Umanistica Digitale – ISSN: 2532-8816 – n. 17, 2024
M. Nicastro – *Combining Network Analysis and GIS for Music Historiography: Genre, Urban Space and Music Ecologies*
DOI: http://doi.org/10.6092/issn.2532-8816/19246

Combining Network Analysis and GIS for Music Historiography: Genre, Urban Space and Music Ecologies

Martin Nicastro

University of Pavia
nicastromartin@gmail.com

Abstract

The objective of this article is to present the potential of network analysis in the field of music historiography. Starting from previous research, I will try to expand the applicative horizons of the technique in two different ways. First, by involving a wide plurality of music practices; then through the employment of Geographic Information Systems (GIS). The case study examined will be the live music scene of Milan at the time of the economic boom (1958-1962), observed through the lens of a data set of 8288 musical events. Network analysis will allow us to synchronically visualize different types of relationships, such as the ones between performers and composers, which appear to have been unequivocally reticular. Then, it will be possible to demonstrate how the properties of these networks are closely linked to music genre and mediated by urban and performative space. Finally, the consonance between the results achieved and pre-existing historiographical research will suggest the effectiveness of an "ecological" approach to musical network analysis.

Keywords: Network Analysis, Digital Mapping (GIS), Music Historiography, Urban Space, Live Music Ecologies

L'obiettivo di questo articolo è mostrare le potenzialità dell'analisi di rete nell'ambito della storiografia musicale. A partire da ricerche precedenti, cercherò di espandere gli orizzonti di applicazione della tecnica coinvolgendo nell'indagine una pluralità di pratiche musicali e utilizzando i sistemi informativi geografici (GIS). Il caso di studio esaminato sarà quello della scena musicale della città di Milano durante il boom economico (1958-1962), osservata attraverso la lente di un data set di 8288 eventi musicali. Le tecniche utilizzate permetteranno di visualizzare in maniera sincronica diversi tipi di relazioni, come ad esempio quella tra performer e compositori, le quali assumono in maniera inequivocabile le caratteristiche di una rete. Attraverso l'analisi algoritmica sarà quindi possibile dimostrare come le proprietà di queste strutture reticolari siano strettamente legate al sistema dei generi musicali dell'epoca, nonché catalizzate dallo spazio, urbano e performativo, in cui prendono forma. Infine, la consonanza tra i risultati raggiunti e ricostruzioni storiografiche preesistenti suggeriscono l'efficacia di un approccio "ecologico" all'analisi di rete in campo musicale.

Parole chiave: Analisi di rete, Mappatura digitale (GIS), Storiografia musicale, Spazio urbano, Ecologie della musica dal vivo

Copyright © 2024 The Author(s)
The text in this work is licensed under the Creative Commons BY License.
https://creativecommons.org/licenses/by/4.0/

Introduction

In parallel with the growing awareness of the ubiquity of reticular structures across different fields of knowledge, network analysis has established itself as a particularly versatile research methodology.[1] Starting around a decade ago, network theory tools have also found application in the musicological field. In particular, the work carried out by Nick Crossley[2] has proven how, given the relational nature of the practices we define as music, network analysis can constitute an innovative front of investigation.

His research moves from "musicking", a neologism coined by Cristopher Small to describe the performative and collective nature of music practices, in contrast with the conception of music as a series of objects ("works") created by individuals.[3] This need for mutual collaboration leads to the formation of "music worlds"[4], which offer the necessary conditions for the coordination between all the individuals involved in musicking. Therefore, these "worlds" are both a consequence and a prerequisite for music practice. Since they are constituted by networks of relationships, Crossley concludes,[5] the study of music worlds can benefit from the employment of Social Network Analysis (SNA) techniques, intended as the application of network theory in the field of social sciences.

This methodology provides the possibility to visualize each network in its historical and geographical specificity: different types of analysis are then available, based on algorithms. It is possible to calculate, for example, the level of centrality of each musician: they can occupy peripheral, less influential, positions or be placed in strategic points, being able to connect otherwise non-communicating portions of the network. At the same time, we can evaluate the overall structure of the network analysing its average degree of interconnection or its relative density. All of this is possible because the relationships that make up each music world can be translated into quantifiable variables, the interpretation of which allows us to understand the consequences that the network entails for each actor and vice versa.

Building on these assumptions, I would like to expand the methodological framework outlined by Crossley. In doing so, I will present as a case study my work on the live music scene of the city of Milan during the years of the first economic boom (1958-1962). In the first part, I will try to involve a plurality of "music worlds" within the analysis, with the aim of highlighting structural differences as well as mutual relationships. In a second moment the investigation will put into practice a combination of network analysis and geospatial data visualization tools (Geographic Information Systems), delving deeper into the role of space, urban and performative, as a relational catalyst.

[1] [2].

[2] [16].

[3] [37], 8-9.

[4] [4].

[5] [16], 2-3.

Analysing multiple music worlds: the reticular structure of genre

In Crossley's work each music world can be classified based on style and geography. Each style can then be broken down into a series of local scenes, often associated with urban centres ("the Liverpool jazz world, the Birmingham metal world, etc.").[6] Following a well-rooted reductionist trend within music studies, SNA tend to examine a given style in a more or less large geographical area.[7] As argued by Ruth Finnegan, the reverse path – i.e. the inclusion of all of practices active in a local context – is rarely followed.[8]

However, the broadening of the perspective is already implicit in the current methodological framework: no music world exists, in fact, in isolation from the others but it functions as part of a wider network of exchanges.

The starting point for the demonstration of this thesis will be a data set including detailed information on 8288 live music performances held in Milan from 1958 to 1962.[9] The data were collected manually starting from two historical sources: the newspapers *Il Giorno* and *Corriere della Sera*. In both cases, I found myself faced with a section specifically dedicated to the music events that would be held, day by day, in the city. These "pagine degli spettacoli" were practical interfaces to access the Milanese cultural life and report precise space-time coordinates (place, address, time), as well as information relating to performers, repertoire, and, less frequently, to the cost of the entrance ticket. Thanks to this data set, it was possible to create various network graphs[10] using the open-source software Gephi.[11] This allowed me to correlate elements such as venues and musicians or to examine the relationships between performers and composers.[12]

[6] [16], 2.

[7] An important exception is represented by the work of Crossley and Emms who, for the first time, used SNA techniques to observe the relations between multiple music worlds (what they defined as a "music universe"), with the exclusion of classical music: [15]. Despite the encouraging results, this approach does not appear to have had any continuation and was only revisited by Crossley himself, starting from the same empirical data about UK music festivals. [12][12], 123-131.

[8] [23], 7.

[9] [34].

[10] All network graphs are accessible in vectorial format on the website dedicated to the research [33].

[11] [3].

[12] All data visualizations created during the research, including network graphs, can be replicated starting from the data sets, scripts and Gephi projects published via Github. [34].

