Maps are good at representing geographic space, but texts have a stronger affordance of telling a story than maps. Telling stories is however important to make information more personal and to arrest the users attention. This paper contrasts the map and the text media in order to understand why texts are good in telling a story but conventional maps are not. We demonstrate that, by a modification of maps, appropriate structural features of the text media can be transferred to maps, which makes them more suitable for telling stories. This new paradigm for map design can lead to new interaction possibilities and provide insights into how maps can be used.

**Keywords:** map; narrative; text; story; structure; story focus

### 1 Introduction

Imagine that you, like thousands of tourists each year, are following El Camino de Santiago, walking for hundreds of kilometres through northern Spain from the Pyrenees to Santiago de Compostela over a period of one month. As a major tourist attraction, this route is well-supported by modern infrastructure and information: guest-houses, food and water suppliers, signposts, fellow travellers, back-up transport options, and maintained routes mean that it is difficult to fail to complete this journey. There is certainly no obvious need to take a map of El Camino with you, although for peace of mind and forward planning, notably for overnight stays and regularity of food supplies, it might seem advisable to pack some form of guidebook. Such a guidebook would be able to share the experiences – physical, social, emotional and mental – which previous travellers encountered; it would give vivid and recognizable descriptions of the terrain and landscape in narrative form; it could incorporate photographs, images and artistic representations of varying type; and it could give a good idea of the temporal dimension of the holiday being undertaken. It could be argued that a map cannot convey such attributes, and that in order to relate the actual or potential story of a pilgrim on El Camino, the guidebook is a far more effective medium. This is despite the fact that the story is primarily a record of spatial activity.

There are clearly differences between the guidebook and the map. Both media represent experiences in space and time by symbols and words. The resulting map graphic and written sentences have more meaning than the symbols and the words alone, because the structure of these representations – the rules of the spatial arrangement and the grammar – give rise to a context. Text might appear to give better accessibility to notions of time, whilst the organization and medium of maps can yield a more natural spatial description: words in a text are linearly combined to represent the narrative they unfold, and symbols on the map are spatially arranged. Casey confirms this initial speculation, indicating that maps have ‘a commitment to description and spatiality (rather than to narration and temporality)’ (Casey 2002, p. 166).

In the context of landscape, Potteiger and Purinton (1998) contend that narrative can allow humans to shape and make sense of experiences of reality. ‘Stories link the sense of time, event, experience, memory and other intangibles to the more tangible aspects of place […] offering]
ways of knowing and shaping landscapes not typically acknowledged in conventional documentation, mapping, surveys’ (Potteiger and Purinton 1998, p. ix). Maps are far worse in telling stories, because they have different functionalities and affordances, i.e. possibilities to render the narrative within the map context. Although today’s digital maps differ radically from conventional maps – they are dynamic, interactive, hyperlinked, multi-dimensional – and the structures of map representations are widening, they share many similarities with conventional maps.

This paper aims to investigate whether it is possible to employ the inherent and varying creativities in the mapping and the writing processes to develop maps that can tell stories more effectively. Maps that tell stories exist, amongst others conventional maps incorporating thematic information, e.g. maps depicting the demographic development, and maps which are enriched by multimedia content. The story is, in many cases, rendered by additional information which is not part of the map, e.g. extensive knowledge about the historical living conditions leading to the demographic development, or information conveyed by multimedia elements which enrich the map. We compare cartographic and textual representations by their structural affordances to represent reality in this paper, to then convey stories by maps without having to refer to contextual and other information which is not contained in the map. While acknowledging that interactive maps, multimedia maps, etc. exist, we examine conventional maps in the course of the paper, because conventional maps focus on the core concepts of maps and are not modified and enriched by additional elements.

In the second half of the paper, we propose a new paradigm of how to modify maps in order to adapt structural elements of narrative texts and thus to strengthen the affordance of telling stories. Most notable, structural features are modified or introduced, such that they can be used in a dynamic and flexible way, a major reason for creativity. In fact, creativity is a fundamental part of the growth in a writer’s process and a contribution to the strength of their portfolio, regardless of the type of writing being undertaken. Creativity in writing helps in the expression of the concepts which are communicated by the author, be they related to presenting a car maintenance manual, telling a story, or conveying the articulation of love. This is in contrast to creativity in cartography, which is not commonly considered in education, although in practice it can be identified as a tangible component of mapping. The introduced paradigm incorporates concepts which are in parts already known in cartography to be used more extensive and in a more flexible way. By bringing structural affordances of texts to cartographic representations, it is hoped that they become more suitable for telling stories than conventional paper maps, while retaining many characteristics of a map.

This paper is organized as follows: Section 2 discusses representations of space, in particular map and text representations; how they communicate information; and how they can be compared. Section 3 contrasts cartographic and textual representations by concepts well known from cartography: dimension, scale, symbols and concepts, interactivity, subjectivity and objectivity, generalization, etc. These contrasts are exemplified in Section 4, by the examples of Robert Macfarlane’s textual descriptions of the terrain and landscape in the Outer Hebrides and Essex. We finally propose the concept of ‘story focus’ in Section 5, which incorporates structural properties of text into maps.

2 Maps and Texts as Representations of Space

Representations formally describe reality and real world phenomena. They emphasize different aspects and ignore others, making them differently suitable for different tasks – story telling, for example, requires space and time to be represented and to be handled in a flexible way. This section discusses representations of space to provide a basis for the comparison of maps and texts in Sections 3 and 4.
2.1 The Nature and Purpose of a Representation

Representations are substitutes for, and transformations of, reality and real world phenomena: they are layers between our understanding and the real world, intended to be used as surrogates for experiencing the real world. Representations are created by human beings – measurers, observers, recorders, interpreters, creators, etc. Similarly, representations only become meaningful when they are exposed to a human being, e.g. as assistance in performing tasks, including acquiring knowledge, being entertained and receiving stories. Representations are often created to solve specific functions, but many are used in different ways to solve different tasks. Not every representation can be used for the same task, and some are less efficient than others for certain purposes, such as telling stories. The varying strength of different representations in addressing tasks is the result of the aspects and characteristics which each can portray and convey: the structures inherent in the medium; the contexts within which they may be used; and the tasks which can be solved by the representation. Each of these forms a valid comparator for evaluating and assessing the abilities of a representation; we shall specifically examine the relative capabilities of maps and text to tell stories about locations and regions in space.

2.2 Map Representations

There are many different types of representations which can be defined as ‘maps’, but characteristics of being graphical, having multi-dimensions and incorporating a scale are commonly acceptable properties of a map. Thus, standard, static, formal and printed documents can be supplemented by sketch maps and schematic maps, digital displays, interactive maps and terrain models, in the list of maps. An overview on the different types of maps, on the elements of a map and their functions, and on how maps communicate has been provided by MacEachren (1995).

Multimedia cartography pushes the boundaries of the concept of maps by the use of multimedia content and technology. Maps used in multimedia cartography are different to conventional maps in respect to many features: different in the way of how geographic information is visualized, even animated; how digital and interactive representations are used to convey information; and how multimedia content, e.g. text, image and video, are incorporated into the representation (Cartwright, Peterson and Gartner 2007). Multimedia cartography is increasingly being translated into populist cartography: journalistic mapping, which aims to tell a story supplemented and enhanced by map objects, is common in both online and broadcast media; and multimedia maps are used in education, particularly lower school teaching, to aid speedy comprehension by the student.

From a social science perspective, Agnew (1993) presents two ‘interpretative communities’ relating space, scale and culture in different ways: space as a construct of political and sociological activity, and local culture; and space as a ‘canvas’ as viewed by geographers and anthropologists. In the first case, theories of spatial behaviour and arrangement are placed within a view of the world as a set of spatial units – nation-states, social class/political neighbourhoods, or cultural zones. In the second, a more structural approach is made with regions defined as ‘core’ and ‘peripheral’, and spatial patterns sought as explanations of processes and systems at work on the earth’s surface.

