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Publishing Complexity in the Digital Humanities

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Abstract When we talk about characteristics of Digital Humanities (DH), digital publishing certainly is a prominent domain to mention. Open access papers and books, blogging, collaborative writing, and digital editions have become deeply rooted in the DH, reflecting a self-confident culture of Open Science. The rational constitution of our writings, however, has received far less attention: How can we design digital publications that mirror epistemological implications of DH methods and the composition of our arguments and narratives better than current publishing formats? In this paper, I argue that the DH need formats that exceed traditional texts and their rather linear design. Digital publishing that provides (meta) data or remarks on applied methods as mere supplements would not be enough, too. Those elements are integral parts of a scholarly demonstration and they should be presented as such. They must be visible as constituents of our sense-making. We need media that depict the complex nature of data-driven research. Interlinked and multimodal digital publishing seems to lead in the right direction. I elaborate on this matter from a theoretical point of view by building on research on hypertext. I will also point to first successful attempts of implementation. Refining these approaches promises to facilitate the presentation of intricate sense-making in the DH.

Keywords Digital publishing. Hypertext. Visualization. Multimodality. Structure of arguments and narratives.

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> The problem with creating sequential documents is this: any sequence cuts connections, just as any grouping omits items. The cutting of connections is the loss of information.
> The problem is worsened with publication. Usually, a document submitted for publication has content edited out. Information is lost, content is lost, connections are lost, often forever.
> Before hypertext, these problems were intrinsic to writing and publication.
>
> (Nelson 2002, 24)

> Design is making sense of things.
>
> (Krippendorff 2006, xiii)

1 Introduction: The Challenge of Communicating Complex Findings

In the Humanities, scholars frequently apply diverse and often interdisciplinary methods while examining a broad range of objects and contexts. They do so to cope with the complex character of a multifaceted research topic. Along the way, they must thoroughly reduce complexity. The latter is a well-known challenge to research and writing a publication alike. Despite this accustomed enterprise, a particularly complex research project can lead to a feeling of limitation when findings are to be expressed in a text. The problem here is the sequential structure of traditional text itself. It conflicts with the author's intention of laying out the intricacy of research. Complexity would get too much reduced. New formats of publishing emerge in reaction.

William G. Thomas III and Edward L. Ayers give us an early example. Their Digital History project *The Differences Slavery Made* (1993) deals with the significance of slavery for two selected counties, one on each side of the front line during the American Civil War. The two historians mainly seek to unravel the intertwined political and social structures of Franklin County (Pennsylvania) and Augusta County (Virginia). This goal led to an online publication with an interlinked design, including collections of digitized source texts and GIS maps. Ayers and Thomas reason about their publication format:

> Our principal goal was to fuse the electronic article's form with its argument, to use the medium as effectively as possible to make the presentation of our work and its navigation express and fulfill our argument. As a result, this piece of electronic scholarship operates on several levels to connect form and analysis. (Thomas, Ayers 2003, 1299-300)

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This "applied experiment in digital scholarship" (Thomas, Ayers *The Differences Slavery Made*, Key = TI1)[1] attempts to use "a language of exposition that works by branching and layers and connections rather than operating on one plane of exposition" (Key = TI3). In other words, the two authors go for a visible disentanglement of an intricate historical phenomenon in order to make this very intricacy comprehensible.

The Differences Slavery Made is but one example. Since its establishment in 1993, DH research and publishing have highly evolved and diversified (Blanke, Pierazzo, Stokes 2014). We now have a broad range of tools to create e-books, enhanced publications or rich internet publications, as Breure, Hoogerwerf and van Horik (2014) classify different types of digital publishing formats.

Nonetheless, the DH have scantly reflected on these new formats as opportunities to mirror and "fulfill" (as Thomas and Ayers put it) scholarly argumentation and narrative. Only few scholars reason about further enhancements, about potentials and limits of digital knowledge representation. Other subjects dominate the discourse about digital publishing. For instance, we hear a lot about Open Access as a fulfilment of Open Science. Other points of interest are data publication, standards for object representation, or semantic web features in machine-readable publications and editions. Furthermore, the DH community addresses weblogs as a means of open and social publishing. Finally, multimedia and transmedia traits play a big role, such as embedded video clips, images, links to other online resources etc. In this context, elements other than the 'actual' written demonstration are mostly seen as useful "supplements" (Breure, Hoogerwerf, van Horik 2014). Media-rich publications then mimic the sequential text flow along fixed sections and chapters, as Leen Breure, Breure and van Horik (2014) have pointed out, but they do not "connect form and analysis" in the sense of Thomas and Ayers. This is even more true for e-books (Drucker 2009, 165-74).

