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Family Network of an Emerging Jewish Intelligentsia (Cracow, 1850-1918)

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Abstract

Mass-genealogical research of the Jewish community in Cracow in 19th and early 20th century provides extraordinary opportunity to investigate the process of the emergence of a new social class: society of traditional merchants and peddlers produced modern attorneys and doctors. Now we are able to capture the dynamics of the process. For many reasons, the Jewish community in Cracow is an outstanding specimen. About 1900 there were about 25,000 Jews in Cracow (about 28% of city population). Almost whole family structure of the population has been revealed and analysed as a connected network. Over 1200 nodes of the network have been identified as the Jagiellonian University students between 1850 and 1918. We know what and when they were studying and often in which house they were born, what was their family social status etc. This data is used to model several key features of new emergent social class: what was the impact of parents' families on the choice of university education and the choice influence on a future marriage. Especially interesting are results about influence of family status on the completion of a doctoral qualification which, in turn, provided basis for discussion of best formula to describe how this influence is spreading.

1 Introduction*

Somewhere between 1860 and 1920 there was a significant shift in the societies of Central and Eastern Europe.[1] The dominant position of landed nobility was replaced by the rule of intelligentsia.[2] Let us look into formation of specific group: Jewish intelligentsia in the former Free City of Cracow, a quasi-independent country created by the Vienna Congress in 1814 and in 1846 incorporated to Austria as Grand Duchy of Cracow. Cracow and especially its Jewish community is a unique place to analyse. It was the old capital of Polish-Lithuanian Commonwealth – a country which was a home for most of European Jews until the end of 18th century. The Jewish community thrived here continuously since Middle Ages until 1939, in the same district of the city and known for their conservatism. In 1860 they solicited Shimon Sofer (Schreiber), to become the chief rabbi of Cracow. Sofer, who held office until his death in 1883 (and passed his office to son-in-law), was a son of Moses Schreiber (Chasam Sofer, the one who coined the motto of the ultra-orthodox Jews (Haredim): "'new' is forbidden by the Torah".[3]

But the "new" happened. Cracow was a home to one of the oldest universities in Europe, the Jagiellonian University (established 1364). The University was attractive to the Cracow Jews because provided good education while other possible destinations (universities in Vienna, Budapest, Breslau, Warsaw and Lvov) were all about 300 kilometers far from Cracow. Among 28,873 students who enrolled at the Jagiellonian University between 1850 and 1918, there were 3,955 Jews (13.7%). Among the University's 7,280 graduates (who re-

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1 Rafał Smoczyński and Tomasz Zarycki, Totem inteligencki. Arystokracja, szlachta i ziemiaństwo w polskiej przestrzeni społecznej (Warszawa: Wydawnictwo Naukowe Scholar, 2017).

2 Jerzy Jedlicki, Maciej Janowski, and Magdalena Micińska, Dzieje Inteligencji Polskiej Do Roku 1918 (Warszawa: Instytut Historii PAN, Wydawnictwo Neriton, 2008).

3 David Ellenson and Daniel Gordis, Pledges of Jewish Allegiance: Conversion, Law, and Policymaking in Nineteenth- and Twentieth-Century Orthodox Responsa (Stanford University Press, 2012), 70.

ceived title of doctor[4]) there were 1,760 categorized as "of Mosaic faith", i.e. Jews (24.2%)[5] Among those students, 1,080 were matched to birth certificates in the records of Cracow Jewish community. If we only count those who were born between 1881 and 1900, we have 671 such Cracow-born Jewish students. Only 57 of those 671 had a father who was also a university student – for over 90% of them being a student was the infamous "new". The 671 represent 3.7% of all 18,025 Jewish births registered in Cracow during 1881-1900.[6]

In our analysis we will employ the framework of mass genealogy. Mass genealogy was first conceptualized by M.J. Minakowski[7] and presented (in English) during EUSN2017 in Mainz.[8] In short, it is a discipline on the crossroads between (classic) genealogy, historical demography and social network analysis. It analyses whole societies (as demography) as graphs (as SNA) of people connected by genealogical ties (as genealogy). The main difference between mass genealogy and "ordinary" (or "historical") genealogy (auxiliary science of history) is that while "ordinary" genealogy consider family ties as properties of individuals (e.g., in order to discuss people's biographies and their family circles), mass genealogy looks from the network perspective: it considers people as nodes in a massive social network (several hundred thousand people at once) and focuses on society (considered as multi-generational network of people connected by family links) and not on individuals who

4 In the discussed period the title granted after successfully completed studies was "doctor", shortened as "Dr." which upon graduation was first part of the name, in the form: "Dr. Samuel Garfunkel" (in civil records, censuses etc.). The title was awarded by faculty and Jewish students became Doctor of Law, medicine or philosophy. Our analysis sometimes sounds clumsy because it is important not to mix it with ordinary English meaning of doctor (that is, doctor of medicine) or PhD (which means literally "Doctor of Philosophy" while philosophers were in minority here).

5 Own calculations based on: Corpus studiosorum Universitatis Iagellonicae 1850-1918 (Archiwum Uniwersytetu Jagiellońskiego, 1999). Jews were not considered a nationality; official censuses in Austrian Empire did not even allow for providing Yiddish as language (Jews were entering Polish or German instead).

6 Own calculations based on: "Akta Stanu Cywilnego Izraelickiego Okręgu Metrykalnego w Krakowie" (n.d.), 29/1472/0, Archiwum Narodowe w Krakowie, https://szukajwarchiwach.pl/29/1472/0/1/str/1/1000#tabJednostki.

7 Marek Jerzy Minakowski, "Modelowanie rozkładu kapitału ekonomiczno-społeczno-kulturowego poprzez genealogię masową," Przeszłość Demograficzna Polski 38 (2016): 63–88, https://doi.org/10.18276/pdp.2016.4.38-03.