In both cases, however, space is assumed to be a ‘given’: it is a board ‘across which social processes “move” […] at particular scales’ (Agnew 1993, p. 252), or within which relationships and patterns, which can be analysed and culturally examined, evolve. Agnew proposes that ‘place’, a location perceived with personal or emotional sentiments, should be core of any form of analysis of spatial behaviour, and that the study of places is best served by ‘open assumptions’: the fixed view of topographical survey (rigorous, ‘closed’ views of features in space) should be superseded by topological representations and other ‘non-mimetic’ views, if we want
to understand the world. Agreeing, Duncan and Ley (1993) in their introduction to the book in which Agnew’s chapter appears, reflect on the challenge to cartographic orthodoxy which was raised by, amongst others, Harley who, in de-constructing maps as representational artefacts created by human beings, showed that objectivity and ‘mimeticism’ (‘realism’) in mapping was an impossibility. Duncan and Ley’s examination of other representations of space, including painting and literature, much of which has attempted to show definitive realism, came to a conclusion that ‘[a] tenacious set of cultural conventions constantly subverts the achievement of mimesis’ (Duncan and Ley 1993, p. 5). Wood (2015) even claims that such cultural interpretations and cited shortcomings of the representational process are completely ignored by the vast majority of those preparing and using maps.

2.3 Text Representations

Texts are a linguistic form of communication which can be read. It is composed of words, which themselves are composed of letters, but a text is much more than just a sequence of letters. Many different characterizations of a text are used; most of them use intrinsic aspects to characterize the concept of a text. De Beaugrande and Dessler (1981) have proposed ‘seven standards of textuality’: cohesion, coherence, intentionality, acceptability, informativity, situationality, and intertextuality. These aspects describe that the words in a text have a meaning; that they are linked together by their meaning; and that a text is able to intentionally communicate information to a reader, which is able to change the reader’s mind.

Text types have been classified by mode and by purpose (Faigley and Meyer 1983). Both classification schemes have their origins in Aristotle’s Rhetoric. A widely used classification by Bain (1867) divides texts into four modes: narration, description, exposition, and argumentation. Jakobson (1960), Kinneavy (1971), and Britton et al. (1975) classify texts by purposes, i.e. by the function that the text has in the communication process. A more detailed discussion of text types has been conducted by Görlach (2004).

As a communication system, text has a significant number of purposes: the narrative function includes story-telling, fairy tales, myths, fiction of various forms (e.g. historical, sci-fi, fantasy), plays, and poetry. Other functions are documentary, relating to events, reports of activities, and investigations; whilst other textual material can be instructional, or descriptive. Texts are very flexible and can convey many different kinds of information, as can be seen by such a large number of modes and functions.

The narrative function of text is intended to draw the reader into a shared experience or a concrete story. Often these relate personal experiences, sometimes incorporating direct dialogue. Descriptive text concentrates on the use of attributes, adjectival forms and simple text constructs which classify or categorize events, objects, and characters. More abstract concepts are represented in expository text, allowing for the elucidation of new information, e.g. by explanations, justifications and persuasions. Through its narrative and descriptive functions, text furnishes the recounting of stories, but through exposition it can also furnish imagination; it can represent action through time, but can also encourage reflective thought; and it can deliver propaganda, but can just as easily destroy dogma and authority.

An analysis of the linguistic possibilities afforded by text might reveal that discourse can be defined with reference to a set of variables – content variables (participants, domains, settings, medium), text variables (content, type, form, structure), and code variables (register, style, rhetoric, language – implying commonly recognized vocabulary and grammar) (Steen 2014). Further, more specific characteristics of text can be identified, such as dialogue, personification, description, symbolism, connotation, simile, metaphor, rhythm, rhyme, onomatopoeia, alliteration, and repetition. All of these text features contribute to the representation and delivery of plot, character, actions, events, chronologies – i.e. to stories.
The visual form of a text, e.g. its colour, font size, typeface, leading (line-spacing) and tracking (letter-spacing), are additional variables which influence the experience of a text. They however are, for most texts, in particular longer ones, not the main factor in telling a story. The visual appearance of a text and its perception can drastically be changed by altering the visual form, but the linguistic variables are able to describe a story much more fine-grained and detailed than the visual form can in most cases.

2.4 How to Communicate by Representations

Representations are used to convey ideas, emotions, concepts and realities, most effectively by employing symbols which stand for the real world phenomena to be represented. The symbols gain their meaning by how they refer to reality, and by the context in which they appear in the representation. After having learned in which context a representation, e.g. a map or a text, is used, we are able to read and interpret other similar representations. Having used maps enables us, for example, to make sense of maps with a similar cartographic style, even if they depict other places. A representation in combination with the knowledge of how the representation can be interpreted is thus able to communicate information.

The experience and the information communicated by a representation do not solely depend on the representation itself, but they also depend strongly on the context – incorporating a common agreement on which symbol refers to which circumstance of reality. A common way of providing context is to resort to widely accepted common knowledge: e.g. by writing the text in an existing language, which assumes a syntax, a semantics and possibly even a cultural background; by adding a legend, which relates the symbols of a map to concepts; by using widely-used categories; and by using similar symbols to represent similar concepts. The choice of the representation does thus not completely determine what is communicated, but the whole process of interpreting a representation in a context is essential.

2.5 Comparing Representations

Representations may be compared to understand the differences in their ability to convey information, and the purposes they are suitable for. At first hand, a comparison by the representations’ features seems to be logical: Broad Street in Soho, London, is depicted by a red line in one map, while another map uses a yellow line. One text refers to Broad Street by the words ‘Broad Street’, while another text uses its changed contemporary name ‘Broadwick Street’. The comparison by features across different media is however not possible. Representations can ‘look different, and we talk about them differently. But these things may or may not reflect substantive differences at the level of cognitive theories of representation. […] We must see through the surface form of those pictures to the information they contain about the represented world.’ (Palmer 1978, p. 278f) It is the mental state of the ‘reader’, which we would like to compare.

The comparison of representations in respect to their impact on the mental state of the reader, the major shared element of different communication methods, rendered by the structural abilities of the medium to convey information, is summarized by Palmer: ‘The representational issues of concern […] are things like the types of information represented, the resolution […], their uniqueness properties, and the higher-order structure […] These are our tools of analysis for dealing with mental representations from a cognitive approach.’ (Palmer 1978, p. 277) The cognitive impact on the reader is – as the product of interpretation, a human process – likely to be variable: there is usually more than one way to interpret a representation. The communication model however assumes that representations do have an intended interpretation in a given context, or at least a number of preferred or possible interpretations – if random interpretations were equally favoured, maps and texts would be meaningless.
3 Structural Similarities and Contrasts of Cartographic and Textual Representations

Communication systems employed by maps and by text each have characteristics and affordances which assist in the representation of reality. This section examines structural aspects of the map and text media to understand which aspects of information can be communicated in a suitable context, and even more important, which aspects cannot be communicated, because the structure prevents their communication. Table 1 contains a prototypical overview of such structural similarities and contrasts.

[Table 1 near here]

Mutual dependencies between the characteristics of a communication system are an important factor for the understanding of the similarities and contrasts. The aspect of scale presumes, for example, that a dimension is exposed, and both, dimension and scale, influence our perception of the represented information. Figure 1 depicts important dependencies and may serve as an outline of this section.

[Figure 1 near here]

The examination of structural aspects is a suitable vehicle to learn how texts can tell a story in terms of temporal processes, movements through time and space, and detailed views of places. It is hoped that by characterizing the structural differences between the text and map media, a synthesis can be sought which can achieve, in particular, an understanding and adoption of textualized methods of spatial representation by the mapping process. Possible enhancements to the practice of representation are discussed in Section 5.

