

EVENT MAPPINGS FOR COMPARING FORMAL FRAMEWORKS FOR NARRATIVES

BERNHARD FISSENI and BENEDIKT LÖWE

ABSTRACT

We present a technique called *event mapping* that allows to project text representations into *event lists*, produce an *event table*, and derive quantitative conclusions to compare the text representations. The main application of the technique is the case where two classes of text representations have been collected in two different settings (e.g., as annotations in two different formal frameworks) and we can compare the two classes with respect to their systematic differences in the event table. We illustrate how the technique works by applying it to data collected in two experiments (one using annotations in Vladimir Propp's framework, the other using natural language summaries).

KEYWORDS

Narrative, Events, Formalization, Comparison of representations and representational formats

1. Introduction

This article presents a method of comparing formal representations of narrative in different formal frameworks by extracting the represented event structures. The method is entirely general and can be applied to give comparison data for any two formal frameworks that are largely event-based and produce annotations that allow us to extract a text representation from the annotation.¹ We illustrate the use of our method with empirical data from two experiments.

In [21, 22], Löwe discusses a general formal approach for comparing formal frameworks for the representations of narrative which will render most existing frameworks incomparable in the formal sense defined in [22, §5.1, Case 3]. But in order to make qualitative judgments about formal frameworks and their adequacy for certain purposes, we shall need to compare

¹ The technique could be generalized in order to get rid of the restriction of being event-based as well, by including higher-order concepts; see §5.

even frameworks that are incomparable in this sense, preferably with a tool that is general and does not depend on the concrete nature of the frameworks.

This paper continues the methodological discussion of [22] with a special emphasis on providing such a general comparison tool based on the represented sequence of events. In § 2.2, we discuss the task at hand in the methodological setting of *conceptual modelling*. In § 2.3, we argue that it is adequate to look for the structural narrative core in the sequence of narrated events. We then discuss some of the frameworks from the literature in § 2.4, and show that they all focus on the story as a sequence of events allows us to apply a general comparison method to them.

§ 3 is the heart of this paper: here, we describe an algorithm for constructing an event mapping. Even though we use the word “algorithm”, the method is not fully automatizable and requires a number of modelling choices that depend on the nature of the two frameworks that are being compared as well as the type of questions that the comparison is aiming to answer.

Finally, in § 4, we apply the method of *event mapping* to concrete data from two experiments. The results of this concrete event mapping serve as an illustration of the use of the algorithm and are interesting in their own right.

2. Related Work

To our knowledge, there is hardly any work comparing different formal representations of narrative (cf. [21]). As a consequence, the practical problem that we are dealing with (the comparison of experimental data that is given in two different formats) has not been discussed before. The broader research context is presented in this section, followed by a discussion of some individual formal frameworks for narrative and a discussion of the notion of event.

2.1. Research Context

In this paper, we shall consider *narrative* as a form of storing and transmitting information and discuss tools to access and compare this information. In practice, narratives are presented to us as informal entities: as natural language text in written or recorded form, possibly with visual components (e.g., if the narrative is given to us as a video). Narrative in this format has many aspects or *dimensions*, many of which are not directly related to the purpose of storing and transmitting information. If we consider narratives

as tools to store and transmit information, we typically reduce them to their *story*, i.e., what is the case and what happens in the narrative. *Story* corresponds to Schmid's second level ("*Geschichte*") of narrative constitution [32] and Bal's *fabula* level [4]. We do not claim at all that this level is the only interesting level of analysis of narratives or that the other levels play no role in human narrative processing: in [12, 11], we have argued that the opposite is the case; however, these other levels are beyond the scope of this paper.

The link between narrative and information has been observed by many authors (often in the form of the crucial role that narrative plays for memory) and goes back to antiquity;² Schank even subsumes almost all of human intelligence in narrative when he says "in the end, all we have [...] are stories and methods of finding and using those stories" [31, p. 16]. Thus, a representation of stories in a description language that captures the *structural narrative core* would be a formidable candidate for a measure of narrative information.³

This paper can be seen as part in a sequence of papers [21, 22, 5, 12, 11] that aim at developing tools for constructing such a description language and empirically establishing its adequacy.

2.2. Nomenclature

By the word *narrative*, we are referring to the informal object with all of its features such as a social and cultural embedding, a context of reception, etc.; the narrative is typically given to us as *data*, i.e., a text or a video or a combination of text and images. In our paper, we shall only deal with narratives that are given to us as text. We refer to the formal systems used for representing narratives as *formal frameworks*, the individual representations

² Cf. [29, p. 1]: "Memory is, then, the precondition of narrative, and when it is disturbed or malfunctioning, narratological coherence and efficiency suffer as well. [...] However, the memory-narrative relation is far from unidirectional: just as memory engenders narrative, so is narrative, at times, indispensable for the agility of the faculty of memory."

It is interesting to compare Aristotle's focus on the chronological sequence of events for memory in his *De Memoria* (451b-452a) with our discussion of the sequence of events as constitutive element of narration in §2.3. For an overview of the development of mnemotechnics from antiquity to the renaissance, cf. [37].

³ With a view towards a possible application in narrative information retrieval, Schank elaborates: "What makes us intelligent is our ability to find out what we know when we need to know it. What we actually know is all the stories, experiences, 'facts,' little epithets, points of view, and so on, that we have gathered over the years. [...] We can compare two stories and attempt to find the similarities and differences, or we alter a story to invent a new one for some purpose. [...] In the end, all we have [...] are stories and methods of finding and using those stories. Knowledge, then, is experiences and stories, and intelligence is the apt use of experience and the creation and telling of stories." [31, pp. 15-16]

as *structures*. The process of transforming a narrative into a structure is called *formalization*: the process of formalization produces an *annotation*, i.e., an assignment to parts of the data of the narrative to the parts of the structure that is the result of the formalization.⁴

2.3. *The structural narrative core: events*

Narrative has many interesting dimensions, not all of which are part of what we call the *structural narrative core*.⁵ For the purposes of this paper, we shall say that the structural narrative core of a narrative consist of its sequence of events narrated.⁶

This is not an arbitrary choice: the most common way to separate narrative texts from non-narrative texts is to say that narrative texts are a *description of a sequence of events*.⁷ Genette discusses the meaning of *récit* via its relationship to *événement*:

“[D]ans un premier sens – qui est aujourd’hui, dans l’usage commun, le plus évident et le plus central –, *récit* désigne l’énoncé narratif, le discours oral ou écrit qui assume la relation d’un événement ou d’une série d’événements.” [14, p. 13]

Also, in text linguistics (cf., e.g., [16, pp. 238ff]), *narrative* is used as a label for texts that relate events in temporal order. Gülich and Hausendorf [15, p. 373] go even further and highlights agreement that narration generally involves events or action (“Handlungen, Ereignisse oder Geschehen”), and that “Handlungsträger menschliche oder zumindest belebte Wesen sind bzw. [...] als solche dargestellt werden”.

Defining *event* precisely is not trivial, especially in the context of Natural Language Processing (cf., e.g., the TimeML guidelines [30]). We follow the general definitions in linguistics and narratology in defining an *event* to be a change in the state of affairs.⁸ If nothing changes, there is no event; following established terminology, we call such non-events *states*.

⁴ We point out that the translation of informal objects into something formal is a methodologically difficult task and comes with many philosophical issues; we refer the reader to [9, 33].

⁵ Human test subjects, when prompted for judgments whether stories are similar, seem to focus mostly on superficial features (such as vocabulary, setting, motifs) [12]. Cf. also the discussion of movie reviews in [11].

⁶ Cf. the discussion of higher-order concepts in § 5.

⁷ The relevant OED definition of the word *narrative* is: “[...] 2. a. An account of a series of events, facts, etc., given in order and with the establishing of connections between them; a narration, a story, an account. [...]” [26].

⁸ For narratological discussions of events, cf., e.g., [18, 25]. We focus on what Hühn [17] calls *event I* and omit the notion of “eventfulness” (cf. [18], Hühn’s entry *Event and*

We assume that a story consists of several events happening in order. In general, events can be recursively decomposed into smaller sub-events and summarized in larger super-events.⁹ We do not claim that there is an objective and unique way of representing the story as a sequence of events;¹⁰ consequently, our high-level description language has to be able to deal with variations in the perception of the story as sequence of events.

For the purposes of this paper, we shall assume that the sequence of events narrated is a good and adequate approximation of the structural narrative core of a narrative. In the following section, we'll give a more pragmatic argument for our choice: our focus on sequences of events is matched by the important formal frameworks for narratives.

2.4. Concrete formal frameworks

The *computational models of narrative* community has provided several approaches for formalizing narrative, some of which claim that the formal representations in the framework correspond to an actual cognitive representation of the story in the human mind.¹¹ Most of the frameworks from this community focus either entirely or primarily on structural properties of the stories, ignoring other narrative dimensions.

In the following, we discuss a number of formal frameworks for narratives that have been proposed and discussed in the literature and show that these are largely event-based and that we can distill events in the sense defined above from the representation, and that thus an event-based comparison method should yield reasonable results.

The first and most celebrated formal attempt is Propp's famous system for classifying Russian folktales [28]. In the following, we shall describe Propp's system [27, 28], Lehnert's *Plot Units* [20], and the doxastic preference framework of [23, 24].

Eventfulness) which is a filter applied to single out events worth telling and relevant for narratological structure.

In the linguistic context, the notion of *event* from [36, pp. 328-329] subsuming all dynamic aspects of [35, 34] (*accomplishment*, *achievement* and *activity*) is largely co-extensive with our notion. For instance, *activities* such as reading a scientific article or skipping rope are considered as "constant change", and thus as events.

⁹ Goethe's famous characterization of a novella as "eine sich ereignete unerhörte Begebenheit" (from his conversations with Eckermann, 29 January 1827) is the extreme case of subsuming events into a super-event.

¹⁰ There is evidence against such an assumption, cf., e.g., [8, 19].

¹¹ Cf. [20, pp. 293-294]: "When a person reads a narrative story, an internal representation of that story is constructed in memory. ... [V]ast amounts of information within the memory representation are selectively ignored, in order to produce a distilled version of the original narrative."

These frameworks are vastly different and incomparable in the formal sense of [22].¹² And yet, they all have in common that the most fundamental building blocks of the formal representations are the events of the narrative. In the following, we give brief descriptions of the frameworks.

Propp's Morphology. Working with a corpus of 100 Russian folktales from the collection of *Narodnye Russkie Skazki* by Alexander Afanas'ev (a selection is presented in English in [1]), Vladimir Propp developed a formal system that could describe the structure of each folktale by short annotation strings consisting of symbols representing what Propp calls *functions*.

Propp identified seven¹³ *dramatis personae* representing roles the characters may play within the tales. They are: the hero (**H**), the villain (**V**), the princess (**P**), the princess's father (**PF**), the dispatcher (**Di**), the donor (**Do**), the (magical) helper (**MH**) and the false hero (**FH**) [28, § 3]. Not every *dramatis persona* occurs in each story, not every character represents a *dramatis persona*, and some *dramatis personae* can be represented by the same character.

The actions of the *dramatis personae* are described by a set of thirty-one functions defined in [28, § 3] by means of examples. These functions are marked by symbols in the order of their occurrence in the folktale; the first seven functions, marked with lowercase Greek letters, are called *preliminary functions*: β Absentation; γ Interdiction; δ Violation, ε Reconnaissance, ζ Delivery, η Trickery, θ Complicity. The *preliminary functions* are not fully developed in [28] and are not included in Propp's own annotation strings. The main functions are: **A** Villainy, **a** Lack, **B** Mediation, **C** Beginning counteraction, \uparrow Departure, **D** First function of the Donor, **E** Hero's reaction, **F** Provision or receipt of magical agent, **G** Spatial transference between two kingdoms, **H** Struggle, **J** Branding, **I** Victory, **K** Liquidation, \downarrow Return, **Pr** Pursuit, **Rs** Rescue, **o** Unrecognized Arrival, **L** Unfounded Claims, **M** Difficult Task, **N** Solution, **Q** Recognition, **Ex** Exposure, **T** Transfiguration, **U** Punishment, **W*** Wedding. These functions are illustrated by non-exhaustive [28, p. 25] examples, which also illustrate the abstraction of the function system, e.g., that despite the label, the function Wedding can also refer to a monetary reward (example **w**⁰ [28, p. 64]). Functions occur in strict sequential order, i.e., they have to occur in the folktale in the order they are given in the list above. In the full Proppian system, there are, however, few specific ways to break strict sequentiality [28, § IX.A]: The

¹² In [22, § 5.2], we show that the concept of “expectation of agents” is not expressible in the plot unit framework but in the doxastic preference framework, and vice versa for the concept of “causality”.