8 Marek Jerzy Minakowski, "Mass Genealogy: Top 1% of 19-Th Century Polish Society as a Single Family Network (PageRank-like Analysis)" (Third European Conference on Social Networks EUSN 2017, Mainz, Germany, 2017), https://www.eusn2017.uni-mainz.de/files/2016/08/EUSN2017_Booklet_25_09.pdf.

happen to be networked with other individuals (in order to create a family tree with a few dozen people so that it could be presented in one, readable chart).[9]

The analysed database consists of 83,000 people, out of whom 64,000 were born in 19th century. It is a single, connected graph (the giant component of a larger graph of 102,000 people)[10]. To build it, we analysed all 10,433 marriage records from the Jewish Registry of Births, Deaths and Marriage in Cracow (Izraelicki Okręg Metrykalny Kraków, literally: Israelite Metrical District Cracow) from 1811 to 1914 (they are available in the National Archives in Cracow) and a considerable part of birth records (all records 1856-1876 and 1891-95 and selected records from other years). Unfortunately, most of Jews in the analysed period did not register their marriages, but fortunately – most of those who enrolled at University, were born in registered marriages (in their birth records they are marked as legitimate offspring).[11]

Usually, in a marriage record, the details of six people were included: both spouses and their parents. The birth record format was varying: initially it contained three people (child and its parents) but since 1868 mother's father begins to be mentioned and since 1873 also her mother, which makes five people in each birth record. In the years 1817-1900 alone, there were 55,300 births recorded in the district. We were not able to closely analyse all those birth records but already most (28,800) of the children born within period 1817-1900 have been placed in the aforementioned giant component of the graph (for the children born between 1856 and 1876 it is even 75.7%).

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9 Further methodological discussion of mass genealogy is published in: Marek Jerzy Minakowski, "Genealogia Masowa – Metodologia Tworzenia i Publikacji Bazy Danych," in Edytorstwo Wobec Masowości Źródeł Najnowszych, vol. 3, Edytorstwo Źródeł XIX i XX Wieku, Teoria i Praktyka (Warszawa: Wydawnictwa Uniwersytetu Warszawskiego, 2018).

10 Network science terms are used according to their definitions in: Albert-László Barabási and Márton Pósfai, Network Science, 1st edition (Cambridge, United Kingdom: Cambridge University Press, 2016).

11 In the period 1891-1895, 4,555 children were born in Israelite Metrical District in Cracow. For 4,505 we know whether they were born legitimately or not. For 229 we know that they studied in Jagiellonian University before 1918. The results are: 75% of future students were born legitimately while only 36% of non-students were born legitimately. A detailed analysis of legitimate and illegitimate births in 19th century Cracow Jewish Community was presented in Marek Jerzy Minakowski, "Jews of 19th-Century Cracow in Civil Registers" (The XIth Congress of the European Association for Jewish Studies, Kraków: Fundacja Alef dla Rozwoju Stiudiów Żydowskich, 2018). The extended version is to be published in the next volume of Przeszłość Demograficzna Polski as Marek Jerzy Minakowski and Anna Lebet-Minakowska, "Legitimate, Legitimized and Illegitimate Families of 19th-Century Cracow Jews," Przeszłość Demograficzna Polski 40 (2018).

In our database people can also be connected to places. We have access to data from censuses which were held every ten years (1857, 1870, 1880, 1890, 1900, 1910 and 1921). We did not manage to collect all data from all censuses, but we focused on the last available census, from 1921.[12] Out of the 1,080 Jagiellonian University students whose birth records we found among Cracow Jews, 465 were found in the 1921 census. From the 1921 census we collected all the data about families of former students, their parents, the families of their siblings and many others. The census provides the detailed address (house number which we converted to coordinates) and such information like a profession (means of living), religious denomination, nationality and language.

From the birth records 1855-59 and 1891-95 we were able to extract data about all Jewish birth places that occurred within these periods (house numbers converted to coordinates with accuracy of about 20 meters).

The last dimension to be included in our database was the families' social standing. To measure this, we used the 1883 electoral roll.[13] Jews in Cracow elected their local authorities according to the tax list; we found and analysed the 1883 list of all 565 Jewish families who were eligible to vote, with the sum of the local tax they had to pay. We managed to identify most of them. Knowing the genealogy of the whole community, we were able to calculate the relative status of everybody (assuming that people who had many rich uncles were from "better" family than people who had little number of affluent cousins).

The above database has been published at Wielcy.pl;[14] it can be browsed and individual records can be analysed. Now we are going to show some interesting results found in the graph as a whole. We believe that many other interesting results can be found and please consider it an invitation to further research.

2 Size and shape of the students' network

The preceding discussion concerned the whole Jewish society of Cracow. Let us focus our attention on the issue of intelligentsia itself. The term "intelligentsia" as a social class can be operationalized in many ways[15] but for the sake of

12 "Spis Ludności Miasta Krakowa z r. 1921" (n.d.), 29/91/0, Archiwum Narodowe w Krakowie, https://szukajwarchiwach.pl/29/91/0/#tabZespol.

13 "Spis Członków Zboru Izrelickiego w Krakowie" (1883), 29/33/0 Akta miasta Krakowa Series: 3.2.3 Akta Magistratu w układzie rzeczowym. File/unit: Kr 7055. Classification scheme code: fasc. 29 konw. 003112/IV/1920, Archiwum Narodowe w Krakowie.