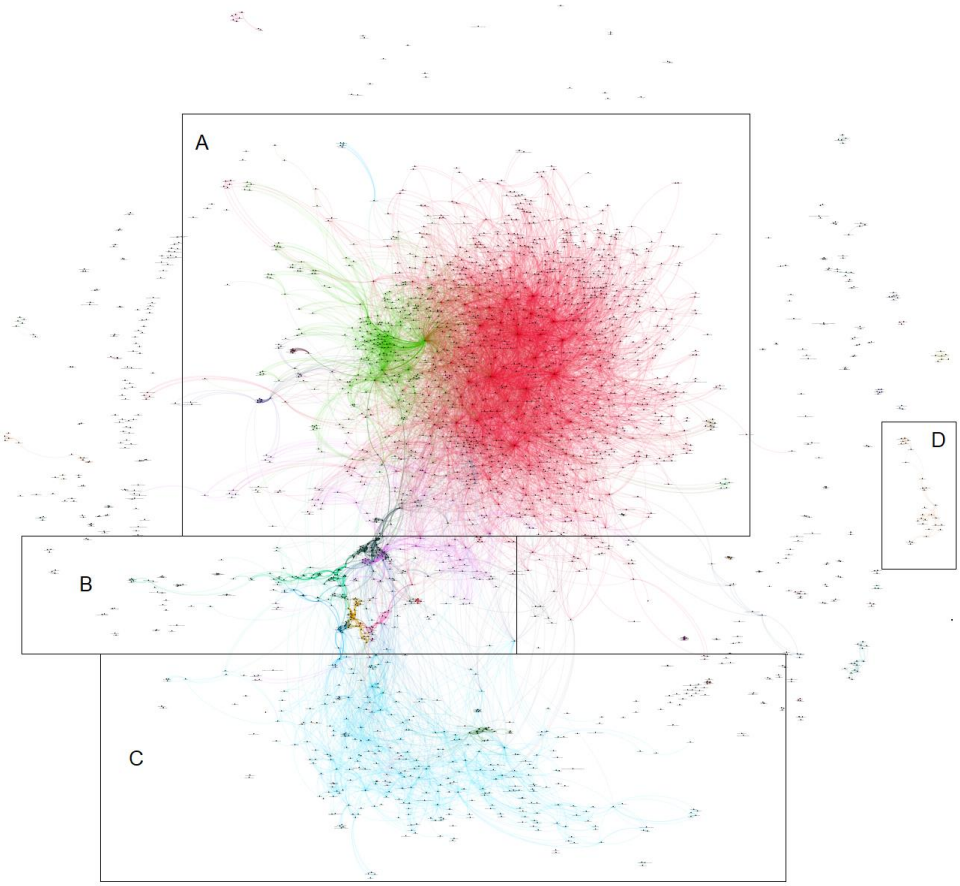

Figure 1: "Performers_composers" graph.

Of particular interest in this phase of the discussion is the "performer_composers" graph[13] [Figure 1]. The visualization represents every occasion in which two musicians participated in the same event and every time a composer's music was played by a given performer. Like any network graph, it is made up of two fundamental elements: nodes, circular symbols that stand for the entities placed in relation; edges, the links that represent the interconnections between the nodes. In this case the graph is made up of 2486 nodes, of which 1907 are performers and 579 composers, and 11904 edges. To each edge is attributed a value that corresponds to the number of times a relationship has occurred. Considering the quantitative weight of each edge, the number of effective connections is 52282.

[13] Direct link to vectorial image (given the size of the graph it may be necessary to decrease the zoom level of the browser): https://bit.ly/perf_comp_graph

The spatialization algorithm used to create the graph considers the totality of these connections. The layout "Force Atlas 2"[14] modulates the level of attraction or repulsion between nodes based on the weight of each relation, working as a gravitational force: the higher the value attributed to an edge, the closer the nodes that it links together will be to each other. Therefore, the topology of the graph is already in itself a detailed analysis of the data in our possession.

From this point of view, we can note three macro-areas: a large cluster, located in the upper part [A]; a connecting portion that acts as a bridge [B]; a second cluster, less extensive and located in the lower part [C]. What immediately catches the eye is how these three areas correspond to three well-defined music worlds: cluster A groups together the performers and composers of Western art music; section B includes music that employs scenography (opera excluded), such as prose theatre, musical comedy and operetta; finally, cluster C brings together the varied practices that compose the universe of popular music and jazz. In the data set there is no mention of music genre or style: the genres, and the respective music worlds, are not defined a priori but emerge a posteriori as a result of the analysis.

This discovery may constitute new experimental evidence within the debate on music genre, a term that I consider more suitable in this context than style. In fact, the definition of genre can entail all the semantic aspects inherent to the differentiation of music practices. Based on a continuous negotiation between all the subjects involved in musicking,[15] music genres appear to play a crucial role in the production of music meaning. On the other side, style is usually described as a more objective categorization system, limited to how sound is concretely organized.[16] Then, going back to what is considered the first theoretical contribution on genre in the field of popular music studies, we can already find an intuition about the reticular nature of the social negotiations that constantly define it.

Building upon his definition of genre as "a set of musical events (real or possible) whose course is governed by a defined set of socially accepted rules,"[17] Franco Fabbri proceeds to delve into how and when these rules come into action, concluding that genre is not definable within "a point" but rather as the result of "a network of relationships."[18]

This theory matches exactly with the results obtained from my application of network analysis techniques to an extended number of live music performances. In this case, music genres did not emerge as categorical attributes but rather indirectly in the morphology of the networks that unite them.

The concept of network is even more central in recent contributions. Rick Altman, a recurring name in the contemporary debate on music genre, states that "every generic system is made up of an interconnected network of user groups and their supporting institutions, each using the genre to satisfy its own needs and desires".[19] David Brackett in *Categorizing Sound* writes that

[14] [27].

[15] [38], 22-24.

[16] [31].

[17] [17], 52-81.

[18] I refer here to the first draft of the contribution, published in Italian on the scholar's website and here translated by me, in which a more explicit reference is made to a reticular conception of the musical genre. [19], accessed March 11, 2024.

[19] [1], 195.

"genre affords us a different perspective on creativity, emphasizing its social nature, and the interconnections between artists (producers) and audiences (consumers)."[20] Finally, Fabian Holt in his ethnographic work on musical genre decides to adopt:

> a broad and inclusive concept of network for the communicative relations between the many different agents that create and sustain a genre's identity. The network of an individual genre remains broad and fluid, interwoven in complex cultural textures.[21]

Despite the recurrence of the words "network" and "interconnection", the comprehensive study of a music generic system in a limited geo-historical context has never been approached through network analysis. Nevertheless, the "performers_composers" graph proves that network theory is a particularly effective tool for the description of generic categorizations.

The graph [Figure 1] offers many other points of interest. At an overall level, it reveals the consistency of the Milanese performance network of the time. The main component, where the definition of "component" stands for a network in which each node can reach the other through a given path,[22] includes 78.39% of the nodes and 95.89% of the edges. Furthermore, this is probably an underestimate given that at least some of the minor components are disconnected from the main one due to data features, not because of an effective isolation.

This is the case of an "island" located in the right portion of the visualization, which represent the relationships between modern jazz musicians from the United States, including John Coltrane, Miles Davis, Ella Fitzgerald, Stan Getz, and Dizzy Gillespie [Figure 1; panel D]. The lack of a connection with the main component demonstrates that in theatrical performances, such as those offered within the format "Jazz at the Philharmonic" founded by Norman Granz, no contamination occurred between these musicians and local jazz musicians. However, it does not mean that there was no contact: other sources testify that these performers played together in more informal situations[23] but given the non-predictability of this type of performances the newspapers were rarely able to track them.

The graph also allows us to appreciate the functioning of each music world based on structural differences in their relational networks. The "classical music" cluster [Figure 2] exhibits a clear "core-periphery"[24] conformation: at its centre we can find the composers of the eighteenth-

[20] [8], 15.

[21] [25], 21.

[22] "A component is defined as a maximal set of nodes in which every node can reach every other by some path. The "maximal" part means that if you can add a node to the set without violating the condition that everyone can reach everyone, you must do so": [7], 20.

[23] [20], 182.

[24] "A network has a core-periphery structure to the extent that there is a set of core nodes that have ties to each other and to the periphery and there is a set of periphery nodes that are only connected to the core and not to each other": [7], 206.

nineteenth century European art music canon, such as Ludwig van Beethoven, Joseph Haydn, Robert Schumann, Wolfgang Amadeus Mozart, Johann Sebastian Bach, or Franz Schubert.[25]

On the contrary, the "popular" cluster [Figure 4] shows a much less dense, more jagged structure, devoid of a core. This could represent the mechanisms that regulate a younger and not yet codified set of practices, in which performers tend to perform their own music and heterogeneous repertoires.

The conformation of the "scenic" cluster [Figure 3] is, once again, different. In addition to the absence of a core, the network takes on a thread-like and long-limbed structure, underlining the involvement of musicians and repertoires from other music worlds. The thickness of the edges, here greater than in other parts, symbolizes a continuity in terms of collaborations, typical of theatre companies that tend to rely on the same group of performers and to produce a high amount of shows.

The results obtained through an analysis of the modularity of the network,[26] which can identify the existence of subnetworks based on relational intensity, further deepen our grasp on the diversity of each music world. Once the minor components and isolated nodes have been filtered, the main component is divided by the algorithm into 20 communities. In the graph they are highlighted by different colours.

[25] Among these W. A. Mozart, L. van Beethoven, and J. S. Bach stand out. Their nodes obtained the highest eigenvector centrality values within the graph (respectively: 1.0, 0.87, 0.83). This centrality measure can be used as an indicator of the existence of a core. The complete results of the analysis are accessible from the dedicated folder in [34].

[26] [6]. Complete results in [34].

