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A dynamic topography for visualizing time and space in fictional literary texts

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This paper presents research on creating interactive prototypes for visualizing temporal spatial relationships in fictional literary texts. Developed within the context of the Chronotopic Cartographies project, a practice-led inquiry yielded dynamic visualizations from literary texts, the research explores the development and application of interactive three-dimensional environments illustrating the 'chronotopic', time-space relationships across a series of fictional literary texts. Expert feedback highlights the potential of the interaction model as a useful visual paradigm for supporting methods of reflective inquiry hypothesis making. The work also represents a potential model for creating interactive temporal visualizations which support hypothesis making across a broader sphere of the humanities.

1. Overview

The research was developed as part of the Chronotopic Cartographies project, a three-year multidisciplinary investigation, led by Professor Sally Bushell at Lancaster University (Bushell, 2020), exploring methods of defining and visualizing the spatial qualities of literary texts. The research outlined in this paper presents a summary of the creation of interactive, dynamic modes of visualization grounded upon the conceptual and data models created by the Chronotopic Cartographies team.

1.1 Background

The overall aim of the Chronotopic Cartographies project was to address the challenge of mapping spaces in fictional literary texts taking a non-geographical approach to free the spatial analysis of the literary text from conventions imposed by geographic or social network models. The project articulated a new approach to literary mapping, developing a 'literary topology', for mapping fictional spaces. The project explored new methods and tools for the visualization and analysis of place, space and time in literature. The project arose from a recognition of the limitations of literary geography methods (Reuschel & Hurni, L, 2011; Piatti et al., 2009), the use of network graphs and diagrams in literary studies. Moving away from geographic (GIS) based approaches (Donaldson et al., 2015; Gregory et al., 2014; Alex et al., 2019) and inspired by social network methods for mapping characters (Rydberg-Cox, 2011), the project explored Gephi generated network map visualizations created from a bespoke XML spatial markup of the texts.

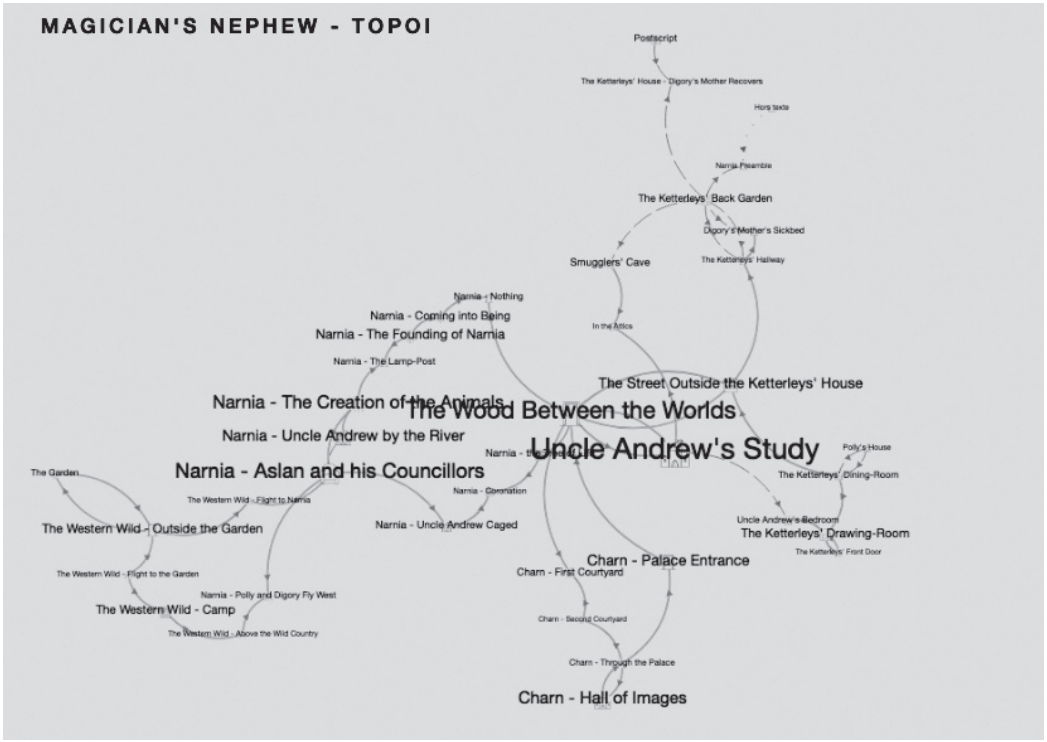

Figure 1. Hay, 2021. An example graph illustrating the literary topology of spaces identified in the novel 'The Magician's Nephew'.[1] The text describes places outlined in the narrative

The project provided a way of re-imaging the relative spatial relationships of fictional literary places; mapping them as 'literary topologies' (Bushell et al., 2021).

1.2 Aims

One of the associated aims of the Chronotopic Cartographies project was to explore the possibilities of dynamic visualization environments (Bushell et al., 2021). Although very insightful, the literary topology graph visualizations were limited due to their static nature, showing the spatial view 'all at once' and thus flattening time and space into a single perspective, as can be seen in Figure 1. The work outlined in this paper is motivated by this fact and seeks to address some of the limitations of the static graphs created by Chronotopic Cartographies. The project seeks to explore 'imaginative responses' (Drucker, 2011) to expand the potential of literary visualizations by exploring ways to add time and interactivity to visualize literary spaces as dynamic 3D environments.

