THE 1920s VIENNESE INTELLECTUAL COMMUNITY AS A CENTRE FOR IDEAS EXCHANGE: A NETWORK ANALYSIS

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I

The history of economic thought is often focused on eminent individuals and published works, with less attention paid to the social elements that affect knowledge creation and innovation diffusion, and the contribution of lesser known intellectuals to an academic community. These elements have been addressed in this article, in which a social network, based on informal seminar attendance, is constructed for intellectuals living and working in Vienna in the 1920s. This period is considered one in which intellectual life, and the Austrian School of economics in particular, experienced "one of its last flowerings" (Mises 2009, 81). In addition to economics, breakthroughs were also experienced in philosophy, mathematics, psychology, law and history, with the members of this community holding a wide-range of interests and abilities. An analysis of the economics profession in Vienna in the 1920s is essentially one of interconnections – between individuals, different fields of study and between the University and public life. By analysing these interconnections in a visual way, this methodology provides a re-telling of the history of a well-known and intellectually significant group of economists, as well as providing new insights into the dynamics of this community as a centre for ideas exchange.

[1] This paper uses *UCINET* and *NetDraw* by Analytic Technologies, as well as texts, memoirs and interviews made freely available by the Ludwig von Mises Institute in Auburn, AL. I would like to thank Cassey Lee for the original idea, and Claire Seaman for discussions and feedback. Thanks to Simon Ville for encouraging me to explore and for helping me hold my nerve. I would also like to acknowledge the comments of two anonymous referees, and the editor. Their suggestions have made substantial improvements to the content and form of this article.

Few will dispute the significant contribution that the Austrian School has made to economics. Carl Menger's *Grundsätze* (1871) is generally accepted as the starting point of the 'Austrian' approach, and his legacy continued to the young Viennese economists in the interwar period and beyond. Though each practitioner of the approach had small variations, Fritz Machlup (2004) has argued that the fundamental tenets of the approach include assumptions of methodological individualism, political liberalism, and consumer sovereignty. Proponents of the Austrian school also generally examine subjective determinations of value, opportunity cost, marginal analysis and time preference in production and consumption. Machlup argues that the group tended to reject mathematical techniques, arguing that mathematics was unable to capture complexities of individual economic action. However, within the wider Austrian academic community there was a wide range of topics, methodologies and political ideologies, with economics frequently engaged with other fields of science and the humanities (Craver 1986a; Leonard 2011, 85). Later in their careers many of these individuals made significant interdisciplinary contributions to knowledge. Friedrich Hayek contributed to psychology and ethics, Ludwig von Mises to sociology and politics, and Oskar Morgenstern to mathematics.

Intellectual life in Vienna, and the economics community in particular has been described previously in a number of important articles (Craver 1986a; Klausinger 2006a; Leonard 2011), as well as through the lens of individualistic studies (Becchio 2008; Kurrild-Klitgaard 2003; Leonard 1998; Salerno 1999; Salerno 2002). The concept of intellectual communities is gaining some traction within the history of economics more generally, with work done on the classical economists (O'Brien 1975; O'Brien 2004), the economists at RAND (Mirowski 2001), the institutionalist movement (Rutherford 2011) and the Cambridge

community (Marcuzzo, et al. 2008). *History of Political Economy* recently devoting an issue to such studies, with pieces analysing various schools and movements (Spring 2011). While these more recent texts analyse the effect of social relationships, physical proximity and institutional arrangements on a community, these components have not been visualised – indeed this work has been undertaken without the use of social network analysis. Social network analysis is a technique used in sociology to describe the pattern of relationships between individuals, texts or any other set of related entities. It has been used here to visualise the Viennese intellectual community based on the individuals' attendance at a number of different informal seminars between 1918 and 1930, providing a cross-section of the overall connections in this period. Social network analysis provides detailed frameworks for analysing how social interactions affect the intellectual character of a community. First, the network maps provide an alternative, visual perspective, highlighting the interrelationships between individuals, seminars, and different fields of study in this period. Second, the application of network theory offers an explanation for how ideas in this community may have been affected by the social interactions that are visualised with the network maps. By linking the social structure to differences in ideas between individuals and groups, social network analysis complements the qualitative techniques that are traditionally used to analyse communities in the history of economic thought. Though this paper visualises only one type of relationship, there is a consensus that Viennese academic life in the 1920s was abnormally concentrated on these informal seminars (Craver 1986a; Klausinger 2006b; Leonard 2011). By visualising the most prominent professional interactions the methodology provides a good starting point for examining the Viennese intellectual community in the 1920s.

II – A BRIEF BACKGROUND

Though the Faculty of Philosophy and the Law School at the University of Vienna were considered first-rate in the 1920s (Menger, Golland, McGuinness & Sklar 1994), the economics group at the University did not attract the bulk of the successful Austrian economists of this period. There is no real agreement as to the reason, though some possible explanations include anti-Semitism (Blau 1964), ideological discrimination against liberal economists (Blau 1964; Hayek 1983; Mises 2009), the youth of the Austrian School compared to the well-reputed German Historical School (Louzek 2011), structural factors from the First World War constraining the opportunities for young researchers (Samuelson 1954, 77 – 80), and the appointment of individuals to chairs ruling out further appointments before 1950 (Blau 1964). Proponents of the Austrian School, therefore, found it difficult to obtain full-time employment at the University of Vienna, leading many to seek positions in the private sector or the public service. Positions as *Privatdozents* were generally the extent of their access to the University[2]. As the University declined in importance for the members of this community, it was rational on the part of the individuals to establish alternative institutions for intellectual activities. Academic pursuits moved away from formal institutions to various informal, after-hours discussion groups and seminars. Craver (1986a, 13) argues that "Vienna continued to function as a marketplace of ideas largely because it had a network of other institutions that kept its traditions alive". Compounded by the close geographic proximity, a lack of anonymity and a high engagement with politics and culture, academic pursuits in Vienna in the 1920s were extremely "social" (Leonard 2011, 85; see also Hayek 2002, 31- 32).

[2] A Privatdozent refers to an academic who has obtained a higher doctoral degree (this is usually a *Habilitation*) that qualifies them to teach at a University. In Vienna in the 1920s, Privatdozents were not paid a salary by the University, though they were entitled to collect fees from students (Blau 1964; Mises 2009).

The prevalence of informal seminars helped to create a unique dynamic in which intellectual interests were not constrained by discipline. Indeed, seminars often covered a range of topics, individuals could be members of a number of different seminars concurrently, and educated businesspeople, journalists and lawyers often participated. Meetings were held in coffeehouses, at the University, in government offices, or at member's homes. Eight major discussion seminars were established in the community between 1918 and 1928. These were the *Nationalökonomische Gesellschaft* (hereafter *NOeG*; also known as Austrian Economic Association or the Austrian Economics Society. Operational from 1918 – 1920, and then 1927 onwards), Hans Mayer's seminar (1924 - 1930), Mises' *Privatseminar* (1920 onwards), Hayek and Herbert Fürth's *Geist Kreis* (1921 onwards), the Vienna Circle (1924 onwards), the Schlick Circle (1924 - 1926), the Austrian Institute for Business Cycle Research (hereafter the Institute; 1927 onwards) and Karl Menger's Mathematical Colloquium (1928 onwards). In the early period, from 1918 – 1923, there were only 3 seminars operational – the *NOeG*, Mises' *Privatseminar* and the *Geist Kreis*. The 1924 – 1930 period was the more prominent, with most seminars operating concurrently during these years[3]. The presence of various intellectuals at these seminars between 1918 and 1930 is the basis of the social network analysis that follows.

III - METHODOLOGY

Social network analysis is a collection of visual and numerical graphs that describe the pattern of relationships among individuals, texts or any set of related entities. It has many applications to contemporary and historical issues, and primarily investigates social structures and the effect of social relationships. In each network map, a participant, referred to as an *actor*, is represented as a *node* in the network. Relationships between actors are shown as

[3] See appendix A for details.

lines, referred to as *ties*, between nodes. Values can be assigned to these relationships, with a thicker tie indicating a proportionally stronger relationship between two actors.

I draw upon Feld's theory of focused ties, which posits that individuals who share a focus (such as a neighbourhood, place of employment or contextual activity) are more likely to share joint activities than individuals who do not share a focus (Feld 1981). As a consequence of interactions associated with these joint activities, individuals who share the same focus will tend to become socially tied and form a cluster. If there is a positive sentiment from this interactions, individuals will then try to find and develop new foci around which to organise activities, beginning the cycle again. This phenomena is also observed in reverse. If there is a social tie between two or more people, they will tend to find and develop new foci around which to organise their activities. The more intense their relationship, the more likely they are to incorporate their different interactions by finding foci around which to bring everyone together. Feld notes that restrictions on time, effort and emotions among members, as well as the number of actors involved in the focus affects the development of the community (Feld 1981). This approach is basically a contextual one – in which entities such as social groups, locations, institutions or workplaces structure interactions in a community. The common location, time period and the prominence of informal seminars in the 1920s Viennese community means that a contextual approach is appropriate.

Network maps describe the probability of a relationship between pairs of people based on their common attendance at one or more informal seminars in Vienna between 1918 and 1930. The strength of ties between individuals depends on their involvement in the seminar and the number of years that both individuals were in Vienna while a particular seminar was operational. Mark Granovetter's view that the strength of a tie is a "combination of the

amount of time, the emotional intensity, the intimacy…and the reciprocal services which characterize the tie" informs the argument (Granovetter 1973, 1361). Details for the duration of each seminar and the individuals in attendance has been compiled from both primary and secondary sources, and these details are a synthesis of current knowledge rather than any fundamentally new information. Attendance scores are assigned based on the description of each member, with members classified as either primary (receiving a score of 4), regular (receiving a score of 2) or sporadic (receiving a score of 1). These classifications are used to show variations in the strength of different relationships in the network, with the geometric scale assuming that a primary member would have twice the influence on the group as a regular member, and a regular member would have twice the influence on the group as a sporadic member. Occasionally, sources differ in terms of their record of attendees, or in the intensity of involvement of certain individuals[4]. Differences may be due to the incomplete or inaccurate memory, bias, or considerations of brevity and clarity. Details for what is included in each source, as well as any membership disputes are given in table A1, appendix A.

Details of each individual's presence in Vienna is largely based on available biographical information, with the primary and secondary material used above incorporated where relevant. Official records of paper presentations and discussants have been used where possible to improve the precision of the analysis, though the informality of seminars means that there is inconsistency in the volume and availability of official records. Any absences from Vienna are accounted for, and interaction scores with other members are adjusted accordingly. The methodology has been adjusted for the particular circumstances of Vienna in the 1920s, accounting for each member's level of involvement in each seminar, his or her

[4] A good example of this is the Vienna Circle's manifesto (Hahn, Neurath & Carnap 1929), which lists Menger as a member, though Menger himself argued that he later wanted to be known as only 'sympathetic' to the group (Menger 1982; Uebel 2012).

presence in Vienna, and the seminar's years of operation. It is a methodology that can be applied consistently to each seminar, and describes the probability of interactions between individuals in this community as accurately as currently possible. Though the best attempt has been made to adjust this data for each specific case, there is no guarantee that individuals were at every meeting of a seminar during their time in Vienna, or that they interacted with every other member in a seminar.

Network maps have been constructed via a matrix, with individuals or groups listed on both the horizontal and vertical axis. The number at the junction of two actors in the matrix describes the presence and strength of that relationship. For the social network analysis that follows, this matrix has been coded manually, considering the level and duration of each individual's involvement in the community. The year 1930 has been chosen as a reference point. This is because 1930 was before the emigration of most of the individuals from Vienna. Secondly, with the exception of the Schlick Circle (which only ran between 1924 and 1926), 1930 was the year in which all seminars had been established and were operational. Finally, the period from 1930 onwards had a distinctive character and involved different individuals, and as such warrants its own analysis. By considering 1930 as the reference point, the duration of each member's involvement in the community up to 1930 can be calculated[5]. The interaction between actor A and actor B in one seminar is equal to:

> (actor A's level of involvement) x (actor B's level of involvement) x (the number of years they were both present in Vienna while that particular seminar was operational).