One might ask, why should we reflect on this subject on a general level, beyond individual approaches like *The Differences Slavery Made*? After all, Thomas and Ayers went for a new publication format specifically suited for their own purposes. There is always a particular research design to be considered. Unique, too, are the argumentative and narrative structures that authors plan to play out. Any publishing design must respect this specific setting – form follows function.

Quite common practices of DH research and demonstration indicate that a broader consideration is indeed required: Scholars regularly release their data and meta data and must refer to them in their

1 Thomas and Ayers published their article as an XML-based website. Each page has a 'key' as an identifier.

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publications. They often assemble complex relations between information chunks when interpreting the contextual use of linguistically analyzed terms. Additionally, they refer to collocation results to support their interpretations. They relate those findings to topic models, further elucidating computational techniques and other applied methods. Data visualization has become a prominent part of DH projects, too. Scholars frequently point to a visualization and its parts in their remarks. By doing so, they give multiple references crossing two different media forms. We might add manifold other practices of complex relation building and transmedia discourse that are typical for the DH. As a subsuming headline, however, we can note: Scholars connect plenty (meta) data, seek to represent it in comprehensible ways, and derive conclusions from these procedures. The entire process must be laid out transparently in the final publication. Here we do not have a mere 'documentation' of used material, applied methods, and derived results. In fact, scholars represent these elements as constituents of their *sense-making*. It does not seem too keen to claim that there is something intrinsic to most of DH research that corresponds with interlinked, media-rich publishing.

Therefore, general reflections on this matter are justified. Theory of digital publishing in the DH comes into play. Theoretical perspectives can provide orientation for at least two contexts: Firstly, they can function as a backdrop for new projects that strive to implement a fitting publication format. Secondly, theory can inform basic research on digital publishing, in order to guide the development of flexible publishing tools.

In this sense, I would like to offer an approach based on hypertext theory. 'Hypertext' is a conceptual term for a digital medium that corresponds with the sketched understanding of digital publishing. In fact, the invention, theorization, and development of hypertext have mainly been motivated by the quest for such new publishing formats. As a medium of non-linear linking of information chunks ('nodes'), it has been an object of interest for a long time and by many disciplines. This trend reached a boom in the 1980's to the 1990's and has declined ever since.

In the following sections, I would like to argue that this depreciation happened for the wrong reasons. Hypertext and its theory still have a lot to offer when it comes to concepts of complexity publishing. This potential has stayed concealed until now. I will show that hypertext was over-hyped, as the hype primarily rested upon utopian visions for the digital medium. 'The end of the book' or the fulfilment of post-structuralism are only two narratives to be mentioned. These bloated expectations led to disappointment and dragged down the interest in hypertext. Furthermore, most of the research has focused on network-like hypertext, meaning that nodes are interlinked as a web. Readers may open up 'pathways' through this web on their own.

In contrast, I will favor a multi-linear design, hypertext that branches in pathways right from the start. This means a reduction of the medium's potential of linking information in any direction, but it is a gainful reduction. For authors normally strife to demonstrate those meaningful relations *they* consider essential. They play out *their* sense-making, consisting of *their* arguments and *their* narratives. All this structuring work leads to *specific* constellations that are complex but rarely follow the logics of a network. In addition, I will address visualized hypertext. A reader gains more insights into the author's complex sense-making if she sees a visualization of the inherent connections and paths. Coherence itself becomes depicted, visible at one glimpse. This adds a powerful quality to hypertextual publishing formats.

I will start with a brief characterization of hypertext. For a better understanding, I will also sketch major motivations that led to the intense engagement with this digital medium and its theory as well as reasons for the dwindling engagement. My paper is no place for extensive remarks, but the short demonstration is necessary to understand my plea to revive hypertext theory for 'publishing complexity'.

