The Visual [Re]Presentation of Textual Data in Traditional and Digital Critical Editions

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Abstract   The prospect of breaking free from the confines of the printed page drives much of the interest in digital critical editions; yet the format of traditional editions in print remains an effective and efficient information visualization. This paper will argue that using the data from a digital edition to [re]present the traditional format of a printed edition can illuminate the strengths and weaknesses of both platforms. In addition to making the data available in a familiar format for offline reading, a print visualization is also a useful test of the digital edition's data model. It can also promote a shift toward thinking about textual data and its visualization (in print or on a screen) as separate concerns.

Keywords   Digital critical editions. Print. Latin. Textual criticism. Data visualization.

1   Introduction

Considering the many techniques of modern information visualization, it may seem backwards or counter-productive to spend time trying to render the data of a born-digital critical edition in the familiar look and format of a traditional printed critical edition. After all, the typographical conventions that scholars have used for centuries to represent textual information developed "under the shadow of the printing press" (Sutherland 2009, 19), with publishers and printers sacrificing the value of scholarship to the cost of materials and labor. In light of that, some (e.g. Heslin 2016; van Zundert 2016; Keeline 2017) argue that the very concept of a critical edition is outdated in an era when technology allows users to browse digital images and transcriptions of the available witnesses and sources for a text, and that we should spend our time developing interfaces and tools for processing, visualizing, and analyzing that data in ways more suitable to a digital paradigm. Others (e.g. Rasmussen 2016; Damon 2016; Olson 2019; 2020), however, see continued value in traditional critical editions as guides to the issues and problems of the texts central to their scholarship. Some of the value they perceive lies in the way printed critical editions represent information. Accordingly, it is worth examining what, in particular, might be valuable about this format and whether that value can be transferred to and from the digital realm.

Those questions are relevant to any project that seeks to publish textual data in digital form, but the specific context for this article is the Digital Latin Library (DLL),[1] a key activity of which is publishing born-digital critical editions of Latin texts in its *Library of Digital Latin Texts* series (LDLT) in partnership with three learned societies.[2] The point of this article is to examine whether that activity, as currently practiced by the DLL, is in thrall to the printed past of traditional critical editions. The DLL's guidelines for encoding critical editions are by and large based on how scholars have communicated their ideas in print for centuries.[3] Does that mean that editions encoded according to those guidelines are unnecessarily bound to the limitations of printed media? Or is it the case that the knowledge representation model for traditional critical editions is valid apart from the media in which it has been expressed? This article will re-

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[1] https://digitallatin.org/.

[2] https://ldlt.digitallatin.org/. The DLL's publishing partners are the Society for Classical Studies (https://classicalstudies.org/scs-news/library-digital-latin-texts-call-submissions), the Medieval Academy of America (https://www.medievalacademy.org/page/LDLTSubmissions), and the Renaissance Society of America (https://www.rsa.org/page/DLLCfS).

[3] https://digitallatin.github.io/guidelines/LDLT-Guidelines.html.

spond to these questions by examining the DLL's efforts to develop a visualization of the data of digital critical editions in the traditional printed format.

In keeping with this issue's theme of [re]constructions, Bordalejo's definition of "critical text" is a useful starting point:[4]

> [W]hen I talk about a critical text, I am not referring to the reconstruction of a lost archetype, but to the construction of a new, well-informed text that can help readers understand the relationships between extant witnesses; a text that functions as a gateway to the others. (Bordalejo 2021, § 68)

Her reframing of "reconstruction" fits well with the project of considering old ideas in a new light. But there is more than one path to a well-informed text, and which one to take depends on any number of factors, including time, resources, and the nature of the textual tradition. Certainly, focusing on transcribing and collating as many witnesses as possible, if not all of them, will yield an important gateway for students and scholars of works such as the Greek New Testament.[5] But critical texts based on more selective use of the available documentary evidence can also help readers understand a work's textual tradition, particularly when those critical texts can be explored in a variety of representations. Accordingly, the central concern here is on a type of reconstruction: '[re]presentation', where the square brackets draw attention to ways of presenting critical texts anew – even, or especially, representations that appear merely to reconstruct the printed past.

In an article bearing the title "Representing the Critical Text", Fischer surveys the long arc of efforts to represent critical texts over the past few centuries, and he argues that the "standards and conventions for presenting the critical text in print […] are fundamentally challenged by the digital paradigm" (2020, 405).[6] Although I agree that those challenges are significant, with '[re]presentation' I propose an alternative view in which the printed form is just one of many possible expressions of an edition created according to the digital paradigm.

The square brackets in '[re]presentation' also have special meaning with reference to their use in textual criticism to signify and

even to create gaps, a point to which I will return in the next section, where I discuss the typographical conventions in traditional printed editions as a kind of visual markup language. As I turn to semantic markup in the rest of this article, the square brackets in '[re]presentation' take on the function of gap-filling and meaning-making that they often have in computer code.[7] For these reasons, the square brackets in '[re]presentation' potentially have many meanings here, from philological symbol of loss to a digital symbol for a data type. For the most part, however, '[re]presentation' here is a shorthand for presentation, representation, and re-presentation, the last in the sense of 'presenting anew'.

