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Abdurrahman Atçıl, Salih Günaydın, Gürzat Kami, Abdullah Karaarslan

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Building a Digital Tabaqat: Challenges, Opportunities, and Research Prospects

Abdurrahman Atçıl, Salih Günaydın, Gürzat Kami, and
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ABSTRACT: The concept of digital tabaqat refers to the ambition to create biographical databases that combine two seemingly contradictory aims: preserving native categories in the source material from which the data are extracted and creating a common interface that allows data from diverse sources, periods, and regions speak to one another. In this article, we present the ongoing Ulema Database project, which aims to develop a relational and semantic database—a digital tabaqat—to record the biographical information for Muslim scholars from different regions and periods. In addition, we discuss some of the implications of using digital tools for biographical inquiry. Creating a digital biographical database dramatically extends the horizons of scholarship. The use of digital tools provides historians unprecedented macroscopic views across time and place and makes it possible for them to pursue more complex questions and visualize their results in richer and more intuitive ways. Yet fascination with these new tools has its attendant dangers as well, including the potential to undermine conventional scholarship’s emphasis on microstructures and the particularities of specific individuals, sources, periods, and regions.

KEYWORDS: Database, Ottoman ulema, biography, prosopography, digital tabaqat.

The *tabaqat*, or biographical dictionary, was one of the most popular forms of history writing in the Islamic world for more than a thousand years.¹ From

1. İsmail Durmuş, et al., “Tabakat,” *Türkiye Diyanet Vakfı İslâm Ansiklopedisi*, accessed 3 December 2022, <https://islamansiklopedisi.org.tr/tabakat>; Wadad al-Qadi, “Biographical Dictionaries as the Scholars’ Alternative History of the Muslim Community,” in *Organizing Knowledge: Encyclopaedic Activities in the Pre-Eighteenth Century Islamic World*, ed. Gerhard Endress (Leiden: Brill, 2006), 23–75. For a study introducing a group of the tabaqat works

the ninth century through the twentieth, these compendia of the short life stories of poets, scholars, Sufis, and others stood out from other forms of history writing. Where chronicles, for example, recorded political and military events and the acts of the ruling class, *tabaqat* preserved more mundane details about the lives, families, educations, interpersonal relations, and accomplishments of groups of people no less influential but often far less prominent. As compilations of such life stories, they contain vital information about the groupings, characteristics, and interactions of particular classes of actors.² And in their style, inclusions, and exclusions, they also provide an illuminating window into the minds of their authors and their influence on contemporary and future discourse and practice.³

Though the *tabaqat* has always been a vital resource for historians, the unprecedented leap forward in digital technologies in recent decades, and their ever-increasing popularity in the humanities, is revolutionizing the way we use these and other collections of biographical information.⁴ In the field

from the twentieth century, see Heather J. Sharkey, “*Tabaqat* of the Twentieth-Century Sudan: Arabic Biographical Dictionaries as a Source for Colonial History, 1898–1956,” *Sudanica Africa* 6 (1995): 17–34.

2. Richard W. Bulliet, *The Patricians of Nishapur: A Study in Medieval Islamic Social History* (Cambridge, MA: Harvard University Press, 1972); Richard C. Repp, *The Mufti of Istanbul: A Study in the Development of the Ottoman Learned Hierarchy* (London: Ithaca Press, 1986); Mohammad Akram Nadwi, *Al-Muḥaddithāt: The Women Scholars in Islam* (Oxford: Interface Publications, 2007); Ruth Roded, *Women in Islamic Biographical Collections: From Ibn Sa‘d to Who’s Who* (Piscataway, NJ: Gorgias, 2018).

3. Michael Cooperson, *Classical Arabic Biography: The Heirs of the Prophets in the Age of al-Ma’mūn* (New York: Cambridge University Press, 2000); Jawid Ahmad Mojaddedi, *The Biographical Tradition in Sufism: The Tabaqat Genre from al-Sulamī to Jāmī* (Surrey: Curzon Press, 2001); R. Kevin Jacques, *Authority, Conflict, and the Transmission of Diversity in Medieval Islamic Law* (Leiden: Brill, 2006); Ali Anooshahr, “Writing, Speech, and History for an Ottoman Biographer,” *Journal of Near Eastern Studies* 69 (2010): 43–62; Aslı Niyazioğlu, *Dreams and Lives in Ottoman Istanbul: A Seventeenth-Century Biographer’s Perspective* (New York: Routledge, 2017).

4. For some examples, see Bärbel Kröger and Christian Popp, “Germania Sacra Online: The Research Portal of Clerics and Religious Institutions Before 1810,” in *Research and Advanced Technology for Digital Libraries*, ed. Norbert Fuhr, László Kovács, Thomas Risse, and Wolfgang Nejdl (Switzerland: Springer, 2016), 8–12; Maxim Romanov, “Toward the Digital History of the Pre-modern Muslim World: Developing Text-Mining Techniques for the Study of Arabic Biographical Collections,” in *Analysis of Ancient and Medieval Texts and Manuscripts: Digital Approaches*, ed. Tara Lee Andrews and Caroline Macé (Turnhout: Brepols, 2014), 229–44; John Nawas, “A Preliminary Report of the Netherlands Ulama Project (NUP): The Evolution of the Class of Ulama in Islam with Special Emphasis on the Non-Arab Converts (Mawali) from the First through Fourth Century A.H.,” in *Law, Christianity and Modernism in Islamic Society*, ed. U. Vermeulen and J. M. F. Van Reeth (Leuven: Peeters, 1998), 97–107.

of Chinese history, for example, the ambitious China Biographical Database has compiled data from biographical dictionaries, chronicles, official documents, letters, and other diverse sources to create a biographical catalogue of pre-modern China from the seventh to the nineteenth century.⁵ The Austrian Center for Digital Humanities and Cultural Heritage has done the same for the people, places, works, and institutions mentioned in the textual sources of the *Austrian Biographical Dictionary* (ÖBL).⁶ Closer to home, the Mamluk Prosopography Project has done something similar for biographical data for people from Syria, Egypt, and Arabia during the period 1382–1468,⁷ as has the project Prosopografía de los ulemas de al-Andalus for Andalusian Muslim scholars from the ninth to the fourteenth century.⁸

Each of these projects brings together a range of historical sources to create a more comprehensive collection of data than could otherwise be found in any one place. In this sense, they may be viewed merely as bigger, better versions of sources that historians have already been using for years.⁹ But in another sense, they are something else entirely. They differ not merely quantitatively in terms of their size and comprehensiveness but also qualitatively in terms of the way they present information to researchers, the kinds of questions scholars can pose to them, and the sorts of analysis they make possible.

We propose a similar approach for the field of Ottoman studies: the digital tabakat. This approach, we argue, will allow scholars to benefit from

5. Song Chen and Hongsu Wang, “China Biographical Database (CBDB): A Relational Database for Prosopographical Research of Pre-modern China,” *Journal of Open Humanities Data* 8 (2022): 1–6. For the project website, see <https://projects.iq.harvard.edu/cbdb> (accessed 3 December 2022).