2 Hypertext: An Extended Form of Writing

'Hypertext' describes a very broad concept. Its nodes might consist of text, video clips, images or any other media product that is cohesively closed. They are connected by hyperlinks ('edges'). Ted Nelson (1965) coined the term, building on earlier concepts, particularly by Vannevar Bush and Douglas Engelbart. Nelson's main idea was to understand text freed from its traditional linear composition. He thinks of hypertext as "the extended, generalized form of writing" (Nelson 1993, 0/3)[2] and states: "Well, by 'hypertext' I mean non-sequential writing – text that branches and allows choices to the reader, best read at an interactive display" (0/2). This generic conception still counts as a minimalistic definition, although later hypertext research has conceptualized a lot more features. In practice, hypertexts may look very dissimilarly. The above-mentioned media formats of the nodes might be different. The overall hyperlink structure might form varying patterns, too. Technological implementation also is not predefined. All in all, 'hypertext' can refer to many things that share only the minimalist definition of a modular and interlinking digital medium.

2 Nelson resets the paging in every chapter of his book. The pagination therefore consists of a number for the chapter and one for the page. Accordingly, the indication above refers to chapter 0, page 3.

2.1 Overrated or Overinterpreted? The Rise and Demise of Hypertext Research

Due to this open concept and the notion of 'overcoming' structural limitations of printed text, different disciplines and various approaches turned to hypertext. Besides computer science and media studies, literary studies became a prominent domain for hypertext research. In all these areas visionary hopes and apotheotic praises arose. For instance, Nelson himself saw an educational revolution on the horizon. He imagined every piece of literature united by "a system of interconnected writings" (Nelson 1993, 2/9). Anyone could explore it online. His famous project *Xanadu* is dedicated to this vision of a "docuverse" (2/53) that would render every library in the world obsolete. Furthermore, poststructuralists like George P. Landow (1992) imagined publishing that would dissolve the concept of finished works. Hypertext would allow for a processual, 'rhizomatic' writing. No one could identify a clear authorship anymore. For poststructuralists, the "death of the author" (Barthes 1977) or at least the end of her authority over the reader seemed near. Others have seen hypertext as a collaborative medium. Members of a writing project would be able to produce their own nodes, connect them to the contributions of others, and in consequence build a many-voiced work. Moreover, hypertext was regarded as a universal paradigm for postmodern societies. In this view, the existence of fixed and stable identities (of societies, social groups, or individuals) was abandoned. Identities would have to be formed contextually. This way of thinking found its counterpart in the flexible design of hypertext networks that a reader could browse freely, thus manufacturing own constellations of information (Krameritsch 2009, 419-25). Beyond that, does not the World Wide Web or our highly interconnected communication practices in the digital age reflect the logics of hypertext networks? The WWW is based on the Hypertext Transfer Protocol (HTTP) and the Hypertext Markup Language (HTML), after all. Here, the reference to the medium is not just metaphorical but a technological one.

This roundup already illustrates how hypertext was considered no less than 'the next big thing' by many proponents. In the boom era of the 1980's and 90's, revolutionary visions and high hopes were projected into it. This explains the theoretical drive that accompanied the medium from the very beginning. However, hypertext has not revolutionized scholarly publishing. There are two major reasons for this failure:

Firstly, practical reasons stood in the way. Hypertext editing was no easy business due to lack of intuitive tools. At the same time, scholars were (and still are) trained to fashion traditional texts. The customs and competencies necessary to produce texts greatly differ from the skills needed to link information chunks – hypertext production

can be wearisome. Another practical reason for the small use goes back to reputation criteria in academia. Until today, most scholars want to see their papers in prestigious journals and their books published by well-known publishers. That promises quality assurance, visibility, and in the end reputation. Reputation is a crucial currency in academic discourses. In this context, traditional publishing still benefits from powerful – historically grown – incentive structures.

Secondly, interest in hypertext itself declined because of disappointment in hypertext theory. Few visions and promises turned out to be true. As they revealed themselves as mere "media philosophical utopias" (Winko 2005, 137; Author's transl.), believe in hypertext research ceased in the new millennium. The label has, subsequently, widely vanished in modern academia. The annual *ACM* conference *HT: Hypertext and Hypermedia* and some other institutions keep up the term. Nowadays, though, we hear more about 'network media', 'interactive literature', 'interactive narrative' or more generic: linking formats of electronic/digital publishing.