In exploring the ambiguity of [re]presentation in the context of digital critical editions of Latin works and their relationship to traditional printed critical editions, I am guided by these questions: In what ways do both printed and digital editions [re]present a work? What gap do they fill? What meaning do they make? Conversely, what gap do they create? And what loss occurs through the [re]presentation of a digital critical edition in a visualization designed for print output? In asking these questions, I do not mean to rehash arguments about the semiotics of markup languages or their suitability for encoding textual data (e.g. Buzzetti 2002; 2009). In truth, I accept as given that the model established by the Text Encoding Initiative (TEI)[8] for using Extensible Markup Language (XML) is valid and appropriate.[9] Although I do not intend to challenge the prevailing theories about the nature of scholarly digital editions,[10] I do mean to complicate the idea that digital editions operate on an entirely different paradigm from traditional printed editions.

Although cleaving to a print-based model risks losing the benefits of working within a digital paradigm, jettisoning the model just because of its connection to a particular medium also risks losing its advantages. For this reason, '[re]presentation' is an apt concept for the project I shall describe since it seeks to present anew the strengths of both printed and digital editions in a way that fills a gap between them. I shall conclude with some observations about how the visualization of digital data in a traditional format can have practical uses that have not yet been replaced by digital media.

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7 For example, square brackets are used in many computer languages to signal the use of Regular Expressions to match patterns instead of specific combinations of characters. Square brackets also signify data types such as a list in Python. They can also be used (e.g. in JavaScript) to refer to properties of data. In these and other ways, square brackets are often used in computer languages to fill gaps and to supply information.

8 https://tei-c.org/.

9 For a summary and rebuttal of the main criticisms of TEI XML, see Cummings 2019.

10 Particularly Robinson 2002; 2013; Gabler 2010; Earhart 2012; Sahle 2013; 2016; Apollon, Bélisle, Régnier 2014; Franzini, Terras, Mahony 2016.

2   [Re]Presenting Traditional Critical Editions

Traditional printed critical editions themselves illustrate the concept of '[re]presentation'. On the one hand, their layout and typographical conventions constitute a presentational format for information about a work, its transmission, and the editor's understanding of both.[11] Through visual cues, a traditional critical edition can effectively communicate, for example, where to find the main text and where to find variant readings and other critical annotations. A subtler example is the ordering of information in a critical apparatus, where the position of a variant reading relative to others can implicitly communicate the editor's judgment about its plausibility. The capital Roman and Greek characters known as *sigla* convey information about hyparchetypes, archetypes, families of manuscripts, and individual manuscripts – not to mention the various diacritical marks that adorn them to indicate the various hands that have intervened in one way or another in a particular manuscript. All of these things and more combine to present arguments about a text.

On the other hand, printed critical editions also re-present a variety of things. Obviously, they re-present works by the fact that the main text is often an eclectic one, a hybrid derived from various sources.[12] Modern critical editions may also be said to re-present the work because, unlike some early printed volumes, they do not seek to recreate the look of the original sources. Even so, every character in the font selected for the edition re-presents the original characters of the autograph manuscript and/or copies of it, whether those copies are other manuscripts or early printed editions. And even when Unicode characters do exist for certain non-standard glyphs that occur in primary sources, those characters represent the original glyphs.[13]

Especially relevant to the use of brackets in this volume's theme are the typographical conventions editors have invented to represent the different kinds of loss that can befall a text.[14] Square brackets in the context of a critical edition can signify an editor's assertion that certain characters, whole words, or even entire passages are inauthentic, even though they occur in the documentary evidence. Then

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[11]   Cf. Buzzetti 2009, 46: "Any particular witness or any particular edition, even the most authoritative one, is only and always a representation of the text".

[12]   I use 'work' and 'text' according to Gabler's definition of a work as an "abstraction projected from one or more material texts in which it manifests itself" (2010, 121 fn. 1). Cf. Rasmussen 2016, 121: "A work is an immaterial entity that serves as a gathering point for all the texts that we classify under a certain title".

[13]   See, for example, the characters available in the Junicode font (`https://github.com/psb1558/Junicode-font`). On the use of Unicode in classical philology, see Tauber 2019.

[14]   For the symbols used in critical editions, see Maas 1958, 22; West 1973, 80-1; Tarrant 2016, 166.

again, square brackets can signify the actual loss of characters in editions of inscriptions and texts written on papyrus, wherein they can also signify the physical boundaries of the support material.[15] Other ways of re-presenting loss include *** for a lacuna (total loss of a part of a text), --- for loss of legibility of an unknown number of characters, slashes (///) for erasures, underdots (ạḅc̣ḍ) for loss of legibility of specific characters, and †† for loss of sense. The loss does not even have to be physically verifiable, since editors can assert that text has been lost (e.g. through careless copying, not physical damage) and could be supplied with text surrounded by < and >, or that some text should be lost (e.g. because it is a scribe's error or interpolation) by enclosing it with either { and } or [and].

These symbols, especially those that enclose text, comprise a visual markup language, as it were.[16] In this way, a critical edition in print differs little from a critical edition in any other media in using encoded information to provide a view onto the state of a text's witnesses and sources, the interventions of previous readers, the opinions of previous scholars, and the judgment of the current editor.

Real differences, however, emerge when we consider the extent of the encoded information that print and digital editions can contain and the editorial philosophies behind them. Of necessity, the print paradigm gave rise to the view that a critical edition should represent only those items that the editor has determined to be important. According to that view, a critical edition does not seek to provide readers with transcriptions of every known witness to the work – that is the scope of a variorum or comprehensive edition. It also maintains that critical editions do not seek to give readers everything they need to reconstruct all the witnesses to the work in their entirety.[17] That is, one cannot recreate manuscript A's text simply by gathering all of its readings from the critical apparatus of an edition, since the editor has probably reported only those variants that are worthy of note. That is what makes each critical edition created on the print paradigm unique: similar though it may be to other editions of the same work, it is, or it ought to be, a novel representation of the work and information concerning it.

