An Approach to Categorize Big History Papers

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Abstract: There is a growing literature on Big History after four years of the Journal of Big History (JBH) and ten years of the Evolution Almanac series. A study was done to 1) construct a reference database of these papers, which includes abstracts and many web links; 2) propose a framework to categorize these papers so that they can be filtered and searched; and 3) analyze the paper categorization to determine the statistics of frequency and topic combinations..

1. Introduction

As fields mature, common themes of research emerge. Furthermore, shared organizational themes allow researchers to identify prior papers for discussion while still allowing for new ideas and approaches. This paper describes an organizational scheme proposed to facilitate this process based on the analysis of the 70 papers published in JBH (Gustafson 2017) and 90 articles published in Evolution (L. Grinin and Korotayev 2011). In addition, this paper complements that of Spier (2017).

This paper discusses the steps necessary to accomplish this, which includes 1) database construction of the relevant papers, 2) proposing an organizational structure based on a few dimensions of topics, 3) analysis of the database; and 4) implementing the sharable reference database, with searchable tags based on the simple framework, which resulted from statistical analysis of the papers. It is shared using the freely available Zotero citation database system, which allows simple transfers between citation software systems, supports searching tags and text, include integrated tools for common word processors, and allows for relatively efficient maintenance with registered digital document identifiers (DOI).

It is recognized that there are many ways to organize the database and tags. It was set up so that the database can be used in a variety of reference manager software. The reasoning behind the proposed tagging system is presented below along with its possible limitations. For example, it was difficult to assign some papers to a single specific set of tags. However, the tagging system is flexible, so that open search, alternative tagging systems, or modifications of specific reference tags can be performed.

2. Database construction

Reference management software offered by commercial companies can offer more sophisticated capabilities, but they require constant updating and training. The reference format used by software systems used to be unique in the past. There is now a standard that allows reference databases to be easily shared. Many groups use Zotero, a free reference management system that supports highly collaborative teams through web-based tools. Zotero offers a large number of features without being too complex. Tools for integrating it into paper editing software (Google Docs, Word, etc.) and extensions for web browsers (e.g., Chrome) make it easy to capture citation data from a web page.

The database allows the Big History references to be imported as a set from a web database or by sharing a file. The set includes IBHA books, anthologies, as well as chapters/papers from JBH and Evolution Almanac. Footnotes and bibliographies can be produced from the entries using a variety of formats. A subfolder was created for all JBH papers. Papers from Evolution were arranged in folders according to their source books. You can easily add any reference that has a DOI by specifying the DOI; the software then retrieves the reference information. Zotero will attempt to extract reference information from the paper's webpage if there is no DOI.

A public version of the database is available on the Zotero groups' website under "BigHistory.". This database is intended to be updated regularly. It is possible to add database contributors and editors to the formal group by contacting the

database owner. A Zotero database can also be exported to a standard reference information system (RIS) format and then imported into another reference management system.

3. Proposed Framework

Frameworks should provide a way to categorize research. While it should provide enough categories to be useful, it should not provide too many so that only one paper fits into each. This can be done with multiple dimensions. An attribute must be specified for each dimension. For example, when specifying a location in a 3 dimensional environment, all three dimensions, x, y, and z, need to be specified. A dimension should have no more than a handful of possible values so that they are easy to remember. The scheme could be extended later by adding more dimensions, or deeper by allowing the tree structure of the values to cascade. For example, a 'vehicle' dimension could support values of car, plane, train, but could be extended with make and model: car.make.model.year).

These papers are research papers on big history topics. Therefore, one dimension of the paper is the research approach (Figure 1). In addition, different phases of evolution are the subject of big history topics (Figure 3). A third dimension can be viewed as an aspect of the evolving complex adaptive system, for instance, organizational, energy, information or interaction with the environment (Figure 2).
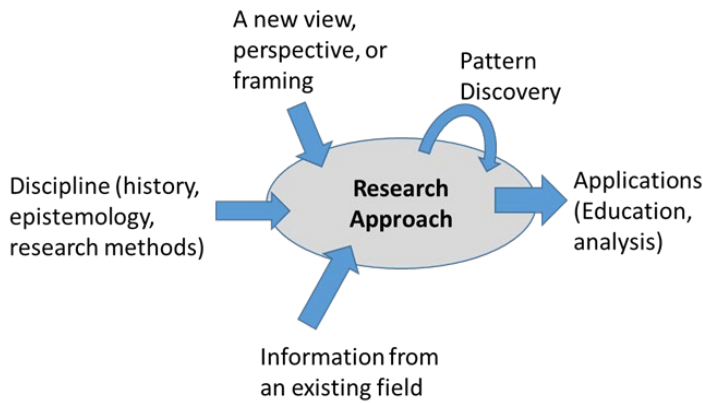