3.1 Dimensionality and Representation of Spatial Relations

The most important difference between maps and texts is how their symbols and words are arranged. A map defines a bijection between locations in space and locations on the map. Spatial relationships between the depicted objects are thus implicitly clarified, because the same relationships hold for real objects, as well as for the symbols in the map. In particular, a map shows relative locations, hierarchies, patterns and arrangements.

A map usually has two spatial dimensions, equivalent to the representational media – paper and screens. Although even words are arranged in a two-dimensional space, the dimensions are not handled uniformly: the focus of our eyes usually moves quickly along the lines of the text during the visual perception—a complex process which is based on the interplay of the eye movement, the central and peripheral vision, and cognition (Rayner 1998). The perception of most types of texts is even independent of line breaks, and the entire text could theoretically be presented in one line without its content being changed\(^1\). Text is thus characterized by only one dimension which is aligned to the reading direction, because we perceive words, sentences and paragraphs mostly in a natural order. The perception of a sequence of words takes time and is progressive, parametrizing the text by time. Due to this difference in the number of dimensions and their meanings, the grammar of a text and a map are very different, and a text is able to emphasize temporal aspects whereas a map is able to emphasize spatial aspects.

Spatial relations between the depicted objects are handled very differently in maps and texts. When a symbol referring to an object is placed in the map space, the relations to all other symbols are automatically exposed, without any exception. Spatial relations thus require no inherent

\(^1\)Poems are one of the rare exceptions: the perception of their visual form may contribute to the overall experience of the text, but the linear perception usually still dominates.
representation: when the number of objects to be represented in a map is doubled, the number of symbols is doubled, too, and no spatial relations have to be explicitly exposed. The size of the representation, e.g. defined by the needed amount of ink, is thus of order $O(n)$, where $n$ is the number of represented objects. Text can ostensibly not implicitly expose any spatial relation, but at a closer look some relations can be concluded by considering other ones. When an object $A$ is, for example, left of an object $B$ which is left of an object $C$, we can conclude that $A$ is left of $C$.

Human cognition however limits the number of such conclusions. Most spatial relations must thus explicitly be exposed in text, and as the number of possible relations grows quadratically in the number of represented objects $n$, the length of the text is of order $O(n^2)$. This demonstrates the varying potential of representing spatial relations in maps and texts.

Thematic aspects are, in addition to spatial and temporal ones, important to both maps and texts. They provide a context to space and time by explaining what is and what happens. Different types of thematic aspects, which are also termed ‘thematic dimensions’, can occur in maps and texts. Layers are a common way of arranging thematic dimensions in a digital map; and printed as well as digital maps usually represent thematic dimensions equally in each part of the areal representation. In contrast to such global use of thematic dimensions, thematic aspects can be handled very differently in text, for example in diverse passages in a text, within the same work. Context can, in consequence, vary very quickly within text, whereas the understanding of a map comes via the subconscious assumption that the context of a map is common across its display. Thematic information is crucial for maps and texts, but is used differently in these representations.

### 3.2 Scale

Representations of space and time are usually characterized by a scale, which describes how represented distances relate to the world, assuming that the representation complies, at least locally, to the inherent concept of dimensions. The scale of a conventional map is fixed for the whole map. Variable-scale map projections in non-conventional maps are designed to emphasize certain regions, but they are rare and often thought of as difficult to comprehend and use, when the scale varies too much. However, schematic and diagrammatic map forms, cartograms and informal sketch maps, which inevitably employ variable spatial scales, are perceived as rendering a clearer and more utilitarian representation of space, even if realistic scaling is difficult or impossible to comprehend from such representations. Cartograms (Raisz 1936) (Figure 2) and maps depicting a city centre at a larger scale than the environmental area (Figure 3) – a technique, for example, used in Falk city maps – are examples where the use of different scales is intuitive (Fairbairn and Taylor 1995).

The local scale of a variable-scale map cannot arbitrarily be chosen, because it depends on the scale of the surrounding areas. This becomes apparent when we are choosing the scale of the area inside the circle in Figure 4(a): the choice is constrained by the scale of the area outside the circle, and when we require the area inside the circle to be of uniform scale, the scale has to equal the one of the surrounding area. In a similar way, we can modify a map such that different paths are represented at different scales. The rescaling of a path in Figure 4(b), for example, affects the other paths as well, constraining how they can be rescaled. Even without formal reasoning, it is apparent that the local scale can, without any significant distortion of space, not be changed such that the solid paths become twice as long, the dashed paths 100 times as long, and the dotted paths 1/100 times as long.
Texts can represent space and time highly dynamically. Unlike in a map, the scale values of space and time represented in a text can change from paragraph to paragraph, or even from sentence to sentence. This circumstance is due to the different dimensionality of maps and texts: a text is parameterized by time and thus often represents paths. For each path, the scale can be freely chosen at each moment in time, because the paths are described sequentially after each other. Text can thus, without difficulty, represent the paths in Figure 4(b) with very differing levels of detail.

Spatial scale also has resonance when the possibility of interactive dynamic map zooming is encountered. Such capability is commonplace in digital mapping, but text has been employing the representation of different levels of time-scale since the first narratives were constructed. The construction of time frames and time gaps, and of temporally varying events which vary significantly from one phrase to the next, is even very natural in text. The representation of spatial information at varying scales and levels of details is thus more flexible in text than in map representations.

3.3 Completeness and Closed- vs. Open-World Assumptions

Maps and texts suggest different assumptions about the completeness of the representation. Real representations cannot capture all aspects of reality and are necessarily incomplete: the drawing space in a map and the number of words in a book are limited. The completeness of a representation can be classified by the representation’s scope. A map has, for example, a spatial scope which is represented, and things outside that scope are not represented. Standard topographic mapping employs a ‘neat line’ for this purpose: the assumption is that represented data is complete within this map edge, and no data is included beyond it. In most cases, also a thematic scope is defined. The map may, for example, depict streets, car parks and restaurants. We implicitly assume that every street in the represented area is depicted in the map; if there is no street depicted between two locations in the map, we assume that no street exists. This is, in particular, true for digital maps, because the affordance to zoom in suggests that the user is able to increase the level of detail until the street is depicted. We thus usually make a closed-world assumption, for spatial and for some thematic aspects of a map.

Texts usually suggest open-world assumptions: if a thing or a fact is not mentioned, we do not automatically assume the thing not to exist, or the fact to be false. The reader may, for example, assume that the number of existing streets may far exceed the number of streets actually described in a narration of spatial behaviours and relationships. The closed-world assumption in respect to some aspects of a map is very different from the open-world assumption of a text. It is the nature of these representations, in particular the expressivity of a text, which implicitly suggests these different assumptions.

3.4 Symbols, Concepts, Categorization, and Non-Spatial Context

Maps use arrangements of points, lines and areas, pictograms, and other formal graphic symbols to represent real objects. Only a limited number of symbols is available, and similar objects are depicted by the same symbol. The objects are categorized by clearly defined and consistently used concepts. If a narrow line is used to depict a street that matches the concept of a street in a residential area, every street depicted by a narrow line must match this concept. Usually, no exceptions are permitted. Maps have thus to strongly generalize by representing a complex world by only few symbols.

The thematic meaning of a symbol used in a map depends only little on the depicted context, because each symbol refers to a concept, and contextual interpretation of a symbol is only possible inside the boundaries of this concept. A street in a densely-detailed urban environment that
is depicted by a narrow line can, for example, only be interpreted as a *street in a residential area* and not as a main road, but the reader may conclude that it may be lined with taller buildings because it is located in a city-centre.

Texts use words to represent reality, and the meaning of a word can, in contrast to symbols on a map, be highly dynamic. Words usually occur in combination with other words, defining a context in which the words can be interpreted. In the following quotation of James Joyce’s *Ulysses* (Joyce 2000, p. 240), for example, the word *square* refers to an open area which is usually located in a town:

> Almidano Artifoni walked past Holles street, past Sewell’s yard. Behind him Cashel Boyle O’Connor Fitzmaurice Tisdall Farrell with stickumbrelladustcoat dangling, shunned the lamp before Mr Law Smith’s house and, crossing, walked along Merrion square.