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15   See the *EpiDoc* project (Elliot et al. 2006-22) for the digital representation of inscriptions and texts written on papyrus. The DLL's own guidelines owe much to the *EpiDoc* project.

16   Apollon and Bélisle (2014, 98) describe the critical apparatus of nineteenth century editions as a "visually retrievable database legitimizing the reconstruction of textual prototypes".

17   Cf. Olson 2019, 332: "[V]ery few editors report all readings in even the manuscripts they do consider. Nor do most editors print all previous conjectures on the text, but instead offer only what they judge – rightly or wrongly – to be the best and most likely among them".

But to what degree has the print paradigm determined that view of critical editions? Ultimately, a traditional critical edition's 'bibliographic codes' (e.g. page size, layout, and typography) require editors to communicate in a particular way.[18] The cryptic expressions and abbreviations that have become standard in the cramped space usually allotted to the critical apparatus are proof enough of that.[19] So, too, are the sigla and other symbols mentioned earlier, since they represent information that, in the interests of both space and efficiency, has been explained in more detail elsewhere.[20]

However much the print paradigm has influenced the way textual data are represented in critical editions, the concepts expressed in printed critical editions are relevant regardless of the media. In the case of printed critical editions, it makes sense to use square brackets, for example, to indicate text that should be considered surplus (i.e. not in the original document or documents), since square brackets do not require a significant amount of space on the page. But the concept of surplus text can be expressed in other ways in other media. For example, TEI XML indicates surplus text with the aptly named element ⟨surplus⟩. What is important is that the representation makes sense in its media.

Sahle's concept of "transmedialisation" is relevant here, since it involves thinking about information beyond how it will appear in any one specific form of publication.[21] Text encoded as ⟨surplus⟩, for example, could be rendered with the conventional symbols common in printed editions, or it could be visualized in color or in any number of other ways. What is important is that the representation makes sense to the entities using the media. In the case of human readers, the traditional printed form of critical editions has worked well for centuries, and many scholars continue to prefer to engage with works in that format.[22] That is likely to be the case for many more years to come – not because scholars are stubborn, but because the format used for printed critical editions is an effective visualization of information.[23] But that does not mean that the knowledge representa-

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[18] Cf. Sutherland 2009, 20 (referring to McGann 1991, 56).

[19] Apollon and Bélisle (2014, 93) refer to the "allusive and hermetic" style of the printed critical apparatus. Fischer (2019, 204) refers to it as "philology's most notorious feature". For abbreviations commonly found in critical editions, see Tarrant 2016, 164-6.

[20] For this reason, Rasmussen (2016, 129) argues that printed editions are "hyperlink-structured. After all, a printed note apparatus is comparable to hyperlinks".

[21] See Sahle 2010 for a full discussion of the concept; for a summary, see Sahle 2016, 32.

[22] Cf. Sutherland 2009, 22: "For most reading and scholarly purposes the stable or stabilized paper text is currently not only sufficient, it is best".

[23] Again, cf. Sutherland 2009, 20: "if we work with literary texts our expectation is almost always zoned to print; we may need another hundred years of electronic creativity

tion system familiar to us from printed critical editions is *ipso facto* subject to the limitations of print media. Rather, that system can be represented to machine readers in a way that opens new possibilities for processing and visualizing critical edition data while preserving the traditional format as an option for the human readers who want it. That will be the topic of the next section.

3   [Re]Presenting Critical Editions Digitally

Many of the same typographical representations mentioned in the previous section are relevant to digital critical editions because they have become the standard for communicating information about texts and the phenomena that occur in them. Leaving aside the increasing availability of high-resolution digital images of manuscripts online,[24] typography will remain the primary means of representing textual data, at least until someone invents a way of experiencing them in another way. That is why the team of scholars working on the DLL looked to printed critical editions when developing the data model for the digital editions it would publish in the LDLT.

That we naturally turned to printed editions is an acknowledgment of their value as a platform for knowledge representation. After all, the format of printed critical editions as we know them today is the product of several generations of advances in both scholarship and printing,[25] so it seemed reasonable to build on that accumulation of knowledge instead of trying to invent something entirely new.[26] On the other hand, it may be argued that developing encoding guidelines from traditional critical editions in print unnecessarily tied them to the physical limitations of the printed page and, by extension, the codex. In promoting a paradigm shift in scholarly communication from print to digital forms, why opt to base the encoding guidelines on a print-based paradigm that many consider antithetical to the aims of digital editions?[27] Indeed, since the digital realm is not limited by the same physical constraints as the ma-

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to nurture into existence a really sophisticated textual model zoned to the computer".

[24]   Of course, digital images, too, may be said to be digital representations of real-world objects. Cf. Buzzetti 2002, 62: "[t]he image itself, to the extent that it is a digital representation of visual information, does not provide merely a 'facsimile' or 'physical reproduction' of the original, but rather a set of 'structured data', that is, a 'logical representation' of the document's content".

[25]   Fischer asserts that "critical editions are among the finest products of scholarly print culture" (2020, 407).

[26]   For the history, see Keeney 1974, esp. 152-7.

