

Uncertainty, narrativity, and critical approaches in Digital Humanities information visualisation projects

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Abstract

Information visualisation practices in the Digital Humanities fueled a long-lasting discussion over challenges posed by the interpretative nature of humanistic knowledge. Numerous contributions discuss narrative solutions and methods of uncertainty representation, promoting critical adaptations of general-use visualisations to address the specificities of the humanistic research material. However, existing surveys provide scarce empirical evidence for such advanced approaches, while addressing minor aspects that do not shed light on overall criticalities or the effective contribution of Digital Humanities methodologies to humanities scholarship. This study extends the scope of previous works and addresses how Digital Humanities web-based interfaces support epistemological approaches. 186 projects are classified by domain, narrativity, visualisation types, critical approaches to design solutions, and methods for visualising uncertainty and interpretation. Results reveal a persistent scarcity of narratives and uncertainty representation methods, as well as the incapacity to integrate results into humanistic interpretive frameworks.

Keywords

Digital Humanities, Information Visualisation, Uncertainty representation, Data-driven narratives, Survey

1. Introduction

The adoption of information visualisation methods in the Digital Humanities (DH) domain faces several challenges posed by the representation of aspects like uncertainty, ambiguity, and complex interpretative frameworks, which characterise critical approaches to humanities data. However, a systematic study of solutions adopted in real-world DH projects is not available, which would shed light on pragmatic solutions in use to cope with interpretive problems.

In this article, we present the analysis of 186 online projects. We extend prior surveys on solutions proposed by practitioners, and we analyse the landscape of strategies addressing narrativity, visualisations of uncertainty, tailored solutions, and their relation with humanities domains, identifying relevant patterns, gaps, and opportunities for interdisciplinary collaboration.

The remainder of the article is the following. In section 2 we provide an overview of existing contributions discussing issues that affect the visualisation of humanities data, summarising key points, and describing existing surveys. In section 3 we describe our research questions, approach, and the classification we performed. We present the results of our analysis in section 4, and our view as well as a comparison to prior studies in section 5. After discussing current limitations, we conclude and outline future perspectives in section 6.

2. Background and related work

In the realm of Cultural Heritage (CH) and the DH, “Generous interfaces” have been advocated as a way to showcase digital collections, promoting exploration and interpretation [1], as well as the adoption of narrative-oriented design strategies to improve emotional connection and user experience [2] while

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acting as interpretative frameworks [3, 4]. Windhager et al. [5] revealed that 20% of CH collection interfaces include “curated paths”, narrative browsing modalities generated by providers or through visitors’ interactions, aligning with author- and reader-driven narratives described by Segel and Heer [6].

The inherent ambiguity and interpretative nature of humanistic knowledge pose significant challenges for conventional visualisation practices, which are borrowed from disciplines founded on different epistemological assumptions than the ones in the DH realm [7, 8]. Drucker argues that DH must reframe the conception of data as situated, interpreted, and uncertain, in critically adapted visual solutions letting ambiguity and qualitative judgements emerge to better support humanistic investigation [7, 8]. The author suggests a distinction should be made between (1) representing ambiguity and uncertainty (e.g. using colours, transparency, etc.); and (2) using the latter as building blocks for representation (e.g. map coordinate dimensions crafted on ambiguity). To this extent, research on the visualisation of uncertainty explored the effects on the perception of trust and transparency [9, 10] and identified descriptive dichotomies for representation methods, such as: coincident (using integrated views)/adjacent (using separate views); intrinsic (altering existing symbols)/extrinsic (adding new elements); static/dynamic (using animation or interactivity) [11]. Other studies focused on the definition of taxonomies to describe representation methods of uncertainty [12], existing codifications [13], multiple coordinated uncertainty visualisations [14, 15], and methods grounded on interaction rather than on visual representation [16]. However, a lack of abstraction techniques and visual solutions is still reported [17, 18].

It has been argued that visual solutions should accommodate data complexity [7, 19] and promote (slower) reflection to support DH enquiry [20, 21, 22], where visualisation also serves as a research approach [23] with an epistemic value [24], able to encourage critical interpretation and act as a mediator between disciplines [19, 22]. Unfortunately, existing surveys acknowledge that the imprecision and interpretation vastly present in humanities contributions have hardly been found [5, 12, 18] and that the interfaces—mostly populated by maps and networks—often use non-temporal visualisations together to counterbalance self-limitations, which still do not account for such representational issues [5].

