The Journal of
HISTORICAL
NETWORK
RESEARCH

10 | 2024

C²DH
LUXEMBOURG CENTRE FOR
CONTEMPORARY AND DIGITAL HISTORY

UNIVERSITY OF
LUXEMBOURG

Imprint

Université du Luxembourg 2024

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ISSN 2535-8863

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Published online at
https://doi.org/10.25517/jhnr.v10i1

The Journal of HISTORICAL NETWORK RESEARCH

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Babylonian Rabbinic Case Narratives as Social Network

Journal of Historical Network Research 10 (2024) 256–288

Keywords Cases, Babylonian Talmud, Assortative degree mixing, Sasanian Mesopotamia, Rabbinic law

Abstract The Babylonian Talmud contains hundreds of narratives depicting cases adjudicated by a sage ("rabbi"). The narratives provide almost the only evidence for local judging in the Sasanian Empire. The network constructed from these narratives is marked by low connectivity and negative degree assortativity. This implies (against some expectations) that we should construe this social group not as a "small world" of highly interconnected sages, but rather as being made up of loosely connected, largely autonomous ones. In light of fundamental historiographical uncertainties, we cannot dismiss the possibility that this network is to some degree fictive. Even granting fundamental historicity, there are likely areas of distortion. To address these, the paper reviews the data for possible underrepresentation of connections and compares the case data with other available data on connections among rabbis extracted from the classical rabbinic corpus. Nevertheless, the impression that as a group, rabbis were loosely connected does fit with other scholarship on interactions between rabbis and deserves further research.

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This paper is a preliminary report on an examination of some 440 case narratives from the Babylonian Talmud as a social network. The case narratives present a named and authoritative figure, usually bearing the Aramaic/Hebrew title *rab* or *rabbi* (hence, "rabbis"), ruling on a legal matter for named or unnamed parties. The narratives provide an interesting test case for the use of network analysis in tracing relationships among members of the rabbinic group. At a minimum, narratives in their context reflect a highly textualized social world constructed by the compilers and editors. In that sense, the analysis below is analogous to the use of social network analysis to study the world of *Les Misérables, Game of Thrones,* or Greek mythology.[1] But the rabbis mentioned are presumably historical figures (however much they have been altered in narration) and the narratives at least plausibly derive from the historical interactions among real persons. In principle, then, these narratives in aggregate ought to give us a perspective on the organization of rabbis in Sasanian Mesopotamia (240–651) as a movement, and on how that movement provided services like adjudication for clients and adherents. What follows is a kind of thought experiment that follows through this logic of aggregation and mapping of connections between figures. Given the paucity of evidence for adjudication and conflict resolution in Sasanian-era Iraq, these Talmudic narratives also promise much needed insights into not only the concerns of a single ethnic minority, but also into the organization of "retail" justice more broadly.[2]

That the internal characterization of rabbinic interactions in classical sources pointed towards social network analysis was noted by Catherine Hezser decades ago.[3] Since then, a number of studies have made use of "network thinking" (to use Greg Woolf's expression), but few have attempted quantitative or even qualitative social network analysis.[4] In the interim, the tools for historical network analysis have multiplied and improved, and several studies have been completed in chronologically and geographically proximate fields.[5] Alongside the recent work

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Acknowledgments: Initial work for this article was completed when I was a fellow at the Katz Center for Advanced Judaic Research at the University of Pennsylvania (2021–2022). My thanks to the fellows for both formal and informal feedback and criticism. Michal Bar Asher-Siegal, Max Grossman, Chaya Halberstam, Benjamin Kay, Dani Kazhdan, Jonathan Levine, and Michael Satlow read versions of this paper at various stages. Lynn Kaye graciously shared her research data.
Data Availability: The data that are the basis of this study this study are openly available in Zenodo at https://zenodo.org/doi/10.5281/zenodo.13286979.

1 See the survey in Labatut and Bost 2019.
2 Macuch 2015.
3 Hezser 1997.
4 See Woolf 2016. For examples see Hezser 2015 and Swartz 2021.
5 Tools: I have made use of both Gephi (Bastian, Heymann, and Jacomy 2009) and Cytoscape (Shannon et al. 2003) for visualizations. Simulation and analysis were done in

by Satlow and Sperling (2020b; 2022), the innovation here is the application of quantitative social network analysis to a distinct slice of material from the Babylonian Talmud.

Case narratives are formally marked and therefore relatively easily identifiable, and have been studied in the past.[6] The present study is more extensive than Gafni (1982) and more explicit and systematic than others in identifying cases. However, the specific contribution is in the application of social network theory. The individual narratives lend themselves to representation as very small networks of judging activity. The focus in this paper is on mapping these narratives in aggregate as a social network, in which judges and litigants or parties are nodes or vertices, and the returning of verdicts are edges or links. After an introduction to the narratives and the historiographical context, I present an analysis of the graph of case narratives. Appropriate data on judging for comparison from outside of rabbinic materials is lacking. I do, however, examine the results of this analysis against similar narratives from the Palestinian Talmud, and against the broader citation patterns in the Babylonian Talmud.

The graph of case narratives is discontinuous, giving the impression that judges appear to act more or less independently in "neighborhoods" of their own. The structure of the narratives themselves lends itself to low connectivity at the local and graph-wide levels. Their form, selection, and deployment is further mediated by the work of tradents and editors. All of this problematizes our ability to interpret the network as fundamentally historical. Even read as a historical network, it appears to under-represent expected connections between/among parties and between/among rabbis/judges, and I pay particular attention to the possibility of precisely such under-representation. Nevertheless, a discontinuous model of judging is possible, and fits with some prior work on Babylonian rabbis as depicted in the Talmud that has underscored the lack of interaction among contemporaries and peers.[7]

Python using NetworkX version 2 (Hagberg, Schult, and Swart 2008). Scholarship: Clark 1991; 1992 predate Hezser. More recent studies include: Schor 2011; Ruffini 2011; Collar 2013; the contributions to Seland and Teigen 2017; Brokaert, Koestner, and Rollinger 2020.

6 Prior studies: Segal 1978; 1979; 1990; Gafni 1982. See also Neusner 1969, 3: 272–337; 4: 183–277; 5: 244–342, although it is not clear what criteria he used to identify the court cases. See now Kaye 2018; 2021.

7 Kalmin 1994; see below.

Case Narratives

An initial 750 narratives were identified on the basis of formal characterizations: they are introduced with the term *ʿobdaʾ* ("event" or "case") or involve a matter that *ʾattaʾ le-qame* (came before) one or another sage. I have attempted to include only stories that depict a rabbi providing a ruling for one or more litigants, excluding other types of narratives such as "consultations" about academic legal matters. These were then examined individually to remove duplications. The result was a total of approximately 440 cases. Even with this reduced number, case narratives are a frequent textual phenomenon: they appear on average about once every six folios in the standard printed edition.

Some examples follow, ordered by increasing complexity. The simplest type is a case represented as *ʿobdaʾ*, which can be inexplicit, requiring us to infer the circumstances or the legal or ritual issue:

> There was a case (*ʿobdaʾ*) and Rab Yosef deemed *terepa* up to thirteen animals. (*b. Ḥul.* 10b)

Only the context – an anonymous discussion attributable to the compilers of the text – enables us to know that the problem at issue was the status of a slaughtered animal if the knife was found to be defective subsequent to slaughter. Specific circumstances have been omitted: who owned the animals? Was this one case or multiple events? How did this matter come before a rabbi? What was done with the carcasses?

Since the possibility of discerning social networks of rabbis is one major area of inquiry, cases where one or both parties are said to be a rabbi or have some association with rabbis (e.g., disciples; kin or household members; employees) are especially notable. The following is one such example, dealing with inheritance. (Although I am using the language of "law" and "cases," it is worth noting that a ruling need not apply a specific principle or statute and may include evaluations based on the party's status and at the judge's discretion.)

> Rab Sapra was left money by his father. He took them [the funds] and engaged in business with them. His brothers demanded payment from him at law before Raba. He said to him: Rab Sapra is a great man; he does not leave his studies to labor for others. (*b. B. Bat.* 144a)

This narrative both provides an encapsulated statement of the circumstances and names the claimant. In many instances, the parties to the case (presumably less interesting than the name of the judge or the legal determination) are presented simply as "a certain man" (*ha-huʾ gabraʾ*) or "a certain woman" (*ha-hiʾ ʾitteta*ʾ).

