International Journal of User-System Interaction 12(1) 2019, 39-53

Computer-based Story Generation. An Analysis from a Phenomenological Standpoint

Ştefan Trăuşan-Matu[1,2,3]

[1] Universitatea Politehnica din Bucureşti
Splaiul Independenţei nr. 313, Bucureşti,
E-mail: stefan.trausan@cs.pub.ro

[2] Institutul de Cercetări în Inteligenţa Artificială
Calea 13 Septembrie nr. 13, Bucureşti

[3] Academia Oamenilor de Ştiinţă din România
Splaiul Independenţei nr. 54, Bucureşti

Abstract. This paper has a starting point on the idea that we need a phenomenological, post-structuralist perspective for generating realistic narratives with Natural Language Processing techniques. Several classifications of existing Natural Language Generation systems have been proposed. A critical analysis is done of the existing theories and approaches for generating narratives. Requirements of realistic narratives are discussed and ideas of using chronotopes and polyphony for these aims are introduced.

Keywords: story generation, natural language processing, natural language generation, polyphonic model, chronotopes, artificial intelligence, creative writing, phenomenology

1. Introduction

Natural Language Generation (NLG) is one of the most difficult tasks of Natural Language Processing (NLP), being implied in many types of applications. NLG has as outcome various kinds of texts: weather forecasts, sport news, answers to questions, utterances (in instant messengers, fora or social networks), machine translation, extractive summarization, abstracts, and even metaphors, jokes, narratives, and poetry generation. As seen from this enumeration, the types of the generated texts may vary very much, from the rather fixed discourse format of weather forecasts and sports news to creative writing. Consequently, the selection and capabilities of NLP techniques vary dramatically along with these types. This paper aims to analyze some of these differences and to discuss the limits of one of the most

difficult classes of NLG: narratives. Some solutions are also sketched.

In order to bring light on achieving these goals, we propose several classifications of NLG systems. A first classification criterion may identify three categories, starting from *the degree of new, unpredicted information in the generated text*. The first category includes systems that can generate even long texts starting from an existing source: unstructured (text without annotations in, for example, machine translation), semi-structured (annotated texts, for example, in HTML, SGML or XML) or structured (tables, taxonomies or ontologies (Gatt and Krahmer, 2018; Cojocaru and Trausan-Matu, 2015)). These texts may be the result of machine translation, automatic summarization, and generation of short texts for weather forecasts (Gatt and Krahmer, 2018) or sports reports (Robin, 1994; Tanaka-Ishii et al., 1998; Barzilay and Lapata, 2005).

The systems from the second category should be able to generate a sentence or an utterance as an answer to a question, the so-called question-answering systems[1]. The answers are usually generated starting from databases, ontologies or even the whole web. Of course, due to the volume of these resources, which may be very large, the generated answers may be unforeseen (as compared with the first category, where you can read the source and compare it with the result). However, for someone that knows the source of the answer or knows the answers from other sources, there is nothing new in the generated text.

The systems from the third category are those that aim writing narratives or poems, that means texts that are appreciated by humans as including original elements, a result of a creative process.

A second classification starts from *the structuring of discourse* in the generated texts, which may be only a simple, linear discourse, hierarchical discourse structures including also rhetoric schemas (Jurafsky and Martin, 2009), or network structuring including polyphonic weaving (Trausan-Matu, 2013, 2014).

Another classification may be done starting from *the source of the machine-generated text*: lists, records or tables of facts (for example, in weather or sport reports), texts and conversations (for summarization and machine translation), meaning representation languages, ontologies, grammars, complex theories, and the needed but hard to achieve

[1] (http://nlpprogress.com/english/question_answering.html#open-domain-question-answering)

computational creativity (Gatt and Krahmer, 2018; Gervás, 2009).

From *the technological approach*, NLG may use grammars, story schemata, planning, and machine learning.