In conclusion, while several contributions advocate for more efforts in the creation of critical, humanities-oriented visualisations and tools that can address unique characteristics that common visual representations are not able to accommodate [20, 25, 26, 27, 28], such approaches were never assessed in a survey. In particular, to the best of our knowledge, no prior studies address the ways narrativity and display of uncertainty interact, and whether ground-breaking solutions in this regard are led by specific humanities fields. In this article, we shift the focus of prior studies toward a more comprehensive view of web-based DH projects. To this end, we reuse Windhager et al.’s approach to identify narrative solutions and adapt their visualisation taxonomy [5]. Moreover, we partially rely on existing taxonomies for uncertainty representation [11, 12] and interpretative metrics [7], while introducing a novel classificatory aspect to report tailored visual solutions that critically adapt general-purpose representations to accommodate the specificities of humanistic research.

3. Materials and methods

To build our corpus of DH projects, we partially relied on Windhager et al. collection [5] to identify suitable instances and related practitioners—designers, developers, and researchers—which were secondly surveyed to find additional material (14 and 19 projects). To claim representativeness, we reviewed the “projects” section on the websites of the Italian (AIUCD¹) and European (EADH²) DH associations, extending the enquiry to their research centres and institutions (12 and 92 projects). Lastly, we examined the “Best DH data visualisation” category of the Digital Humanities Awards³ website (49 projects).

¹Associazione per l’Informatica Umanistica e la Cultura Digitale (AIUCD). The section holding related projects can be found at <https://www.aiucd.it/progetti/>.

²European Association for Digital Humanities (EADH). The section holding related projects can be found at <https://eadh.org/projects>.

³<http://dhawards.org/>

The selection focused on instances that were: (1) web-based dissemination projects; (2) outcomes potentially produced through visualisation tools or storytelling software, but not tools or software themselves; (3) free from access barriers like registration forms; (4) significantly reliant on visualisation techniques; and (5) being accessible at the time of assessment.

The final dataset [29] includes 186 projects and was analysed via a Jupyter Notebook [30] for reproducibility purposes. Overall, the enquiry was driven by the following research questions:

RQ1. How are Digital Humanities characterised according to the usage of information visualisation and narrative techniques?

- Which are the most popular visualisations?
- How many projects are narrative projects (entirely or partially)?
- How many projects use more than one visualisation?
- How do these figures relate to the humanities domains to which the projects belong?

RQ2. How do Digital Humanities projects provide solutions to describe the humanities epistemic process?

- How many projects visualise uncertainty and interpretation and how do they do it?
- Is there a relation between uncertainty representation and humanities domains?
- Are there original attempts to produce novel visual solutions to address and represent the peculiarities of the research object? If so, is there a relation with the humanities domain?
- What is the relationship between uncertainty, critical adaptations, and narrativity? How many projects visualising uncertainty and interpretation rely on such original attempts?

The classification is based on direct observation of the visualisation systems and evaluates visual solutions without accounting for documentation, so as to minimise the bias carried by descriptions not reflecting features of the system at the time of evaluation. The classification schema is defined through an iterative process similar to [6], testing column configurations over samples of projects. The final classification was tested by two annotators who reviewed a sample of instances, which nonetheless come with inevitable degrees of subjectivity. Features relevant to the analysis are the following:

Narrativity (*narrative* or *non-narrative*) whether visualisations are used within narratives, in author-driven stories, user-directed experiences [6], or hybrid approaches.

Domain. A categorical value to describe the humanities field of the project. It is based on [31, 32] and includes: (1) *History and archaeology*; (2) *Art and art history*; (3) *Language and literature*, including linguistics, philology, narrativity and literary studies; (4) *Music and musicology*; (5) *Multimedia and performing arts*; (6) *Philosophy and religion*; and (7) *Other*, with no unique focus.