6. Christine Gruber, Josef Kohlbacher, and Eveline Wandl-Vogt, eds., *The Austrian Prosopographical Information System (APIS), Vom gedruckten Textkorpus zur Webapplikation für die Forschung* (Vienna: New Academic Press, 2020). For an article introducing the database and presenting a case based on the analysis of the data in it, see Maximilian Kaiser, Matthias Schlögl, Katalin Lejtovicz, and Peter Alexander Rumpolt, “Artist Migration through the Biographer’s Lens: A Case Study Based on Biographical Data Retrieved from the Austrian Biographical Dictionary,” *Journal of Historical Network Research* 2 (2018): 76–108. For a project seeking to digitize the ÖBL to create a biographical database, see <https://www.oead.ac.at/acdh/oeb1> (accessed 27 November 2022).

7. For information about the Mamluk Prosopography Project, see <https://www.mamluk.ugent.be/IHODP/MPP> (accessed 3 December 2022).

8. For the project Prosopografía de los ulemas de al-Andalus, see <https://www.eea.csic.es/pua/index.php> (accessed 27 November 2022).

9. This is not to minimize some of the methodological issues attendant to such collections, however. For a brief but illuminating discussion of some of these issues, specifically regarding the use of digital sources rather than traditional archives, see Lara Putnam, “The Transnational and the Text-Searchable: Digitized Sources and the Shadows They Cast,” *The American Historical Review* 121, no. 2 (2016): 377–402.

the new opportunities digital tools provide while preserving the insights of conventional scholarship. To clarify the concept of digital tabaqat, we can underline the following three essential features: (1) capturing the information content of textual biographical sources as semantically structured data while preserving the provenance of each atomic piece of information, which makes it possible to explore data with both simple and complex queries; (2) preserving the native categories of the source material in the database while allowing researchers to explore the characteristics of individual sources (tabaqat and others), regions, and periods; and (3) assembling the infrastructure for creating intermediate and/or abstract categories to combine information from diverse sources in a way that allows for integration with Linked Open Data resources.

In the pages that follow, we take up some of the implications of what this means for Ottoman historians through a discussion of our own ongoing experience of developing the Ulema Database. We begin with some background information on our project, how we arrived at it, and a discussion of our approach and our sources. We proceed to elaborate on our project's data model and methodology, including how it handles individual historical figures, their written works, institutions, dates, and places, as well as the issue of overlapping and sometimes conflicting source material. We then address the usefulness and potential future applications of our work and offer a few closing words on the implications that digital tools like ours have for the historian's craft going forward. In brief, we argue that creating a digital tabaqat dramatically extends the horizons of scholarship in the humanities. The use of digital tools provides historians unprecedented macroscopic views across time and place and makes it possible for them to pursue more complex questions and visualize their results in richer and more intuitive ways. Yet fascination with these new tools has its attendant dangers as well, including the potential to undermine conventional scholarship's emphasis on microstructures and the particularities of specific individuals, sources, periods, and regions.

Toward a Digital Tabaqat: The Ulema Database Project

Our first experience of applying digital tools to biographical material came in 2017 with the start of a project entitled Professional and Intellectual Networks and Groupings of High Ottoman Scholars (1470–1650).¹⁰ For that project, we compiled biographical data on over six hundred members

10. "Yüksek Osmanlı Ulemasının Mesleki ve Entelektüel İlişki Ağları ve Gruplaşmaları (1470–1650) / Professional and Intellectual Networks and Groupings of High Ottoman Scholars (1470–1650)," funded by the Scientific and Technological Research Council of Turkey (ARDEB 3501–116K404).

of the Ottoman ulema from a range of different historical sources. The tabakat literature proved especially valuable, but categorizing the wealth of information it contained, turning it into data that we could then place in a database, and doing so in a way that was analytically useful was no easy task.

Shortly before the end of that project, in 2019, the Centre for Islamic Studies (İSAM) in Istanbul approached us about their desire to compile a similar but more comprehensive historical database about Muslim scholars and Sufis, a database they hoped would aid in the task of selecting the biographical articles to be included in the new edition of *İslâm Ansiklopedisi* (Encyclopedia of Islam).¹¹ They wanted a database that could provide fast and easy access to basic information about scholars and allow queries about basic categories like date and place of birth and death, madhhab, disciplinary expertise, etc. The work started from scratch. It did not seek to transform a previously collected body of biographical data into a usable database; nor did it build on an existing database model.

We began with one of the pre-eminent examples of Ottoman tabakat literature: Ahmed Taşköprizade's (d. 1561) *al-Shaqā'iq al-Nu'māniyya fī 'Ulamā' al-Dawla al-'Uthmāniyya*, which was completed in 1558 and contains biographical entries on 519 scholars and Sufis who lived in Ottoman Anatolia or Rumelia or had a connection with the Ottoman dynasty between 1300 and the 1550s.¹² Taşköprizade organized his book chronologically in ten sections (*tabaqa*s), each representing the reign of one of the first ten Ottoman sultans. Within each section, he first provided the entries for scholars, whom he introduced with the title *al-mawlā*, and then those for Sufis, whom he labeled *al-shaykh*. Within the entries, he generally recorded each person's name, their father's name, and their date and place of birth and death. In addition, he provided what information he had on their teachers, the institutions where they received their training, and their children, relatives, students, and charitable works, as well as occasional anecdotes.

We started by breaking down all the biographies contained in *al-Shaqā'iq* into their most essential elements, which left us with a large pool of biographical material. We then worked to categorize the information contained in this pool (Figure 1) by identifying its most frequently appearing units (e.g., place of birth, teacher, location, etc.) and the types of connections that bound these

11. The online portal for the existing version of the encyclopedia, the *Türkiye Diyanet Vakfı İslam Ansiklopedisi*, can be accessed at <https://islamansiklopedisi.org.tr/>.

12. Taşköprülüzâde Ahmed Efendi, *Eş-Şakā'iku'n-Nu'māniyye fī Ulemāi'd-Devleti'l-Osmāniyye: Osmanlı Âlimleri*, ed. and trans. Muhammet Hekimoğlu (Istanbul: Türkiye Yazma Eserler Kurumu Başkanlığı, 2019).