14 Marek Jerzy Minakowski, "Wielka Genealogia Minakowskiego," 2018, http://wielcy.pl/.

15 Jedlicki, Janowski, and Micińska, Dzieje Inteligencji Polskiej Do Roku 1918.

current discussion let us operationalize it as a group of people who were enrolled to the Jagiellonian University in Cracow and their close families. Considering the family structure as a graph, let us consider "close family" as people who are connected by a path no longer than five links (A, B) such that A is a child, parent, sibling or a spouse of B. A path of five will be, e.g., a father-in-law of one's first cousin (i.e., the father of a wife of a son of a brother of one's father) or son-in-law of one's wife's niece (husband of a daughter of a daughter of a sister of one's wife). The value "five" seems to be a limit of what people can consider their families (people who can be met during family events organized by somebody located on the path between them). The choice of "five" was arbitrary and should be considered rather an upper limit, aiming to eliminate ties that are not *family* ties.

Therefore, for further discussion, let us select from our network all paths (A … B) such that: (a) the path is composed of no more than five links, (b) each link is a relation of being a child, parent, sibling or a spouse, (c) both A and B were enrolled as students of the Jagiellonian University between 1850 and 1918; strictly speaking: A and B are listed in the *Corpus Studiosorum Universitatis Iagellonicae*[16], and (d) both A and B: either have a birth record in the Israelite Metrical Department of Cracow or their parents have a marriage record there or any of their parents have birth certificate there.

The sum of the paths (all nodes and links between them) forms a network. In the giant component of the network there are 5,905 people, each connected to everybody else. Within the network, 1,236 were enrolled as students at the Jagiellonian University between 1850 and 1918. The other 4,669 people are at a distance of no longer than three links (edges) to some student.

For 925 (75%) of the 1236 Jewish students there is a birth record in Israelite Metrical Department of Cracow. The total number of Jewish students of this period who have birth record in Israelite Metrical Department of Cracow was 1,080, so these in our network make 86% of them. For the next 136 there is a birth record of any of their parents or their parents' marriage record. If we count all students who either have birth certificate here or any of their parents have birth certificate here or their parents have marriage certificate here the numbers are: 1061 are in the giant component in our graph, which is 86% of all 1,236 Jewish students in our graph (some are from outside) and also 86% of all 1,230 students who satisfy the above conditions for birth or marriage certificate (some are outside of the giant component).

16 Corpus studiosorum Universitatis Iagellonicae 1850-1918.

Faculty	Jewish students in the network		Percentage for non-Jewish students
	number	percentage	
Law	611	49.4%	40.7%
Medicine	340	27.5%	16.1%
Philosophy	263	21.3%	36.9%
Theology	0	0.0%	5.0%
No data / other	22	0.6%	0.5%
Total	1236	100.0%	100.0%

Table 1. The faculty of the Jagiellonian University where students enrolled to; in the cases where a student changed faculty, only first enrolment is counted. All students in the analysed network of Jewish students from Cracow connected by family ties. Non-Jewish students according to volumes 7-8 of the *Corpus Studiosorum Universitatis Iagellonicae* (total number in these volumes: 7,620, non-Jewish 6,660). Own calculations.

The shape of the network can tell us whether the Jewish intelligentsia in Cracow was composed of some distinct communities. We could imagine, for instance, that there were parts originating from different religious groups or from distinct districts of the city. It could have happened also that there was some counter-elite, as among the readers circle of 19th century *Kurier Warszawski*[17] where two groups of Catholics (one from old aristocracy and other descendants of Frankist sect) formed two opposed elites of Warsaw intelligentsia in the middle of 19th century.

First approach was to visualize the network in Gephi[18] using the ForceAtlas2 layout[19] and then apply the Louvain modularity algorithm for community detection[20] several times to see whether there are some outstanding communities. This method did not provide any meaningful results: the calculated communities did not stand out, they were mixing and overlapping.

17 Marek Jerzy Minakowski, "Sieć społeczna wokół Kuriera Warszawskiego na podstawie jego nekrologów z lat 1821–1861," Przeszłość Demograficzna Polski 39 (2017): 209–51, https://doi.org/10.18276/pdp.2017.39-09.

18 "Gephi - The Open Graph Viz Platform," accessed August 13, 2018, https://gephi.org/.

19 Mathieu Jacomy et al., "ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software," PLOS ONE 9, no. 6 (June 10, 2014): e98679, https://doi.org/10.1371/journal.pone.0098679.

20 Vincent D. Blondel et al., "Fast Unfolding of Communities in Large Networks," Journal of Statistical Mechanics: Theory and Experiment 2008, no. 10 (October 9, 2008): P10008, https://doi.org/10.1088/1742-5468/2008/10/P10008.

The other try was to apply the Louvain method ten times with the resolution = 15. This resulted in splitting all 1,236 students into 5–8 separate communities (five times: five communities, three times six communities, once seven and once eight communities). The largest community size was at least 316 or 26% (median: 450 or 37%). The question was: whether these communities are consistent and reflect the real divisions within the society or are just an accidental artefact of used method (which had to return something even if the result was to be artificial). The number of nodes that always (ten times) belonged to the largest community was 0. The sizes of largest sets of nodes that always kept together were, in decreasing order: 39, 37, 22, 21 and 20. If the conditions were to be relaxed and instead of ten subsequent application of the method, five applications were to be performed in two separate experiments, the number of nodes that five times belonged to largest community was either 36 or 13 and the sizes of largest sets of nodes were, in decreasing order, either 44, 40, 36, 35, 32 or 70, 50, 46, 41, 32. Therefore we can conclude that there were no deep, real divisions within the analysed society that could be detected.

For measuring modularity of a partition (a scalar value between -1 and 1 that measures the density of links inside communities as compared to links between communities), the Neuman's algorithm was employed[21]; for the above calculations of Louvain method with resolution = 15, it produced scores for modularity from 0.61 to 0.77 (average: 0.70, median: 0.69). When resolution was set to 1.0, modularity score was varying from 0.913 to 0.916 but the number of detected communities was much larger: it was from 63 to 67. Each of the smaller communities have between 6 and 41 students; 85% of the communities had between 10 and 30 students.