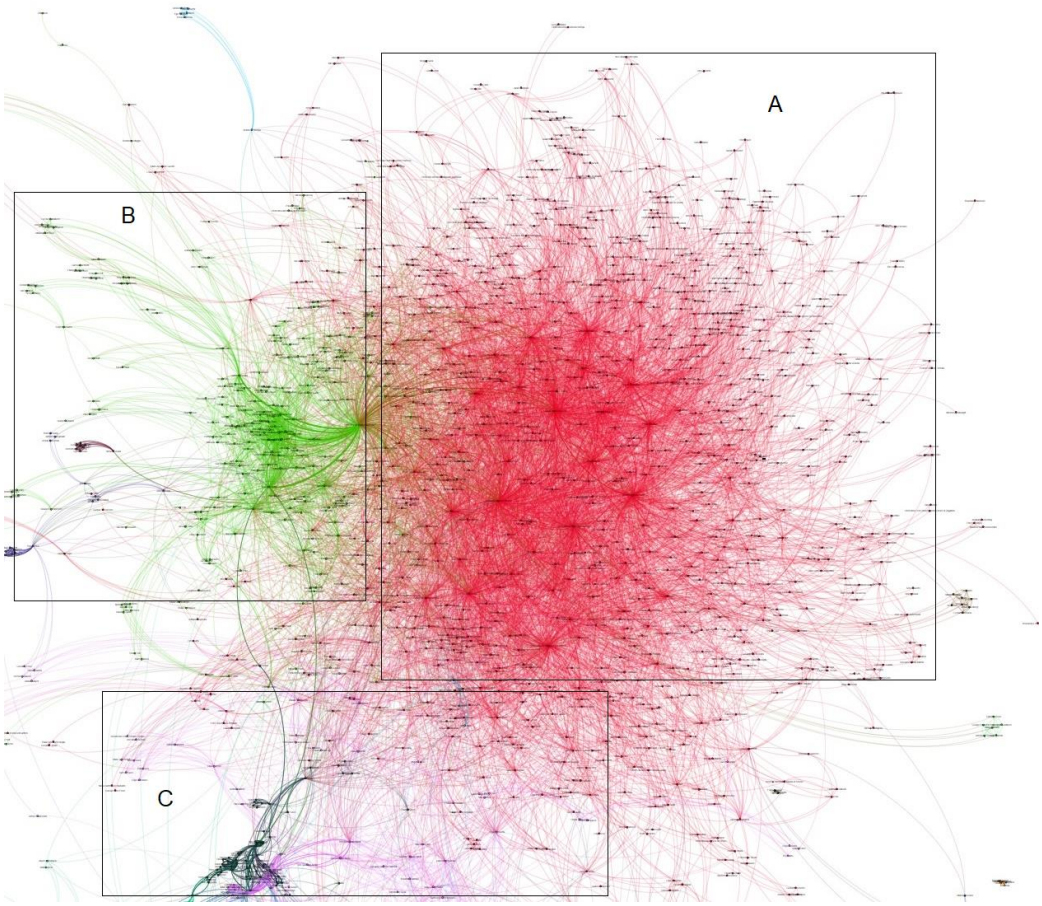

Figure 2: The "classical" cluster.

Each of the three clusters reacted differently to the algorithm. The "classical music" cluster [Figure 2] was divided into three communities, coinciding with three music subgenres: the world of instrumental music in red [Figure 2; A] and that of opera, clearly distinguishable, in green [Figure 2; B]. The world of early music is highlighted in pink, albeit with significant trespassing into the scenic area [Figure 2; C].

The "scenic" cluster [Figure 3] was decidedly reactive to the analysis, which detected five different communities (six if we count the portion common to the early music area). As before, the results produced by the analysis delimit different music genres and highlight their relationships. At the top, next to the connection with the "classical music" cluster, we find the area of prose theatre, where the performers linked to Piccolo Teatro stand out [Figure 3; D]; theatre companies linked to operetta are located in an intermediate and more lateral position [E]; several performers engaged in musical comedy are just below [F], connected to the "popular" cluster.

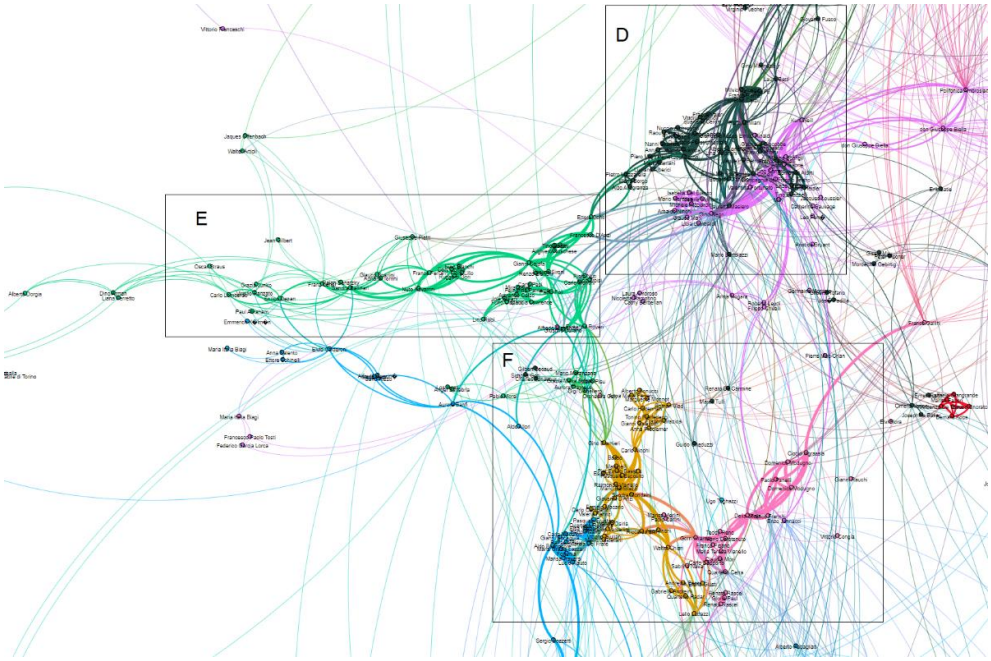

Figure 3: The "scenic" cluster.

Finally, it's important to note the lack of differentiation within the popular world [Figure 4], even though this includes an extremely large number of genres, such as different traditions of song (Neapolitan, Italian, French and international), jazz (modern and traditional), *cantautorato* and rock and roll. The entire cluster appears uniform in light blue, except for two rather small communities [Figure 4; H, G].

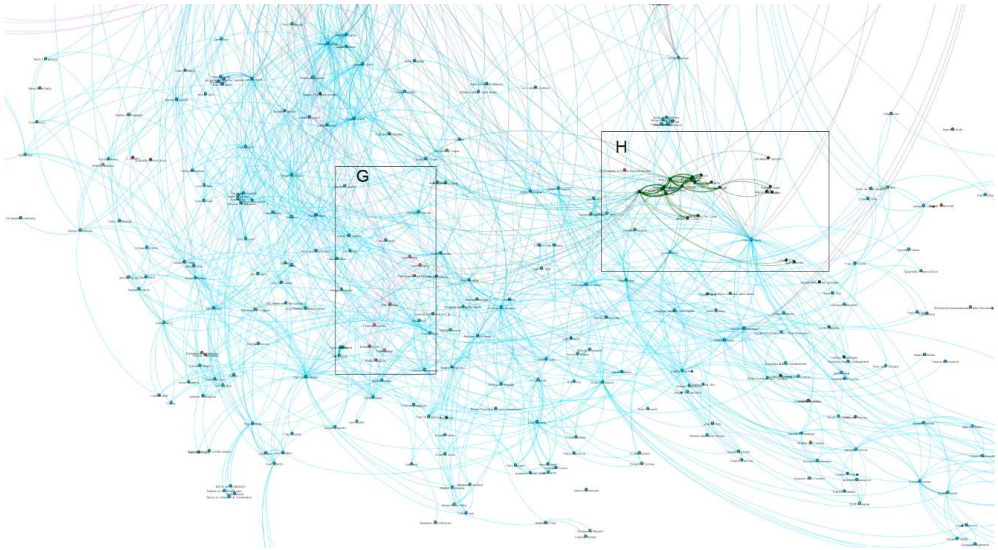

Figure 4: The "popular" cluster.