[5] For details of seminar duration, see table A2, appendix A. For the duration of each individual's presence in Vienna, see table B2, appendix B.

If two members attended more than one seminar together, the principle is the same, with the interaction value for each seminar simply added together. For example, Engel-Janosi and Fröhlich both attended Mises' *Privatseminar* and the *Geist Kreis*. They were both present in Vienna for 5 years during the operation of each seminar. So their interaction is calculated as:

Privatseminar: (2 x 2 x 5)

+ *Geist Kreis*: (2 x 2 x 5)

Engel-Janosi-Fröhlich interaction = 40

These simple interaction scores have been calculated for each pair of individuals. The completed matrix is then analysed using *UCINET* and visualised with its built-in graphing module *NetDraw*.

Netdraw has been used to visualise the Viennese intellectual community. In the figure, names have been replaced by identifier codes, which includes an alphabetically-assigned number, and a letter denoting the disciplinary group to which the individual primarily belonged. Those who participated mostly in the economics seminars are identified by 'E', those who participated in philosophy seminars by 'P', and those who were members of the mathematics seminar are identified by 'M'. A list of the individuals included in this network, the corresponding identifier codes, and the seminars in which they participated can be found in table B1, appendix B. Though this community included individuals from a large number of disciplinary allegiances – indeed many had multiple intellectual interests simultaneously – these identifier codes are intended to de-clutter the network map, and to assist in the analysis of various visual trends for Viennese informal seminar attendance.

Netdraw's in-built spring embedding function has been used to place nodes with more shared ties closer together, and move those with fewer shared ties away. This means that individuals who had stronger relationships or had a number of connections in common are placed together in a cluster. These clusters indicate groups of individuals who held membership of the same key seminars. Individuals who had connections across a number of seminars are placed in between or outside of clusters. This indicates the variety of information or ideas that these individuals would have been exposed to through their connections in the network, as well as their role in bridging otherwise disconnected groups. The spatial placement of individuals based on their interactions presents a large amount of information about this community in a tangible, visual way. Furthermore, the use of network maps for this community makes it possible to apply network theory to the group, with the structure of social interactions used to explain the intellectual character of this community.

UCINET is also able to compute a series of simple metrics for each network, which are used here to show the relative importance of each individual based on their position in the network compared to others. *Degree* simply describes the number of connections a node has, with a higher *Degree* score implying that the actor has the opportunity to influence more people, as well as being less dependent on any one person for information or contacts (Hanneman & Riddle 2005). *Two-step degree* is based on the same principle, measuring the number of connection that a node has within two 'steps' (within two ties), of themselves. This captures the effect of indirect ties, and can compare those that may be highly connected in a dense cluster with those that have greater reach. *Betweenness centrality*, formally developed by Linton Freeman, measures prominence in a network based on "the frequency with which a point falls between pairs of other points on the shortest or geodesic paths connecting them" (Freeman 1979, 221). This is calculated as a percentage of shortest paths in

the network that pass through the actor, indicating the extent to which that actor forms a bridge between groups. It assumes that ideas and contacts diffuse in a network through these shortest paths, and that an actor with a high *betweenness* is prominent through both their role as an intermediary, as well as the source of ideas and contacts from different groups (Hanneman & Riddle 2005).

When discussing these network maps, it is helpful to keep in mind that the analysis considers only interactions at informal seminars in Vienna. The relationships that individuals had with each other were diverse, and may have included co-authorship, citations, familial ties, common places of work, or teacher-student relationships. Still, it is widely agreed that informal seminars made up the majority of academic activity in Vienna in the 1920s (Craver 1986a; Klausinger 2006b; Leonard 2011). By visualising the most prominent professional relationship for this community, this network provides a good overview, and a good starting point for the analysis. Additionally, though this social network analysis accounts for temporal differences by adjusting interaction scores for the number of years each seminar ran, and the years each individual was present in Vienna, it collapses the 1918 – 1930 period into a single unit of analysis. This disregards the temporal dynamics within the 1920s, and makes no distinction between interactions that may have been separated by a decade or more. Finally, any use of social network analysis requires relationships between individuals to be reduced to a number. As human interactions can rarely be sufficiently rationalised in this way, network maps may provide an overly simplistic interpretation of this community. Social network analysis is intended, therefore, only to augment the existing literature and to provide an alternative perspective to the traditional qualitative methods used by historians of economics and applied to the interwar Austrian community.

IV – ECONOMISTS, PHILOSOPHERS AND MATHEMATICIANS

Economists

Viennese economists in the interwar period had an unofficial leader in Mises. He was a prolific writer, a *Privatdozent* at the University and helped a number of the interwar graduates obtain positions in the public service. Although Mises held no formal university position, having "made no further advances in [his] academic career in Austria" beyond his teaching role, he established his informal discussion group, the *Privatseminar* in early 1920, running meetings out of his offices at the Vienna Chamber of Commerce, where he and a number of other members were employed (Craver 1986a, 13 – 16; Leonard 2011, 84). Membership was by invitation only, and the seminar was affiliated with neither the Chamber of Commerce nor the University. The agenda of the *Privatseminar* naturally included economics, as well as philosophy, epistemology, sociology, logic and various aspects of historical research (Mises 2009, 81). Table 1 shows that Mises' seminar not only attracted the greatest number of participants, but had an impressive range. Alongside economists such as Steffy Braun and Hayek was the legal philosopher Felix Kaufmann, the political scientist Eric Vögelin and the social scientist Alfred Schütz. Mises has argued that the group was strongly multidisciplinary, engaging with a number of different fields and united by a "burning interest" in the fields of science and human action (Mises 2009, 81). With a maximum of 20 participants at any one time (and usually about 12 members at any one meeting), Mises comments that each member was "seeking no reward other than the recognition – not the applause – of friends" (Mises 2009, 82).

Table 1: Informal seminar attendance lists

	Primary members	*Regular members*		*Sporadic members*
NOeG	Mayer Mises	Bloch Braun Fürth Graetz Haberler Hayek Kaufmann Lieser-Berger Machlup Mahr Menger	Mintz-Schüller Morgenstern Reisch Rosenstein-Rodan Schams Schlesinger Schüller Strakosch von Feldringen Strigl	
Mayer Circle	Mayer	Bayer Haberler Hayek Mahr Morgenstern Reisch Rosentstein-Rodan Schams Schönfeld-Illy Schüller		
Mises' Privatseminar	Mises	Bettelheim-Gabillon Bloch Braun Engel-Janosi Fröhlich Fürth Haberler Hayek Herzfeld Kaufmann Klein Lieser-Berger Löbl Lovasy Machlup	Mintz-Schüller Morgenstern Offenheimer-Spiro Redlich-Redley Rosenstein-Rodan Schams E Schiff Schlesinger Schreier Schütz Stonier Strigl Tintner Vögelin Waelder Winternitz	
Geist Kreis	Hayek Fürth	Benesch Engel-Janosi Fröhlich Glück Haberler Kaufmann Machlup Menger Mintz Morgenstern G Schiff Schütz		

		Vögelin Waelder Wilde Winternitz	
Vienna Circle	Hahn Schlick	Bergmann Carnap Feigl Frank Gödel Hahn-Neurath Natkin Neurath Radakovic Taussky-Todd Waismann	Brunswik Gomperz Hollischer Juhos Kaufmann Kraft Menger Morgenstern Neider Neumann Rand Rauscher Reidemester Schachter Zilser
Schlick Circle	Schlick	Carnap Gödel Hahn Kaufmann Neurath	
The Institute	Hayek Morgenstern	Gerschenkron Haberler Mises E Schiff Tintner Wald	
Mathematical Colloquium	Menger	Alt Beer Bergmann Carnap Gödel Hornich Nobeling Schams Schlesinger Schreier Taussky-Todd Tintner Wald	Morgenstern

Note: See Table A1 for source details.

Hayek's *Geist Kreis* was established in the following year, and had similar core members to the *Privatseminar*[6]. Hayek has recalled that the *Geist Kreis* began as a discussion between himself and former classmate Fürth, later including common acquaintances. Hayek and Fürth never aimed for the *Geist Kreis* to become an economics circle, instead encouraging broad interests within discussions. Hayek has recalled that of the papers presented in the group, "there were very few on economics" (Hayek 1983, 36). Feeling that economics was sufficiently represented by himself, Machlup and Gottfried Haberler, Hayek and Fürth broadened the horizons of the seminar by including members representing law, political science, sociology and mathematics[7]. Both the *Geist Kreis* and Mises' *Privatseminar* are a good examples of the multidisciplinary interests of the individuals in this community, and the engagement of economics with a number of other fields.

Mayer was one of the few Austrian School economists who was appointed to a position at the University. Though Mayer was handpicked by Friedrich von Wieser as his successor, he failed to live up to his early potential, leaving "articles unpublished and papers un-edited" (Craver 1986b, 8). Mayer's Circle is not well-defined, though after his return to Vienna in 1923 he began an informal, private seminar (Klausinger 2015a, 281). Younger pupils and assistants such as Hayek, Haberler and Morgenstern were in attendance, and the seminar was strongly linked to the to *Zeitschrift für Nationalökonomie*, one of the most important German-language economics journals, of which Mayer was editor (Klausinger 2015a; Craver 1986a).

[6] See Hayek's recollection (Hayek 1983, 39), which is of course reiterated by attendance lists in table 1 above.
[7] See Hayek (1983, 34). Similar points are made in the secondary literature (Craver 1986a, 16; Leonard 2011, 86). Engel-Janosi's reproduction of *Geist Kreis* presentations shows a wide range of topics and presenters (Engel-Janosi 1974, 125 – 128).

Though Mayer is credited with good insights into incorporating time into economic analysis, he has been remembered as fairly neurotic, disorganised, and as the 1920s went on, largely inactive (see Hayek 1983, 15; Morgenstern's recollection in Leonard 2011, 90; Rosenstein-Rodan interview 1978, in Craver 1986a, 13). He has also been remembered as a coffeehouse man, with Hayek and Morgenstern both recalling discussions at the Café Künstler (Hayek 1983, 38; Morgenstern's recollection in Leonard 2011, 90). Logistically, his seminar was "[held] at a time that was inconvenient to most of us who were already in a job" (Hayek 1983, 38). Mayer's Circle has the strongest relationship is with the *NOeG*, with table 1 listing eight individuals in common (an unsurprising result considering Mayer's primary role in both). Beyond this, however, the links between Mayer's Circle and the other economics seminars are comparatively limited. Because the seminar itself was held within the University, it can be thought of as outside the usual model of intellectual activity in this period. However, his wider circle including pupils, members of the *Zeitschrift* and those he assisted with their academic careers is much closer to the trend of informal seminars of Vienna in the 1920s.

The *Nationalökonomische Gesellschaft (NOeG*), although it had links to earlier, pre-WWI iterations, was founded in 1918. Meetings ran until 1920, after which there is no evidence of activity until the society's revival in 1927 (Klausinger 2015b). This revival was through a joint effort by Mayer (as president) and Mises (as vice president), to the exclusion of Othmar Spann, one of the other economics professors at the University[8]. This seminar was more formal than others in the period: presentations normally involved completed papers and assumed a high level of technical knowledge (Craver 1986a, 18). Hayek presented work on

[8] Spann was, by all reports, a difficult character, and one who clashed with Mayer (see Rosenstein-Rodan interview 1978, in Craver 1986a, 13; Schulak & Unterkofler 2010) and with Mises (Mises 2009, 78).

rent control; Rosenstein-Rodan, on the time element in economics; and, in one of the earliest meetings after the 1927 revival, Menger on the Petersburg Paradox (Becchio 2008; Craver 1986a, 18). The eminence of many of the attendees as well as its link with the *Zeitschrift* meant the society was an important focus for the economists in this period, though its characteristics meant it did not really fit the same model as the other, informal seminars.