It seems, then, that the whole social graph does not exhibit visible structural divisions. Instead, we may assume that the whole society of the Jewish intelligentsia in Cracow between 1850 and 1918 was composed of about 65 families of about 15-20 students or alumni of the Jagiellonian University, closely connected within themselves and more distantly connected with other such families.[22]

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21 M. E. J. Newman, "Modularity and Community Structure in Networks," Proceedings of the National Academy of Sciences 103, no. 23 (June 6, 2006): 8577–82, https://doi.org/10.1073/pnas.0601602103.

22 Some connections between families were stronger than another. Such families can be merged; e.g., we can also assume resolution = 3 and find about 30 communities/families with modularity of about 0.905.

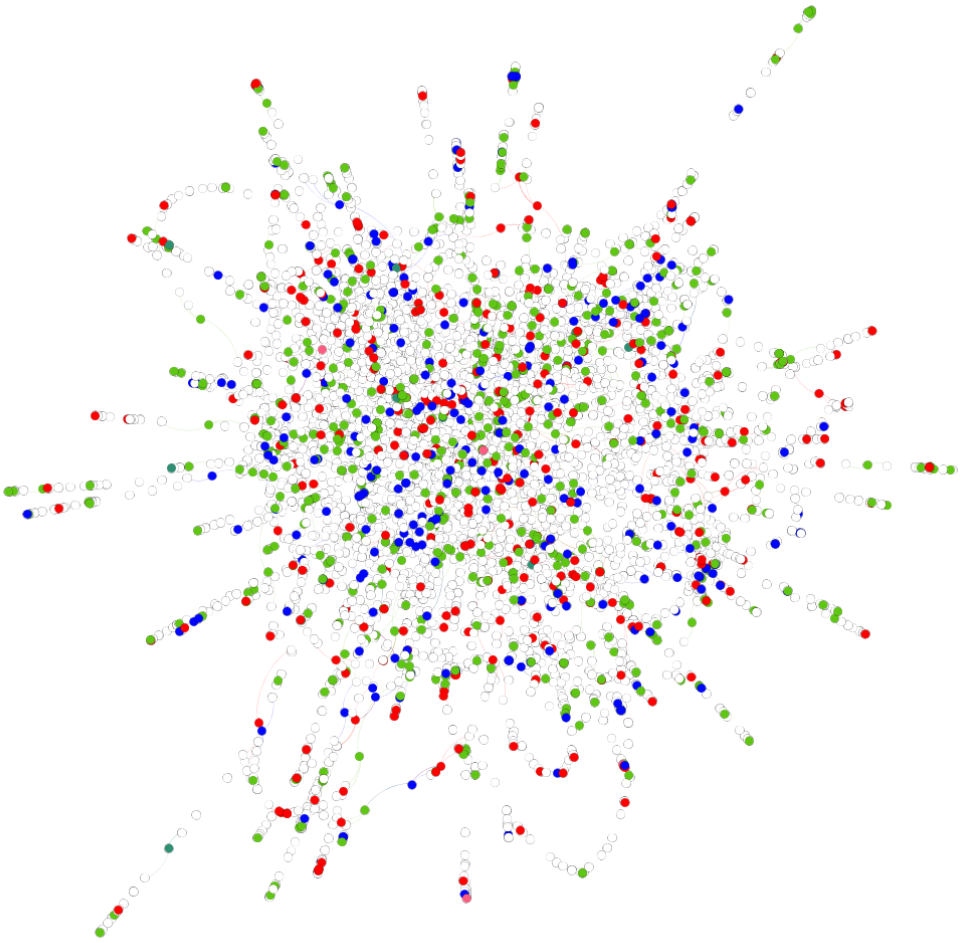

Figure 1. The network of the Jewish intelligentsia (students and links between them). ForceAtlas2 in Gephi. Law: green; medicine: red; philosophy: blue; non-students: grey.

Not only the structure, but also quality of the communities can be important. We could hypothetically assume that there were families specializing in medicine, families of lawyers and families of teachers (studying philosophy, i.e., all sciences and humanities except law or medicine). But the close look into the network shows that there are no visible distinctions between faculties they chose.

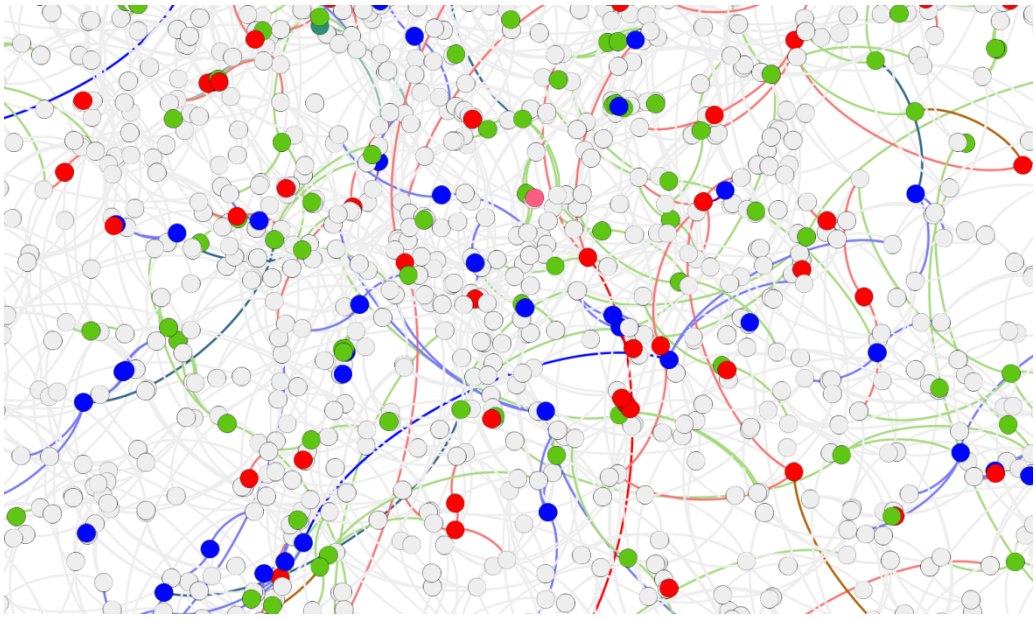

Figure 2. The network of Jewish intelligentsia (students and links between them). ForceAtlas2 in Gephi. Zoom showing internal structure. Law: green; medicine: red; philosophy: blue; non-students: grey.