This paper will focus on the third category of the first and second classifications, that means story generation, emphasizing the utility of considering the polyphonic model of discourse, firstly introduced for chat conversation analysis (Trausan-Matu, 2000; Trausan-Matu, Dascalu, and Rebedea, 2014; Trausan-Matu, Stahl, and Zemel, 2005), and of the chronotopical perspective (Trausan-Matu, 2014), both of them inspired from the writings of Mihail Bakhtin (1981). Aspects of time and spatial information should play a central role in analyzing and generating discourse in natural language processing. However, as we know, there is not yet an integrated space-time-polyphonic approach for NLG. A theoretical framework based on the idea of chronotopes has an important existential component, considering discourse from the perspective of the phenomenology of experiencing life for both readers and writers. The type of chronotope influences the way of perception, thought, action and storytelling. Various elements determine a certain chronotope, for example, the architecture of a city, its organization, the public, and private transport, the landscape, etc., which influence the effect on readers of a story describing actions in that area.

The paper continues by analyzing several narrative generation approaches. Theories, models, and techniques used to generate narratives using natural language processing are considered. The third section discusses some requirements for generating realistic narratives, while in section four, some ideas are proposed for introducing chronotopes and polyphony. The paper ends with conclusions and references.

2. Existing approaches for generating narratives

Research in the development of narrative (story) generation systems has a history of more than five decades, the first one being Klein's Novel Writer reported in 1973 (Gervás, 2009). In general, the developed systems were based on cognitive theories, where various components are identified, such as the purposes of the characters and of the author. Generation was done through planning techniques, story schemata, problem-solving (e.g. case-

based), for example, from storytelling grammars, and recently, using deep neural networks.

2.1. Theories of story generation

Among the theories used by story generation systems, we can mention those of Propp, Genette, Jauss, or Rumelhart. Some sources of inspiration are the literary studies of narratology. Vladimir Propp in his morphology of folk stories (Propp, 1927, 1968), starting from the analysis of a corpus of 100 Russian stories, considered that a story is: "a description of the tale according to its component parts and the relationship of these components to each other and to the whole" (Propp, 1968, p. 19). This vision is related to that of a grammar of stories (Turner, 1994, pp. 1-2), and it can be included in the structuralist paradigm.

Propp took Aristotle's idea that actions have primacy over characters (Gervás et al. 2006):

> "1. Functions of characters serve as stable, constant elements in a tale, independent of how and by whom they are fulfilled. They constitute the fundamental components of a tale.
> 2. The number of functions known to the fairy tale is limited." (Propp, 1968, p. 21, apud Gervás et al. 2006)
> Gervás et al. (2006) write that Propp is mentioned by Bringsjord and

Ferrucci as a forerunner to the stories grammar (Bringsjord and Ferrucci, 2000, p. 154), which they use in the BRUTUS system for knowledge formalization in the style of Thorndyke (1977). Gervás also presents a similar example of such a grammar that was used for stories' summarization by Rumelhart, as mentioned by Gervás et al. (2006).

Bailey (1999) classifies story generation systems into three categories:

- Based on character simulation ("character-centric"). This category includes Tale-Spin (Meehan 1977a, 1977b, 1981) and Virtual Storyteller (Theune et al., 2003);
- focused on the author, for example, the MEXICA system (Perez, 1999; Perez and Sharples, 2001, 2004), which attempts to model the author's thinking during the writing of a story;
- story-based systems, such as Fabulist (Riedl and Young, 2006).

The models used in narrative generation programs can be categorized in several ways. A first classification separates the models into those dedicated to the story, content ("what to say"), and those considering discourse ("how to say").

(1) Story → Setting + Episode
(2) Setting → (State)*
(3) Episode → Event + Reaction
(4) Event → {Episode|Change-of-state|Action|Event + Event}
(5) Reaction → Internal Response + Overt Response
(6) Internal Response → {Emotion|Desire}
(7) Overt Response → {Action|(Attempt)*}
(8) Attempt → Plan + Application
(9) Application → (Preaction)* + Action + Consequence
(10) Preaction → Subgoal + (Attempt)*
(11) Consequence → {Reaction|Event}

Figure 1: Rules of Rumelhart's Story Grammar (Gervás et al., 2006)

Another classification identifies (Gervás et al., 2006):

- Models of the author, trying to model the process in which an author creates a story. Examples of systems in which such modeling is made are MINSTREL (Turner, 1993) and MEXICA (Pérez, 1999; Pérez and Sharples, 2001).
- Models of the story, using an abstract representation of it, for example, a grammar of the story.
- World models, in which story generation is seen as building a world governed by rules and characters with individual goals. The story develops as a result of how the characters are trying to achieve their goals. Tale-Spin (Meehan, 1977a, 1977b, 1981) or Story Generator are examples of such systems (Gervás et al., 2006).

