, Grandmother's house), remove(Little Ring Girl, gold earrings), bathe(Little Ring Girl, Grandmother's house), go(Little Ring Girl, Mother's house), misses(Little Ring Girl, gold earrings), go(Little Ring Girl, Grandmother's house), meet(Little Ring Girl, Joe), grab(Joe, Little Ring Girl), put_in(Joe, Little Ring Girl, sack), go (Joe, village house), ask_to_sing(Joe, sack), sing (Little Ring Girl), receive_money(Joe), go(Joe, Mother's house), recognize_voice(Marie, Little Ring Girl), invite_to_drink(Hunter, Joe), sleep(Joe), cut (Hunter, sack, scissors), jump_out_of(Little Ring Girl, sack), fill_with(Hunter, sack, excrements), wake(Joe), go(Joe, village house), ask_to_sing(Joe, sack), stroke(Joe, sack), fell(Joe, possessed).

Story 7: go(Hunter, the woods), go(Joe, Grandmother's house), knock(Joe, Grandmother's house), go(Joe, Shopkeeper), go(Joe, Grandmother's house), knock (Joe, Grandmother's house), go(Joe, Baker), go(Joe,

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Grandmother's house), knock(Joe, Grandmother's
house), eat(Joe, Little Ring Girl), go(Joe, outside),
lay_down(Joe, tree), sleep(Joe), go(Hunter, Grand-
mother's house), cut(Hunter, Joe, scissors), jum-
p_out_of(Little Ring Girl, Joe), fill_with(Hunter,
Joe, stones), die(Joe).
```

which correspond, respectively, to the story of *The Girl with Gold Earrings* (**AT 311B∗**) and the story of *The Wolf and the Seven Young Kids* (**AT 123**) instantiated with the names of characters and objects used in the initial formulation of the Grimm brothers variant. The stories have been considered paradigmatically related with the Grimm brothers variant because they have a sequence of three important events in common: $Z = \{sleep(villain)$, *cut(hero, X, Y)*, *jump_out_of(victim, X)*}. The **AT 311B∗** variant replaces the wolf and his belly by an ugly man and his bag, the **AT 123** variant follows a storyline very similar to the Grimm brothers variant.

5.3.3. Meronymic relation (unfolding)

The meronymic relation is used to expand parts of stories using plots extracted from variants of different types. The first step to apply this relation over a variant g_i consists of finding a sequence of events $s \in g_i$ that characterizes the occurrence of a motif in g_i that is not directly related to its type $g_i^{L_k}$. In turn, to characterize the occurrence of a given motif M_j in g_i, the sequence of events of M_j must occur in g_i and its parameters must match the characters' roles, constants and variables defined in M_j. The occurrence of this sequence of events in g_i, without the direct relation between $g_i^{L_k}$ and M_j, is an indication that s can be the starting point for a secondary story that will expand s towards the related motif.

Let C be a set of n variants pertaining to types that contain the key motif M_j, i.e., $C = \{C_1, C_2, \ldots, C_n\}$, and let c_i be the sequence m of events derived from C_i (starting from the first occurrence of s in C_i and incorporating all the subsequent events of C_i). The extracted events $c_i = e_1^i, e_2^i, \ldots, e_{m_i}^i$ are introduced in the new variant v_i according to the following conventions: (1) v_i starts with all events of g_i that precede the occurrence of s in g_i; (2) the event e_1^i is inserted in v_i replacing the whole sequence of events $s \in g_i$; and (3) the next events of c_i, that is, $e_2^i, e_3^i, \ldots, e_{m_i}^i$, are introduced in v_i interchangeably with the next events of g_i that do not include interactions with characters related with the events of c_i. By intercalating the events of c_i and g_i, we assume that both storylines are occurring in parallel.

For instance, if the plan recognition algorithm finds *The Story of Grandmother*, the application of the meronymic relation over this story will generate the following variant:

```
Story 8: ask_to_take(Marie, Little Ring Girl, tea,
Anne), go(Little Ring Girl, the crossroad), meet(Lit-
tle Ring Girl, Joe), go(Joe, Grandmother's house),
pick(Little Ring Girl, needles, seventy-year-old
corpse), kill(Joe, Anne), pick(concubine, the last
needle, seventy-year-old corpse), disguise(Joe,
Anne), marry(concubine, seventy-year-old corpse),
lay_down(Joe, Grandmother's bed), go(seventy-year-
old corpse, city), buy(seventy-year-old corpse,
clothes), buy(seventy-year-old corpse, patience
stone), buy(seventy-year-old corpse, black-handled
knife), go(seventy-year-old corpse, fort), give
(seventy-year-old corpse, patience stone, Little
Ring Girl), give(seventy-year-old corpse, black-
handled knife, Little Ring Girl), enter(Little Ring
Girl, oven), open(seventy-year-old corpse, oven,
hands), jump_out_of(Little Ring Girl, oven), marry
(Little Ring Girl, seventy-year-old corpse), go(Lit-
```