The Austrian Institute for Business Cycle Research (the Institute) was established by Hayek (with Mises acting as a benefactor) in 1927 (Klausinger 2006a, 27; Klausinger 2006b, 621; Craver 1986a, 19). The Institute conducted applied and theoretical economic research, producing a monthly bulletin of economic conditions and conducting detailed investigations into special issues (amongst which was Hayek's *Geldtheorie und Konjunkturtheorie* in 1929). Morgenstern joined the Institute in 1928, taking over as director after Hayek's departure to the London School of Economics in 1931 (Leonard 2010, 148; Klausinger 2006a, 27). While the Institute was a formal centre for research, the small staff size (in 1930, five members and two research workers) and its separation from both the University and the government meant that it displayed similar dynamics to informal seminars of the period. Beyond Hayek, Mises and Morgenstern, the Institute engaged a number of the key individuals in this community, with table 1 showing an overlap in members with Hayek's *Geist Kreis*, the *Privatseminar* and the *NOeG*.

Philosophers

The philosophic community in 1920s Vienna is considered one of the first movements of 'logical positivism', a doctrine that was characterised by the application of logical analysis to empirical material. Those phenomena that the Viennese philosophers considered part of legitimate scientific effort were those that could be precisely defined and were statable by a

"step-wise reduction to other concepts" (Hahn, Neurath & Carnap 1929, 8). Knowledge about these phenomena could then be gained only though positivist, empirical evidence. Logical positivism was fairly incongruent with the subjective analysis that characterized the economics clique, which created some disagreement between the more extreme individuals in each discipline (Hayek 1983, 17; Mises 2009, 107). However, a number of participants were present in seminars across both groups, and adopted a more blended approach.

The Vienna Circle (*Wiener Kreis*) was established in 1924 and was spearheaded by Moritz Schlick, a man with an "exaggerated politeness" and "extreme modesty", and Hans Hahn, a "strong, extroverted, highly articulate person who always spoke with a loud voice" (Menger, Golland, McGuinness & Sklar 1994, 57). Other members of the Circle generally had a background in scientific research, though they too were multidisciplinary, with interests spanning music, dramatic art and literature. Initially established as the Ernst Mach Society, it is hardly surprising that Mach's work was of primary concern (Stadler 2001, xv – xxi). Ludwig Wittgenstein's *Tractatus Logico-Philosophicus* (1922) was also very important (Neurath 1973, 306). While table 1 shows that Wittgenstein was not actually a participant of any of the seminars in this community, and therefore outside the realm of the network analysis, Oberdan (2013) argues that Wittgenstein remained influential through Rudolf Carnap's reading of the *Tractatus*. Carnap first introduced Wittgenstein's work to the Schlick Circle (*Schlick Zirkel*). In the years 1924 - 1926, Schlick, along with a number of other collaborators and members of the Vienna Circle, studied philosophers such as Gottlob Frege and Bertrand Russell. Following Carnap's introduction of *Tractatus*, Schlick became committed to meeting Wittgenstein in person. Finally, from 1927, Schlick and Wittgenstein (often accompanied by Schlick's student Friedrich Waismann) visited each other when time permitted, travelled together, and discussed a range of philosophical topics (Oberdan 2013;

Stadler 2001, 219 - 229). It was through these discussions and the subsequent propagation of his ideas through the Vienna Circle and the Schlick Circle that Wittgenstein had an impact on this community.

Otto Neurath initially introduced economic theory to the Circle, as he had spent some time studying under Böhm-Bawerk as an undergraduate (Becchio 2008). In the Vienna Circle's manifesto, economics is cited as one of the five sciences towards which the Circle directed its new empiricism (Hahn, et al. 1929, 4). By using constant objects to rationalise any scientific question, economics would be purged of its subjective elements (Becchio 2008, 68). Hayek has since recalled that the economists were aware of the philosopher's plan for economics, primarily due to "one man who was supposedly a member of [the *Geist Kreis*], and also the Schlick Circle, the Vienna Circle proper" (Hayek 1983, 17). The network analysis here can be used to identify this un-named individual, with table 1 indicating that it's likely that Hayek was referring to Kaufmann. Kaufmann is the only individual who was a member of the Vienna Circle, the Schlick Circle and the *Geist Kreis* (as well as, of course, the *NOeG* and the *Privatseminar*). Craver supports this identification, noting that Kaufmann often "excitedly briefed fellow members of the circles to which he bore stronger ties about developments in the Wienerkreis [Vienna Circle]" (Craver 2012, 162). Looking more broadly, to those who held seminar membership in both economics and philosophy, Menger was a member of the Vienna Circle, the *Geist Kreis* and the *NOeG*, and Morgenstern was a member of the Vienna Circle, the *Privatseminar*, the *NOeG* and the *Geist Kreis*[9].

Figure 1 visualises seminar attendance in this community. *Netdraw*'s spring embedding function has placed those who had a number of common connections together in clusters.

[9] See table B1, appendix B.

This shows that social connections between individuals in this community were broadly clustered by discipline. Those involved in economics seminars (denoted by 'E') fell into three main groups: members of the *Privatseminar* form the primary cluster; those who were only members of the *NOeG* and the Mayer Circle form the secondary cluster, and those who were only members of the *Geist Kreis* form the tertiary cluster. The economics cluster is the most dense area in figure 1, which reflects the longevity of the seminars (the *Privatseminar* and the *Geist Kreis* were operational for 11 and 10 years respectively), the greater number of seminars, and the tendency of individuals to attend a number of economics seminars concurrently. Those who were involved in philosophy seminars (denoted by 'P') form a singular, distinctive cluster in figure 1, which has fewer strong ties than the economics cluster due to fewer members and fewer seminars. Those who participated in the Mathematical Colloquium (denoted by 'M') are located in the intermediary region between the economists and the philosophers.

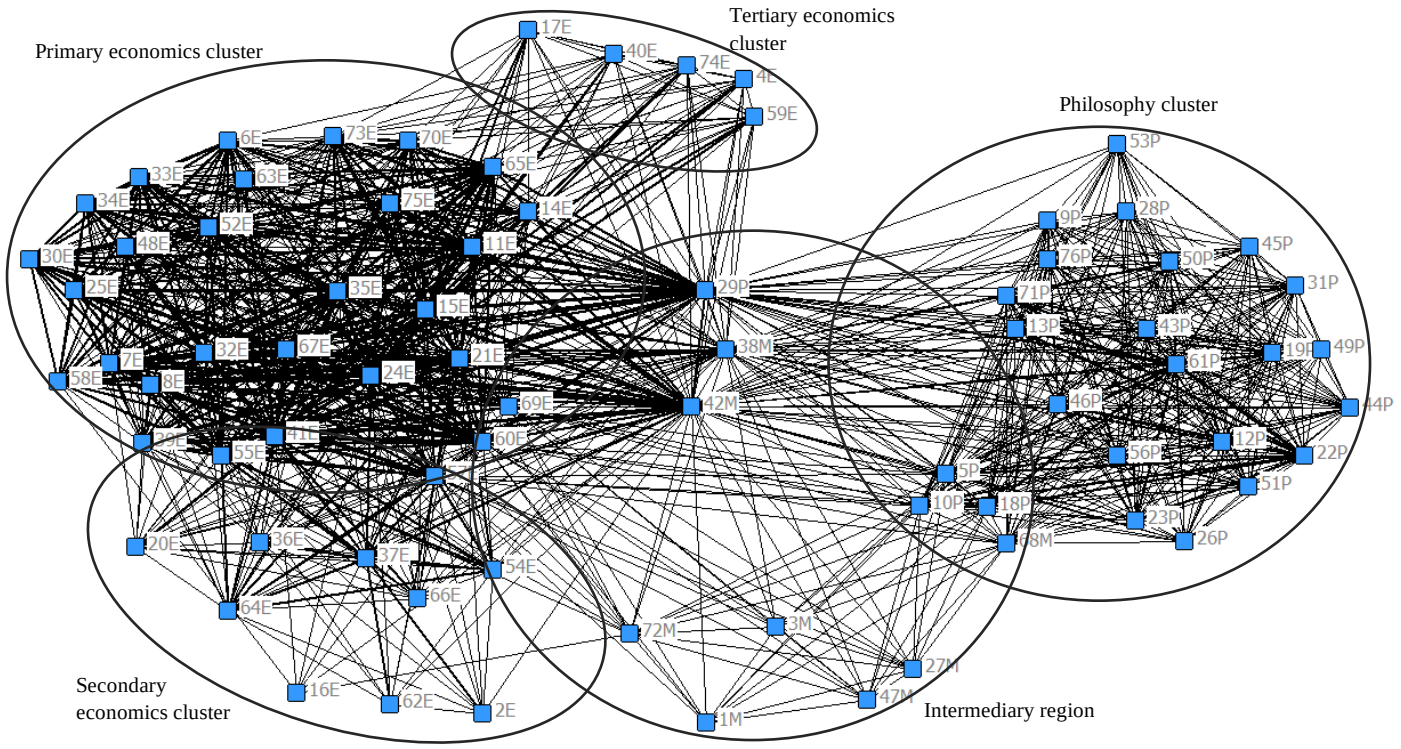

Figure 1: The Viennese intellectual community, 1918 – 1930.
Note: Based on weighted attendance at 8 possible seminars in Vienna between 1918 and 1930. Ties between individuals indicate that they both attended at least one seminar and were present in Vienna for at least one year while that seminar held meetings. Thicker lines indicate stronger relationships through a larger number of common seminars, a greater level of involvement in seminars, or a longer duration of interaction. Actors in the network have been located based on Netdraw's spring embedding function, which places those with more shared ties closer together, and moves those with fewer shared ties away.

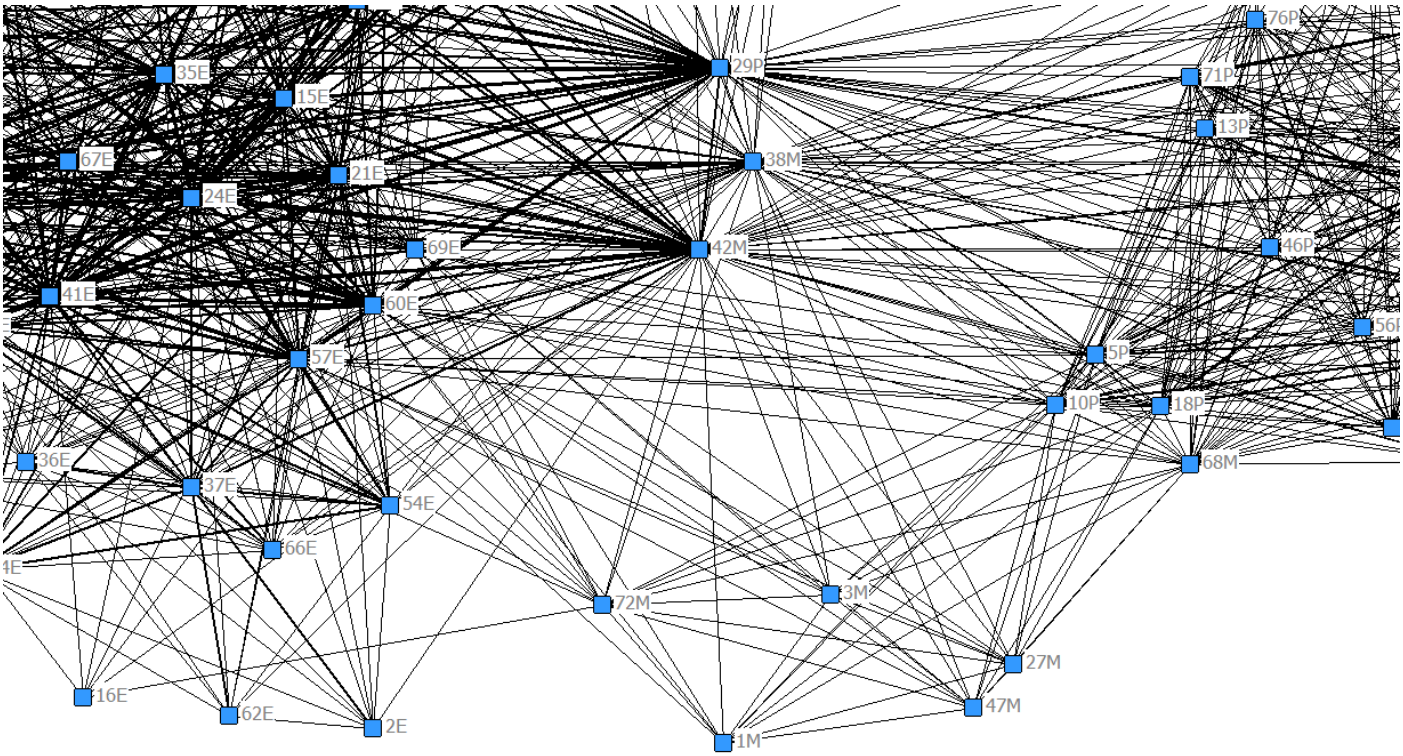

Figure 2: The Viennese intellectual community, 1918 – 1930. Intermediary region.