However, these two subnetworks are particularly limited in extension. They do not correspond to defined subgenres but rather to scenes which take shape around specific venues, as in the case of the Olimpia Music Hall [Figure 4; H]. The tendency exhibited by the "popular" cluster is only apparently inconsistent with the rest of the results. At a closer look, it is instead coherent with the reconstruction proposed by music historiography on the topic. At the time, popular music industry continuously involved jazz instrumentalist as session musicians for both live and studio productions. A partial commonality in terms of musical language between jazz and popular repertoires, united with a high level of expertise, made them the most suitable professionals for setting up accompaniment groups. Franco Fabbri writes in this regard:

> At least until the end of the 1960s, when a new generation of musicians trained in rock'n roll and beat appeared, the instrumental parts of "pop music" records (in Milan as elsewhere) were recorded by musicians of jazz extraction, many of whom came from the Orchestra di Ritmi Moderni della Rai. Therefore, it is not at all surprising if we find, in the night clubs and in the same formations where jazz was cultivated in the fifties and sixties, the names of the singers and instrumentalists who animated the nascent rock'n roll, and little later, cantautori scene: Ghigo Agosti, Adriano Celentano, Giorgio Gaber, Enzo Jannacci, Luigi Tenco, up to Lucio Battisti.[27]

The fact that network analysis, starting from an extremely large and generic data set, has clearly highlighted the interdependence between these practices proves its potential in the context of music historiography. It is also important to underline that this is only one of the numerous

[27] [18], 131, my translation.

arguments that could be made starting from even just a single graph.[28] Here, however, we opt to use the remaining space to further expand the approach, introducing digital mapping tools into the discussion.

Space as a relational catalyst: combining network analysis and GIS.

The "performers_composers" graph [Figure 1] offered a first look at the relationships between different music worlds in the Milanese local scene, detecting the role of "scenic" practices as a bridge between art and popular music. The same point is proven by a second graph, named "spaces_performers" [Figure 5], where each musician is put in relation with the venues where they performed.[29]

The graph is made of 1985 nodes (123 venues and 1714 performers) and connected by 2517 edges. As in the previous case, each edge comes with its own weight, based on the number of times a performer has played in each location, for a total of 18371 links. The internal cohesion of the network is even higher than before, given that the main component of the graph involves 95.11% of the nodes and 97.81% of the edges.

The colours of the edges represent the categories of the venues. These are based on their original classification within the newspapers used as sources. From top to bottom we find: concert halls in light blue, theatres/concert halls in red (i.e. theatres that hosted both scenic and instrumental performances), "pure" theatres in dark blue, night clubs in orange on the bottom-left, and *cinema teatro* in green on the bottom-right. From the topology of the graph alone, it is already possible to observe how theatres (in red and dark blue) function as a connective tissue between the upper and lower portions of the network. The spatialization algorithm, which is a first layer of analysis, placed them in the central area.[30]

[28] We could, for example, study the role played by certain performers or composers within the network. Through an analysis of betweenness centrality it is possible to identify which of them play a more important role in connecting portions of the graph, and therefore music genres, that are distant from each other. Among these, the figure of Gino Negri reached a very high position in terms of centrality, proving, via different means than "traditional" musical analysis and archival research, his extraordinary versatility. [30]; [34].

[29] Direct link to vectorial image: https://bit.ly/spaces_perf_graph

[30] Also in this case, the graph was created using the "Force Atlas 2" layout.

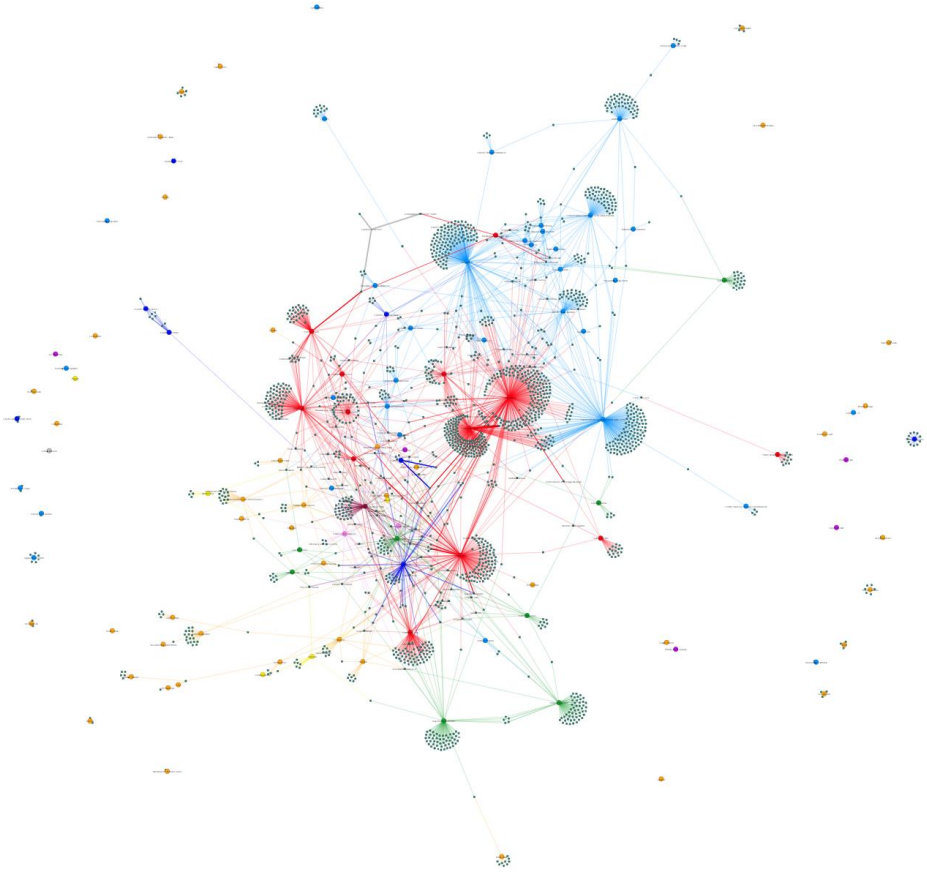

Figure 5: "Spaces_performers" graph.

This trend can be examined in more detail through betweenness centrality [Figure 6], a measurement that detects which nodes occupy strategic positions within the network based on their placement on obligatory paths between far away areas.[31] Seven positions in the top ten are occupied by venues that host "scenic" performances. Among these we find Teatro Nuovo, which obtained the first position with a notable margin.[32] The presence of three concert halls dedicated almost exclusively to the repertoire of Western classical music, namely the two halls of the Conservatory and Angelicum, should be contextualized.

[31] [9].

[32] Complete results: https://bit.ly/perf_spaces_analysis

Name	Category	Betweenness Centrality
Teatro Nuovo	Theatre/concert hall	738557.44
Teatro Lirico	Theatre/concert hall	381289.80
Conservatorio G. Verdi (sala Verdi)	Concert hall	346057.04
Teatro alla Scala	Theatre/concert hall	318953.43
Angelicum	Concert hall	282932.51
Teatro Gerolamo	Theatre/concert hall	217562.26
Teatro Manzoni	Theatre/concert hall	137195.64
Supercinema Alcione	*Cinema teatro*	129045.93
Teatro Olimpia (Olimpia Music Hall)	Theatre/conc. hall/dancing	110411.95
Conservatorio G. Verdi (sala Puccini)	Concert hall	104988.13

Figure 6: Betweenness centrality results.

Contrary to what happens in the case of scenic performances, where a single event is repeated numerous times without any substantial change, recitals dedicated to Western instrumental classical music were different each time. For this reason, the networks formed around concert halls involve a higher number of performers. As a consequence, the values assigned to them by this type of analysis are higher on average.[33] The predominance in the top positions of theatres that host scenic music performances is then even more relevant. The remarkable margin between first and second position [Figure 6] can also be explained in this way, since Teatro Nuovo is the only theatre that consistently hosted both musical comedy (the most prevalent genre of scenic performance in the data set) and instrumental classical concerts.