The majority of stories appear as standalone narratives that perform legal work in the discussions in which they are embedded. A small proportion of cases (less than one quarter) explicitly invoke a rabbinic opinion or dispute attributed to named parties in the ruling, and fewer still are introduced with a citation formula.[8]

A significant minority (more than one quarter) have some discussion attributed to rabbis in the sequel or framing narrative.[9] A typical sequel begins with a named rabbi (or *rabbanan,* "our rabbis") questioning or challenging the ruling. These challenges may be resolved in favor of the questioner or of the judge. In some cases, the sequel appears to occur after the fact and involve external discussants; by implication, such sequels can be read as part of the core narrative. In others, the implication is that the question concerning the ruling took place at the moment of issuance.

The following example has an unusually complicated presentation that includes a number of these features.

> Said Rab Pappi, Rabina said to me, A certain one of the rabbis – Rab Tabot is his name; and there are those who say: Rab Samuel bar Zutra – who, if they were to give him all the world would not alter what he said, said to me: A case happened to me.
>
> On a certain day, it was the evening before the Sabbath, and I was sitting and a certain man came and stood in the doorway.
>
> He said to me, Do you have sesame to sell?
>
> I said to him, No.
>
> He said to me, Let this money be a deposit with you, since it is getting dark.
>
> I said to him, The house is before you.
>
> He put it in the house, and it was stolen.
>
> He [the sesame dealer?] came before Raba. [Raba] said to him: Any [statement that] "the house is before you": not only is [the recipient] not [liable as] a paid depositary, but he is not even an unpaid depositary. [Tabot has no liability at all.]

8 Lapin 2024, sections 2, 3.
9 Lapin 2024, section 1.

> I [Rabina] said to him [Tabot/Samuel bar Zutra]: Did not the Sages say to Raba: He [presumably, Tabot/Samuel bar Zutra himself?] must accept upon himself the [curse] "May the one who exacted payment ..."?[10]
>
> He said to me: Those things [that last exchange?] never occurred. (*b. B. Meṣ.* 49a–b)

Occasionally, case anecdotes serve as the basis for an important narrative set piece. A man is said to have "come before" the first-generation Babylonian, Rab, because he intended to show his fellow's grain to the authorities and was instructed not to do so.[11] As a "case," the narrative seems suspiciously artificial: it primarily provides an occasion for the villain to refuse to comply, prompting Kahana, Rab's disciple, to kill the man peremptorily. An elaborate narrative follows, recounting Kahana's escape to Yohanan's academy in Palestine where he bested the great Yohanan himself, seemingly pointing to the superiority of the Babylonian Torah over its Palestinian variant.[12]

Historiographical Framework

For heuristic purposes, this paper assumes a minimalist reconstruction of Babylonian rabbis and their history.[13] Rabbis constituted a movement in Palestine by no later than the early third century CE. The two Talmuds (Palestinian, completed ca. 400?; Babylonian ca. 600?), refer extensively to Babylonian named rabbis starting from the first half of the third century (roughly coinciding with the rise of the Sasanian dynasty) up to about 500 CE, implying a movement in Mesopotamia as well, from this period forward.[14] Material originating in Palestine or ascribed to Palestinian sages makes up a significant proportion of the contents of the Babylonian Talmud.[15] Numerous traditions presuppose the movement of rabbis between Palestine and Mesopotamia and consequent transmission of knowledge.[16] This suggests that Palestinian tradition continued to be formative in Babylonian circles for some time. At some point in the development of the

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10 A reference to *m. B. Meṣ.* 4:2, taken to serve as an imprecation.

11 *b. B. Qam.* 117a–b. For another set piece attached to rabbinic judicial activity see *b. Berak.* 58a, which even more dramatically thematizes rabbinic orientation to Persian legal authority.

12 Sperber 1982; Schremer 1997; Friedman 2002; 2006; Herman 2008.

13 A fuller historiographical treatment of case narratives will appear in Lapin, Forthcoming.

14 For the period in which the cases are *set,* the classic treatment is Gafni 1986 (in Hebrew); see also Gafni 2006; 2002. More recent work has focused on the impact of the editors who shaped this material (see below n. 18). Kiel 2022 surveys the cultural contexts of Mesopotamian rabbis. For rabbis in second century (Parthian) Mesopotamia, see the appendices to Neusner 1969, I, 184–87, 192–200.

15 Nikolsky and Ilan 2014 discuss the literature. See also the individual contributions to that volume.

16 Recent studies include Gray 2005; Redfield 2016; Schwartz 2015; Kiperwasser 2021.

rabbinic movement in Babylonia (certainly by the completion of the Babylonian Talmud), some material stresses the superiority of Babylonian knowledge, dialectical skill, and authoritativeness over Palestinian learning. The narrative about Kahana cited above is a prime example.

Two developments in scholarship on the Babylonian Talmud over the last half century have shaped the heuristic assumptions. The first is the emergence of a widely accepted paradigm for the composition of the Talmud. According to this paradigm, editors collected traditions that primarily circulated orally. The work of the anonymous ("*stam*") editors, dated to roughly the sixth century CE, was to collect, incorporate, and in many ways reshape this material into discourses (*sugyot*) that were strongly marked by comparison, juxtaposition, and to some degree systematization.[17] The raw materials are identifiable by language and style, as well as by comparison with other surviving rabbinic texts from a Palestinian context. These can be classified as *tannaitic,* deriving from Palestine in the first to the early third centuries CE, or *amoraic,* deriving from Palestine and Babylonia through the fourth and fifth centuries, respectively.

One of the proposed institutional settings for our case narratives is the rabbinic academies, presided over by significant rabbinic sages.[18] Already predating the dominance of the current *stam* paradigm, Goodblatt questioned the very existence of rabbinic academies by closely examining the actual anecdotes that feature masters and disciples interacting, and argued instead for disciple circles that do not necessarily survive the death or departure of a particular master. Rubenstein subsequently located this argument within the redactional model, arguing that discussions of formal academies that do appear derive from the interests of the latest layer.[19]

The second, somewhat more recent, development has been attention to the Sasanian Mesopotamian context of the Babylonian Talmud. This has meant serious engagement with Christian Syriac and Middle Persian texts, as well as with archaeological (albeit overwhelmingly epigraphic and unprovenanced) ma-

17 For treatments in English see Friedman 1977 with an extensive English abstract; Halivni 2013. See also Vidas 2014. Revisions in Kalmin 1989 and more recently Schwartz 2019. Some scholarship rejects this model, notably Brody 2010 (revisiting earlier work). For orality, see Sussman 2005. For critique, particularly of the assumption of orality, and a welcome attempt to view the formation of the Babylonian Talmud through the lens of late-antique book formation, see Amsler 2023.

18 Gafni 1982.

19 Goodblatt 1975; 2006; Rubenstein 2003. Gross 2022, 204–5, argued that Goodblatt did not go far enough in distinguishing academies from circles. Incidentally, one of the foundational applications of quantitative social network theory studied the fragmentation of such a circle (Zachary 1977).

terial.[20] Attention to the Sasanian context has undermined yet another proposed candidate for the institutional background of rabbinic jurisdiction. The exilarch (*resh galuta,* "head of the exile"), a dynastic figure who appears quite a few times in the Babylonian Talmud, has long been assumed to have controlled various areas of Jewish self-governance including judging, with authority perhaps derived from the state.[21] However, recent reexamination has underscored the paucity of positive evidence for a regular or central administrative, fiscal, or legal role for the exilarch.[22]

Ultimately, these methodological advances have not so much clarified the history of rabbis in Mesopotamia as problematized it. We are left almost exclusively with the Babylonian Talmud itself, and the inevitably circular process of teasing out more or less submerged historical data from its robust textual context. For the kind of retail, everyday adjudications that the Talmudic texts exemplify and specifically locate in the third to fifth centuries, there is relatively little in Syriac or Middle Persian sources against which to triangulate.[23]

Although the motivating questions are historiographical, the approach taken here is to treat the case narratives in the first instance as distinctive textual objects that depict interactions that are formalizable as graphs, and to then aggregate all of these interactions into a larger (ultimately discontinuous) network. That network may exist entirely in a textual universe and bare no relationship to any historical network. Beyond the narratives, this study does not begin with a presumption about whether judges did in fact have either have or lack local, centralized, institutional, formal, or charismatic authority. We do not know why people would have come to them for adjudication since we have no guarantees that these narratives are historical and because, in any case, we lack substantial evidence for decision-making or alternative venues.

I do make two simplifying assumptions that are at least textually reasonable within the context of the Babylonian Talmud and the broader rabbinic literature. First, there is a rabbinic group whose primary members are marked in the texts in a variety of ways (most visibly by the use of the honorific "rabbi"). Although

20 Elman 2007; Herman 2012; Secunda 2014; Mokhtarian 2015; Gross 2024. Epigraphy: Friedenberg 2009; Shaked 2013. For the connection between incantation bowls and rabbis in particular see, recently: Manekin-Bamberger 2015; 2020; Gross and Manekin-Bamberger 2022.