Figure 1 *Research Approaches*

The three dimensions along with examples of their possible values are listed in Table 1. Examples of categorization of specific big history topics are given in Table

2. Each dimension has a corresponding figure (Fig 1-3) showing the relationship of some possible topics. The model for a complex adaptive system is similar to the one proposed by Friston (Friston 2010) for the free-energy model of the brain and ecosystem.
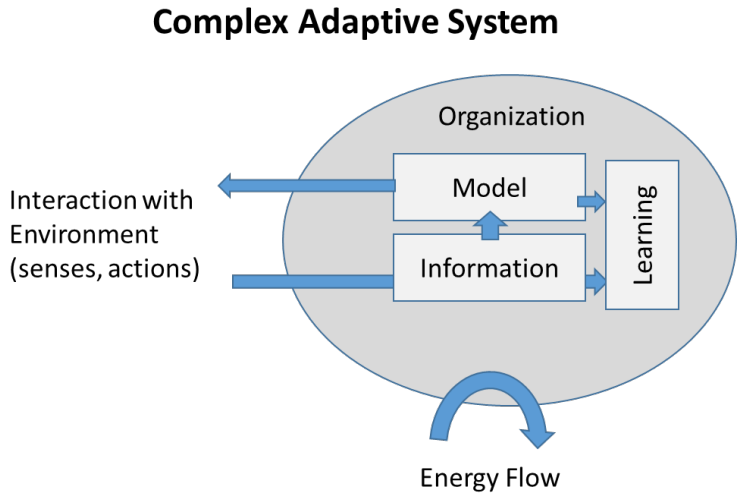
Complex Adaptive System

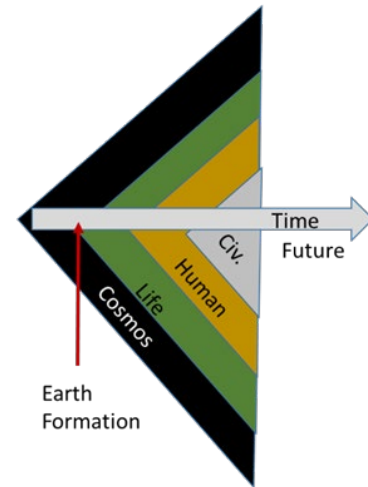***Figure 2*** *Complex Adaptive System (CAS) Elements*

Figure 3 *Periods with time progressing to the right*

4. Analysis

The analysis includes comparing the distribution of papers by each dimension within the two publishers of Big History papers: the Journal of Big History and the Evolution

Dimension	Values	Definition
Research Approach		
	Pattern	A relationship is explored
	View	New perspectives on how existing information can be viewed
	Information	New information found in a contributing field is discussed as to its impact on Big History
	Education	New ways of approaching Big History in education
	Discipline	Either philosophical discussion or history of Big History development as a field
	Application	A way to take lessons from Big History and apply them to issues
Period		
	Cosmos	From the Big Bang to Earth formation
	Planetary	The formation of Earth and its special characteristics to support life evolution
	Life	The development and evolution of life from about 5 billion years ago) including chemical evolution
	Human	The development and evolution of intelligent life such as humans (about about 5 million years)
	Civilization	The development and evolution of civilized societies from about 5,000 years ago
	Current	Topics related to current issues
	Future	Topics related to futures (Scenarios, trends, and paths)
	All	Inclusive of all other periods (Sometimes excluding cosmos, i.e., all periods with agency)
Complex System Component		
	Energy	Energy source, usage, extraction
	Information	Information for collective learning or evolution (DNA, mind, tools, senses, storage, mental models)
	Environment	The conditions and natural resources that a system develops and evolves
	Organization	The arrangement of tasks and information flow to support complexity (Specialization, Symbiosis, Binding, Panarchy, Emergence)
	Growth	Development and evolution of system
	All	Inclusive of all system components