In addition to the crucial role of the theatres – an element to which we will return in the following pages – a second tendency emerges: the first sixteen highest betweenness centrality values were all assigned to venues, not to performers. These results appear in line with the thesis proposed by Crossley in his investigation of the punk and post-punk worlds of Liverpool, London, Manchester, and Sheffield. The scholar states that certain urban performative spaces, such as Eric's in Liverpool, played a central role in forming relational networks. For this reason, they are identifiable as "network foci":[34]

> The most important mechanism of network formation, however, was what Feld terms the network focus: a place or event which like-minded individuals gravitate

[33] This tendency is further accentuated by eigenvector centrality, which measures how much a given node tends to be connected to nodes that possess a high number of connections themselves. Since Western art music venues are usually connected to more performers, both performers and venues obtained even higher values during this type of analysis. In this case, Teatro alla Scala placed second and numerous performers engaged in Western art music, such as Severino Gazzelloni or Gloria Davy, climbed up the ranks.

[34] [21].

> towards, bringing them into contact. […] The central focus of Liverpool's post-punk world between 1978 and 1980 was Eric's, a cellar-based club which hosted the lion's share of punk and post-punk gigs in the city. […] If, as I have suggested, networks are crucial to the formation of new music worlds then so too are the foci which generate those networks.[35]

Subsequently, Crossley argues that when similar "foci" spatially cluster, they multiply their network-shaping ability and therefore enhance the catalysation of music worlds.[36] Based on the data in my possession, I tried to verify this thesis by geolocating the "spaces_performers" graph.

The first step was running a modularity analysis in the attempt to break down the visualization into different music worlds as we effectively did for the "performers_composers" graph, with the historically motivated exception of the "popular" cluster. At a later stage, I proceeded to locate these subnetworks in geographic space, trying to prove the correlation between spatial proximity and music world distinctions based on the attendance by different sets of musicians.

This operation – carried out after excluding minor components and isolated nodes – led to the identification of ten different subgroups: these are observable in a different version of the graph, where colouring is based on the results of community detection.[37] During the analysis, the parameter linked to the resolution of the algorithm[38] was controlled in order to avoid an excessive atomization, given that each venue can potentially constitute a community in its own right. This is anything but a secondary aspect. If the segmentation of the "performers_composers" graph [Figure 1] rather clearly highlighted the extension of different music worlds, the introduction of venues made these boundaries much more blurred. In this case, a clear division is to a certain extent arbitrary: the resolution of the algorithm could also have been modulated differently, without necessarily producing a less effective visualization.

The high level of interconnection of the "spaces_performers" graph further problematizes the idea that urban music practices exist in watertight compartments, univocally connected to certain spatial contexts. This happens because, at least in the case of the Milanese scene of the time, the same venue lends itself to a multiplicity of practices at different times, while performers often play in heterogeneous places.

[35] [14], 45.

[36] "Individual gigs, venues and record shops might suffice for this but where they cluster, geographically, creating a wider urban space where the like-minded hang out over extended periods, network formation is clearly enhanced". [14], 45-46.

[37] [33].

[38] In practical terms lower resolution values produce smaller communities and vice versa. [29], 76-90.

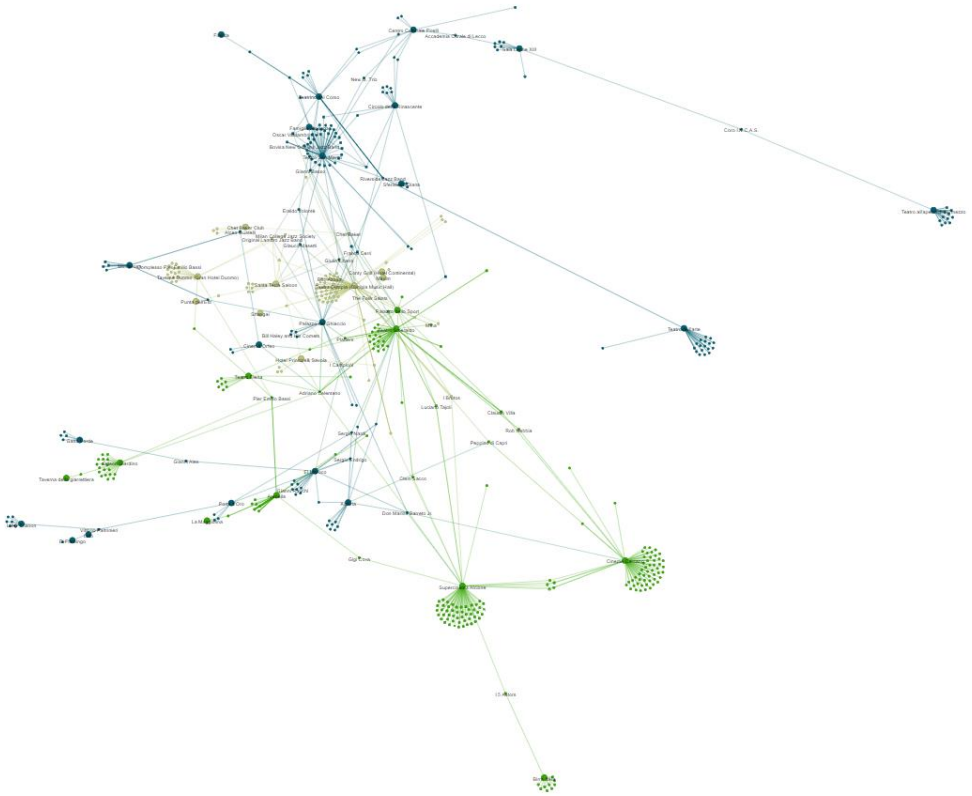

Figure 7: Subnetworks 5, 6 and 7.

This does not weaken the theory according to which music worlds are differentiated by music genre. Nevertheless, it invites us to consider the role played by discursive processes in the creation of these boundaries. It is not only the fact that one or more performers have regularly performed in a venue to determine the latter's belonging to a particular scene, but also how these actions are negotiated within a community. The results of the collective discourse influence in turn the future choice of performers hosted by that venue, creating a continuous mediation, active on multiple levels, which constitutes the crux of music generic systems. This is why they are so elusive to reductionist definitions. These meaning production processes also play a major role in how we interpret data related to music practices, inevitably reflecting on the way we, as scholars and community members ourselves, circumscribe them. In this sense, the comprehensive analysis of a music system based on location, without limiting to one or more music genres, can reduce the risk of motivating on a quantitative level something that may be already implicit from the delimitation of the corpus.

This does not mean that the subnetworks identified through the analysis do not highlight any type of regularity. By filtering communities 5, 6, and 7 [Figure 7],[39] we can observe that names related to jazz, such as Gianni Basso, Chet Baker, and Franco Cerri, are predominant in the upper area of the graph, while artists linked to the world of Italian song, such as Mina, Claudio Villa and Adriano Celentano, are located in the lower section. However, defining these networks as a representation of the "Milanese jazz world" or the "world of Italian song in Milan" is not possible without incurring in arbitrary choices, such as having used a certain resolution value during the modularity analysis. The decision to exclude other subnetworks, given that they are all part of the same component, is also discretional.

For this reason, I prefer here the term "circuit", adopted by Cohen in her work on live music practices in Liverpool:

> Yet, circulation seems a particularly appropriate metaphor for thinking about live music because in Liverpool at least musicians commonly referred to live music "circuits" involving a sequence of regular performances around a particular group of venues circuits that were shaped by music genre (hence the notion of a "folk circuit") […].[40]

Not being exclusive (multiple live circuits can exist for a given genre), this concept appears to better describe the complexity of the relationship between venues and music genres. At the same time, it matches the results obtained through the geolocation of these subnetworks within a digital map. In this web GIS application[41] each layer, activated by a selector located in the top right corner, represents one of the communities identified by the modularity analysis. They also maintain the same colours used in the graph to improve readability.

To create this visualization, the original one was converted from a "two-mode" graph representing two different identity classes, namely "performer" and "venue", to a "one-mode" graph. In more practical terms, the geographical graph only represents links between spaces, using the number of shared musicians as edges. This value constitutes the weight of the new edges, which determines the thickness of the connection lines within the map. In the interactive version, the exact number becomes visible by hovering the cursor on each connection. The transformation from "two-mode" to "one-mode" was carried out in Gephi using the Multimode Networks[42] plugin and allowed the geolocation of all the nodes of the new graph.[43]

[39] Vector image: https://bit.ly/perf_spaces_communities

[40] [11], 598.

[41] Direct link to interactive version: https://bit.ly/perf_circuits_map. I built the application using the Leaflet for R package. [10].

[42] [28].

[43] The geolocation is based on the addresses found in the newspapers. For the visualization of geographic coordinates I have employed Gephi and the GeoLayout plugin. [27].

