








BRIEF REPORT

Towards a computational history of modernism in European literary history: Mapping the Inner Lives of Characters in the European Novel (1840–1920) [version 1; peer review: 1 approved, 2 approved with reservations]

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v1 First published: 23 Aug 2023, 3:128
<https://doi.org/10.12688/openreseurope.16290.1>

Latest published: 23 Aug 2023, 3:128
<https://doi.org/10.12688/openreseurope.16290.1>



Abstract

In this paper, we investigate the common narrative in literary history that the inner lives of characters became a central preoccupation of literary modernism. We operationalise this notion via a proxy, tracing the use of verbs relating to inner life across 10 language corpora from the ELTeC collection, which comprises novels from the period between 1840–1920. We expected to find an increase in the use of inner-life verbs corresponding to the traditional periodisation of modernism in each of the languages. However, different experiments conducted with the data do not confirm this hypothesis. We therefore look at the results in a number of more granular ways, but we cannot identify any common trends even when we split the verbs into individual categories, or take canonicity or gender into account. We discuss the obtained results in detail, proposing potential reasons for them and including potential avenues of further research as well as lessons learned.

Open Peer Review

Approval Status 

	1	2	3
version 1 23 Aug 2023	 view	 view	 view

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Keywords

distant reading, literary history, European novel, modernism, literary characters

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Competing interests: No competing interests were disclosed.

Grant information: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [861952](SGA3). Research for this paper was conducted as part of the COST Action 'Distant Reading for European Literary History' (CA16204). More information on the Action, Management Structure, Resources and Publications can be found here: <https://www.distant-reading.net>

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How to cite this article: Radak T, Burnard L, Francois P *et al.* **Towards a computational history of modernism in European literary history: Mapping the Inner Lives of Characters in the European Novel (1840–1920) [version 1; peer review: 1 approved, 2 approved with reservations]** Open Research Europe 2023, 3:128 <https://doi.org/10.12688/openreseurope.16290.1>

First published: 23 Aug 2023, 3:128 <https://doi.org/10.12688/openreseurope.16290.1>

Introduction

In 1924, Virginia Woolf famously proclaimed that “on or about December 1910, human character changed” (2009: 38) and argued that it was the task and responsibility of modern(ist) fiction to represent the complexities of a character’s interiority through new and innovative literary techniques. Since the introduction of the “inward turn” (Kahler, 1973), the notion that the “inner life, the soul, *l’âme*, *die Seele*, *sjælen*” (Bradbury & McFarlane, 1991: 196) of characters constitutes a central preoccupation of literary modernism has become a critical staple. In line with recent contributions to the understanding of literary characters through distant reading methods (e.g. Freitas & Santos, 2023; Piper, 2023), we aim to test this notion by tracing references to “inner life” in the European Literary Text Collection, a collection created within the COST Action “Distant Reading for European Literary History”.¹

Measuring modernism through “inner life”

In the field of Computational Literary Studies, phenomena often cannot be modelled in their entire complexity; therefore, a proxy is considered as indicative of the phenomenon in question. In our case, the hypothesis is based on the above-mentioned narrative that the characters’ inner life became central to literary modernism. Hence, we operationalize the use of inner-life verbs, such as *feel* or *think* (see the Methods section), as a proxy. Our assumption has been that these verbs are employed when inner processes are (re)presented and that their use may correspond to the development of literary modernism in each of the languages. The issue at hand seemed a good test case for a comparative computational study of the novel corpora included in ELTeC,² since the approach allows us to identify and visualise trends appearing at different times and compare similarities and differences across languages.

We want to emphasize that the terms ‘modernism’, ‘modern’ and ‘modernity’ are not unambiguous, but rather carry fluctuant meanings across national literary histories (Călinescu, 1987; Friedman, 2001). Some sources locate the start of modernity during Romanticism or even the Renaissance, while others consider only the changes in the literary/aesthetic field around 1890 as ‘modern(ist)’. Additionally, the themes and techniques perceived as ‘modern’ or ‘modernist’ did not develop synchronously throughout Europe. While there is thus no common and/or uncontested periodisation of ‘European Modernism’, we can observe processes implying formal innovation in national literatures throughout Europe at different times. Therefore, we assume that, based on the traditional periodization(s) of modernism in each language, certain upward trends can be observed over time, and we do expect to see an increase at least in those European languages which are commonly considered to be prominent driving forces of ‘modernism’ during the period sampled by ELTeC.

¹ See www.distant-reading.net/eltec/.