The same word refers to a geometric form in another passage of the same text (Joyce 2000, p. 82):

> Mr Bloom folded the sheets again to a neat square and lodged the soap in it, smiling.

The meaning of an unknown word can even be inferred from its context, as with ‘stickumbrelladustcoat’ in the above quotation. The high expressivity of the text is due to the strong contextual dependency of its meaning. The modification of a word’s meaning by its context renders the representation of more fine-grained concepts possible.

### 3.5 Spatial Context

Maps can intuitively represent a spatial context in terms of relative spatial relations, because geographical space and map space are both mostly perceived as two-dimensional. The forms and spatial arrangements of entities in a map visually suggest how things and phenomena spatially relate in reality, and the same spatial rules are valid in real space and in map space. The same ‘point’ object can, for example, not be both west and east of another ‘point’ object in reality, nor in a map. And when one walks straight forward on a straight line, one never comes back to the origin, apart from having orbited the earth. A map cannot represent such an impossible possibility, because the context provided in the map does prohibit such impossible constellations. When a symbol is added to a map, it has to be placed somewhere, which implies that it gets a location in the map and is thus set into context to the other entities of the map.

The spatial context in a map is limited by the representation of thematic aspects: the width of the representation of a road does, for example, not relate to the exact size of the road, but it relates to the function of the road, e. g. to which vehicles are allowed to drive on the road. This example shows that spatial properties of a road and its representation can be different or even unrelated, which hinders us from transferring the spatial context of reality to the map. Thematic context, e. g. the categorization of the road, is thus competing with the spatial context, e. g. the representation of the width of the road (Freksa 2015).

A text represents spatial relations by words and sentences, and the rules immanent to space do thus not apply. It is, for example, possible to represent contradicting spatial relations in a text – we may speak of an unfaithful narrator in this case – and to represent things without providing any spatial relations, i. e. without spatial context. This discrepancy of how maps and texts represent spatial context manifests itself by the number of encoded spatial relations: maps implicitly encode all spatial relations, while texts can, due to their limited length, only represent a small amount of spatial relations (see Section 3.1). Spatial relations can implicitly act as spatial indices, because they can convey an understanding of which symbol is placed where. This implicit spatial index becomes evident when two readers orally communicate the position of a symbol in the map by ‘in the left corner’, ‘in
the lower half”, or ‘along the river’; or when they communicate the relative positions of two symbols by ‘on the other side of the street’, ‘next to’, or ‘surrounding’. Using such an implicit index renders possible to locate entities in the map by locating entities of decreasing importance or extent: to locate Broadwick Street (former Broad Street), one can, for example, locate the city centre of London and the River Thames, then Soho north of the river and in the northwestern part of the centre, and then by reading the street names in the centre of Soho, or alternatively by using a graphical or grid-based gazetteer. Finding a description of Broadwick Street in a text, e.g. a travel guide, can however become tedious if no explicit register is used.

3.6 Perception and Interactivity

Texts and maps are perceived and read very differently. Maps can be animated; they are visual; some features can be recognized at a glance; and parts of a map can be browsed and read without adhering to some contemplated order, because its symbols are spatially arranged and thus implicitly indexed by their location. By reading the entire map at once, we obtain an overview; a closer look reveals more details. Digital maps allow zooming in and out to read the map at the desired level of detail; and they can be modified by showing or hiding thematic layers, or by a time slider. Maps, in particular digital maps, can even be designed to be used in a certain order, e.g. to follow the widely used principle overview first, zoom and filter, then details-on-demand, introduced by Shneiderman (1996), but such an order is not obligatory. Words of a texts are, in contrast, to be read in the contemplated order to become meaningful. The predominance of linear perception strongly restricts the interaction methods – one of the few possible is to re-read parts of a text, but this involves some effort to orient oneself in the text.

3.7 Subjectivity and Objectivity

All representations are subjective to some degree, because the creation of a representation involves choices: What should be represented, and in which way? Which symbols should be used, and which scale is appropriate? The creator of a representation may have some intended interpretation in mind, but the reader may interpret it in a different way. This subjectivity applies for maps as well as for texts, because implicit knowledge and the context influences the way the reader interprets the representation.

Maps, in particular conventional ones, are, in many cases, more objective than texts in regard to spatial relations, because the description of a location in a map is often less vague than in textual descriptions. Qualitative and vague spatial relations, such as ‘north of’, ‘to the right’ or ‘next to’, are often used in texts, but these relations cannot be encoded in a map. Travel guides, for example, sometimes provide a spatial description of a place that can be interpreted in different ways (Leapman 2011, p. 11):

The London Eye offers passengers a thrilling ride and spectacular views above the city on the South Bank […] Nearby there is plenty of other entertainment, especially in County Hall […], which was the seat of London’s local government for more than 60 years.

This text passage does not clarify how the London Eye and the County Hall are spatially related, because the description of ‘nearby’ does not specify the actual distance nor other quantitative spatial relations between both attractions. It is also not clear whether ‘nearby’ refers to Euclidean distance, walking distance, travelling distance by tube, etc. Another travel guide lists the address of the London Eye (Brewer and Fisher 2012):

This address suggests that the London Eye is related to the County Hall, but it does not suggest how exactly they are related. None of the examples actually reveals that the London Eye’s ticket centre is located inside the County Hall. These textual representations demonstrate that the representations as well as their interpretations can be very different.

The London Eye and the County Hall are depicted in maps each at their respective location with only very little deviation, because both locations are, at large extend, beyond dispute. The spatial relation between the attractions in terms of distance and direction, which can be concluded from their locations in the map, has an objective character – it is most likely interpreted in similar ways by map readers. This is in contrast to the textual relation ‘nearby’, which has a subjective character and can be interpreted in many different ways. The shape of the attractions is however represented differently, as can be seen in Figure 5, because different generalizations are used.

[Figure 5 near here]

### 3.8 Atmosphere

Texts are able to transport the atmosphere of a place. A description of which things are present at the place, how these things are organized and how they look conveys a multifaceted picture of the situation. The following passage of *Emil i Lönneberga* by Astrid Lindgren (2004) draws a picture of the situation at a yard called Katthult in the southern part of Sweden:

> Nu var detta verkligen en dag att hålla kalas på. Solen sken, syrener och äppelträd blommade, luften var full av fågelsång, hela Katthult var vackert som en dröm, där det låg på sin kulle. Och gården var nykrattad, huset var skurat i alla vrår, maten var färdig, nu fattades ingenting. Jo, en sak! ”Oj, vi har ju glömt att hissa flaggan”, sa Emils mamma.

[translation by Mocnik] This truly was a day to have a party. The sun was shining, the lilacs and apple trees were blooming, the air was filled by birdsong, the entire Katthult was as beautiful as a dream, located on its small hill. And the yard was straightened, the house was scrubbed in every corner, the food was prepared, nothing was missing. Yes, one thing! ‘Oh, we have forgotten to hoist the flag’, said Emil’s mum.

The reader may imagine this idyllic yard, and how it integrates into the Swedish landscape. The residents of the yard may have been busy and the preparations for the party, stressful, but at this very moment, the yard and its surroundings are ready for the party. The residents may have this quiet and satisfying feeling that one has when one is waiting for the first guests. The reader can thus empathize with the residents.