2. Approach

Visualizing the relationship between time and space in a 3D environment is exceptionally challenging and there are many factors to consider (Schöttler et al., 2021). In order to explore methods and solutions, an open-ended practice-led, experimental methodology of 'sandcastle building' (Hinrichs et al., 2019) was adopted. A range of 'creative' coding environments and technologies (Bostock, 2021; Fry & Reas, 2021; Threejs.org, 2021) were explored, and a series of experimental prototypes were constructed to develop and test concepts, models, and approaches. The research drew inspiration from other experimental or novel visualization of texts developed for close or distant reading (McCurdy et al., 2015; Posavec, 2006). Related projects which explore the challenges of visualizing data as 3D information landscapes (Goldfarb et al., 2011), and temporal visualizations of cultural data (Stange and Dörk, 2016; Boyd Davis & Kräutli, 2015) also informed the project. Initial experiments with space-time cube visualizations, commonly used for visualizing relationships between time and space (Nöllenburg, 2007), highlighted limitations and complexities and suggested that this approach would lead to a degree of visual complexity which would render the visualizations difficult to parse and read (Bach et al., 2014; Aigner et al., 2011). An alternative to conventional 'space-time' visualization was developed by combining spatial and temporal attributes into a coherent visual 'landscape'. The concept envisaged adding a 'time' value as a vertical projection up from objects on the network diagrams of literary topologies of the Chronotopic Cartographies project, building a temporal 3D landscape onto a spatially organized ground.

3. Data

3.1 Literary time-space (chronotope)

The concepts and decisions regarding the 'data' for the project, i.e., how space and time are identified in a literary text, were established as part of the research developed by the literary experts in the Chronotopic Cartographies team and centered around Bakhtin's (1981) notion of the 'chronotope'. The chronotope describes the way in which different literary genres (adventures, romances, *bildungsroman*, for example) represent space and time, which for Bakhtin are inseparable in literature. In his essay 'Forms of Time and of the Chronotope in the Novel', Bakhtin gives a number of examples from the history of European literature to illustrate this concept. For example, in classical Greek romances, the distance between the opening of the story (the meeting and separation of two lovers) and the conclusion (their eventual happy marriage) can be indefinitely postponed by innumerable adventures. Although these adventures have a real purpose within novels of this type, in that they provide the substance of the story, the fact that they have no psychological impact on the characters nor bearing on the ultimate conclusion of the story means that they lie, in Bakhtin's words, 'outside biographical time'. Such a representation of time is not naturalistic—that is, it does not seek to realistically depict the passing of time as experienced by these characters. Such stories unfold in 'adventure time' (p. (Bakhtin, 1981, p. 90), and as such follow a logic of 'random contingency': coincidences, chance meetings, sudden occurrences. In order for this narrative logic to play out, space must be similarly abstract. For characters to meet in the right place and at the right time to intervene in the narrative, space must be malleable, and therefore must be similarly non-naturalistic in its representation.

The chronotope of the Greek romance is therefore defined by Bakhtin as:

> [A]n interchangeability of space; what happens in Babylon could just as well happen in Egypt or Byzantium and vice versa. Separate adventures, complete in themselves, are also interchangeable in time, for adventure-time leaves no defining traces and is therefore in essence reversible. The adventure chronotope is thus characterized by a *technical, abstract connection between space and time*, and by the *reversibility* of moments in a temporal sequence and by their *interchangeability* in space. (Bakhtin, 1981, p. 100)

This particular conjunction of time and space is what constitutes the essence of stories of this type: in short, what constitutes their genre. Bakhtin's essay goes on to show the way other types of narrative are constituted by their differing modes of spatio-temporal representation. Chronotopic Cartographies took this concept of time and space in literature and sought to use it as the basis of a form of mapping appropriate to literary studies. That is, one that can bring to visual representation the distortions of space and time inherent to fiction.

3.2 XML source

It is also worth noting here that the question of what constitutes 'data' in the context of literary studies is not necessarily straightforward. The texts the research team worked with on Chronotopic Cartographies can be considered data in the sense that they are digitized versions of printed works. Recent advances in natural language processing and machine learning have made 'unstructured' text data of this sort amenable to computational analysis, allowing them to be analyzed using quantitative methods, so as to identify patterns within individual works (stylometry) or broader trends across large textual corpora (Moretti, 2005). Chronotopic Cartographies took a different approach. The data with which it was concerned were narrative forms, expressed spatially and temporally, within the literary text. These textual features are structural: that is, they are the 'building blocks' of story, considered as a network of spaces and times. The boundaries of these spatio-temporal units are much more subjective than linguistic features, and therefore much more difficult to extract computationally, and defining them constitutes an interpretation (or reading) of a text. In order to make these features processable by the computer, it was therefore necessary to devise a data model to represent them, and, using XML markup, to provide structure and semantic data to allow them to be visualized and manipulated. In this context, literary data are not strictly speaking the texts themselves, but the structure and semantic annotations added by XML markup. In this respect, the acknowledged subjective nature of the data reflects something of the notion of data in literature as 'capta', i.e., what is acknowledged to be actively 'taken' and constructed rather than as being a self-actualized pre-existing entity (Drucker, 2011).