2.2. Narrative generation systems

TALE-SPIN

As Pérez and Sharples (2004) remark, TALE-SPIN (Meehan, 1977) generates text assigning goals to narrative characters and then recording their attempts to achieve goals. This system uses a refinement scheme based on planning (Meehan, 1977), a classic approach in artificial intelligence. However, this predefined structure is rigid. The result is extremely monotonous, for example: "John Bear is hungry, John Bear gets some boobs, John Bear is not the hungry anymore, the end."

MINSTREL

Perez and Sharples (2004) consider MINSTREL (Turner, 1993) as the first system based on an explicit computerized model of creativity. This system generates stories shorter than a page about King Arthur and Round Table Knights. Each of them is based on a moral, such as: "Deception is a weapon difficult to aim." (Gervás, 2013)

MINSTREL is based on Propp's ideas. He uses the aims (of the characters and the author, of the meta-level: theme, drama, consistency, and presentation (Turner, 1994)) and plans for their satisfaction. In addition to action planning, the system also uses a problem-solving based on cases for reuse of knowledge from previous stories (Gervás et al., 2006).

MEXICA

The MEXICA system (Pérez, 1999; Pérez and Sharples, 2001) generates short stories about native inhabitants of Mexico in two phases. In the first phase unrestricted by adding new facts and in the second by "reflection" generic restrictions (Gervás, 2013)). There is also a corpus of previous stories (Gervás et al., 2006).

An original contribution of the system is the consideration of emotional aspects and tensions among the characters (Gervás, 2013), based on a psychological analysis of creative writing, the cycle of cognitive engagement and reflection (Sharples, 1999) which is the justification of the two processing phases above (Gervás et al., 2006). Also, MEXICA is said that it "is programmed to ensure at least P-creativity (in Boden's terms), whereas the

other systems have no guarantee of either P- or H-creativity[2] (results after the first run may stop being novel as very similar stories to initial outputs are obtained).” (Gervás, 2009)

An example of a story generated by MEXICA is as follows:

> “Jaguar knight was an inhabitant of the Great Tenochtitlan. Princess was an inhabitant of the Great Tenochtitlan. Jaguar knight was walking when Ehecatl (god of the wind) blew and an old tree collapsed, injuring badly Jaguar knight. Princess went in search of some medical plants and cured Jaguar knight. As a result, Jaguar knight was very grateful to Princess. Jaguar knight rewarded Princess with some cacauatl (cacao beans) and quetzalli (quetzal) feathers.” (Gervás, 2013)

BRUTUS

The approach used in BRUTUS (Bringsjord and Ferrucci 1999) is to generate short stories of betrayal, starting from a logical model of them. The system can make many inferences and uses knowledge about literature and grammar. Although it has remarkable performance, the authors state that these are not the result of true creativity, the program is in fact obtained by inverse engineering of a story (Gervás, 2013)

3. Requirements for generating narratives

The text generation systems analyzed in the previous section address various aspects of stories such as characters’ and author’s goals, story content, and the world in which the story unfolds. However, the phenomenological perspective of the life experience of the writer and reader, and the effect of the story to the readers is less investigated.

> “word is a two-sided act. It is determined equally by whose word it is and for whom it is meant. As a word, it is precisely the product of the reciprocal relationship between speaker and listener, addresser and addressee”

[2] “Historical creativity (H-creativity) involves the production of ideas that have not appeared before to any one else in all human history. Psychological creativity (P-creativity) involves the production by a given person of ideas that have not occurred before to that particular person.” (Gervás, 2009)

(Voloshinov, 1973, pp.83-86).

Propp's theory follows the structuralist paradigm, to whom Bakhtin's post-structuralism opposes a socio-cultural approach.

> "People participate in a social field that gives form (an ideology) to ideas and attitudes. Bakhtin showed, for instance, that Dostoevsky used several linguistic approaches to the world (heteroglossia) rather than simply one (monologia), and that he offered a plurality of centers of consciousness engaged in a dialog that reflects those various centers' disagreements and disputes." (Polkinghorne, 1988, p. 96).

Narratives may take several forms. There may be short fairy tales for kids, short fairy tales for adults, jokes, shorter or longer (even hundreds of pages) novels. In fact, even NLG of a sport event, weather forecast or a life event in a newspaper includes a simple short narrative. In all these cases the reader, his/her life experience and socio-cultural context are implicitly considered. Narratives are, in fact, the transmission of real or imagined life experiences of a person directed to the understanding of another person.