Table 1: Dimensions and Values for tagging system

	Energy	**Information**	**Environment**	**Organization**	**Growth**
Cosmos	Fusion	Forces	Physics Laws, Temperature		Expansion, Gravitational Aggregation
Planetary	Atmosphere, solar,	Grand Tack	Galactic & solar location	Differentiation	Formation rate
Life	Photosynthesis	DNA	Ecosystem	Cell, Multicellular	Evolution, Development
Human	Fruits, fire, animals	Brain	Grasslands, Forests, Climate Change	Bands, Tribes	Human development, brain evolution
Civilization	Wind, Water, Fossil fuels	Writing, Religion	Rivers, Soil, Climate	Social Organizations	Civilization sizes and technological development
Current	Transition to renewables	Internet	Climate Change, Convergence	Economic, Government	Transition in energy, environment, trade
Future	Fusion, conservation, space	Artificial intelligence, human computer interface	Circular economy, space	Next level of emergence	Improvement indices
All	Energy density flow and complexity	Information capture, storage, retrieval, and processing	Relationship of objects and environmental scale	Panarchy	General evolution/ development processes

Table 2: Example topics in each combination of CAS Aspect and Period.

Almanac. The results are shown in the Figure 4. There are some slight differences between the distributions of paper categories between the two publishing outlets.

- Research approach: The JBH has slightly more education research papers, whereas Evolution has more on patterns.
- Period: JBH has slightly more cosmic/planetary period papers whereas Evolution has more in the Human, civilization, and current categories.
- System Element: JBH has more in the all and environment category whereas Evolution has more in the remaining categories including more in energy topics.

The distribution of papers with the combination of two dimensions (System Aspect and Research Approach) shows high frequency of papers in the Discipline category with no specific CAS aspect. Paper discussing a specific CAS aspect tend to be in the "View" research category (Table 3).

Currently, Google Scholar (evaluated on 1/30/2021) identifies 115 citations to 27 of the 58 JBH papers. Just under half of these citations were to two papers: Andrey Korotayev's "The 21st Century Singularity and Its Big History Implications (Korotayev 2018)" with 25 citations and David Christian's "What is Big History" (Christian 2017) with 22 citations.
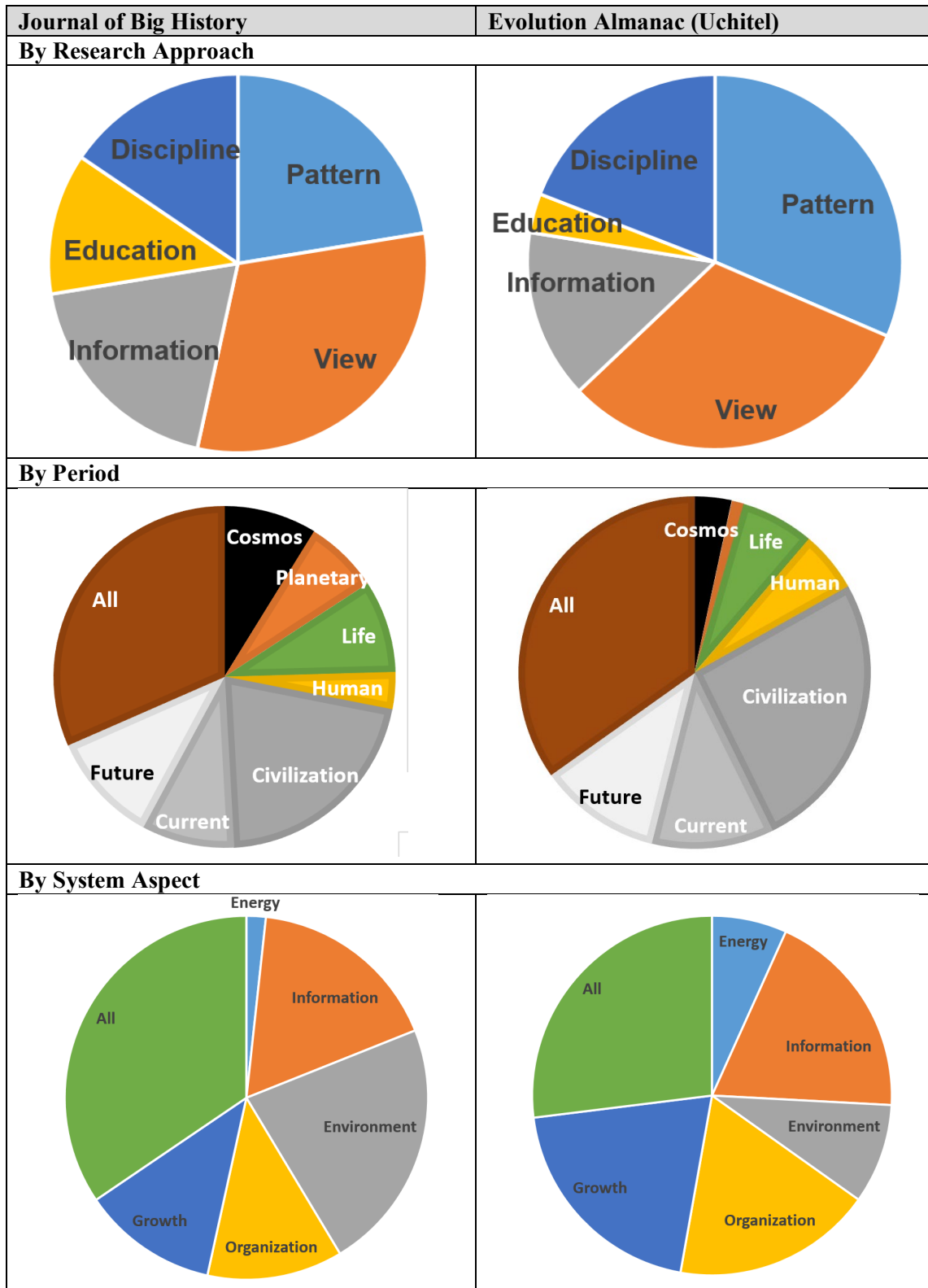
Journal of Big History	Evolution Almanac (Uchitel)