Using Bakhtin's notion of the chronotope (Bakhtin, 1981) as a way of conceptualizing literary time-space as its conceptual base, the Chronotopic Cartographies team developed a bespoke XML schema, to 'chunk' a wide range of fictional literary texts in terms of individual chronotopic, 'literary time-space zones. Attributes of individual passages were classified into a series of connected spatial entities or passages, or 'topos'. Each passage was given a specific 'type', corresponding loosely with the notion of 'setting' or, 'chronotype' (for example 'idyll' 'castle' or 'road'), and 'framename' attribute, a reference to the place name mentioned in the narrative (for example 'The Town' or 'The Island'). The spatially annotated XML markup of literary texts created the data and the conceptual base for the remaining visual experiments.

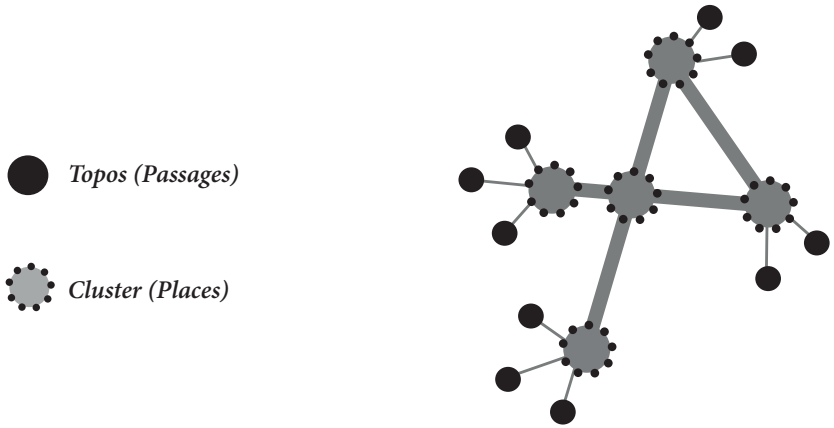

Figure 2. An illustration of the network which defines the spatial organization of passages and places. The force-directed structure is used to organize spaces and form the ground for the visualization

4. Visualization

4.1 Aesthetic approach

The core concept which informed the visual aesthetics throughout was that of the fluid landscape from text. This approach was taken to deliberately avoid 'hard edged' visuals in favor of a softer visualization style in which data entities combine and merge into mountain peaks and ranges. The concept of the text as landscape was developed as a way to visually reflect the subjective fuzziness of literary spaces and create an interpretive environment to prompt exploration. Design decisions throughout the project reinforced this concept; labels were added as waymarkers to signpost objects in the landscape and connections between spaces are shown as pathways which crisscross the base of the map. Using the bespoke XML source, created by the Chronotopic Cartographies team, spaces on the landscape were visualized horizontally, as network of connected objects defining the spatial 'ground', and vertically with height values, using Three.js (2022), to illustrate and animate the flow of the narrative across the spaces as emerging mountain peaks.

4.2 Space: Horizontal ground

Objects were initially configured into a spatially organized network graph along the horizontal plane. A combination of force-directed calculations from the D3 framework (Bostock, 2021) defined the spatial relationships between places and passages. A combination of attraction and repulsion forces were used on each of the objects to create a visualization network which illustrated both the narrative connections of the passages in textual sequence and their association with specific spaces identified from the core spatially marked up XML data. In this way a network 'map' of the text was created, which showed the spatial relationships between each of the passages to each other and to their shared spaces. Figure 2 gives an illustration of this network map. The force-directed visualization approach was selected as the most appropriate way to represent the network map, as it was consistent with the Gephi-based force-directed calculations used to generate the 'literary topology' of texts in the main Chronotopic Cartographies project. The result was that text passages were spatially organized, relatively positioned according to their connection with

each other and to shared places in the narrative, rather than on approximate geographical proximity. This network configuration forms the 'base ground' onto which the vertical temporal attributes were added.

4.3 Time: Vertical terrain

Height values were subsequently added to each object on the map, to visualize the proximity of each passage to the user's point in the story and illustrate the effect of narrative time on each of the spaces. The concept of narrative time follows that which was defined by the data model in the Chronotopic Cartographies project, i.e., a sequence of discrete chronologically defined text passages. This approach is adopted by this part of the research for reasons of continuity. Although there are many other ways to think about narrative time within literature (flashback, memory, etc.), using a linear time sequence in this instance helped to keep the project within definable limits and allowed the work to focus on the visualization of spaces, without additional complexity. By using this approach, each passage was given a time value, a fixed value corresponding to its location in the chronological sequence of the narrative. A single, global, point-in-time value was also added to track the user's *current* position in the text as they navigated through it. The distance between these two values was calculated as a 'narrative' proximity of each passage which was visually translated into the vertical height attribute given to each object. In this way, passages close to the user's point in time appear higher than those further away, as illustrated in Figure 3. Height values therefore visualize the ebb and flow of the changing prominence of places and spaces during the narrative. The height values were combined with corresponding width values calculated according to the size (the word count) of each passage and combined to generate a three-dimensional surface, a 3D heatmap, as shown in Figure 4.