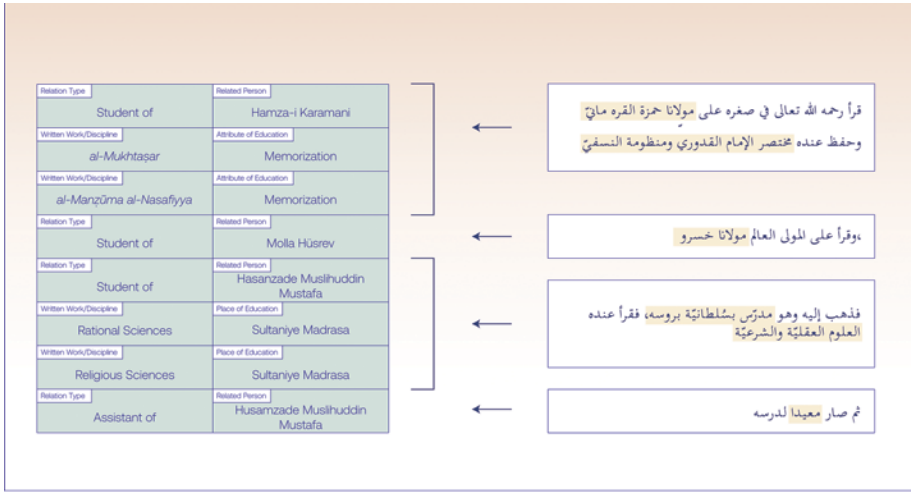


Figure 1: Data Extraction from Biographical Source Material.

units to one another (e.g., kinship, student–teacher ties, etc.). The result, after much discussion and debate, was a data model (Figure 3) with categories and subcategories that we felt faithfully reflected the categories Taşköprizade himself employed and that allowed us to capture as much of the information his work contained as possible in the form of semantically structured data.

Because we wanted our database to be scalable, that is, to allow for the inclusion of data from a wide range of sources beyond *al-Shaqā'iq*, we then expanded our source pool to other *tabaqat* works to test how well our categories fit the data they contained. In this, the second phase of our Ulema Database project, we extracted data from three additional *tabaqat* works. The first of these was Nevizade Atayi's (d. 1635) *Ḥadā'iq al-Ḥaqā'iq fī Takmilā al-Shaqā'iq*, which was written as a continuation of *al-Shaqā'iq* and contains entries on 1,101 scholars and Sufis, almost all of whom lived in Anatolia and Rumelia from the mid-sixteenth century to the early 1630s.¹³ The second was Mehmed Şeyhi Efendi's (d. 1731) *Waqā'ir al-Fuḍalā'*, which was a continuation of Atayi's *Ḥadā'iq* and contained entries on more than 2,000 scholars and Sufis, again mostly from Anatolia and Rumelia.¹⁴ And the last was Najm al-Dīn al-Ghazzī's (d. 1651) *al-Kawākib al-Sā'ira bi-Manāqib A'yān al-Mi'a al-Āshira*, which contains the biographies of 1,552 scholars, Sufis, and

13. Nev'izâde Atâî, *Hadâiku'l-Hakâik fî Tekmileti's-Şakâ'ik*, ed. Suat Donuk (Istanbul: Türkiye Yazma Eserler Kurumu Başkanlığı, 2017).

14. Şeyhî Mehmed Efendi, *Vekâyi'u'l-Fuzalâ Şeyhî'nin Şakâ'ik Zeyli*, ed. Ramazan Ekinci (Istanbul: Türkiye Yazma Eserler Kurumu Başkanlığı, 2018).

statesmen from the tenth century A.H. (circa 1494–1592), but in this case mostly from Syria and Egypt (though with a few from Anatolia, Rumelia, and the Hijaz).¹⁵

Would it be possible to enter the data from these other sources—sources with different perspectives and covering different regions and periods—in the database we had designed based on the categories we developed from *al-Shaqā'iq*, or would we need new categories? All *tafaqat* works have some common types of information, such as a person's name, the name of their father, their date and place of birth and death, and their teachers and students. Our initial categories fit these types of information without a problem. In terms of our other categories, *Ḥadā'iq* and *Waqā'i'* were written as continuations to *al-Shaqā'iq* and adopted the latter's conventions, such as the division of the entries according to the reigns of the Ottoman sultans, calling scholars *al-mawlā* and Sufis *al-shaykh*, and so forth. Thus, these two books did not require creating many new source categories in our database.

Al-Kawākib, however, differed significantly from the other works we examined. It had three sections (*tafaqat*), each covering thirty-three years and presenting biographical entries in alphabetical order. In addition, different from the *mawlā-shaykh* categorization in *al-Shaqā'iq*, *Al-Kawākib* used a variety of titles (*al-shaykh*, *al-adīb*, *al-faqīh*, *al-imām*, etc.) to characterize the people in its entries. In order to accommodate and reflect the distinctive perspective of *al-Kawākib*, we had to create multiple new source categories.

We also ran into another issue: that of overlapping sources and conflicting information. For example, what was to be done if *al-Kawākib* included a particular fact about a person (for example, date of death) that diverged from *al-Shaqā'iq*? In such cases, we wanted to ensure that we could preserve both sets of data, but to do so, we needed to distinguish which information came from which source. We therefore modified our database to make it possible to enter multiple sets of data in a particular category and to record both sets as sourced data, referring to the source and its relevant page numbers. To prevent potential future conflicts, we opted to list the source not just in cases of obvious disagreement but for all of the information we added to the database.

Although our data model, discussed in greater detail in the next section, resembles those of several other biographical databases, we made a few significant interventions in terms of our model and its implementation. From the beginning, we paid particular attention to the relationship between the biographical material in the historical sources and the pieces of data recorded in the database. For reasons discussed above, we insisted on linking every

15. Najm al-Dīn al-Ghazzī, *al-Kawākib al-Sa'ira bi-A'yān al-Mi'a al-Āshira*, ed. Khalīl al-Manṣūr (Beirut: Dār al-Kutub al-'Ilmiyya, 1997).

Person Category	Scholar	Full Name	Ali b. Ahmed b. Muhammed el-Cemali
Project Name	Zenbilli Ali Efendi	Full Name	Ali Efendi
Gender	Male	Full Name	Ali b. Ahmed
al-Shaqʿiʿ Person Type	Mawla	al-Shaqʿiʿ Nisba	el-Cemali
Hadāʾiq Person Type	ʿĀlim	al-Kawākib Nisba	el-Rumi
al-Shaqʿiʿ Tabaqa	8	al-Shaqʿiʿ Laqab	Alaeddin
Hadāʾiq Tabaqa	12	al-Kawākib Laqab	Zenbilli
al-Kawākib Tabaqa	1	al-Kawākib Madhab	Hanafi
Patronymic	-		

Figure 2: Biographical Data about Zenbilli Ali Efendi (d. 1526) Extracted from *al-Shaqʿiʿ*, *Hadāʾiq*, and *al-Kawākib*.

piece of data recorded in the database with the historical source from which we obtained it. So too for our data categories, which distinguish between categories taken from the sources themselves and those formed by the project team or other researchers.

These two aspects of our approach are essential aspects of our Ulema Database. First, our data is sourced. We extract it directly from and connect it to the relevant sources and pages. Because all the data we collect is sourced, our database has the ability to record multiple data points for each dimension of a person’s biography, even when different historical sources yield divergent, inconsistent, or conflicting data. This feature also provides the option to filter the data at a later stage on the basis of the sources, which is essential for exploring the structures of particular sources along the lines of conventional humanities scholarship.