Visualisation of uncertainty and interpretation. A categorical value distinguishes between precise and impressional communication of uncertainty. Precise methods use explicit approaches [11] to represent quantifiable uncertainty—such as missing, unknown, or uncertain data—as separate, additional information. We distinguished: (1) *interactive distinction*, dynamic methods [11] to isolate uncertain data through filters while not making it visually distinguishable; and (2) *visual distinction*, extrinsic and intrinsic approaches [11] to let uncertainty “emerge” visually, usually by leveraging glyphs and spatial or visual cues. On the other hand, impressional methods are implicit approaches [11] using “experiential” techniques [12] to communicate abstract and unquantifiable uncertainties. They show the constructed and situated nature of data by exposing the interpretative layer of visualisation using either graphical aids or interpretative metrics [7]. We distinguished: (1) *ambiguation*, when graphical expedients—like permeable glyph boundaries or broken lines—are used to visually convey the ambiguity of a phenomenon (e.g. an uncertain timespan); and (2) *interpretative metrics*, when expressive, non-scientific, or non-punctual metrics are used to build a visualisation.

Critical adaptation. A boolean value identifies projects where at least one visualisation: (1) is tailored to reflect data peculiarities instead of an uncritically repurposed generic solution; and (2) accommodates complexity instead of simplifying it, promoting time-spending visualisation-based enquiry.

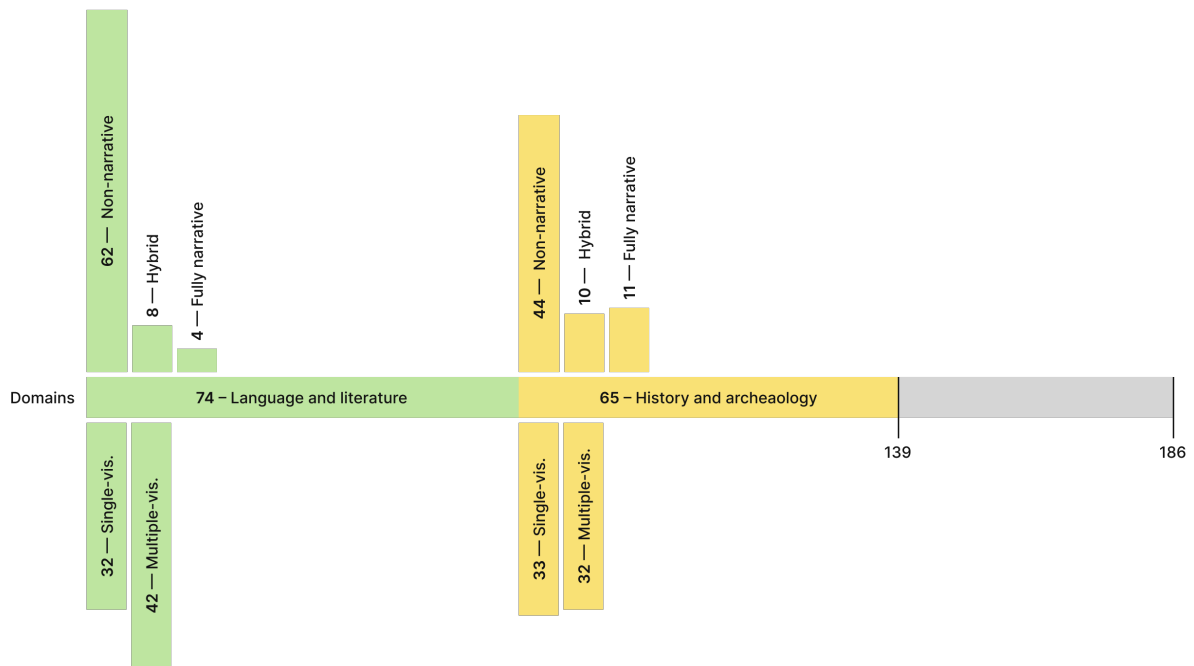


Figure 1: Narrativity and multi-visualisations in “language and literature” and “history and archaeology”.

Visualisation techniques. Adapted from Windhager et al. [5], a boolean value identifies the presence of the following visualisation types, including their stacked layouts and variations: (1) *plot*; (2) *cluster or set*; (3) *map*, including a description of statistical symbol maps (i.e. data points are statistical charts); (4) *network*; (5) *hierarchical diagram*; (6) *treemap*; (7) *word cloud*; (8) *bars*; (9) *line chart*; (10) *area chart*; (11) *pie chart*; (12) *3D plot*; (13) *proportional area*; (14) *timeline*; (15) *other*, miscellaneous.