4.4 Additional features

Additional visual attributes were added to reinforce the idea of the explorable map, aid the communication of the features in the environment, enhance the user experience, and allow multiple ways of seeing, filtering, and exploring the visualization. Figure 5 shows a screenshot of the visualization with the added elements on the interface—for example, tags and labels were added to each of the spaces on the map, and a pathway of lines were added to the ground. A menu of labels was added to allow the places on the map to be viewed and filtered according to their chronotype. Interactive controls were added to allow users to explore the visualization from multiple viewpoints, angles and levels of zoom.

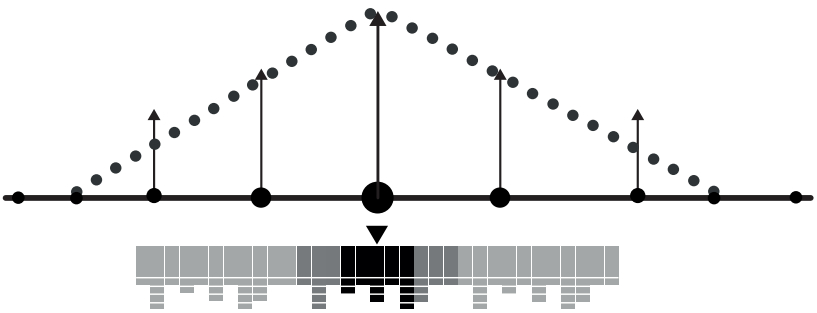

Figure 3. An illustration of how the height values for each passage are calculated according to their proximity to a given point along the narrative timeline. The scrubbable timeline sets the number of passages to be included

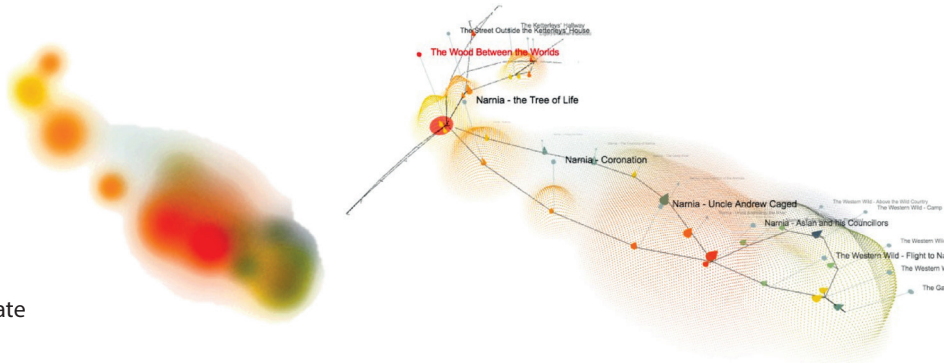

Figure 4. The height and word count values are used to generate a heat map bitmap (left) which is translated into the three-dimensional surface (right)

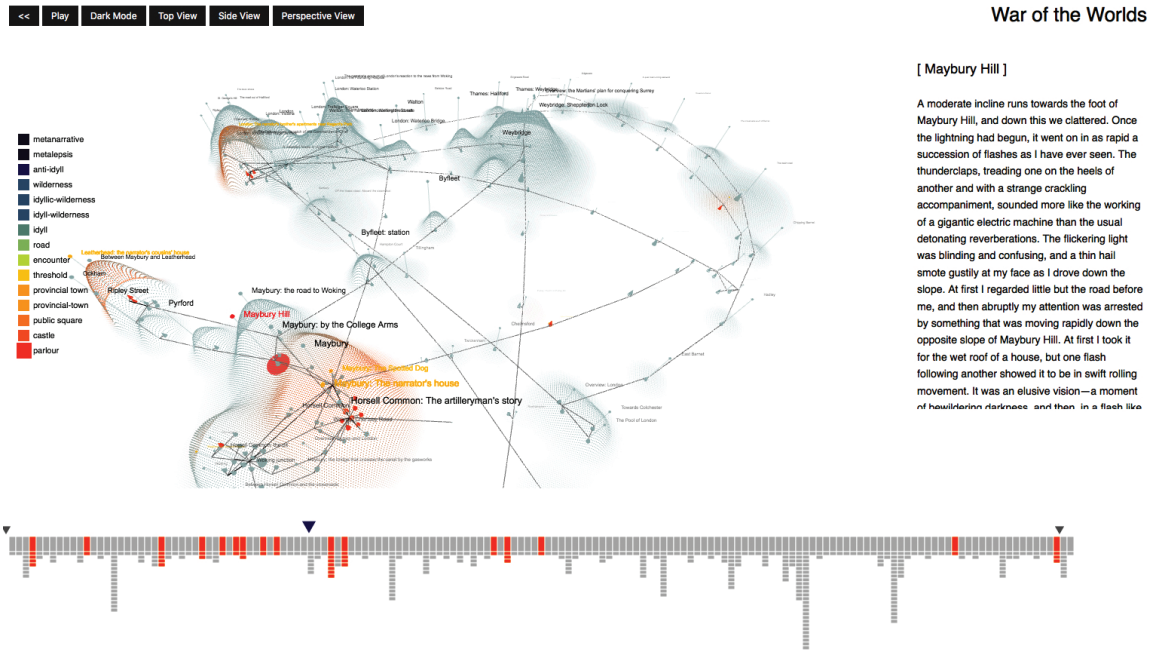

Figure 5. A screenshot of the visualization prototype.[2] The map in the center is generated from the text. The text on the right of the screen is an extract from the original text, in this case, 'War of the Worlds'. Labels on the map highlight spaces in the text