At least, there are no visible sign. But this may be misleading. Actually, the author was strongly confident that there must be some regularities, that people were sharing professions (legal, medical, teaching) in families, from father to son or between cousins. Also, the idea of marital homophily (homogamy) was very compelling, claiming that "birds of a feather flock together" and people tended to marry people of similar interests and similar profession.[23] Yet another argument could be found in the institution of arranged marriage, still widespread in Jewish societies in this part of Europe those times: it is enough to remind that the novel S. Aleichem's *Tevye the Dairyman*[24] was first published in 1894, known better as *Fiddler on the Roof* (Broadway musical and Hollywood film).

The data was prepared in the following way: we took all 1226 students of Jagiellonian University between 1850 and 1918 who either have birth record in Israelite Metrical District of Cracow or any of their parents have it or their parents married there. Then we found the shortest paths between them, no longer than five links, where each links is one of following, directed relationships:

23 Henryk Domański and Dariusz Przybysz, Homogamia małżeńska a hierarchie społeczne (Warszawa: Wydawnictwo IFiS PAN, 2007).

24 Sholem Aleichem, Tevye the Dairyman and Motl the Cantor's Son, trans. Aliza Shevrin, New edition (New York, N.Y: Penguin Classics, 2009).

being child, father, mother, husband, wife or a sibling. We found 17,456 such pairs, between 1,124 students (102 had no pair: the shortest path to another student was longer than five or was infinite).

For each path its length was recorded and the side from which it begins. "Side" is the attribute of first link in the path (child, father, mother, husband, wife or a sibling). The paths are the shortest ones, so if a path is labelled as "father side", it means that the person on the end of the path is closer to one's father than to one's mother, one's sibling, one's children or one's spouse(s). Thus, for instance, the path to one's father-in-law was labelled "spouse side" while path to one's grandchildren was be labelled "child side".

Out of the 1,124 students, for 1,110 we know the faculty they enrolled as one of the three: law, medicine and philosophy (for four of them the faculty was not recorded while ten of them enrolled to lately opened faculties of pharmacy and agriculture). For the 1,110, the distribution was following:

Faculty	**Number**	**Percentage**	**Confidence interval**
Both men and women			
Law	571	51%	49% – 54%
Medicine	298	27%	24% – 30%
Philosophy	241	22%	19% – 25%
Total above	1110	100%	
Men only			
Law	571	66%	63% – 69%
Medicine	221	26%	23% – 28%
Philosophy	72	8%	6% – 10%
Total men	864		
Women only			
Law	0	0%	0% – 0%
Medicine	77	31%	26% – 38%
Philosophy	169	69%	73% – 79%
Total women	246		

Table 2. Faculties where Jewish students from Cracow enrolled first. Absolute number, probability and confidence intervals. Own calculations.

The confidence intervals (higher and lower limits of confidence) in the Table 2 and in following discussion are calculated according to the formula:

$$\mathrm{CI} = a \pm 1.96 \times \sqrt{\frac{a \times (1-a)}{n}}$$

Formula 1: Confidence interval. *a* is the rate of all paths ending with a student of the given faculty and *n* is the number of all pairs (shortest paths) satisfying the tested conditions. The value of *n* in most cases is above 100, so the normal distribution was assumed (which explains why for 0.95 significance level the 1.96 factor was used).

The differences between male and female students are so great that they had to be analysed separately. One thing is that women were not allowed to study law; but this was an obvious trap that could be avoided. More important difference was in the proportion of female students of medicine and philosophy: while for men the proportion was 1.23:1, for women it was 0.46:1. That is why many differences resulting from sex could be falsely attributed to the faculty.

The tests were performed as follows: all students have been divided according to the faculty (law, medicine or philosophy). Then, for each group all other students from their families (satisfying the tested conditions) were found and the probability that they enrolled into the same faculty has been calculated. For instance, for all lawyers we took all people from their families with path no longer than three; the probability that they were also lawyers was 54%: there were 1,312 such paths out of 2,439 paths from a lawyer to somebody else with distance no longer than three. In this case, the 95% confidence interval was between 52% and 56%. In general, the confidence interval for being a lawyer was between 49% and 54% (see Table 2), so we could not refute zero-hypothesis: the average member of (such defined) family of a lawyer had a little greater possibility of studying a law (instead of medicine or philosophy), but the difference could also be due to an accident.

The tests were taken in cases where *n* was enough to provide any meaningful results for all these three faculties. For the network distance of no longer than five (as defined above), the results are presented in the Table 3.