By Research Approach

By Period

By System Aspect

Figure 4. Comparison of Distribution of Topics by Dimension in the two journals.

Table 3. Combination matrix of JBH (top) and Evolution Almanac (bottom)

CAS	View	Pattern	Informat.	Disciplin	Educatio	Total
All	4	4	2	8	2	20
Environment	5	1	4		3	13
Information	5	2	1		2	10
Growth	1	3	2	1		7
Organization	3	2	2			7
Energy		1				1
Total	18	13	11	9	7	58

CAS	View	Pattern	Informat.	Disciplin	Educatio	Total
All	1	3	2	15	3	24
Environment	5	2	1			8
Information	13	4				17
Growth	2	11	4	1		18
Organization	5	6	5			16
Energy	2	2	1	1		6
Total	28	28	13	17	3	89

The analysis of authors include the number of authors per paper and the number of papers per author. Details are presented below but roughly 20% of the authors contributed to more than 1 paper (i.e., 80% of the authors have only 1 contribution). Around 70% of the papers have a single author. The highest number of authors on a paper is four.

Evolution has 70 distinct authors of which 24% contributed to more than 1 paper. The ratio of papers to distinct authors is about 1.3. The editors Leonid Grinin and Andrey Korotayev lead the paper count with 22 and 15 articles (including the editors' introductions). There are six authors (8.5%) with 3-4 papers (Anton Grinin, Baker, Hookes, LePoire, Markov, Spier). About 72% of the papers have a single author with the remainder papers mostly split between 2 and 3 authors. Two papers have four authors which

is the largest number of authors.

The JBH has 58 distinct authors of which 17% contributed to more than 1 paper. The ratio of papers to distinct authors is about 1.05. Barry Wood has the largest number with six papers. Nine others have more than 1 paper contribution. About 87% of the papers have a single author. Three papers have four authors which is the largest number of authors.

There are nine authors who contributed papers to both (Christian, A Grinin, L Grinin, Korotayev, Spier, Voros, Nazaretyan, Baskin, LePoire).

5. Discussion

This paper was constructed to explore a possible framework for a simple categorization of Big History papers and then applying it to compare the two main publishers, JBH and Evolution. The three dimensions used for categorization include the research approach along with the Big History topic formed by the combination of an evolutionary period and CAS aspect. Big History papers often (compared to other specific fields) include further generalization, views from unique perspectives, and analogies. It is hoped that this is only the beginning of research papers in this form.

Clearly, many papers that would be considered Big History topics are published in other journals, for example, in the "parallel" fields such as astrobiology (Crawford 2019), SETI, existential risks, futures, Anthropocene, Evo-Devo, Cosmic Evolution (Vidal 2008; Chaisson 2011), Anthropic Principle, Entropy-Spontaneous pattern formation, and Complex Systems. It is not clear how these papers should be brought into the system.

Later, it is hope that this analysis could be extended to identify networks of idea flow between authors, the integration of Big History with other fields, and further refinement of categorization. Currently, it seems like there is a small but growing discussion in the Big History community surrounding topics such as common themes, periodization, common vs unique development on Earth (Schwartzman 2020), and ways to integrate the findings of the field to enhance education and identify further applications to help understand and guide potential futures.