¹³ One of these, the *Princess/Princess's Father*, can be split into two with a slightly difficult delineation. Here, we are using the resulting list of eight *dramatis personae*.

most important one is that some folktales contain a series of individual tale units, called *moves*. Examples are *trebling*, the triple repetition of moves within the tale, and moves in which a magical agent is obtained in the first move but only used in the second move of the tale.

Most of the Proppian functions represent events in the sense of §2.3. The only one that does not necessarily (but still often) represent an event in the story is the function *Lack*. However, large spans of the text (and hence: a good part of the events) may go unlabelled in Propp's system, and will then be omitted from the structure.¹⁴

Plot units. In the plot units framework, we represent a narrative as a grid of events. Each *agent* in the narrative is represented by a column in the grid; all events occurring in that column are events affecting that particular agent. There are three types of events: *mental events*, and *positive* and *negative events*; here, “positive” (“negative”) means “positively (negatively) affecting the agent corresponding to the column where the event is listed”. Events in the same column can be linked by *causal links* of which there are four types: motivation, actualization, termination and equivalence. Events in different columns can be linked by *interactive links*. There are a number of rules as to which links are allowed (cf. [20] for details). A list of basic constituents in the form of plot unit structures can then be used to generate more elaborate narratives.

The plot unit structures can now be represented graphically as labelled graphs where +, – and **M** represent the three types of events (positive, negative and mental, respectively), and m, a, t, and e label the causal links as “motivation”, “actualization”, “termination”, and “equivalence”, respectively. In Figure 1, we give an example of a plot unit structure with two agents: we read it from top to bottom, thinking of time flowing downwards; the second agent (right column) has a mental state representing the desire to perform an action of mutual benefit to both agents; this action in turn motivates the first agent (left column) to reciprocate in kind.

The notion of event used here is not identical with the notion of event from §2.3: This formalism only captures such events that have a mental/emotional impact on the agents. Events represented in the narration (such as “the birds are singing”) would only be included if the song affects the agents' emotional or mental state;¹⁵ Lehnert herself notes that she is only concerned with “gross distinctions between ‘positive’ events, ‘negative’

¹⁴ Cf. [7] for examples. This fact was also observed by the authors of [5] as a quantitative outcome of their second experiment, but is not mentioned explicitly in the published paper; cf. also [10].

¹⁵ If one wants to be pedantic, it could even be difficult to deal with clearly relevant events such as the death of one of the agents, as this is strictly speaking not a change of the agent's emotional state.

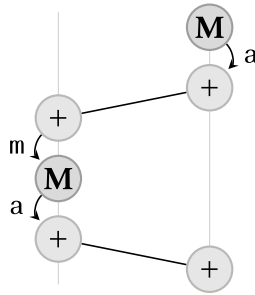


FIGURE 1: An example of a plot unit structure with two agents.

events, and mental events of null or neutral emotionality” [20, p. 294]. In this regard, the selection mechanism for events can be seen as an elaboration of the concept of *eventfulness* (cf. footnote 8).

Doxastic preference framework. The doxastic preference framework [23, 24] considers narratives as game-theoretic (perfect information) decision trees where each node of the tree represents either a decision of one of the agents or an event. The terminal nodes of the tree are the possible *outcomes* of the narrative, and the agents of the story have a preference concerning those outcomes, represented by a linear order of the set of outcomes.

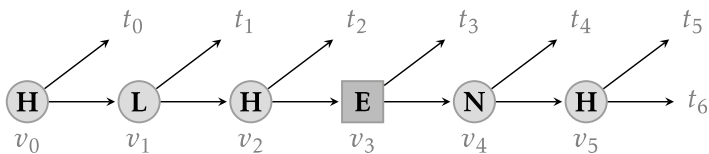
All nodes of the doxastic preference framework fall under our notion of event from §2.3, even though, in the terminology of the framework, there are two types of nodes (*action nodes* and *event nodes*), classified according to whether the change of the state of affairs is caused by a conscious subject or not. The focus of the framework on counterfactual reasoning requires to include a number of fictitious events that never take place in the story.

In addition, we have layers of belief about these preferences: at the first level of these layers, agent **X** has a belief about what he or she thinks is the preference relation of agent **Y** for each point in time (i.e., a node of the decision tree). At the next level, we have the belief about what agent **X** thinks what agent **Y** believes are the preferences of agent **Z** for each point in time.

Formally, this is represented as follows. For each sequence of agents $\vec{\mathbf{P}} = (\mathbf{P}_0, \dots, \mathbf{P}_n)$ of agents, every agent **X**, and every node v of the decision tree, we write

$$S(v, \vec{\mathbf{P}})(\mathbf{X})$$

for “the belief of \mathbf{P}_0 about the belief of \mathbf{P}_1 about ... about the belief of \mathbf{P}_n about the preference of **X** at decision node v ”. If $\vec{\mathbf{P}} = \emptyset$, then $S(v, \emptyset)(\mathbf{X})$ stands for the true preference of agent **X** at node v . We represent preferences as a sequence of terminal nodes, i.e., $t_1 t_2 t_0$ stands for “ t_1 is preferred



$S(v_0, \emptyset)(\mathbf{H}) = (t_3, t_0)$; $S(v_1, \emptyset)(\mathbf{L}) = (t_2, t_1)$; $S(v_1, \mathbf{L})(\mathbf{H}) = (t_2, v_3)$;
 $S(v_1, \emptyset)(\mathbf{H}) = (t_3, t_2)$; $S(v_2, \emptyset)(\mathbf{H}) = (t_3, t_2)$; $S(v_2, \mathbf{H})(\mathbf{E}) = (t_3, v_4)$;
 $S(v_3, \emptyset)(\mathbf{E}) = (v_4, t_3)$; $S(v_4, \emptyset)(\mathbf{N}) = (t_6, t_4)$; $S(v_4, \mathbf{N})(\mathbf{H}) = (t_6, t_5)$;
 $S(v_5, \emptyset)(\mathbf{H}) = (t_6, t_5)$

FIGURE 2: An example of a doxastic preference structure.

over t_2 and t_2 is preferred over t_0 ". If v is a non-terminal node and t is a terminal node, we write (v, t) to mean "all terminal nodes succeeding v are preferred over t ", and similarly for (t, v) . Figure 2 gives an example of a typical doxastic preference structure representing a narrative. Details can be found in [23, 24].

3. Event mapping

In this section, we shall describe the technique of *event mapping* that allows us to compare representations in different formats based on which parts of the structural narrative core they represent. The input for the event mapping is a finite list of *text representations* of the same narrative.

In the case of a formal framework, the process of formalization produces an *annotation* of the narrative data. This annotation is an assignment of parts of the structure that represents the narrative to parts of the next data. In this case, we consider the part of the text data that is linked via the annotation to some part of the formal representation as a *text representation* of the narrative.

Event mapping produces, based on the given list of text representations, a list of events that we shall call the *event table* in which the rows correspond to all events represented in at least one of the representations from the list and the columns correspond to representations from our list. The entries in the table indicate whether the event corresponding to the row is represented in the representation corresponding to the column. We should stress that the result of *event mapping* is highly dependent on the finite list of representations it is produced from: starting with a different list of representations might greatly affect the resulting *event table*.¹⁶

¹⁶ For instance, if a given list of representations produces an event table M , and you add one additional representation to the list producing an event table M' , you cannot assume that

Caveat. The algorithm as it is presented here relies on human judgments and can therefore not be implemented as a computer programme at the moment, as the knowledge resources that would be necessary are not available yet.¹⁷

3.1. *Description of the Algorithm.*

We shall now give a description of the algorithm that produces the *event mapping* from a given list of text representations R_1, \dots, R_n , possibly stemming from different formal frameworks. The algorithm is not deterministic, but involves a number of modelling choices which we shall highlight in the description. In 3.2, we will discuss a simple example story and exemplify the steps of the algorithm.

Let us fix our terminology first: we first construct an *event list* for every representation; these lists are then aligned and structured during a *merging process* that produces the rows of a *table*. The columns of the table will then contain the occurrence information for each of the representations. The event table then constrains the *evaluation phase* (§ 3.3) for the representations, which can be understood as mapping events from these representations to each other. We refer to both the whole process and its result as *event mapping*.

Granularity. Before we start, we must choose a granularity level, defining the level of resolution of the comparison. Possible options would be the level of granularity of the original narrative, the level of granularity of one of the frameworks or the common refinement of the two frameworks to be compared.

Step 1. Initialization. Each representation R_i in our list ($i \leq n$) is translated into an event list L_i . After this step, the differences between the frameworks that produced the individual representations R_1, \dots, R_n have been removed and the created event lists are comparable. Therefore, obviously, the initialization

M' differs from M by just having one extra column (corresponding to the extra list item). Instead, the process of determining the structure of the rows may be affected by the additional list item, resulting in a rather different event table. The procedure should, however, yield the same result for the same input independently of the order in which the input is processed. As our algorithm depends on human judgments about event relationships (super- and sub-eventhood), we can only phrase this as a theorem under an additional assumption that these human judgments always result in the same structure. We exemplify this in § 3.2.

¹⁷ A consequence of this is that we do not separate linguistic processing from formalisation. If the algorithm were implemented in a computer program, it would take as input a representation in which linguistic disambiguation and coreference resolution have already been applied.

step requires the largest amount of human judgment in determining whether an event occurs in the text representation and whether two text fragments refer to the same event (and these judgments may depend on details of the formal frameworks that produced the text representations).

An example for the initialization step: text mapping. For a simple text representation, a list of all occurring events is created from the text by following the linguistic structure of the text as described below. In this example, the choice of sentence predicates in the text representation will indicate what is presented as an event.

To *identify events* and overall the elements to include, we count a sentence or fragment of a sentence as an *event description* if it describes a change of the state of affairs. So, for instance, “Shortly after that, the seven brothers *are orphaned*” is an event description, whereas “Seven *orphans ...*” is not.

Event descriptions can regroup non-contiguous events (e.g., “Every year, Joan published an article.”). For the initialization step, we treat such descriptions as if they were a single event and insert them into the event list at the point where they are mentioned in the text. In the merging step described below, these may be decomposed into constituents.

The decision to base the identification on the grammatical structure of the natural language text is one of the *modelling decisions* that we were referring to earlier. In addition to the events, we decided to include non-events if they were expressed as a full clause, and also references in sentences to states resulting from events in the story description of the original narrative. Again, this was a modelling decision, and one might have considered to include also *state references* of the type “the seven orphans” as a reference to the event of the children’s losing their parents. We decided against this as this would have inflated the number of elements in the mapping beyond measure.

Step 2. List merging. After **Step 1**, we now have an event list L_i for each of the text representations R_i (we call these the *individual event lists*) and merge them recursively into one event list (called the *merged event list*). We start with $M_1 := L_1$ and assume that we have already merged lists L_1, \dots, L_i to a merged list M_i and describe how to merge list L_{i+1} with M_i to produce the new merged list M_{i+1} . For each event e occurring in L_{i+1} , we proceed as follows:

1. If e occurs in M_i , then we just keep it in M_{i+1} .
2. If e does not occur in M_i and no event occurring in M_i is a sub-event or super-event of e , we simply add e to M_{i+1} .
3. Assume that e does not occur in M_i , but M_i contains a related event e' . *Related* means that e' is a sub-event of e or a super-event of e , or that

e' implicates or implies e or any of its super- or sub-events. In this case, we have a number of options:

- (a) *add a hierarchical structure* to M_{i+1} , which indicates that we *unfold* e into sub-events e_1, e_2, e_3 , or subsume e with other events into one *super-event*. We use the following notation for this:

$$e\langle e_1, e_2, e_3 \rangle$$

- (b) sub-events occurring *non-contiguously* in the text are regrouped and reordered into a (*super-*)*sequence of sub-events*. Assume that one of the lists under scrutiny contains (in temporal order) the events e_1, e_2, e_3, e_4 , while the other contains event descriptions $e_{1,3}^*$ and $e_{2,4}^*$, which comprise e_1 and e_3 and e_2 and e_4 , respectively. We want to add this information to our list. As pointed out above, we want to retain the original temporal order; hence we have to use some notation to indicate reordering groups. We use the following notation for this:

$$e_1, e_2, e_3, e_4, e_{1,3}^* \{e_1, e_3\}, e_{2,4}^* \{e_2, e_4\}$$

Note that $e_{1,3}^*$ and $e_{2,4}^*$ are not real events, but rather labels for the text fragments that represent the events e_1 and e_3 or e_2 and e_4 , respectively. Therefore, it does not matter where in the sequence we place them.