Faculty	Confidence interval	N	Reference values	Notes
all sides, distance ≤5:				
law	66%–68%	6946	63%–69%	
medicine	24%–27%	2633	23%–28%	
philosophy	5%–9%	849	6%–10%	
father's side, distance ≤5:				
law	63%–67%	2233	63%–69%	
medicine	23%–29%	808	23%–28%	
philosophy	5%–12%	225	6%–10%	
mother's side, distance ≤5:				
law	67%–71%	2360	63%–69%	
medicine	23%–29%	774	23%–28%	
philosophy	2%–7%	233	6%–10%	
wife's side, distance ≤5:				
law	62%–70%	595	63%–69%	
medicine	17%–26%	328	23%–28%	
philosophy	-1%–5%	98	6%–10%	Below
sibling's side, distance ≤5:				
law	65%–70%	1658	63%–69%	
medicine	22%–28%	652	23%–28%	
philosophy	6%–13%	277	6%–10%	
all sides, distance ≤ 4:				
law	65%–69%	3388	63%–69%	
medicine	22%–27%	1254	23%–28%	
philosophy	8%–14%	428	6%–10%	
all sides, distance ≤ 3:				
law	66%–70%	1928	63%–69%	
medicine	21%–27%	682	23%–28%	
philosophy	9%–18%	230	6%–10%	
all sides, distance ≤ 2:				
law	64%–70%	886	63%–69%	
medicine	17%–26%	329	23%–28%	
philosophy	8%–21%	113	6%–10%	
sibling's side, distance ≤ 4				
law	65%–71%	1042	63%–69%	
medicine	16%–24%	377	23%–28%	Low
philosophy	7%–17%	172	6%–10%	
sibling's side, distance ≤ 3				

law	66%–73%	753	63%–69%	
medicine	13%–22%	276	23%–28%	Below
philosophy	8%–22%	107	6%–10%	
sibling's side, distance ≤ 2				
law	64%–72%	574	63%–69%	
medicine	11%–20%	212	23%–28%	Below
philosophy	7%–24%	72	6%–10%	

Table 3. Confidence intervals for proportions of Jewish students from Cracow (1850-1918) that were related to other students of the same sex who enrolled in the same faculty. Males related to males. Various sides and distances tested. N: number of all other students (from any faculty) related to a student of this faculty. Own calculations.

What we can see in the Table 3, in most cases there are no significant results: the sons of Jewish families had rather equal tendency to study in various faculties. The irregularities can be found in (a) philosophers and their wives' families and in (b) students of medicine and their brothers and families of their brothers and sisters. We will discuss it later, after looking at the Table 4, where results for female students are shown.

Faculty	**Confidence interval**	**N**	**Reference values**	**Notes**
all sides, distance ≤5:				
medicine	26%–38%	234	26%–37%	
philosophy	73%–79%	656	63%–74%	Low
father's side, distance ≤5:				
medicine	32%–57%	61	26%–37%	
philosophy	74%–85%	206	63%–74%	Low
mother's side, distance ≤5:				
medicine	18%–34%	112	26%–37%	
philosophy	62%–74%	223	63%–74%	
sibling's side, distance ≤5:				
medicine	25%–52%	49	26%–37%	
philosophy	75%–88%	146	63%–74%	Over
sister, distance ≤5:				
medicine	35%–73%	26	26%–37%	High
philosophy	70%–90%	60	63%–74%	
all sides, distance ≤4:				
medicine	33%–52%	99	26%–37%	High

philosophy	76%–85%	297	63%–74%	Over
all sides, distance ≤3:				
medicine	38%–64%	59	26%–37%	Over
philosophy	80%–90%	189	63%–74%	Over
all sides, distance ≤2:				
medicine	35%–71%	30	26%–37%	High
philosophy	80%–93%	106	63%–74%	Over

Table 4. Confidence intervals for proportions of Jewish students from Cracow (1850-1918) that were related to other students of the same sex who enrolled in the same faculty. Females related to females. Various sides and distances tested. N: number of all other students (from any faculty) related to a student of this faculty. Own calculations.

Table 4 contains similar data to discussed Table 3 but related to women (female students). Women could not study law at Jagiellonian University in the discussed period; they could study philosophy since 1897 and medicine since 1899. We can see two interesting things in this table.

First, there is higher dependence in the closest distances. Unlike male students, women were prone to choose the faculty according to the choice of other women from their family circle. Their number is not big enough to make more detailed analysis but it seems that while for boys studying law or medicine was important for their future job (so that even poor boys could try to clench their teeth and do their best to get a degree and started new, prosperous life), for girls studies were rather a case of social status and – as such – it was more closely connected to the status of their families.

Another important result is that for women there is a strong dependence between them and their siblings' side, that is their sisters, their sisters-in-law or mothers-in-law of their brothers and sisters. We can connect it to the result we noticed in male students, where especially students of medicine were often connected to their brothers and their families. In both observed cases (female philosophers and male students of medicine) the high result (over the threshold of confidence) appears in the moment when there is no such effect for the families of their parents.

We can suggest the following interpretation of the presented results, which is compatible with the presented data. The Jewish community of Cracow did not contain inherent differentiation that could result in studying in different disciplines by different social groups. Predilection towards specific disciplines was not something that could be inherited or otherwise acquired from atmosphere in grandparents' house. It was not shared between cousins. But brothers and sisters who attended the same schools and had common friends did influence each other, which also applied to the families of one's

girlfriends and boyfriends; we can also expect that the crucial cause was to have friends who are already studying.

3 Wealth

The next attribute in the network that can be taken into account is wealth. The relationships between economic position of a family and educational chances can be different. There is an obvious assumption that children from affluent families can have better start and receive better support of their families but we should remember that in 19th and early 20th century the social divisions were more visible and among obstacles in receiving university education were such hard ones like hunger, child labour, illiteracy or homelessness.

We don't know the value of property and income of everybody but knowing the structure of the family network we can guess it. Let us assume that the economic position is smoothly spread across families: that cousins or grandchildren of rich (or poor) people are also rich (or poor). We have the list of 571 most wealthy heads of families of Cracow Jews, who paid local tax at least 5 Austrian gulden in 1883[25]. If rich people are related to rich and poor are related to poor, we may suppose that people who have many rich people in their close families are also rich and people who have no such relationships (or a few, or very distant) are poor.