Figure 2 shows this intermediary region in more detail. This highlights the role for those involved in the mathematics seminars (see below), as well as the role of Kaufmann (29P), Menger (38M) and Morgenstern (42M) for this intellectual community. These individuals had ties to many of those in the economics and philosophy clusters, with Menger and Morgenstern also connected with the other mathematicians in the intermediary region. Differences in tie thickness in figure 1 and figure 2 show Kaufmann, Menger and Morgenstern had stronger connections to the economists than to any other region. This may be due to the greater number of economics seminars and overall, more participants. Figure 1 and figure 2 also show that Kaufmann, Menger and Morgenstern were the strongest and most direct link between the economics cluster and the philosophy cluster. This supports the conclusion that these individuals were prominent in the community by acting as intermediaries between the philosophy and economics groups.

There was some tension between the philosophers and the economists, with Mises easily being the most critical of what he called "panphysicalism" and the way logical positivism made science "palatable" to the masses (Mises 2009, 107). However, others were not quite so against the logical positivism of the philosophers. Kaufmann, as we have seen was a member of both groups. He commented that "very often […] different methods will coexist within a certain field of inquiry, each leading to certain achievements denied to the others" (Kaufmann 1944, 74). Machlup, an economist, agreed, stating in the introduction of *Methodology of Economics and Other Social Sciences* (1978):

> "Models…are used by everybody who thinks, talks, and acts in everyday life…What is important is to understand the differences in applicability of alternative models in particular instances…"

(Machlup 1978, 74).

It is important to note the diversity of approaches that co-existed within this community. While each cluster had some broad tendencies and thought leaders that strongly promoted these tendencies, there was a good deal of overlap in membership of each group.

Mathematicians

The mathematicians had strong links with both the economics and philosophy clusters. As the son of the 'father' of the Austrian School, Karl Menger was quite active in the economics discipline (he edited the second edition of his father's *Grundsätze* in 1923 and wrote his first economics paper in the same year). Also, Morgenstern began his career in economics under Mayer before moving towards mathematical economics later in his career. Figure 1 shows that the mathematicians were well-connected to the philosophers in terms of informal seminars, though there was some conflict between these disciplines at meetings of the Vienna Circle. Menger was frustrated by both the philosophers and the economists, rejecting the Vienna Circle's jargon and methodological monoism, and the subjective analysis of the economists. He commented that the use of models and equations could express more than words could, arguing that the mathematicians "[paid] less attention than the Austrians do … to the definition of concepts represented by symbols" (Menger 1973, 52-53). Regarding the philosophers, he argued that the idea of a unified science conflicted with "those schools of science, then flourishing … which extolled intuiting, cognition of essences and consciousness of absolute values" (Menger 1974, 111).

As a result of this disagreement with the philosophers, Menger established the Mathematical Colloquium in 1928. Its informal meetings in the evenings included students,

colleagues, and foreign visitors (Menger, et al. 1994, see also Stadler 2001, 206 - 214). Within the Colloquium's publication in 1935, Menger wrote that "in this Kolloquium [*sic*], beyond studying the recent developments of geometry and logics, we are interested in the new applications of exact sciences to sociological problems" (translation in Becchio 2008, 64). The Colloquium, and Menger's presentation on the Petersburg Paradox at a meeting of the *NOeG* sparked the formation of the mathematical economics field that gained prominence in Vienna in the 1930s, with Morgenstern showing a "lively interest" in Menger's work (Leonard 2011, 90).

Because of their connections with both the economists and the philosophers, those involved in the Mathematical Colloquium can be thought of as the intermediaries between the two larger clusters. This is shown in figure 1 with members of the Colloquium (denoted by 'M') shown in the intermediary region between the economists and the philosophers. Figure 2 shows this intermediary region in greater detail. Some mathematicians were only members of the Colloquium, which places them in their own cluster in the intermediary region. This includes Alt (1M), Beer (3M), Hornich (27M) and Nobeling (47M). Others participated in the Colloquium, but had other links to the economics group (see Schams, 57E; Schlesinger, 60E; Schreier, 63E; Tintner, 69E) or to the philosophy group (see Bergmann, 5P; Carnap, 10P; Gödel, 18P; Taussky-Todd, 68M). The key role of Menger (38M) and Morgenstern (42M) is again demonstrated, as they held seminar membership across all three disciplinary groups. Combined, those that participated in the Mathematical Colloquium spanned the two larger clusters.

V – THE 1920s VIENNESE COMMUNITY AS AN INFORMAL NETWORK

Having presented the overall network and the broad characteristics of each group, this section applies network theory to the interwar Austrian community. By doing so, the multidisciplinary nature of the community is accounted for by differences in the social interactions of the individuals. Figure 1 shows that the community consisted of two large groups, one containing mostly economists and the other mostly philosophers. Those involved in the Mathematical Colloquium spanned the two groups, which shown by their place in the intermediary region (figure 2 shows this region in more detail).

Table 2 presents selected centrality scores for the members of this community. These metrics describe the importance of each individual to the network based on the number of connections they have (*Degree* and *Two-step degree*), and their position in the network (*betweenness centrality*). These metrics show that the community was generally quite well-connected, with the *Two-step degree* scores indicating that of the 76 people in the network, each individual had access to everyone else in the community within two ties of themselves.

Table 2: Selected centrality scores, ordered by betweenness centrality

Name	*ID code*	*Degree*	*2Step Degree*	*Betweenness*	*Betweenness as % of base value*
Morgenstern, O	42M	75	75	510.24	100
Kaufmann, F	29P	67	75	349.38	68
Menger, K	38M	62	75	276.32	54
Schams, E	57E	48	75	80.45	16
Schlesinger, K	60E	46	75	62.66	12
Tintner, G	69M	41	75	51.2	10
Haberler, G	21E	46	75	44.27	9
Hayek, FA	24E	46	75	44.27	9
Bergmann, G	5P	35	75	29.36	6
Gödel, K	18P	35	75	29.36	6
Carnap, R	10P	34	75	26.52	5
Taussky-Todd, O	68M	34	75	26.52	5
Machlup, F	35E	42	75	18.31	4
Fürth, H	15E	42	75	18.31	4
Rosenstein-Rodan, P	55E	39	75	15.9	3
Mises, L von	41E	39	75	15.86	3
Wald, A	72M	18	75	8.26	2
Engel-Janosi, F	11E	36	75	7.8	2
Fröhlich, W	14E	36	75	7.8	2
Schütz, A	65E	36	75	7.8	2
Vögelin, E	70E	36	75	7.8	2
Waelder, R	73E	36	75	7.8	2
Winternitz, E	75E	36	75	7.8	2
Schiff, E	58E	33	75	7.28	1
Bloch, V	7E	37	75	6.61	1
Braun, MS	8E	37	75	6.61	1
Lieser-Berger, H	32E	37	75	6.61	1
Strigl, R	67E	37	75	6.61	1
Mintz-Schüller, I	39E	36	75	6.1	1
Mahr, A	36E	23	75	2.89	1
Mayer, H	37E	23	75	2.89	1
Reisch, R	54E	23	75	2.89	1
Schüller, R	64E	23	75	2.89	1
Bettelheim-Gabillon, L	6E	30	75	1.25	0
Kraft, V	31P	27	75	0.42	0
Juhos, B von	28P	27	75	0.42	0
Neumann, R	45P	27	75	0.42	0
Neurath, O	46P	27	75	0.42	0
Rand, R	50P	27	75	0.42	0
Rauscher, J	51P	27	75	0.42	0
Schlick, M	61P	27	75	0.42	0
Waismann, F	71P	27	75	0.42	0
Brunswik, E	9P	27	75	0.42	0
Feigl, H	12P	27	75	0.42	0
Frank, P	13P	27	75	0.42	0

Gomperz, H	19P	27	75	0.42	0
Hahn, H	22P	27	75	0.42	0
Hahn-Neurath, O	23P	27	75	0.42	0
Zilser, E	76P	27	75	0.42	0
Mintz, M	40E	18	75	0.41	0
Nobeling, G	47M	13	75	0.08	0
Hornich, H	27M	13	75	0.08	0
Beer, G	3M	13	75	0.08	0
Glück, F	17E	17	75	0.06	0
Schiff, G	59E	17	75	0.06	0
Herzfeld, M	25E	30	75	0.03	0
Klein, R	30E	30	75	0.03	0
Löbl, R	33E	30	75	0.03	0
Lovasy, G	34E	30	75	0.03	0
Offenheimer-Spiro, E	48E	30	75	0.03	0
Redlich-Redley, AG	52E	30	75	0.03	0
Schreier, F	63E	30	75	0.03	0
Strakosch von Feldringen, S	66E	21	75	0	0
Graetz, V	20E	21	75	0	0
Benesch, O	4E	16	75	0	0
Wilde, J	74E	16	75	0	0
Hollischer, W	26P	26	75	0	0
Natkin, M	43P	26	75	0	0
Neider, H	44P	26	75	0	0
Radakovic, T	49P	26	75	0	0
Schachter, J	56P	26	75	0	0
Reidemester, K	53P	19	75	0	0
Schönfeld-Illy, L	62E	10	75	0	0
Bayer, H	2E	10	75	0	0
Alt, F	1M	12	75	0	0
Gerschenkron, A	16E	7	75	0	0

Note: Compiled by author based on UCINET output for Figure 1.

It is worth reiterating that the mathematicians had the greatest engagement with seminars in different disciplines, with figure 1 visually showing these individuals in the intermediary region between the economics and philosophy clusters. However, the community as a whole was also quite multidisciplinary, with engagement with other disciplines relatively common. This may be because of the nature of Viennese intellectual life in the 1920s, with the dominance of informal seminars encouraging the diffusion of ideas between disciplines. Informal seminars meant that individuals could be members of a number of different seminars concurrently, and the seminars themselves were also able to be multidisciplinary. As such, Viennese intellectuals had greater access to ideas from different disciplines than they would if academia had been based within the faculties of the University.

The contextual approach to intellectual history can provide some explanation for this. Feld's focus theory argues that the nature of the activities in which the community engages affects the interactions between members (Feld 1981). More specifically, when discussing contemporary intellectual communities, collaboration and the diffusion of ideas between members has been found to be affected by the nature of contextual factors such as geographic proximity, conferences, journals and professional societies (Boschma 2005; Crane 1972; Jaffe, Trajtenberg & Henderson 1993; Katz 1994; Kuhn [1962] 1970; Mullins 1973; Ponds, van Oort & Frenken 2007; Price 1963. See Cappell & Guterbock 1992; Hu & Racherla 2008; Pieters & Baumgartner 2002 for some applied examples). For the case of the Viennese intellectual community, the social context is one in which academia had greater informality and a lack of constraints. This means that, on average, ties between individuals were weaker than they would be otherwise. As repeat interactions were not enforced by a formal institutional structure, the pattern of communication between individuals was instead encouraged through like-mindedness and collegiality.