6. References

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Appendix: How to connect and use the Big History Reference Database

Background: A database of papers from the Journal of Big History and the Evolution Almanacs was created and published online for all to use. The ability to edit and add references can be given upon request. This allows reference/citation tools such as Zotero (free) and similar commercial software to be included in document editors to quick cite and reference the publications. The database also contains searchable abstracts, a simple index system described in the paper, a short description, and identified keywords.

The database was created with Zotero software but can be exported in a standard reference database format: .RIS, which can be read into other similar software.

To get started with Zotero:
Download and install the free Zotero software from:
https://www.zotero.org/
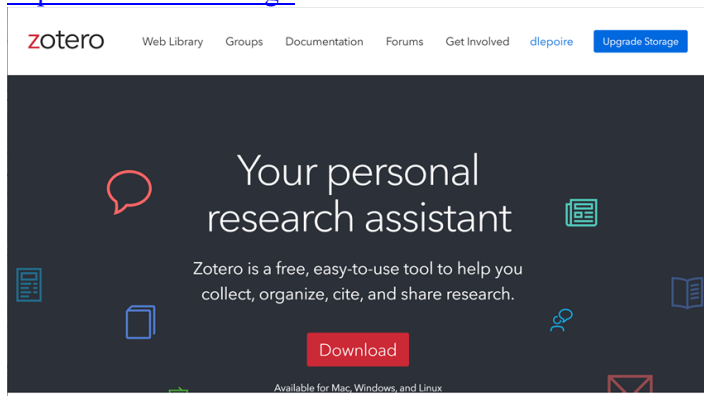
The interface is quite easy to use (but documentation on various topics can be found at:
https://www.zotero.org/support/
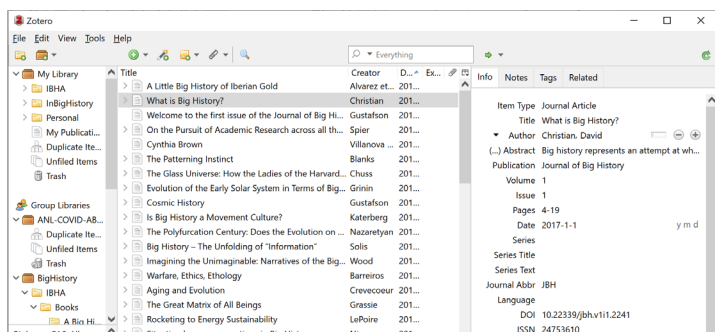
To connect to the BigHistory shared reference database: register for a free Zotero account (for example, going to the zotero.org/groups page will ask you to login or register as seen in the upper right in the image below).
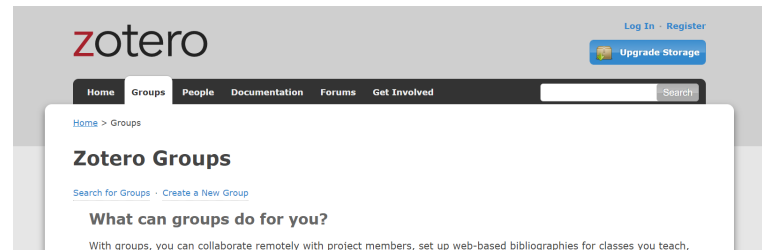
Then you can search for "BigHistory" and click "Join" to add the web database to your reference collection. It will be placed in the Group Libraries section (as seen on the bottom left of the interface figure).
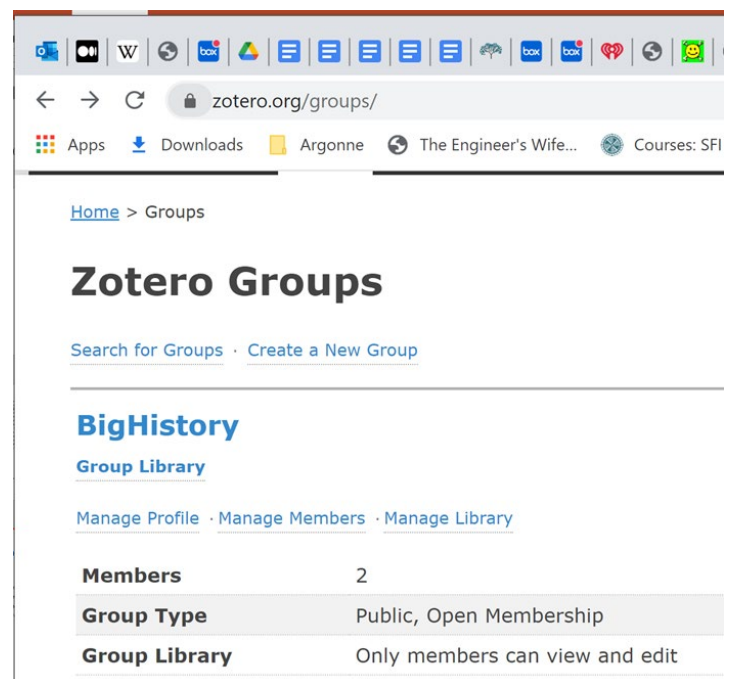
To use the database
- Install the Zotero app to document editing software (e.g., Word). A Zotero tab should now be available. It has two important buttons: "Add/Edit Citation" and "Add/Edit Bibliography" as shown below.
- To add a citation, move the mouse to the place you want it added and then click the "Add/Edit Citation". A Zotero text box appears with a red outline. Start typing