2.2 Reason for Revision: Representing Arguments and Narratives

Albeit this development, it is important to note that unfulfilled social, educational or poststructuralist promises do not necessarily diminish other potentials that hypertext does offer. Shifting our view towards argumentation, the logic connections inherent to it, and to structuring narratives, we still can learn a lot from hypertext theory. Representing these connections and structures is a key goal in every academic publishing, after all.

It becomes pertinent in this respect that hyperlinks can function as "meaningful links" (Nentwich 2003, 267-9) if they show a projection to the other end of the link. Propositional relations between the linked nodes become apparent to the reader. She follows along a series of nodes and edges and thereby may absorb "multithreaded stories composed of many intersecting plots" (Murray 1997, 86). The possibilities for exploitation of this mechanism are numerous, including the creation of diverse patterns of hypertext stories (Bernstein, 1998). I do not intend to elaborate on these patterns or a typology here, because I am more interested in two other aspects: On the one hand authors structure narratives that may contain any complex kind of interconnections, byways, marginalia etc. On the other hand, they represent these coherent yet complex narratives by the very structure of nodes and edges. In contrast to traditional texts, hypertexts do not rely on descriptions (i.e. metalingual references) of complex coherence to make it comprehensible. A reader of a traditional text must 'decode' the linear demonstration as a representation of non-

linear, complex interconnections. A Hypertext already 'shows' this complex structure by its modular appearance and functionality. Here we find an epistemic quality because a hypertext mirrors how the author has composed a narrative with all its propositional ties. The 'architecture' of narratives becomes apparent to the reader.

This is also true for arguments that authors embed into their narratives. Arguments have a logic structure, meaning that authors introduce premises, derive intermediate and final conclusions. This syntactic process runs by the application of logic operations. In this context, Anne Britt et al. (1994) invented the term "global argument model". It says that one must interpret and correlate diverse documents to understand a research topic. This would result in a

> mental representation in which each document contributes to the issue by providing either a factual background, an opinionated interpretation, or the evidence to support or to confirm these interpretations. (74)

The ensemble of potentially available documents, "their contribution to the issue, and their relationships among them define the global level of an argument model" (74-5). Here, Britt et al. focus on hypertext as a tool to study and reason about history. Hypertext would grant access to historical topics, addressing arrangements of entire documents. If we switch this perspective from unlocking a topic to building-up a topic the same systematics apply. Scholars regularly build and represent their own global argument models with the same intricate structures of logic connections. Additionally, not only entire documents contribute to their argumentations but also single information or data points. These basic principles of argument-building are not exclusive for history, of course. They are at work in all the humanities.

To sum up, hypertext theory shows us that hypertexts may represent narrative and argument structures with their entire complexity. This has traditionally been seen as a network-like representation. Most of the theory has addressed literary hypertext, foremost hyperfiction (Rettberg 2016). Academic publishing has been much less a focus, and contributions specifically to DH publishing are scarce. This is surprising in my view, since DH scholars regularly make complex references to (meta)data, visualizations, applied methods etc. DH seem to form an area of research that is particularly predisposed to hypertextual publishing formats.

3 Beyond Traditional Hypertext: Multi-linear, Multimodal Publishing

So, why do we not infuse our conceptions of digital publishing with strands of hypertext research? Is there not a greater momentum to advance traditional publishing policies and reputation regimes than in the last decades? Does it not seem conclusive for DH scholars to publish works that fulfil the idea of a network of information chunks?

We might embrace this idea by shedding further light on the conditions of data-driven research and publishing: There usually is a multitude of interrelations between data points in a collection. Those interrelations are defined semantically, but they may also remain implicit if the connections have not (yet) been defined. Beyond that, scholars relate data points to each other in their discursive demonstrations. Scholars build up interrelations by interpretation. A common goal in DH publishing is to provide access to both data collection and academic dealing with data. A network-like display of all the intrinsic and explicit connections may count as a value of its own because it communicates: 'There are a lot of data relations that are (more or less) meaningful. We may select some of them for a closer look, depending on the context of interest. We could apply further research questions to them'. That would be a system theoretic perspective that understands hypertext as a sort of database or knowledge base.

