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Activate, collaborate, participate: The network revolutions of riot grrrl- affiliated music worlds

ABSTRACT

Social networks act as a metaphor for discussion about many historical and contemporary music worlds. Much of the literature on feminist music movements like riot grrrl, ladyfest and Girls Rock camps conceptualize collective action and participation in network terms. However, in doing so, the approach is almost exclusively qualitative. Individuals tie movements, collectives and organizations together and help their cultural spread across cities and countries. Yet individuals can also cause ruptures in networks that may lead to their collapse or fracturing. This article uses mixed-methods social network analysis (SNA) to unpack the structure, development and impact of a riot grrrl-associated music network across geographical space and time. By investigating the strong ties of shared band membership and playing together, the centrality of key bands and musicians across overlapping music movements associated with riot grrrl are explored at micro, meso and macro levels of network interaction. The ability to visualize music collaboration networks allows us to see patterns and connections that may not have been previously apparent. Whilst there is a small but growing body of work on punk using SNA methods, these have overwhelmingly been male dominated. This is the first formal network application on punk-inspired feminist music worlds that redresses the gender imbalance.

KEYWORDS

social network analysis
riot grrrl
homophily
scenes
critical mass
social movements
mixed-methods
music worlds

INTRODUCTION

Participants in feminist music worlds are a loose collection of self-reflective and collaborative cultural activists, involved in a process of articulating and understanding their activities whilst carrying them out. These activities might be perceived as being akin to social movement participation by virtue of an individual's involvement in particular politically orientated creative worlds. This conceptualization of feminist music worlds stems from earlier work (O'Shea 2014) influenced by Becker's art worlds thesis (Becker 1984) where he uses networks as a metaphor to describe collective action. Although riot grrrl chapters were active in a select number of cities across the United States, it was, and remains, a non-formalized network of associated music movements that came before it such as queercore (homocore) (Halberstam 2003; Shoemaker 2010) and the grassroots ladyfest festival movement that followed (Schilt 2004). Girls Rock camps are strongly connected with ladyfest and riot grrrl, but they operate within a formalized geographically bounded network structure. The camps are designed to help young girls (and more recently women, queer or non-binary people) participate in music creation activities whilst advocating for gender equality working within the bounds of mainstream society, rather than counter to it, or on the margins of it. Built on the back of a solid 1970s and 1980s punk movement with a small, but highly influential number of punk women, a network of individuals and bands began to emerge from a strongly connected do-it-yourself (DIY) infrastructure in Olympia and Washington, DC, in the United States in the early 1990s. This network began to spread to different locations within and beyond the geographical boundaries of North America. As these links developed, they built upon previous art and music-based movements to influence the organizers of ladyfest festivals and Girls Rock camps (Schilt and Zobl 2012).

There is an extensive literature on riot grrrl which sets out its origins (Wald and Gottlieb 1993); highlights how it confronted gender inequality through activism in music spaces and wider society (Rosenberg and Garofalo 1998); comments on the lineage of the movement and forgotten feminist histories (Strong 2011); unpacks a bricolage of sound collage and visual aesthetics through band studies (Sormus 2015); lays challenge to patriarchal and heteronormative punk spaces (Ambrosch 2016) and explores its impact on young adult fiction narratives (Sormus 2016). For that reason, this article does not go over well-trodden ground but instead focuses on how this novel application of mixed-methods social network analysis (SNA) can illuminate new perspectives on riot grrrl. Findings help explain the position of bands in wider city-based music scenes. They provide a better understanding of the roles played by different musicians and their impact on the development of a transnational music movement with a far-reaching effect on feminist music worlds and beyond. SNA methods can be used as tools for understanding other contemporary DIY and punk music worlds using network visualizations as an exploratory method to unpack social relations and using quantitative analysis to understand the structure and positionality of band collaboration networks. In part, the recent renewed interest in riot grrrl has been helped by bands like Bikini Kill touring again. Sleater-Kinney are on their first tour since parting ways with long-term band member and drummer Janet Weiss, who unexpectedly left, or rather felt discouraged from remaining within the band, due to supposedly creative differences (Gormley 2019). This renewed

media and public interest (Ewens 2019; Martin and Tidmarsh 2019; Pelly 2019) has helped bring new information to light on the relationships between and within bands.