4. Results

RQ1. Popular visualisations. Overall, maps are the most frequent visualisations, used by 65,6% of the projects (122/186), followed by bar-based charts at 37,6% (70/186). Other relatively popular visualisations are networks (24,2%; 45/186), timelines (20,4%; 38/186), and line charts (19,9%; 37/186). 21,5% of the projects chose other unspecified solutions (40/186). Treemaps, hierarchical diagrams, and clusters or sets are less used, while no 3D plot was found.

RQ1. Narrativity. Non-narrative projects represent 76,9% of the corpus (143/186). The remaining 23,1% of narrative instances can be divided into *fully narrative* (10,2%; 19/186)—with visualisations used only in narrative contexts—and *hybrid* projects (12,9%; 24/186). In this context, maps acquire even more importance, occurring in 83% of such projects, while networks appear only in 18,6% of general narrative projects (15,8% considering solely fully narrative instances).

RQ1. Multiple visualisations. Regardless of the narrative approach, 57,5% of projects use multiple visualisation techniques (50% considering only non-temporal visualisations), leveraging 2,5 different solutions on average, with the highest count reaching 12 different techniques. In particular, the majority of non-narrative (54,6%; 78/143) and hybrid projects (87,5%, 21/24) use multiple visualisation techniques, while 57,9% (11/19) of fully narrative projects use a single visualisation.

RQ1. Humanities domains. Most projects fall under “language and literature” (39,8%; 74/186) and “history and archaeology” (34,9%; 65/186), followed by “art and art history” (10,8%; 20/186), “multimedia and performing arts” (3,2%; 6/186), “music and musicology” (1,1%; 2/186), and others (10,2%; 19/186).

“Language and literature” primarily characterises non-narrative projects (43,3%; 62/143), followed by “history and archaeology” (30,8%; 44/143). However, the latter is the most active among narrative instances (48,8%; 21/43), while the former is less (27,9%; 12/43).

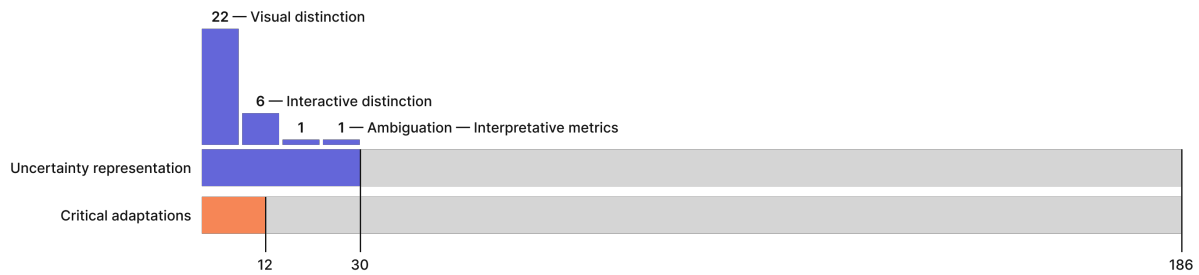


Figure 2: Distribution of uncertainty representation methods and critical adaptations across 186 Digital Humanities projects.

While single- and multi-visualisation approaches are balanced in “history and archaeology” (33/65 to 32/65) and “music and musicology” (one single- and one multi-visualisation project), all other domains account for more multi-visualisation projects.

Besides “multimedia and performing arts”, maps are most frequent in all domains. “History and archaeology” use them the most, accounting for nearly half of the overall occurrences (57/122). Bar-based charts (20), line charts (10), and other techniques are less represented. “Language and literature” is the category where visualisation types are more diverse: maps are the most used (39/74), followed by bars (32/74), networks and line charts (20/74), non-specified visualisations (18/74), timelines (16), and pie charts (11). In “art and art history”, maps (13) are followed by networks (8) and timelines (7). In other non-classified domain projects, maps (11) are followed by bar-based charts (10) and networks (7). Given the lowest frequency, “music and musicology” do not show significant patterns.

RQ2. Uncertainty and interpretation: magnitude and methods. Only 16,1% of projects (30/186) visually represent uncertainty or interpretation. Among these, only two represent unquantifiable uncertainty with impressional methods. One employs dashed lines and permeable boundaries as ambiguation techniques to visually suggest uncertainty about the length of time spans, while the other relies on an interpretative metric to determine element placement within the visualisation. On the other hand, 28 projects use precise methods to represent quantifiable uncertainty. Among these, 22 use visual distinction aids such as dedicated glyphs (e.g. bars that quantify unknown-data entities), different colours and patterns to identify uncertain data, or dedicated sections of the visualisation, while six use interactive distinctions based on the inclusion of uncertainty-based parameters in visualisation filters (e.g. checkboxes to include/exclude uncertain data elements).