[27]   E.g. Fischer remarks, "to encode an *apparatus criticus* is to encode a phenomenon inherited from the print era, whereas digital textual scholars seek to go beyond what

terial one, why even bother at all with traditional critical editions that privilege the editor's perspective? Moreover, since it is (theoretically, at least) possible to publish a digital edition consisting of transcriptions and images of all available witnesses to a text, what is the point of a critical edition that, to some anyway, appears only to list the significant variants? These are good questions, but they come from a point of view that sees the representational system of the traditional critical edition as inextricably tied to the physical form in which it has always been expressed. If instead we view the printed form as just one among many visualizations of critical edition data, we can reframe the print-digital divide as a continuum of renderings, from print to fully digital.

It is important first to confront the question of whether traditional critical editions are even relevant when the flexibility of digital media allows direct access to the witnesses and sources for a text. Critical editions ought to be more than just lists of variant readings. They ought to be windows onto the issues and problems in the transmission of the text, and they ought to reflect the judgment of editors who have spent time and energy trying to understand those issues and problems. Some readers (e.g. Robinson 1993; Heslin 2016; Keeline 2017) may want direct unmediated access to source materials; others (e.g. Sutherland 2009; Olson 2019; 2020) appreciate the guidance that a good critical edition provides. The fact is that not everyone wants to sift through the documentary evidence, even if they have the requisite skill or resources to do so.[28] That will remain true as long as there are what Rasmussen (2016, 127) refers to as "readers" (i.e. those "mainly interested in scholarly editions as reliable academic versions of literary works"), as opposed to "users" (i.e. those seeking "an understanding of the work, but in a more intertextual context") or "co-workers" (i.e. those seeking "to go beyond the user and reader roles, and to contribute actively to the scholarly enterprise").[29] But that does not mean that editions must serve only one of those categories.

Although it is true that the confines of the printed page and the concerns of publishers can limit the amount of information that editors include in their editions, nevertheless it is also true that those limitations have to do with the medium itself, not with the model for representing the information. To be sure, traditional critical editions in print are so effective at communicating rich information precise-

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is seen as merely one possible physical embodiment of the editorial arguments and decisions about the textual tradition" (2020, 416-17).

28   See Olson 2020 for a strong articulation of this point of view.

29   Rasmussen's categories map onto the different categories of digital editions that Fischer (2020, 417-26) surveys.

ly because of the limits of their medium. That is, the limitations of the print medium force editors to identify the kinds of information they are dealing with and to develop efficient ways of communicating rich information about texts. Let us not forget, moreover, that the compressed form of annotations in critical editions is a signature of the minimalist approach, so the physical constraints of the printed page are not necessarily limiting factors.[30] It stands to reason that the same model for communicating knowledge in printed editions can be even more useful in digital media that do not have the same physical limitations.

Of course, the prospect of working outside of the physical limitations of print media opens the door to maximalist, or even totalist, editions.[31] But the value of a critical edition does not necessarily increase in proportion to the number of variant readings and conjectures it contains.[32] In truth, excessive reporting of readings can detract from a critical edition's value as a scholarly tool. That is why the DLL encourages scholars to publish collations, transcriptions, and other related materials alongside their critical editions, in the interest of making the editorial process more transparent to readers and providing access to materials for further research.[33] In this way, the critical edition is presented as a curated database, while the ancillary materials provide access to the raw data.

In their printed form, critical editions do present structured data in their own way (e.g. through punctuation, line numbering, layout, etc.), but it is not easily computed against by anything other than the human brain.[34] But there are plenty of instances of unstructured, or at least loosely structured or implicitly structured, data in printed editions (e.g. in the ordering of variants and their witnesses in the critical apparatus). In short, the data in a printed critical edition are structured in so far as a human being can recognize and correctly interpret the visual cues. To a machine, those visual cues are just strings of text without any special meaning.

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[30] Cf. Tarrant 2016, 130: "[a]t the heart of the minimalist approach is the idea that the apparatus as well as the text should be the product of the editor's judgement, and that it should contain only what is essential to the establishment of the text".

[31] For the barriers to producing comprehensive digital editions of classical texts, see Monella 2018.

[32] Tarrant (2016, 153) thinks "it would be a grievous loss if the apparatus were to be reduced to a mechanical record of variants and conjectures, and the editor's personal voice no longer heard".

[33] See Bordalejo, Vázquez 2021, particularly § 68, where they observe: "With computer-assisted collation methods and complete text transcriptions, the process that leads to a critical text becomes comprehensive, thorough, and more transparent to the reader". See, however, Dähne et al. 2022 for a discussion of the flaws in current computer-assisted collation algorithms.

[34] On the data model of traditional printed editions, see O'Donnell 2009.

Accordingly, the DLL sought to implement the implicit model of traditional critical editions in a way that makes it explicit to both human and machine readers. Of course, basing a model for digital editions on the one for printed editions could mean simply reproducing or imitating the same visual cues in printed editions.[35] But doing that would miss the point of making a digital edition in the first place: to leverage the power of machines to process, analyze, and visualize information. We needed to look with fresh eyes at the typographical conventions of printed editions that we had long ago learned to interpret and accept as part of the language of scholarship. In this way, we would re-present critical editions to ourselves.