The example demonstrates that texts are able to convey the atmosphere of a place. Two reasons favour this affordance. First, texts are able to convey the ‘inner dynamics’ of a place: things that are present at the place can be listed, their features can be described, and the relations between the things can be explained. Text can even specify *why* things are at their place, *why* they have certain features, and *why* they are related. The reader can thus get a detailed impression of the place. Secondly, texts can evoke emotions. While Miall (1989) and Kneepkens and Zwaan (1994) describe this effect based on empirical data, they cannot explain how this process of evoking emotions works, and it is yet not clear whether emotions are featured by the text, or whether they are a product of the cultural context. An overview of text elements favouring emotions has been provided by Winko (2003). Both factors, the inner dynamics and the emotions, put the reader into the position of feeling the atmosphere of the place. The information about the inner dynamics renders it possible to envision the location, and when the reader imagines how it would feel to be one of the characters, he or she is able to feel the atmosphere from the position of this character.
Maps draw a much less detailed picture of the situation at a specific place. Features of a place can, for example, only be conveyed in a limited manner; non-spatial relations cannot be made as clear as in a text; and reasons for why things are at their places, why they have certain features, and why they are related are difficult to provide. The reader can thus not gain the same detailed picture of the inner dynamics as by a text. Maps about emotions either represent the emotions (e.g. Greenwich Emotion Map (Nold 2016)), or they evoke the emotions by using texts and other additional modes of representation (e.g. Emotions of London (Historypin et al. 2016)). In being able to convey the atmosphere of a place, maps seem to fare worse than text.

3.9 Algorithmic Generalization

Representations are abstractions of reality and have limited ability to portray and convey the fullest detail of the real world. The concept of levels of detail, which is common in spatial data depiction, depends on the inherent characteristic of scale and the affordance of generalization, both properties of maps. The structured nature of the map and its capturing of spatial relationships mean that levels of detail can be derived algorithmically, often with the intention of communicating spatial information in an objective manner regardless of scale. Some connotations may change during generalization: for example, the representation of a city may morph from a polygon to a point; or a classification scheme for land use may lose its finely categorized nature. The use of generalization, however, retains topological relationships and spatial meaning as far as possible during a change of scale. Whilst variation in the scale has an influence on its eventual application and may inhibit some uses, cartographic generalization often aims at retaining the nature of the mapped area – a task eased by algorithmic generalization routines.

The variability of textual representation means that its generalization is much more difficult. Word-processing methods of automated summary and abstract construction, a form of generalization, rely primarily on word count to establish relative importance of concepts, and retention of those existing whole sentences which focus on such concepts to maintain grammar and meaning. The possibilities of changing levels of detail in text can involve modification of the representation to a significant degree: the narrative of a representation can be changed with altered perspectives (e.g. different narrators); variable time scales (e.g. shifting action quickly or slowly, even rendering explanations in reverse); and varying levels of complexity, richness and content (e.g. limited descriptive passages interspersed with finely detailed representations of selected phenomena). The scope for re-tellings of the same story is wide, and the application of standardized and automated methods of summarizing is hardly possible. As an example, even the simple task of orientation (positioning oneself with the narrative) is much more difficult, if the textual description has been presented at a different level of detail.

The particular characteristics of maps and texts discussed here vary in many respects. The affordances, which each form of representation possesses, lead to differing abilities in representing things, objects, characters, relationships, structures, events, happenings, actions, and organization within reality. There are wide ranges of modes and functions of both maps and texts, leading to significant flexibility in representing reality using either. The strengths and weaknesses of each have been explored in this section, but it is worth demonstrating this contrast at a concrete example in the next section.
4 Contrasting the Affordances of Cartography and Text

The contrasts between maps as representations and text as representations have been highlighted. We next attempt to explore such distinctions at typical text extracts of contemporary chorographic literature, which is experiencing a significant renaissance in the English language due to the success of authors such as Ian Sinclair, Peter Ackroyd and Will Self, alongside conventional map representations of the areas written about. This exploration is prototypical in the sense that it compares two extremes on purpose: narrative texts, which have a great capability of conveying a story, and conventional, non-interactive maps, which have the affordance to convey spatial relations very well. The comparison of less narrative text extracts, e.g. recipe books or encyclopaediae, to interactive maps would be less contrastive but, in principle, lead to similar conclusions. Texts and map representations are too diverse to be exhaustively studied at only some few examples. This section however aims at illustrating the structural differences between examples of texts and maps, without claiming that other texts and maps are as contrastive.

Robert Macfarlane draws in his book The Old Ways (Macfarlane 2013a) a vivid picture of the terrain in the Outer Hebrides, an island chain off the west coast of mainland Scotland, also called the Western Isles:

For the two main surface substances of the Western Isles – black peat and pale gneiss are differently hostile to path-making. The peat swallows paths, and the gneiss refuses them […] So it was that […] routes became cairned onto the moor as guide-lines, designed to avoid boglach (general boggy areas), blàr (flat areas of the moor that can be very boggy), or, most dangerously, breunlach (sucking bog disguised by the alluring bright green grass that covers it), and lead the walker safely to tulach na h-àirigh – the site of the shieling.

This narration is more evocative of place than any standard map, or even an aerial photograph. In this example, the map (Figure 6) is rigidly structured by scale: the paths are either thin lines scaled to their width or are not shown at all; the symbology is incapable of rendering the complexity of the classification of the paths. Even the more extensive areas (of bog and moorland) are not defined or represented; the cairns are not systematically portrayed; and the destination of safety (the shieling) is outside the bounds of the map. In effect, the map representation is showing the limitations of scale – in the exclusion of some features described in the text; the limitations of ‘closedness’ – in the bounding of the area mapped; the limitations of symbology – in attaching semantic information and meaning to the design of graphical marks; the limitations of classification and categorization – in omitting a breakdown of ‘unsafe’ land cover; and the limitations of interactivity – in its static, non-zoomable display. It does convey the affordances of cartography, however, in its dimensionality and context, and consequent effective representation of spatial relations; and in its regularity of appearance and level of generalization.

A further extract from Macfarlane’s Silt (Macfarlane 2013b) reinforces these notions that text can bring something more to the narrative of places and journeys through places than a map can. In his story of a walk on the ‘Watt’ (German) or ‘wad’ (Dutch) area in Essex, England, Macfarlane once again emotes in his writing of the nature of the terrain in a much more effective way than the standard topographic map of the area:

The air was grainy and flickering like an old newsreel. The sea wall had hazed out to a thin black strip. Structures of unknown purpose – a white-beamed gantry, a low-slung barracks – showed on the shoreline. […] The light had modified again, from nacreous to
granular to dense. Sound travelled oddly. The muted pop-popping of gunfire was smudgy, but the call of a cuckoo from somewhere on the treeless shore rang sharply to us. A pale sun glared through the mist, its white eye multiplying in polls and ripples. The miniature sandscapes of ridge and valley pressed into the soles of my feet [...]

Clearly the conventional map is not telling the story as the text is (Figure 7). Both map extracts presented are using standardized, bounded, classified representations to represent the landscape, which are valid and efficient for some representational purposes. The text extracts are using personalization, simile, onomatopoeia, rhythm, alliteration, and even extending the vocabulary of the text into other languages, which yields a different representation that is telling a story much more effectively.

Maps are not effective in representing characteristics and aspects of a particular place which is small compared to the extent of a map.

Structurally they present arrangements of symbols, which stand for spatial patterns, trends and other summaries of spatial distribution: they can indicate where a place is in relationship to other places (at a certain distance away, conjoined on a network, within a region, sharing part of a name with a neighbouring location, in a different characterized zone, e.g. a separate land use category); and they can reflect the way in which space is summarized (e.g. a densely-populated area alongside a less-densely populated one). Texts in contrast can describe a particular place more effectively by describing its attributes and characteristic-rich features, and by describing what happens at that place – much unlike maps, which ‘mainly belong to geography, which is largely indifferent to place’ (Casey 2002, p. 167).

5 Bringing Characteristics of Literary Representations to Cartography

The narratives of Macfarlane demonstrate how effective texts are in telling a story which is structured by time, and in characterizing places rather than relations between places. By the systematic treatment of the contrasts between texts and maps in Section 3, we will discuss how to bring characteristics of literary representations to maps, with the intention of applying some of the flexibility of textual representation to cartographic representations. By identifying those characteristics and affordances of text which render reality in more engaging, more emotive and more organic ways, we intend to develop a toolkit which can be used by those cartographers who are creating and disseminating maps that tell a story.