Analysis starts by focusing on meso-level network interactions, which is the level where music scenes and bands comfortably sit and where most movement planning and activism takes place. This level looks at the relationship between bands and cities. Staggenborg claims that social movement theories need to pay greater attention to 'the connections among processes at different levels' (Staggenborg 2002: 138), with a particular focus on the under-researched meso level. Staggenborg also suggests that movement scholars need to be able to articulate the relationships between all three levels (Staggenborg 2015). This article offers an empirical application to address this gap. The macro-level interactions assess the global network and the spread and development of the movement across different countries. The focus then moves to the micro level to examine relationships between key players in more detail and the movement of musicians between bands, cities and countries. This helps to clarify the role of individuals in the global network. Network visualizations are used as an exploratory tool for understanding the different levels of network interactions and this is complimented by quantitative network measures. Within the context of punk cultural studies, the article draws on key concepts from social movements and social network theory to illustrate the riot grrrl movement as a transnational intersection of political motivations and music collaborations.

THEORETICAL FRAMEWORK

Punk, a fundamental component of riot grrrl, is simultaneously both a movement and an anti-movement. Punk had, and still has, an important cultural currency that transcends the brief period it has become known for, from its perceived nascence in the United Kingdom in 1975 to its supposed demise in 1979. However, punk's reach moved well beyond the imagined boundaries of the United Kingdom, sometimes with much greater effect (Zavella 2012; Sharp 2019). In many ways, the seed was sown for its UK 'breakthrough' year as early as 1964 in the United States with the Velvet Underground and the emergent club scenes open to art and music in equal measure, intensifying with the New York Dolls forming in 1971 and the Ramones in 1974. Punk is referred to by academics in some of the following, sometimes complementary and sometimes contradictory, ways: as a musical genre (Coupland 2011) made up of sub-genres like queercore; as a subculture (Leblanc 1999); as signified by bricolage (Hebdige 2012); as fashion and anti-fashion (Langman 2008); as a means of voicing disaffection with capitalist culture (Thompson 2012) and as a practice of rebellion and resistance (Dunn 2016). More often than not punk is a combination of much of the above. What punk did was to create a blueprint for a DIY ethic that would go on to influence countless cultural and music movements (Adams 2008) and generations of young people looking to (re)invent something for themselves, to create a movement of their own.

There is much debate over what constitutes a riot grrrl band, as there were only a handful of bands that labelled themselves riot grrrl when the movement originated in the early 1990s. A broad definition is taken here to incorporate riot grrrl-associated bands which widens the network capturing something more akin to a scene, as discussed in detail by Schilt (2004). This includes separate but related genres of music such as queercore (homocore), grunge and various styles of punk. It is also important to recognize that riot

grrrl was not just a movement in the United States and the United Kingdom, although many of the core bands hailed from both countries. There was, and still is, a strong affinity with riot grrrl across Europe in particular Belgium and the Netherlands, in Canada and especially so in Brazil.

Musicians, or activists, must find one another and interact for music worlds to develop. Crossley (2009) suggests that resources must be mobilized for events to occur and that networks can manage the critical mass required to make that happen. Critical mass is important in social dynamics, representing the point in time where a sufficient number of people subscribe to a social movement ideology so that the movement becomes self-sustaining and growth is possible. It is not widely understood how the mechanisms underlying critical mass happen or who initiates them, but it is likely that homophily will play an important role. These mechanisms occur at the meso level as described by Staggenborg (2002). Homophily is a key concept in SNA. McPherson describes homophily as 'the principle that a contact between similar people occurs at a higher rate than among dissimilar people' (McPherson et al. 2001: 416), or that birds of a feather flock together. Homophily is closely related to social influence and social selection network theories. Social influence theory tends to look at how people influence each other's behaviour or attitudes (Friedkin and Johnsen 2014), whereas social selection network theory looks at how particular pairs of actors may be drawn to one another based on specific characteristics or attributes (Robins et al. 2001). These two network mechanisms are difficult to disentangle and are increasingly the topic of empirical network studies as well as sociological theory development (Steglich et al. 2010).