4 [Re]Presenting Critical Editions as Databases

Our first exercise involved projecting pages of a critical edition onto a dry-erase board and marking the different types of information we saw there.[36] Describing aloud the interpretative moves that we usually made while reading in silence helped us to identify the relative strengths and weaknesses of the system of visual communication that we were now analyzing in common. For example, one reader might 'front-load' the critical apparatus data by reviewing it before reading the main text; another might glance at the apparatus only when a passage presented difficulties; yet another might review the apparatus after reading the main text on the page. Discussing the different ways of interpreting the symbols, abbreviations, and other typographical conventions also revealed to us some ambiguities that could be resolved through semantic encoding. M^1, for example, could signify a particular hand in a manuscript or the first edition of a particular printed edition; abbreviations such as *codd.*, *cett.*, and *recc.* are useful shorthand references, but different editors use them differently and with varying degrees of precision. But despite these issues, seeing the different varieties of information that we had identified on the dry-erase board made it clear to us how efficient the existing model could be in communicating a network of complex data about real-world objects and the intellectual contributions of scribes and scholars.

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35 Fischer (2020, 417-26) describes a range of digital editions, from reproductions (e.g. a PDF of a printed edition) and imitations (editions that "do not significantly exceed print formats in terms of content and function") to collaborative and progressive editions that leverage digital tools to create something that cannot exist in print.

36 The outcome of this exercise resembled Fischer's figure 6.3-5 (2020, 414). We began working with editions of Servius' commentaries on Vergil's *Aeneid*, since the difficulties of representing them have pressed the limits of typography and layout. An LDLT edition of Robert Kaster and Charles Murgia's edition of *Serviani in Vergili Aeneidos Libros IX-XII Commentarii* is in preparation.

From marking up a text in common on a dry-erase board, we began to experiment with marking up a text digitally in TEI XML.[37] We selected the *Bucolica* of Calpurnius Siculus as published in Giarratano's 1910 edition as a test case for developing the DLL's encoding guidelines. It is a relatively short work with many textual issues, and Giarratano's maximalist approach gave us a lot to consider.[38] Of course, the universe of Latin texts is much larger than Calpurnius Siculus' bucolic poetry, so to help us expand the guidelines to accommodate a wide variety of texts, we recruited scholars to produce pilot editions. The texts ranged from the pseudo-Caesarian *Bellum Alexandrinum* (with an editorial team led by Cynthia Damon) to Servius' commentary on books 9-12 of Vergil's *Aeneid* (as edited by Charles Murgia and Robert Kaster) to a single-manuscript edition of the *Miracula sancte Frideswide* (edited by Andrew Dunning) and a portion of Peter Gracilis' commentary on the *Sentences* (edited by Jeffrey C. Witt and John T. Slotemaker).

The editorial approaches taken by the scholars were as varied as the texts they proposed to edit. Some approached their work from a decidedly print-oriented point of view. They preferred to use a word processor to do their work because that allowed them to reproduce the traditional conventions of printed critical editions on their screen or on a printout of their work. One even vowed never to key in a single angle bracket during the project! That turned out to be a good thing, not only because it prompted us to work on ways to automate as much of the encoding process as possible, but also because it clarified for us the distinction between low-level encoding and encoding that requires scholarly expertise.[39] Others were comfortable working directly in XML. Yet they, too, had a strong affinity for printed critical editions. Dunning, for example, has considerable expertise in the use of LaTeX to typeset digital editions for print (cf. Dunning 2020). Before working on a pilot edition for the DLL, Witt had built an entire ecosystem for publishing critical editions of *Sentences* commentaries, including an application that delivers a print-on-demand PDF output in the format of traditional critical editions (cf. Witt 2018). Indeed, our decision to devote time and resources to delivering a PDF of DLL editions owes much to Witt's work in that area and his input on the DLL's steering committee.

Both groups of scholars helped us to understand and appreciate the traditional printed form of critical editions as an important and useful way of thinking about critical editing. Those who are comforta-

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[37] On the selection of TEI XML for the LDLT, see Cayless 2018, 253-6.

[38] See Cayless 2018, 252-62, for more on the choice of this edition and its use in the development of the guidelines and the DLL Viewer.

[39] Cf. Michelone 2021, 33.

ble working in XML acknowledge that the traditional format has value as a particularly human-friendly representation of their data. It certainly shapes the way print-oriented critical editors think about and visualize their work, either in their mind's eye or by using word processors that allow them to reproduce the visual communication system of printed editions. For example, in discussions with editors who view their work in this way, it is common for them to speak in terms of the main text and the apparatus criticus as separate entities, as indeed they are on the printed page. In the XML version, however, the information usually found in an apparatus criticus at the bottom of a printed page is encoded alongside the individual lemmata in the text, like so (ironically using *lorem ipsum* text for the sake of illustration):

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<p>Lorem ipsum dolor sit <app>
    <lem>amet</lem>
    <rdg>amat</rdg>
    <rdg>amit</rdg>
</app>, consectetur adipiscing elit.</p>
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In this simple example, the paragraph (`<p>`) proceeds until there is a difference among the various sources for the text. An apparatus element (`<app>`) signals the start of the variation. The lemma (`<lem>`) is listed first, followed by variant readings (`<rdg>`). A closing tag marks conclusion of the apparatus entry, and the paragraph continues until its conclusion, also marked with a closing tag.

Even those with a strong preference for the traditional format find that the simple, yet radical, change of including the apparatus data at the site of the variation is a more accurate representation of textual variance than segregating it in a smaller typeface at the bottom of a page, possibly with nothing to indicate the one's relationship to the other.[40] Nevertheless, they still prefer to view the edition in the traditional layout, or at least in a representation that does not include XML tags.