² For detailed discussions of the selection criteria for the ELTeC collection, see Burnard *et al.*, 2021; Schöch *et al.*, 2021

Data

This study uses 10 ELTeC corpora: English, French, German, Hungarian, Norwegian, Portuguese, Romanian, Serbian, Slovenian, and Spanish. ELTeC was created to reflect the narrative literature (novels) in various languages from 1840 to 1920 in a comparable way. Each of the corpora includes 100 public-domain novels, with diverse metadata (author name, gender, time slots, word count, etc.) that operationalize concepts (e.g. canonicity, reflected in reprint count). Although the editors aimed at balanced collections and fair distribution according to variables, not all collections could comply with the proposed criteria (see Burnard *et al.*, 2021; Herrmann *et al.*, 2020; Schöch *et al.*, 2021).

For the purpose of the present study, we chose ELTeC – level 2, that is, corpora that were xml texts, TEI encoded and POS-tagged. The size of the full material appears in Table 1.³

Methods

Just as there are many conceptual ways and proxies available to start unpacking the relationship between literary modernism and the use of inner-life verbs, for the methodology, too, we had a range of options to operationalize and then test our hypothesis. The methodology described here has slowly evolved over multiple discussions, during which we carefully weighed advantages and disadvantages for each approach. Our methodology emerged from a trial-and-error process that will have to be repeated/expanded on in larger studies. Even so, the data gathered as part of alternative approaches is available in the supplementary material. Originally, we wanted to compare two approaches: the first based on the methodology described in this paper, with the difference that we simply selected any 10 inner-life verbs rather than 3 verbs from 6 categories. This first attempt was perceived as inferior, as the choices were not underpinned by theoretical literature and differences among languages across categories went unnoticed. Our second approach also had two iterations. The first iteration used seed words (*feel*, *think*, *believe*, *know*, *hope*, *wish* and their translations in the ELTeC languages), augmented by 15 nearest neighbours. This resulted in a list of up to 100 words. However, filtering the noise from this list was, for the moment, beyond the scope of this first paper. The second iteration expanded on this attempt by also using the 6 internal state language categories.⁴

It is important to see the methodology we settled on in the end, above all, as a first conceptual bloc in a longer debate. Thus, our methodology revolves around two sets of choices: 1) how the items on the language-specific wordlists are selected, and 2) how the data is analysed. The choice of the morphological category is informed by recent literature on

³ We have also conducted preliminary work with Serbian, with the same overall results.

⁴ For an overview of the dispatched methodological choices that were later discarded and of the reasoning behind these, see Burnard, 2022.

Table 1. Data overview.

Language	No. works	Reprint Count distribution (frequent/rare)	Word Count	Inner-life verbs
(A) ELTeC				
deu	100	48 / 46	12,738,842	306,040
eng	100	32 / 68	12,227,703	170,431
fra	100	44 / 56	8,712,219	169,719
hun	100	32 / 67	6,948,590	117,661
nor	58	32 / 26	3,686,837	83,794
por	100	26 / 60	6,799,385	115,427
rom	100	24 / 76	5,951,910	230,260
slv	100	48 / 52	5,682,120	112,436
spa	100	46 / 54	8,737,928	137,050
(B) Diachronic corpora				
por_1840-1949	233	n/a	14,882,964	245,334
ger_1760-1920	1147	n/a	114,208,981	933,488
fra_1750-2000	1086	n/a	77,988,445	1,489,292

“internal state language”, which has been studied intensively, especially in the context of the Theory of Mind framework (Tompkins *et al.*, 2018). From this framework, we derived six relevant categories:

- **perception:** verbs relating to sensory experience (e.g. “see” something, “listen” to something, “perceive” somebody);
- **physiology:** verbs relating to the body/bodily experience that influences one’s inner life (e.g. “hurt”, “feel hungry”);
- **affect:** verbs relating to emotions or emotional states (e.g. “love”, “hate”)
- **volition and ability:** verbs relating to wishes, desires etc. and/or ability (e.g. “desire”, “wish”)⁵;
- **cognition:** verbs relating to mental processes (e.g. “remember”, “forget”);
- **moral judgment and obligation:** verbs that contain evaluative statements (e.g. “she preferred x over y”) and/or that refer to an obligation (e.g. “they should be careful”; “he was obliged to her”).

We asked domain experts for each language to go over the entire verb frequency list and select three verbs for each of

the abovementioned categories. It is noteworthy that this procedure maximizes diversity within the total of inner-life verbs. If we had simply scored for absolute frequency, the category ‘perception’ would have been dominantly represented. Instead, our approach gives the six categories equal weight and thus also allows us to inspect them individually.

The analysis step is centred around establishing, for each language-based corpus, the prevalence of each inner-life verb. The prevalence in one novel is defined as the proportion of instances of each inner-life verb relative to all instances of verbs used. For this analysis, this prevalence is established (a) for all six categories taken together and (b) for each of the categories separately.

We visualize the data in three ways:

(1) Using a detailed scatterplot, we can show each novel as a function of its publication year and the prevalence of inner-life verbs; this allows for the calculation of a linear regression line that shows whether the prevalence increases or decreases over time.