For instance, a merged structure after unfolding and reordering might look as follows:

$$e_1\langle e_2, e_3 \rangle, e_4\langle e_5, e_6 \rangle, e_{2,5}^* \{e_2, e_5\}, e_{3,6}^* \{e_3, e_6\}$$

In both cases, the decision to introduce additional structure is a modelling decision. This decision should be made in such a way that the representation stays as close to the original text as possible. In borderline cases, the modeller should avoid introducing additional structure in order to facilitate comparison.

After n merging steps, we have produced the merged list M_n which is the final product of **Step 2**.

As mentioned, a major source of difficulty is the fact that both the original narrative and the natural language text representations could lack direct references to events and instead only have implicit, implied or implicated events (cf. the examples in the next section). The modeller has to justify the modelling decisions by comparing the resulting merged event table with the original narrative.

Step 3. Occurrence Tabulation. **Step 2** produced the merged list M_n which represents the rows of our event table; now, we are populating the

table by entering the data of which of the text representations in our list mentions each given event. We could either mark this on a binary basis (“occurs” vs. “doesn’t occur”), or add some additional information about the form of occurrence. In our applications, we distinguished three levels of occurrence:

- *explicit occurrence*, the “normal” and obvious case (including strict implication and decomposition),
- *implicature* or some other kind of *inferrability*,
- *state references*.

3.2. Illustration of the Algorithm

We now illustrate the basic application of the algorithm and the modelling decisions in two examples.

Hierarchical Structure. The first example illustrates merging with super- and sub-events. It uses the following four simple stories.¹⁸ In the presentation, we already segment the full clauses, to facilitate reference in the event table. The text representations R_1 , R_2 , R_3 , and R_4 are given in (1), (2), (3), and (4) below, respectively.

- (1) a. The king and the queen died,
b. and were buried.
- (2) a. The king died,
b. and then the queen died of grief.
c. Then a great state funeral was held.
- (3) a. After the queen died,
b. a great state funeral was held.
- (4) a. After the state funeral had taken place,
b. the prince got invested.

We generate the following event lists. In doing so, we notice that the sub-clauses (1-b), (2-c), (3-b) and (4-a) refer to the same event, which we designate by “burial b ”. The merging process will give us the opportunity to double-check this decision.

- | | |
|-------------------------------------|---------------------------|
| L_1 | L_3 |
| a. deaths of king and queen (d) | a. death of queen (q) |
| b. burial (b) | b. burial (b) |

¹⁸ These stories were inspired by Forster’s classical examples [13].

L_2

- a. death of king (k)
- b. death of queen (q)
- c. burial (b)

 L_4

- a. burial (b)
- b. investiture (i)

Note that in producing these lists (**Step 1**), we already made a number of modelling decisions, e.g., by dropping the state reference “of grief” from R_2 which is not represented in L_2 .

We now merge the lists L_1 , L_2 , L_3 , and L_4 according to our recursive algorithm. We start with $M_1 := L_1$. With our human judgment, we observe that d (“deaths of king and queen”) is a super-event of both k (“death of king”) and q (“death of queen”), and so the algorithm requires us to unfold d into k and q . During the merging process, we also check the identification of the events made in the initialization step (e.g., in this case whether “[the king and the queen] were buried” and “a great state funeral was held” refer to the same event). Issues that can arise during this check are discussed in §4.5. We obtain

$$M_2 = d \langle k, q \rangle, b.$$

In the next step, we are merging L_3 into M_2 , but all events occurring in L_3 are already in M_2 , so we obtain $M_3 := M_2$. Finally, we are merging L_4 into M_3 and observe that i (“investiture”) has to be added since it did not occur in M_3 . As the final merged list, we obtain

$$M_4 = d \langle k, q \rangle, b, i.$$

The final event table now uses M_4 as the rows and tabulates the occurrences of events in R_1 , R_2 , R_3 , and R_4 in its four columns (Table 1).

Event	Sub-event	(1)	(2)	(3)	(4)
deaths of king and queen d		(1-a)			
	death of king k		(2-a)		
	death of queen q		(2-a)	(2-b)	
state funeral b		(1-b)	(2-c)	(3-b)	(4-a)
investiture i					(4-b)

Table 1: Result of the example merging.

We invite the reader to check that the order of the four text representations does not matter for the final event table: every permutation of the four text representations would have resulted in Table 1.¹⁹

¹⁹ We take this to be evidence for the claim we made in footnote 16.

Regrouping. Our second example concerns *regrouping repetitive sequences*. Consider the examples in (5) and (6). We notice that the events recounted in (6) are those regrouped in (5).

- (5) a. Every year, Joan published an article.
 (6) a. In 1995, Joan published *The Event – a review*. [...]
 b. Joan published *John Smith – an underestimated writer* in 1996. [...]
 c. In 1997, Joan barely managed to finish her annual article.

We obtain the following initial Lists:

- L_5 annual publication (a^*)
 L_6
 a. article 1995 (a_{1995})
 b. article 1996 (a_{1996})
 c. article 1997 (a_{1997})

By merging L_5 and L_6 , we obtain

$$M_6 = a^* \{a_{1995}, a_{1996}, a_{1997}\}, a_{1995}, a_{1996}, a_{1997}.$$

The final event table is shown in table 2.

Event	(5)	(6)
$a^* \{a_{1995}, a_{1996}, a_{1997}\}$	(5)	
a_{1995}		(6-a)
a_{1996}		(6-b)
a_{1997}		(6-c)

Table 2: Event table for (5) and (6).

These examples illustrate the procedure, but an in-depth discussion of finer parts of the algorithm requires real data. We shall therefore resume the discussion in §4.5 with data from the experiment described in §4.3.

3.3. Evaluation

After we produced the *event table*, we can now use it for evaluation and comparison. For a quantitative analysis, we should typically want to derive numerical data from the table by counting occurrences, overlaps and other features. A number of decisions have to be made concerning the counting process.

The following are examples of different counting practices for super-events:

1. We count a super-event only if it occurs.
2. We count a super-event if it or any of its sub-events occur.
3. We count a super-event if it occurs or all relevant sub-events occur (and human judgment is necessary to define what “relevant” means in a given concrete case).

For our example mapping given in § 3.2, this would mean that using counting method 1., *deaths of king and queen* only occurs in R_1 ; using counting method 2., it occurs in R_1 , R_2 , and R_3 ; and using counting method 3. (assuming that both sub-events are relevant), it occurs in R_1 and R_2 .

Similarly for folded events, the following are examples of counting practices:

1. We count e_i as occurring, only if e_i itself occurs.
2. We count e_i as occurring if either e_i itself or some folded event $e^* \{ \dots e_i, \dots \}$ referring to e_i occurs.

To see the difference between these two counting methods, consider the event table given in Table 2: In the first case, a_{1996} would be counted as occurring in (6), while in the second case it would be counted as also occurring in (5).

Finally, we can give different weights to events depending on their type or whether they are mentioned implicitly or explicitly. For example, we could assume that in (4), the *deaths of king and queen* is implied or implicated by the mention of the funeral, and we could decide that this implicature is relatively weak (weight $\frac{1}{2}$) compared to an explicit mention as in the other stories (weight 1).

Evidently, these choices will be motivated by an underlying conceptualization of events, and they have a strong influence on the resulting number with which we measure similarity.

4. Empirical Study: Propp vs. Summaries

In this section, we present an application of the *event mapping* described in § 3 to data obtained in two experiments, labelled **Propp** and **Summaries**. The first experiment asked the test subjects to provide annotations in the Proppian framework (cf. § 2.4), the second one asked test subjects to provide natural language summaries of the same narratives. As mentioned before, the Proppian annotations are assignments of Proppian functions to passages in the text data, and we can see the selection of the annotated text (i.e., the text that the test subject considered to be corresponding to a Proppian function) as a text representation.

Assuming that the natural language summaries are a good candidate for what is naturally included in the structural narrative core, this comparison allows us to make judgments about which parts of Propp's system are natural (or, to be more modest, which parts of Propp's system are considered relevant enough by untrained human subjects to be included in a summary).

A full quantitative analysis of the two experiments was not possible due to the small numbers of test subjects involved (each of the experiments had six test subjects). Instead, we considered whether events and functions occurred reliably reusing a notion of stability used in [5] defined in terms of "a majority of test subjects":

We say that a event (or a Proppian function) occurs *stably* in one of the two experiments if at least four of the six test subjects list it. A given Proppian function can be assigned to different text passages (and even different events) by different annotators: we call a stable function *strongly stable* if there is a text overlap in the assigned text passages of at least four of the six annotators and *weakly stable* if this is not the case.

4.1. Data Labels

We refer to the two experiments by the labels **Propp** and **Summaries**. These experiments are described in detail in §§4.2 and 4.3; in the next paragraph, we give a short overview of the narratives used for the sake of understanding the examples.

The empirical data were all generated using the same narratives as material. We used the folktales *The Seven Semyons*, 147, *Shabarsha*, 151, and *Ivan the Bear's Son*, 152 from Afanas'ev's corpus *Narodnye Russkie Skazki* as also Propp had worked with them; in the following, we refer to these folktales as *Semyons*, *Shabarsha*, and *Ivanko*.²⁰

Data and Labels. In the summary experiment, test subjects were instructed to write summaries of the narratives. All references to data from experiment **Summaries** are labelled as follows:

$$\langle \langle \text{narrative} \rangle \langle \text{test subject} \rangle, \langle \text{sentence} \rangle \rangle.$$

²⁰ We used the translations of Gutermann [1] for *Semyons* and *Ivanko*, and the translation of Cook [2] for *Shabarsha*.

In *Semyons*, seven orphans meet the Tsar and pledge to work hard in their professions. The seventh becomes a thief and, with the help of his brothers and their respective talents, journeys to capture Elena the fair as a bride for the Tsar. In *Ivanko*, Ivanko is born of a peasant woman and her kidnapper, a bear. After returning to human society, he causes some damage and is sent to a lake in which devils dwell. Through a series of tricks, Ivanko gains all of the devils' gold and the services of a little devil for a year. In *Shabarsha*, the protagonist Shabarsha takes a day off to earn some money for himself and his boss. He goes to a lake to catch fish, meets a little devil and threatens to evict all of the devils from the lake if they don't pay rent. Through a series of tricks he acquires all of their wealth.

These labels can be used to find the data in Appendix B; the narratives are abbreviated as *Iv*(anko), *Se*(myons) and *Sh*(abarsha). Some sentences were split into sentence parts, marked by a dot:

- (7) <Iv1,2.1> = *Ivanko* summary of the *first test subject*, second sentence, first part.

In the experiment **Propp**, test subjects assigned Proppian function labels (cf. § 2.4) to concrete passages of text. These assignments are labelled as follows

$\langle \text{function} \rangle : \langle \text{sentence} \rangle > (\langle \text{test subject} \rangle, \langle \text{narrative} \rangle)$

as given in the following example:

- (8) A:<1,2> I:<2,12> L:<3,4,2> P:<3,6> Q:<3,10> S:<8,5>—<8,6>
T:<8,8,1> U:<8,10> (subject 1, *Ivanko*)

4.2. Experiment Propp

The experiment **Propp** is described in detail in [5, § 2.3] where it is called **Propp II**: Six test subjects, all students of the *Universiteit van Amsterdam*, and all with native or near-native competence of English, read the three folktales *Ivanko*, *Semyons*, and *Shabarsha* and produced a list of the Proppian functions occurring in the folktale,²¹ and marked text passages corresponding to each of the functions that occurred.

In the following, we give the experimental results obtained in [5]: Table 3 gives the annotation string produced by the test subjects. In *Ivanko*, β , **I** and \downarrow were strongly stable and \uparrow and **H** were weakly stable (of which \uparrow , **H**, **I** and \downarrow are annotated by Propp); in *Shabarsha*, **a** and \uparrow were strongly stable and **H** and **I** were weakly stable (of which \uparrow , **H**, and **I** were annotated by Propp); in *Semyons*, **a**, **B**, **G**, and **W** were strongly stable and \uparrow and **K** were weakly stable. Note that in both *Ivanko* and *Shabarsha*, there is a strongly stable function not annotated by Propp (**B** and **a**, respectively).

4.3. Experiment Summaries

A summary of a text is an account “containing ... the chief points or the ... substance of the matter” (OED 1989, *summary*, *adj.*), i.e., a “distilled version of the original” [20, p. 294]. What the *chief points* or the *substance of*

²¹ For Propp’s formal system, cf. 2.4, *Propp’s Morphology*.