21 Neusner 1969; see also Beer 1970, 57–93; this view can be traced back to nineteenth century scholarship.

22 See, already, Goodblatt 1979, and Herman 2012, 194–202; more emphatically, Gross 2022; 2024, 33–85.

23 Middle Persian: Macuch 2015. Syriac: Kaufhold 2012, 295–314. For Eastern Syriac evidence from the pre-Islamic (sixth century) period, see Erhart 2001, 123–28; Tillier 2019, para. 106 ff. Gross 2024, 70 discusses some of this material.

the data discussed below underscores the lack of connections between members, these rabbis share commitments to the authority of a body of texts and traditions, necessitating study and discipleship, and to common ritual and other practices. Second, we can group the primary figures by both geography (Palestine and Mesopotamia) and by generation, groupings that appear consistently across the larger rabbinic corpus and were systematized by early medieval chronographers or historians.[24]

Preliminary Exploration

We can think of our graph as being constructed from two lists: a list of unique nodes (in this case, persons) and a list of links or edges (representing judgment) between nodes. Because we are interested in the exercise of authority, the flow of information, or the rendering of services, edges are directed: an incoming edge means that the person named appears as a judge; an outgoing edge that the person was a party to a case. Figure 1 provides an initial view into the data. Each node represents a person (party or judge). Edges, or links, between nodes, represent relations of judging. The algorithm used to generate the figure has the effect of spacing nodes evenly while drawing nodes with more connections (judges) toward the center.[25]

The structure of the individual case narratives in many ways dictates the shape of our graph. Cases tend to be organized around a small number of parties and a single judge. Overall, there are 604 nodes and 598 edges; average degree (the number of edges at each node) and density (the number of edges as a fraction of all the possible edges) are thus very low, resulting in low connectivity (average clustering coefficient of 0.008). The low average degree mirrors the format of our case narratives directly, favoring unconnected units and highly partitioned, star-like configurations where a relatively small number of nodes serve as judges for more than one case and very few nodes are parties to more than one case. (Note that coding of the narratives as graphs counts only judging relationships; ties between parties as, say, members of a household, are not counted. (A revised coding and tabulation would increase the number of edges that are not between rabbinic judge and client. See below on degree assortativity.)

24 *Seder tanna'im wa-amora'im,* ed. Kahana 1935; Epistle of Sherira Gaon, ed. Lewin 1921. These works may have access to extra-Talmudic historical information (dates of death, academic headship) but are nonetheless also heavily dependent of the Talmud itself, and derive from a period when formal academies existed and genealogies of succession were important claims to significance.

25 Fruchterman and Reingold 1991, as implemented in Gephi.

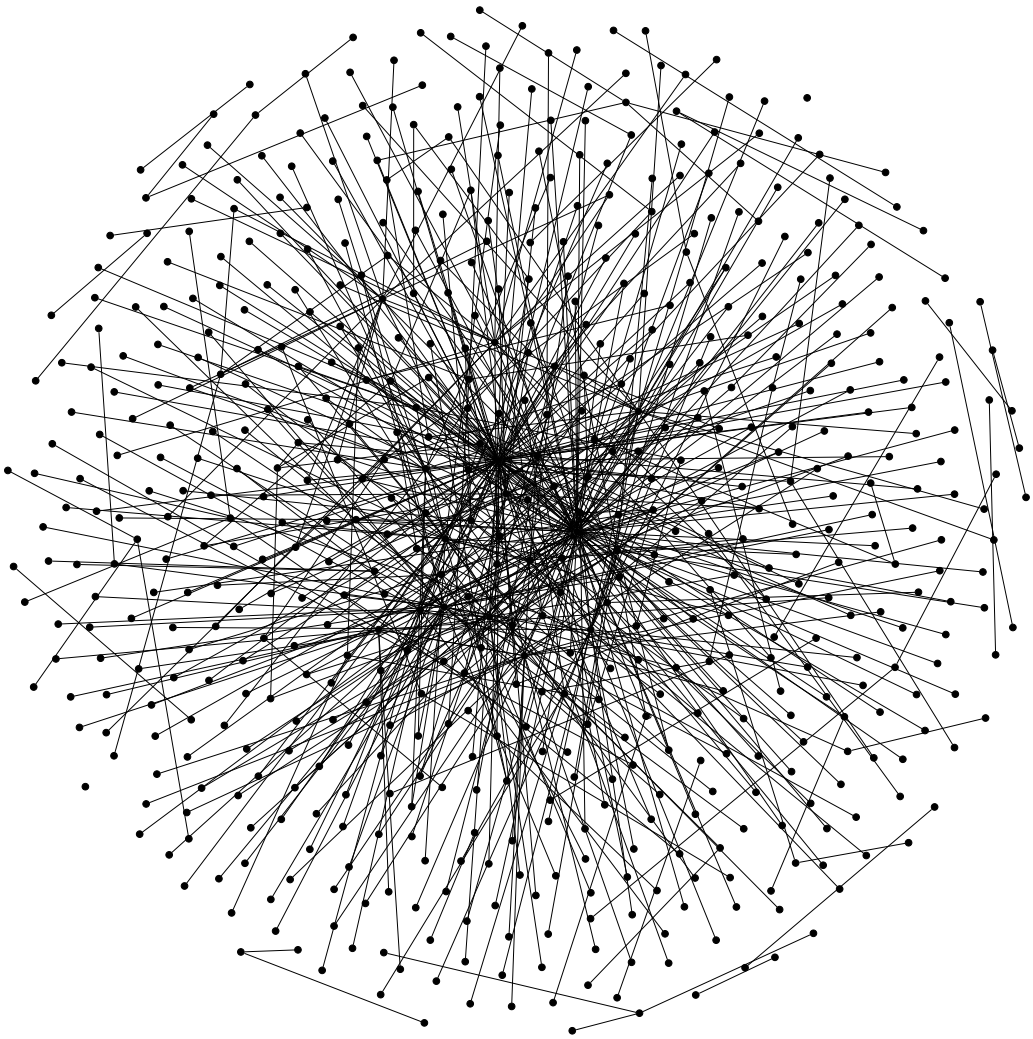

Fig. 1 All case narratives, Fruchterman Reingold layout (Gephi). Dots represent persons, edges connect judges and judged.

eISSN: 2535-8863
DOI: 10.25517/jhnr.v10i1.74

Figure 2 makes the partitioning apparent by (1) sizing nodes in proportion to the number of cases the persons judge ("in-degree"), (2) applying a force-directed model to pull connected nodes closer and push unconnected nodes apart, and (3) using the Louvain modularity algorithm to color "communities" of persons.[26] Judges are surrounded by neighborhoods of persons connected to themselves exclusively or primarily. At the center of Figure 2 is a group of connected units that accounts for about half of the judges and some 85 percent of the case narratives. Figure 3 extracts this "largest loosely connected component" and distinguishes nodes by color based on whether the person is explicitly marked as a rabbi himself, as a member of rabbinic households or circles, or is a named individual. This component is similar to the entire graph in terms of degree (the number of edges linking to each node) and overall density.[27]

The network based on case narratives is marked by very low connectivity. The small average shortest path length (approximately 2) in this case indicates that it is generally impossible to get very far at all from any one node. Even if we treat our observed network as undirected (i.e., as a proxy for a network in which communication flows in either direction between connected nodes), the average clustering coefficient remains low, although the average shortest path length now jumps to 5.3.[28] Instead, a small number of judges, some of whom appear in many narratives (high in-degree), interact with a much larger number of non-judges who appear only once (in-degree of zero), resulting in negative degree assortativity (–0.241). This observation is interesting because the empirical expectation is that social networks will tend to be positively assortative: people (in this case rabbis and their disciples or household members) will associate with people who are "like" them.[29] It is the negative degree assortativity that creates the "neighborhoods" visible in Figures 2 and those that follow. Moreover, experiments with randomly generated graphs that share the same degree sequence as observed in the case narratives suggest that the observed assortativity – what the Talmud presents – is *more strongly* negative than might otherwise be expected.[30]

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26 The force directed algorithm is "ForceAtlas 2," Jacomy et al. 2014. For modularity, Blondel et al. 2008, as implemented in Gephi (Bastian, Heymann, and Jacomy 2009)

27 Compared to simulations for the largest component (see note 12), the observed average clustering coefficient, although small, was statistically significant and in fact larger than expected.

28 According to the clustering coefficient algorithm implemented in Networkx (and Cytoscape): 0.023; the implementation in Gephi gives 0.111.