To bring the characteristics of text representations to maps is a structural approach. Such structural views, approaches and methods can be highly successful, if the examined thematics is of structural nature. Mocnik and Frank (2015) and Mocnik (2015) argue that spatial information statistically exposes structural commonalities, independent of which concept of space is considered. A modification of the structure of a map representation thus suggests itself to be meaningful, because it can, by the structure of the information, be argued which influence the modification has. The concept of ‘story focus’, which is to be introduced in this section, is discussed against the background of the structure of the represented information.
Some of the presented modifications have, too some degree, already been applied to maps, but the proposed extensive use and the combination of these modifications, while bearing a text-like use in mind, is novel.

5.1 Existing Approaches

Maybe the first map telling a more extensive story was the map about Napoleon’s army in the Russian campaign 1812–1813, drawn by Charles Minard (see Figure 8). It relates the reduction of the army to the temperatures, which gives us an idea how the army was approaching Moscow, and why it reduced in size. The map succeeds in telling the story, because it incorporates diagram like visualizations. Contemporary innovations in cartography attempt to overcome some of the limitations of maps presented in Section 4, by even incorporating other contrasting media – texts, diagrams, images, video, sound, etc. This trend emerges, most notably, in multimedia cartography (Cartwright, Peterson and Gartner 2007).

Several tools are available which aim to assist in the creation and display of multimedia maps. StoryMapsJS (Knightlab 2016) and Story Maps (ESRI 2016) provide extensive functionality to enhance the representation of spatially located phenomena, including historical events and developing phenomena, e. g. by overview inset maps, movement of maps along ‘tracks’ on screen, embedded videos, logically successive frames, and back and forward movement. Further flexibility in representing map-based narratives is evident in other standard tools. Multimedia boxes pop out when features are selected on screen; and controls for the selection of data and visible content allow for choice of observable layers. Dynamic representation is similarly standardized, using ‘slippy maps’ concepts allowing for zooming and panning under viewer control. Such functions assist in focusing the map display to areas of interest and improving explanations of spatial phenomena. Temporal capabilities in map display are readily available by slider bars which can be easily incorporated into web mapping representations. The hyperlinking of map displays allows for the supplementing of a map interaction session with material available on the web explicitly accessed through sensitive and highlighted points on the map itself. Hyperlinked sites and information sometimes become the new focus of the user experience, with the map in a superseded window, replaced by separate screens of words, images, and videos. Finally, adaptive possibilities of contemporary mapping allow for user interaction to change design, select and highlight features, incorporate new (often real-time) feeds which change the map display, and modify complexity using a range of tools.

Associated advice is available on the best ways to create an effective story map: connect with the audience; attract the viewer by headlining core concepts; consider the model of storytelling – a diary is a different representation to an episodic series; use simple design; and distil the message to ensure focus. The end result, however, of most story mapping exercises is to present maps in a pre-set sequence, with limited interactivity or user control.

5.2 Story Focus – A New Approach for Modifying the Structure of Maps

Existing approaches for improving maps in terms of expressivity and dynamics have achieved significant results, often making excessive use of supplementary media to narrate the story. Such contrasting media are placed alongside the map, but the map’s ability for telling stories is, despite being enriched by interactive and dynamic features, often not improved and far away from having the same characteristics as texts. The structural differences between text and map representations suggest, that it should be possible to modify maps such that they incorporate narrative elements which go beyond the use of supplementary media. Such optimization of the
communication of spatial information through the medium of the map must acknowledge the specific cartographic issues, as well as affordances involved in the representation of space, and the subsequent shortcomings. We introduce here the concept of ‘story focus’, a paradigm which incorporates structural elements of texts into maps to improve their abilities to relate a narrative story, communicating information in ways more redolent of textual representations.

Maps with a story focus depict, similar to other maps which aim at telling a story, characters, i.e. people, groups of people, or features which play an important role in the story, moving around through space and time (Figure 9(b)). In contrast to other maps, story focus aims at adopting the structural features of textual representations, allowing for a dynamic representation of the relevant elements of the story. Everything that is irrelevant for the story remains unrepresented, and as the relevance of features and events changes during the course of the story, the map has to change over time. This approach can, from a cartographic perspective, be viewed as a variable generalization technique, designed for adaptation to a story, which represents reality with varying layers of content, levels of detail, scale, precision and uncertainty, emotion and mood. The new paradigm, story focus, replaces the current paradigm of how to use and interpret features of a map, which suggests even already used concepts to be interpreted differently.

The introduction of story focus aims to push the boundaries of map representations towards encompassing the abilities of a text, although we acknowledge the continuing differences in approach to representation, knowing that many of the affordances of a text cannot be reached. While story focus may be counterintuitive at first hand – it is part of a fundamental change of how we understand a map and thus a fundamental change of the mapping process –, it creates new possibilities and allows a more flexible use of existing ones: temporal aspects can be emphasized by the absence of non-temporal information; non-spatial information can be represented more flexible; the scale of the map can be adjusted locally as well as over time; the expressivity can be increased by making an open-world assumption for some more aspects of the map; and the map style can be adjusted locally as well as over time. The following sections discuss these aspects and the ways in which they improve the ability to tell stories through maps.

5.3 Emphasizing Time and Non-Spatial Context

Time and non-spatial aspects play an important role in stories, but they are, due to the strong emphasis on spatial aspects, structurally underrepresented in a map. This section discusses how to highlight temporal aspects: either by actively adding time as a new aspect to the map space, or by weakening the role of space and thus providing the possibility to implicitly emphasize non-spatial aspects.

Incorporating Time to the Map Space. Space and features in space are intrinsically represented by the map space: symbols in the map represent features, objects and characters; and the same relations hold for symbols in the map space and the corresponding features in reality. Time suggests itself to be analogously represented by ‘map time’: when features change their place and appearance in time, the symbols in the map do the same. The influence of the tide to the coast line can, for example, be depicted by animated shifting of the boundary of the blue area which represents the sea, or by symbolizing the tidal range with two lines, representing ‘high’ and ‘low’ (Figure 9(f)). The shift may not necessarily represent the actual position of the coast line at a given point in time. Instead, it may be purely figurative to communicate the importance of the tide for the story, and it may appear and disappear, when it becomes relevant or irrelevant to the story. As an affordance of contemporary mapping, more complex animations can be used to reflect the representation of successive ‘time slices’ of data, to incorporate slider bars and
other control mechanisms for display of time-dependent mapping, and adopt the video player metaphor for interacting with the time dimension (pausing, rewind, fast-forward, etc.).

**Avoid Implicit Spatial Relations.** Map space is constituted by the existence and representation of spatial relations, which communicate to the user of the map that the depicted things are placed, and indeed arranged, in a space rather than arbitrarily on paper or screen. The communication of spatial aspects is weakened and non-spatial aspects are thus emphasized, when spatial relations are masked. The question of how to mask spatial relations by adjustment of the symbols in a map has however no obvious solution, because each symbol has to be depicted somewhere on the map, and thus implicitly has a location in map space. This impression can be countered by additional constraints and non-spatial relations between symbols. Which relations are, by the reader of the map or a text, assumed to be true, and which are only possible but not intended interpretations, depends on many factors, in particular the representation media. In a map, spatial relations are often assumed to be of higher importance than non-spatial ones, while grammatical and linguistic rules are commonly assumed to be much more important than spatial relations in a text. The order of the letters in a word, and of words in a text, are, for example, usually assumed to afford a meaning according to some non-spatial interpretation scheme, but the letters’ location on a sheet of paper are much less important*. The reader of the sentence ‘David knows Franz-Benjamin’ thus commonly does not infer any spatial relation between David and Franz-Benjamin by this sentence, even if the words ‘David’ and ‘Franz-Benjamin’ have a location on the paper.