This prevalence of weaker ties has been argued to increase the diversity of knowledge and potential for innovation in an intellectual network (Burt 2004; Harary, Norman & Cartwright 1965; Podolny & Baron 1997; Wang, Rodan, Fruin & Xu 2014. Granovetter's 1973 work in this area is seminal). Weak ties mean there is a lower chance that an individual's connections are also acquainted. This lower *redundancy* of ties means that weak ties lead to contacts that have diverse backgrounds, giving the community access to richer and more diverse resources. Weak ties are also the source of 'bridges' between different groups or domains of knowledge, as fewer redundant ties mean it is likely that a particular individual is the only path between two clusters (Granovetter 1973). Innovative ideas emerge from the synthesis of ideas across these bridges (Burt 1992; Burt 2004; Granovetter 1973; Reagans & McEvily 2003). The informality and lack of constraints on academic activities in Vienna in the 1920s mean that there was a greater diversity and diffusion of knowledge amongst members. This interpretation is reflected in the well-known characteristics of seminars in this period – with topics ranging across many fields, with discussants joining seminars from a variety of disciplines, and with individuals able to be members of a number of different seminars concurrently.

Turning to the micro mechanisms in the community, the network analysis highlights the role of Morgenstern, Kaufmann and Menger. Table 2 shows that in terms of *Degree*, Morgenstern had the most connections, directly tied to every other member of the community. This was because Morgenstern was a member of every seminar except the Schlick Circle[10]. Morgenstern is closely followed by Kaufmann (with 67 connections) and Menger (with 62 connections). *Betweenness centrality* has been calculated for this network,

[10] See table B1, appendix B.

with rankings based on the percentage of shortest paths in the network that pass through each actor. Table 2 includes both the raw score, as well as this as a proportion of the 'maximum' for this community (which is Morgenstern's *betweenness* score). Morgenstern, Kaufmann and Menger have a *betweenness centrality* far surpassing other members of the community[11]. Those individuals that were leaders of particular disciplines, such as Mises, Hahn or Schlick had only a fraction of Morgenstern's *betweenness*, with Mises ranked highest of these at 3%. Those individuals who held membership across a number of seminars, and were members of seminars in different disciplinary groups, were more prominent in the network. This was, as the *betweenness centrality* metric describes, by being the shortest path through which ideas and contacts diffused in the community.

The importance of Morgenstern, Menger and Kaufmann is reiterated visually in figure 1. Here, these individuals provide the most direct link between the philosophy and economics clusters. This gap between larger clusters is called a 'structural hole', and it is argued that while information and behaviour is quite homogeneous within clusters, those that span structural holes can be thought of as having an informational advantage (Burt 1992; Burt 2004; Granovetter 1973; Reagans & McEvily 2003). This is because those individuals have access to the ideas of both clusters, can control *what* and *how much* certain ideas diffuse within the community, as well as having a greater capacity for innovation by being able to synthesize ideas from different groups in new ways (Burt 2004). Because of this, it is likely that Morgenstern, Menger and Kaufmann contributed positively to the multidisciplinary nature of the Viennese community. These individuals had the ability to influence a large proportion of the community, they could act as intermediaries between otherwise

[11] Within this, table 2 shows that Morgenstern's *betweenness* dominated. Kaufmann, ranked second, had only 68% of Morgenstern's *betweenness*, and Menger had only 54%. This is due to Morgenstern's extensive seminar membership, involved in 7 out of the 8 seminars for this community.

disconnected individuals, and were an important conduit through which the larger clusters were exposed to diverse ideas.

By applying network theory to the interwar Viennese intellectual community, this community can be reinterpreted as a centre for ideas exchange built on interactions through informal seminars. In doing so, the intellectual character of the community is able to be linked to the structure of social relationships. This extends the understanding of this community, and incorporates the impact of academic context, the overall network structure, and the importance of certain individuals to the network. The informality of seminars, and their separation from the structures of the university contributed to an overall increased diffusion of ideas between different domains of knowledge. Additionally, Morgenstern, Kaufmann and Menger's role in assisting ideas to flow between the two larger clusters means that the multidisciplinary nature of this community can be argued to be due to a combination of macro and micro dynamics.

CONCLUSIONS

The alternative quantitative and visual perspective of a social network analysis of the intellectual life in Vienna in the 1920s allows us to re-tell the history of one of the most historically significant communities of economists and other intellectuals. A range of primary and secondary sources have been compiled to provide a dataset on the duration, operation and membership of informal seminars, and the movement of individuals through this community between 1918 and 1930. Social network analysis has been used to visualise this data, offering an overview of the relationships in this community through informal seminar attendance in the 1920s. This is intended to provide additional insights into the overall characteristics of this network, as well as highlighting the contribution of those who may not have been thought

leaders of a particular discipline, but were instead prominent as intermediaries between different domains of knowledge. The value of social network analysis is in the theoretical and methodological frameworks that suggest the way in which social relationships affect the ideas of individuals. Social network analysis complements the qualitative techniques that are traditionally used to analyse intellectual communities and the technique certainly warrants further applications within the history of economic thought.

The Viennese intellectual community was a centre for the exchange of ideas in economics, certainly, but also in philosophy and mathematics. These fields were related, with individuals able to move between seminars in the three disciplines, and seminars themselves often engaging adopting a multidisciplinary focus. This was made possible by the informal nature of the community and the removal of academia from the structures of the University of Vienna. It has been found that the community consisted of two main clusters, with members of the Mathematical Colloquium acting the intermediaries. In particular, Morgenstern, Kaufmann and Menger contributed to the multidisciplinary nature of the community by acting as the most direct link between the larger clusters. Rather than the leaders of particular disciplines, the most prominent members of this network were those whose interests spanned a number of fields.

While intellectual life flourished in Vienna in the 1920s, the 1930s were tumultuous. The social and political unrest that culminated in Austria's *Anschluß* with Germany in 1938 promoted the emigration of prominent intellectuals. The loss of their home base, along with their networks and the benefits of geographic proximity undermined the coherence of their collective projects in the period after WWII. A network analysis of the Austrian intellectuals

in the 1930s and beyond, as well as an analysis of the temporal dynamics of the network in the interwar period, is welcome.

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Appendix A

Table A1: Informal seminar attendance source details

	Source details
NOeG	Craver lists Mayer and Mises as primary members, and Hayek, Machlup, Morgensten, Schlesinger, Schams, Strigl, Graetz, Strakosch von Feldringen, Schüller as regular members (Craver 1986, 17-18). Mises has commented that the nucleus of the group was made up of *Privatseminar* participants, but adds Schüller, Strakosch von Feldringen and Gratz as regular members (Mises 2009, 83). Leonard's (2011, 87 – 88) list of regular participants fairly closely follows Craver's, though he adds Kaufmann and Gerschenkron as regular members, and adds Menger as a sporadic member. However, Klausinger (2015b, 22) notes that Menger gave a paper at the society during this period. This may classify Menger as a regular participant. Klausinger (2015b, 20) finds evidence to also include Bloch, Fürth, Lieser-Berger, Mahr, Mintz-Schüller, Reisch and Rosenstein-Rodan as regular participants. Hayek (Hayek 1983, 45) supports the case for Lieser-Berger, mentioning that she was secretary of the society for a time.
Mayer Circle	The Mayer Circle is the most ill-defined seminar included here. Craver lists Morgenstern, Rosenstein-Rodan, Gershenkron, Mahr, Schönfeld-Illy and Schams as regular members (Craver 1986, 11). However, as Gerschenkron did not write a thesis under Mayer, it is unlikely that he attended. As co-editors of the *Zeitschrift für Nationalökonomie*, and the publication's links to this seminar, Reisch and Schüller are included in this Circle. Mayer supported the *Habilitation* of Bayer, Haberler, Hayek, Mahr and Morgenstern (Klausinger 2015a, 283), so these younger economists can be considered a regular part of Mayer's community. Hayek in particular has recalled participating in coffeehouse discussions with Mayer (Hayek 1983, 38).
Mises' Privatseminar	Kurrild-Klitgaard contains the most comprehensive list, including Mises as a primary member, Bettelheim-Gabillon, Bloch, Bode, Braun, Engel-Janosi, Fröhlich, Fürth , Haberler, Hayek, Herzfeld, Kaufmann, Klein, Lieser-Berger, Löbl, Lovasy, Machlup, Mintz-Schüller, Morgenstern, Offenheimer-Spiro, Rosenstein-Rodan, Schams, Schiff, Schlesinger, Schreier, Schütz, Stonier, Strigl, Tintner, Vögelin, Waelder, and Winternitz as regular members (Kurrild-Klitgaard 2003, 12). Craver maintains a similar list (Craver 1986, 15). Mises' list is similar, though he adds Redlich-Redley to the list of regular participants (Mises 2009, 83). Redlich-Redley's participation is supported by Beller, who cites a letter from MS Braun (Beller 1989, 20). Recollections from other members include more limited lists: Hayek briefly mentions an incomplete list of participants, namely Strigl, Engel-Janosi, Braun, Lieser, Mintz-Schüller, Schütz, and Schlesinger (Hayek 1983, 38 – 42). Haberler (Haberler, Ebeling & Salerno 1979) has recalled Hayek, Morgenstern, Machlup, Kaufmann, Strigl, Schams and Rosenstein-Rodan were in attendance. Machlup (Machlup, Salerno & Ebeling 1980) has recalled Kaufmann, Schütz and Schreier as the non-economists in attendance. Engel-Janosi has recalled his involvement, as well as Mises, Hayek, Haberler, Morgenstern, Kaufmann, Schütz and Vögelin (Engel-Janosi 1974, 110 – 112). Though Kurrild-Klitgaard (Kurrild-Klitgaard 2003, 12) includes Menger as a regular member, he is not mentioned in any other primary or secondary sources, so is not included here.
Geist Kreis	It is widely known that Hayek and Fürth jointly established this seminar. Engel-Janosi recorded the full list of presenters obtained from Fürth, and as such this is probably the most reliable source. He lists Hayek, Fürth, Vögelin, Kaufmann, Glück, Schiff, Mintz, Fröhlich, Haberler, Winternitz, Wilde, Schütz, Machlup, Morgenstern, Benesch and of course, himself (Engel-Janosi 1974, 117; full list of presentations: 125 – 128). Craver follows the same list, with the addition of Waelder as a regular participant, and confirming that the Schiff that Engel-Janosi refers to is in fact Georg, the cousin of Erich Schiff and Karl Popper (Craver 1986, 16). Hayek and Vögelin both mention a reduced list of the same core members (Hayek 1983, 33- 35; Vögelin 2011, 34 – 36). Kurrild-Klitgaard, drawing on an unpublished interview with Herbert Fürth, lists Hayek and Fürth,