RQ2. Uncertainty and humanities domains. Both projects representing unquantifiable uncertainty fall under “language and literature”. The majority of visual distinction methods are found in “history and archaeology” (9/22), “language and literature” (8/22), and “art and art history” (3/22). Differently, projects using interactive distinctions are equally split into “history and archaeology” (3/6) and “language and literature” (3/6) domains.

RQ2. Critical adaptation and humanities domains. Tailored approaches accounting for critical adaptation of visualisations were found in only 6,5% of the projects (12/186). Among these, five are “language and literature” projects, three are “multimedia and performing arts”, and two are from “history and archaeology”. Only one project is related to “art and art history” and one to non-classified domains.

RQ2. Uncertainty, critical adaptation, and narrativity. 90% (27/30) of projects representing uncertainty and interpretation employ non-tailored visualisation techniques. Moreover, both projects visualising unquantifiable uncertainty belong to the remaining 10% (3/30) along with a project using visual distinction methods. A qualitative analysis reveals that in the two projects addressing unquantifiable uncertainty, uncertainty is integrated into a visualisation using critical adaptation, while in the third project, these aspects are integrated into separate visual solutions.

Overall, non-narrative projects prevail, with one non-narrative and one hybrid project representing unquantifiable uncertainty, and the great majority of solutions using visual (17/22) and interactive (5/6) distinction methods, with three additional hybrid projects. Shifting perspective, the vast majority of fully narrative (89,5%; 17/19) and hybrid (79,2%; 19/24) projects do not visualise uncertainty or

interpretation. The percentage rises by considering narrative instances lacking tailored approaches accounting for critical adaptation—94,7% of fully narrative (18/19) and 91,7% of hybrid projects (22/24). The pattern witnesses that most projects encompassing critical adaptation are completely non-narrative (75%; 9/12), with only one fully narrative and two hybrid instances.

In conclusion, while 64,5% of projects (120/186) neither use narrativity nor represent uncertainty, 60,8% (113/186) also do not use critical approaches to visual solutions.

5. Discussion

Overall, while in CH collections [5] and musicology interfaces [18] maps and networks are the most recurring methods, in our results only maps appear to be very frequent. Instead, networks are under-represented compared to prior studies [5] [12]. This could be explained by their poor readability and the limitations of connections to represent data features across different types of scales compared to other visual variables [33]. The co-occurrence of temporal and non-temporal visualisations also reveals significant differences. Whereas in CH collection interfaces timelines are mostly used with maps and networks, in DH projects they mainly occur with maps, bar-based charts, and line charts.

We found that projects use a modest number of visual solutions overall, with a notably lower tendency to use multiple non-temporal visualisations compared to CH collections (30% fewer projects – from 80% to 50%). Moreover, while narrative approaches are slightly more frequent in DH projects than in CH collection interfaces, the difference is not significant and the count is still low if we consider the advantages such approaches are claimed to bring to information visualisation [4, 34].

Notably, only two DH domains appear to be active in information visualisation projects. In particular, “language and literature”, non-narrative, multi-visualisation projects are the most frequent ones, which may be indicative of an exploratory approach, wherein creators aim at revealing the added value of the dataset rather than posing and testing explicit hypotheses. On the other hand, “history and archaeology” projects mostly accommodate narrative, single-visualisation (maps) solutions.

Compared to prior studies [18], we found a higher but still not significant number of instances that visually communicate uncertainty (16,1%; 30/186), mostly in non-narrative projects. Results are in line with Panagiotidou et al. [12] on DH research (15,9%; 20/126). It is argued that researchers’ goals and skills impact the decision to represent both uncertainty and complexity [35], since uncertainty might make the message noisy and visualisation tools lack standards to visualise uncertainty [12]. However, the low number of empirical evidence seems to clash with the dimension of the theoretical debate [5], being the imprecision and interpretation (vastly present in humanities texts) hardly reported in CH interfaces and visualisations design. Our study confirms the disappointment emerged from prior studies in not finding more uncertainty visualisation [12]. Also, solutions coping with unquantifiable uncertainty through impressional methods are rare. On the contrary, more traditional approaches to represent quantifiable uncertainty through visual distinction methods are the majority. A smaller but still relevant number of projects use filters for the same purpose. On the one hand, the latter approach prevents adding visual complexity and related issues [10, 11, 14, 15, 16, 36]. On the other, we may argue that the lack of visual distinction in the initial views remains potentially misleading, since ambiguity is imperceptible without deeper engagement with interactive components, hindering the effective communication of critical information.