When spatial and several non-spatial constraints and relations coexist in a map or another representation, it is not self-evident which relation is assumed to be intended, and which one is assumed to be true. In case of contradicting relations, it is obvious that not all relations can be true. The reader of the map has to choose a subset of possible relations to avoid contradictions. When the same entity is depicted multiple times in the same map, spatial contradictions can, for example, easily occur when the symbols’ location on the map are interpreted in a spatial way.

Many aspects influence which relations afforded by a representation are assumed by the reader to be true. One nearby assumption is to favour relations which obviously are in agreement with our experience, and to ignore those that contradict our experience. When symbols representing objects and information important to a character are, for example, depicted at a fixed distance around a character, the reader could interpret the objects to always be located at a fixed distance to the character in reality, but this would contradict our experience: Even if our belongings, such as a mobile phone or a key in example of Figure 9(c), may be carried around with the person and thus always be located within a certain distance, our experience tells us that their distance to the person may vary, e. g. when the key is put on a desk while the person is walking around the car. When these objects are despite of this spatial discrepancy depicted at a fixed distance around the person, one may assume that they are in some other way related to the person. The depicted balloons can, in particular, be interpreted as not to spatially exist at all, but to depict thoughts of the person. Similar effects can be gained when no objects are depicted at all in some areas of the map, symbols appear and disappear and even move in unexpected ways in the map space, or when symbols move much more strictly along a given geometric form than expected. A polyline representing a bus route is, for example, usually not interpreted as the actual route that a bus is driving along, but as lines connecting consecutive bus stops – busses only driving along straight lines contradict our experience.

*This assumption is, for example, made when web sites and e-books are rendered dependent on the screen size of the output device.

Further, location can be attenuated by reducing the indexing or spatial referencing capability of the map representation: if spatial relations are missing for some symbols, they cannot
implicitly be indexed and the structural aspect of the spatial representation is further diluted. Variable scaling also reduces indexing capability, because the reference frame is distorted and quantitative calculation of spatial relations, e.g. distance and bearing, become impossible. The more non-spatial and temporal information is included in the map, the more situative the representation becomes, and the more a story can be told.

5.4 Emphasizing the Subjectivity

The possibilities of more flexible representation, such as portraying more subjective information, are limited by spatial structure. Further, the uniformity of symbolization and constancy of scale on a map also limit the representation of subjectivity. Storytelling embodies figurative and emotional concepts, including subjectivity, which are rendered well in texts but not on maps.

Focus and Nimbus. Within environments and over time, humans, and indeed animals, focus their attention on a limited number of things and events. The concept of focus describes this situation: some things and events gain more attention than others, and are thus inside the focus of a person, while things outside the focus gain less attention. By the definition of the concept, the focus depends on the context and is thus subjective. A person can his- or herself be the subject of attention by others, and thus appear in their focus. We even say, that the other people are in the nimbus of this person. The concepts of focus and nimbus are dual – they describe the same situation from a different person’s perspective (Benford et al. 1993; Rodden 1996).

Social interaction can be described in terms of personal space, i.e. the neighbourhood which is psychologically taken up by that person: when the personal spaces of two people intersect, each has entered the focus, and also the nimbus, of the other person. The size and shape of the personal space depends on several factors, amongst others the emotional state of the person, the activity performed, the cultural background, and the physical space which the person is in (Hall 1963). Personal spaces, and social interaction in terms of personal spaces can thus reveal the person’s subjective view at least in parts.

A map with a story focus can use this mechanism to represent social interaction and subjective views, while increasing the emphasis of the information relevant to the story. The depicted personal space, focus or nimbus as the neighbourhood of a character is not necessarily an isotropic circular zone but a more complex shape. A car driver’s attention is, for example, usually pointing towards the driving direction, while the nimbus is pointing backwards. The user may even remember a much longer part of the road than is visible ahead of the car (Figure 9(d)). The depicted neighbourhood can vary, depending on how familiar the driver is with the road and the environment, on the driving speed and the lighting conditions, on the mood of the driver, etc. When several characters are important to the story, their depicted neighbourhoods provide a good view of how these characters can meet and interact (Figure 9(e)).

Flexible Scale. Even in variable-scale maps, the local scale of an area cannot arbitrarily be chosen, as it is constrained by the scale of the surrounding areas. This restriction can partly be removed when varying regions or districts of the mapped area are depicted with gaps between them, i.e. when the map data is disjoint and the regions mapped do not exhaust space. A map showing only those characters and features relevant to the story, and their neighbourhoods, can be depicted in such a non-conjoined way; this offers a more flexible way of varying scale and orientation, and introducing spatial distortion. These characteristics can also be made to change over time if desired (Figure 9(g)).

The concept of scale is not restricted to the equivalence of space on the map to space in reality, but it also impacts the amount and type of information which is represented: we expect less information to be represented when the map portrays a large area at small-scale, and more detailed information for a smaller area at large-scale. By only showing disjoint neighbourhoods,
the content of the map can be varied, possibly even over time, without introducing incompatibilities and incoherencies, allowing for significant adjustments of the thematic content.

Dynamic Concepts. The concepts which are referred to by the symbols of a map are mostly static. By making concepts more dynamic in respect to space, time, context and the affected characters, symbols can express subjective information (Figure 9(h)). The symbolization of emotion, for example, by associating properties of feelings, prejudices, antipathy or joy with particular characters or features in space, can be tackled in a similar way to any other representation of space using map symbols. However, the changeability of such emotions when confronted by features at varying scales may require more careful consideration: feelings about an entire town may differ significantly from feelings about particular neighbourhoods or streets. The unpredictable interactions among time, space, characters and features, require flexibility in representation. Such flexibility extends to the design process itself, as different symbology may well be used for the same type of feature at different scales, and subjectivity can be reflected in the choice of symbol and its relationship with the character or feature presented.

5.5 Increasing Expressivity

Expressivity refers to how, how much and which information can be represented. In this section, we propose structural adjustments to a map which let the user make, at least in parts, an open-world assumption, and which allow for a better communication of the atmosphere of a place.

Open-World Assumption. The closed-world assumption, in respect to many aspects of a map, implies that a common schema is adopted for the representation: there is a structured approach to portraying space; one assumes that all content is presented to the same level of detail within, and no information outside an arbitrary neat line; scale is predictable across the map face; and the symbology applies equally throughout the map face. By contrast, an open-world assumption would increase expressivity by freely choosing what to communicate. Variable levels of detail, gaps in content, use of discrete symbolization for emphasis, and indirect hints that the mapped information may be incomplete, are all means by which an open-world assumption can be used. While a map is expected to either depict all minor streets, or none of them, a text has the affordance to communicate the relative importance of minor streets by only depicting some of them, or even a minor street being more important than a major one. Open-world assumptions however come at the cost of not being able to communicate some fact to be false.

A representation can neither stipulate a closed-world nor an open-world assumption, but the representation itself may suggest one of these assumptions. An experienced map reader or a person familiar with an area can, depending on the perception of the graphic symbols, e.g. the pattern of minor streets and its relationship to other features such as the pattern of buildings, assume that in fact an open-world assumption was being made, and that the mapper has deliberately distorted the representation. Our example of the disjoint map depicting only the immediate neighbourhood of characters or features, can communicate that only certain streets are depicted (Figure 9(i)).

Atmosphere. Narratives live on the atmosphere of the places and happenings of the story, because they put the reader him- or herself in the position of a character or an innocent bystander, by retracing emotions, feelings and affects. The already discussed modifications to the structure of maps help to convey a more vivid and detailed picture of a place and its inner dynamics: the open-world assumption in combination with the ‘neighbourhoods’ put emphasis on the important aspects of the story; the expressivity is increased and the level of detail is more flexible, when concepts become more dynamic and more fine-grained; and temporal aspects, e.g. represented by animations, can even convey the reason for why things happen. When a character
of the story drives, for example, to the forest and meets another character there, to finally drive back to his or her home, it is very probable that the first character drove to the forest for the purpose of picking up the other character. While such conclusions cannot be drawn in general, and can even be wrong, we are, at least in parts, able to understand how and why things happen.