	as well as Schütz, Engel-Janosi, Froelich, Haberler, Kaufmann, Machlup, Menger, Morgenstern, Vögelin, Winternitz, and Waelder (Kurrild-Klitgaard 2003, 49).
Vienna Circle	The formally published list is in the Circle's manifesto (Hahn, Neurath & Carnap 1929, 14 – 16), which includes Bergmann, Carnap, Feigl, Frank, Gödel, Hahn, Kraft, Menger, Natkin, Neurath, Hahn-Neurath, Radkovic, Schlick and Waismann. Zilsel is mentioned as 'sympathetic' to the Vienna Circle. While Menger and Kraft are included in the list of regular members, Uebel comments that they "later wanted to be known only as sympathetic associates" (Uebel 2012). This is reiterated by Menger (Menger 1982). Uebel also mentions other, later participants not mentioned in the *Manifesto* including Juhos, Schächter, Hollitscher, Neider, Rand, Rauscher, Steinhardt, Neumann, Kaufmann and Brunswik. Stadler (Stadler 2003, xxi). Dekker cites a similar list, with the addition of Taussky-Todd, Gomperz and Kelsen (Dekker 2014, 237). However, Kelsen himself wrote that while he had many contacts in the Vienna Circle, he did not belong to it (see Jabloner 1998, 378). Leonard mentions that Morgenstern "occasionally participated" (Leonard 1998, 24). Feigl has recalled Schlick, Hahn, Waismann, Neurath, Kaufmann, Kraft, Reiemeister (in the early period), Carnap, Bergmann, Gödel, Menger, Natkin,as members (Feigl 1981, 60 - 67). Taussky-Todd has recalled her own membership of the Vienna Circle (Taussky-Todd 1980, 16).
Schlick Circle	Details on this group are relatively limited, and the group was only operational between 1924 and 1926. Oberdan mentions Schlick as the primary member, with Carnap, Hahn, Gödel and Neurath as regular members (Oberdan 2013). Craver argues that Kaufmann was also a "lesser known" member of the Schlick Circle (Craver 1986, 14). While Wittgenstein did meet with Schlick a number of times in the 1920s, he was never a member of this seminar (Oberdan 2013).
The Institute	Leonard mentions that Hayek and Morgenstern were co-directors of the Institute from 1928 (Leonard 2010, 148). Klausinger names Erich Schiff and Haberler as Hayek's early collaborators at the Institute, and Steindl, Tintner, Wald, Gerschenkron, John, Kamitz and Kozlik as present later (Klausinger 2006b, 623). However, John, Kamitz, Kozlik and Steindl were not present in Vienna until the 1930s, so do not qualify for this network. Craver confirms Haberler's early presence at the Institute (Craver 1986, 19). Craver and Klausinger both add Wald to the list of individuals present under Morgenstern's leadership (Klausinger 2006a, 32; Craver 1986, 27). Mises' role in establishing the Institute is reflected in his classification as a regular member.
Mathematical Colloquium	As the founder of the seminar, Menger is classified as the primary member. Stadler's record of Mathematical Colloquium presenters and discussants lists Alt, Gödel, Hornich, Nobeling, Schlesinger, Schams, Taussky-Todd, Tintner and Wald (Stadler 2001, 206 – 214). A similar list is reproduced by Fasshauer, who also includes Carnap as a participant (Fasshauer 2013). Alt's oral history lists Gödel, Wald, Taussky-Todd and Beer (Akera 2006, 6), and Dekker mentions Beer, Schams and Tintner (Dekker 2014, 236). Leonard also includes Alt, Gödel, Nobeling and Taussky-Todd, adding Bergmann and Otto Schreier as participants (Leonard 2011, 96). However it is unlikely that Otto Schreier was in attendance, because although he was a friend and fellow student of Menger's, he lived in Hamburg during this period, and died in 1929. Leonard elsewhere also mentions that Morgenstern occasionally participated (Leonard 1998, 24).

Table A2: Seminar duration, 1918 – 1930

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
NOeG[12]	■	■	■							■	■	■	■
Mayer Circle[13]							■	■	■	■	■	■	■
Mises' Privatseminar[14]			■	■	■	■	■	■	■	■	■	■	■
Geist Kreis[15]				■	■	■	■	■	■	■	■	■	■
Vienna Circle[16]							■	■	■	■	■	■	■
Schlick Circle[17]							■	■	■				
The Institute[18]										■	■	■	■
Mathematical Colloquium[19]											■	■	■

[12] Klausinger's recent history of the *NOeG* is the most comprehensive. The society was established in 1918, with meetings running until 1920. There is no evidence of further activity from 1920 until 1927, when meetings reconvened. Meetings continued from 1927 into the 1930s and beyond (Klausinger 2015b, 6 – 12).

[13] Mayer's Circle is the most informal and uncertain in terms of participants and time period, and as such presents a challenge to map quantitatively. Mayer's return to Vienna from Graz in 1923 gives some indication of the start of the Circle. There are suggestions that the Circle existed from 1924 until 1928 or until he departed to spend 1931 in Kiel (I thank one of the referees for assistance on this point). The latter classification is used here, with 1930 marking the end-point of this Circle.

[14] Meetings of the *Privatseminar* began in 1920 (Mises 2009, 81). Schütz's earliest recollection (in Kurrild-Klitgaard 2003, 45) of the *Privatseminar* was also from 1920. There is a consensus that the seminar ran throughout the 1920s and into the 1930s (Leonard 2011, 85; Hayek 1983, 40; Haberler, Ebeling & Salerno 1979), until Mises emigrated in 1934 (Mises 1984, 4; Kurrild-Klitgaard 2003, 56; Schulak & Unterkofler 2011, 113).

[15] Established in 1921, as recalled on two separate occasions by Fürth (Craver 1986, 16; Kurrild-Klitgaard 2003, 48). This is consistent with Hayek's recollections that they established the seminar immediately after they left University (Hayek 1983, 33). This seminar continued throughout the 1920s and into the 1930s, with the final session in the winter of 1937/38 (Kurrild-Klitgaard 2003, 56).

[16] The Vienna Circle meetings ran between 1924 and 1936, with the society going public and electing a board of directors in 1928 (Uebel 2012). This is consistent with recollections from Fiegl (1981, 60) and Stadler's compilation of recollections from Frank, Carnap, Neider and Kraft (Stadler 2001, 44).

[17] The Schlick Circle operated between 1924 and 1926 (Oberdan 2013, who cites a more recent collection of Schlick's body of work and archival papers: Schlick, Friedl & Rutte 2008, 33 – 56).

[18] The Institute was established in 1927 with Hayek as the first director (Klausinger 2006a, 27; Klausinger 2006b, 621; Craver 1986, 19). Morgenstern joined the Institute in 1928, until Hayek's departure in 1931. Morgenstern then took over as director (Leonard 2010, 148; Klausinger 2006a, 27).

[19] The Colloquium was established in 1928 (Leonard 2011, 96; Stadler 2001, 206). Regular meetings commenced in 1929, and ran through to 1935/36 (Fasshauer 2013; Stadler 2001, 206 – 214).

Appendix B

Table B1: Informal seminar membership

	Identifier code	*Seminar membership*
Alt, F	1M	Mathematical Colloquium
Bayer, H	2E	Mayer Circle
Beer, G	3M	Mathematical Colloquium
Benesch, O	4E	*Geist Kreis*
Bergmann, G	5P	Vienna Circle; Mathematical Colloquium
Bettelheim-Gabillon, L	6E	Mises' *Privatseminar*
Bloch, V	7E	*NOeG*; Mises' *Privatseminar*
Braun, MS	8E	*NOeG*; Mises' *Privatseminar*
Brunswik, E	9P	Vienna Circle
Carnap, R	10P	Vienna Circle; Schlick Circle; Mathematical Colloquium
Engel-Janosi, F	11E	Mises' *Privatseminar*; *Geist Kreis*
Feigl, H	12P	Vienna Circle
Frank, P	13P	Vienna Circle
Fröhlich, W	14E	Mises' *Privatseminar*; *Geist Kreis*
Fürth, H	15E	*NOeG*; Mises' *Privatseminar*; *Geist Kreis*
Gerschenkron, A	16E	The Institute
Glück, F	17E	*Geist Kreis*
Gödel, K	18P	Vienna Circle; Schlick Circle; Mathematical Colloquium
Gomperz, H	19P	Vienna Circle
Graetz, V	20E	*NOeG*
Haberler, G	21E	*NOeG*; Mayer Circle; Mises' *Privatseminar*; *Geist Kreis*; The Institute
Hahn, H	22P	Vienna Circle; Schlick Circle
Hahn-Neurath, O	23P	Vienna Circle
Hayek, FA	24E	*NOeG*; Mayer Circle; Mises' *Privatseminar*; *Geist Kreis*; The Institute
Herzfeld, M	25E	Mises' *Privatseminar*
Hollischer, W	26P	Vienna Circle
Hornich, H	27M	Mathematical Colloquium
Juhos, B von	28P	Vienna Circle
Kaufmann, F	29P	*NOeG*; Mises' *Privatseminar*; *Geist Kreis*; Vienna Circle; Schlick Circle
Klein, R	30E	Mises' *Privatseminar*
Kraft, V	31P	Vienna Circle
Lieser-Berger, H	32E	*NOeG*; Mises' *Privatseminar*
Löbl, R	33E	Mises' *Privatseminar*
Lovasy, G	34E	Mises' *Privatseminar*
Machlup, F	35E	*NOeG*; Mises' *Privatseminar*; *Geist Kreis*
Mahr, A	36E	*NOeG*; Mayer Circle
Mayer, H	37E	*NOeG*; Mayer Circle
Menger, K	38M	*NOeG*; *Geist Kreis*; Vienna Circle; Mathematical Colloquium
Mintz-Schüller, I	39E	*NOeG*; Mises' *Privatseminar*

Mintz, M	40E	*Geist Kreis*
Mises, L von	41E	*NOeG*; Mises' *Privatseminar*; The Institute
Morgenstern, O	42M	*NOeG*; Mayer Circle; Mises' *Privatseminar*; *Geist Kreis*; Vienna Circle; The Institute; Mathematical Colloquium
Natkin, M	43P	Vienna Circle
Neider, H	44P	Vienna Circle
Neumann, R	45P	Vienna Circle
Neurath, O	46P	Vienna Circle; Schlick Circle
Nobeling, G	47M	Mathematical Colloquium
Offenheimer-Spiro, E	48E	Mises' *Privatseminar*
Radakovic, T	49P	Vienna Circle
Rand, R	50P	Vienna Circle
Rauscher, J	51P	Vienna Circle
Redlich-Redley, AG	52E	Mises' *Privatseminar*
Reidemester, K	53P	Vienna Circle
Reisch, R	54E	*NOeG*; Mayer Circle
Rosenstein-Rodan, P	55E	*NOeG*; Mayer Circle; Mises' *Privatseminar*
Schachter, J	56P	Vienna Circle
Schams, E	57E	*NOeG*; Mayer Circle; Mises' *Privatseminar*; Mathematical Colloquium
Schiff, E	58E	Mises' *Privatseminar*; The Institute
Schiff, G	59E	*Geist Kreis*
Schlesinger, K	60E	*NOeG*; Mises' *Privatseminar*; Mathematical Colloquium
Schlick, M	61P	Vienna Circle; Schlick Circle
Schönfeld-Illy, L	62E	Mayer Circle
Schreier, F	63E	Mises' *Privatseminar*; Mathematical Colloquium
Schüller, R	64E	*NOeG*; Mayer Circle
Schütz, A	65E	Mises' *Privatseminar*; *Geist Kreis*
Strakosch von Feldringen, S	66E	*NOeG*
Strigl, R	67E	*NOeG*; Mises' *Privatseminar*
Taussky-Todd, O	68M	Vienna Circle; Mathematical Colloquium
Tintner, G	69E	Mises' *Privatseminar*; The Institute; Mathematical Colloquium
Vögelin, E	70E	Mises' *Privatseminar*; *Geist Kreis*
Waismann, F	71P	Vienna Circle
Wald, A	72M	The Institute; Mathematical Colloquium
Waelder, R	73E	Mises' *Privatseminar*; *Geist Kreis*
Wilde, J	74E	*Geist Kreis*
Winternitz, E	75E	Mises' *Privatseminar*; *Geist Kreis*
Zilser, E	76P	Vienna Circle

Note: Based on source details in Table A1.

Table B2: Details of individual arrivals to and absences from Vienna, 1918 – 1930.

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Alt, F[20]											■	■	■
Bayer, H[21]							■	■	■	■	■	■	■
Beer, G[22]												■	■
Benesch, O[23]		■	■	■	■	■	■	■	■	■	■	■	■
Bergmann, G[24]							■	■	■	■	■	■	■
Bettelheim-Gabillon, L[25]	■	■	■	■	■	■	■	■	■	■	■	■	■
Bloch, V[26]	■	■	■	■	■	■	■	■	■	■	■	■	■
Braun, MS[27]				■	■	■	■	■	■	■	■	■	■
Brunswik, E[28]				■	■	■	■	■	■	■	■	■	■
Carnap, R[29]									■	■	■	■	■
Engel-Janosi, F[30]			■	■	■	■	■	■	■	■	■	■	■
Feigl, H[31]							■	■	■	■	■	■	
Frank, P[32]	■	■	■	■	■	■	■	■	■	■	■	■	■
Fröhlich, W[33]									■	■	■	■	■
Fürth, H[34]	■	■		■	■	■	■	■	■	■	■	■	■
Gerschenkron, A[35]							■	■	■	■	■	■	■

[20] Arrived in Vienna to study in 1928, obtained his PhD in 1932 (Alt's oral history: Akera 2006, 2, 4). Alt has recalled that Menger invited him to join the Colloquium in 1929 (Alt's oral history: Akera 2006, 6), and Stadler's record of Colloquium proceedings confirms this (Stadler 2001, 207-8). Emigrated in 1938.