In the context of activist music movements such as riot grrrl, I suggest that *value homophily* between bands and musicians in bands needs to be strong for the movement to build critical mass, for the message to spread and for feminist music worlds to evolve. Value homophily is a measure of how much those around us share the same values and beliefs. Riot grrrl requires participants to subscribe to the values implicit in the slogan 'revolution girl style now!' (Bikini Kill 1991). Whilst it is not possible to retrospectively fit motivations or reasons for individual participation in the movement, it is reasonable to assume that participants socially select into the movement based on some measure of value homophily. This, of course, may change over time as relationships develop. Schilt (2004) discusses this in relation to the development of the network and the blurring of the boundaries between political activism and music creation, feminist ideology and commercial success. From a network perspective, Centola et al. test the idea of homophily dynamics in the context of cultural co-evolution networks. They suggest that

Some neighbors in the social network may become so different from one another that they no longer share any cultural traits in common. When this happens, the weight of the tie between them drops to zero and no longer functions as a means for cultural influence.

(Centola et al. 2007: 909)

DATA AND METHODS

The data presented here examines, improves upon and significantly extends an aspect of a wider study on feminist music worlds using mixed-methods SNA. A more modest network dataset was originally constructed in 2013, although

the data collection was rigorous at the time within the bounds of availability and accessibility. It originally consisted of 118 bands associated with 43 cities (O'Shea 2014). The current dataset has been extended to include 236 bands with 81 cities/municipalities. As the boundaries around the riot grrrl network are blurred, data management strategies are required to ensure only the most relevant bands are included in the network. To construct the network, a well-referenced contemporary list of riot grrrl-associated bands (Wikipedia 2019) builds on the 2013 dataset. It includes bands that are documented in the literature as being associated with the movement before, during and since the core period of riot grrrl activism from 1991 to 1994.

Reflecting the geographical diversity of the movement, it was important to document bands outside the dominant domains and bring them into the core network. Therefore, the dataset also includes, to a lesser extent, bands from Indonesia, Ireland, Italy, Australia and Russia. Additionally, bands included in eight regional specially curated YouTube playlists were integrated into the dataset. Artists, musicians, publishers and labels associated with the music of riot grrrl contributed to this curated music series for Alien She. Alien She was an exhibition of memorabilia and ephemera from the Riot Grrrl Collection at the Fales Library and Special Collections at New York University, along with artefacts from personal and private collections. Contributors include Elisa Gargiulo of Brazilian band Dominatrix and feminist art collective CARMEM (Gargiulo 2015), Tammy Rae Carland co-founder of Mr. Lady Records (Carland 2015), Pete Dale of Slampt Records and Pussycat Trash (Dale 2015), Donna Dresch of Team Dresch and Chainsaw Records (Dresch 2015), Lynne T and Bernie Bankrupt of Lesbians on Ecstasy (Lynne T and Bernie Bankrupt 2015), zinester Ceci Moss and ladyfest's Bay Area and DC organizer Astria Suparak (Moss and Suparak 2015), Maaike Muntinga of Ladyfest Amsterdam and Jessica Gysel Riot Grrrl Benelux, and ladyfest founder (Olympia 2000) and Bratmobile member Allison Wolfe (Wolfe 2015).

The chronology of bands, from when they were first formed, begins in 1985 with Sugar Babydoll, featuring Courtney Love, Kat Bjelland and Jennifer Finch and extends to more contemporary bands like Big Joanie who cite riot grrrl as an influence. The majority of bands included were at their most active in the 1990s. This is by no means a definitive list. It is acknowledged that having a greater input from different countries would be welcome. It does, however, signify a good range of bands representing a diverse riot grrrl network. Members of each band are identified and a second-level search is conducted to identify additional bands associated with core members. This includes appearing on recordings as well as playing live on tour or as guest performers. Bands that self-define as riot grrrl, or say they are riot grrrl influenced on their band profiles or social media, or are associated with the movement via other media sources are included in the network. Crowd-sourced online music-based archives (e.g. Discogs, AllMusic, RateYourMusic) were used for cross-referencing purposes. Finally, the dataset was cleaned and errors and duplications were removed and names of bands and personnel checked for spelling and location consistency.