Second, our approach allows for layered categorization. The bottom layer consists of categories employed by the sources themselves—source categories. Every time a new source is studied, any new categories and subcategories in that source are added to the database to reflect the explicit preferences or patterns in that particular source’s presentation of biographical information. Any categories, relations, and other patterns used by the source material are explicitly captured in this initial stage, as is, before any abstraction is applied. In addition, the biographical textual information in the sources is disaggregated to its most basic elements. Above this layer of source categories is an

additional layer of categories—project categories. These are not necessarily source-dependent but are developed by members of the project team or other researchers using the Ulema Database, who may wish to analyze the data in a way that would have been foreign to the authors of the original sources.

To date, we have completed inputting and verifying the data from *al-Shaqā'iq*. We aim to complete our work on the other three sources by August 2023.¹⁶ Provided that funding is available, a group of researchers trained in the features of the database will continue to expand the database through the addition of data from other *tabaqat* works from other periods and regions of Islamic history.

Data Model and Data Entry

The data model of the Ulema Database includes five main entities that we have found to be essential for capturing the biographical data in *tabaqat* works: (1) person, (2) written work, (3) institution, (4) place, and (5) source. These entities are fundamental—they cannot be reduced to one another as a subcategory or property. Naturally, the entity of “person” is the most developed at the current stage, given our project’s focus on historical persons; we plan to develop the other entities further in future stages of our project. However, the entities are all on the same level from a data-model perspective and can be used as valid entry points for data capture, representation, and analysis.

Each entry in a given entity has several fixed attribute fields, which serve as a basic, project-imposed identifier for the given record. Moreover, each entry can have as many source-dependent attribute fields (source categories) as needed. These serve to record the data that is contained within a specific source. For example, each person in the database is given a single project name, source independent (project category); but that person also has as many name fields as necessary to capture all the variations in the studied sources (for example, see Figure 2). The source-dependent data fields may be shared between multiple sources. For example, a certain variation of a nickname may be present in more than one source, or they can be source specific, if, for instance, a source categorizes people in an idiosyncratic way.

The user interface of the web application used for inputting data will adapt to the type of entity that is being recorded in a given entry, and the categories that are used by the specific source, by showing appropriate input fields and dropdown menus. Besides entering data for each entity separately, the model also supports entering any relation types mentioned by the sources between multiple entities, such as family ties.

16. The Ulema Database can be accessed at ulemadatabase.com from August 2023.

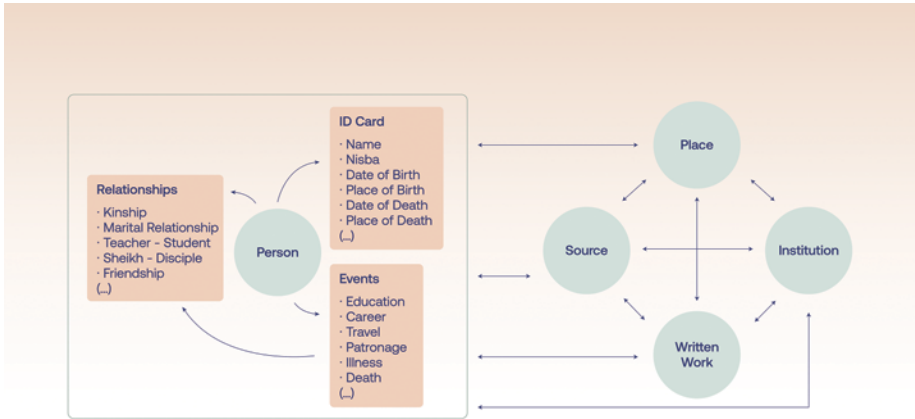


Figure 3: Simplified Model of the Ulema Database.

The Ulema Database uses an event-based approach in order to capture the spatio-temporal information present in biographies. In this approach, the biographical source material is conceived as the sum of happenings in time and place. Births, deaths, educational and career events, travels, illnesses, etc. are all construed as happenings in time and place, or as the result thereof.¹⁷ Without this approach, a person's biography would consist of a collection of attributes and a set of relations to other persons and entities of other types but would fail to capture the chronological order of these events. One of the distinguishing features of the event-based model of the Ulema Database is that the chronological order itself is construed as source-dependent, thus giving users the ability to examine multiple conflicting chronologies of a person's life side by side. In addition, the Ulema Database allows cross-referencing and displaying the relations between multiple entities and subcategories.

To ensure the integrity of the entries in our database and to maximize its utility for future researchers, we carried out the process of entering data into the Ulema Database in three stages. In the first stage, we prepared initial lists of all the names of persons, institutions, places, and written works in a particular source. After editing and cleaning up duplicates and misspellings, the lists were uploaded to the database and made available in the relevant fields of the data-entry forms. In the second stage, individual biographies were assigned

17. For another database using an event-based model, see Aero Hyvönen et al., "Biography-Sampo—Publishing and Enriching Biographies on the Semantic Web for Digital Humanities Research," in *The Semantic Web*, ed. Pascal Hitzler et al. (Switzerland: Springer, 2019), 574–89, https://doi.org/10.1007/978-3-030-21348-0_37.

to researchers to extract all the biographical data into the proper data fields. In the third stage, an editorial process was used whereby researchers acted as editors of one another's work and either verified the data, completing its entry, or rejected it and sent it back to the initial researcher for correction and/or completion.

Person

Because of our project's biographical focus, individual people are the central entity in the Ulema Database. Three main types of data are recorded under this entity: (1) basic data as represented by simple attributes, including the fixed project fields (e.g., project name) as well as the source-dependent fields (e.g., *al-shaykh*); (2) simple relational data between the person and other entities (e.g., A studied at X, under B); and (3) the simple or composite "events" that constitute a source-dependent chronological "retelling" of a person's life (e.g., born, wed, died).

The first of these, basic data, includes essential static attributes about the person whose biography is examined, including name, patronym, title, geographical signifier, occupational signifier, nickname, gender, physical characteristics, and so on.

The second, relational data, constitutes the links that connect one person to another person, willingly or unwillingly. We have prepared a detailed inventory of all the different types of person-to-person relationships we have encountered in the sources we have examined so far. The users of the Ulema Database can aggregate them under higher categories, such as relationships of family, kinship, marriage, patronage, friendship, enmity, etc., as well as teacher–student and sheikh–disciple relationships. As the relationships have two sides, upon recording a relationship for one person, its reverse is recorded for the other. For example, when the relationship "A is the father of B" is entered in A's entry, "B is the child of A" is automatically recorded in that of B.¹⁸

While this sounds simple enough in theory, it is a more complex matter in practice. When entering the biographical data for particular people, the data about all their relations are recorded, but it is often difficult to determine the exact identity of these relations. Many people carry the same name. For example, our database currently lists 928 persons with the name Mehmed and 748

18. Other relational data that are explicitly recorded are person-to-work relationships (representing works authored, or books studied) and person-to-institution relationships (representing architectural structures or institutions founded by the person under examination). However, as will be seen below, data recorded as important life events also implicitly contains additional relational data between persons, places, and institutions.

persons with the name Ahmed. In such cases, patronym, geographical signifier, nickname, etc. can occasionally help, but in many cases, the researcher needs to know the historical context to identify, for instance, a certain Mehmed or Ahmed mentioned in the examined source. If it is impossible or impractical to do so, researchers have the ability to record the name of the person as “unidentified,” which means that this entry is not treated by the application as an actual person with a unique ID, but merely as a textual signifier whose identity is yet to be determined. If the person is identified at a later stage, their status can always be changed, and they can be added to the database as an actual person with the assignment of a unique ID.