29 Newman 2002; 2003. See now Cline and Hasaki 2023.

30 Simulations generated 1,000 graphs using the "directed configuration" method and again using the "random rewiring" method (mixing time: 1230, following the recommendation of Zweig 2016, 419) that preserved degree sequence. In both simulated cases, the observed degree assortativity coefficient was well outside the one-tailed 95% confidence interval.

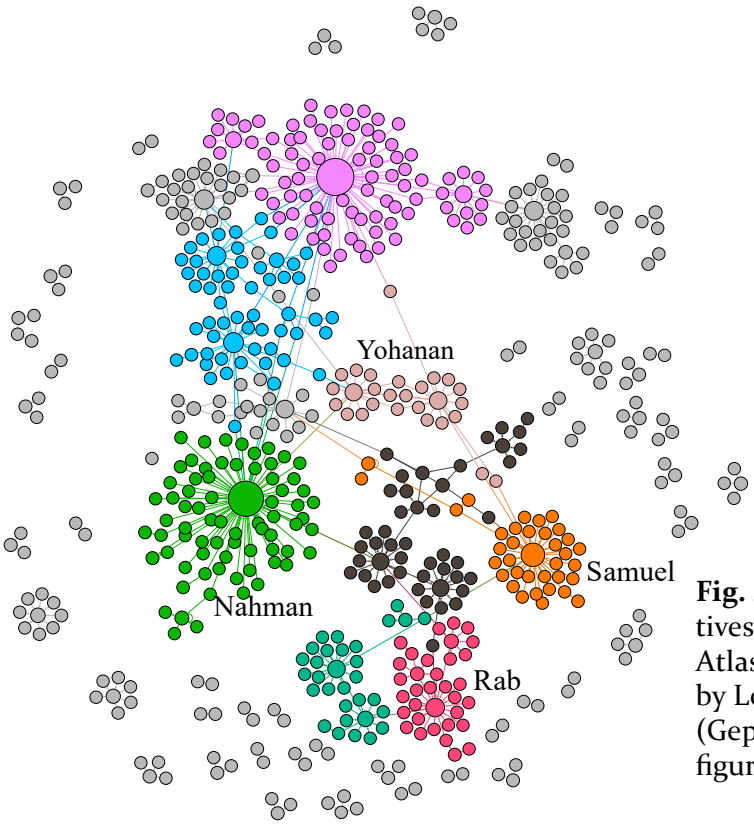

Fig. 2 Case narratives arranged by Force Atlas 2 algorithm; colored by Louvain modularity (Gephi). Some significant figures identified by name

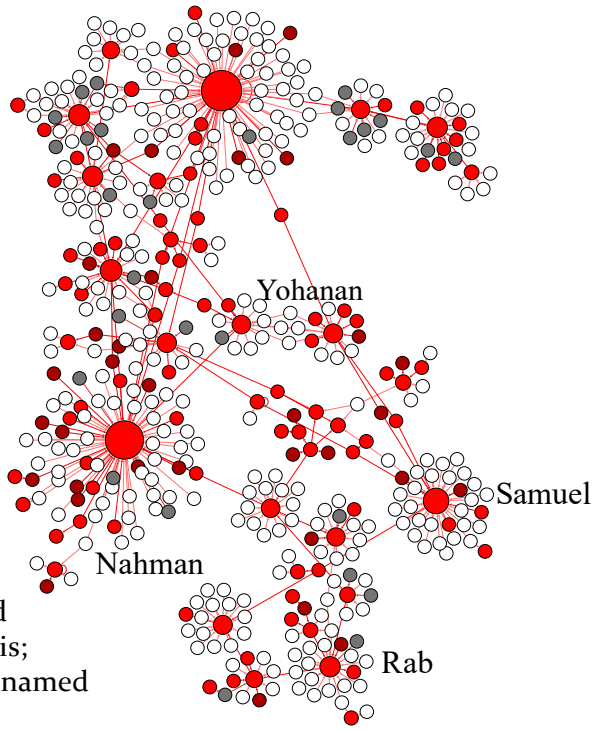

Fig. 3 Largest component, colored by affiliation to "rabbis." Red: rabbis; dark red: relations of rabbis; gray: named persons; white: no data.

In summary, the mapping of case narratives yields a network that is weakly connected overall, has a weak interconnected core, and is highly partitioned. It is not, in other words, a representation of a "small world" where even peripheral participants are connected through well-connected hubs constituting (in our case) a robust religious elite or a class of authoritative judges that disseminates its influence outward or deploys it in practice. It is, rather, a social archipelago.

Comparanda

The preceding section modeled the case narratives in the Babylonian Talmud as a network. That network is constrained by the type of sources used and may underrepresent connectivity at both the center and the periphery. It would be helpful to be able to compare this network with others shaped by similar constraints or that provide counterexamples. To my knowledge, datasets from geographically or chronologically proximate settings are not directly comparable in scale or in structure. For instance, Cline analyzed social networks in fifth century Athens (constructed from narratives in Plutarch) and Schor a late-antique Antiochene episcopal network (based on collections of episcopal letters).[31] But both of those cases involve contemporaries (by contrast, the Talmudic network spans centuries), include a much smaller set of nodes, and collect interactions that are not as formally constrained as those extracted from the case narratives.

For the present, I consider two additional rabbinic data sets. One is the corresponding set of cases from the Palestinian Talmud. These present a fairly similar picture to that of the Babylonian Talmud despite the geographical, cultural, and chronological distance between the corpora. A second dataset, published by Michael Sperling and Michael Satlow, collects citation patterns in the Babylonian Talmud. A comparison shows that the case narratives and citations do not simply reproduce the same set of prominent names.

Case Narratives in the Palestinian Talmud

Figures 4 and 5 present Palestinian Talmud cases using the same methods as Figures 2 and 3 for the Babylonian Talmud.[32] Rabbinic judges in these case narratives again operate in "neighborhoods" made up of persons who are marked as members of the rabbinic community, as well as others who are not. As with the Babylonian cases, degree assortativity is negative (–0.2). Visually, case narratives in the Palestinian Talmud appear much less connected than the Babylonian Talmud cases. The largest connected component is both a fraction of the size of the

31 Cline 2020; Schor 2011.

32 For the Palestinian data see Lapin 2010; 2012, 169–96. For overlaps between the Babylonian and Palestinian cases see Lapin 2024, section 4.

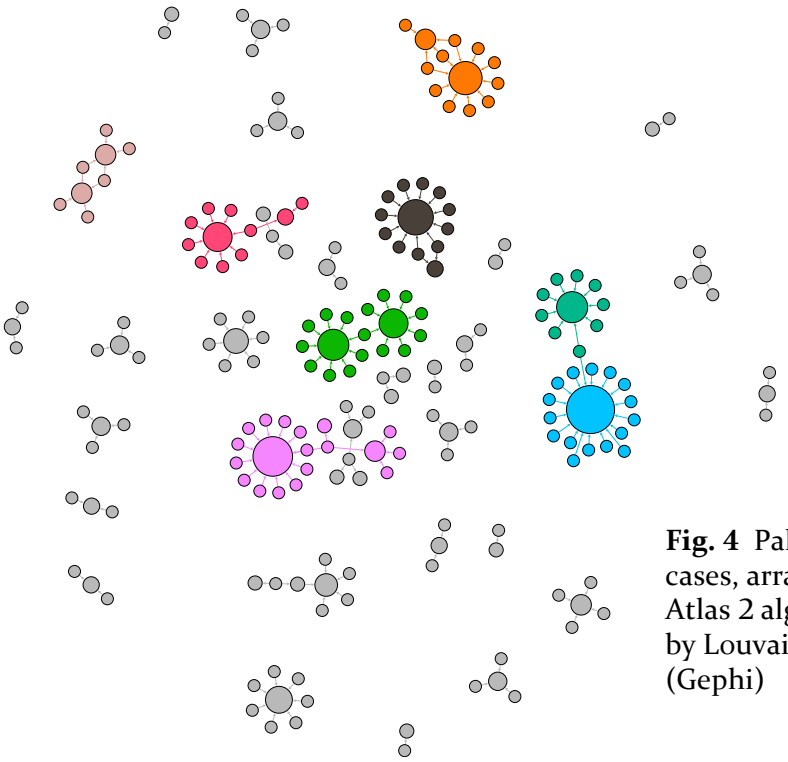

Fig. 4 Palestinian Talmud cases, arranged by Force Atlas 2 algorithm; colored by Louvain modularity class (Gephi)