Rate	Number of payers
4	1
5	297
6	1
7	1
8	82
10	72
12	31
15	43
20	23
25	8
30	12

Table 5. Number of taxpayers for every tax rate in the 1883 election list for Cracow Jewish Religious Community

The hypothesis can be formulated as following: (a) the educational success, as measured in the probability of finishing studies as doctor (of philosophy, medicine or law, i.e. PhD, MD or J.D.) depended on (b) how close was a student to

25 "Spis Członków Zboru Izrelickiego w Krakowie."

as many "rich people" as possible. The closeness can be defined in different ways, for instance the following:

$$wealth\ index\ of\ A\ = \sum_{d(A,B)=0}^{5} \frac{t(B)}{2^{d(A,B)}}$$

Formula 2. Wealth index. A is one of our students, B is a person listed in the 1883 voters list, *t(B)* = tax rate paid by B in 1883 and *d(A,B)* = distance from A to B.

The results of our analysis are presented in Table 6.

Faculty	Average wealth index	Total	Dr rate	Av. Wealth Index if Dr	Av. Wealth Index if Dropout
Law	6.50	620	69%	6.95	5.51
Medicine	6.46	328	67%	6.83	5.72
Law or Med.	6.49	948	68%	6.91	5.59
Philosophy	6.56	263	16%	6.58	6.56

Table 6. Average wealth index of Jewish students from Cracow according to faculty they enrolled

There is a strong difference between students of philosophy and students of law or medicine: while only 16% of Jewish students enrolled in the Faculty of Philosophy received PhD title (42 out of 263), in the faculties of law and medicine over two thirds (average: 68) were awarded the title of doctor.

The statistically significance of the results have been checked using Kruskal-Wallis test (kruskal.test in R). The result for all students and for each of the faculties were not statistically significant (p-value > 0.05). However, if law and medicine were to be considered together, the p-value was 0.0478 which is should be enough for claiming statistical significance. The results for law and medicine are very similar: average doctor had wealth index either 6.95 (law) or 6.83 (medicine) and average dropout (person who did not receive title of Dr.) had either 5.51 (law) or 5.72 (medicine); the difference between them being small is also not statistically significant, so we will consider them as one kind of studies; we can call them "vocational studies" because being doctor of medicine or doctor juris provided immediate professional status (in medicine or law); on the other hand, doctor of philosophy (i.e., all other sciences and humanities except for law, medicine and theology) could be a teacher or a clerk but it wasn't so directly related.

Now we can reverse the process: having concluded that there was a visible and statistically significant connection between "wealth index" and "success in vocational studies" we can try to optimize the wealth index to see whether the effect can be strengthened with some changes of algorithm.

First: is it important to consider the actual value of tax rate? Maybe it is enough to count whether some relative was a member of established community (having voting rights) with no differentiation in the actual income? The key values to compare should be: (a) the ratio of "average wealth index if dr" and "average wealth if dropout" and p-value of the Kruskal-Wallis test for the difference. For the above, it was 1.236 and 0.0478. If we assume that everybody paid the same tax rate (t = 1), we receive 1.175 and 0.0429: the difference is smaller but more significant. If only those who paid over 5 gulden (the richer ones) receive t=1, the rate drs/dropouts was 1.20 but the result is not significant (p-value 0.129). If those who paid no more than 5 gulden received t=1 and the richer received t=2, the rate was 1.225 and p-value was 0.0425. If the richer (paying more than 5) received t=5, the rate was 1.223 and p-value 0.0684. Therefore the tax rate should not be ignored.

One can argue that we should not mix cause and result and count the former students as 1883 taxpayers (people whose distance was = 0) because for them the position was the result of being successful student and not a cause for it. If we ignore them, the original ratio is 1.161 bat the p-value is over the threshold: 0.0616. If, instead of Kruskal-Wallis test, we could use one-way ANOVA test (aov in R) the result were significant (p-value is 0.0349) but the author is not sure whether use of ANOVA is justified here. Therefore, we would be happy to ignore the cases of d=0 but it is not easy.

The next aspect that can be tested is the effect of network itself. In the denominator of Formula 2 we have 2^d. What if, instead, we had d or 3^d or 4^d? For 2^d we had ratio of 1.236 and p-value 0.0478. For 3^d we have ratio 1.368 and p-value 0.0290: both much better. For 4^d even better: ratio is 1.494 and p-value is 0.0264. This time the p-value is so small that we can try what happens if we remove cases when d=0: in such case we obtain ratio 1.337 and p-value 0.0398. For doctors of law he have ratio of 1.341 and for medicine: 1.292 but still, for more granular data the distinction is not statistically significant (for law p-value is: 0.0868 and for medicine: 0.239). If, instead, we assume just d in denominator (and $d>0$), the ratio is 1.169 but p-value is 0.0945.

We can summarize this part of discussion with the conclusion that there was a visible and statistically significant relationship between vocational studies (law or medicine) and social standing of family: Jewish students from "better" families were more likely to obtain title of Doctor of Medicine or Doctor of Law. Another important conclusion is that this relationship is best visible when we assume that the influence of other member of family is reversely proportional to powers of 4, that is a member of family removed by n links had

influence four times stronger than a member removed by *n*+1 links (his parent, child, spouse or a sibling).

4 Jews from Cracow, other Jews and Christians

We can compare Jews from Cracow with non-Jews (i.e., Christians) and Jews from outside Cracow. We have data for 31% of Christian students from this time (5,642 of 17,938 - those whose surname starts with S-Z)[26]. Out of the 5,642, 5,520 enrolled in faculties of philosophy, law, medicine or theology and either got their doctoral diploma in the same faculty or did not get it at all (see Tables 7 and 8).

Faculty	Jews (Cracow, networked)			Other Jews			Christians (S-Z)		
	All	Dr	%	Drop-out	Dr	%	All	Dr	%
Law	606	437	72%	1223	634	52%	2231	557	25%
Medicine	337	219	65%	838	313	37%	916	475	52%
Philosophy	248	28	11%	536	35	7%	2045	167	8%
Theology	0	0	0%	0	0	0%	328	10	3%

Table 7. Percentage of those who successfully finished studies (Drs) according to faculty, religion and origin

The data from Table 7 can be presented in the form of confidentiality intervals (calculated with discussed Formula 1). The results are in the Table 8.