Is an edition conceived in this way in fact just a "born-digital printed edition", as Bordalejo describes the *Editio Critica Maior* of the Greek New Testament (Bordalejo, Vázquez 2021, § 52, referring to Bordalejo 2013, fn. 65)? Does the print heritage of a data model preclude new ways of thinking about critical editing and editions? As van Zundert (2016, 85) puts it, is the DLL encouraging "paradigmatic regression"? These are the questions that will drive the next section.

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40 This is by no means the only way to encode textual variance. The TEI Guidelines describe two methods (double end-point attachment and parallel segmentation). See Bordalejo 2021 for a system derived from methods used in the field of bioinformatics.

5   Visualizing Digital Critical Editions

Although we based the DLL's encoding guidelines on what we found in traditional printed editions, we did not have in mind a printed output for the digital editions we planned to publish. Rather, a significant amount of the project's funding from the Andrew W. Mellon Foundation supported efforts to develop novel ways of visualizing and working with textual data. Indeed, the aim of this part of the project was to illustrate the benefits of shifting away from the print paradigm. We wanted to move as far away as possible from traditional critical editions in print to demonstrate the potential benefits of making critical edition data available to machines for processing and visualization.

A team led by Christopher Weaver, of the University of Oklahoma's School of Computer Science, developed experimental visualizations using Improvise,[41] an application he developed and maintains for visualizing complex data from a variety of domains.[42] Hugh Cayless, a co-author of the encoding guidelines for the DLL, focused on developing an online reading environment for LDLT editions.[43] He built the DLL Viewer using CETEIcean, an application he developed with Raffaele Viglianti that uses HTML Custom Elements to minimize the amount of processing needed to transform TEI XML into something that can be viewed and manipulated in a web browser.[44]

All of this is to say that the plan was always for LDLT editions to have a one-to-many model for representing their data. Unlike traditional publishers, who literally bind an edition's data to a single presentational format (the codex), the DLL aims to separate the content of a critical edition as much as possible from its presentational form(s).[45] The reasons for this are two.

First and foremost, we want editors to focus on editing texts, not creating visualizations and interactive interfaces. For the most part, readers do not hold the editor of a printed edition accountable for the layout, the typeface, or the other details of print production, so why should we hold editors accountable for developing digital tools to display their work? In the same way, we want to promote the efforts of scholars in the fields of information visualization and human-computer interaction by highlighting their work as scholarship

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41   https://www.cs.ou.edu/~weaver/improvise/index.html.

42   For their work, see Asokarajan 2016; Silvia 2016; Sunchu 2016; Vangala 2016; Rathnam 2017.

43   For a full description of his work, see Cayless 2018.

44   Cayless, Viglianti 2018. The code for CETEIcean is available at https://github.com/TEIC/CETEIcean.

45   On the separation of content and presentation, see Pichler, Bruvik 2014; Witt 2018; Fischer 2019, 210.

in its own right. Indeed, the DLL's effort to visualize a digital critical edition's data according to the traditional model for representing critical editions in print should be considered and evaluated as research and/or creative activity apart from the production of the critical edition itself.

Second, we are concerned with the longevity of LDLT editions. We simply cannot maintain unique interfaces and visualization tools for each edition we publish. Maintaining the files that contain edition data, however, is a much simpler task.[46] Indeed, the only presentational form the DLL publishes is the TEI XML file that contains the edition's data. If XML ceases to be a standard format for the TEI in the future, the files will still be readable by machines, since they are, in the end, text files.[47] Moreover, the publication format is a version-controlled repository of edition data, including not only the TEI XML file but also other data an editor might want to include (e.g. images, collation tables, correspondence, notes, etc.). In this way, we endeavor to publish editions that are more scientific than printed editions ever could be, since a version-controlled repository of data gives Rasmussen's "users" and "co-workers" greater access than before to the editor's process, method, and working materials so that they can interrogate those items for themselves.

That will not satisfy those who want (or think they want) unmediated access to comprehensive editions or those who aver that editors should assume the role of curators and compilers.[48] But that is not the aim or scope of the DLL. Rather, we seek to publish critical editions in a format that can be visualized in a variety of ways, along with other data that might at least approach what the totalists want.

6 The Round Trip to Print

As lofty as the ideal of separating content from its visualization might be, and as scientific as it might be to publish critical editions as data repositories, it would be foolish to ignore the fact that most humans simply do not want to read XML, regardless of how human-readable it is. Moreover, the experimental visualizations produced by Weaver and his students are exactly that: experimental. However much these

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46   Cf. Fischer 2020, 427: "Whereas we seem to be relatively safe when it comes to archiving and preserving data in standardised models and formats, crucial issues remain problematic when it comes to software and technical infrastructure for keeping digital editions alive and accessible".

47   See Cummings 2019 (esp. 59), on why the TEI exists apart from XML.

48   Heslin, for example, considers "textual criticism as a mental disorder" (2016, 503-9) and argues, "the job of the editor should now be not to decide on the text, but to marshal all of the evidence in such a way for the reader to manipulate conveniently" (509).

visualizations might reveal about the data in a critical edition, they are not designed primarily for reading a text, which is what we anticipate most users of LDLT editions will want to do. That is why we provide Cayless' implementation of CETEIcean as an official 'reading room' in which readers can view and interact with editions in a web browser without having to work directly with XML. But the more we worked with editors and potential readers of LDLT editions, the more we realized the vital purposes the traditional printed format serves.