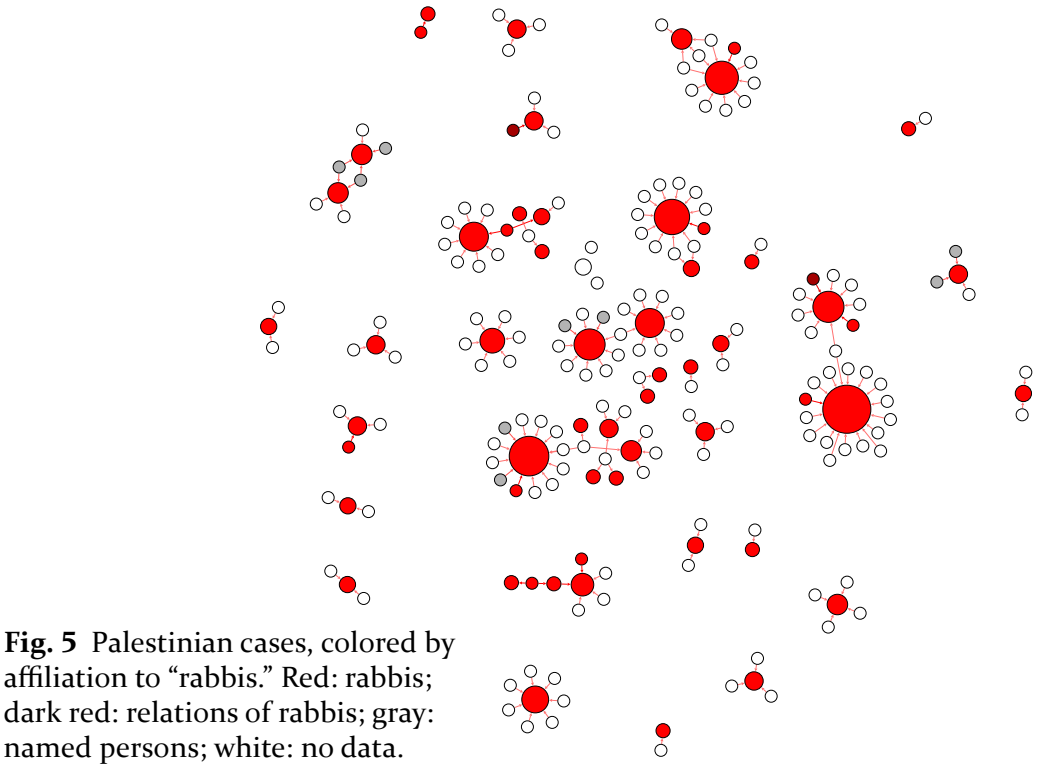

Fig. 5 Palestinian cases, colored by affiliation to "rabbis." Red: rabbis; dark red: relations of rabbis; gray: named persons; white: no data.

corresponding Babylonian component (27 compared to 460) and a smaller proportion of the total number of nodes (13 percent rather than 77 percent).

To gauge the significance of these differences between Palestinian and Babylonian, I have constructed graphs of varying sizes by resampling from the collected dataset.[33] Starting from resampled graphs with one hundred edges and increasing to six hundred significantly increases the number of judges at each step (thus, the number of neighborhoods), the number of cases the cited judges are associated with (the size of the neighborhoods), and the size of the largest component (because rabbis appear as both parties and judges, creating links between sets of cases). However, the average clustering coefficient, a measure of how many of a node's neighbors are also connected to each other, remains negligible. A look at the summary statistics in Table 1 suggests that in most respects, the observed network based on the Palestinian Talmud fits well within what we might have expected on the basis of 100-edge and 200-edge graphs resampled from the Babylonian Talmud.

In other words, aggregated case narratives in the Palestinian Talmud constrain the shape of the observed network in ways that are structurally similar to the constraints our Babylonian cases impose on the observed network. The difference between the two graphs is not itself an indicator of distinctive real or textual social orientations (for instance, that Babylonian rabbis interact less frequently with non-rabbis than their Palestinian counterparts).[34] If the Palestinian Talmud re-

	Resampled Graphs from Bab. Tal. Data				**Bab. Tal.**	**Pal. Tal.**
Nodes	135.78	243.31	434.28	605.2	604	211
Edges	100	200	400	600	598	176
Largest Component (nodes)	20.96	67.24	267.83	461.31	460	27
Maximum In-Degree (nodes)	14.27	27.19	52.37	76.89	77	17
Average Degree	1.35	1.22	1.086	1.01	0.99	0.834
Number of Judges	41.76	61.23	87.35	104.91	103	46
Average Clust. Coeff.	0	0.001	0.004	0.009	0.011	0

Tab. 1 Mean values of random re-sampled graphs from Babylonian Talmud data (1000 iterations)

33 Procedure: for each graph size, sample edges from the original with replacement. If the nodes exist in the new graph, link them; if not, add them. Repeat 1,000 times and calculate average graph statistics.

34 Kalmin 1994, 14 and passim.

ported three times as many cases, we could well expect to see a larger component connecting rabbis, however loosely.

Citations in the Babylonian Talmud

Our case narratives include between fifty and sixty judges who are Babylonian rabbis, out of several hundred Babylonian rabbis named in the Babylonian Talmud.[35] Although we lack the data to put this into any sort of demographic context, clearly, only a small number of the people who might have been the subject of case narratives actually appear in them. Two judges in particular, Naḥman and Raba (between them spanning the first half of the fourth century according to the conventional chronology), account for about a third of all the case narratives.[36] Can we say anything about the selection process by which certain figures were given priority? Not directly, perhaps, although the mapping of a network of citations in the Babylonian Talmud by Satlow and Sperling provide some comparative data.[37] A comparison suggests that the inclusion of names in the case narratives is not directly related to which rabbis cite or are cited the most.

"Citation" refers to the widespread phenomenon in the Talmud (and other rabbinic texts) of introducing statements or anecdotes with a formulaic statement of transmission (e.g., "X said in the name of Y"; see, for example, the narrative from *b. B. Meṣ.* 49a–b quoted above). Satlow and Sperling recently published a study of these citations as a network and have made the underlying data available. This makes it possible to ask how our judges fit into their different and also much larger sample of rabbis and texts. Figure 6 reproduces their visualization of the complete data set (based on Satlow and Sperling 2020b Figure 1), with judges highlighted. As in Figure 1 above, the algorithm used to display the graph pulls more linked nodes to the center. The result is a peripheral belt of singletons (in fact the majority of the named rabbis, who do not necessarily appear in the Talmud with citation formulae) and an inner disc of about 620 names with at least some linkage (in-degree or out-degree ≥ 1).

Our judges (marked in red) are mostly (75 percent) from that inner circle, but they are a small subset (only 12 percent) of that inner circle. About one quarter do not appear among those cited or citing at all. The two sets of data give priority to different individuals: those with the highest centrality in the citation net-

35 Judges: 103, of which 53 are Babylonians, 42 are Palestinians, and 5 uncertain. Babylonian rabbis: I have counted 412, expanding somewhat on Albeck 1969. Based on a digital version of Ilan, Ziem, and Hünefeld 2002, kindly provided by Ilan, there were 879 Babylonian persons, a number that includes females (32) as well as an unspecified number of named but non-rabbinic males.

36 *Seder tanna'im wa-'amora'im* dates the death of Naḥman to 631 Seleucid (319 CE) and of Raba to 663 Seleucid (351 CE), Kahana 1935, 5.