Finally, the third type of data that is recorded for each person is life events. Events are defined as any “significant” happening in a person’s life that can potentially be associated with a time or duration and a place. The event types that are deemed significant by the Ulema Database and therefore recorded include those related to birth, death, marriage, divorce, education, book writing, career, travel, patronage, illness, charity, and incarceration. Events like illness are called simple events. They are used to mark a certain period of a person’s life with a certain type of “activity” but do not contain any other semantic data. Most event types, however, are complex, meaning they can make use of other relational data to form a composite whole. For example, an education event can contain references to other persons, but only in certain defined roles (e.g., teachers and classmates); references to books or disciplines studied; and other quantifiers and qualifiers further specifying the event. Similarly, other complex event types, like patronage, can be linked to relationships that are meaningful for that type of event. In this way, the spatio-temporal extent of the relationship is correctly captured.

A significant issue relating to temporal information is the sequence of undated events. The sources occasionally list the events in a person’s life without any explicit temporal information. We are convinced that for the source material under consideration, in most cases, the order in the lists is not random but most likely reflects the actual order of the events in the author’s mind. Therefore, we decided to record the particular order of the sequence of events as a piece of data as well, and to link it with its source.

Conceiving and categorizing happenings in time and place as events make it possible to outline and to represent the critical moments in the life of a person on a timeline or a map. Yet this runs the risk of blurring the significance of some types of events in the life of a person. Therefore, in the presentation page for each person, events related to education, charitable works, and anecdotes are presented in separate headings as well.

In addition to the three types of data listed above, a separate but no less essential type employed by historical biographical sources is that of the anecdote.

dotal story. These stories may include diverse topics and themes, including reports, gossip, dream narratives, miracle stories, or a note on the author's relationship with the person under examination. In accordance with the project's ambition to include all the elements of the printed tabaqat works, these stories are recorded as semi-structured data that can be linked to an event when the time (or chronological order) and place of their occurrence is known. The anecdote has three subtypes: a general report or narrative, a dream narrative, and a miracle narrative. Any mentions in the anecdote of entities in the database (e.g., persons, works, places, institutions) are cross referenced. However, as it is almost impossible (and perhaps useless) to identify deeper patterns in the anecdotal narratives, they are recorded as texts, not as structured data.

Written Work

Written works are another entity for which data are collected and recorded in the database. The names of written works are recorded and associated with the person under study (e.g., who wrote it, or studied or taught it, or presented it to someone else), and with the events in that person's life (such as the event of "book writing," "education," or "patronage"). Our database contains data categories for the discipline of the work (jurisprudence [*fiqh*], Qur'anic exegesis [*tafsîr*], medicine [*tibb*], logic [*mantiq*], etc.), its type of composition (original composition [*matn*], commentary [*sharh*], supercommentary [*hāshiya*], translation [*tarjama*], etc.), its form of composition (poetry, prose, or hybrid), its date and place of composition, its manuscript copies, and its published editions. The database also records a written work's relationships with other works, such as its commentaries, translations, abridgements, and continuations.

Recording the details of written works in our database involves many of the same challenges as doing so for people (unidentified items, misidentifications, duplicate items, different interpretations of the researchers). In the case of written works, however, researchers sometimes have the opportunity to consult published and manuscript copies of the work in question to clear up any ambiguous points or even fix errors contained in the source material. For example, *al-Shaqā'iq* attributes the authorship of *Unmūdḥaj al-'Ulūm* to Şemseddin Fenari (d. 1431),¹⁹ and the work was therefore credited to him on his page in the database. However, the manuscript copies of the work and the evidence in other sources make it clear that the work was actually written by Mehmed Şah Fenari (d. 1435[?]).²⁰ In this case, the feature of sourced

19. Taşköprülüzade, *Eş-Şakā'iku'n-Nu'māniyye*, 57.

20. Tahsin Deliçay, "Mehmed Şah Fenârî," *Türkiye Diyanet Vakfı İslâm Ansiklopedisi*, accessed 3 December 2022, <https://islamansiklopedisi.org.tr/mehmed-sah-fenari>. For a manuscript copy of *Unmūdḥaj al-'Ulūm*, see Süleymaniye Library, Şehid Ali Pasha, ms. no. 2871.

data helped to resolve this problem. The “wrong” data remains visible on Şemseddin Fenari’s page and linked to the source *al-Shaqā’iq*, but this misattribution is explained in a text note; the “correct” data has also been added and linked to the relevant sources.

Institution

This entity covers all institutions associated with physical structures and/or resources, practices, and rules—that is, all structures that may or may not be the setting of any professional activities in a person’s life, that may or may not be an actual physical building, and that may or may not be the result of a charitable act by a person.

Madrasas, mosques, dervish lodges, soup kitchens, bathhouses, and bridges are examples of institutions, but so too is an endowed teaching circle with no physical structure of its own. For institutions in our database, we included data about founders, places, dates of construction, and relationship with other institutions. Institutions are not a subject of inquiry in their own right at this stage of our project; instead, we treat them primarily as places or results of the events in the lives of the people who are our primary focus. A madrasa, for example, could be recorded as the site of an event relating to a person’s education or career, or as the result of a charitable act/event.

Identifying some of the institutions mentioned in the *tabaqat* biographies can prove difficult, as they were often referred to by different names on different occasions or in different sources, or they were demolished and later rebuilt under a different name.²¹ The biographical sources usually do not provide detailed information about the institutions they mention. For this reason, the project team has made recourse to the secondary literature. In some cases, extant physical structures help in clearing up the ambiguity.

In the biographical sources, several institutions connected to one another are sometimes referred to by a single name. For example, each of the eight madrasas that were part of Mehmed II’s complex in Istanbul were typically referred to as one of the Sahn Madrasas in *al-Shaqā’iq* and *Ḥadā’iq*. Similarly, each of the four madrasas in Süleyman II’s complex in Istanbul were mentioned as one of the Süleymaniye Madrasas in the same sources. In such cases, the relevant data are recorded using the name of the larger institution of which they were part (e.g., “Sahn Medreseleri” [Sahn Madrasas] and “Süleymaniye Medreseleri” [Süleymaniye Madrasas]), and their relationship with the respective larger complexes, the Fatih Complex and Süleymaniye Complex, is indicated.

21. For example, Ali Bey Madrasa in Edirne was also referred to as Taşlık Madrasa. For this, see Cahid Baltacı, *XV–XVI. Asırlarda Osmanlı Medreseleri* (Istanbul: Marmara Üniversitesi İlahiyat Fakültesi Vakfı Yayınları, 2005), 718–719.