A scrubbable timeline allows users to move and read through the text, either by moving through the passages in turn or jumping to select a specific section. The timeline also allows adjustments to be made to the time span settings, which determine the range of the narrative 'spotlighted' on the visualization. At all times there is a link to the full source text, so that viewers are always able to read complete extracts from the source novel or poem at each point along the timeline. The link also allows viewers to view the map in relation to the original text.

5. Outcomes

Each text passage is visualized on the map *horizontally* as part of a network of interconnected spaces, and *vertically* according to its proximity to a given point in the narrative. By combining space, width and time values, a dynamic 3D dynamic surface is created which translates the relative positioning, narrative proximity and word count of each passage into an undulating surface generated from the text.

5.1 Horizontal network

The configuration of the ground network is generated from intrinsic narrative associations rather than from geolocated positions, and reveals the relationships, associations, and proximities indicative of the spatial organization within the text. This reflects the literary topologies created in the Chronotopic Cartographies project. Initial observations of these configurations reveal four main visual features, hubs, clusters, chains and loops, as seen in Figure 6, which are suggestive of underlying patterns within the literary topology (Bushell et al., 2021). Hubs are groups of connected topoi linked around a specific place and suggest significant or often visited places in the narrative. Clusters are items which are grouped closely together and are suggestive of closeness, both in terms of their proximity in the narrative and of having connections to shared places. Chains are regularly spaced passages which are signifiers of narrative flow, indicative of a directional narrative journey. Loops are figure-of-eight shapes which are suggestive narratives that are structured around places that are often revisited in a story.

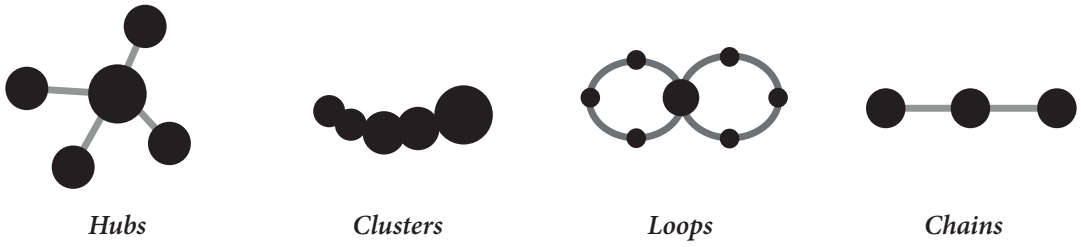

Figure 6. Spatial configurations of the horizontal network, characterized as 'hubs, clusters, loops and chains' which reflect features of the underlying literary structure

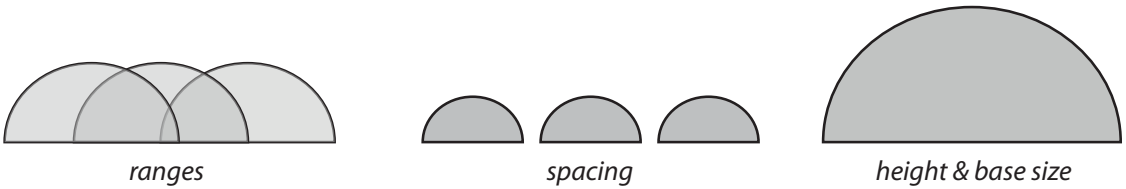

Figure 7. Temporal, vertical features. Shapes and sizes of peaks and ranges give insight into the nature and significance of spaces in the narrative

5.2 Vertical forms

The shapes of the vertical distortions, the peaks and ranges, provide insight into the flow and change in significance of the places during the narrative. Peaks are created by a combination of height and width values; height being determined by the proximity of the corresponding passage to the user's point in the narrative (i.e., its narrative 'prominence'), and a base width representative of the number of words contained within the passage. The overall shape and size of each peak is created by combining these values. This provides visual cues both to the significance of each passage within the entire text as well as its prominence at a specific point in the narrative. Narrow and high shapes can be seen to represent textually short passages which have prominence at the current narrative point. Broad but shallow shapes indicate passages which are more narratively distant, but which contain a significant portion of text within the original writing. Whilst individual passages create single peaks, groups of clustered passages, which share spatial and temporal proximity, emerge as mountain ranges which indicate collections of passages which have collective significance in the text. These features are summarized in Figure 7.