		Ivanko									
Test subject		Proppian Functions									
Propp		A		↑	H	I	K	↓			
1	β	a		↑	G	H	I	K	↓		
2	$\beta\gamma$			↑						M	N
3	β	B		↑	H	I					U
4	β			↑	H	I		↓			U
5	β	a	B	↑	H	I		↓			
6	β	a	B	↑	H	I	K	↓			W

		Semyons									
Test subject		Proppian Functions									
1		a	B	↑	G	K					W
2	β	a	B	↑		K	↓				W
3	β	a	B		G					o	N
4	η	a		↑	G			Pr			W
5		a	B	↑		K	↓	Pr	Rs		W
6	β	a	B	C	↑	G	K	↓	Pr	Rs	W

		Shabarsha									
Test subject		Proppian Functions									
Propp		A	B	C	↑	H	I	K	↓		
1		a				H	I	K			N
2		a	B		↑					M	N
3		a		C	↑	H	I			M	U
4		a			↑	H	I			M	N
5		a			↑	H		K			
6		a	B	C		H	I	K			W

Table 3: The annotation strings for the three folktales in **Propp**. Preliminary functions are separated from the others by a bar.

the matter are depends on the task and the context, and thus writing summaries is not a natural but an acquired skill. This skill features prominently in reading and writing education and is used frequently in everyday communication about narratives, even though there is no unique definition of what constitutes a good summary.²² Summaries are also a text type that has

²² As an example for quality measures, consider the *Writing Framework for the 2011 National Assessment of Educational Progress* of the National Assessment Governing Board of the U.S. Department of Education (pp. 10-11). Cf. also the discussion of the differences

been extensively studied as a measure of adequacy of story understanding systems [3]. In this study, we assumed that our test subjects have the general ability to construct adequate summaries. We were not concerned with the quality of the summaries of our test subjects.

Experimental setup. The experiment was conducted with six students of the *Universität Hamburg*; they all had native or near-native competence of German. The text data were German translations of the Russian folktales used in the experiment **Propp**.

Test subjects were given a sheet of instructions which was not only provided in written form, but also read aloud by a native speaker of German. The instructions highlighted that the story should be *recognizable* from the summary and that it should not give comments on style or order of events. No example of a summary was given, and similarly no precise algorithm was given how to determine the important facts to mention in the summary, nor even to focus on events. Test subjects were instructed to use “simple sentences”; and examples of simple sentences were provided containing at most one level of subordination or coordination (cf. Appendix A for the part of the instructions given to the test subjects that describe summaries).

Test subjects were then given $2\frac{1}{2}$ hours to read the folktales and write the summaries, and were given a modest financial compensation.

Results. The complete summaries in the original German without any corrections can be found in Appendix B. In the following, we give an overview of the recurring features of the summaries:

In *Semyons*, test subjects agree least about which details to include in their summary. However, all agree to mention some events before the theft, in particular meeting the Tsar, presenting their plans what trade to learn and the test cases (four test subjects each). All agree in naming *Theft* and *Reward*, and all except one mention the *Wedding* of Tsar and Princess. The fact that a trick was performed is only mentioned by four.

In *Ivanko* and *Shabarsha*, test subjects agree on the central events: All mention some event leading up to the competition between the hero and the little devil (Ivanko’s blunders and assignment to go to the lake; Shabarsha’s fishing plans or presence at the lake). The competitions are always mentioned, so is receiving the gold. The trickery is only mentioned by four (one test subject fails to mention trickery in all three tales). The final trick to obtain the gold is completely omitted in *Ivanko* summaries but mentioned by four for *Shabarsha*.

in “holistic encoding” (*holistische Kodierung*) of texts between Germany and the United States in [6, pp. 38-39].

The narratives *Semyons* and *Shabarsha* ended with a narrator’s commentary (which was quite surreal in the case of *Shabarsha*). Only very few test subjects mention these commentaries in their summaries.

4.4. The Event Tables based on the experimental data

For each of the three narratives, we followed the description of the algorithm in § 3, applied to the six summaries. We chose the granularity of the **Summaries** as the level of comparison.²³ This means that we have not subdivided events occurring in the summaries unless necessary for merging event lists, even if they occur in a more fine-grained version in the original narrative. After doing the event mapping with the six summaries, we enriched the table by including the data from the **Propp** experiment: in two cases, we had to add events because they were annotated by test subjects in the **Propp** experiment.²⁴ We tested the reproducibility of our event mapping by having it repeated independently: the differences were relatively small.²⁵ Figures 3, 4 and 5 show the event mappings for *Ivanko*, *Semyons* and *Shabarsha*, respectively. Columns S1 to S6 correspond to the six test subjects in the **Summaries** experiment and columns P1 to P6 correspond to the six test subjects in **Propp**.

–	for deficient or incomplete descriptions, for mistakes or errors,
§	for anonymous super-events,
{...}	for non-event (situation descriptions),
{{...}}	for state references,
G:	for event groups,
BG:	for explicitly stated background assumptions,
*	for events occurring only in Propp, and
#	for auxiliary events only occurring in the summaries.
j ...!	marks that an event was unfolded from an event group.

TABLE 4: List of annotations used in the event tables.

²³ The original text data was also a natural language text (albeit with much more detail than the summaries), and one could have considered including it as one of the text representations in the list. We did not do this in our construction of event tables: the rather different level of granularity of the text data from the other representations would have made the event table much larger without any real benefit for the comparison task.

²⁴ Cf. § 4.5.2, *To Unfold or Not to Unfold? The Devil in the Details*, for a discussion of the interesting case; the less interesting case concerned the reaction of the stolen princess’s father in the *Semyons*, which were omitted in all of the summaries and hence had to be introduced in the merging process.

²⁵ Main differences were a lack of alignment of the introduction of sub-events and super-events, esp. where the super-events were not instantiated. This means that all counts that do not count sub-events for super-events are unaffected.

Event	Sub-Event	Sub-Sub-Event	TS1	TS2	TS3	TS4	TS5	TS6	PII 1	PII 2	PII 3	PII 4	PII 5	PII 6
{Peasant and Wife}			1		1a									
§	Goes to Forest							(1a)		[β]				[β]
	Got Lost							1a	[β]					
	Cave		2				1	1a			[β]			
	BG:Meet the Bear					1a		(1b)				[β]		
Kidnapping				1b		2a	1b						[β]	
BG:Siring					1b									
Birth			2		1c	(1b)	2b	2a						
{Half-bear}				1	3	{ {4} }		2b						
Naming					2	{ {4} }								
Flight							3a	3a						
Return			3		3	2a	3b	3b						
Reception (by peasant)						2b	4							
Chores, Mistake, Damage	G: Chores		4a	3a	3a	4	5a							
	G: Mistake		4b	3b	3b	4	5b							
	G: Damage			4?										
	Sheep	Chores (sheep)				4					[γ]			
		Mistake (sheep)				5								
		Damage (sheep)		4	5			6						
	Meat	Chores (meat)				6								
		Mistake (meat)				7a								
		Damage (meat)		4	7c									
		*Discovery (meat)									[a]			
{Desperation} = Contemplation				{2}								[a]	[a]	
{Sea with devils}				6			{ (7b) }							
Idea			5a,6b		4b									
Assignment		5	5b	8	4a	5,6a	7	[1]	[1]	[B]	[1]	[B]	[B]	
Journey									[G]		[1]	[1]	[1]	
Winding														
Meet the Devil				7a	9a	5a	6b							
§	Threat						7			[H]				
	= Demand Rent		6a	7b										
Grandfather Assignment							8a							
Competition	G: Competition Challenge		6b	8		5b†	8b							
	G: Devil's Turn		(6b)	(8)			(8)							
	G: Trick					6b	9	8 ⁻						
	G: Success			9a		6a	9							
	Run	- Challenge Run	i6b!	i8!		i5b†!	i8b!					[H]		
		- Trick Run	7a				i(8)!							
		- Devil's Turn Run	i(6b)!	i(8)!		i6b!	i9!				[H]			
		- Success Run	7b	i9a!		i6a!	i9!							
		Throw	- Challenge Throw	i6b!	i8!		i5b†!	i8b!					[H]	
	- Devil's Turn Throw		i(6b)!	i(8)!		i(8)!								[H]
	- Trick Throw		8a			i6b!	i9!							
	- Success Throw		8b	i9a!		i6a!	i9!							
	Horse	- Challenge Horse	i6b!	i8!		i5b†!	i8b!			[M]		[H]		[H]
		- Devil's Turn Horse	9	i(8)!		i(8)!								
		- Trick Horse	9a			i6b!	i9!						[1]	
		- Success Horse	9b	i9a!		i6a!	i9!							[1]
	Devil Gives Up				9b				[1]	[N]	[1]	[1]		[1]
	*Pricing											[1]		
*Devil Fetches Gold								[K]						
*Hat Trick										[U]				
Gold Received		10a	10	9b	7a	10	9				[U]			
*Labourer				9c	7b		10							
*Loads Cart										[W]				
*Takes Home									[1]		[U]	[1]	[1]	[K]
*Speaks														[1]
§	Gold → Father		10b			8	11	11						
	Labourer → Father			11		8	11	11						[W]

FIGURE 3: Synoptic annotations of *Ivanko* from **Summaries** and **Propp** (cf. Table 4 for explanation of labels).

Event	SubEvents	TS1	TS2	TS3	TS4	TS5	TS 6	PII 1	PII 2	PII 3	PII 4	PII 5	PII 6
§	{Childless}						1	[a]					
	Prayer						1						
§	Birth						2.1						
	{Name}	1.2	{ {1} }	{ {1.1} }	{ {1} }		2.2						
BG: Live in Tsar's Kingdom					1								
Orphaned		1.1	{ {1} }	{ {1.1} }			3.1		[β]	[β]			[β]
Field work			2			1	3.2						[a]
§	{Tsar wants kids}			2.1†									
	Meet the Tsar		(3)	2.2	(1.2)	1	4						[a]
	{Admiration Tsar}		3										
Adoption		1.1	I:3	D:1,5†		2	I:4						
Ask for Edu Plans					1.2		5						
Edu Plans	Edu Plans Others		5.2	3.1	2.1		6.1						
	Edu Plans Thief		6.1	3.2	2.2	3.1	6.2						
Reproach / Threat			6.2	4	3								
Education		2				2							
Skill Presentation:					4		7						
	Pillar & Ship		4										
	Discovering Helena				4.3								
	Thief: attempt				5.1								
Nearly executed				4	5.2	3.2							
Offer					6.1	4.1	8						[B]
*Enamoured w/Elena									[a]	[a]	[a]	[a]	
*Decision										[B]			
Permission/Assignment		3,A	7=P	6=A	(6)			[B]	[B/†]	[B]		[†]	[B] [C]
*Loading													[†]
Departure	Journey			7.1			9	[†]					
	Arrival							[G]		[G]	[G]	[†]	[G]
Theft		D:3	D:7?		7.1								
	Trick	4	8		7.1		10						
	*Disguise									[o]		[n]	
	*Kitten Gift												
	*Boarding												[K] [K]
	Help	5				5			[K]				[†] [K]
Success	(5)	(8)	7.2	(7)	5	(10)							
*Water Settling													[†]
*Sad Kingdom													[Pr]
*Pursuit											[Pr]	[Pr]	[Pr]
*Failure												[Rs]	[Rs]
Return			{9}	(7.2)			10		[†]	[N]			
§	{Gift to Tsar}	5		7	7.2	(4-6)		[K]					
	{Tsar's Pleasure}	6	"Dank"?	8			11						
Reward		6	9	8	7.3	6.2	(11?)	[W]		[W]		[W]	[W]
Wedding		6	10	9		6.1	12		[W]		[W]		
Feast			10				12						
{Epilog}		7											

FIGURE 4: Synoptic annotations of *Semyons* from **Summaries** and **Propp** (cf. Table 4 for explanation of labels).