37 Satlow and Sperling 2020a; 2020b.

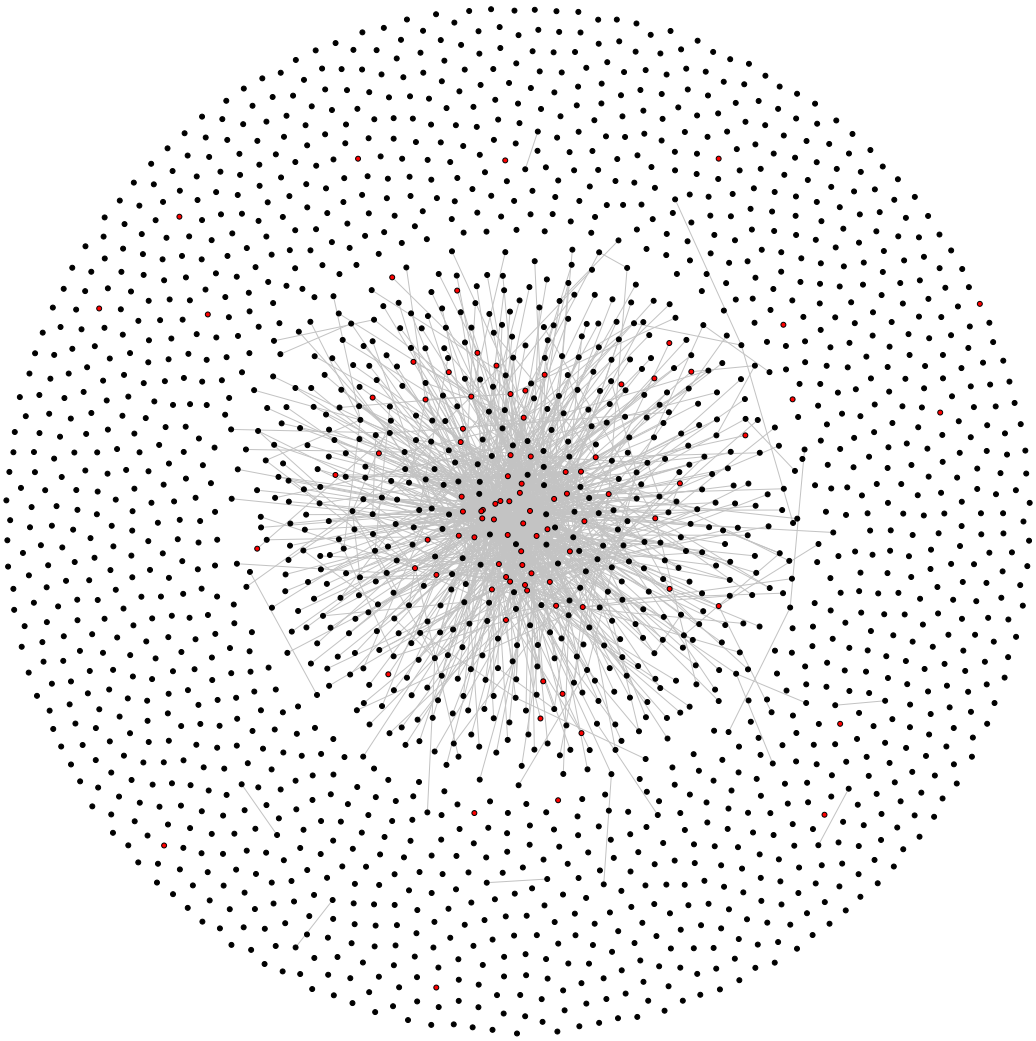

Fig. 6 Graph of Talmudic citations (Satlow and Sperling 2022a). For contrast, judges are enlarged and highlighted in red and edges grayed out.

eISSN: 2535-8863
DOI: 10.25517/jhnr.v10i1.74

Ten most Frequent Names							
	A	**B**	**C**	**D**	**E**	**F**	**G**
A	1.00						
B	0.18	1.00					
C	0.15	**0.54**	1.00				
D	0.25	**0.67**	**0.82**	1.00			
E	0.18	0.18	0.18	0.25	1.00		
F	0.11	0.18	0.25	0.25	0.28	1.00	
G	0.18	0.11	0.11	0.18	**0.53**	0.43	1.00
Twenty Most Frequent Names							
	A	**B**	**C**	**D**	**E**	**F**	**G**
A	1.00						
B	0.43	1.00					
C	0.38	0.28	1.00				
D	0.38	**0.74**	**0.54**	1.00			
E	0.43	0.29	0.38	0.29	1.00		
F	0.25	0.21	0.21	0.25	0.34	1.00	
G	0.43	0.29	0.38	0.29	**0.68**	0.43	1.00

A: Frequency of names in Babylonian Talmud; **B:** number of times a figure is cited (in-degree); **C:** number persons a figure cites (out-degree); **D:** B and C combined (degree); **E:** number of distinct figures for whom respondent appears as judge (in-degree); **F:** number of judges a figure is associated with (out-degree); **G:** E and F combined (degree). Highlighted: citations vs cases. Bold: Jaccard ≥ 0.5.

Tab. 2 Table of Jaccard similarities between lists of names

work are not necessarily the most frequent judges, and vice versa. Table 2 roughly quantifies the overlap between our judges and the Satlow and Sperling citations, by comparing the most frequent names in several counts: by raw frequency of appearance in the Talmud (A), frequency in citations (B–D), and frequency in case narratives (E–G). Since both case and citation graphs are directed, I further distinguish in-degree (the number of times a person is cited, B, or is a party to a case, E) and out-degree (how often they cite another sage, C, or appear as judge, F), in addition to combined degree (D, G). The values reported are the Jaccard similarity (the number of items in common as a proportion of the total number of distinct items; the order is not considered). The upper part of the table takes the ten most frequent names in each category; the lower, the twenty most frequent.

The overlap in names between the citation data (B–D) and the case narratives (E–G) is consistently low. (These regions of the table are highlighted in blue.) By contrast, the greatest similarities appear within the citation data. For the ten most frequent names, those who cite and those who are cited are drawn from a common list. Turning to the case data, the overlap between the names of judges and those who are judged is comparatively small. Since our lists of names are finite, the deeper we go into our lists, the more overlap between groups we should expect to see, and this appears to be true across the board when examining the Jaccard similarities for the twenty most frequent names. Interestingly, the overlap between rabbis who cite and those who are cited appears to decrease when we add more names.

Alongside the frequency of individual sages, the two sets of data prioritize different generations. The scholarly practice of clustering sages into generations, dominated by highly significant figures, has been in evidence since at least the ninth century. However, the raw citation data collected by Satlow and Sperling do not immediately sort by generations. As Figure 7 (a) illustrates, although some

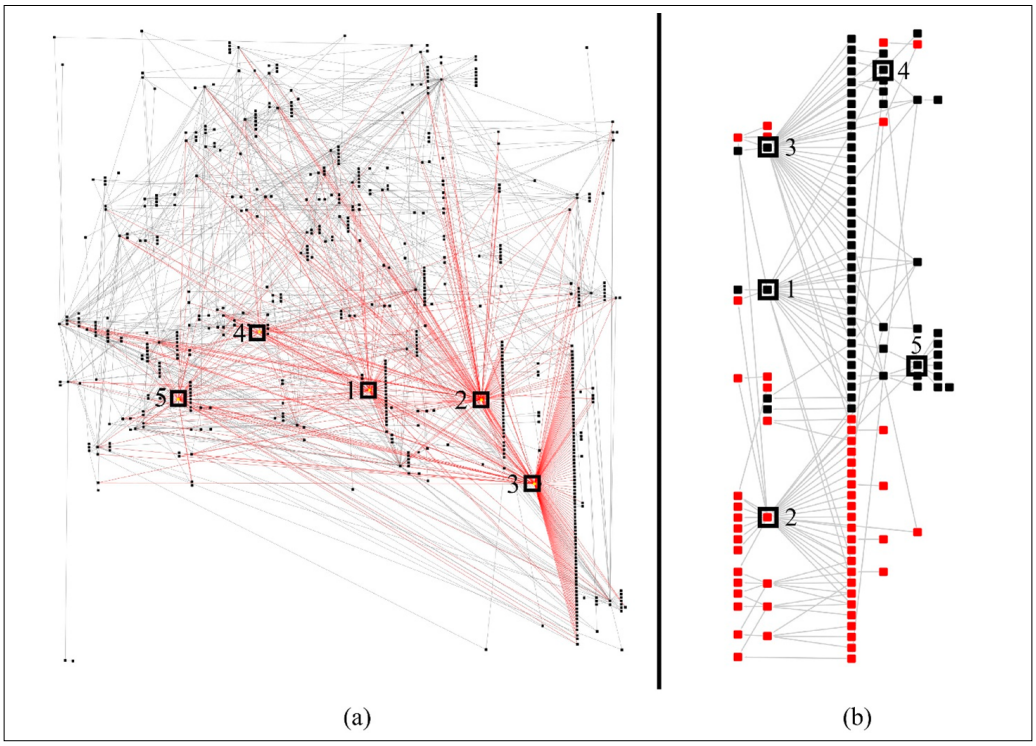

Fig. 7 Rabbis hierarchically sorted (yFiles hierarchical layout for Cytoscape). (a) All names, incoming edges for five persons highlighted. (b) Figures citing or cited five times or more. In both (a) and (b), multiple citations between figures are represented as a single edge. Highlighted persons: 1: Samuel; 2: Yohanan; 3: Rab; 4: Nahman; 5: Raba.

figures have more or less dedicated citers (who appear in a vertical line to the right of the node representing the person cited), the data as a whole show no clear linear or tree-like structure representing either chronology or generational transmission.