Conventional maps rarely represent thoughts, emotions and the atmosphere of a place. The increased expressivity of maps with a story focus however allows for the communication of such information. The car driving character in Figure 9(c), for example, thinks about rain and carries an umbrella. This suggests that the character tries to avoid getting wet and, if this information is set into the context of a story by depicting the person running from the car through the rain to a house, it may suggest that the person feels uncomfortable when running through the rain. Texts can however still convey far more emotions.

Another, more drastic modification is the change of map style, which changes the meaning of colours and symbols in a map. Colours can evoke emotions and have an effect on moods (Hemphill 1996); and map styles are thus able to transport emotional states to the reader of the map. By changing map styles over time, and by using different map styles for the neighbourhoods of different characters, the conveyed description becomes more subjective, i.e. more dependent on the character.

In contrast to the traditional use of map styles, which are, for example, used to evoke certain feelings for certain aspects of the map when promoting a region of a country or a museum, map styles can become less consistent and more flexible. The inconsistent use of colours, symbols, and other stylistic elements can even make map styles degenerate to a much less concise and thus richer set of possible interpretations.

It is recognized, however, that despite these possibilities of a map with a story focus being able to convey thoughts, emotions and the atmosphere of a place, texts are still much more capable of transporting this information.

6 Summary and Outlook

Maps represent spatial relations and spatial features by the intrinsic properties of map space, which makes them, to a large extent, not suitable for telling stories: they emphasize space over time; the choice of scale is limited; and the concepts used in maps are less flexible, context-dependent and less situative. This article has contrasted these structural properties of maps to the ones of textual representations, which are parametrized by time; allow for qualitative spatial descriptions; are more flexible in terms of scale and concepts; afford more subjective descriptions; and often transport the atmosphere of a place.

We have attempted to identify what makes narrative text work when telling a story. This knowledge has been used to embed characteristics of a text within the map representation itself, proposing a new paradigm of design, called ‘story focus’, which, by and large, retains the affordance of maps, while introducing some of the characteristics of text. Unlike interactive multimedia maps, which can transport a story in additional media alongside the map, story focus embeds the story within the map, meaning that characteristics of the map and characteristics of texts can be mixed within the same representation. Adopting such practices in the design of maps can allow for more effective communication, engaging narratives exposed through maps, and the raising of awareness of the power of mapping to tell a story.

The most prominent similarities and contrasts between maps and texts have been tackled in this article. Future research may compare and contrast more advanced concepts of texts to maps, including the structure created by paragraphs, sections, and arcs of suspense, as well as figures of speech, such as metaphors, irony, and sarcasm – concepts that are themselves subject to current research in linguistics. It seems even natural to compare cartographic representations to other media beyond text, such as photographs, paintings, sound recordings, and music –
media that also often tell a story. In addition, map representations may be contrasted to verbal communication, which is an example of a two-way alternate communication, negotiating the meaning of words and context during the course of the communication.

The emergence of interaction possibilities, e.g. by computers or mobile devices, has led to the development of increasingly interactive maps, which have additional abilities to convey information when compared to conventional maps. The use of story focus for such interactive maps is yet to be explored, possibly leading to a more lively and more intensely experience of the story. Interaction methods may even make the reader become a player, because he or she interactively influences the story and thus identifies with one of the depicted characters, much like in a computer game.

The proposed new paradigm of design, story focus, has been discussed at prototypical examples. Further work may implement story focus as an extension to some existing web mapping framework, to make possible a detailed evaluation of this paradigm, and to identify how effective different aspects of story focus are. Telling a story with story focus involves, besides programming work, the story to be excogitated and new stylistic devices to be used. This design process is uncommon to a cartographer, because it leads to more choices that can and have to be made, compared to the design process of a conventional or digital map. The open-world assumption, for example, gives us the freedom to choose what to represent; the flexible use of scale requires the choice of the local level of detail; and conveyance of subjective information presumes to put oneself in the position of the story’s characters. How to teach cartographers the skills needed to convincingly tell a story by a map, and how to teach writers about the basics of cartographic representation remain open questions. The answers may synthesize the different creative impulses of cartographers and text authors, which may advance the concept of story focus.

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Author Contributions

Both authors jointly developed the ideas and wrote the paper. D. Fairbairn was primarily responsible for Sections 1, 2 and 4; F.-B. Mocnik was primarily responsible for Sections 3, 5 and 6.

References


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| jects                                        | jects                                        |
| spatial incoherencies and contradictions im-| spatial incoherencies and contradictions pos-
| possible                                     | sible                                        |
| strong spatial context                       | strong temporal and thematic context          |
| limited flexibility of the scale             | high flexibility of the scale                 |
| closed world assumption                      | open world assumption                         |
| possibly animated                            | static                                        |
| can be perceived in arbitrary order          | to be perceived in a contemplated order       |
| inflexible use of categories                 | flexible use of categories                   |
| more objective                               | more subjective use possible                 |
| implicit spatial index                       | no implicit spatial index                    |
| algorithmic generalization possible          | algorithmic generalization hardly possible   |

Table 1: Overview of the prototypical similarities and contrasts between the map and the text media; observe that this table only contains prototypical extremes
Figure 1: Dependencies between the structural characteristics

Figure 2: Map representations of the British Isles, showing the pubs stored in Wikipedia. (a) map, depicting the pubs by points; (b) choropleth map, decoding the density of pubs by colour; (c) cartogram, decoding the number of pubs by scale. Map © OpenStreetMap contributors (cf. http://openstreetmap.org)
Figure 3: Flexible use of scale for a city map. (a) map with uniform scale; (b) map, depicting the centre area at a larger scale than the surrounding area. Map © OpenStreetMap contributors (cf. http://openstreetmap.org)

Figure 4: Flexible scale. (a) The scale of the area inside the circle is constrained by the scale of the area outside the circle; (b) Can the map be modified such that the solid paths become twice as long, the dashed paths 100 times as long, and the dotted paths 1/100 times as long? Map © OpenStreetMap contributors (cf. http://openstreetmap.org)
Figure 5: Maps of the London Eye and the County Hall. (a) © OpenStreetMap contributors (cf. http://openstreetmap.org); (b) © OpenStreetMap contributors, Andy Allan (cf. http://openstreetmap.org); (c) © Oxford Cartographers Ltd.; (d) supplied by Map Marketing Ltd., map derived from Collins Bartholomew Digital Data © Collins Bartholomew Ltd. 2015
Figure 6: Topographic map representation of coastal moorland, Outer Hebrides, Scotland (grid interval 1 km). © Crown Copyright and Database Right 2015 Ordnance Survey (Digimap Licence)

Figure 7: Topographic map representation of coastal mud flats, Essex, England (grid interval 1 km). © Crown Copyright and Database Right 2015 Ordnance Survey (Digimap Licence)
Figure 8: Map depicting the successive losses in men of Napoleon’s army in the Russian campaign 1812–1813; drawn by Charles Minard; first published on November 20, 1869
Figure 9: Some aspects of story focus. (a) a classical map; (b) a character moving around through space; (c) non-spatial information provided for the character; (d) only the character’s neighbourhood depicted; (e) several characters; (f) the position of the tide as a temporal aspect; (g) flexible scales: the characters’ neighbourhoods with different non-uniform scales; (h) dynamic concepts: a car driver having lost his or her way and a skipper being unable to determine his or her position have very different challenges (both issues represented by the question marks), and cars and boats are locked in different ways (both cases depicted by a ‘key’ symbol); (i) open-world assumption: some paths and roads are not depicted, because they are unimportant to the character at that point in time.