Moreover, only a few projects propose innovative and tailored visual solutions to fulfil requirements for critical adaptation, the majority being part of “language and literature” and using a non-narrative approach. Overall, the lack of critical approaches to visualisation reflects a broader trend in DH that favours quantitative validation and measurable outputs over tailored, interpretative solutions [37]. The uncritical repurposing of generic and technically convenient visualisations often reduces them to proofs for output production, which however neglects their epistemological potential as humanistic forms of knowledge, failing to integrate them within the interpretative framework that aligns with the humanistic roots of the projects.

Interestingly, projects using impressional methods are among the few representing uncertainty while

also meeting our criteria for critical adaptation, testifying the challenges of integrating qualitative aspects and the lack of ready-made solutions to this aim [17, 18]. Conversely, almost all the projects using precise methods to represent quantifiable uncertainty rely on traditional non-tailored approaches, demonstrating that uncertainty can be still represented without extensive customisation. Notably, uncertainty representation and critical adaptations are mostly found within non-narrative project, while narrative approaches tend to rely on more conventional representations.

Although specialised skills are required for tailored visualisations and unquantifiable uncertainty in the absence of ready-made solutions, general-purpose visualisation and precise methods remain viable. Moreover, given storytelling's benefits for improving the communication and interpretation of complex information [4, 34], we argue that adopting more narrative approaches can mitigate the complexities introduced by uncertainty representation in non-narrative visualisations, especially for casual users.

Most projects neither represent uncertainty nor use narrative or tailored approaches, leaving substantial room for improvement. While visualisation skills remain a barrier for tailored critical adaptations—best overcome by interdisciplinary collaboration—we suggest that narrativity could compensate for the lack of uncertainty visualisation methods, capturing the complexities at the core of DH.

Limitations of this work. We remark that our custom classification schema focuses on specific selected approaches and techniques. As such, our framework does not capture examples similar to Foster et al. [38], where the constructedness and interpretation emerge from interactions rather than from visual representation. The number of projects in our corpus is higher than in similar studies, which allowed us to derive some representative conclusions such as the impact of narrativity, or the use of critical approaches for humanities visualisations. However, narrative projects are underrepresented, and the conclusions within this sample are not generalisable. Furthermore, the focus on projects as the primary object of enquiry inevitably leads to a series of limitations. While it cannot be distinguished when multiple visualisations are used within the same view or in separate sections of the website, also pinpointing the exact visualisation responsible for the representation of uncertainty is not possible.

6. Conclusion

This contribution provided an analysis of critical approaches for humanities visualisations in web-based projects, with a focus on interpretation and uncertainty visualisation methods and on critical adaptations to accommodate the peculiarities of humanistic knowledge and data. These aspects were put in relation to humanities domains and narrativity, providing an overview of used visualisation techniques. We extended the context and the scope of previous studies, comparing results across contributions. The manifold discussion around visualisation methods and issues posed by the peculiarities of humanities data underscores the relevance of this study, which demonstrates how such topics are poorly reflected in DH practices and interfaces. Our analysis reveals a small set of very popular visualisations and a large tail of less common solutions, as well as a few narratives and projects challenging and critically adapting traditional visualisation methods to represent uncertain and interpretative phenomena.

Our findings suggest the need to advocate for more informed and critical approaches to the development of DH visualisation interfaces, by encouraging greater interdisciplinary collaborations among digital humanists, humanists, and information visualisation practitioners to design critical solutions that fill the gap highlighted in the theoretical discussion. Alternatively, we propose leveraging narrativity to overcome intricacy issues posed by uncertainty representation, compensating for the lack of alternative solutions. By doing so, we believe DH can effectively support the development of new research methodologies in the humanities to solve complexity rather than simplify it.

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