A Note about Time

Our database records the times and dates of specific events and relationships in a person's life wherever that data is available. This is occasionally a daunting task, for the temporal information in the sources is quite often deficient, inconsistent, or approximate. For this reason, we have designed our database's input panel to record all available temporal data and facilitate standardization of the entries. The historical biographical sources consulted in this project mostly use the lunar Hijri calendar. The sources usually give the date but rarely the month and day. Sometimes, the year and month are given, and the day is determined as approximate (e.g., the "first days" [*awā'il*], "middle days" [*awāsiṭ*], or "last days" [*awākhir*] of a given month). Dates might also be given as a range, or a named period, generally referring to a ruler's name, and they might be indicated as "approximate" or "estimated" by the source itself. All these variations can be recorded in the database.

Al-Shaqā'iq, *Hadā'iq*, and *Waqā'i'* are organized according to the reigns of the Ottoman sultans, with each section covering all the scholars and Sufis who died during the reign of a particular sultan. Thus, if a person's biography in these sources does not give a specific date of death, then the duration of the reign of the respective sultan is assigned as the possible time of death for this person. We believe that this attribution of the date of death is critical, as it will help locating this person in a timeline and including them in future analyses pertaining to a particular period.

Place

This is the entity under which we record all place names mentioned in the examined biographies. Our goal here was to systematically collect the geographical data related to the events in the life of a person, written works, and institutions so that they could be analyzed spatially at different levels.

The project team was consistent in recording only the names mentioned in the sources. However, they had to use their discretion in creating categories, which we dubbed project categories, to make the geographical data analyzable. For example, all place names mentioned in the sources are not uniform as far as the level of the geographical unit they signify. Some of them are larger units that include others. For example, we see Ajam, Khorasan, and Tus. Ajam referred to a geographical area that included Khorasan, which in turn included Tus. Thus, it was a challenge to record all of these in a way that would make it possible to carry out spatial analysis.

As a solution, we assigned all the place names encountered in the sources to one of three hierarchically ordered categories:

- Large region: The database currently has seven large regions: (1) *Bilad-ı Acem* (the Persianate world); (2) *Bilad-ı Arab* (Arabic-speaking lands including North Africa); (3) *Bilad-ı Rûm* (“Roman” lands, roughly corresponding to Anatolia and the Balkans); (4) *Bilad-ı Sūdān* (sub-Saharan Africa); (5) *Çin* (China); (6) *Deşt-i Kıpçak* (the Qipchak steppe); and (7) *Hindistan* (India). These seven regions are construed as contiguous and intended to cover the whole geographical area covered in the database so far.
- Region: Twenty-five regions have been recorded so far (e.g., *Bilad-ı Shām* [Greater Syria], *Mısır* [Egypt], *Bilad-ı Karamān* [Karamanid lands]). The regions are not deemed to be contiguous, and some of them overlap with one another. There are some locations that are not associated with a particular region. However, every region is necessarily associated with a large region.
- Location: 565 locations have been recorded in the database so far. Only the names of the localities mentioned in the sources are recorded. Every location is associated with a region or a large region, meaning that it is placed within that region or large region.

Each place name was assigned a point coordinate determined by the project team. The place names are matched with the data in the GeoNames Database, if available.²² In addition, when different sources appear to mention the same locality, these two names are linked as equivalent, referring to the same particular geographical area (e.g., Amid and Diyarbekir).

Source

We employed this entity to record all the bibliographical information regarding the historical and contemporary sources from which we extracted the biographical data for our database. As discussed above, all the data in the database are sourced—they are explicitly linked to the source from which they were obtained.

As for the challenges of data entry regarding this category, there are cases where two different sources yield the same data in a particular data field. In these cases, the entered piece of data is linked to all the relevant sources. On the other hand, if different sources provide different information on a particular point, each piece of information is entered separately and linked with the relevant source (for example, see Figure 2).

Additionally, sometimes the source material does not state a piece of information explicitly but seems to imply it. In such cases, that information can be recorded in the database and credited to the source as the researcher’s inference. Such cases are marked as “inferential.”

Possible Uses of the Ulema Database

The Ulema Database can be used at different levels and in different ways. One of the uses can be simply opening the page for a particular person and

22. See the website in <https://www.geonames.org> (accessed 3 December 2022).

seeing all the relevant data (that is, his/her life events, relationships, education, charities, anecdotes, etc., which are extracted from his/her own biography or mentioned in other biographical entries). It is possible to filter the data of a particular source and to compare the data from different sources about this person. A map showing the professional and geographical mobility of the person can be examined as well (for example, see Figure 4). It is also possible to take a tour in the database by clicking on the cross-referenced entities or people with a relationship to the person under review. In addition, one can use the text-search function, which allows the user to see the occurrence of the searched text in the database. In this way, one can have a quick overview and pinpoint the information that one needs.



Figure 4: Molla Lutfi's (d. 1495) Professional and Geographical Mobility.

A more advanced use of the Ulema Database involves utilizing the filtering options to follow the distinctive features of the sources from which the data are extracted. Thus, for example, researchers can set the source filter and limit their search to one or more sources. After this, they can use the category filters to further focus the results on their specific research questions. Source categories may help in seeing the approach and taxonomy suggested by the source, while project categories, available in the database or created by the researcher, make it possible to manipulate the data in different ways.

As a digital tabaqat, the Ulema Database also allows combining the data of different sources, regions, and periods and exploring common features, continuities, and ruptures. The researcher can include data from multiple

sources in a single search and implement filters to find answers to broader questions. For example, it is possible to include the data from *al-Shaqā'iq*, *Ḥadā'iq*, and *al-Kawākib* and set a query to find the books that had the highest number of commentaries and supercommentaries in Anatolia, the Balkans, Syria, and Egypt from the fourteenth to the seventeenth century. The result can be divided according to period, region, or source to arrive at comparative insights.

Another way of using the Ulema Database is to export query results for further processing with the help of package software programs. This creates a wide variety of options for analyzing the information in the database, including network analysis, regression, and spatial analysis.²³ Below is an example of an analysis of the data of student-teacher relationships in *al-Shaqā'iq* using UCINET and its visualization component NETDRAW.²⁴

In *al-Shaqā'iq*, 374 people are mentioned as one of the sides of 502 teacher-student relationships. To obtain a simplified network of these relationships, teachers who had fewer than 5 students were excluded from the exported dataset. The remaining 28 teachers, who had at least 5 students, account for 236 out of the 502 teacher-student relationships in the dataset. Figure 5 visualizes the network of teacher-student relationships (edges) of these most popular 28 teachers (nodes) in *al-Shaqā'iq*. The directions of the arrows indicate the direction of relationship from student to teacher. The colors of the nodes depict the section (*ṭabaqa*) of *al-Shaqā'iq* in which the biography is included—yellow representing the fourth section, blue representing the sixth, green the seventh, orange the eighth, red the ninth, and black the tenth. The size of the nodes depends on their score of betweenness centrality, which, as defined by Freeman, is a measure of global centrality—that is, their centrality and overall prominence in the network, in this case the number of other teachers in the graph they are linked to in their biographies.²⁵

23. For a recent example of a study of this sort, one examining the professional careers of Ottoman chief judges in the period 1516–1622 using data mostly from *al-Shaqā'iq* and *Ḥadā'iq*, see Abdurrahman Atçıl and Gürzat Kami, “Studying Professional Careers as Hierarchical Networks: A Case Study on the Careers of Chief Judges in the Ottoman Empire (1516–1622),” *The Journal of Historical Network Research* 7, no. 1 (2022): 1–32.