NETWORK VISUALIZATIONS

A social network, according to de Nooy, 'is a set of vertices (or nodes, units, points) representing social actors or objects and a set of lines representing one or more social relations among them' (de Nooy 2010: 378). The connections

between people and other social entities such as organizations quickly become complex and difficult to interpret. The larger a network, the more possibilities there are for people to connect. There are three ways of representing a network – attribute-based measures, scaling methods or graph theoretic methods. Graph theory helps us untangle some of the complexity by helping make sense of multifaceted social relations, in qualitative ways through network visualizations and in quantitative ways when used in conjunction with robust statistical methods. The visualizations in this article are referred to as *sociograms* and use the graph theoretic method to display them. This method utilizes the properties of the network itself. This might include exploiting the inherent structures of a network to represent it, such as by cliques or subgroups. Bands are naturally occurring cliques. The spring embedder system is used whereby nodes repel each other and the edges pull actors together. Each sociogram is then slightly modified in order to reveal more about the structure of the networks and to aid interpretation. This is done by manipulating the size and shape of the node, and by applying different shades.

From the initial visualizations, key nodes are identified and those are then examined in closer detail by looking at their ego networks. An *ego network* provides an alternative to the complete network approach as it focuses on the personal networks of a node (ego). For ego network analysis, the actor is at the centre of their own network, and their immediate contacts are known as alters. It is often useful to pull interesting-looking nodes out of a complete network to look at them in closer detail using ego network methods. This might include nodes that *bridge*, or connect, two different social groups in a network. Exploratory visualization methods are useful for this study in order to investigate the different levels of riot grrrl network interactions, including meso, macro and micro levels (Table 1).

Micro (actors)	Meso	Macro
Individual	Local (city)	Translocal (country)
Activist	Network/organization (specific group)	Movement/network (global concept)
Participant (audience)	Community (place/site)	Intermediary (government, local council, funding body, etc.)

Table 1: Network levels of interaction.

NETWORK MEASURES

Much of the network data in this study consists of *two-mode networks* also known as bipartite or *affiliation networks* and represents a system of relations between two different node sets or types of nodes (e.g. musicians by bands or bands by cities). Two-mode networks are then converted into *one-mode networks* defined as a set of similar nodes (actors). In this case, one-mode networks are band-by-band, or musician-by-musician, networks. *Degree centrality* is best conducted on one-mode networks and can help indicate the level of an actor's involvement in the network. In the case of the riot grrrl band network, degree centrality is examined by looking at music collaborations, measured by the frequency with which musicians play with other musicians.