something to search for (e.g., author or title). Zotero will show the matches below the text box. Select one of the matches. Then the citation will be added (with the style set under the "Document Preferences").

- To get the bibliography at the end, Click on the "Add/Edit Bibliography" button and it will be constructed based on the references you have selected.
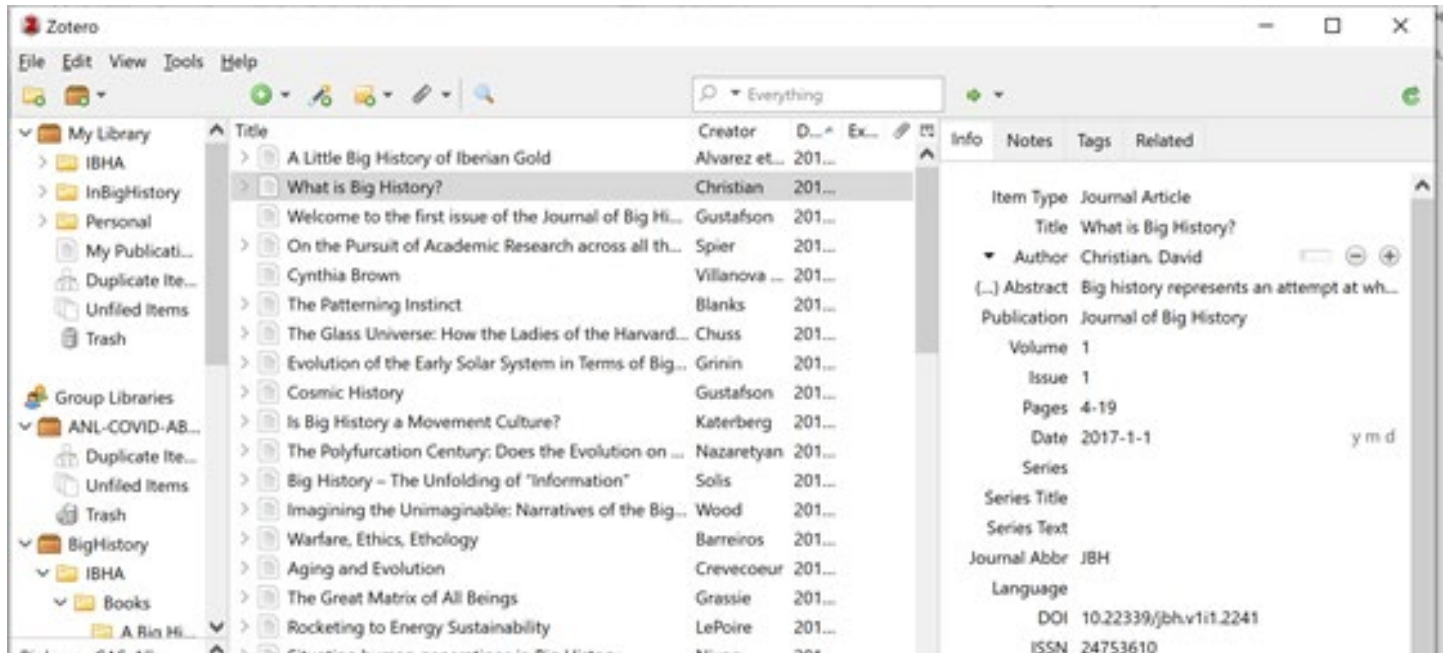
Adding a citation to a Word file:

It automatically shows up in the paper's reference section.

The user interface for Zotero (either desktop or web-based).