Event	Sub-Event	Sub-Sub-Event	S1	S2	S3	S4	S5	S6	P1	P2	P3	P4	P5	P6
Hire himself out					{1}	{1}		{1}						
*Master's Contemplation									[a]	[a]	[a]	[a/1]	[a]	[a]
{Help Intention}			1	1	1		1							
Free Day						1					[C]			[B]
§	Pond		2a	2b	2a	3a	1a	2a		[B/1]		[a/1]	[1]	
	Fishing Plan		2b	2a	2b	2		2b						[C]
BG: {Devils in the Lake}			2c											
Twine							1b							
Meet the Devil					3+	3b								
	Jump			3a				3		[H]				
	Ask			3b			2a							
Threat			3b			3c	2b	4						[C]
Protest			{4?}	4	1:4	4?								
Demand Rent† = Demand Cap Filled (later!) / Plan Soliloquy			3a†				3b	5+						
Talk to Grandfather (= Grandfather)							3a	6a						
Assignment by Grandfather							4b							
G: Competition, consisting of: challenge, trick, success					5		4a							
	G: Overall Challenge			4a	i5!	4	4b	7a						[H]
	G: Overall Trick						5a	5b	7,8a					
	G: Overall Success			5	6a	5b	5a	7,8b						
Shabarsha superior	Wrestling	Challenge	4	i4a!		i4!		i:6b						
		Trick	5a+		i5!	i5a!	i5b!							
		Success	5b	i5!	i6a!	i5b!	i5a!							
	Running	Challenge		i4a!	i5!			i7a!						
		Trick	6a			i5a!	i5b!	i7,8a!						
		Success	6b		i6a!	i5b!	i5a!	i7,8a!						
	Whistling	Challenge		i4a!	i5!			i7a!			[H]		[H]	
		Trick	7a			i5a!	i5b!	i7,8a!			[H/1]		[H]	
		Success	7b		i6a!	i5b!	i5a!	i7,8a!			[1]			
	Throwing	Challenge		i4a!	i5!			i7a!		[M]	[M]	[M]	[H]	
		Trick	8b			i5a!	i5b!	i7,8a!					[N]	
		Success	8a		i6a!	i5b!	i5a!	i7,8a!		[N]			[N]	
	additional detail: near-loss of cudgel			6								[1]	[K]	[1]
	Intervention Grandfather			7			6		[1]		[U]		[K]	[1]
	Demand for Gold (by Shabarsha) †					5c†								
	Gold Received			9a	8	7	6	7b						
Filling Cap					6b			9	[K]	[W]	[U]			
Last Chest/Finish				(8)							[W]			[K]
Gold Trick#			9b		8		7a	10						
{Rich}			10a	9		6	8a	12+	[N]		[W]		[W]	
{Mead bitter}			10b				8b							

FIGURE 5: Synoptic annotations of *Shabarsha* from **Summaries** and **Propp** (cf. Table 4 for explanation of labels).

4.5. Merging Redux

In this subsection, we use examples from the experiments to illustrate finer points of *event mapping*. This section resumes the discussion of the decisions involved in executing the algorithm from § 3.2, using the construction of the event mapping for the data from the experiment **Summaries** as an example.

Data which is suitable for the application of the algorithm cannot be generated easily *in abstracto*, so that the data used here should be taken as an example of data to which the algorithm can be applied. The algorithm is by no means restricted to them.

4.5.1. *Constructing Super-Events and Unfolding*

If different text representations contain different levels of granularity of a given event, the modeller will need to make decisions about the sub-event structure in the event list. In general, containment relations between events are not trivial, and involve issues of implication, implicatures and unclear event boundaries.

Example for different granularity: Fishing plan. We introduced (sometimes anonymous) super-events in case that we felt that a certain event was mentioned *pars pro toto*, or that events form a unit in the original narrative. For instance, we used the label *fishing plan* to refer to the event “Shabarsha decides to go fishing with the intention to earn money to support his master”. This event essentially coincides in the narrative with “Shabarsha goes to the pond” and the fishing plan motivates the latter event. One summary omits the fishing plan and only lists the latter event. We decided to consider these two events as two sub-events of an unlabelled super-event in our event mapping.

4.5.2. *Regrouping Repetitive Sequences: challenges and tasks.*

Repetitive sub-events are often combined in the summaries: in *Shabarsha*, there are four competitions, each consisting of a challenge, a trick and the success); in *Ivanko*, both the mistakes made and the competitions with the devil occur in several forms. As discussed above, reordering super-events are not really events, but they are treated as such in the summaries. As we decided to follow the textual structure relatively closely, we retain this structure, and later add a significant amount of structure information. Without this structure information, a comparison to the **Propp** data would not have been possible.

An example of such a regrouping is the following:

- (9) a. <Iv5,8.1> Vom Großvater beauftragt <Iv5,8.2> geht der Teufel mehrere Wettkämpfe mit dem Sohn ein.
- b. <Iv5,9> Der Sohn überlistet den Teufel jedes mal.

To Unfold or Not to Unfold? The Devil in the Details. In the **Propp** experiment, one test subject consistently marked challenge passages and passages corresponding to the devil’s turn in *Ivanko* (but not in *Shabarsha*),

and we would like to represent this in our comparison. However, consider the following **Summary** data:

- (10) a. <Iv1,6.1> Dort fordert Ivanko von einem Teufel eine Pacht <Iv1,6.2> und dieser ihn zu Wettkämpfen heraus.
 b. <Iv2,9.1> Da der Teufel jede Wette verliert, <Iv2,9.2> gibt er anschließend klein bei.
 c. <Iv3,9.1> Dort trifft er einen Teufel, <Iv3,9.2> von dem er einen Hut mit Gold und ihn selber ein Jahr als Knecht gewinnt.

We notice that in (10-a), we can infer that there were several competitions (“Wettkämpfe”), but in (10-b), the test subject confuses *Wettkampf* (*competition*) with *Wette* (*bet*). Strictly speaking, the word *Wette* does not allow us to infer that each of the contestants has a turn. In (10-c), we cannot infer that competitions take place at all. Counting all of our summaries, we get two inferrable, one questionable (10-b) and three non-inferrable cases for *Ivanko*. For *Shabarsha*, the devil’s turn is always inferrable in **Summary** data (if you read “Wette” as “Wettkampf”, again); however, here we do not need to unfold the devil’s turn events because there is no similar annotation in the **Propp** data which necessitates this unfolding.

4.5.3. *Decomposing a Trick: Success*

We give an example of an event that occurs in all summaries, but could be seen as an artifact of our method. We labelled this event as *success*. In *Ivanko* and *Shabarsha*, *success* refers to the protagonist’s victories over the devil(s), in *Semyons*, it refers to the success in getting Elena. This event is expressed in quite different forms in the various summaries, but in each summary it is at least implicated. We decided to count it as a separate event in order to compare it with the Propp annotations (where the Proppian function **I** (*Victory*) triggered the annotation). Consider the following examples:

- (11) a. <Sh1,5> Schabarscha ist dem Teufel überlegen und gewinnt jede vorgeschlagene Wette.
 b. <Sh6,7> Bei jeder Aufgabe trickst Schabarscha den Seeteufel aus.

In the first example, only the challenges and the victory are mentioned, but in the second, the trick is focused, and *austricksen* entails success of the trick. Therefore the challenge episodes are segmented into three sub-events: *challenge*, *trick*, and *success*. Yet *success* is also mentioned explicitly in similar cases (cf. next paragraph, (12)), so that the separation as an event in its own right is justifiable.

4.5.4. *Implicit and Implicated Events*

In the *Semyons*, the following is the description of the return of the brothers: “[...] and soon [the ship] came to the shores of the Semyons native land. The tsar was overjoyed; he had not even dreamed of ever receiving Elena the Fair in his own house.” Note that in the original text, there is no explicit mention of the fact that Elena is actually delivered to the Tsar, but since the task was to steal Elena and the Tsar was “overjoyed”, it is implicated that Elena has been delivered. In contrast, this event is explicitly present in some of the summaries:

- (12) a. <Se1,5> Seine Brüder helfen ihm und bringen sie zum Zaren.
 b. <Se3,7.2> und schaffen es sie zum Zar zu bringen.
 c. <Se4,7.2> schenken sie dem Zaren.

We decided to separate the state {*Tsar’s Pleasure*} from the event *Gift to Tsar*: they are ontologically different, but belong to a common super-event and occur simultaneously.

Implicature/Inference and Event Conflation. When measuring what information of the original narrative (in terms of events) is contained in the summaries, we find that certain events are only implicated; consider the following examples:

- (13) a. <Se2,3> Der Zar bewundert den Fleiß der Kinder und will ihr Vater werden.
 b. <Se1,3> Später sollen sie, unter Anführung des Diebes-Simeon, die Prinzessin Helene stehlen.

Example (13-a) does not explicitly say that the Tsar indeed adopts the children, but is close to the original narrative where the Tsar utters the sentence “I will be your father.” This utterance only expresses a wish or commitment, not its fulfillment, but (uttered by the Tsar) can be seen as a performative formula that also executes the action. The successful adoption is later presupposed in the narrative by showing that the Tsar listens to the children’s plans and dismisses them “having bound the Semyons as apprentices”.

In (13-b), the obligation to steal is reported, but we understand this to also report the event of *Permission/Assignment* to steal the princess. As there is no negation of the fact, this also implicates that they accept the assignment and are going to (try to) steal Elena, which is reported in the next sentence. In our application, there was nothing to be gained by adding these additional implicated events, and so we decided to understand *Permission/Assignment* to include the acceptance. This differs from the Tsar’s order to

execute the first Semyon, which is later cancelled by the *Permission/Assignment* to steal Elena.

Implicature, Non-Occurring Events and TimeML. As we are concerned with processing events in texts, one might consider an annotation language like TimeML [30] to be close to our goals. Yet the two approaches are quite different: our event mapping follows the text quite closely, but does not link the lists directly to the original text, thus alleviating some of the difficulties of annotation. In particular, our method differs from TimeML annotations in the treatment of events that are reported or are assigned a modality or aspectual information, because our event lists only contain events that are real (within the story).

We need not treat what TimeML calls *REPORTING_VERBS* or *I[ntentional]_STATES*, since we only check whether descriptions perform, presuppose or conversationally (and hence defeasibly) implicate the reported or intended action. In our approach, we would just add reported events to the event list in the order they happened (not in the order they were told); however, our three narratives did not have examples of this. We have examples of intentions stated but not carried out, e.g., the execution of the seventh Semyon which we didn't add to the event list by a modelling decision.

4.6. *Application of the method of Event mapping to the two experiments*

To show that the event-based comparison can deliver interesting results, we focus on some qualitative examples of differences in the following: storylines omitted from function assignment, *stable events*, some (strongly) *stable functions* from the **Propp** data that are not present in the summaries, and an example of a *stable passage* which we find in all Propp annotations but in no summary.

Framework Difference: Density. Summary descriptions tend to be very dense, making use of certain implicatures (cf. the examples in §4.5). Since the Propp annotations refer to actual passages of the original text, this type of density cannot occur here. Rather, a reverse effect to density occurs in the Propp annotations: test subjects have a tendency to mark relatively long stretches of text as pertaining to one Proppian function. We have many assignments of Proppian functions to text that mark several lines of text; three of these assignments annotate text that adds up to more than 25 lines, thus considerably more text than the summaries, but still only a small fragment of the entire text of the folktale. These long text passages correspond to several events, thus creating a mismatch between the functions and the listed events. This is interesting because it means that a function cannot

always be subsumed under one event, even though Propp’s system would suggest that this is intended.²⁶

Focus on the main storyline. In both frameworks, test subjects tend to agree to concentrate on the main storyline: Both *Ivanko* and the *Semyons* have a prelude storyline that leads up to the central story line of the competition with the devil (*Ivanko*) and the theft of the princess (*Semyons*). Such a prelude does not fit Propp’s system as used in our experiment. Consequently, we find very few annotations in the part of the text corresponding to the prelude storylines.²⁷ As mentioned, *Shabarsha* and *Semyons* also have a final narrator’s commentary; this is listed by only one summary and no Proppian annotation for the *Semyons* and by three summaries and three Proppian annotations for *Shabarsha*.

The missing representations of the prelude and the coda are an example of framework bias for the Propp annotations, but the fact that the summaries reproduce the Propp results in not representing these parts of the narrative can be seen as an argument that this particular framework bias is natural.

Similia contrariis annotantur. We observe that in the Propp annotations, similar events are sometimes assigned to different Proppian functions. E.g., in *Shabarsha*, we consider the four challenges (*Wrestling*, *Running*, *Whistling*, and *Throwing*) and their sub-events *Challenge*, *Trick*, and *Success* as largely parallel. However, in the some of the annotations, the Proppian functions **H**, **I**, **M**, and **N** are assigned parts of the text corresponding to these events.

Story	Summary	Propp	Common
Semyons	10 / 17	5 / 7	2 / 3
Shabarsha	17 / 24	5 / 9	1 / 5
Ivanko	16 / 24	9 / 12	3 / 6

TABLE 5: Stable events for the three stories; giving the minimal count (counting only events) / maximal count (counting all sub-events, states, state references)

Stable Events. As mentioned in § 3.3, there are several counting methods that we could have used. In the following, we used the minimal and the

²⁶ Cf. the following quote: “Function is understood as an act of a character, defined from the point of view of its significance for the course of action.” ([28, p. 21], original emphasis)

²⁷ Exceptions to this are annotations of the functions *Absentation* or *Lack* to the preludes. The correctness of these with respect to Propp’s system is questionable, as the prelude storyline (at least in the case of *Ivanko*) does not involve the *dramatis personae*.

maximal counting method. The minimal count ignores states and state references and does not count sub-events; the maximal count includes all sub-events, states and state references. The minimal and maximal counts of *stable* events are given in Table 5.²⁸

There is only a very small overlap in the stable events between the two experiments. In the minimal count, the following are the events that are stable in both the **Propp** and the **Summaries** data: *Shabarsha* goes to the pond (one common stable event); the *Semyons* get the assignment to bring Helena and are rewarded in the end (two common stable events); and *Ivanko* is assigned the task to go to the lake, and challenged to do a horse-carrying contest which he wins (three common stable events).