> "Narrative recognizes the meaningfulness of individual experiences by noting how they function as parts of a whole. Its particular subject matter is human actions and events that affect human beings, which it configures into wholes according to the roles these actions and events play in bringing about a conclusion" (Polkinghorne, 1988, p. 36).

> "The word in language is half someone else's. It becomes 'one's own' only when the speaker populates it with his own intentions, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention." (Bakhtin, 1981, p. 294)

The life experience is characterized by a space-time complex, which is represented in texts by chronotopes (Bakhtin, 1981). Michael Holquist emphasizes that for Bakhtin "time/space are at the heart of knowing" (Holquist, 2009, p. 12). The subject is "the ground zero of perception, the experimental laboratory where understanding is produced" (Holquist, 2009, p. 12). Chronotope is "potentially a unique mix of individual, cultural, and institutional calibrations" (Kent, 2009, p. 78), "an instrument for calibrating

existence" (Holquist, 2009, p. 12).

Moreover, in order to reflect a real-life experience, discourse in the generated narration should have a complex, multithreaded, polyphonic weaving (Bakhtin, 1984), capturing the counterpoint that, as Bakhtin remarked "Everything in life is the counterpoint, that is, opposition" (Bakhtin, 1984). In NLP (and, implicitly, in NLG), discourse is rather seen in a simplistic way, linear or hierarchical (Jurafsky and Martin, 2009). A polyphonic structure might contribute to the veracity of the story, its realistic character, the sensation of living, as exemplified by Bahtin referring to Dostoevsky's novels (Bahtin, 1984). On the other hand, polyphony is closely linked to the chronotopes generated by inter-positioning and inter-animation of voices. The generated text should be both coherent and attractive, having conflicts, dissonances, similarly to the musical case.

Another fundamental feature of our existence is metaphors (Lakoff and Johnson, 1980; Blaga, 1985), which also characterize creative writing (Gatt and Krahmer, 2018). However, their automatic generation is a very difficult task because is related to life experience (Trausan-Matu, 2000).

In developing stories, NLG systems should take also into account that the writer-reader sharing through narratives is facilitated by the collective archetypes (Jung, 1981) and by the archetype structures of the imaginary, which include alterity, double, escape, fight, future, origins, transcendence, and unity (Boia, 2000).

Considering the phenomenological perspective, a major, fundamental difficulty in generating narratives that may be characterized as creative writing is due also to what is called the "Winograd's schema" (Levesque, Davis, and Morgenstern, 2012), which emphasize the lack of NLP systems to handle commonsense reasoning, which includes considering simple space and/or time physical or abstract relations, such as in the following examples:

- "The trophy doesn't fit in the brown suitcase because it's too small. What is too small?

  Answer 0: the trophy
  Answer 1: the suitcase

...

- Joan made sure to thank Susan for all the help she had received. Who

had received the help?

Answer 0: Joan
Answer 1: Susan" (Levesque, Davis, and Morgenstern, 2012)

Starting from the above observations, another classification of text generation systems, apart from those in the second section of this paper, is the one that considers or not the reader's chronotopical, existential, polyphonic space-time dimension of living experience. Most text generation systems consider only time sequences of actions in narratives, speech acts connected in pairs of adjacent conversations, and in some way rhetoric schemata (Mann and Thomson, 1988), which implicitly include time sequences. However, rhetorical schemes may also include aspects that we assimilate to the spatial ones. For example, the antithesis may be viewed, according to the polyphonic model a transversal, a differential model of inter-animation (Trausan-Matu, Stahl, and Sarmiento, 2007), that can be considered from a spatial perspective.

4. Ways of introducing chronotopes and polyphony in the generated texts

4.1. Introducing chronotopes

Inducing chronotopic features requires the explicit or implicit presence of spatiality, in deep conjunction with temporal sequencing. For example, in narrative generation systems, the induction of cronotopes might be done by the explicit description of exploring a route in which some spatial landmarks are identified, some "crossing points" that can indicate the correctness of the path. Transitions from one state (one segment of the road) to another might be described with different durations. Additionally, the rhythm that characterizes the journey might be induced, for example, specific to a walk or a run.