5.3 Movement

The animated flow of the landscape, as the user scrubs along the timeline, gives a view of the changing spatial structure and of the way in which the story moves between literary spaces. As the user explores the narrative and scrubs along the timeline, peaks and ranges emerge. These peaks and ranges change in shape and size to reflect the changing significance of places as they get nearer to or further from the reader's point in the story. Passages with the closest narrative proximity emerge and grow as peaks, whilst those further away diminish and vanish. Spaces which are visited briefly, as the movement of the story passes from one place to the next, quickly rise up and then fade down, as shown in Figure 8. Spaces of lasting significance to the story, which are never far from the core of the narrative, remain with more visual prominence on the map for longer periods of time, as illustrated in Figure 9. In this way a type readerly experience of encountering and foregrounding places is visualized. The outcome is an interactive visualization, a shifting landscape of peaks and ranges generated from a text, whose spatial configuration, changing size and shape reflect spatial and qualities within the narrative. The visual environment is interpretive; users can explore

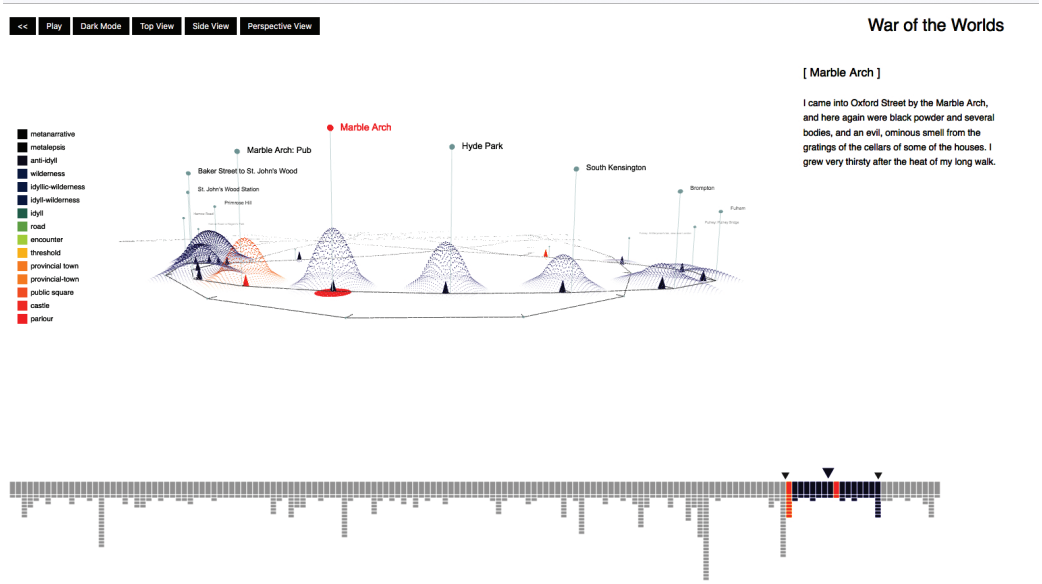

Figure 8.
Chains of regularly spaced passages are indicators of narrative flow, indicative of a directional narrative journey, as this example of the movement of the story during the narrative of the 'War of the Worlds'[3]

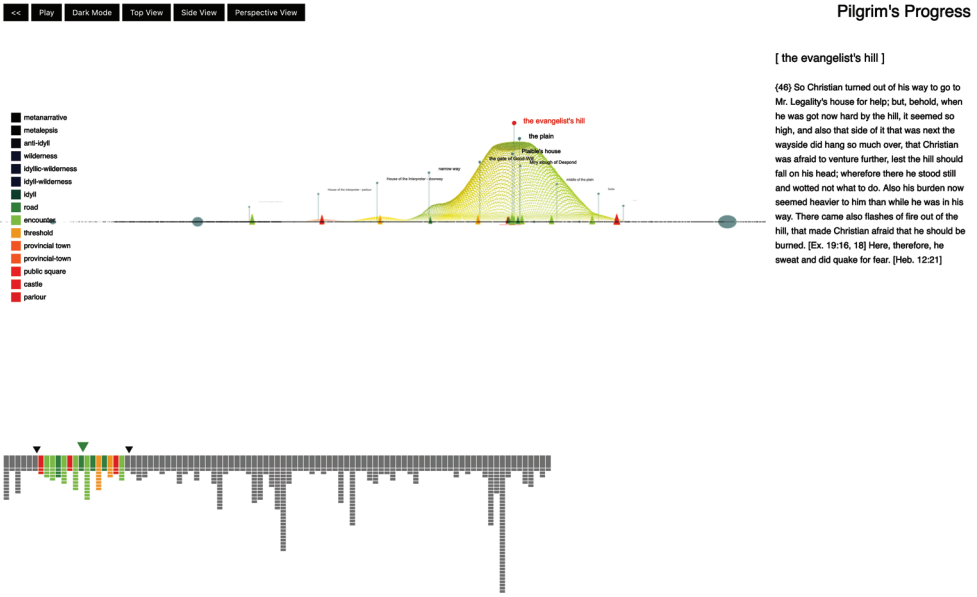

Figure 9.
Places in the narrative of lasting significance emerge as larger peaks on the terrain, as this example of 'Evangelist's Hill' from the 'Pilgrim's Progress'[4]

the way in which the spaces in the text change and develop throughout the narrative, and the deliberately fuzzy edges between spaces as they combine and merge suggestive of the overall nature of the spaces and their relationship to one another.

The landscape does not render direct clear insights but instead provides opportunities for reflection and analysis to support an open-ended 'activity of interpretation' (Drucker, 2011).