(2) Using a group of boxplots, each showing the distribution of the prevalence of inner-life verbs during one decade, we summarize the data.

(3) Splitting the data into an earlier (1840–1870) and a later phase (1890–1920), and visualizing the distribution of inner-life verbs as a density plot, we display the degree of

⁵ For this category, we focussed primarily on “volition”.

overlap and similarity between the data for the earlier and the later period. This also allows for the calculation of a test statistic and the probability that the two distributions are part of the same underlying distribution. Only if this probability is below a threshold (traditionally, $p < 0.05$) should we assume a genuine underlying difference between the distributions of the earlier and later phases in the data.

Results

Based on the corpora, lists of verbs and methods of analysis described in the previous sections, we have obtained a set of results in the form of frequency tables and data visualizations.⁶

The examination of scatterplots and boxplots for all verbs first shows various slight trends, whether upwards (English, Hungarian), downwards (French, Norwegian, Portuguese and, most markedly, Slovenian) or more or less flat (German, Romanian, Spanish). However, the density plots and tests for statistical significance do not detect any differences with statistical significance.⁷ For a summary of these data, see Figure 1.

As a consequence, we look at the data in several more fine-grained ways. First, we consider whether individual

categories of verbs may display more marked trends than was the case for all verbs taken together. However, this yields similarly inconclusive results for all corpora. Second, we consider whether there is any divergence in the trends according to ELTeC canonicity and gender criteria.⁸ We only find slight divergences, with strongly overlapping confidence intervals and therefore no statistically significant divergences.

Finally, we want to exclude the possibility that we do not see significant trends because the datasets are too small, or because the time period 1840–1920 is too short for such trends to become visible. Therefore, for languages where more data from a wider chronological range is available (French, German, Portuguese), we perform the same analysis. This time, in the French data, we do see statistically-significant downward trends, both overall and most markedly for verbs of affect (Figure 2). This, however, contradicts our initial expectation of an upward trend.

Discussion

For the period primarily investigated here (1840–1920), the proportion of inner-life verbs, at least in the way we have defined and operationalized them, appears to be remarkably stable across a number of different languages, corpora, and subsets of the data. Additionally, it appears to be somewhat stable even when considering corpora with a larger diachronic scope. In other words, the data do not confirm our hypothesis

⁶ All data visualizations referred to in this section, as well as the data and code used to create them, are available from the project repository at: github.com/COST-ELTeC/innerlife/, DOI: [http://doi.org/10.5281/zenodo.8189812](https://doi.org/10.5281/zenodo.8189812).

⁷ In some cases, the number of novels was insufficient, especially for the earlier period, to allow for a meaningful calculation.

⁸ We used the variables provided by the ELTeC metadata for these two categories (binary canonicity categories based on reprint count, a three-class system for author gender).