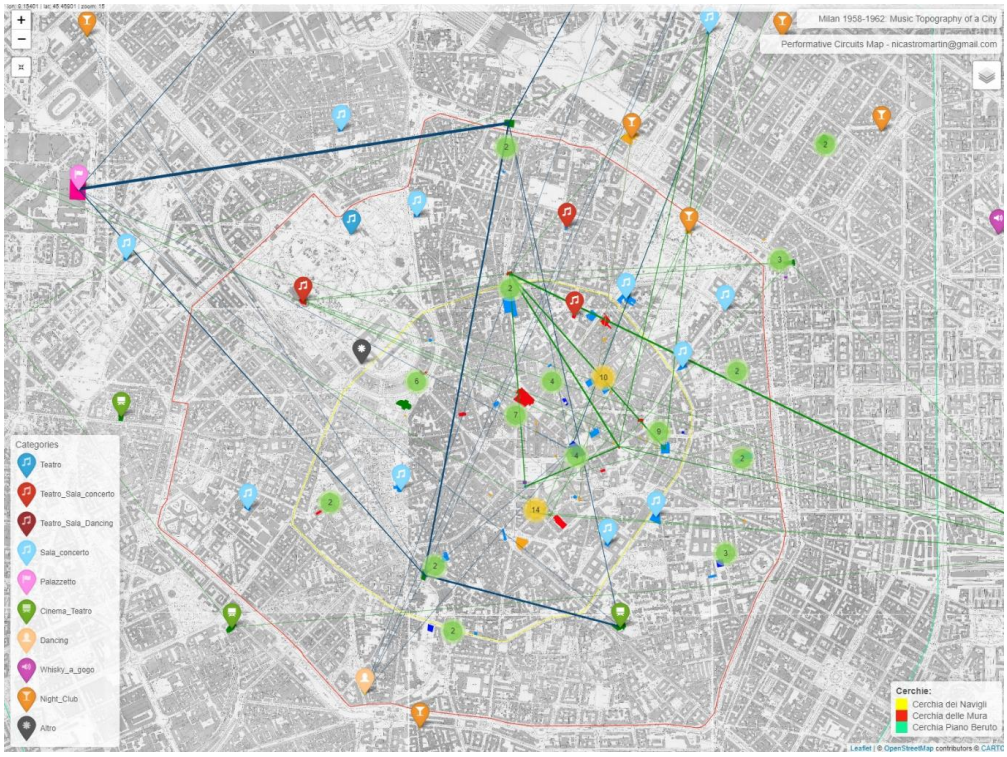

Figure 8: Subnetworks 5, 6 and 7 in geographic space.

If we examine the three previously filtered communities [Figure 8], we realize that these networks do not necessarily connect venues close to each other. On the contrary, musicians appear to travel urban space in all its length, taking the opportunity to perform where circuits are already consolidated or where it is possible to create new ones, regardless of distances.

The possibility of considering the spatial characteristics of a network graph through its geolocation helps us understand how, at least in this case study, movement and temporality are equally important metaphors as those relating to accumulation and delimitation. More than spatial proximity, it is the internal spatial features of the venues that influence the trajectories of the musician within the individual circuits: *cinema teatro* tend to be connected to other *cinema teatro*, even if they are distant from each other. This is the case, in fact, of subnetwork 6 (in dark blue) where we can observe the links between Teatro Elena [Figure 9; A], Teatro Smeraldo [B], Supercinema Alcione [C], and Cinema Carcano [D].

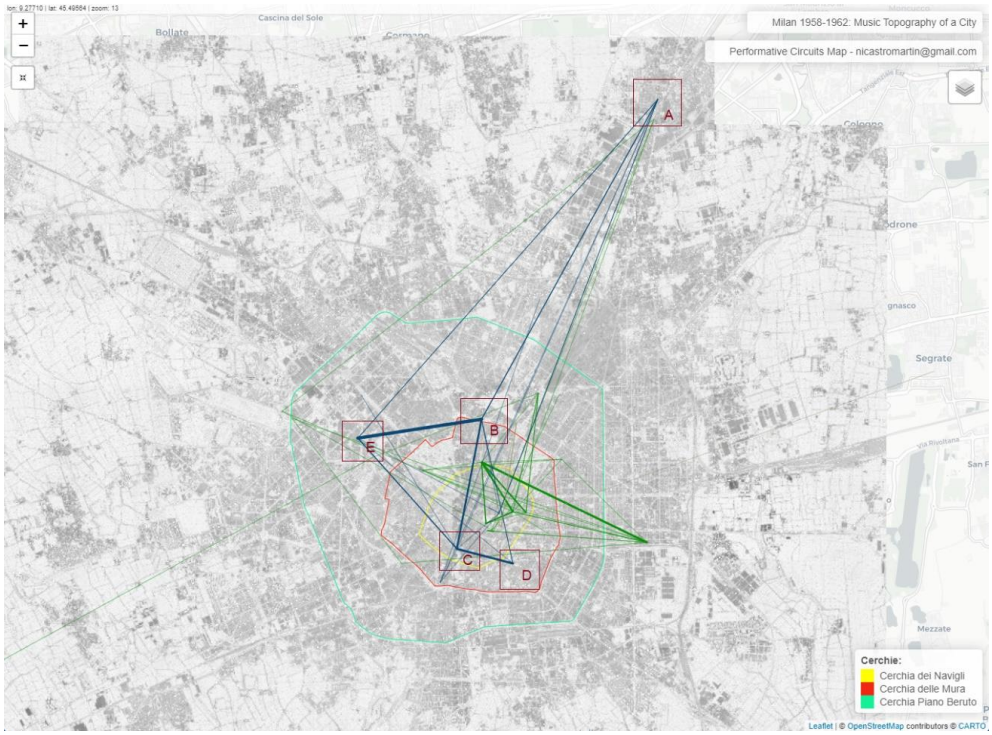

Figure 9: Subnetwork 6.

The data at our disposal seem to problematize Crossley's hypothesis on the correlation between urban clusters and their contribution to the formation of music worlds, from which we started. On the one hand, we found it difficult to identify a unique correspondence between places and practices solely based on quantitative data. On the other hand, performative circuits seem to be catalysed by the internal spatial characteristics of the venues, rather than by their positioning in the urban texture.

In truth, we happen to observe the same hypothesis re-emerge in a different light by just changing perspective. The betweenness centrality values of the "spaces_performers" graph [Figure 6] highlighted the ability of the "theatres/concert halls" to connect distant portions of the network. Using a dedicated map,[44] we can see that the venues belonging to this category were concentrated in the most central area of the city, more specifically within what is called "Cerchia dei Navigli" [Figure 10, in yellow]. Thanks to the combination of network analysis and GIS we discover how the centre of the performative networks corresponds to the centre of the city. As many as 11 out of 13 "theatres/concert halls" are located within an area whose average diameter is approximately 2 km, exhibiting a unique profile compared to that of the other categories, which are positioned differently within of the urban structure.