24. S. P. Borgatti, M. G. Everett, and L. C. Freeman, *Ucinet 6 for Windows: Software for Social Network Analysis* (Harvard, MA: Analytic Technologies, 2002); S. P. Borgatti, *Network Netdraw Visualization* (Harvard, MA: Analytic Technologies, 2002).

25. Robert A. Hanneman and Mark Riddle, “Betweenness: Freeman’s Approach to Binary Relations,” chap. 10 in *Introduction to Social Network Methods* (Riverside: University of California, 2005), http://faculty.ucr.edu/~hanneman/nettext/C10_Centrality.html#Betweenness. Also see John Scott, *Social Network Analysis* (London: Sage Publications, 2013), 83–98.

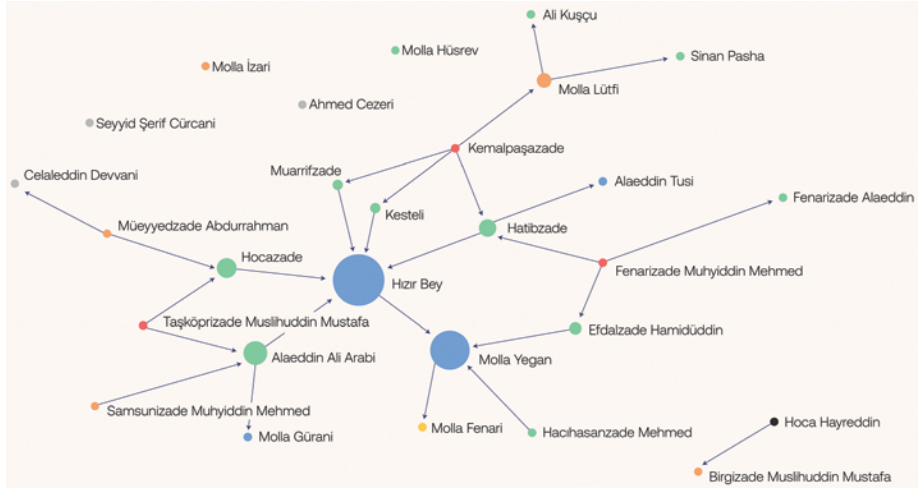


Figure 5: Teachers and Their Bridging Role in the Transmission of Knowledge in *al-Shaqā'iq*.

We give Figure 5 and the data and analysis it represents as just one example of the sorts of things one can do by exporting data from the Ulema Database and analyzing it with other software programs. It is not our aim to make a well-rounded argument and put forward a conclusive historical claim on the basis of Figure 5. However, we can make some general observations to underline the potential and limitations of such analyses.

First, the data represented in Figure 5 are extracted only from *al-Shaqā'iq*. This is a limitation but gives the researcher a chance to reflect on the distinctive features of this source and the preferences of its author.

Second, if we look at the nodes, it is remarkable that there are no teachers in sections one, two, three, or five (corresponding to the reigns of the first three sultans and the fifth) who had 5 or more students in the network. Molla Fenari (d. 1430) is the only representative from section four. This finding is in accord with the argument that until the second quarter of the fifteenth century, the scholarly system in Anatolia and the Balkans was not self-sustaining, and that most Ottomans scholars were people who had received education in Iran, Syria, Egypt, or other lands before starting to teach in Anatolia and the Balkans.²⁶

26. Abdurrahman Atçıl, "Mobility of Scholars and the Formation of a Self-Sustaining Scholarly System in the Lands of Rum during the Fifteenth Century," in *Literature and Intellectual Life in Medieval Anatolia*, ed. Andrew Peacock and Sara Nur Yıldız (Würzburg: Ergon Verlag, 2016), 315–32. See also Ertuğrul Ökten, "Scholars and Mobility: A Preliminary Assessment from the Perspective of *al-Shaqā'iyi al-Nu'māniyya*," *Osmanlı Araştırmaları/The Journal of Ottoman Studies* 41 (2013): 55–70.

Third, it is possible to see the scores of betweenness centrality as indicating the bridging role of the relevant teacher and his effect on the transmission of knowledge in the network as a whole. The number of a teacher's students and their later performance as teachers who attracted students of their own affect the betweenness centrality score for the teacher. The four scholars with the highest betweenness centrality scores are, in order, Hızır Bey (d. 1459), Molla Yegan (d. ca. 1461), Alaeddin Ali Arabi Efendi (d. 1496), and Hocazade Muslihuiddin (d. 1488). As indicated by the size of the nodes representing them, these four scholars shared the status of training a large number of students who in turn went on to do the same.

Fourth, it is well known that Seyyid Şerif Cürçani (d. 1413) affected the Ottoman scholarly milieu through the seventeenth century.²⁷ This is corroborated by the appearance of his name in this graph—that is, he had at least five students mentioned in *al-Shaqā'iq*. Yet his isolation in this graph, and the fact that none of his own students appear in it (meaning that they have fewer than five students of their own), suggests that his influence may have been on the wane from the fifteenth century or may have continued only through the channels of his works rather than through an actual teacher-student genealogy. The same applies to Molla Hüsrev (d. 1480), Molla İzari (d. 1496), and Ahmed Cezeri.

In evaluating these results, however, it is necessary to bear in mind that the entire dataset is from *al-Shaqā'iq* and may reflect its author's perspective and limitations. It might be possible to develop a stronger argument after comparing, and possibly combining, the results here with an analysis of the data from other sources about the same or comparable subjects.

The Future of the Ulema Database

The Ulema Database is a project in progress. It can be developed in different directions. Currently, most of the data in the database concerns particular regions and periods—Anatolia, Rumelia, Syria, Egypt, and Arabia, from the fourteenth to the eighteenth centuries. This can be expanded by extracting data from other sources concerning different regions and periods. This can be done in two ways: (1) the biographical data from other sources, regions, and periods can be entered manually; and/or (2) the current data can serve as the “gold standard” to extract as much data as possible from other biograph-

27. Khaled El-Rouayheb, *Islamic Intellectual History in the Seventeenth Century* (Cambridge: Cambridge University Press, 2015), 43; Mustakim Arıcı, “Bir ‘Otorite’ Olarak Seyyid Şerif Cürçânî ve Osmanlı İlim Hayatındaki Yeri,” in *İslâm Düşüncesinde Süreklilik ve Değişim: Seyyid Şerif Cürçânî Örneği*, ed. M. Cüneyt Kaya (İstanbul: Klasik Yayınları, 2015), 61–95; İsmail Çiftcioğlu, “XV. Yüzyıl Osmanlı İlim Hayatında Sâdeddin Taftâzânî ve Seyyid Şerif Cürçânî Etkisi,” in *38. Uluslararası Asya ve Kuzey Afrika Çalışmaları Kongresi: Bildiriler* (Ankara: Atatürk Kültür, Dil ve Tarih Yüksek Kurumu Başkanlığı, 2011), 87–102.

ical sources without human intervention, either by using specifically trained machine-learning models or by preparing a list of regularly occurring expressions to capture algorithmically. Although this approach cannot compare to manually verified data in its accuracy, it could quickly produce a large dataset which could be well suited for prosopographical research questions.