There is an underlying generational structure, but to find it we need to reduce some of the inevitable noise in the dataset.[38] In the background of the citation data are centuries of scribal copying and later typesetting, with numerous opportunities for confusion and error. (Examples: dropping the name after the title to leave only Rab and Rabbi, since a small number of individuals are conventionally referred to by those titles alone; or replacing unfamiliar or uncommon names with familiar ones.) Sages with the same or similar names contribute to the noise. The best-studied example is the orthography of the names Rabbah and Raba. The orthographic difference (a single letter) is conventionally used to distinguish two prominent sages thought to have lived a generation apart: Abbah b. Nahmani and Abba b. Joseph. However, the manuscript evidence is much more equivocal, with potential historiographical implications.[39]

While the Talmud generally cites distinct persons, some sort of disambiguation between distinct bearers of the same name is necessary. However, disambiguation strategies potentially generate new, fictive persons proposed in order to resolve apparent inconsistencies in the sources. Thus, scholars have long differed over how many distinct bearers of the name Kahana there were (two of whom are said to be contemporaries or disciples of Rab).[40]

We can reduce the noise significantly by restricting ourselves to people who appear in citations five times or more. Doing so retains about 71 percent of all the citations, although much smaller percentages of named persons.[41] Although a hierarchical ordering of this smaller group does resolve into "generations" that approximate traditional reconstructions, at least for significant figures, we are

38 See Satlow and Sperling 2022, 317.

39 Friedman 1992; Kalmin 1994, 178–82.

40 Friedman 2002, 250–51, for the problem of the early Kahana(s). *Seder tanna'im wa-'amora'im* (Kahana 1935, 11) appears to know only one early Kahana. Sherira only mentions one early Kahana (text: *Rab Kahana' qama'*, "the first," Lewin 1921, 61, although possibly distinguishing him from the later Kahanas appearing in the epistle). For the name in general see Hyman 1910, 841 (no fewer than six bearers of that name); Margalioth 1951, 611, at least 4; the index to Albeck 1969 lists five Kahanas with no byname, two early and three late.

41 Starting with a threshold of one, I constructed a graph of all figures with in-degree or out-degree greater than the threshold, and tested for cycles using NetworkX. Increasing the threshold repeatedly by one showed that with an in-degree or out-degree of five or more there were no longer cycles. This retains only about 24% of the persons cited and about 19% of the persons citing.

still left with a large number of figures who cite or are cited by only one person and cannot be placed in a specific generation.[42] Figure 7 (b) shows that three early individuals, Rab, Samuel, and Yohanan, play extraordinary roles as persons cited by later generations. Moreover, there is little overlap among the persons who cite them, and especially between the Palestinian Yohanan on the one hand and the Babylonians Rab and Samuel on the other.[43]

As already implied by the data in Table 2, the prominence of Rab, Samuel, and Yohanan is not directly echoed in the case data (see their relative contexts on Figure 2 and Figure 7 (b)). While Rab does appear among the ten most frequent judges, Samuel (fourteenth) and Yohanan (fifteenth) do not. Conversely, our two most prominent judges, Nahman and Raba, are conventionally dated to the fourth century (third and fourth generation respectively). Although Raba does appear among the ten most frequent citers and persons cited, Nahman does not.

To a very limited extent, the citation data and the case narratives are structurally similar. Like our case data, the citations display negative degree tassortativity (–0.26). In particular, significant numbers of individuals cite Rab, Samuel, and Yohanan exclusively, and are not cited in turn. Removing these individuals predictably lowers the negative assortativity; removing all singletons (nodes with a degree of 1) reduces the negative degree assortativity to nearly zero (–.05), rather than the positive assortativity we might expect from social networks. As a result, the citations also do not imply a typical "small world." As with the case narratives, the assortativity profile is at least partly an artifact of the underlying textual processes: where citation networks based on academic journals may reveal both practitioners' training and their awareness of each other's work, the rabbinic citation network as reconstructed by Satlow and Sperling marks antecedence.

In the hierarchical structure that emerges, Rab, Samuel, and Yohanan play crucial roles as either bottlenecks or bridges. Since all three are cited directly by figures who, both by convention and citational steps, must be several generations later (see Figure 7 (b)), something other than stenographic recording of citations is at work here. In the Babylonian Talmud, Yohanan frequently appears where

42 I used a topological sorting algorithm with grouping (after https://stackoverflow.com/questions/56802797/digraph-parallel-ordering; accessed June 7, 2023) from "earliest" to "latest": citers are at least one generation later than the latest person they cite; figures that do not cite but are cited are by definition in the first generation. The hierarchical visualization Figure 7 (b) approximates the results of the topological sort. (Reversing the direction of the sort results in a significant number of names assigned to the latest generation by default.)

43 Jaccard similarity: Rab × Yohanan: 0.07; Samuel × Yohanan: 0.08: Samuel × Rab: 0.19. Note that although small, the amount of overlap for Rab × Samuel is larger than for the other two pairs combined.

Tractate	Num Cases	Most Frequent Judges		
		From Group 0	From Group 6	Other
Baba Batra	66	Raba, Nahman, Judah	Rabbi	Abbaye
Ketubot	60	Raba, Nahman, Joseph	Ammi	Abbaye
Baba Metsi'a'	51	Raba, Nahman, Pappa		Rab, Abbaye
Gittin	36	Nahman, Raba, Huna	Ammi, Abbahu	
Hullin	36	Raba, Hisda,	Ashi, Rabbi, Yohanan	
Yebamot	33	Raba	Ammi, Yohanan	Hiyya, Abbaye
Baba Qamma	27	Huna, Nahman, Rabbah, Raba		Rab
Avodah Zarah	21	Hisda	Eleazar, Yohanan	Samuel, Hiyya
Nedarim	19	Assi, Hisda,	Rabbi, Yohanan, Eleazar	
Niddah	16		Eleazar, Rabbi, Yohanan	Samuel, Hiyya
Qiddushin	12	Raba, Joseph	Ammi, Ashi, Yohanan	

Tab. 3 Appearance of Frequent Names in Tractates with Ten Cases or More Separated by Louvain Modularity Group.

in external parallels a tradition is attributed to another Palestinian tannaitic or amoraic sage.[44] Possibly, the work of transmission and redaction may in fact accentuate the role of Rab, Samuel, and Yohanan as founding figures.

This excursus on the frequency of three names in the citation data suggests that in other respects, the citation data and the case narratives are demonstrably unalike. Additional, closer analysis may uncover further complexity. Satlow and Sperling published a visualization showing the results of applying the Louvain modularity algorithm, grouping nodes into potential "communities" (2022, 307, Figure 5).[45] Judges in our narratives appear to be drawn disproportionately from two particular groups: modularity group 0 (predominantly Babylonians, especially of the third generation and later), and modularity group 6 (Palestinians from the third and fourth century). Table 3 shows the eleven tractates that include at least ten cases. In ten tractates, at least one of the five most frequent

44 Harel 2013, 166, for the phenomenon of name changes in general. For Yoḥanan in particular see Wald 2007, 370.

45 Graph data was made available in Satlow and Sperling 2020a. Groups 0 and 6 are represented as 2 and 5 in Satlow and Sperling 2022, Figure 5. Satlow and Sperling 2022, 306–7, report their procedures for paring the data down to 139 relatively connected nodes. I was not able to reproduce their outcomes working from their complete data set.

judges comes from Group 0. In nine tractates, at least one is from Group 6. Our two most frequent judges, Raba and Nahman, are both in Group 0. Yohanan is in group 6, but Rab and Samuel are in neither. In addition, tractates that have more judges from Group 0, tend to have fewer from Group 6 and vice versa.[46] All this may point to differential practices in the production of individual tractates and possible subsets of the citation data that may have provided the names for judges.

Discussion

The impression from the individual narratives, and from the network we derive by aggregating them, is of individuated judging with a strong tendency towards more or less exclusive "neighborhoods" attached to significant judges. We know that the structure of the case narratives has shaped this particular network pattern, so any underlying historical network is necessarily distorted. Given the inevitable circularity of mining our texts for historical information, we cannot exclude the possibility that the network is an entirely textual, that is to say fictional, structure, or at least one so distorted that it cannot be recovered. In that case, we can derive nothing about the rabbis' organization, judicial roles, or the ritual or legal concerns that might have been brought to them from these narratives. The similarities in structure between the Palestinian and Babylonian Talmud case narrative networks may support this view of case-based networks as textual constructs.