[44] Direct link to interactive version: https://bit.ly/perf_spaces_map

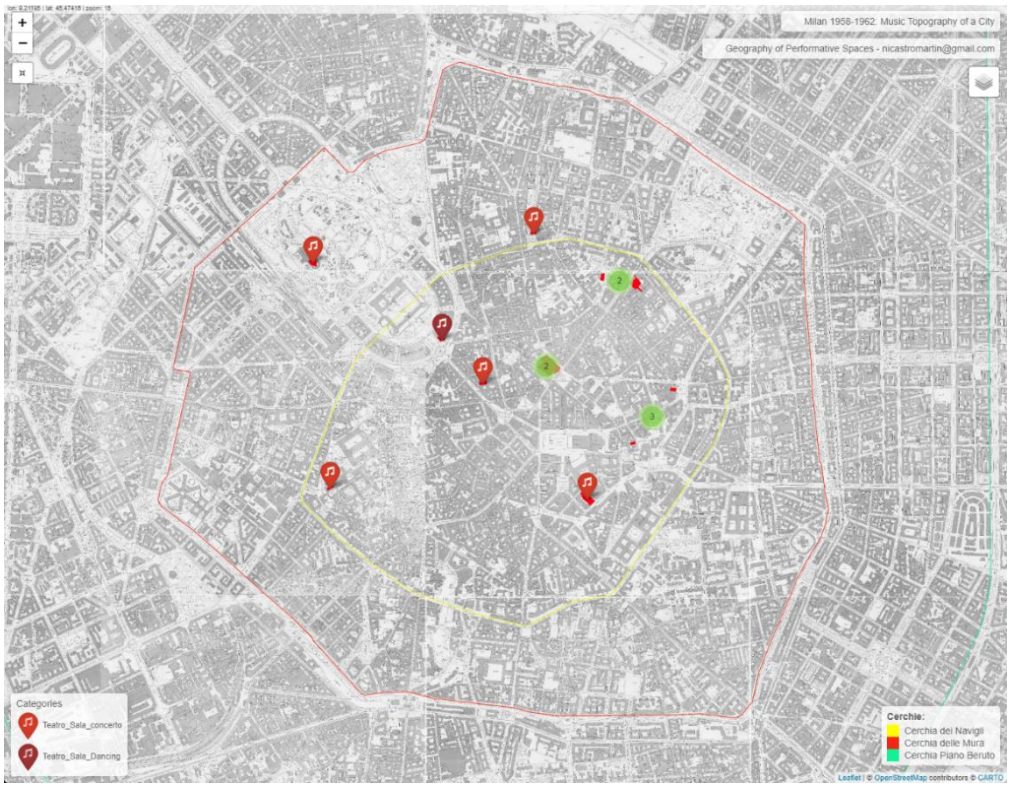

Figure 10: "Theatres/concert halls".

Conversely, the places located in the periphery of the graph, playing a secondary role in the overall network connectivity, tend to be positioned in the outermost circles of the city and to be separated by greater distances. This is what happens, for example, in the case of the "dancing" [Figure 11].

From this point of view, the correlation between the clustering of network foci in the urban space and their ability to catalyse connections appears to be concretely demonstrable, even if in a partially different sense. Instead of leading to the formation of individual music worlds, the concentration of venues in the urban fabric seems to have contributed to the connection between different subnetworks, heterogeneous performers, repertoires, and practices. Based on the metaphor of the "circuit", the city centre of Milan would have therefore acted as a directional hub where multiple trajectories crossed, allowing musicians to switch from one itinerary to another.

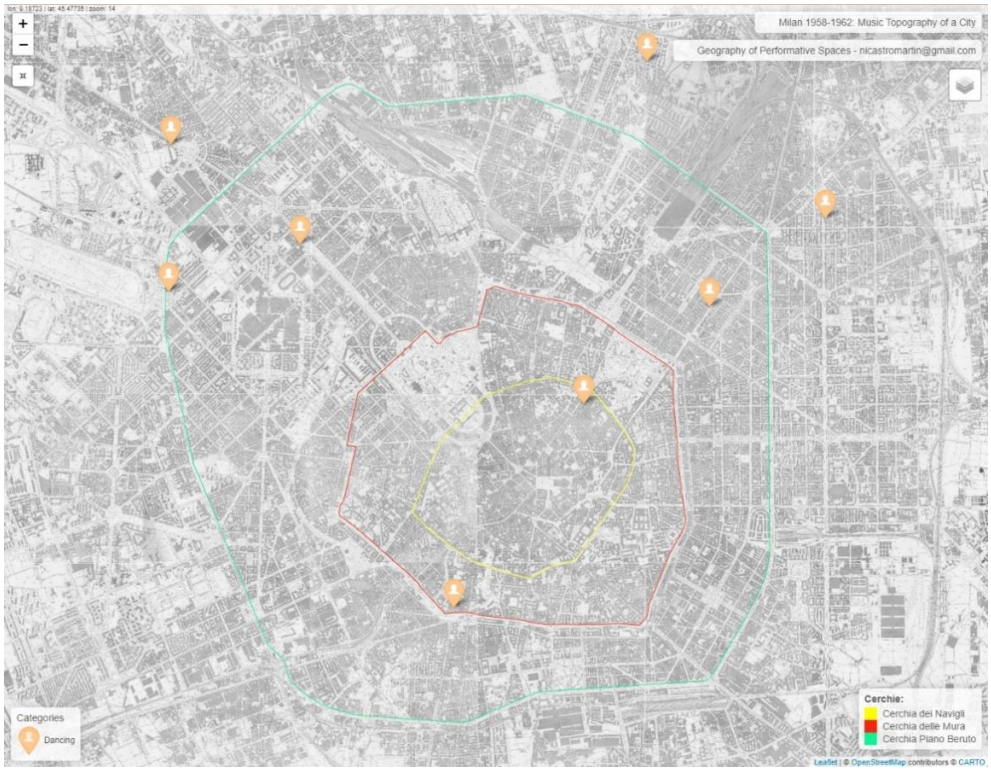

Figure 11: "Dancing".

Conclusions

Throughout the article I have provided an overview of two possible lines of development in the application of network analysis to the study of music practices. On the one hand, the comprehensive investigation of a spatially delimited live music system offered an innovative point of view on the functioning of music genres. On the other hand, the combination of network analysis and GIS allowed us to analyse the role played by urban and performative space in shaping the relations that bind different practices together.

In both cases, we moved beyond a strictly sociological approach. In fact, some of the relationships examined within the two graphs are not socially quantifiable. Within the "performers_composers" graph [Figure 1], a link between a performer and a composer does not necessarily mean that the two have come into direct contact, but just that the first performed music written by the latter. This is obviously the case of composers who lived in a distant past, such as the ones belonging to the classical canon. Similarly, the fact that two musicians played in the same venue, as represented in the "spaces_performers" graph [Figure 5], does not mean that they did so at the same time and that they were involved in a social relationship. While borrowing some techniques and concepts from social network analysis (SNA), the two

visualizations operate at a higher level of abstraction, in an attempt to assess whether the conceptual model of the network can be successfully applied outside the social relations that constitute music worlds.[45] From this point of view, I have adopted an "ecological" approach that includes a plurality of levels, such as materiality, within a socio-spatial consideration of music environments:

> Cultural sociologists have long understood the importance of a sense of place to our concepts of society, as can be seen in the various spatial metaphors that they have supplied popular music studies: milieu social (Durkheim), art world (Becker), cultural field (Bourdieu), pathway (Finnegan), and scene (Straw). But […] they do not really take into account the material and physical aspects of music making. […] an ecological study of live music means studying social agents which are not in any coherent ideological way members of the social networks that are described by Becker's art worlds, Bourdieu's cultural fields, or Finnegan's social pathways. Historically, as we discovered in our research, promoters have been well aware that the environment in which they have to work is material as well as cultural and political as well as economic.[46]

Based on the examples presented, the application of an "ecological network analysis" to the study of music practices appears to be promising. Despite the brief examination, this approach allowed us to demonstrate that the materiality of space acted not only as a context for performance but moulded music practices and their structural relationships.

In the case of Milan, we observed how the clustering of a certain type of venues, defined as "theatres/concert halls", in the city centre did not contribute to the formation of mono-genre performance networks. On the contrary, their central location corresponded to their role in connecting different genres and practices, as exemplified by the high centrality values obtained during the analysis of the "spaces_performers" graph [Figure 6]. It is then reasonable to affirm that this characteristic, linked to the specificity of Milan's urban structure of the time,[47] has contributed to shape the music production of the city. In fact, in one of the first historiographical contributions dedicated to the Milanese music scene after the Second World War, the period between 50s and 60s is so described:

> In the city of 25 April, which would soon become the "moral capital", new energies were released and initiatives multiplied […] These initiatives were often interconnected, a fact which the historiographical reconstruction cannot fail to take into account. […] the crossing of elements and, for example, the overcoming of a rigid opposition between art and popular spheres is a fairly accepted and visible feature of the music world to which we refer […].[48]

The conclusions reached from an ecological application of network analysis roots this reconstruction in the historical materiality of urban space. The agreement between historical data analysis and traditional music historiography is once again striking. At the same time, it must be

[45] Other attempts in this direction have been towards harmonic analysis ([32]) or classical music recordings metadata ([35]).

[46] [5], 6.

[47] [24]; [36].

[48] [22], 96-97.

said that the experimental nature of this methodology has important implications for its effectiveness. It does not allow, in fact, a truly comparative approach yet.

The percentages related to the extension of the main components of the graphs here examined[49] seem to provide further proof of the level of interconnection that distinguished the Milanese music of the time. However, in the absence of comparisons from other geo-historical contexts, we can only state that these are high numbers in an absolute sense, not that it was an exceptional case. The same point is valid for the conformation of the "performers_composers" network graph [Figure 1]. Without means of comparison we cannot tell if the bridge-like structure of the "scenic" cluster, connecting art and popular music, was common or peculiar during that period of time.