In addition, as can be seen in the data model (Figure 3), the focus in this project has been on the entity of “person,” and our database has recorded in detail the attributes, relationships, events, and anecdotes connected to the individual people in the *tabaqat* sources we have examined so far. In the future, new sub-projects could be developed to expand the database entries for written works, institutions, and places. The general data model itself would not have to change, since the data for these entities could be recorded along the same lines, although new categories might have to be introduced to capture the relevant relational data and specific event types.

It is possible to design the Ulema Database as a research platform. This can be achieved through further developing the user authorization module and opening the data entry and processing application to outside researchers, which would allow researchers to collect biographical data from their own sources and record it using the Ulema Database infrastructure and its data categories, or they could customize their own. They would then be able to process their own data separately or in combination with the existing data to identify similarities, differences, and distinctive trends.

Another aspect of the Ulema Database is its visualization and search options. Currently, there are some visualization functions in the front-end application, such as showing a person’s mobility on a map and an ego-network, as well as tables and charts showing filtered search results. Adding other functions, such as a timeline, network maps, genealogical tables, etc., could make the database even more useful. More importantly, the infrastructure to produce citable search results and visuals could be added, which would make it easier to incorporate the database in scholarly research and publication. For this purpose, the data contained within the Ulema Database would always be versioned when periodically updated with corrections and/or new source material, thereby allowing each query and relevant visualizations to be timestamped and therefore reproducible at any point in time. Providing a permalink for not only the source material but also search queries carried out on it will allow third parties to readily reference the Ulema Database in their own research.

One of the ultimate goals of the Ulema Database project as a digital *tabaqat* is to make it what is called a Five-Star Linked Open Data resource. The data is currently accessible to anyone, semantically structured, and machine-readable. Some of the data is linked with other databases, like GeoNames. However, the

task of using open standards (such as RDF and SPARQL) to identify particular entities within the database is yet to be undertaken.

Epilogue: What Does a Digital Tabaqat Not Offer? Where Does the Human Researcher's Craft Start?

The concept of digital tabaqat refers to the ambition to create biographical databases that combine two perhaps seemingly contradictory aims: preserving native categories in the source material from which the data are extracted and creating a common interface that allows diverse sources, periods, and regions speak to one another. As a digital tabaqat, the Ulema Database proposes ways of achieving these two ambitions at the same time. The feature of sourced data makes it possible for researchers to go back to the source for every piece of data as well as to filter the data according to source. This means that researchers can go back to the source and still benefit from the digital filtering functions of the database at any point if they become disenchanted with the task of combining several sources and analyzing data from them together. Another important feature is that of layered categorization, which allows a researcher to differentiate between the categories suggested by the sources under study (source category) and those suggested by researchers (project category). In other words, the Ulema Database allows researchers to preserve the perspective of the sources and to explore them while also enabling them to create new categories to explore the common and diverging features in the data of different sources.

The Ulema Database provides an interface for multiple users to input and verify data. To avoid any problems stemming from having multiple registered researchers simultaneously collaborating on possibly overlapping data, and to ensure data integrity and security, every input is authenticated and associated with the researcher who entered it. In addition, the database allows researchers to cross-reference between entities, record person-to-person relationships, and display associations between events, time, and place. Moreover, it allows the data to be analyzed in-house as well as exported and processed with other applications.

With all these features, the Ulema Database in a sense invites researchers, in the words of Peter Gould, to "let the [biographical] data speak."²⁸ We believe that using the Ulema Database will assist researchers in abandoning unsubstantiated theoretical structures, impressionistic observations, and unverifiable assumptions to build new, data-driven understandings about diverse groups of people from different regions and periods. They can identify

28. Peter Gould, "Letting the Data Speak for Themselves," *Annals of the Association of American Geographers* 71 (1981): 166–76.

connections, patterns, and rising and declining trends in people's education, mobilities, professional lives, relationships, etc.

However, we believe that the Ulema Database—or any other biographical database, even with digital tabaqat features—cannot replace the skillset of the human researcher but can only be an aid for it. In other words, without the human researcher's craft, the data cannot speak. First, in any research project, it is essential to reflect on the retrieved data and decide what they can and cannot potentially show. For example, while reflecting on Figure 5, we have mentioned the limitations and possibility of bias in the data extracted from *al-Shaqā'iq*. What is the value of the results of this analysis, based solely on *al-Shaqā'iq*'s data? Do we need to consult other sources to corroborate, qualify, or reject these results? If so, which sources will enable us to evaluate the results at hand convincingly? Answering such questions will definitely require the skills and insights of the conventional historian's craft.

It is possible to throw random queries at the data from a particular source or multiple sources and reach seemingly interesting results. However, to be able to ask meaningful and historically relevant questions, it is essential to have knowledge of the existing historical scholarship. What questions have been discussed, and which have already been successfully answered? What are the lacunae in the scholarship that can be filled through analysis of the data at hand? What assumptions in the existing scholarship can be tested and possibly changed on the basis of the analysis of the available data? It is impossible to answer these questions using only the Ulema Database, or any other biographical database, without having a firm grasp on the existing scholarship.

The Ulema Database does not tell a researcher anything about the significance or implications of the results of an analysis he or she has performed on its data. Only researchers with knowledge of the data's immediate and broader context can appreciate the value of the results and derive from it a meaningful conclusion or argument. Equipped with knowledge of the connections between contextual elements, such as political, social, and economic developments, they can produce new concepts, identify trends, and arrive at broader and global conclusions. In other words, the Ulema Database, a digital tabaqat, is a useful and efficient research tool but not a replacement for the skillset of the human researcher.

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ABDURRAHMAN ATÇIL is an associate professor of history at the Faculty of Arts and Social Sciences at Sabancı University, Istanbul. (abdurrahman.atcil@sabanciuniv.edu).

SALİH GÜNAYDIN is a software engineer working at the Centre for Islamic Studies (İSAM), Istanbul. (salih.gunaydin@gmail.com).

GÜRZAT KAMI is a post-doctoral researcher at Sabancı University, Istanbul. (gurzat.kami@sabanciuniv.edu).

ABDULLAH KARAARSLAN is a PhD student in history at Sabancı University, Istanbul. (abdullah.kara@sabanciuniv.edu).