6. Evaluation

Feedback was gathered via a series of informal evaluation sessions with the team of literary academics who worked as part of the wider Chronotopic Cartographies advisory team. Each person was asked to select a specific text for visualization and to provide feedback via semi-structured interviews along with the visualizations, followed up by written reflections and comments. The texts selected for feedback included *The Pilgrim's Progress* by John Bunyan, *The Voyage of the Dawn Treader* by C. S. Lewis, *Strange Case of Dr Jekyll and Mr. Hyde* by Robert Louis Stevenson, *and Home at Grasmere* by William Wordsworth. Each participant was asked to spend time exploring the visualization environment and to comment on the impact of the aesthetics, interactive functions, any insights that the visualization reveals or re-enforces and the overall effect of the visualization as a model that supported their work as a literary scholar. The users commented positively on the value of the environment as one which supported *a* reflective mode of speculation, inquiry and imagination to inform their thinking and develop ideas about the texts. During the feedback sessions users reflected on the way that the interactive controls, especially the scrubbable timeline, were used as a way of interactively reading the text. The participants commented on the way in which the environment foregrounded the spatial organization of a text based on its own intrinsic structure; revealed the flow between literary spaces during the narrative; and provided a valuable metaphorical construct as an aid to speculative and critical enquiry, as one user remarked, a "springboard for hypothesis making".

6.1 Visualization of movement and flow

The feedback highlighted that users valued the ability to explore the movement of the narrative across spaces by using the scrubbable timeline. This feature enabled users to move backwards and forwards through the narrative and to observe the changing size and shape of the spaces and the flow of the connections between them.

Users commented particularly on the way in which the interactive timeline not only revealed the expected significant narrative places (e.g., The Wood Between the Worlds in C. S. Lewis's '*The Magician's Nephew*'), but also brought new insight and attention to the in-between connections and 'bridging spaces' in the narrative, which would be otherwise not possible to examine. A comparative study of two structurally similar C. S. Lewis texts (*The Voyage of the Dawn Treader* and *The Magician's Nephew*), for example, showed that whilst both texts have similar spatial structures, the time flow visualization revealed key differences in the nature of mediating 'bridging' spaces, which revealed key differences in the way in which the narrative flowed between key places, as shown in Figure 10. In this way the visualization was able to unlock previously unnoticed differences in the structural qualities of text and create a base for closer critical study. Users also commented on the way in which the differences in speed and shape of the animated flow of shapes over the surface could be read as being visual indicators which visualized changes to the narrative voice. The user studying the Jekyll and Hyde visualization noted how the speed and type of movement across the landscape were illustrative of changes

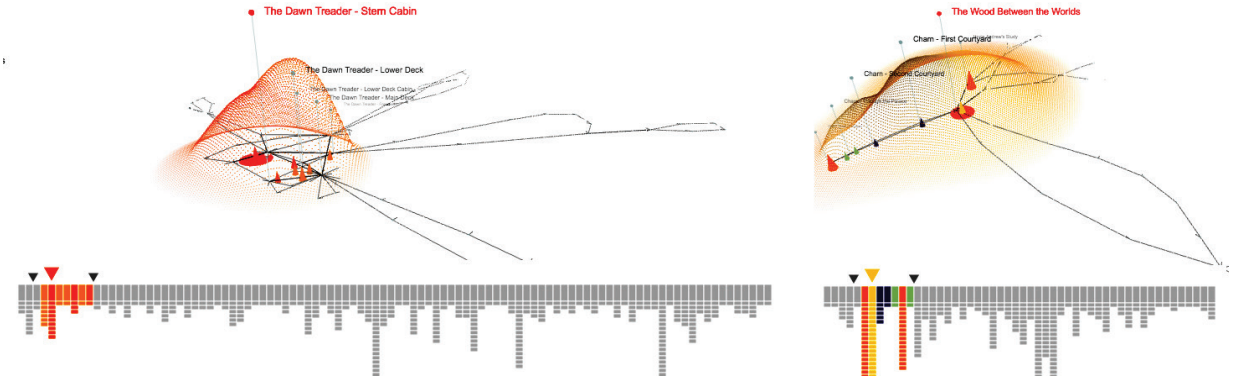

Figure 10. A comparison between bridging spaces in two similar novels—Dawn Treader (left) Magician's Nephew (right) reveals differences[5]

in narrative style and voice—short, small, "jumpy" peaks on the visualization reflecting periods of intense character energy and movement, whilst slow movement and larger peaks were read to be "signifiers of character introspection". This insight confirmed something that the academic was already aware of. The revelation in this case was the idea that subtle changes of narrative voice or style, hidden in text, was clearly *seen* through study of the visual and animated qualities of the shapes across the surface. The significance of this can be seen in the feedback from an academic who wrote that "the capacity [of the visualizations] to … capture the movement of the text from beginning to end improves on every existing representation of literary space that I have ever seen".