[21] Finished his doctorate in 1924 and became Mayer's assistant. Achieved his *Habilitation* in Vienna in 1929 (Schulak & Unterkofler 2011, 132-3).

[22] Biographical information is not available, though Stadler's reproductions of the Colloquium's proceedings list him regularly present in 1929 and 1930 (Stadler 2001, 207 – 209).

[23] Was present from 1918, with no absences. Emigrated in 1938 (Wendland 1999, 38).

[24] Born in 1906, Bergmann earned his PhD from the University of Vienna in 1928. While studying, he was asked to join Vienna Circle. It is likely that this was from 1924. For the Colloquium, Stadler's record of Colloquium meetings lists Bergmann as attending from 1928 (Stadler 2001, 206-9). Was absent during 1931 to work with Einstein in Berlin (Hochberg 2001, 1). Moved to New York in 1938 (Feigl 1981, 72).

[25] Detailed biographical information could not be obtained, though he was employed by the Austrian finance ministry and so it is likely he was present throughout this period.

[26] Detailed biographical information could not be obtained, though it is known he was a banker and alive 1883 - 1968 (Klausinger 2015b, 10). He was likely present throughout this period.

[27] Braun received her doctorate in 1921 after studying in Germany. No other absences before emigration in 1938 (Keintzel & Korotin 2002, 92; Schulak & Unterkofler 2011, 135).

[28] From 1921 - 1923 was at the Vienna *Technische Hochschule*, then transferred to the University. He received his PhD in 1927. Was absent from Vienna in 1931/32 and in 1935/36. He emigrated permanently in 1937 (Tolman 1956, 315).

[29] Carnap visited Schlick in Vienna in 1925, but didn't take the job at the University until 1926. Moved to Prague in 1931 (Feigl 1981, 61-62; Murzi 2001).

[30] No absences, worked at a Viennese Bank from 1920 – 1924, and then was the director of the family lumber factory (Epstein 2002, 68; Engel-Janosi 1974, 80, 94).

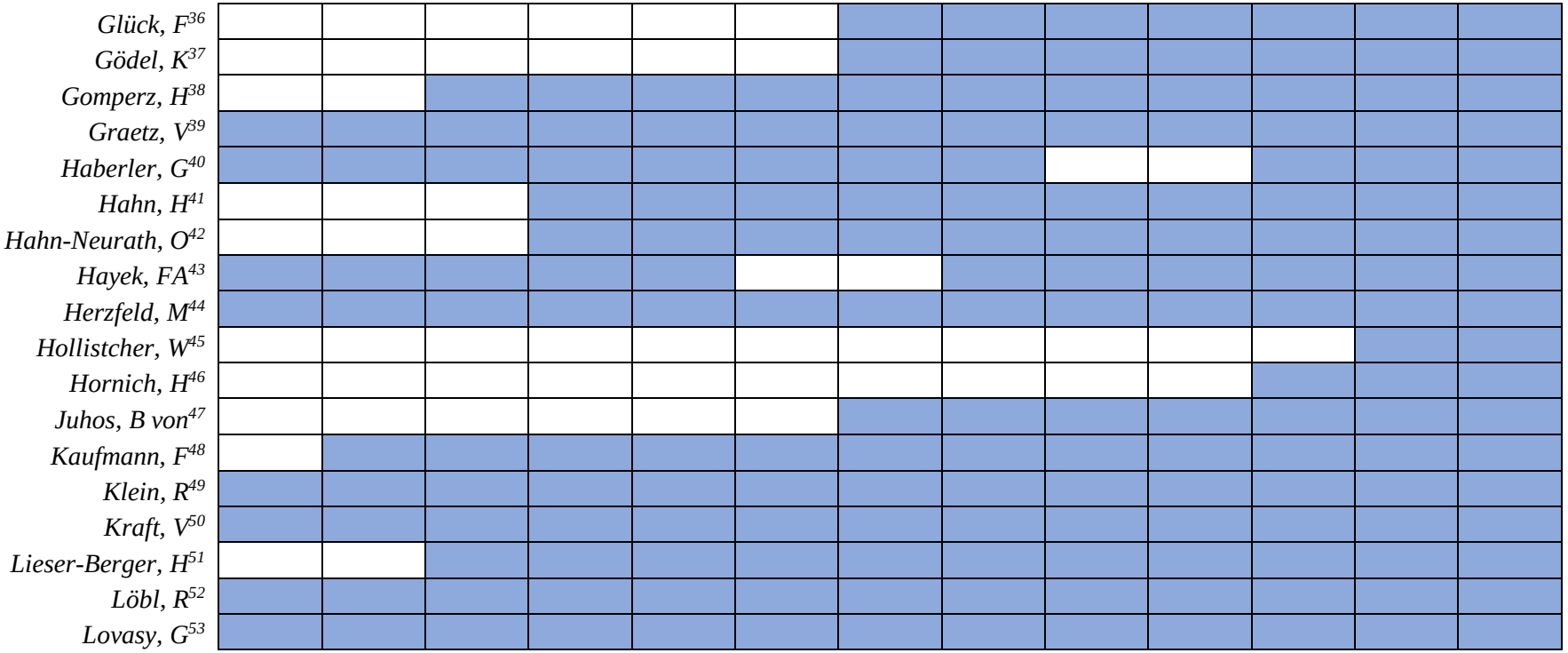
[31] Was a student of Schlick's as early as 1924 (and was involved in the Vienna Circle from that time). Completed his doctorate in 1927 under Schlick (Feigl 1981, 6; 60). Was on a Rockefeller Scholarship in 1930 at Harvard (Feigl 1981, 10). From 1931 - 1937 was at the University of Iowa.

[32] Born in Vienna, but held a position at the University of Prague from 1912 - 1938 (Holton, Kemble, Quine, Stevens & White 1968, 2). However, the official Manifesto of the Vienna Circle lists him as a regular member (Hahn, Neurath & Carnap 1929), so it is assumed he made regular trips to meetings. Stadler's record of Circle activities certainly features Frank consistently throughout (Stadler 2001).

[33] Biographical information is limited. Hayek has recalled that Fröhlich was a contemporary of his while he was at University (Hayek 1994, 49), but also that he was born in 1908 (Hayek 1994, 146). This birthdate indicates that he wouldn't have been at the University until at least 1926. He was an attorney, so it is unlikely that he had any extended absences (Schulak & Unterkofler 2011, 108).

[34] Born in Vienna, Fürth began at the University with Hayek in 1918. Spent 1920 studying abroad in Germany. Spent 1931-32 in the US on a Rockefeller scholarship. Emigrated to the US in 1938 (Hawrylchak 2005; Hayek 1983, 31).

[35] Fled Russia to Vienna in 1920, but didn't enrol in the University until 1924. Earnt his doctorate in 1928 and emigrated to the US in 1938 (Dawidoff 2002).



[36] Born in 1899, Glück was an art historian that studied abroad, earning his PhD in 1923. From 1924 he worked in publishing in Vienna. No other absences (Hayek 1983, 33, 36, 39; Czeike 2004).
[37] Entered the University in 1924 at the age of 18. Earned his doctorate in 1929 under Hahn's supervision. Was in the US from 1933 – 34 (Kreisel 1980, 153-54). Accepted a job at Princeton in 1938 (Feigl 1981, 72). Stadler's record of proceedings for the Mathematical Colloquium confirms him as a regular participant from 1928 (Stadler 2001, 206-214).
[38] Was at the University of Vienna from 1920 – 1934 (Austrian Academy of Sciences 1959, 30).
[39] Biographical details are sparse for Graetz. He was a contemporary of Mises and was in Vienna very early on (as early as 1909), but worked in industry. Was still there when Mises left in 1934 (Mises 2009, 59, 83).
[40] Entered the university in 1918 and received his doctorate in 1925. Went abroad for further study, but returned to teach at the University of Vienna from 1928 - 1931 (Salerno 2013; Dieterle 2013, 117). In 1931 he was at Harvard, and in 1934 he moved to the League of Nations in Geneva (Dieterle 2013, 117; Schulak & Unterkofler 2011, 111).
[41] Held an appointment in Bonn from 1916 – 1920. Returned to Vienna in 1921, remained there until his death in 1936 (Sigmund 1995, 20, 29).
[42] Biographical details are sparse. Married Otto Neurath in 1912, so it is assumed she returned to Vienna with him in 1921. Fled Vienna in 1934 for Holland (Feigl 1981, 60; Cat 2011).
[43] Received his doctorate in 1921 and spent 1923-24 studying at NYU. Moved to LSE in 1931 (Schulak & Unterkofler 2011, 122-23; Hayek 1983, 33, 373).
[44] Herzfeld was an older member of the community (Hayek 1983, 45) who completed school in the early 1910s (Keintzel & Korotin 2002, 297 - 280). Worked at a bank in Vienna, with no known absences.
[45] Entered the University of Vienna in 1929 and received his doctorate in 1933 under Schlick and Robert Reininger. Emigrated in 1938 (Dieter 1982, 399 - 401).
[46] Received his doctorate in 1929 under Karl Menger (Fasshauer 2013). Proceedings for the Mathematical Colloquium list Hornich attending from 1928 – 1930 (Stadler 2001, 206-7).
[47] Born in 1901, received his doctorate in 1926 with Schlick (Kraft 1971, 314, 316, 338-39). Was an early member of the Vienna Circle while he was a student, so probably from 1924 (Stadler 2001, xxi). No known absences.
[48] Received his doctorate in law in 1919, and a doctorate in philosophy in 1926. Was a *Privatdozent* at the University of Vienna from 1922 - 1938 (Cohen & Helling 2014, 2).
[49] Biographical details are scarce. Grew up in Vienna and was a banker (Allen 1991, 198). He was present in the *Privatseminar* but didn't publish much (Schulak & Unterkofler 2011, 136).
[50] Kraft was employed at the University of Vienna library until the 1930s and beyond. No known absences (Stadler 2001, 440).
[51] Completed her doctorate in 1920 under the supervision of Spann and Mises. Was present in Vienna until 1938 (Keintzel & Korotin 2002, 476).
[52] Detailed biography is not known. Also known as Loebl. Mises mentions Löbl as a regular member of the *Privatseminar* (Mises 2009, 83) and Schulak mentions him as a member of Mises' circle who did not really publish (Schulak & Unterkofler 2011, 136).
[53] Biographical details are sparse. Lovasy was born in 1900 and worked in industry in Vienna (for a train cartel). Regularly attended Mises' *Privatseminar*, with no known absences (Feichtinger 2001, 250).

Machlup, F[54]													
Mahr, A[55]													
Mayer, H[56]													
Menger, K[57]													
Mintz-Schüller, I[58]													
Mintz, M[59]													
Mises, L von[60]													
Morgenstern, O[61]													
Natkin, M[62]													
Neider, H[63]													
Neumann, R[64]													
Neurath, O[65]													
Nobeling, G[66]													
Offenheimer-Spiro, E[67]													
Radakovic, T[68]													
Rand, R[69]													
Rauscher, J[70]													

[54] Born in 1902, Machlup joined the University in 1920. He completed his dissertation in 1923, and worked in his parents' cardboard factory. Was absent from Vienna in 1933 and moved to America in 1935 (Schulak & Unterkofler 2011, 70, 133; Haberler 1983, 11-12).

[55] Born 1896, Mahr graduated from the University of Vienna in 1921. Received his doctorate in 1925. Was a student of Mayer's and was one of the few Austrian economists that participated in neither the *Privatseminar* nor the *Geist Kreis* (Schulak & Unterkofler 2011, 130). Fleck mentions that Mahr was granted a Rockefeller foundation fellowship (Fleck 2011, 108), which was most likely from 1926 – 1928.