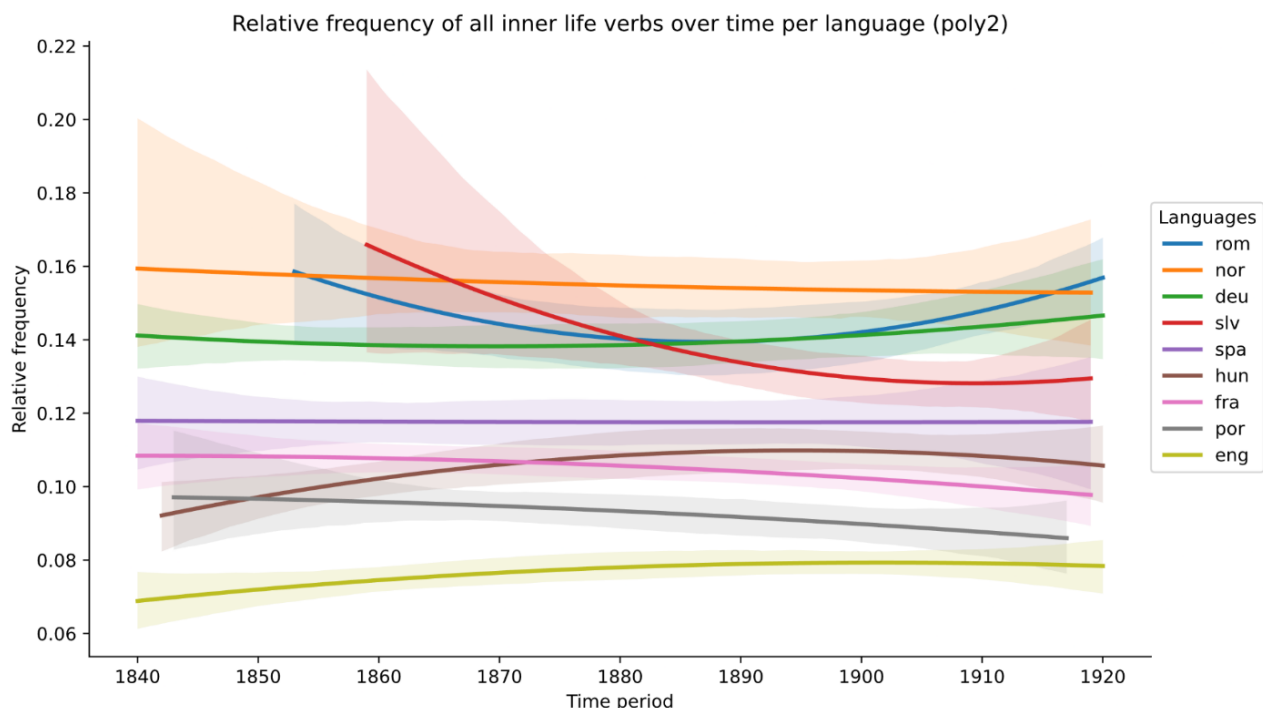


Figure 1. Relative frequency of all inner-life verbs over time, per language (second-order polynomial regression line).

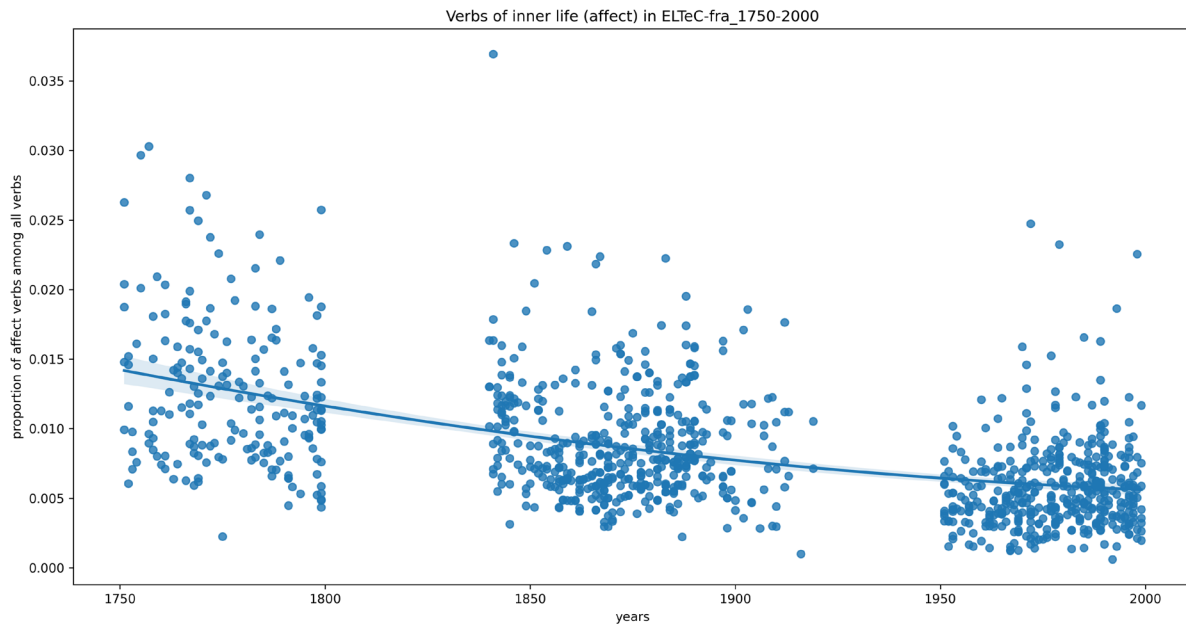


Figure 2. Relative frequency of inner-life verbs (affect category only) in the extended French data (1750–2000), with a second-order polynomial regression line.

about detecting a rising trend, an increase in the use of inner-life verbs. The reason for this finding could be that the assumptions in literary history about this aspect of modernism are false. However, it is probably much too early to reach such a conclusion, because there could be other reasons, for example:

The time slot could be too short. As the experiment with the French 1100 novels shows, we can see a trend when we look at the long history from 1750 to 2000, but it is a decreasing one. Conversely, there is no trend visible in either the German or Portuguese data. We assumed that we would find the trend in some languages earlier and in others later, so our time window of 80 years could be too short for the phenomenon we are interested in. However, as the experiments with larger corpora show, this expectation is not supported by the data.