The use of the chronotopic patterns in text generation might take into account ideas from mnemotechnics (Yates, 1966), beginning with the inclusion of landmarks in a mental map containing certain paths, the distances between landmarks and the possibilities to navigate, for example, the means of locomotion, route quality, etc. It might be a good idea to use other textual

descriptions that induce the space sense, for example, symmetries, sizes and relative positioning of objects, etc.

Of course, it is much more difficult to achieve these effects only through text, through mental images, without real images. There are concerns about other researchers, such as Zoran (1984), which distinguishes three levels of spatial structure in texts:

- the topographic level, which makes descriptions (for example, how Balzac describes various architectural configurations);
- chronotopic level;
- the textual level.

4.2. Introducing polyphony

Starting from our discourse model (Trausan-Matu, 2013), the polyphonic feature may be introduced through the co-occurrence of several voices in the extended sense (Trausan-Matu, 2008, 2010, 2013; Trausan-Matu, Dascalu, and Rebedea, 2014), which may be generated by repetitions of words, threads of discussion or ideas, all these entering in a game of inter-animation that is characterized by pairs of divergences-convergences (Trausan-Matu et al., 2007, 2014). Inducing a polyphonic dimension in narrative generation systems might improve the veracity of the resulting stories.

5. Conclusions

Narrativity, stories and, in general, creative language generation is still a difficult task for NLP. The recent successes of using deep learning techniques for NLG (Gatt and Krahmer, 2018; Fan, Lewis, and Dauphin, 2018) do not offer very good results, several major difficulties arise, as discussed in this paper and emphasized also by the requirements discussed by Gatt and Krahmer:

> "analysing both the defining characteristics of narrative, such as plot or character, and more subtle features, such as the handling of time and temporal shifts, focalisation (that is, the ability to convey to the reader that a story is being recounted from a specific point of view), and the interaction of multiple narrative threads, in the form of sub-plots, parallel narratives" (Gatt and Krahmer, 2018)

It should be remarked from the above quote that "the interaction of multiple narrative threads, in the form of sub-plots, parallel narratives" (Gatt and Krahmer, 2018) is exactly the polyphonic phenomenon, which has been emphasized also in this paper as an important feature of a narrative, and of discourse, in general (Trausan-Matu, 2013).

Winograd (1987) remarked that artificial intelligence cannot go beyond the performance of a bureaucrat since it misses empathy. Even if in several AI applications is included a module that tries to behave empathically, this is still either a set of rules designed by some human or learned by machine statistical methods, that means also a sort of bureaucracy. Moreover, another dimension that misses from AI and, in particular, NLG, is real creativity. Gatt and Krahmer have recommended in this sense to integrate into NLG also results of computational creativity (Gatt and Krahmer, 2018). However, real creativity by AI is still out of reach.

The spatial dimensions, and especially the space-time complex, are very important in generating narratives. The polyphonic model and the chronotopical perspectives provide a solid ground to consider the space-time complexity in text generation. In this study, in addition to the critical analysis of existing systems, several ideas have been proposed for the use of polyphony and cronotopes in text generation.

References

Bailey, P. (1999) "Searching for storiness: Story generation from a reader's perspective", *Narrative Intelligence. Papers from the 1999 AAAI Fall Symposium*, pp. 157–163, AAAI Press.

Bakhtin, M.M. (1981) *The Dialogic Imagination: Four Essays*, University of Texas Press.

Bakhtin, M.M. (1984) *Problems of Dostoevsky's Poetics*, University of Minnesota Press.

Barzilay, R. and Lapata, M. (2005) "Collective content selection for concept-to-text generation", In *Proceedings of the conference on Human Language Technology and Empirical Methods in Natural Language Processing*, pp. 331–338. Association for Computational Linguistics.

Blaga, L. (1985) *Trilogia culturii*, Ed. Minerva.

Boia, L. (2000) *Pentru o istorie a imaginarului*, Traducere de Tatiana Mochi, Bucureşti, Editura Humanitas.

Bringsjord, S. and Ferrucci, D.A. (1999). *Artificial Intelligence and Literary Creativity: Inside the Mind of BRUTUS, a Storytelling Machine*. Routlege.

Cojocaru, D.A., Trausan-Matu, S. (2015) "Text Generation Starting from an Ontology", In (Eds.): M. Dardala and T. Rebedea, *Preceedings of the Romanian Conference on Human-Computer Interaction, RoCHI 2015*, pp. 55-60, Ed. MatrixRom.