6.2 Immersive, explorable landscape

Comments and observations from participants made positive reference to the impact of the overall aesthetic language of the environment, and to how the "landscape of text" acted as an "evocative visual aid" for critical thinking. Participants highlighted how the visualization of texts into a 3D landscape, explorable from multiple viewpoints and perspectives, provided a rich visual metaphorical environment for reading the texts in a way which echoed elements of critical vocabulary and "aided thematic thinking about literary space". For example, commenting on the visualization of Bunyan's Pilgrim's Progress, one user noted that the landscape of the text served to add a new layer comparable with the metaphorical landscape used within the story, noting how "it elevates other places because of their significance, overlaying Bunyan's authorial topography with one generated by the book itself". Another participant commented on the way in which the visualizations emphasized the importance of seeing Wordsworth's poem Home at Grasmere entirely as a spatial construct, commending on the way in which the visualization, with its affordance of viewpoint and perspective, "re-enforces the verticality of poem" and enables new

spatial reading of the text for "developing a new critical vocabulary".

The feedback from participants revealed how users gained individual insights into their texts. Most importantly, the feedback overwhelmingly reinforced the potential of this visualization model for enabling a reflective mode of seeing, exploring and reading texts which has the potential to sit alongside other critical reading methods. Many users commented on how the visualization helped them to think about the texts in a new way. Several users made comments about the potential of these environments, and how they could be used with their students as an aid to thinking and reflection. As one user commented, "these are potentially enormously valuable as ways of visualizing features of literary texts [and] improve on every existing representation of literary space that I have ever seen".

7. Reflections and future work

This work responds to both the specific challenge of the Chronotopic Cartographies project, that is, to develop tools to show the movement of spatial qualities in literary texts, and to the broader challenge to explore imaginative responses for developing visual environments to support humanistic inquiry. In terms of the project-specific challenge, participants highlighted how the open-ended fuzziness of the 3D environment helps develop insight into literary texts, encouraging exploration, reflection and enquiry; not via a singular authorial stance of visual truth telling, but through a suggestive environment designed to evoke "hypothesis forming". In this respect development of these experimental environments have the potential to support new forms of literary reading and analysis (Bushell et al., 2022), a middle ground somewhere between close and distant reading, in which the visualizations play an active part of interpretation.

In terms of addressing broader concerns around developing speculative tools for humanities visualization, there is evidence to suggest that the approach taken here does go some way towards developing ideas of spatial representation over time and has produced dynamic visualizations which begin to "break the grid" (Drucker, 2011) of traditional graphical display. Feedback illustrates how the results of the novel approach, which was supported by the project, represent an imaginative step which can support other dynamic, suggestive and interpretive environments. For example, the fuzzy edges and spatial distortions of the surface which are developed in this model, subject to calculations based on the proximity and word count, could be re-applied to visualize other metrics of significance within a document, such as levels of emotion. The authors also recognize the limitations of the prototypes, especially in terms of supporting more flexible notions of temporality. However, it is possible to see how the dynamic forces which locate the relative positions of objects on the ground of the map could also be made subject to change by external data values which could realign the network configuration and alter the relative positions.

In terms of future development, it is possible to see how this model can be adapted and developed toward other aspects of literary study; the spatial and temporal map could, for example, be applied to visualize the literal or emotional journeys of characters within text. Another immediate potential area for future development would be to consider how the addition of extra surface layers to the visualization could be used to show the way in which some texts move between multiple worlds or universes. The 3D interactive nature of the environment also has the potential to be reapplied within a broader sphere of digitally immersive environments, such as augmented or virtual reality experiences. This would allow this model to be used in the creation of explorable, virtual landscapes of literary worlds generated from the texts,

and to open up new encounters and experiences of the texts which can be explored by a user group beyond the literary experts.

8. Conclusion

This paper has presented an exploratory prototype visualization for mapping and visualizing the spatial qualities of literary texts. The combination of horizontal spatial representation together with the temporal vertical visualization of time developed into a fluid terrain has provided a useful and evocative environment from which new insights into familiar texts can be gained. Evaluation and feedback have shown how this approach can encourage more open-ended and interpretive studies and readings of literary texts—the visual language of the landscapes promoting new ways of expressing and thinking about the texts. In addition to this, the visual model created in the project and the introduction and representation of time as a 3D terrain make it possible to explore ways in which visual significance around time or spaces can be represented and has the potential to be re-applied to other areas of humanistic data settings and scenarios.

The work also contributes to the wider discussions concerning the role of visual models for analysis of humanistic data within the broader sphere of the digital humanities. The interpretive nature of the landscapes encourages explorative modes of enquiry which open up new perspectives on familiar source materials and provide a departure point for further critical study. As such, this prototype can be considered to be a move away from positivist models of visualization and towards a more interpretive one—one which encourages a visual approach to hypothesis making (Jessop, 2008; Champion, 2017). Making the visualization alongside humanities scholars has been a valuable experience and it would be useful to see future development of this environment work in tandem with academics and researchers from across other areas of the humanities. There is more work to be done in this arena. Nevertheless, this project should be seen as a stepping stone and reference for ongoing development into wider issues concerning the visual representation of humanistic data for the digital humanities.

Notes

1. https://www.lancaster.ac.uk/chronotopic-cartographies/

2. http://agrichardson.com/chrono/

3. http://agrichardson.com/chrono/

4. http://agrichardson.com/chrono/

5. http://agrichardson.com/chrono/

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