The network becomes even more complex if we add information on applied methods. When DH scholars interpret data, they must illustrate procedures of data retrieval and analysis. Which tool was used for text mining? What was the tag set for manual annotations? Which reference corpus made automatic analyses possible? Answers to methodical questions like these are crucial to elucidate research findings and their interpretation. In some way scholars must give such commentary in their publications.

Following these short remarks on some basic characteristics of DH research, network-like hypertext does indeed seem to support central publishing needs. However, this impression neglects that scholars typically put their interpretative demonstrations into the foreground when writing a publication. Scholars weave (meta) data and methodological remarks into their overall explanation. The explanation may rely on the totality of intricate interrelations, but in the end scholars do not simply document this totality – they primarily carve out those relations that are most relevant to their unique research perspective. This does not mean that the demonstration would follow one linear, even teleologic line, in the end. It may branch when scholars refer to many data points and make various methodological remarks. Scholars may offer divergent, yet equally valued, interpretations of data. They may also refer to entangled fields of research, utilizing cross references, forking elaborations, and so on. Demon-

strations like these are indeed intricate and non-linear, but they do represent *specific* argumentations, narratives, and descriptions. They have a directed structure because they are coherent products of the scholar's sense-making. The network that connects nodes in *all kinds* of direction is no fitting model here.

3.1 Multiple Hypertext Paths: Complexity Must be Structured

The notion of 'trails' or 'paths' leading through a hypertext helps us in this context. The metaphor goes back right to Bush (1945). He originally thought of the cells of the brain that would connect pieces of information by association, forming a "web of trails" (106). Technology might at least partially mimic this web, so his idea. Bush focused on challenges in storing and accessing information – he worked on knowledge management and information retrieval, not on publishing designs. Anyway, the idea of paths has remained prominent in hypertext theory. In later research this feature was largely attributed to the reader: She must find her own pathways through a hypertext network. Authors create webs and readers create paths, so the understanding. Except for hyperfiction proponents, only a minority has thought of creating hypertext in a multi-linear design ab initio. Such a conception has even been considered half-baked, actually "weaker" than the network (Krameritsch 2007, 134).

I would like to flip this verdict. If scholars want to give a complex, yet coherently structured demonstration, multi-linear hypertext is not a mere compromise. On the contrary, it is the very fulfilment of the scholars' communicative intention to convey *her* arguments and *her* narratives to the reader. Multi-linear hypertexts seem to set up what Murray has described as "intersecting plots". Admittedly, one might very well think of a network-like hypertext that highlights multi-linear paths. A hybrid implementation like this would confront readers with paths as the dominating trait of the user interface. They would still be able to navigate along own paths. This conception promises to be very powerful, because it leads to the representation of the whole information/data base with all semantic constellations, on the one hand. On the other hand, it clearly represents those connections that the author has in mind as the primary content of her publication.

This kind of publication design already tackles two problems that critics have prominently attributed to hypertext: Firstly, 'lost in hyperspace' describes the phenomenon of orientation loss when a reader is confronted with too many opportunities for her navigation. The sense of coherence perishes. Secondly, reading a hypertext should not require too many cognitive resources. A reader can have trouble in deciding which node makes sense to next jump to. She might

be even overwhelmed if the interface design does not signalize what narrative waits behind a specific selection of nodes and edges. She must step back and make up her mind of the record of already consumed contents. Only then she can decide which node she should navigate next to, or she just performs trial and error. This cannot be done constantly without fatigue. The phenomenon goes by the name 'cognitive overhead'. 'Lost in hyperspace' and 'cognitive overhead' are classical objections to hypertext literature. Since the boom era of hypertext, they have led to an intense occupation with better usability and interface design (Shneiderman, Kearsley 1989; Nielsen 1990; 1991). The two phenomena have basically been addressed towards network-like hypertexts. They apply to multi-linear hypertext to a much minor extend, because it already reduces complexity on a representational level. Hypertext paths are devices of reader guidance.

3.2 How It can be Done: Forms of Implementation

What may multi-linear hypertext publishing in the DH look like? While the primary goal of my paper is to carve out advantages of hypertextual publishing from a theoretical point of view, practical solutions remain to be addressed. I would like to do this by pointing at some interesting attempts, beyond Thomas' and Ayers' early example. Not all of these modern initiatives are clearly multi-linear but they can serve as a basis for further considerations. In any case, they demonstrate how media-rich and non-linear publishing meets central requirements of DH research.