Stable functions as a framework bias. In *Semyons*, four Propp annotators agree that the Tsar's love for Elena constitutes a *Lack* (*strongly stable function*), while none of the summaries mentions this condition. Similarly so for the *Lack* that affects *Shabarsha*'s master right at the beginning of the story, which is, however, not mentioned in any summary. We interpret this as a framework bias: the function *Lack* plays an important role in the Proppian framework (since it acts as a motivation for other functions), and so Proppian annotators are likely to include it in their representation. The fact that this is not explicitly mentioned in the summaries indicates that it is a genuine framework bias that does not have a direct natural correspondence.

5. Conclusion and future work

We presented the method of *Event Mapping* and applied it to a concrete case to illustrate the procedure. In the application, our aim was to find out whether a formal framework tends to annotate the events deemed relevant by untrained readers, and our method of event mapping produced an adequate and useful comparison tool. The comparison allowed us to identify phenomena that are due to a bias in the framework, as well as judgments whether some instances of such framework biases are natural (in the sense discussed in §4). A similar comparison could be done with other event-based frameworks, comparing them to each other or to natural language summaries.

In order to use the technique of event mapping for more general narratives, a number of modifications would be necessary:

More flexible chronology. The table structure does not allow for breaking the chronological order (with the exception of event merging) or simultaneous

²⁸ Figures for any other counting variant can easily be produced by the reader using the event tables in Figures 3, 4, and 5.

events. A generalization of the technique in this direction will help us to treat more complex narratives.

Higher-order concepts. Our current technique focusses solely on the events themselves and not on the relations between events (e.g., that one event is the motivation for another one). In more complex narratives, the inclusion of these higher-order concepts would be necessary.

Acknowledgements

The research in this paper was funded by the *John Templeton Foundation* (JTF) via the project *What makes stories similar?* (20565) and the *Nederlandse Organisatie voor Wetenschappelijk Onderzoek* (NWO) via the projects *Integrating Cognition* in the VICI programme (DN 277-70-006) and *Dialogical Foundations of Semantics* in the ESF EuroCoRes programme LogICCC (LogICCC-FP004; DN 231-80-002; CN 2008/08314/GW). Parts of the paper go back to the academic year 2010/11, when the second author was a fellow of the *Vlaams Academisch Centrum* at the Royal Flemish Academy of Belgium; other parts were written while the authors were fellows of the *Isaac Newton Institute for Mathematical Sciences* (programme *Semantics & Syntax*). The authors wish to thank the Rens Bod and Aadil Kurji for giving permission to use the data of the experiment **Propp** from [5] in this paper. In the experiment **Summaries** as described in §4.3, the authors were assisted by Alexander Block, Carlos León, and Deniz Sarikaya. Mira Viehstädt helped by repeating the event mapping of §4.4, as mentioned there. The method of event mapping was discussed at the *AG Digitalisierung und Formalisierung von Erzählstruktur* of the *Sommerakademie Salem* (Studienstiftung des deutschen Volkes) in August 2013, and we should like to thank the student participants for their feedback.

References

- [1] Aleksandr NIKOLAYEVICH AFANAS'EV. *Russian fairy tales*. Pantheon, New York, 2nd edition, 1973. Translation by Norbert Guterman from the collections of Aleksandr Afanas'ev. Folkloristic commentary by Roman Jakobson.
- [2] Aleksandr NIKOLAYEVICH AFANAS'EV. Shabarsha, translated by Kathleen Cook. In *The Three Kingdoms. Russian Fairy Tales From Alexander Afanasiev's Collection, illustrated by Alexander Kurkin*. Raduga Publisher, Moscow, 1985.
- [3] Richard ALTERMAN. Understanding and summarization. *Artificial Intelligence Review*, 5:239-254, 1991.
- [4] Mieke BAL. *Narratology. Introduction to the Theory of Narrative*. University of Toronto Press, Toronto, 3rd edition, 2009.

- [5] Rens BOD, Bernhard FISSENI, Aadil KURJI, and Benedikt LÖWE. Objectivity and reproducibility of Proppian narrative annotations. In Mark A. Finlayson, editor, *The Third Workshop on Computational Models of Narrative*, pages 17-21, Istanbul, 2012.
- [6] Albert BREMERICH-VOS and Miriam POSSMAYER. Zur Reliabilität eines Modells der Entwicklung von Textkompetenz im Grundschulalter. *Didaktik Deutsch*, 31:30-49, 2011.
- [7] Claude BREMOND and Jean VERRIER. Afanassiev et Propp. *Littérature*, 45(1):61-78, 1982.
- [8] Mary CARROLL and Christiane VON STUTTERHEIM. Event representation, time event relations, and clause structure: a crosslinguistic study of english and german. In Jürgen Bohnemeyer and Eric Pedersen, editors, *Event representation in language and cognition*, pages 68-83. University Press, Cambridge (UK), 2011.
- [9] Catarina DUTILH NOVAES. *Formal Languages in Logic. A Philosophical and Cognitive Analysis*. Cambridge University Press, 2012.
- [10] Bernhard FISSENI, Aadil KURJI, and Benedikt LÖWE. Annotating with Propp's *Morphology of the Folktale*: Reproducibility and trainability, submitted.
- [11] Bernhard FISSENI, Aadil KURJI, Deniz SARIKAYA, and Mira VIEHSTÄDT. Story comparisons: Evidence from film reviews. In Mark A. Finlayson, Bernhard Fisseni, Benedikt Löwe, and Jan Christoph Meister, editors, *2013 Workshop on Computational Models of Narrative*, volume 32 of *Open Access Series in Informatics (OASIs)*, pages 94-99, Dagstuhl, Germany, 2013. Schloss Dagstuhl – Leibniz-Zentrum für Informatik.
- [12] Bernhard FISSENI and Benedikt LÖWE. Which dimensions of narratives are relevant for human judgments of story equivalence? In Mark A. Finlayson, editor, *The Third Workshop on Computational Models of Narrative*, pages 114-118, Istanbul, 2012.
- [13] Edward MORGAN FORSTER. *Aspects of the Novel*. Arnold, 1927.
- [14] Gérard Genette. *Discours du récit*. Points, Paris, [1972/1983] 2007.
- [15] Elisabeth GÜLICH and Heiko HAUSENDORF (2000). "Vertextungsmuster Narration". In *Text- und Gesprächslinguistik: Ein internationales Handbuch zeitgenössischer Forschung. 1. Halbband*, pages 369-385. de Gruyter, Berlin, New York, 2000.
- [16] Wolfgang HEINEMANN and Dieter VIEHWEGER. *Textlinguistik*. Niemeyer, Tübingen, 1991.
- [17] Peter HÜHN. Event and eventfulness. In Hühn et al. [18].
- [18] Peter HÜHN, Jan Christoph MEISTER, Wilhelm SCHERNUS, John PIER, Wolf SCHMID, and Jörg SCHÖNERT, editors. *The Living Handbook of Narratology*. Hamburg University Press.
- [19] Monique LAMBERT, Mary CARROLL, and Christiane VON STUTTERHEIM. Acquisition en L2 des principes d'organisation de récits spécifiques aux langues. *Acquisition et interaction en langue étrangère*, 26:5-10, 2008.
- [20] Wendy G. LEHNERT. Plot units and narrative summarization. *Cognitive Science*, 5(4):293-331, 1981.
- [21] Benedikt LÖWE. Comparing formal frameworks of narrative structures. In Mark Finlayson, editor, *Computational models of narrative. Papers from the 2010 AAAI Fall Symposium*, volume FS-10-04 of *AAAI Technical Reports*, pages 45-46, 2010.

- [22] Benedikt LÖWE. Methodological remarks about comparing formal frameworks for narratives. In Patrick Allo and Giuseppe Primiero, editors, *Third Workshop in the Philosophy of Information, Contactforum van de Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten*, pages 10-28, Brussel, 2011. KVAB.
- [23] Benedikt LÖWE and Eric PACUIT. An abstract approach to reasoning about games with mistaken and changing beliefs. *Australasian Journal of Logic*, 6:162-181, 2008.
- [24] Benedikt LÖWE, Eric PACUIT, and Sanchit SARAF. Identifying the structure of a narrative via an agent-based logic of preferences and beliefs: Formalizations of episodes from CSI: Crime Scene Investigation™. In Michael DuVigneau and Daniel Moldt, editors, *Proceedings of the Fifth International Workshop on Modelling of Objects, Components and Agents. MOCA'09, FBI-HH-B-290/09*, pages 45-63, 2009.
- [25] Jan-Christoph MEISTER and Silke LAHN. *Einführung in die Erzähltextanalyse*. Metzler, Stuttgart, 2008.
- [26] *OED: Oxford English dictionary: the definitive record of the English language*. Oxford University Press, Oxford, 2010.
- [27] Vladimir YAKOVLEVICH PROPP. *Morfologiya skazki*. Akademiya, Leningrad, 1st edition, 1928.
- [28] Vladimir YAKOVLEVICH PROPP. *Morphology of the folktale*. University of Texas Press, Austin, Texas, 2nd edition, 1958. English translation of [27].
- [29] Itay SAPIR. Narrative, memory and the crisis of mimesis: The case of Adam Elsheimer and Giordano Bruno. In Matti Hyvärinen, Anu Korhonen, and Juri Mykkänen, editors, *The Travelling Concept of Narrative Studies across Disciplines in the Humanities and Social Sciences 1*, pages 84-96. Helsinki Collegium for Advanced Studies, 2006.
- [30] Roser SAURI, Jessica LITTMAN, Bob KNIPPEN, Robert GAIZAUSKAS, Andrea SETZER, and James PUSTEJOVSKY. TimeML annotation guidelines, version 1.2.1. Technical report, TimeML Working Group, 2005.
- [31] Roger C. SCHANK. *Tell Me a Story: Narrative and Intelligence*. Northwestern University Press, Evanston, 1990.
- [32] Wolf SCHMID. *Elemente der Narratologie*. de Gruyter, Berlin, 2nd edition, 2008.
- [33] Fenner TANSWELL. Proof and prejudice: Why formalising doesn't make you a formalist, 2012. M.Sc. thesis, Universiteit van Amsterdam, ILLC Publications MoL-2012-07.
- [34] Robert D. VAN VALIN and Randy J. LAPOLLA. *Syntax. Structure, meaning and function*. Cambridge University Press, Cambridge, 1997.
- [35] Zeno VENDLER. Verbs and times. *Philosophical Review*, 56:143-160, 1957.
- [36] Christiane VON STUTTERHEIM. Makrostrukturelle Planungsprozesse in Erzählungen. *Zeitschrift für germanistische Linguistik*, 32:325-356, 2004.
- [37] Frances A. YATES. *The Art of Memory*. Routledge & Kegan Paul, London, 1977.

A. Original instructions given to the test subjects for the experiment *Summaries*

Sie sollen in diesem Experiment Zusammenfassungen von Geschichten erstellen, und zwar in möglichst einfachen Sätzen. Die Zusammenfassung sollte etwa 8–12 Sätze lang sein. Was wir unter einer *Zusammenfassung* und unter *einfachen Sätzen* verstehen, ist im Folgenden erläutert.

Was ist eine Zusammenfassung? Eine Zusammenfassung im Sinne dieses Experiments ist ein Text, der die wesentlichen Aspekte der Geschichte wiedergibt. Jemand, der Ihre Zusammenfassung liest, sollte die Geschichte wiedererkennen können, wenn er/sie sie bereits kennt oder später einmal liest. Üblicherweise sind Zusammenfassungen chronologisch aufgebaut, auch wenn Sie in begründeten Fällen von dieser Ordnung abweichen können.

Die Zusammenfassung sollte auch deutlich kürzer als das Original sein; Sie sollen also keine Nacherzählung verfassen. Das bedeutet, dass natürlich nicht alle Details der Geschichte vorkommen können, auch unter Umständen nicht alle wichtigen Personen. Die Zusammenfassung muss auch nicht besonders unterhaltsam oder witzig sein.

Die Zusammenfassung sollte keine stilistischen Kommentare, Kommentare über den Verlauf des Textes oder Wertungen enthalten. Die folgenden durchgestrichenen Texte würden also nicht in eine Zusammenfassung gehören:

- (a) ~~Der Text ist schwer verständlich.~~
- (b) ~~Dann wird es ganz sprunghaft:~~ Der Prinz heiratet die Prinzessin.
- (c) ~~Es folgt im dritten Absatz eine Beschreibung der Landschaft.~~
- (d) ~~Die Stelle, wo der Prinz die Prinzessin küsst, gefällt mir besonders gut.~~

Schließlich sollte die Zusammenfassung im Wesentlichen im Präsens (Gegenwart) verfasst sein.