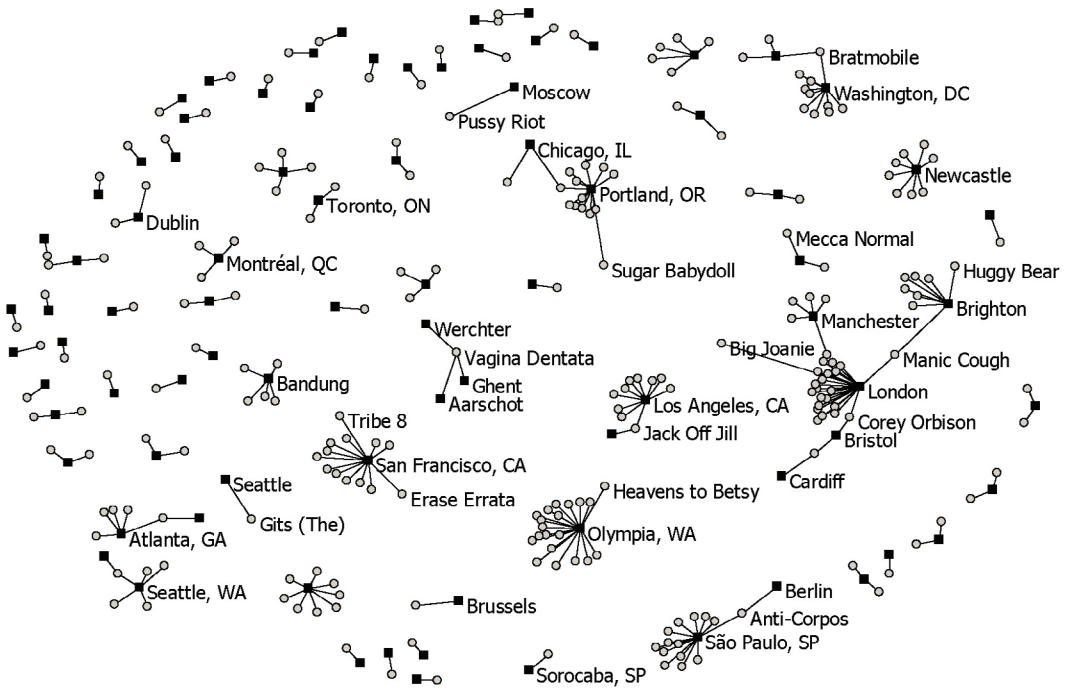


Figure 1: Riot grrrl bands making a scene.

For additional discussion on graph theoretic perspectives on centrality, see Borgatti and Everett (2006) and Everett and Krackhardt (2012).

A more sophisticated measure of centrality is *betweenness centrality*, having advantages over degree measures. It takes into account the whole network as well as direct ties to *ego* (the individual actor). Betweenness is a measure given to the position of an actor located between two disconnected actors and this position is thought to bring the actor network advantages. Riot grrrl networks are visualized using the betweenness measure to great effect. Betweenness, according to Prell ‘draws attention to who is critical for a network’s information flow, i.e. who connects different segments of the network together and is an important intermediary or broker’ (Prell 2012: 13). Analysis was carried out using Ucinet 6.619 (Borgatti et al. 2002) and visualizations were generated using NetDraw 2.168 (Borgatti 2002).

RESULTS AND DISCUSSION

The following results correspond to the meso, macro and micro levels of network interaction displayed in Table 1. They highlight how a formalized social network approach can move beyond networks as metaphors frequently referred to in the literatures on punk, riot grrrl and associated music worlds, towards empirical quantifiable evidence. The results enable a theoretical extension that is applicable to punk and DIY music studies at the level of community or scene, yet has the ability to transcend the local presenting a more globally diverse and connected community (translocal scene) than is evidenced by qualitative data alone.

MESO-LEVEL NETWORK INTERACTIONS: BANDS MAKING A SCENE

From previous research, we know that particular cities in North America and the United Kingdom were important sites for the development of the riot grrrl movement which shared strong punk and indie music scenes and subcultures. Cities included Olympia, Portland, Washington and Seattle in the United States. Over the border in Canada, Toronto played a role as the birthplace of the queercore movement, which would prove to be highly influential on riot grrrl activists in San Francisco, and beyond. In the United Kingdom, London is an obvious important site, but so too are Newcastle (Tyneside), Manchester and Brighton as evidenced by the number of bands affiliated with them. Figure 1 is an extension of an earlier version of the network. It is possible to see clusters of band activity around particular cities and key riot grrrl-associated bands are visible including Heavens to Betsy, Bratmobile, Bikini Kill, Tribe 8 and Huggy Bear.

Strong riot grrrl clusters are evident in Figure 1 in other cities in different parts of the world including São Paulo in Brazil and Bandung in Indonesia. Prasetyo (2017) discusses the importance of the relationship of space and place and how transnational cultural and political relationships are at the core of the punk movement in Indonesia. The vast majority of cities highlighted in the network, and overall in the dataset, have either hosted one or more ladyfest festivals and/or has an established or planned Girls Rock camp. This would suggest that the cities from which riot grrrl bands and activists emerge hold on to those feminist histories and cultural activism and subsequently continue the revolutions (transformations) required to keep a scene alive for, and with, new generations of activists and participants. Bader and Scharenberg summarize essential movement and scene maintenance mechanisms.

As it is largely tacit knowledge, musical knowledge is anchored locally, too, and it is integrated in networks based on reciprocity [...] The innovative potential of networks of creativity is bound to a certain place and can thus primarily be used in close personal contact. For the success of a label, tacit knowledge about the scene is crucial. With respect to subculture, knowing musicians and being known within the scene is a precondition for signing musicians, precisely because for these actors, in contrast to major record companies, trust is a central category for cooperation.