[56] Mayer had a number of appointments in Switzerland, Prague and Graz before returning to Vienna in 1923 (as Wieser's successor). Spent 1931-1932 in Kiel (Klausinger 2015a, 272 – 275).

[57] Born in 1902, Menger attended the University of Vienna between 1920 and 1924. Spent 1924 – 1927 in Amsterdam, and was in the US from 1930 – 1931 (Becchio 2008, 64; Becchio 2009, 87; Fasshauer 2013). The latter point is confirmed by Stadler's reproduction of Colloquium proceedings, with Nobeling taking over direction of sessions in 1930-31 (Stadler 2001).

[58] Born in 1904 and was a student at the University of Vienna from 1922 – 1927 (Keintzel & Korotin 2002, 665). Emigrated to the US in 1938.

[59] Born in 1899. Biographical details are sparse. He was a lawyer, married to Ilse Mintz-Schüller (Keintzel & Korotin 2002, 665). No known absences.

[60] Mises was born in 1881 and joined the Vienna *Handelskammer* in 1909. No absences before emigrating in 1934 (Mises 2009, 40, 76).

[61] Born in 1902, Morgenstern received his PhD in political science from the University of Vienna. Was on a Rockefeller fellowship for 3 years before joining the Institute (Klausinger 2006a, 27) which, as mentioned in table A2, was in 1928 (Leonard 2010, 148).

[62] Born in 1904 and received his PhD in 1928 (Hacohen 2000, 250). Stadler mentions that Natkin studied philosophy under Schlick from 1926 - 1928 and was a member of the Vienna Cirlce at this time (Stadler 2001, 594, 51). No known absences.

[63] Born in 1907. Member of the Vienna Circle from 1927 (Stadler 2001, 53). No known absences.

[64] No biographical information available. Robert Neumann, a secondary teacher, signed the *Manifesto* of the Vienna Circle and attended regularly (Stadler 2001, 72).

[65] Born in 1882. After a brief post-war period in Heidelberg, Neurath was in Vienna from 1921 - 1934 (Cat 2011).

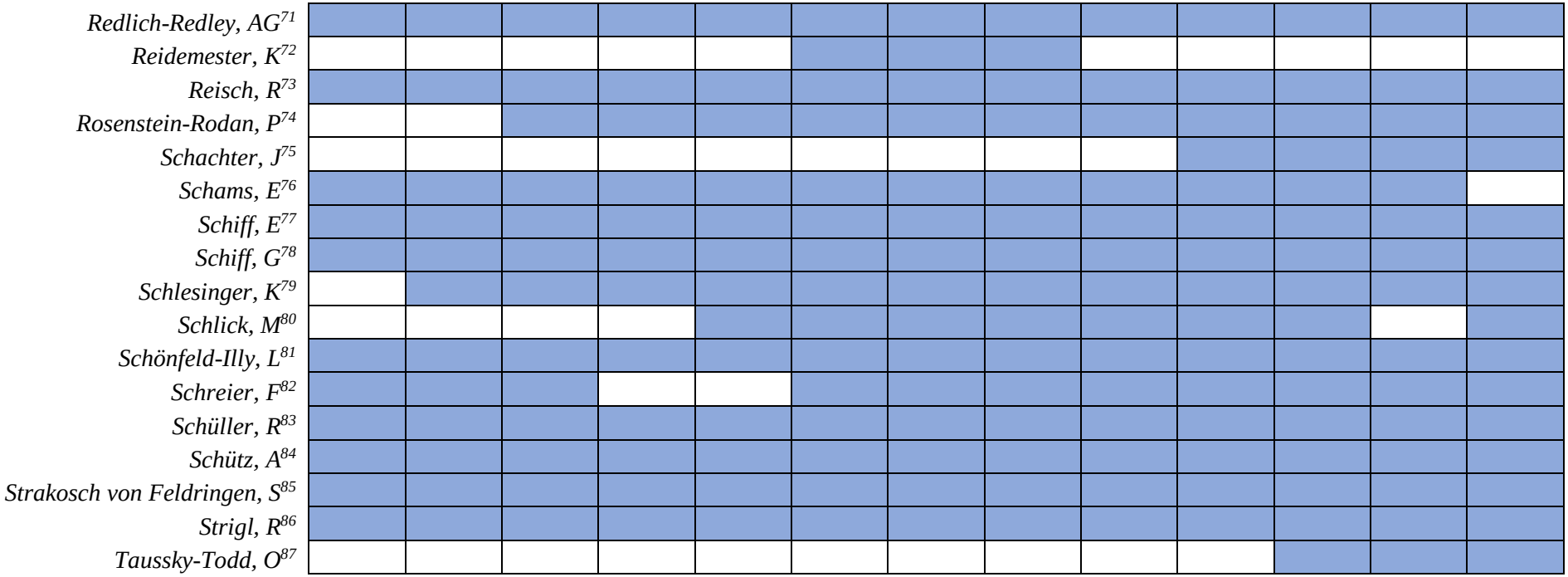
[66] Born in 1907 and studied under Menger at the University of Vienna. Received his PhD in 1931. In 1933 moved to Germany (Fasshauer 2013). Stadler's records of Colloquium proceedings show he attended regularly from 1928 until 1933, and directed sessions when Menger was absent (Stadler 2001, 206-14).

[67] Born in 1903, she enrolled in the University of Vienna in 1922. Lived in Vienna until she moved to Frankfurt in 1929 (Keintzel & Korotin 2002, 540).

[68] Born in 1895 in Graz. Was *Privatdozent* at Vienna *Technische Hochschule* from 1928 - 1938 (Stadler 2001, 51).

[69] Born in 1903, Rand attended the University of Vienna in 1924 (from this time participating in the Vienna Circle). Graduated with doctorate in 1928. As a postgraduate she worked and remained in Vienna until she emigrated in 1939 (Rand 2002; Keintzel & Korotin 2002, 605).

[70] Born 1895, Rauscher achieved a doctorate in law in 1924. He was student of Schlick's (Stadler 2001, 594; Uebel 2012). No other absences.



[71] Biographical details are unknown.
[72] Born and educated in Germany, Reidemester arrived in Vienna in late 1922. Left Vienna in 1925 (Bachmann, Behnke & Franz 1972, 1; Becchio 2009, 104). Feigl has recalled that Reidemester had not been in Vienna long when the early Vienna Circle meetings began in 1924 (Feigl 1981, 60).
[73] Reisch was president of the Austrian Central Bank in the 1920s, and was in Vienna throughout this period. No known absences (Krasensky 1988, 55; Klausinger 2015b, 5).
[74] Born in Poland in 1902, Rosenstein-Rodan came to Vienna to study (probably in 1920). Gained his doctorate in law in Vienna and became Mayer's assistant. Was present until he emigrated to Britain in 1931 (Schulak & Unterkofler 2011, 134).
[75] Biographical details are limited. Schachter was ordained as a rabbi in 1926. He then received his doctorate from the University of Vienna in 1931 (Tadmor 1997, 89). It is likely he was present from 1927 onwards.
[76] Born in 1889, Schams was a student of Schumpeter's at Graz (Hayek 2002, 30; Schulak & Unterkofler 2011, 135). He then taught at Vienna's *Technische Hochschule* (Schulak & Unterkofler 2011, 135). In 1931 was a public official, before that had perhaps spent some time in Paris on a Rockefeller scholarship (Hülsmann 2007, 367; Hayek 2002, 167). Mises recommended Schams for a scholarship in 1929 (Hülsmann 2007, 367), so it is likely he spent 1930 away from Vienna.
[77] Born in 1901, Schiff had no absences before emigrating from Vienna in 1938 (Schulak & Unterkofler 2011, 135).
[78] Biographical details are limited. All that is known was that he was the cousin of Erich Schiff and Karl Popper, and was arrested during *Anschluß* (Hacohen 2000, 345; Craver 1986, 16).
[79] Born in 1889 in the Hungarian Soviet Republic. He fled to Vienna in 1919 (Leonard 2011, 87), and pursued a career in banking. No absences before he committed suicide on the day of *Anschluß* (Schulak & Unterkofler 2011, 135-136).
[80] Born in Berlin in 1882, Schlick held early academic appointments in Germany. He was appointed to Vienna in 1922, and was present for this period except for a visiting position in the US during 1929. He was murdered in Vienna in 1934 (Becchio 2008, 63; Akera 2006, 3; Oberdan 2013).
[81] Born in 1888, Schönfeld-Illy worked as an accountant and auditor in Vienna after WWI (Schulak & Unterkofler 2011, 136). No known absences.
[82] Biographical details are limited. Born in 1897, Schreier studied at the University of Vienna, obtaining his doctor of jurisprudence in 1920. He then spent some time studying in Germany. Back in Vienna, he made a living as an attorney (Schulak & Unterkofler 2011, 108) and successfully completed his *Habilitation* in 1925 (Klausinger 2014, 193).
[83] Was in Vienna throughout this period, worked at the Austrian Ministry of Trade and lectured at the University (Klausinger 2015b, 5; Schulak & Unterkofler 2011, 61).
[84] Born in Vienna in 1899, Schütz returned to Vienna from WWI in 1918 (Kurrild-Klitgaard 2003, 43). No absences before emigration in 1938 (Kurrild-Klitgaard 2003, 57; Barber 2012).
[85] Biographical details are sparse. Strakosch von Feldringen was born in 1867 and worked in industry in Vienna (Craver 1986, 18; Mises 2009, 69). No known absences.
[86] Strigl was a contemporary of Mises, and was present in Vienna throughout this period (Schulak & Unterkofler 2011, 129; Hülsmann 2013).
[87] Entered the University of Vienna in the fall of 1925 (Taussky-Todd 1980, 10), and obtained her doctorate in 1930. Spent 1931 and 1932 in Gottingen, was back in Vienna in 1933, but left for the US in 1934 (Taussky-Todd 1980).

Tintner, G[88]													
Vögelin, E[89]													
Waismann, F[90]													
Wald, A[91]													
Waelder, R[92]													
Wilde, J[93]													
Winternitz, E[94]													
Zilser, E[95]													

[88] Born in 1907 and earned his doctorate in 1929. It is likely that Tintner entered the University of Vienna in 1926. He conducted research work at the LSE in 1930, and had a Rockefeller Scholarship from 1934 - 1936 (Sengupta 1969, 20-21; Klausinger 2006b, 623).

[89] Born in 1901, Vögelin studied at the University of Vienna and obtained his doctorate in 1922. Conducted further studies in the US from 1924 - 1925, and spent a third year in Paris in 1926. Returned to Vienna in 1927, stayed there until 1938 (Heilke 1999, 3 - 5; Vögelin 2011, 31, 56, 66, 68).

[90] Waismann grew up in Vienna and began his tuition in 1922 under Schlick. He emigrated to England in 1937 (Feigl 1981, 60).

[91] Wald arrived in Vienna in 1927 from what is present-day Romania, graduating with his doctorate in 1931. He was absent from Vienna from late 1931 to 1932. Returned in 1933 and was present until 1938 (Leonard 2011, 96-97; Morgenstern 1951). Stadler's record of Colloquium proceedings indicate Wald only began participating in the 1930 sessions (Stadler 2001, 208-9).

[92] Waelder was a Vienna-born psychoanalyst. He achieved a doctorate in physics in 1921. No absences except emigration in 1938 (Guttman 1986, 839).

[93] Wilde was born in Budapest in 1891. He achieved his doctorate at the University of Vienna in 1918. He was back in Budapest from 1918 – 1922, and was present in Vienna from 1923 -1938 (Hirst 1971, 155).

[94] Born in 1898, Winternitz studied in Vienna and obtained his doctorate in political science in 1922. He studied in Hamburg in 1923 and was back in Vienna from 1924. Emigrated from Vienna in 1938 (Kopp 2004).

[95] Zilsel was born in 1891. He was in Vienna throughout this period, emigrating to the US in 1939 (Raven & Krohn 2000, xix).