Was sind einfache Sätze? Einfache Sätze im Sinne dieses Experiments sind solche Sätze, die: keine komplizierten grammatikalischen Strukturen enthalten, unter anderem wenige Nebensätze, und typischerweise aus weniger als 14 Wörtern bestehen.

Beispiele für einfache Sätze wären die folgenden:

- (a) Drei Schwestern treten in ein Kloster ein.
- (b) Er kauft ein schwarzes Pferd und durchquert die Wüste.
- (c) Der Prinz heiratet die Prinzessin.
- (d) Der Drache verwandelt sich in eine goldene Ziege.
- (e) Der Magd wird es untersagt, die goldene Feder aufzuheben.
- (f) Das Ei, in dem die Liebe der Zarentochter steckt, wird gestohlen.

- (g) Die Kinder vertauschen heimlich ihre Kleider mit denen der Hexentöchter.
- (h) Die Prinzessin zwingt die drei Streitenden, einen Wettlauf zu machen.
- (i) Der Krieger bezwingt den Bewohner einer Waldhütte, der daraufhin flieht.
- (j) Die Zauberin fliegt dem Offizier nach.
- (k) Der Zwerg zerbricht den Becher, weil er ärgerlich ist.

B. Data of the experiment *Summaries*

In the following, we reproduce the text data produced by the test subjects without any corrections.

B.1. IVANKO

B.1.1. Subject 1

- <Iv1,1> In einem Dorf leben ein reicher Bauer und seine Frau.
- <Iv1,2.1> Die Frau gerät in eine Bärenhöhle
- <Iv1,2.2> und gebärt einen Bärbling.
- <Iv1,3> Die Frau kehrt mit ihrem Bärblings-Sohn zurück ins Dorf.
- <Iv1,4.1> Dort soll Ivanko Bärbling mithelfen,
- <Iv1,4.2> doch macht er allerlei dumme Fehler.
- <Iv1,5> Der reiche Bauer will ihn loswerden und schickt ihn zu einem See voller Teufel.
- <Iv1,6.1> Dort fordert Ivanko von einem Teufel eine Pacht
- <Iv1,6.2> und dieser ihn zu Wettkämpfen heraus.
- <Iv1,7> Ivanko überlistet den Teufel bei einem Wettlauf, sodass der Teufel verliert.
- <Iv1,8.1> Ivanko überlistet ihn auch beim Krückstockwerfen,
- <Iv1,8.2> obwohl der Teufel eigentlich besser ist.
- <Iv1,9> Beim Pferd-tragen reitet Ivanko das Pferd, obwohl der Teufel das Pferd trägt, und gewinnt.
- <Iv1,10.1> Dann lässt er sich ganz viel Gold geben
- <Iv1,10.2> und bringt es zu seinem Vater.

B.1.2. Subject 2

- <Iv2,1> Ivanko Bärbling ist halb Mensch und halb Bär.
- <Iv2,2> Ivankos Stiefvater ist verzweifelt angesichts des Verhaltens von Ivanko.
- <Iv2,3.1> Ivanko tut zwar das, was man ihm aufträgt,
- <Iv2,3.2> doch er nimmt den Stiefvater stets wörtlich.
- <Iv2,4.1> Der Stiefvater verliert auf diese Weise seine Schafe
- <Iv2,4.2> und wird bestohlen.
- <Iv2,5.1> Um Ivanko loszuwerden,
- <Iv2,5.2> schickt sein Stiefvater ihn an den See.
- <Iv2,6.1> Im See leben viele Teufel

- <Iv2,6.2> und der Stiefvater hofft, sie ziehen Ivanko zu sich.
 <Iv2,7.1> Am See begegnet Ivanko einem Teufel
 <Iv2,7.2> und fordert ihn auf, Geld für den See zu zahlen.
 <Iv2,8> Der Teufel fordert Ivanko daraufhin zu einer Reihe von Wetten auf.
 <Iv2,9.1> Da der Teufel jede Wette verliert,
 <Iv2,9.2> gibt er anschließend klein bei.
 <Iv2,10> Ivanko erhält vom Teufel eine Wagenladung voll Gold.
 <Iv2,11> Außerdem verpflichtet er den Teufel als Knecht für seinen Stiefvater.

B.1.3. Subject 3

- <Iv3,1.1> In der Geschichte “Ivanko der Sohn des Bären”, geht es um eine Frau,
 <Iv3,1.2> die von einem Bären in einer Höhle gefangen hielt
 <Iv3,1.3> und ihm ein Bärbling,
 <Iv3,1.3.1> welcher halb Mann und halb Bär ist,
 <Iv3,1.3> gebar.
 <Iv3,2> Sie nennt ihn Ivanko.
 <Iv3,3.1> Die Mutter und der Bär ziehen in ein Dorf,
 <Iv3,3.2> in welchem sie ihren Mann wiedertrifft.
 <Iv3,4.1> Der Mann erteilt dem Bärbling einen Auftrag,
 <Iv3,4.2> er soll ein Schaf schlachten nämlich jenes ihn zuerst ansieht.
 <Iv3,5> Da ihn alle ansahen schlachtet er alle.
 <Iv3,6.1> Der Vater ist verärgert
 <Iv3,6.2> und sagt ihm, dass er das Fleisch in die Hütte bringen soll
 <Iv3,6.3> und das Tor bewachen soll.
 <Iv3,7.1> Der Bärbling bewacht das Tor,
 <Iv3,7.2> jedoch nicht das Fleisch,
 <Iv3,7.3> sodass es gestohlen wird.
 <Iv3,8> Der Vater schickt ihn zum See.
 <Iv3,9.1> Dort trifft er einen Teufel,
 <Iv3,9.2> von dem er einen Hut mit Gold und ihn selber ein Jahr als Knecht gewinnt.

B.1.4. Subject 4

- <Iv4,1.1> Die Frau eines Bauern trifft eines Tages im Wald auf einen Bären,
 <Iv4,1.2> der mit ihr ein Kind zeugte.
 <Iv4,2.1> Eines Tages kehrt die Frau und das Mensch-Bär-Wesen namens Ivanko zurück zum Bauern,
 <Iv4,2.2> der beide glücklich aufnimmt.
 <Iv4,3.1> Der Bauer erteilt Ivanko Aufgaben,
 <Iv4,3.2> welche dieser wörtlich aufnimmt
 <Iv4,3.3> und sie so, zum Erschrecken des Bauern, bewältigt.
 <Iv4,4.1> Dieser entscheidet Ivanko zum Fluss zu schicken,
 <Iv4,4.2> wo er durch einen Teufel umgebracht werden soll.
 <Iv4,5.1> Ivanko trifft am Fluss angekommen auf einen Teufel,
 <Iv4,5.2> der ihm drei Aufgaben zu lösen erteilt.
 <Iv4,6> Diese drei Aufgaben löst Ivanko, indem er drei mal den Teufel austrickst.
 <Iv4,7> Als Belohnung gewinnt Ivanko eine Menge Gold und den Teufel als Sklaven.
 <Iv4,8> Den Gewinn schenkt er dem Bauern.

B.1.5. Subject 5

- <Iv5,1> Die Frau eines Bauern verirrt sich in eine Höhle.
- <Iv5,2> Dort behält ein Bär sie bei sich und sie gebärt einen Sohn.
- <Iv5,3> Nachdem beide aus der Höhle flohen, gehen sie zum Bauern.
- <Iv5,4> Die vom Bauern aufgetragenen Aufgaben erledigt der Sohn falsch.
- <Iv5,5.1> Um ihn loszuwerden,
- <Iv5,5.2> schickt der Bauer ihn zum See.
- <Iv5,6.1> Dort solle er Stricke aus Sand drehen,
- <Iv5,6.2> wobei ihm ein Teufel begegnet.
- <Iv5,7> Nachdem er dem Teufel droht, dass er ihnen schaden wird, wird dieser ängstlich.
- <Iv5,8.1> Vom Großvater beauftragt
- <Iv5,8.2> geht der Teufel mehrere Wettkämpfe mit dem Sohn ein.
- <Iv5,9> Der Sohn überlistet den Teufel jedes mal.
- <Iv5,10.1> Somit zahlt der Teufel dem Sohn Pacht,
- <Iv5,10.2> damit sie im See bleiben dürfen.
- <Iv5,11> Den Teufel als Knecht und das erbeutete Geld bringt der dem Bauern.

B.1.6. Subject 6

- <Iv6,1.1> Die Frau des Bauern verirrte sich im Wald
- <Iv6,1.2> und wurde vom Bären in seine Höhle gezogen.
- <Iv6,2.1> Dort gebahr sie ihm ein Sohn:
- <Iv6,2.2> Ein Mann bis zur Hüfte und ein Bär unter der Hüfte.
- <Iv6,3.1> Eines Tages rannten die beiden Weg
- <Iv6,3.2> und kamen ins Dorf zum Bauern zurück.
- <Iv6,4> Der Bauer nahm Ivanko den Bärensohn auf.
- <Iv6,5> Ivanko machte die Aufgaben des Bauern nach dem Wortlaut, nicht aber nach dem Sinn.
- <Iv6,6> So verlor der Bauer alle seine Schafe.
- <Iv6,7.1> Der Bauer wollte Ivanko loswerden
- <Iv6,7.2> und schickte ihn zum See mit Seeteufeln.
- <Iv6,8> Ivanko trickste den kleinen Seeteufel aus.
- <Iv6,9> Die Seeteufel haben Ivanko die Pacht gezahlt.
- <Iv6,10> Der kleine Seeteufel musste 1 Jahr lang als Knecht Ivanko dienen.
- <Iv6,11.1> So ging Ivanko zurück zum Bauern mit einem Wagen voller Gold
- <Iv6,11.2> und einem Seeteufel als Knecht.

B.2. SHABARSHA**B.2.1. Subject 1**

- <Sh1,1> Der Knecht Schabarscha will für seinen Herrn etwas Geld verdienen.
- <Sh1,2.1> Er geht zu einem Teich
- <Sh1,2.2> um zu angeln,
- <Sh1,2.3> doch darin wohnen Teufel.
- <Sh1,3.1> Schabarscha fordert Gold und
- <Sh1,3.2> droht, die Teufel herauszuangeln.
- <Sh1,4> Doch der Teufel will erst einen Ringkampf ausfechten.

- <Sh1,5.1> Schabarscha lässt ihn zuerst gegen einen Bären, seinen vermeintlichen “Bruder”, kämpfen,
 <Sh1,5.2> woraufhin der Teufel aufgibt.
 <Sh1,6.1> Beim Wettlauf überlistet Schabarscha den Teufel wieder
 <Sh1,6.2> und dieser verliert.
 <Sh1,7.1> Beim Wettpfeifen wird der Teufel,
 <Sh1,7.2> eigentlich der Bessere,
 <Sh1,7.1> wieder überlistet.
 <Sh1,8.1> Als Letztes besiegt Schabarscha den Teufel beim Wettwerfen,
 <Sh1,8.2> wieder durch eine List.
 <Sh1,9.1> Daraufhin geben die Teufel ihm all ihr Gold,
 <Sh1,9.2> weil Schabarscha seinen kaputten Hut auf ein Loch stellt.
 <Sh1,10.1> Seitdem lebt der Knecht wie ein König,
 <Sh1,10.2> doch sein Met und Bier sollen trübe sein.

B.2.2. Subject 2

- <Sh2,1> Der Knecht Schabarscha versucht für seinen Herrn etwas Geld zu verdienen.
 <Sh2,2.1> Um Fische zu fangen und danach zu verkaufen,
 <Sh2,2.2> setzt sich Schabarscha an den See.
 <Sh2,3.1> Aus dem See springt ein kleiner Teufel
 <Sh2,3.2> und fragt Schabarscha nach seinem Tun.
 <Sh2,4.1> Um nicht von Schabarscha gefischt zu werden,
 <Sh2,4.2> schlägt er ihm mehrere Wetten vor.
 <Sh2,5> Schabarscha ist dem Teufel überlegen und gewinnt jede vorgeschlagene Wette.
 <Sh2,6> Der Teufel verwettet fast die Keule seines Großvaters.
 <Sh2,7> Da befiehlt der Großvater dem Treiben ein Ende zu setzen.
 <Sh2,8> Schabarscha erhält alle Geldreserven des Teufels Großvaters.
 <Sh2,9> Seit dem hat Schabarscha keine Geldsorgen mehr und lebt in Saus und Braus.