(2010: 85)

Another way to visualize the band affiliation network and to test the strength of ties within the movement is to examine the shared membership between bands. Figure 2 displays 123 bands that share at least one to three members. The darker the line, the greater number of shared members. This indicates that there is a strong cohort of musicians in local music scenes that manage to sustain an affiliation to the wider riot grrrl network and that the network develops over time rather than existing for one distinct time period. This would suggest a high level of value homophily between active musicians.

Scenes do not emerge independently of bands' shared communication and organizing strategies. However, these relationships are not always equal. By examining the position of bands in relation to one another, it is possible to uncover which particular bands are more central in the wider network. To do this, it is useful to visualize the bands sized by betweenness measures – the larger the circle, the higher the betweenness score. This measure assumes that bands with higher betweenness (standing between other nodes in the

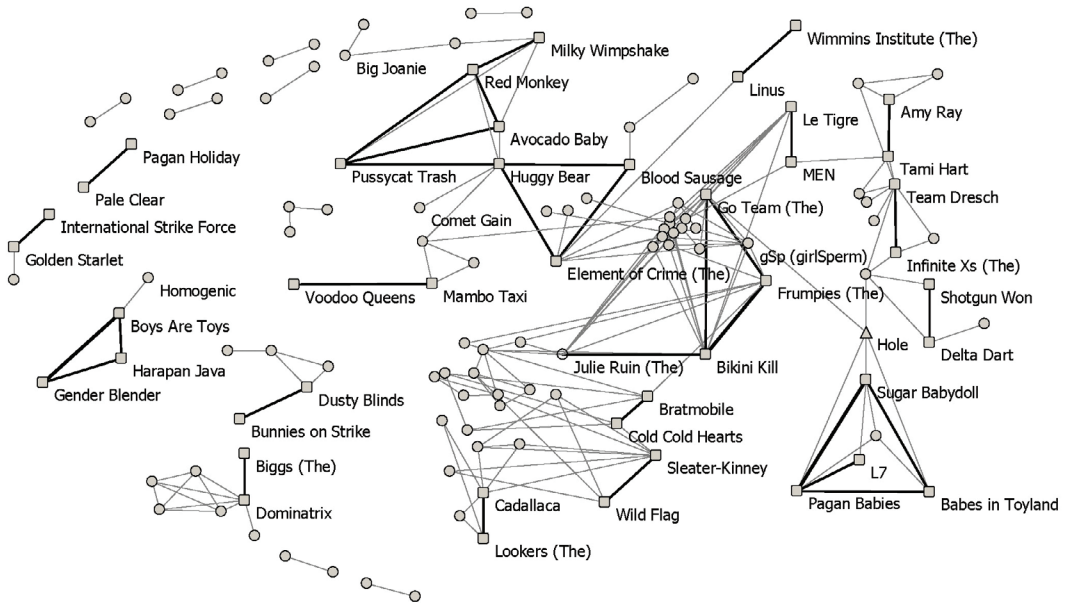


Figure 2: Strength of collaboration ties between bands.

network) would be more important or might have greater control as they are central to the communication structure. It is worth recalling that the method of connecting bands and places with actors over time examines the networks of shared band personnel, meaning this is a particularly strong tie. Figure 3 reveals some interesting observations about the position of key players.

Whilst it might be expected that particular bands like Bratmobile and Huggy Bear would score highly on betweenness, as they connect the US and UK scenes and are well-documented key players in the riot grrrl movement, there are perhaps a few unexpected high scorers. For example, gSp, the Go Team, the Frumpies and Hole all score highly. This means that they occupy important positions in the network which can be positions of strength as well as weakness. If a band is positioned between two other key bands that are not well connected to one another, then they occupy a position of power and may control or facilitate the information flow. However, this could also risk disconnecting the network if that band were to be removed. There are several possible reasons for this that relate to the relative position of key members of each band. This will be explored further when micro-level network interactions are discussed in relation to Hole. For now, it is worth noting that the Go Team emerges as a key player in the riot grrrl movement. There is some reference in the literature to this (Schilt 2004; Downes 2007), but their importance is perhaps underplayed. Many of the individual members and collaborators of the Go Team have played direct and indirect roles in the associated music scenes and the network itself including Tobi Vail (Bikini Kill), Kurt Cobain (Nirvana), Billy Karren (Bikini Kill), Donna Dresch (Team Dresch, Fifth Column) and Lois Maffeo. Likewise, the band gSp include Tobi Vail, Marissa Magic and Layla Gibbon. Gibbon has also played in, or collaborated with, Element of Crime, Modern Reveries, Petty Crime and Skinned Teen. This makes her an important possible conduit of knowledge and information about and around the wider network.