Canonicity: The mix of novels in the ELTeC could be misleading. The description of literary history usually refers to a rather small set of texts which represent retrospectively the most advanced trends of their time and which made it into the literary canon. The various corpora also contain non-canonical novels, a category which sometimes refers to texts from high literature (literature meant to be read by educated readers, often employing complex literary devices) that were not considered to be relevant. Sometimes, the category refers to texts which are precursors of popular fiction. But even despite this ambiguity, the meaning of canonicity is rather clear, and if we consider only these novels, we can see that in the French and Portuguese data, the trend decreases, while there is no trend for the German corpus and only small

trends for the Spanish one. Only in the English data we see exactly the upwards trend we expected.

Confounding variables: The distribution of narrative devices is certainly not stable for the time period we are interested in, as writers developed innovative techniques that challenged “ill-fitting” (Woolf, 2009) realist forms of literature. There are two connected trends described by literary history: the disappearance of the narrator (at least a trend to avoid third-person narrators or strong commenting voices) and the trend to prefer showing and avoid telling (Klauck & Köppe, 2014). The latter trend has not only been confirmed but shown to be visible in the history of the novel between 1750 and 1950 (Heuser & Le-Khac, 2012). The French long-term data show a decrease of verbs indicating a description of affects, which seems to conform to this tendency. Conversely, although we know from other experiments that the German novel is also changing in the direction of a preference for more concrete expressions, we cannot see any long-term trend with respect to the inner-life verbs.

While acknowledging recent work that challenges the notion of the “inward turn” in modernist literature (Conroy, 2014; Gang, 2013; Herman, 2011; Miguel-Alfonso, 2020), there are good reasons to conduct further research regarding the assumption that modernism comes with an increased interest in the inner life of characters. At the same time, it has become very clear that the European history of the novel is not just a trickling down of modernism from the centre to the periphery: we see very different trends in the data, even if we grant something like a time lag between national developments. This indicates that modern interests and sensibilities were integrated into very different national

histories and any attempt to tell this story on the European level must start from a more complex model of literary history.

Conclusion: Lessons learned and further research

By using corpora in 10 different European languages, we have attempted to operationalize the hypothesis that characters' inner lives become a central concern of literary modernism.

This has been an exploratory endeavour, partly owing to the multilingual feature of the ELTeC. Several factors may have been responsible for the inconclusiveness of our results. Some might be related to the materials worked with, as discussed in the results and discussion sections:

- the size and scope of the collection
- the fact that 'modern', 'modernist', 'modernism', as well as associated questions of periodisation, differ across languages and national literatures

However, the inconclusiveness may also owe to methodological choices:

- Were we sufficiently 'deep' in our approach? Provided the verbs are indeed indicative of inner life in all our languages: is the occurrence pattern of these verbs more complex than a pure counting of relative occurrences or even than 'the company they keep' (traceable through their embedding-neighborhood)⁹?
- Have we been paying enough attention to the different distributions of the categories in the different languages?

With regard to these points, a comparative study employing similarly complex tools and methods as Piper, 2023 (bookNLP, "super-sense tags") might provide a further potentially fruitful avenue of research. With its focus on embodiment, rather

⁹ This path was not pursued further; see footnote in the methodology chapter.

than emotional states, in the Hathi1M corpus, Piper's paper proceeds from a diametrically opposed starting point, yet arrives at a similar result that corroborates our findings: While verbs referring to "embodiment", in particular those referring to "motion", experienced a steady rise in the period between 1800 and 2000, verbs of cognition do not display a similar upward trend (Piper, 2023: 7).

Finally, working together in a multilingual and interdisciplinary setting is, no doubt, a very rewarding and enriching endeavour. At the same time, it entails its own challenges regarding explicit or implicit expectations, conventions, and terminologies that are important to consider when embarking on comparable projects.

Data and software availability

Data, code and results relevant to this paper are made openly available at <https://github.com/COST-ELTeC/innerlife/> (DOI: <https://doi.org/10.5281/zenodo.8189812>). All raw data in the repository is made available with a Creative Commons Zero (CC0) licence. All figures and code in the repository are made available with a Creative Commons Attribution 4.0 International CC BY licence.

Acknowledgments

The authors would like to express their sincere gratitude to members of the COST Action "Distant Reading for European Literary History" (CA16204) who have contributed ideas, data, and discussion points during any part of the process and/or without whom the current project would not have been possible. We would particularly like to thank Rosario Arias, Borja Navarro Colorado, Ronan Crowley, Marko Juvan, Janicke S. Kaasa, Cvetana Krstev, Jessie Labov, Luiza Marinescu, Carolin Odebrecht, Stefano Ondelli, Antonija Primorac, Jan Rybicki, Ranka Stankovic, Åse Kristine Tveit, Andrejka Žejn.