As I mentioned earlier, visualizing the data of an LDLT edition in the traditional format of a printed edition was far from our top priority. It did not even become a topic of interest until we began working actively with the various constituencies that view printed editions as important professional tools. These included not only the textual scholars whose research products are critical editions, but also those peers tasked with reviewing editions prior to and after their publication, not to mention the scholars who simply need access to a stable, reliable edition to do their work.

6.1   Textual Scholars

Many textual scholars, particularly those who do not work directly with XML, are used to a process that lets them see the product of their work to make sure that it accurately reflects their views. That used to happen only when a publisher delivered page proofs of an edition, but desktop publishing has made it possible for scholars to approximate, at least, the look of a printed edition as they work, giving them instant verification that the information they have entered is rendered as expected on a screen or a printed page.[49] In this way, they represent their work to themselves. By recreating the visual and typographical system of printed editions, they give form to their work, and that allows them to relate to it.

Ostensibly, they could have the same experience working directly with XML. But the difficulty of comprehending an XML file increases with the accumulation of elements and attributes. However easy it might be to verify that a particular word or phrase in an XML file is encoded with `<surplus>` tags, for example, an XML file often has hundreds, if not thousands of elements and attributes on tens of thousands of lines. Those who know how to build and execute XPath queries have access to powerful tools for navigating XML files to find specific information, but relatively few textual scholars are in that group. Considering the technical barriers to working directly with XML, even with tools such as Oxygen or the various configurable text

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[49]   The Classical Text Editor (`https://cte.oeaw.ac.at/`) is particularly good at this.

editors,[50] it is no wonder that many textual scholars prefer to work in the familiar and comfortable environment of LibreOffice or other word processors.[51]

The LDLT reading room mentioned above is one way of bridging this gap. Although it does not provide the instant feedback that editors receive from a word processor, it does give them the ability to verify visually that their encoding reflects their intentions. Indeed, Cayless created a 'sandbox' version of the LDLT reading room so that editors could use it in this way.[52] The trouble is that this option has the additional technical barrier of needing to know how to use the version control application Git to stage, commit, and push files to a remote repository.[53] Of course, editors should already be using Git for local development of their editions, since the final published product will be a Git repository, but that, too, is a significant technical barrier for many scholars who are used to saving their work through a word processing program.

Besides, many editors do not want to review their work on a screen, however nice the interface might be.[54] For a variety of reasons (portability, the satisfaction of working with pen or pencil and paper, etc.), they simply prefer having a hard copy, particularly one that at least resembles a final product. One of the motivations behind our efforts to customize the TEI XSLT Stylesheets is to give editors an option to see their work in a traditional format for offline viewing, or to use as a tool to verify their encoding.[55]

It is our hope that this option will also encourage editors to make the transition to a digital paradigm by thinking of their editions as databases first and products later. Free to work without having to think simultaneously about typography and other extra-textual concerns, they can focus on the clarity and quality of the information in their editions. It will be difficult for many to leave the comfort of a purely 'what you see is what you get' environment, but the expanded possibilities of an edition-as-database should make the transition worthwhile, particularly, and paradoxically, if one of those possibilities is the familiar format of a traditional printed edition.

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50 The Oxygen XML editor (`https://www.oxygenxml.com/`) has many powerful features built into it. Text editing programs such as Atom (`https://atom.io/`) and Visual Studio Code (`https://code.visualstudio.com/`) can be configured to do many of the same things for free.

51 `https://www.libreoffice.org/`.

52 `https://github.com/DigitalLatin/training`.

53 `https://git-scm.com/`.

54 On this point, see Andrews, van Zundert 2018, 4.

55 XSLT = Extensible Stylesheet Language Transformations. The TEI XSLT Stylesheets may be found at `https://github.com/TEIC/Stylesheets`.

6.2   Reviewers

The scholars who review editions prior to and after publication are another important constituency for a print-ready visualization. From the beginning, the DLL has made peer review of LDLT editions a top priority. That was the main concern of the DLL's advisory committee, which met several times during the funding periods to develop a peer review process. A central question in those discussions was what should be reviewed. The XML file? Surely it would be difficult to find qualified reviewers who were willing to read an XML file, let alone review both the textual content and the use of XML tags and attributes. A browser-based interface, such as the DLL's reading room? That seemed more likely, but it also seemed probable that reviewers would be tempted to focus more on the interface, which the editor did not design, than on the textual scholarship.[56]

The best solution to this question seemed to be providing a print-ready PDF, especially one that replicates, as much as possible, the look of a traditional printed edition. In this context, the print visualization is represented as a neutral format for the purposes of facilitating peer review of an edition's content. Of course, a printed visualization is anything but a neutral format, since it brings with it the rhetoric, history, and traditions of the printed page – not to mention physical limitations. But the printed format is neutral in the sense that editors are not typically held responsible for the layout, typography, and overall quality of the printed product that contains their work. Reviewers sometimes remark on those issues, but usually as a criticism of the publisher, not the editor. Presented with a digital edition in a traditional and familiar format, reviewers can focus on content, not interface or visualization, both of which call for an altogether different kind of review by an altogether different kind of reviewer. If ever a case arises where a print visualization cannot satisfactorily convey a digital edition's contents, it will, of course, be necessary to supplement it with other visualizations to facilitate the work of the reviewer. If anything, that will highlight the benefits of working on the digital paradigm.