International publishing companies have created own formats. Elsevier's digital *Article of the Future* (Cope, Phillips 2014), for instance, augments traditional linear text by interactive elements. The interface has a main panel that presents a typical academic paper. It can include interactive elements, too, such as digital maps or diagrams. Additional side panels show further material like a representation of data, digitized resources, visualizations, or side remarks to the paper. The panels allow for cross linking, so a reader may navigate between them. She may also scroll down them individually. This design allows for zooming into the details that an author refers to in the article. At the same time, these details are visibly attached to the main presentation which makes them more than a supplement. The *Article of the Future* is developed for the sciences, but the format appeals to other data-driven domains of research, too.

The Luxembourg Centre for Contemporary and Digital History (C^2DH) and De Gruyter publishing group have created another promising format, the *Journal of Digital History*. It applies a multi-layered approach (University of Luxembourg, De Gruyter 2021): a 'narration layer' facilitates transmedia storytelling. A 'hermeneutic layer' ex-

plores methodological implications of the use of digital tools and data. Finally, a 'data layer' grants access to data and code by means of a professional infrastructure. This publishing format addresses the needs of data-driven research in a profound way. Scholars can fuse their coherent arguments and narratives with detailed accounts on methodological issues. They may directly include the data they have investigated. Therefore, readers absorb research results presented in their broader contexts. The publishing format connects central constituents of research and lays it out transparently.

The two presented publishing formats enhance traditional text by integrating interactive elements. The scholarly demonstration resembles a traditional text, but it provides branches to further material. Multiple strands of demonstration, therefore, complement the main course of exposition. *Scalar* is another initiative in that sense. It takes the notion of multi-linear publishing even more serious. The tool is developed by *The Alliance for Networking Visual Culture* and aims at open, media-rich online publishing. On the one hand, *Scalar* publications mimic traditional codex-books. Chapters align in a linear order and readers can access them via a menu. One the other hand, the tool allows for breaches through this hierarchic structure by a 'path' feature: An author may select and thematically group any page, whenever she wants to give (additional) demonstrations that are transverse to the chapters. Pages function as hypertextual nodes here. The multi-linear paths are prominently represented by special menus, so readers can easily select them and follow along. Paths may intersect and readers can jump over. The showcase on *Scalar*'s website documents numerous ways of exploiting this feature.[3] DH publishing can very much benefit from such a publication design. A nodal page may represent a section of the scholar's overall narrative. It may also contain data representations, visualizations, or methodological information. The author may link these chunks to multiple other parts of her overall discourse, wherever it seems fitting. She may also curate paths that gather all the relevant information on specific domains of research. A path on 'applied methods of topic modeling', for example, could bind together all relevant pages that otherwise scatter in other strands of the publication. Paths may also provide differing perspectives on the same set of analytic data. If scholars use *Scalar* in this way, they create a multi-linear hypertext that weaves nodes into a complex, yet coherent demonstration. The branching publication format lets readers explore the intricate connections but keeps the scholar's vision of sense-making in the foreground. Since *Scalar* is open-source and allows for flexible customization, design possibilities are numerous.

3 https://scalar.me/anvc/scalar/showcase/.

Another interesting property of *Scalar* is a set of visualizations that depict the publication's contents. Different visualization formats – graphs, trees, radial, or grid visualizations – provide an overview of the contents. These are all the pages, all the paths, media contents, tags, or individual object categories. If a reader clicks on any representation of an instance, descriptions appear, connecting lines become visible, and the user may jump to the represented node. In the DH visualizations play a huge role. There has been a lively discussion about the topic in recent years, and the community has developed ever more sophisticated techniques (Drucker 2014; Manovich 2020). Visualizations provide an overview over large amounts of data, patterns of (cor)relations and other features, facilitating access to the complexity of digital research objects. However, visualization of data is something else than visualization of an authors' discourse. Why do we not use visualizations for the depiction of our complex sense-making, too? Why do we not create multimodal publications in that sense? Multi-linear arguments and narratives have complex architectures that often are neither easy to express nor to follow. If we depicted the structure of logic and narrative conjunctions between the nodes of a publication, as *Scalar* offers this possibility, we could add quality to our demonstrations. Showing complexity and reducing complexity go hand in hand. David J. Staley (2014, 156) uses the term "meta-narrative" to emphasize that a visualization can communicate the coherent composition of an academic demonstration. Pure text cannot provide 'the bigger picture' with the same degree of explicitness.