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Open Peer Review

Current Peer Review Status: ? ? ✓

Version 1

Reviewer Report 27 November 2023

<https://doi.org/10.21956/openreseurope.17586.r35113>

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Major Points:

The article studies whether the theorized increasing focus on the 'inner-lives' of characters associated with modernism can be quantitatively shown by measuring the relative prominence of 'inner-life' verbs over time. The authors study this phenomenon in ELTeC corpora for 10 languages. After identifying three 'inner-life' verbs from each of six relevant categories for each of the ten languages, they measure the usage of these verbs as a proportion of all verbs each year from 1840-1920. The proportion of 'inner-life' verbs used over time does not change significantly over the time period, except for a larger corpus of French literature, in which they find a decrease in the usage of 'inner-life' verbs.

Given that Open Research Europe seems to be a broad repository venue rather than a specific journal, I am uncertain of the expected level of contribution or intended audience for this piece. My comments assume an audience of Digital Humanities researchers and those interested in DH work. Overall, the work seems sound if not particularly exciting. I can see it as a baseline for a more sophisticated study, but at present I feel that the work would be too preliminary to publish in a competitive journal or conference.

My main criticism is that the assumption that inner life can be characterized by specific verbs, and more importantly that those verbs indicate descriptions of inner life, seems thin and reductive. Does Catullus not hate and love? At this point we have language models that can operate in multiple European languages and extract high-level conceptual constructs. Counting verbs seems somehow both unambitious and unworthy of the subtlety of the concept of inner life. If this were presented as a relatively weak opening play at operationalizing inner life to be empirically disproved, and to be followed by speculation about stronger methods, I would feel more confident. At least looking at objects and subjects in addition to verbs might provide more

variation.

An alternative, and perhaps stronger motivation might be to clarify that even if an observation does not define a construct, it can still serve as an indicator of the presence of the construct. The famous Stanford lit lab result that the Gothic novel is characterized by greater use of locative prepositions does not mean that those prepositions are what makes the novel Gothic, it is that the Gothic is a distinct and noticeable phenomenon that has innumerable statistical manifestations, of which prepositions are just the most countable. "Inner life" verbs could be similar, and they are not.

Another potential threat to validity is the composition of the corpus. I believe that this collection was developed for general purposes and not for this specific study. I don't know anything about the novels except their rough publication date and the fact that they were prominent enough to be digitized and selected for these collections. Do they represent modernism? Could the early ones have been chosen because they are avant garde (and thus happen to have more modern features), or the later ones because they are in a more conservative prestige-literary tradition? I don't expect so, but the point is that I don't know.

There are well-known large-scale patterns in literature (at least in English) over this time period, see Ted Underwood's work on narrative time measurements. Over the 19th century English-language literature shifts from a more narrative style to a more dialog-oriented style. I wonder if there are

I am also concerned that the choice of only three verbs from each 'inner-life' category could skew results. If certain authors favor particular verbs over others or there was a transition from using one verb to another over time – both easily imaginable scenarios – the given results would not reflect the phenomenon being studied. It is particularly concerning to me that the criteria for choosing these verbs is not given. To account for the concern that studying all verbs would skew the results in favor of one category of verb, one could report general trends for all verbs and then individual trends for each category, thus allowing for both a broad and fine-grained study of the phenomenon.

I don't know how the confidence regions in Figure 1 are defined, but they look like bootstrap CIs, which would be a good option to increase statistical reliability. The second-order curve fit may be too smooth, I would rather see this as the actual numbers in a line plot with per-decade confidence bars.

Finally, and less importantly, I found the paper difficult to follow in places and believe it could benefit from some reorganization and simplification of language. I comment more on this in the section below.

Introduction

A final word describing what COST Action "Distant Reading for European Literary History" is (project?) would help clarify for those unfamiliar.

Measuring modernism through "inner life"

This section feels slightly disjointed; I think that splitting its content between the Introduction and Methods sections would help. Specifically, moving the hypothesis and discussion of modernism to the Introduction and the portion on methods to the Methods section would likely increase flow.

The second sentence of the section mentions a hypothesis before one is given which feels odd although the hypothesis can be guessed.

The next sentence seems to tease the methods without providing much information on them – this could just be moved to Methods.

In the sentence beginning “Our assumption...”, “has been” should be changed to “is” or “was” for clarity.

The phrase “seemed a good test case” feels overly informal and implies this project was just created to use ELTeC. Perhaps rephrase to say that an additional benefit of the experiment was that it was an opportunity to explore the uses of ELTeC.

Adding some clarification to what the “upward trends” referenced in the final paragraph of this section are would be helpful! I assume this means upwards trends in the usage of inner-life verbs, but it would help to have that explicitly stated.

Data

The sentence beginning “ELTeC was created...” reads slightly awkwardly and may benefit from rephrasing. Specifically, including a specific number instead of saying “in various languages” would be beneficial. The phrase “in a comparable way” sits awkwardly and could be removed.

Writing “ELTeC level 2 [corpora or texts]” instead of “ELTeC – level 2” may help those unfamiliar with the corpora.