Fan, A., Lewis, M., and Dauphin, Y. (2018) *Hierarchical Neural Story Generation*, arXiv:1805.04833v1

Gatt, A. and Krahmer, E. J. (2018). "Survey of the State of the Art in Natural language Generation: Core tasks, applications, and evaluation." *Journal of Artificial Intelligence Research*, 61(1), pp. 65-170, AI Access Foundation.

Genette, G. ([1972] 1980). *Narrative Discourse: An Essay in Method*. Cornell University Press.

Gervás, P. (2009). "Computational approaches to storytelling and creativity", *AI Magazine* 30.3, pp. 49–62.

Gervás, P., Lönneker-Rodman, B., Christoph Meister, J., and Federico Peinado (2006). "Narrative Models: Narratology Meets Artificial Intelligence", *Proceedings of the LREC-06 workshop Toward Computational Models of Literary Analysis, Genoa, Italy*.

Gervás, P. (2013) "Story Generator Algorithms", *Peter et al. (eds.) The living handbook of narratology*. Hamburg University Press, http://www.lhn.uni-hamburg.de/, last accessed on 31 July 2019.

Holquist, M. (2009) "The Role of Chronotope in Dialog", *The Second International Interdisciplinary Conference on Perspectives and Limits of Dialogism in Mikhail Bakhtin*, Keynote Address, Stockholm University.

Jung, C. G. (1981), *The Archetypes and The Collective Unconscious, Collected Works, 9 (1) (2 ed.)*, Princeton University Press.

Jurafsky, D. and Martin, J.H. (2009) *Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition*. Prentice-Hall.

Kent, S.J. (2009) Novelizing Simultaneous Interpretation, in *Procs of 2nd Int. Conf. Perspectives and Limits of Dialogism in Mikhail Bakhtin*, pp. 74-86, https://www.academia.edu/9650284/Novelizing_Simultaneous_Interpretation, last accessed on 31 July 2019.

Lakoff, G. and Johnson, M. (1980) *Metaphors We Live by*, The University of Chicago Press.

Levesque, H.J., Davis, E., and Morgenstern, L. (2012) "The Winograd schema challenge", *Proceedings of the Thirteenth International Conference on Principles of Knowledge Representation and Reasoning,* AAAI.

Mann, W.C. and Thompson, S.A. (1988). Rhetorical Structure Theory: Toward a functional theory of text organization. *Text*, 8 (3), pp. 243-281.

Meehan, J.R. (1977a) Tale-Spin, an interactive program that writes stories, *Proceedings of the Fifth International Joint Conference on Artificial Intelligence*, pp. 91–98, Kaufmann.

Meehan, J.R. (1977b). *The Metanovel: writing stories on computer*. PhD Thesis, Department of Computer Science, Yale University.

Meehan, James R. (1981). "Tale-Spin", In R. Schank (ed). *Inside Computer Understanding*, pp. 197–225, Lawrence Erlbaum.

Pérez y Pérez, R. (1999). *MEXICA: A Computer Model of Creativity in Writing*. PhD Dissertation, The University of Sussex.

Pérez y Pérez, R. and Sharples, M. (2001): "MEXICA: A Computer Model of a Cognitive Account of Creative Writing", *Journal of Experimental and Theoretical Artificial Intelligence 13.* pp. 119-139, Taylor & Francis.

Pérez y Pérez, R. and Sharples, M. (2004). "Three Computer-Based Models of Storytelling: BRUTUS, MINSTREL and MEXICA", *Knowledge-Based Systems* 17.1, pp. 15-29, Elsevier.

Polkinghorne, D. (1988) *Narrative Knowing and the Human Sciences*. SUNY Press.

Propp, V. ([1928] 1968, 1988). *Morphology of the Folktale*. 2nd ed., University of Texas Press.

Riedl, M.O. and Young, R.M. (2006). "Story Planning as Exploratory Creativity: Techniques for Expanding the Narrative Search Space", *New Generation Computing*, 24 (3), pp. 303–323, Springer.

Robin, J. (1994) *Revision-based generation of Natural Language Summaries providing historical Background*. Ph.D. thesis, Citeseer.

Sharples, M. (1999) *How we write. Writing as creative design.* Routledge.