On the other hand, incongruities between the case narratives and the citation data at the very least show that the texts are not simply a function of attaching traditions to the same small group of principals. If we now address the possibility that in some fundamental way the case narratives refer to judging practice by rabbis, how do we interpret the highly discontinuous network? To the extent that rabbis did indeed constitute a group that shared ritual and scholarly expertise, a common body of textual material and, by implication, training, we might reasonably expect highly represented rabbis to also be connected to one another, even constituting the group as a "small world."[47]

Perhaps, then, our network of cases obscures this more highly connected world. As Table 1 shows, although the case narratives form a discontinuous network, the largest connected component grows with the number of cases. The derived graph may involve an effective core of more highly connected figures while

46 Correlation, $r = -0.7067$ ($r^2 = 0.4994$); significant at $p = 0.05$. Also intriguing, but less pronounced: the Palestinian sages (modularity group 6) appear more strongly represented in tractates with fewer cases.

47 Zweig 2016, 162–65, 373–77.

minimizing the visibility of that core.[48] The presence of rabbis who appear as both judges and parties may in fact imply that they draw on overlapping persons. Of the 103 judges who appear in the entire dataset, twenty-five also appear as parties to cases. For the largest component, the proportion is twenty-three out of fifty, approaching half. More generally, in a corpus where parties to cases are overwhelmingly anonymous, 106 of the cases (24 percent) involve parties who are identified as rabbis themselves (73) or as persons with familial or other relationships to rabbis (33) (Figure 3).[49] Even if we allow that rabbinic judging served a wide cross-section of the population, among those whom the narratives depict as coming before rabbis, a significant proportion are people *already pre-selected for other reasons*.

On the local, "neighborhood" level, it is reasonable to suppose that people within the circle of rabbis – say, among the seventy-seven people in the circle of Raba, or the seventy-two in the circle of Nahman – could also have interacted with each other. We can measure the effect of this supposition in a simulation that randomly creates edges among the parties (here, assuming that half of the people before a given judge might each interact with some other person depicted as appearing before the same judge).[50] Since these alterations to the graph affect primarily the smallest nodes, they inevitably *increase* the negative degree assortativity (hence, discontinuity) in the network. Nevertheless, this modest increase in the number of edges increases the average clustering coefficient overall, and could arguably align with a model in which peripheral members are connected through connections among central members.

In a now classic study of case narratives in one very long tripartite tractate, Gafni used prosopographical data to argue that the judges were typically heads of academies and that their respondents in the sequels were members of the academy.[51] This would account for the insular character of the network of case narratives while providing an institutional basis for hearing cases. As noted, however, academies may enter Talmudic discourse relatively late. Gafni's identification of academy heads is based largely on the tenth century report of Sherira

48 See Satlow and Sperling 2022, 308–9.

49 Figures are for the largest component; for the whole data set, the proportions are similar: 85 rabbis and 33 relations of rabbis for a total 23%. Another 5–6% are named figures who are not necessarily rabbis themselves.

50 The procedure: for each judge of in-degree greater than 2, randomly add one edge for every two parties, skipping over edges that already exist. This adds on average 146 edges to the graph (running the simulation 1,000 times). The clustering coefficient more than doubles (although it is still quite low) from 0.011 to 0.028; treating the original and simulated graphs as undirected, the average clustering coefficient rises from 0.023 to 0.047.

51 Gafni 1982.

	Original Network		Network after Removal of Nodes Degree = 1			
			Cases and Sequel (cumulative)			
Graph Features	**Cases Only**	**+ Sequels**	**Cases Only**	**+ Present, Connected**	**+ Uncertain**	**+ Not Present**
Complete graph						
Total number nodes	604	657	113	135	139	143
Largest component						
Nodes	460	579	101	129	137	141
Edges	503	672	132	193	210	234
Average degree	1.09	1.161	1.317	1.496	1.533	1.660
Average shortest path	5.275	5.275	5.953	4.479	4.436	3.997
Clustering coefficient	0.023	0.023	0.064	0.246	0.278	0.324
Degree assortativity	–0.26	–0.241	–0.262	–0.273	–0.242	–0.205

Note: All calculations assume an undirected graph

Tab. 4 Incorporating Case Sequels into Graph

Gaon, and even then Nahman's prominence as a judge and the presence of others requires special comment.[52]

Still, it is necessary to ask whether incorporating sequels into our graph of relations significantly alters the connectivity. At first glance it does not: that is the implication of the first two columns of Table 4. A closer look is suggestive. Dropping nodes with a degree of one – overwhelmingly, persons who only appear as parties to cases and do so only once (Table 4, third column) – but adding persons based on the sequels raises the degree assortativity, lowers the average shortest path length, and increases the clustering coefficient considerably (Table 4, fourth to seventh columns). Although the size and order of the network (the number of nodes and edges) become larger, the "world" of the network becomes "smaller" and better connected.

52 Gafni 1982, 31, 33. To be sure, certain amoraic figures are said to have played leadership roles within their own circles (see, e.g., *b. Ber.* 64a; *b. Hor.* 14a on third- and fourth-generation sages; *b. B. Bat.* 12b on late sages). In contrast to Sherira, *Seder tanna'im wa-'amora'im,* also post-Talmudic but probably substantially earlier, does not describe the succession as closely bound to academies (Kahana 1935, 3–5). From the death of Nahman onwards (631 Seleucid, or 319 CE), the author appears to provide death dates of significant figures rather than naming academy heads.

However, one might be justified in drawing the opposite conclusion from the data in Table 4: that it is precisely the work of tradents and redactors that has created a connected network from an originally dispersed and discontinuous one. In a limited way, this is consistent with the citation network as well, where we noted the segmentation of the citers of Rab, Samuel, and Yohanan; Satlow and Sperling also identified sub-groups within the citation data. It may be worth re-examining the citation data while controlling for the over-representation of the most frequently appearing figures. Finally, the evidence of the case narratives appears to be in line with discussions by Kalmin of relations between contemporaneous Babylonian rabbis. Kalmin argued that Raba and Abbaye, prominent fourth-generation rabbis, are in fact rarely presented as interacting, and when they do appear together there may be some editorial intervention at work.[53] More generally, Babylonian rabbis of similar rank are only infrequently depicted as interacting with one another and their relationships, such as they are, are conflictual and competitive.[54]

Conclusions and Implications

If we were to graph trials in a contemporary court system but include virtually no information except for the judge and the parties, we might expect a network similar to the one we have created based on the Talmudic cases. There might be some particularly litigious persons who appear before more than one judge, or judges who also appear as litigants before other judges, but overall judges would appear as high-degree centers of low-degree neighborhoods. In practice, although invisible in the graph, contemporary judges are paid employees of a government, subject to official regulations, and applying a common body of law. (One can even imagine these judges as pawns in a "deep state" that directs outcomes at a high level of specificity.) In addition, our graph by definition includes no lawyers at all; nor does it reveal connections between judges or attorneys based on schooling, prior clerkships or internships, or membership in professional associations.

We have considered the possibility that the network of Talmudic case narratives may be textually constructed, or so distorted as to have little relationship to actual judging practices. However, even positing underlying historicity, our network under-represents interactions and connection in ways that are sharpened by comparison to our imagined contemporary one. From the parties' perspective, our imagined contemporary litigants interact with a designated judge, not with the appointee of X, the disciple of Y, or the colleague of Z. In the Sasanian, Babylonian context, by contrast, social rank and connections are perhaps what bring litigants before judges. Evidence for institutional structures that author-

53 Kalmin 1994, 175–92.
54 Kalmin 1994, 194–209.

ize judges, whether centralized (the exilarch and, by extension, possibly the Sasanian state) or dispersed (academy heads), is shaky at best. If so, litigation in rabbinic courts may be imagined as in some significant measure voluntary or, if forced, compelled by non-governmental pressures. As suggested, the case narratives themselves may imply that parties are preselected, drawn from people who interact with each other or have other reasons to associate with rabbis. It is unclear, however, whether those interactions are local (this rabbi, because he is familiar to me or my immediate network) or broader (this rabbi, because rabbis are known to be wise or pious or to have access to authoritative traditions and knowledge).

As for the judges, if there is any verisimilitude to the thousands of statements attributed to Babylonian rabbis of the third to fifth century, rabbis will have shared common interests, a technical vocabulary, and a body of material, whether formalized (e.g., the Mishnah) or as loosely organized traditions. All this presupposes training, and if that training was oral, as is usually supposed, it required face-to-face interactions. Perhaps, then, we should construe Babylonian rabbinic case narratives as produced by a well-connected network of sages, disciples, practitioners, and adherents.

It is striking, though, that the discontinuity of our network of rabbinic cases corresponds to a discontinuity also identified in other types of Talmudic narratives concerning the same or contemporaneous figures, as distinct from the textual framework in which they now appear. In both cases, it is an absence of continuity that we are detecting. What remains unresolved is how historically salient that absence is, and how to explain it.

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