“... corpora that were xml texts” should be “corpora containing XML texts, which are TEI encoded and...”

Why are the results for Serbian, referenced in the footnote, not included if they show similar trends?

Methods

The first sentence of the section is confusing and may benefit from reorganization. Specifically, “unpacking the relationship between literary modernism and the use of inner-life words” is referenced but I am not sure where this has been discussed in the paper so far.

The discussion of how you settled on the methodology (beginning with the sentence “The methodology described here...” and ending with “The second iteration...”) could be significantly shortened or cut. The way the general process described – iterative refinement through testing and discussion – seems standard of this kind of research project. Instead, the section could be formatted as “we chose these methods instead of --- because of ----” or the paper cited in footnote 4 could just be referenced.

The sentence beginning “It is important to see the methodology...” distracts from the intention of

this paragraph and could be cut. Beginning with “Our methodology revolves around...” would be more impactful.

I'm not sure what “the morphological category” is at the point it is mentioned.

The criteria by which the language experts selected the verbs for analysis is important.

The sentence which starts “The analysis step is centred around...” is confusing and can be cut.

It feels odd to have the different visualizations listed before they are shown, particularly because not all of the visualizations are used in the upcoming analysis. Perhaps just mention visualizations in the results when they are used. For the description of the third visualization category, what test statistic is calculated? A technical audience will also know what significance is and the traditional thresholds for p-values; including it is unnecessary.

Table 1 and Figure 1

I would change the language codes to full language names to increase legibility.

Results

The first paragraph can be cut.

In reference to Footnote 6: I would include any visualizations referenced in the paper. Or, if there is only space for Figure 1, it seems it can be referred to for all of your analysis in this section.

“...any differences with statistical significance...” should be “...any differences of statistical significance...”

The paragraph beginning “as a consequence” could likely be condensed to one sentence per tested theory.

Discussion

In the first sentence, the phrase “at least in the way we have defined and operationalized them” undercuts your analysis and its contents are clear from the framing.

The word “somewhat” in sentence two feels vague; perhaps you could say “statistically stable in all but one language”?

The sentences which begin “The reason for this finding...” and “However, it is probably...” contain a lot of hedging and could likely be combined.

The time slot could be too short

Moving the sentence about the German and Portuguese data to the end would improve flow.

Canonicity

“in the ELTeC” should be “in the ELTeC corpora”

I'm not sure what is meant by “The description of literary history.” Common discussions of literary history?

The distinction between canonical novels and those from high literature is not entirely clear to

me. Who considers these books irrelevant?

"...the meaning of canonicity is clear..." does not hold true in my experience.

When stating "we only consider these novels" do you mean only the canonical novels? If so, how are those determined?

Confounding variables

Are the "two connected trends" those that could explain the results? Some qualifier about what these trends are / how they were chosen would be helpful.

Please cite or include the "other experiments" referenced. It would be particularly valuable to know what method for measuring inner-life verbs are used in these experiments.

The sentence beginning "While acknowledging..." is confusing and could benefit from rephrasing.

What is the "centre" and what is the "periphery"?

Instead of "we see," I would write "our results show" so that it is clear what leads to this conclusion.

I am not sure how the data show that "modern interests and sensibilities were integrated into very different national histories. I fully believe this is true, but struggle to follow how the data demonstrate this.

Conclusion

Why does the multilingual. Nature of ELTeC make this an exploratory endeavor?

Saying "provided the studied verbs" or similar instead of "provided the verbs" would add clarity.

"... such Piper 2023" should be "such as Piper 2023"

The final paragraph commenting on interdisciplinary research may be obvious to an audience used to such collaborations.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Digital humanities, text mining

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 25 September 2023

<https://doi.org/10.21956/openreseurope.17586.r35112>

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This paper investigates the hypothesis that modernist novels focus more on the inner life of characters. The hypothesis is operationalized by counting the frequencies of inner life verbs. Contrary to what would be expected, modernist novels do not show a significantly higher frequency of such verbs.

The paper is generally well written. However, some details are missing or are unclear.

For example, the section of the selection of verbs talks about "nearest neighbors", but it is not clear by what method that was operationalized (the GitHub repository shows that word embeddings were used, apparently). Furthermore, several references to "categories" are made on page 1, without introducing how they are derived from the Theory of Mind framework.

It is also unclear whether in the end there are different inner life verbs for each language, or whether translations of the same words are used. If only 3 verbs are selected per category for each language, the risk could be that these 3 words are not representative for the category.

It would have been ideal to use an already validated lexicon for the project. For example, the LIWC lexicon has been validated in independent studies (and has been translated in several languages). In the current paper, it is not possible to separate the question of whether the lexicon is appropriate from the result for the research question.