Faculty	Jews (Cracow, networked)	Other Jews	Christians (S-Z)
Law	68.5% – 75.7%	49.0% – 54.6%	23.2% – 26.8%
Medicine	59.9% – 70.1%	34.1% – 40.6%	48.6% – 55.1%
Philosophy	7.4% – 15.2%	4.4% – 8.6%	7.0% – 9.4%
Theology	0.0% – 0.0%	0.0% – 0.0%	1.2% – 4.9%

Table 8. Percentage of those who successfully finished studies (Drs) according to faculty, religion and origin, confidentiality intervals

In the fields of medicine and law there are big, important differences: "The big Jewish family of Cracow" is doing much better than other Jews and Christians. Other Jews are still better than Christians in law but worse than Christians in medicine (this was probably connected to the fact that studying medicine and

26 In the volumes of the "Corpus Studiosorum" covering letters A-R (21,253 entries) we have analysed only Jewish students (2996) and in the volumes S-Z (7,620 entries) all students (Jewish and Christian) have been analysed.

not becoming "Dr." was useless – which was not the case for law or philosophy; that was why even Christians did they best to complete their studies and receive title of MD; in this case they even outperformed Jews from outside Cracow).

5 Geographic networks

It was also interesting to analyse networking aspects related to geographic neighbourhoods. What made people study?

From all birth records since 1891 to 1895 we know that 4,555 children were born in Jewish Cracow in this period, out of whom 228 started to study in Jagiellonian University before 1918. The exact address of birth (street and house number) was recorded for almost everybody and it was possible to collect the detailed location. We are able to propagate the location through the whole network and connect everybody with the district closest in their family network if it was unique. If there were two concurrent possibilities, we left it blank.

The outcome showed that there was no visible difference, families were mixed. We can also compare the rate: doctors vs. dropouts for every district, but the result is very similar, about 55-56%. The only difference was for the people who had two or more simultaneous possibilities – they had rate of 61% which suggests that it was not place but change of place (mobility) that mattered, but the difference was not statistically significant (χ^2=0.12). It is likely that further analysis of mobility of Jewish families (especially moving from the old Jewish District in the direction of the city centre) will provide results that will be statistically significant but it is too early now.

6 Final remarks

In recent times we can see growing interest among scholars who are studying processes of status attainment, educational opportunities and new class formation worldwide. This can be seen in sociologists studying disadvantaged groups like African-Americans or destitute immigrants in the United States or class formation in countries of the former Soviet Bloc in Europe. Such research can be based on contemporary data, acquired from living subjects through direct questionnaires and from national and international statistical bureaus. Such research is fascinating because it helps in understanding contemporary societies and establish and test theories that help in understanding them.

One cannot be an expert on everything, however. The author of the present article grew in quite another intellectual framework: the paradigm of history of East European intelligentsia where enrolment to university was considered not a step in one's professional career but rather a door to some kind of hereditary nobility. One of the most famous students of the Jagiellonian University of the

analysed time, Tadeusz "Boy" Żeleński (enrolled 1894 in the faculty of medicine, doctor of medicine 1900), famous poet, essayist and translator of French literature, promotor of emancipation of women and man who had a great impact on self-consciousness of Polish intelligentsia, published an essay in 1932 under the title "Bourgeois nobility" comparing high school finishing examination ("matura", finishing high school and opening door to university) as contemporary form of ennoblement.[27] The history of Polish intelligentsia has been summarized in detail by the already quoted *Dzieje inteligencji Polskiej*.[28] The pre-1918 Eastern European societies still retained much of medieval feudal structure and had features different from the societies commonly analysed by contemporary sociologists.

The Jews in Cracow cannot be subject to contemporary analysis because virtually all of them have been killed by the German invaders between 1939 and 1942. But when they were still thriving and nothing suggested their extinction, they were subjects to process of acculturation: virtually all educated Jews in Cracow (using the title "Dr" attached to their surname) in the 1921 census declared Polish nationality and Polish as their main spoken language. [29] They were not "Jews", they were rather "Poles of Mosaic faith", unlike their non-educated cousins, who spoke Yiddish at home.

The data about educated Jews in Cracow can be therefore used as a bridge allowing cross-disciplinary research between the classic notion of university education as "bourgeois nobility" and present sociological analysis of status attainment in minority groups. The author is not able to do this on his own but it seems that shared work, using the already collected or easily available data can be of great interest to scholars in all these areas: general sociological analysis (of education, status attainment or social networks), history of Eastern European intelligentsia and history of the Ashkenazi Jews and their culture.

7 Conclusions

The analysis of family network of Jewish Community of Cracow in 19th and early 20th century is far from being complete. It already reveals some interesting and statistically significant results, however.

Not all students of Jagiellonian University were born equal: those born in Jewish families in Cracow, closely related to rich citizens of the Jewish City, had better opportunity to be granted Doctor of Law or Doctor of Medicine

27 Tadeusz Żeleński, "Burżuazyjne Szlachectwo," Wiadomości Literackie 9, no. 33 (450) (August 7, 1932).

28 Jedlicki, Janowski, and Micińska, Dzieje Inteligencji Polskiej Do Roku 1918.

29 "Spis Ludności Miasta Krakowa z r. 1921."

than those who were Christians or were Jewish but from outside Cracow or were Jewish and from Cracow but had less strong connection to local Jewish elite.

The best matching formula for calculating the influence of relatives (formula that provides strongest and most significant results) we found in this community was following: in the network where every link between A and B means "A is a child, parent, spouse or sibling of B", extending a path by one link makes influence of the distant end about four times weaker.

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