To appreciate the full potential of ecological network analysis, it will be crucial to expand the numbers of case studies, both synchronically and diachronically. Depending on data availability, the proposed techniques are highly scalable: they offer the chance of analysing any music scene in any given time through a fixed number of quantitative variables. Comparation, in fact, is implicit in the very concept of network theory. This may allow a large-scale study of the correlation between urban space and music production. If similar spatial and reticular features emerged in the case of similar practices then a typological theory would be at reach, laying the foundations for an ecological approach to music historiography.

Bibliography

[1] Altman, Rick. *Film/Genre*. London: British Film Institute, 1999.

[2] Barabási, Albert-László. *Linked: The New Science of Networks*. New York: Perseus Publishing, 2003.

[3] Bastian, Mathieu, Sebastien Heymann, and Mathieu Jacomy. "Gephi: An Open Source Software for Exploring and Manipulating Networks." *Proceedings of the International AAAI Conference on Web and Social Media* 3, no. 1 (March 19, 2009): 361–62. https://doi.org/10.1609/icwsm.v3i1.13937.

[4] Becker, Howard S. *Art Worlds*. Berkley: University of California Press, 1982.

[5] Behr, Adam, Matt Brennan, Martin Cloonan, Simon Frith, and Emma Webster. "Live Concert Performance: An Ecological Approach." *Rock Music Studies* 3, no. 1 (January 2, 2016): 5–23. https://doi.org/10.1080/19401159.2015.1125633.

[6] Blondel, Vincent D., Jean-Loup Guillaume, Renaud Lambiotte, and Etienne Lefebvre. "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.

[49] 78.39% of the nodes and 95.89% of the edges in the "performers_composers" graph; 95.11% of the nodes and 97.81% of the edges in the "spaces_performers" one.

[7] Borgatti, Stephen P., Martin G. Everett, Jeffrey C. Johnson, and Filip Agneessens. *Analyzing Social Networks Using R*. Newbury Park: Sage Publications, 2022.

[8] Brackett, David. *Categorizing Sound: Genre and Twentieth-Century Popular Music*. Oakland: University of California Press, 2016.

[9] Brandes, Ulrik. "A Faster Algorithm for Betweenness Centrality*." *The Journal of Mathematical Sociology* 25, no. 2 (June 2001): 163–77. https://doi.org/10.1080/0022250X.2001.9990249.

[10] Cheng, Joe, Barret Schloerke, Bhaskar Karambelkar, and Yihui Xie. "Leaflet: Create Interactive Web Maps with the JavaScript 'Leaflet' Library," 2024. https://github.com/rstudio/leaflet.

[11] Cohen, Sara. "Live Music and Urban Landscape: Mapping the Beat in Liverpool." *Social Semiotics* 22 (November 1, 2012): 587–603. https://doi.org/10.1080/10350330.2012.731902.

[12] Crossley, Nick. *Connecting Sounds: The Social Life of Music*. Manchester University Press, 2019.

[13] ———. *Networks of Sound, Style and Subversion: The Punk and Post–Punk Worlds of Manchester, London, Liverpool and Sheffield, 1975–80*. Manchester: Manchester University Press, 2015. https://www.jstor.org/stable/j.ctt18mvkkz.

[14] ———. "Totally Wired: The Network of Structure of the Post-Punk Worlds of Liverpool, Manchester and Sheffield 1976–80." In *Social Networks and Music Worlds*, edited by Nick Crossley, Siobhan Mcandrew, and Paul Widdop, 39–59. Abingdon: Routledge, 2014.

[15] Crossley, Nick, and Rachel Emms. "Mapping the Musical Universe: A Blockmodel of UK Music Festivals, 2011–2013." *Methodological Innovations* 9 (January 1, 2016): 2059799116630663. https://doi.org/10.1177/2059799116630663.

[16] Crossley, Nick, Siobhan Mcandrew, and Paul Widdop. *Social Networks and Music Worlds*. Abingdon: Routledge, 2014.

[17] Fabbri, Franco. "A Theory of Musical Genres: Two Applications." In *Popular Music Perspectives: Papers from the First International Conference on Popular Music Research, Amsterdam, June 1981*, edited by David Horn and Philip Tagg, 52–81. Gothenburg & Exeter: International Association for the Study of Popular Music, 1982.

[18] ———. "Altre Musiche a Milano, Dal Dopoguerra a 'Musica Nel Nostro Tempo.'" In *Milano Laboratorio Musicale Del '900*, edited by Oreste Bossini, 125–44. Milano: Archinto, 2009.

[19] ———. "Una Teoria Dei Generi Musicali. Due Applicazioni (Versione Originale Italiana)." Accessed March 11, 2024. https://www.francofabbri.net/files/Testi_per_Studenti/Teoria_dei_generi.pdf.

[20] Fayenz, Franco. "Milano, La Città Del Jazz." In *Le Capitali Della Musica. Milano*, edited by Giorgio Taborelli and Anna Crespi Morbio. Cinisello Balsamo: Silvana Editoriale, 1984.

[21] Feld, Scott L. "The Focused Organization of Social Ties." *American Journal of Sociology* 86, no. 5 (1981): 1015–35.

[22] Fertonani, Cesare, and Emilio Sala. "Per Una Storia Della Musica a Milano Nel Secondo Dopoguerra." In *Milano Laboratorio Musicale Del '900*, edited by Oreste Bossini, 95–98. Milano: Archinto, 2009.

[23] Finnegan, Ruth. *The Hidden Musicians: Music-Making in an English Town*. Wesleyan University Press, 2013.

[24] Foot, John. *Milan Since the Miracle: City, Culture and Identity*. Oxford: Berg Publishers, 2001.

[25] Holt, Fabian. *Genre in Popular Music*. Chicago: University of Chicago Press, 2007.

[26] Jacomy, Alexis. "GeoLayout," January 9, 2023. https://github.com/jacomyal/GeoLayout.

[27] Jacomy, Mathieu, Tommaso Venturini, Sebastien Heymann, and Mathieu Bastian. "ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software." *PLOS ONE* 9, no. 6 (giu 2014): e98679. https://doi.org/10.1371/journal.pone.0098679.

[28] Kuchar, Jaroslav, and Joan Codina. "Multimode Networks Transformations," January 9, 2023. https://github.com/jaroslav-kuchar/Multimode-Networks.

[29] Lambiotte, R., J.C. Delvenne, and M. Barahona. "Laplacian Dynamics and Multiscale Modular Structure in Networks." *IEEE Transactions on Network Science and Engineering* 1, no. 2 (July 1, 2014): 76–90. https://doi.org/10.1109/TNSE.2015.2391998.

[30] Moiraghi, Marco. *Voglio Un Monumento in Piazza Della Scala, La Milano Musicale Di Gino Negri*. Roma: Squilibri, 2011.

[31] Moore, Allen F. "Categorical Conventions in Music Discourse: Style and Genre." *Music and Letters* 82, no. 3 (August 1, 2001): 432–42. https://doi.org/10.1093/ml/82.3.432.

[32] Nardelli Buongiorno, Marco, Garland Culbreth, and Miguel Fuentes. "Towards A Measure Of Harmonic Complexity In Western Classical Music." *Advances in Complex Systems (ACS)* 25, no. 05n06 (2022): 1–11.

[33] "Network Graphs · Milan 1958-1962." Accessed March 11, 2024. https://musictopography.github.io//network_graphs/.

[34] Nicastro, Martin. "Milan_1958_1962_Music_Topography_of_a_City (v1.0.0)." Zenodo, 2023. https://doi.org/10.5281/zenodo.8340459.

[35] Park, Doheum, Arram Bae, Maximilian Schich, and Juyong Park. "Topology and Evolution of the Network of Western Classical Music Composers." *EPJ Data Science* 4, no. 1 (December 2015): 1–15. https://doi.org/10.1140/epjds/s13688-015-0039-z.

[36] Rossari, Augusto. "Milano 1861-2020." Accessed March 15, 2024. https://www.milanoattraverso.it/territorio/.

[37] Small, Cristopher. *Musicking. The Meaning of Performing and Listening*. Middletown: Wesleyan University Press, 1998.

[38] Tomatis, Jacopo. *Storia Culturale Della Canzone Italiana*. Milano: Il Saggiatore, 2019.