Another aspect is the statistical methodology. It is not made explicit how statistical significance was tested. Also, the Methods section announces that a linear regression line will be plotted, but

Figure 1 and 2 actually show a polynomial regression. Why was polynomial regression chosen rather than linear?

A suggestion: in Table 1 it would be more useful to show the percentage (or relative frequency) of inner life verbs, rather than absolute counts. There is a surprisingly large variance in word counts in the corpus, making absolute counts difficult to compare.

Finally, one possible explanation for the results is that modernism gives more attention to inner life not through explicit inner life verbs, but through devices such as free indirect discourse, in which the thoughts of characters are described with explicitly marking them as such.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Computational linguistics, computational literary studies.

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Reviewer Report 19 September 2023

<https://doi.org/10.21956/openreseurope.17586.r34680>

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This article seeks to use the European Literary Text Collection corpus (ELTeC) to put pressure on

the widely held belief in Literary Studies that Modernist writing (writ large) directed attention to the inner lives of characters. Across the languages contained in the ELTeC, the authors track the usage of verbs that express characters' interiority as a proxy for the attention to the inner life of characters that the authors hypothesize should increase as a function of time through the Modernist period. The results of the study, however, indicate that, barring some unique contexts, these verbs do not increase in a systematic way that would suggest that their increasing use is a hallmark of modernism.

Overall, this research is compelling and aims to address a longstanding, yet largely unfounded, belief in Literary studies regarding the importance of interiority to 20th century literary fiction. This is not only an interesting subject of study in and of itself, but it also provides a fascinating test case for the ELTeC corpus. I believe that the article has a great deal of merit and will make an important addition to our understanding of both the limits of computational literary study and the role of characterization in Modernism; however, there are a few, relatively minor, aspects of the study that I would like the authors to address before I can recommend the text for publication.

Overall, my largest concern is the justification of the topic itself. I would not advocate for any substantive change to the methods employed by the authors, or their interpretations of their results; however, it will be important to include a bit more material justifying aspects of the study at the outset. For example, the authors suggest in their paragraph "Measuring modernism through 'inner life'" that Modernism is not a universal phenomenon and does not take place across all languages at the same time. They do suggest that there are observable "processes implying formal innovation in national literatures throughout Europe at different times", suggesting that they have underlying data which indicates the advent of Modernism in each language/cultural tradition represented by their corpus, but they do not make this data apparent. It is unclear if all of the languages represented in the corpus experience a "Modernist" period, or just some, and what kinds of formal innovation take place (these may be confounding variables to the study). It would be helpful for the authors to add in a little extra material explaining the periodization of the corpus they are using and the results that lead them to hypothesize the presence of "Modernist" literature in each of the languages that their corpus contains. This would allow for a more fine-grained hypothesis and help justify the goals of the study overall.

Similarly, while the authors do an admirable job of explaining how they selected the verbs that may represent interiority, they do not explain how they treated these terms in the context of the different languages that the corpus contains. How were each of the verbs in the categories selected across languages? What efforts were made to ensure that the same selection of words would remain consistent despite the differences in meaning and frequency across the languages? Since part of the paper's goal is to experiment with a multi-lingual corpus, this would be a very helpful detail to include. I'm also curious about how the authors counted the verbs. From the paper, it appears that, once the verbs were selected, the authors counted their incidence across the texts. While this is an understandable method, I would like some small explanation of why the frequencies of the verbs themselves were counted across the text as a whole, rather than being first filtered by their attachment to descriptions of character (through, for example, a dependency parse). Such a filter would ensure that the verbs are only being counted when they are attached to a named entity (presumably a character) rather than used in other contexts. Again, I'm not asking the authors to do this, simply to reference their choice not to.

Aside from these two more substantive concerns, there are a small number of very minor points

that the authors could augment or correct:

1. The Authors indicate that they use a “nearest neighbor” approach to building out their wordlist in one of the initial trials. Some more detail on what this approach was (a knn test, or something else) would be helpful.
2. In figure 1, the authors visualize the trends in their results using a second order polynomial as a best fit line: why did authors choose this particular regression rather than a simple linear one?
3. In their description of Heuser and Le-Khac’s 2012 paper, the authors suggest that they found a trend to avoid telling in favor of showing from 1750-1950. The paper that they cite, however, only tracks this phenomenon in nineteenth century texts and their corpus stops in 1900. This is a relatively minor point, but considering that this paper is interested in modernism (which is often understood as a 20th century phenomenon, this is an important caveat).

With these minor changes made (most of which just involves supplying the reader with some more information about the choices made by the authors), I would be happy to recommend this paper for indexing.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am an Associate Professor of Digital Humanities in a Literary Studies department (English) with over 20 years of experience in the field referenced by the article. My research focuses on quantitative and computational literary analysis, nineteenth-century literature and aesthetics, and the history of the novel.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