Hypertext research also informs about this combination of modalities (textual and visual). So-called *spatial hypertexts* (see Bernstein 2011) present a visual map of nodes and edges. The map dominates the user interface and nodes are represented in different sizes, distances to each other, with or without linking lines between them, and feature other design characteristics. These properties indicate semantic qualities, such as the weight of a node for the overall demonstration or its isolation from other information chunks. When selected, the contents of a node come into the foreground (in a new window, a pop-up box, or any other kind of appearance). The total design is therefore multimodal and the user experience clearly contrasts hypertexts without any visualization (document-centered hypertexts). Spatial hypertext concepts and editing tools are promising antetypes for multimodal publishing formats because "[r]epresentation of argumentative structure in spatial hypertext has been a conspicuous goal", as Bernstein (2011, 108) states. Admittedly, spatial hypertext has primarily served as a tool for individual note taking and management of ideas. Academic publishing is an entirely different domain. Nevertheless, research on spatial hypertext provides informative conceptions of structuring and representing information

visually, in order to convey a "meta-narrative" about complex academic sense-making.

4 Summary and Outlook: Towards Multi-Linear and Multi-Modal Publishing

The DH are an area of complex sense-making. Data-driven research deals with interdisciplinary methods and extensive data analyses. Scholars must refer to intricate interrelations between all these constituents of research in their publications. This task often proves to be difficult, as complexity is not easily represented by a written text. Non-linear digital publishing seems to answer to the DH better than traditional publication formats. Surprisingly, this has not yielded a broader reflection on the issue. While it is a well-known exercise to create multimodal and linked representations of digital objects, DH scholars normally express their complex arguments and narratives in a rather linear fashion. They may supplement their publications with other media formats, but the 'actual' demonstration remains a traditional text.

Hypertext theory is a powerful backdrop for conceptions of innovative digital publishing. A hypertext organizes arguments and narratives in a non-linear way, representing their intricate architecture. This potential has remained widely overlooked until now because hypertext research has focused on other issues. Additionally, the digital medium was burdened by illusionary expectations what led to disappointment and, in consequence, a dwindling interest. Hypertext research has also largely narrowed its perspective on network-like hypertext. As I have illustrated, the underrated multi-linear hypertext has yet more to offer. An author can represent those specific arguments and narratives *she* intends to convey. The multi-linear format nevertheless allows for complex demonstrations.

Only a few initiatives have created publishing formats in that sense. They are innovative sources of inspiration and build the ground for further conceptions. The examples I have presented in this paper tackle essential demands of DH publishing, making them interesting role models. Especially *Scalar*'s path feature is a powerful means to represent the lines of arguments and narrative that an author wants to communicate. Other formats dedicate special panels or layers to digital data and methodological remarks. They are no supplement but integrate central elements of data-driven research into the publication.

Visualizing the multi-linear structure of a publication is another promising potential for the DH. A reader may grasp 'the bigger picture' of intricate arguments and narratives. Thus, she gains a better access to the overall demonstration. Research on spatial hypertext

may advance further development of such techniques, as it offers a lot of conceptual thought on visual "meta-narrative", as Staley calls it. For instance, *Scalar*'s visualizations offer an overview in this respect, but one must specifically select them from a menu. If they had more weight in the default user interface the "meta-narrative" would be emphasized. *Scalar*'s visualizations are labeled with little information, too. One must choose and explore nodes with attention. A more extensive labeling might lead to a more expressive combination of textual and pictorial features.

These ideas may yield new design challenges and problems on their own. Furthermore, the developers of *Scalar* might not have the same publishing contexts in mind that I have stressed. However, *Scalar* and similar tools can still serve as a source of inspiration. They demonstrate means of implementation for hypertextual publishing. They give clues for potential improvement, and they indicate that multi-linear and multimodal formats satisfy essential demands of 'publishing complexity' in the DH.

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