B.2.3. Subject 3

- <Sh3,1.1> In der Geschichte “Schabarscha”, geht es um einen Knecht, Schabarscha,
 <Sh3,1.2> der seinem Herrn helfen will und an Geld kommen will.
 <Sh3,2.1> Schabarscha geht zum Teich,
 <Sh3,2.2> um Fische zu fangen.
 <Sh3,3> Er angelt einen Teufel.
 <Sh3,4> Der Teufel will das er das Wasser in Ruhe lässt und die Teufel im Wasser am Leben lässt.
 <Sh3,5> Sie führen mehrere Wettkämpfe aus.
 <Sh3,6.1> Schabarscha gewinnt
 <Sh3,6.2> und somit sollte er einen Hut voll Gold und Silber erhalten.
 <Sh3,7> Der Teufel holt sein gesamtes Gold und füllt es in den Hut.
 <Sh3,8> Schabarscha schneidet ein Loch in den Hut, damit er nicht voll wird.

B.2.4. Subject 4

- <Sh4,1.1> Schabarscha ist ein Knecht eines Herrn,

- <Sh4,1.2> der ihm eines Tages einen Tag frei gibt, weil Schabarscha es sich so gewünscht hat.
- <Sh4,2> An diesem Tag nimmt er sich vor Fische zu fangen und diese zu verkaufen.
- <Sh4,3.1> Am See angekommen
- <Sh4,3.2> trifft er auf einen Teufel,
- <Sh4,3.3> welchem er droht, dass er alle anderen Teufel aus dem See ziehen will.
- <Sh4,4> Der Teufel aber will sich zuerst mit ihm in verschiedenen Duellen messen.
- <Sh4,5.1> Schabarscha schafft es durch Tricks
- <Sh4,5.2> den Teufel zu überlisten
- <Sh4,5.3> und fordert darauf hin viel Gold.
- <Sh4,6> Mit diesem Gold lebt Schabarscha bis heute glücklich und zufrieden.

B.2.5. Subject 5

- <Sh5,1.1> Schabarscha setzt sich an den See
- <Sh5,1.2> und dreht eine Angelschnur.
- <Sh5,2.1> Ein Teufel fragt warum er dies tut, er sagt
- <Sh5,2.2> um Teufel zu angeln.
- <Sh5,3.1> Ängstlich fragt er den Großvater,
- <Sh5,3.2> ob sie die von Schabarscha geforderte Ablöse zahlen sollen.
- <Sh5,4.1> Der Großvater beauftragt den Teufel
- <Sh5,4.2> mehrere Wettkämpfe mit Sch. auszutragen.
- <Sh5,5> Hierbei überlistet Schabarscha den Teufel jedes mal mit Tricks.
- <Sh5,6> Somit beschließt der Großvater die Ablöse zu zahlen.
- <Sh5,7.1> Hierbei überlistet Schabarscha die Teufel erneut
- <Sh5,7.2> und erbeutet viel Gold.
- <Sh5,8.1> So wird Schabarscha reich,
- <Sh5,8.2> wobei seine gekauften Dinge angeblich unschön waren.

B.2.6. Subject 6

- <Sh6,1.1> Schabarscha ist ein Knecht
- <Sh6,1.2> und will seinem Herrn aus der Not helfen.
- <Sh6,2.1> Schabarscha geht zum See
- <Sh6,2.2> um die Fische zu fangen und sie gegen Geld zu verkaufen.
- <Sh6,3> Dann taucht aus dem Wasser ein kleiner Seeteufel auf.
- <Sh6,4> Schabarscha sagt ihm, dass er den See von den Seeteufeln befreien wird.
- <Sh6,5> Er fordert vom Seeteufel Gold und Silber für die Pacht.
- <Sh6,6.1> Das Seeteufelchen berät mit seinem Großvater
- <Sh6,6.2> und will es mit Schabarscha in einem Ringkampf austragen.
- <Sh6,7> Bei jeder Aufgabe trickst Schabarscha den Seeteufel aus.
- <Sh6,8.1> Er selbst macht die Aufgaben nicht,
- <Sh6,8.2> sondern findet einen Weg, den Seeteufel auf schlaue Art zu besiegen.
- <Sh6,9> Die Teufel zahlen Schabarscha die Pacht in seine Mütze.
- <Sh6,10> Schabarscha macht ein Loch in seine Mütze und legt sie auf eine Grube.
- <Sh6,11> Die Seeteufel geben Schabarscha ihr ganzes Gold.
- <Sh6,12> Seitdem leben Schabarscha und sein Herr gut und kennen keine Not.

B.3. THE SEVEN SEMYONS

B.3.1. Subject 1

- <Se1,1.1> Die sieben Waisenjungen,
- <Se1,1.2> die alle den Namen Simeon tragen,
- <Se1,1.1> werden vom Zaren in Obhut genommen.
- <Se1,2> Sie werden Schmied, Späher/Bote, Schiffsbauer, Steuermann, Schiffsverstecker und Dieb.
- <Se1,3> Später sollen sie, unter Anführung des Diebes-Simeon, die Prinzessin Helene stehlen.
- <Se1,4> Der Dieb stellt allerlei Listen an, um Helene aus ihrem Land zu stehlen.
- <Se1,5.1> Seine Brüder helfen ihm und
- <Se1,5.2> bringen sie zum Zaren.
- <Se1,6> Dieser ist hocheifrig, heiratet Helene und macht die Simeons reich.
- <Se1,7> Doch die Reichtümer scheinen nicht für die Ewigkeit zu sein, und nicht zu befriedigen.

B.3.2. Subject 2

- <Se2,1> Die sieben Simeons sind allesamt Waisenjungen.
- <Se2,2> In der Erntezeit arbeiten sie auf dem Feld.
- <Se2,3> Der Zar bewundert den Fleiß der Kinder und will ihr Vater werden.
- <Se2,4> Die Simeons bauen einen Pfeiler und ein Schiff.
- <Se2,5.1> Den Zar erfreut es,
- <Se2,5.2> dass seine Ziehsohne ihm Nützliches tun wollen.
- <Se2,6.1> Einer der Simeons beschließt Dieb zu werden
- <Se2,6.2> und wird dafür vom Zar gerügt.
- <Se2,7> Er bekommt vom Zar die Möglichkeit, die weit entfernt lebende Prinzessin Helena zu stehlen.
- <Se2,8> Durch eine List wird Helena auf das Schiff der Simeons gelockt.
- <Se2,9> Im Reich des Zaren angekommen befreit er die Simeons aus Dank von Pacht.
- <Se2,10> Der Zar heiratet Helena und gibt ein großes Fest.

B.3.3. Subject 3

- <Se3,1.1> In der Geschichte "Die sieben Simeons", geht es um sieben Waisen,
- <Se3,1.2> welche von einem Zar aufgenommen werden sollen.
- <Se3,2.1> Der Zar will Kinder haben
- <Se3,2.2> und trifft auf die Simeons
- <Se3,2.3> und fragt nach deren Handwerk.
- <Se3,3.1> Alle wollen einem Handwerk nachgehen,
- <Se3,3.2> außer einer, der Dieb werden möchte.
- <Se3,4> Der Zar ist erbost darüber und will ihn hinrichten.
- <Se3,5> Der Zar nimmt die anderen Simeons auf.
- <Se3,6> Als der Zar den Dieb erhängen will, trifft er mit ihm ein Abkommen, die Prinzessin Helena zu ihm zu bringen.
- <Se3,7.1> Die Simeons reisen zu der Prinzessin
- <Se3,7.2> und schaffen es sie zum Zar zu bringen.
- <Se3,8> Der Zar ist glücklich und belohnt die Simeons.
- <Se3,9> Der Zar heiratet die Prinzessin.

B.3.4. Subject 4

- <Se4,1.1> Die sieben Simeon Brüder leben im Königreich des Zaren,
- <Se4,1.2> der sie in jungen Kindesalter befragte, was sie werden wollen.
- <Se4,2.1> Sechs nannten zur Freude des Zaren geschätzte Berufe,
- <Se4,2.2> nur der jüngste wollte Dieb werden.
- <Se4,3> Bestürzt sagt ihm der Zarr, dass er ihn hängen wird, wenn dies geschehen soll.
- <Se4,4.1> Viele Jahre später führen wollen die sieben Brüder dem Zarren ihre gelernten Berufe vorführen,
- <Se4,4.2> wobei einer der Brüder,
- <Se4,4.3> der einen ähnlichen Beruf wie ein Späher ausführt, den Zaren von der Prinzessin Helene erzählt,
- <Se4,4.4> welche in einem anderen Königreich lebt.
- <Se4,5.1> Als der jüngste Bruder den Zaren seine Künste vorführen will,
- <Se4,5.2> will der Zarr ihn hängen lassen.
- <Se4,6.1> Doch der jüngste bietet den Zarren an, Helene für ihn zu stehlen,
- <Se4,6.2> was der Zarr nicht verneinen kann.
- <Se4,7.1> Also stehlen die sieben Brüder Helene mit einem Trick aus dem benachbarten Königreich und
- <Se4,7.2> schenken sie dem Zaren
- <Se4,7.3> und dürfen so mit einigen Vorzügen alle weiterleben.

B.3.5. Subject 5

- <Se5,1> Sieben Waisen namens Simeon entdeckt der Zar hart arbeitend auf dem Feld.
- <Se5,2> Er holt sie zu sich und lässt sie ihr Wunschhandwerk erlernen.
- <Se5,3.1> Einer will Dieb werden
- <Se5,3.2> und rettet sich vor dem Tode durch den Zar.
- <Se5,4> Hierzu bietet er dem Zar an, eine schöne Prinzessin zu stehlen.
- <Se5,5> Mit den Fähigkeiten seiner Brüder gelingt ihm dies.
- <Se5,6.1> Der Zar heiratet die Prinzessin
- <Se5,6.2> und die Simeons werden belohnt.

B.3.6. Subject 6

- <Se6,1> Ein alter Bauer ist kinderlos und fragt Gott nach einem Sohn.
- <Se6,2.1> Seine Frau gebärt ihm sieben Söhne,
- <Se6,2.2> die Simeon genannt werden.
- <Se6,3.1> Kurz darauf verwaisen die sieben Brüder
- <Se6,3.2> und gehen auf das Feld arbeiten.
- <Se6,4> Der Zar sieht die Kinder arbeiten und will adoptieren.
- <Se6,5> Er fragt sie, welches Handwerk sie ausüben wollen.
- <Se6,6.1> Sechs Simeons nennen ihm ein gutes Handwerk,
- <Se6,6.2> nur der siebte will Dieb werden,
- <Se6,7> Nach einer Zeit kommen die Brüder zum Zar und jeder zeigt ihm sein Handwerk.
- <Se6,8> Der siebte Bruder sagt, er wird Helena die Schöne für den Zar stehlen.
- <Se6,9> Die Brüder machen sich auf und reisen mit dem Schiff in das entfernte Königreich.

<Se6,10> Der siebte Simeon holt Helena die schöne durch List auf das Schiff und sie verschwinden.

<Se6,11> Der Zar ist bei ihrer Ankunft sehr glücklich und zufrieden mit den Brüdern.

<Se6,12> Er heiratet die Prinzessin und es gibt ein großes Fest.

Bernhard FISSENI

Fachbereich Mathematik,

Universität Hamburg,

Bundesstraße 55, 20146 Hamburg,

Germany

Fakultät für Geisteswissenschaften,

Universität Duisburg-Essen,

Universitätsstraße 12, 45117 Essen,

Germany

Benedikt LÖWE

Fachbereich Mathematik,

Universität Hamburg,

Bundesstraße 55, 20146 Hamburg,

Germany

Institute for Logic, Language and Computation,

Universiteit van Amsterdam,

Postbus 94242, 1090 GE Amsterdam,

The Netherlands

PHILOSOPHIA MATHEMATICA

Edited by Robert S. D. Thomas



**PHILOSOPHIA
MATHEMATICA IS THE
ONLY JOURNAL IN THE
WORLD DEVOTED
SPECIFICALLY TO
PHILOSOPHY OF
MATHEMATICS.**

The journal publishes peer-reviewed new work in philosophy of mathematics, the application of mathematics, and computing. In addition to main articles, sometimes grouped on a single theme, there are shorter discussion notes, letters, and book reviews.

**VISIT PHILOSOPHIA MATHEMATICA
ONLINE FOR:**

- Content alerting services
- A sample issue
- Abstracts and tables of contents
- Subscription information, such as the discount price for members of the Association for Symbolic Logic

WWW.PHILMAT.OXFORDJOURNALS.ORG



OXFORD JOURNALS
OXFORD UNIVERSITY PRESS