Tanaka-Ishii, K., Hasida, K. and Noda, I. (1998) "Reactive content selection in the generation of real-time soccer commentary", *In COLING-ACL*, pp. 1282–1288.

Theune, M., Faas, S., Nijholt, A. and Heylen, D. (2003): "The Virtual Storyteller: Story Creation by Intelligent Agents", In S. Göbel et al. (eds.): *Proceedings TIDSE 2003: Technologies for Interactive Digital Storytelling and Entertainment,* pp.204-215, Fraunhofer IRB Verlag.

Thorndyke, P. W. (1977) "Cognitive Structures in Com-prehension and Memory of Narrative Discourse", *Cognitive Psychology*, 9(1), pp. 77–110, Elsevier.

Trausan-Matu, S. (2000) "Metaphor Processing for Learning Terminology on the Web", in S.A. Cerri (ed.), *Artificial Intelligence, Methodology, Systems, Applications*, pp. 232-241, Springer.

Trausan-Matu, L., Canciu, V.A., Trausan-Matu, S. (2008) "Analiza imaginarului din text", in S. Buraga and I. Juvina (eds.), *Lucrările celei de-a 4-a Conferinta Nationala de Interactiune Om-Calculator – RoCHI 2008*, Bucuresti, pp. 97-104, Ed. MatrixRom.

Trăușan-Matu, S. (2008) "Polifonia colaborării dialogale", in Șt. Trăușan-Matu (ed.), *Interacţiunea conversaţională în sistemele colaborative pe web,* București, pp. 41-57, Ed. MatrixRom.

Trausan-Matu, S. (2010) "The Polyphonic Model of Hybrid and Collaborative Learning", in F. Wang, L., J. Fong., and R. C. Kwan (Eds.), *Handbook of Research on Hybrid Learning Models: Advanced Tools, Technologies, and Applications,* pp. 466–486, Information Science Publishing.

Trausan-Matu, S. (2013) "A Polyphonic Model, Analysis Method and Computer Support

Tools for the Analysis of Socially-Built Discourse", *Romanian Journal of Information Science and Technology* 16(2-3), pp. 144-154.

Trăușan-Matu, S. (2014) "Analiza cronotopica a discursului in texte si conversatii", *Conferinta Nationala de Interactiune Om-Calculator (RoCHI 2014)*, pp. 35-40, Ed. MatrixRom.

Trăușan-Matu, Ș. (2015) "Timp, kairos și cronotop, în inteligența artificială, lingvistică și teologie", in A. Lemeni, A.S. Mihalache (coord.) *Viață și conștiință în orizontul temporalității - Abordare teologică, filosofică şi ştiinţifică*, pp. 179-189, Ed. Basilica.

Trausan-Matu, S., Calinescu, A. (2015) "Compunerea de muzică prin sonificarea conversaţiilor chat conform modelului polifonic"*, Revista Romana de Interactiune Om-Calculator*, 8(1), pp. 33-44, Ed. MatrixRom.

Trausan-Matu, S., Dascalu, M., and Rebedea, T. (2014) "PolyCAFe - automatic support for the polyphonic analysis of CSCL chats". *Int. Journal. of Computer-Supported Collaborative Learning* 9(2), pp. 127-156, Springer.

Trăușan-Matu, Ș., Niculescu, I. (2016) *Studiu asupra ritmicității în limbajul natural,* Raport de cercetare ICIA.

Trausan-Matu, S., Stahl, G., & Sarmiento, J. (2007) "Supporting polyphonic collaborative learning", E-service Journal, 6(1), pp. 58–74, Indiana University Press.

Turner, S.R. (1993). Minstrel: a computer model of creativity and storytelling. Ph.D. Dissertation, University of California at Los Angeles.

Turner, S.R. (1994). The Creative Process: A Computer Model for Storytelling and Creativity. Lawrence Erlbaum.

Voloshinov, V.N. (1973) Marxism and the Philosophy of Language, transl. Ladislav Matejka and R. Titunik, Seminar Press.

Winograd, T. (1987) Thinking machines: Can there be? Are we?, Report No. STAN-CS-87-1161, Stanford University.

Zoran, G. (1984) "Towards a theory of space in narrative", Poetics Today, vol. 5, pp. 309–335.

Yates, F. A. (1966) The Art of Memory. University of Chicago Press.

.