6.3   Readers

Although Canonical Text Services and Distributed Text Services enable the citation of works and individual digital texts with great

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56   For this reason, it seems unlikely that LDLT editions would meet the criteria for review in a publication such as RIDE (`https://ride.i-d-e.de/`), but the interfaces for using LDLT editions might be candidates.

specificity,[57] the fluidity and perceived ephemerality of digital interfaces can leave readers feeling uneasy. Many undeniably still prefer the fixity of a printed product when they must refer to works in their scholarship.[58] Rasmussen describes the situation well:

> A scholarly edition in print, one might say, is a complete and singular object in the world: the results of scholarly effort are locked in a printed edition that can be conceived of as completed and closed. The publisher or editors have completed a scholarly effort whose outcome can be accessed using the edition, which is frozen in time (the date of publication) and space (the physical edition). From this spatiotemporal point onward, such an edition's textual representation of the work can inscribe itself into the work's reception history, including the history of research about the work. (Rasmussen 2016, 124)

Put in another way, "stability is a function of print, and it is a useful one that we should not give up lightly" (Sutherland 2009, 22). I suspect that this is true even of a print visualization of a digital edition, especially if it is not easily distinguished from the products of a traditional press. That is why the DLL aims to include a PDF copy in the repository of every edition it publishes. It is important to note, however, that the PDF is emphatically not the published edition, but only one possible rendering of the officially and verifiably published data.[59] The edition, as mentioned above, is a distributed version control repository of data published by the DLL on behalf of one or more scholarly associations that manage the peer review process.[60]

6.4 The Process

The process for producing a printable PDF from an LDLT edition's data is the final example of [re]presentation in this piece, and the square brackets are fully justified in this instance. Just as we customized the TEI Guidelines to create the DLL's guidelines, we are customizing the TEI XSLT Stylesheets for the purpose of visualizing LDLT edition data in PDF form.[61] The XSLT consists of multiple queries of an edition's TEI XML for the purpose of creating a new representation of

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57 See Tiepmar, Heyer 2019; Blackwell, Smith 2019.

58 See, however, Michelone 2021, 32, on the fixity of digital editions.

59 On the verification of the data, see Huskey, Witt 2019.

60 See Michelone 2021, 39, on the importance of publishing authority for digital editions.

61 The DLL's customization of the TEI XSLT Stylesheets may be found at `https://github.com/DigitalLatin/DLL-Stylesheets`.

the data in LaTeX, a "document preparation system used for the communication and publication of scientific documents".[62] The package "reledmac",[63] specifically written for typesetting scholarly critical editions, handles the calculations for allotting space to the text and critical apparatuses, along with marginal notations (e.g. line numbers) and other features of traditional critical editions. When compiled and processed, the LaTeX code produces a PDF of similar quality to editions published by traditional presses.

I say that the use of '[re]presentation' to describe this process is 'fully justified' because it captures well several aspects of the project. The PDF is not the officially published edition; rather, it presents the edition in a specific form. But that presentation is really a re-presentation. Since the data go through at least two transformations (from XML via XSLT to LaTeX, then from LaTeX via XeTeX to PDF), they are presented anew each time. Furthermore, the semantic encoding of the data is represented in the visual encoding of traditional printed editions. The PDF is thus a [re]presentation in that it fills the gap between human-readability and something that humans prefer to read. It also represents the work of a team of professional scholars working on the interpretation and visualization of humanities data.

7 Conclusion

Why make the effort and spend the time to encode critical editions if we are just going to print them out in the same old format? Sahle's words echo loudly here: "A digital edition cannot be given in print without significant loss of content and functionality" (2016, 27) and "Scholarly digital editions are scholarly editions that are guided by a digital paradigm in their theory, method and practice" (28). As I wrote in the introduction to this article, I would like to complicate this view and suggest that, at least in this case, the ability to render an LDLT edition's data in print is proof that LDLT editions are guided by a digital paradigm. That is, their encoded data can be computed against to produce many outcomes, a visualization optimized for print being one of them. There is no question that loss occurs when an LDLT edition is rendered in print, but at least some of the loss is made up by the ability of human readers to supply meaning through the interpretation of symbols and visual cues that comprise the standard bibliographic code of traditional critical editions in print. Moreover, any loss in the transformation to print can always be restored

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62 https://www.latex-project.org/about/.

63 https://www.ctan.org/pkg/reledmac.

by examining the original data or viewing it in another interface.[64]

On the other hand, it may be objected that LDLT editions do not follow a digital paradigm because the encoding guidelines for LDLT editions are based on the examination of how various textual issues are handled in printed critical editions. But even though the format of traditional critical editions in print was developed in part to address the economic considerations of publishers, the model for representing knowledge about a text and its transmission is not itself determined by the constraints of the printed page. Rather, it can be successfully and usefully transferred to a machine-readable format so that the information in a critical edition can be visualized and manipulated in a variety of interfaces and environments. Print is just one of them.

'[Re]presentation' is thus an apt description for many aspects of this work. The DLL's encoding guidelines present the visual encoding of traditional critical editions to machines in a language they can understand. They re-present the work of textual criticism on a digital paradigm, encouraging scholars to think of textual information as data for human and machine readers to consume. And they enable the representation of those data not only beyond but also including the traditional format of print.

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64 See Cayless 2018, 256, on loss as a default behavior of data transformation when there is not a matching template for a type of data.

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