```
tle Ring Girl, Grandmother's house), delivery(Little
Ring Girl, tea), eat(Little Ring Girl, Grandmother's
flesh), undress(Little Ring Girl), lay_down(Little
Ring Girl, Grandmother's bed), question(Little Ring
Girl, Joe), fool(Little Ring Girl, Joe), go(Little
Ring Girl, Mother's house), go(Joe, Mother's house).
```

which corresponds to *The Story of Grandmother* (**AT 333**) with the girl's gesture of picking needles expanded to the wider scope of a disenchantment ritual extracted from *The Seventy-Year-Old Corpse* (**AT 437**). The secondary story occurs while the wolf goes to the grandmother's house; that is, there are two stories in parallel. However, temporal issues are not considered in the current version of our system.

5.3.4. Antithetic relation (opposition)

The antithetic relation is used to explore variants of opposite types. The process of applying the relation over a variant g_i consists of finding variants of different types with a certain degree of *opposition* with g_i. We define opposition as a function $opp(g_i, c_i)$, which determines the degree of opposition between g_i and another variant c_i. The function computes the sum of the weights of all *opposition factors* ($oppf_i(g_i, c_i)$) that hold between the variants:

$$opp(g_i, c_i) = \sum_{k=1}^{n} oppf_k(g_i, c_i)^{weight_k}[oppf_k(g_i, c_i) = 1]$$

where [.] is the Iverson bracket notation, as explained before.

For instance, $oppf_k(g_i, c_i)$ has $weight_k$ of 0.7 and is true iff: (1) c_i contains two characters (c_i^{ch1} and c_i^{ch2}) whose attributes (personality and physical characteristics) are similar to the attributes of two other characters of g_i (g_i^{ch1} and g_i^{ch2}) and (2) the characters of c_i have roles inversed with the roles performed by their respective characters of g_i, i.e.: $c_i^{ch1_{role}} = g_i^{ch2_{role}}$ and $c_i^{ch2_{role}} = g_i^{ch1_{role}}$.

If $opp(g_i, c_i) \geqslant \gamma$, then c_i is instantiated as an opposite variant of g_i using the rules for instantiating event variables previously described. The constant γ determines the degree of opposition that variants must have to be considered opposite, which we call "minimum degree of opposition". As in the case of paradigmatic relations, values of the parameters (weights and γ) used in the opposition assessment are specified by the user of the system.

By applying the antithetic relation over the Grimm **AT 333** variants (Story 1) and considering the minimum degree of opposition $\gamma = 0.6$, the following story is generated:

```
Story 9: go(Little Ring Girl, Uncle Wolf's house),
meet(Little Ring Girl, Uncle Wolf), ask(Little Ring
Girl, skillet, Uncle Wolf), give(Uncle Wolf, skillet,
Little Ring Girl), make(Marie, pancakes), ask_to_-
take(Marie, Little Ring Girl, pancakes, Uncle Wolf),
ask_to_take(Marie, Little Ring Girl, bread, Uncle
Wolf), ask_to_take(Marie, Little Ring Girl, wine,
Uncle Wolf), eat(Little Ring Girl, pancakes), eat
(Little Ring Girl, bread), eat(Little Ring Girl,
wine), make(Little Ring Girl, false pancakes), make
(Little Ring Girl, false bread), make(Little Ring
Girl, false wine), give(Little Ring Girl, false pan-
cakes, Uncle Wolf), give(Little Ring Girl, false
bread, Uncle Wolf), give(Little Ring Girl, false wine,
Uncle Wolf), go(Little Ring Girl, Grandmother's
house), go(Uncle Wolf, Grandmother's house), eat
(Uncle Wolf, Little Ring Girl).
```

which correspond to the story of *Uncle Wolf* (**AT 366**) instantiated with the names of characters and objects used in the initial instance of the Grimm brothers' variant. The story has been consid-

ered antithetically related with the Grimm brothers' variant because the girl and the wolf have reversed roles of villain and victim.

6. Concluding remarks

The imagination of storytellers far surpasses what automatic tools can produce at the current state of the art, but there is always a hope that technology can advance by the observation and analysis of human creative processes. Folktales offer a suitable model to begin with, given their amazing fertility in the proliferation of variants, favoring different – sometimes *very* different – perspectives to view what is basically the same story.

In this paper, we explored how variants of a widely disseminated folktale emerged as they were told and retold by successive generations of oral storytellers. Our study is founded on the classification of types and motifs contained in the Index of Aarne and Thompson [8]. The main contribution of the paper is to show that variants are often the consequence of type interactions, which are characterized in terms of semiotic relations expressing, respectively, *connection*, *similarity*, *unfolding*, and *opposition*. We validated the proposed characterization through the development of a computational system capable of generating new variants by applying the semiotic relations over related types.

We expect that our analysis of variants, stimulated by further research efforts in the line of computational narratology, may contribute to the design of new methods for supporting interactive plot composition, to be usefully incorporated into interactive storytelling systems and computer assisted authoring tools. A number of future works are envisaged, such as an extensive analysis of the Aarne-Thompson-Uther Index [13], an investigation of other story genres (e.g. detective stories), a search for computational solutions to conciliate conflicting situations (blending problem [49]), and more general and robust methods to generate stories in the text modality.

Acknowledgements

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