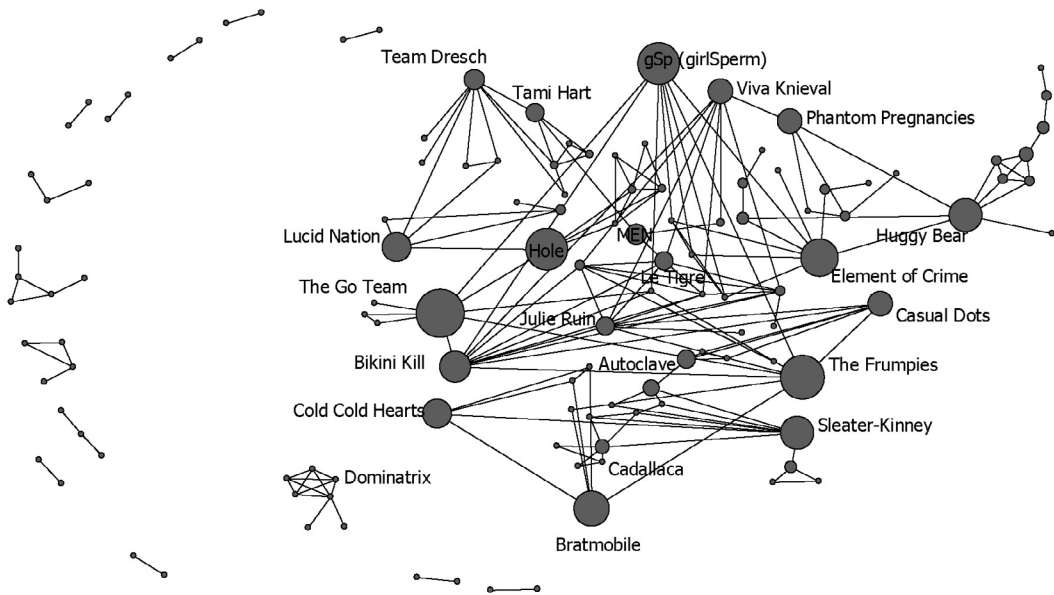


Figure 3: Band betweenness: a measure of centrality.

MACRO-LEVEL NETWORK INTERACTIONS: MAKING A GLOBAL NETWORK

So far, the relationships between bands and cities making a scene, and the centrality of particular bands to the riot grrrl network, have been explored. Visualization findings and centrality measures suggest there are other underlying mechanisms at play. In order to understand macro-level network processes and conceptualize riot grrrl as a global network it is necessary to consider the connections between individual musicians, not just bands, and their relationship to place. The two-mode incidence matrix (bands by musicians) was converted into a one-mode affiliation network that connects musicians with musicians directly. The data was transformed in Ucinet using the affiliations conversion tool and the sum of cross-products method which allows for network overlap.

It is worth noting that a qualitative review of the network in Figure 4 suggests there is a core-periphery structure. However, conducting a statistical core-periphery analysis on the whole network would not be appropriate due to the geographical dispersion and the clique-based nature of the network. A core cluster is located centre-bottom of the graph. The peripheral nodes around the edges are connected to each other as band members and there is some cross-over with other local bands but they do not connect to the core riot grrrl network along the designated strong tie, playing together. It might be expected that the division would be strictly on geographical boundaries, and whilst geography plays an important role in restricting or facilitating collaborations, this is not always the case. By examining the network on the level of the individual musician, a more global picture of collaborations across cities and even countries begins to emerge. This is because key actors are mobile and move between places, within and between countries. Musicians that play together do so by being full band members, session musicians,

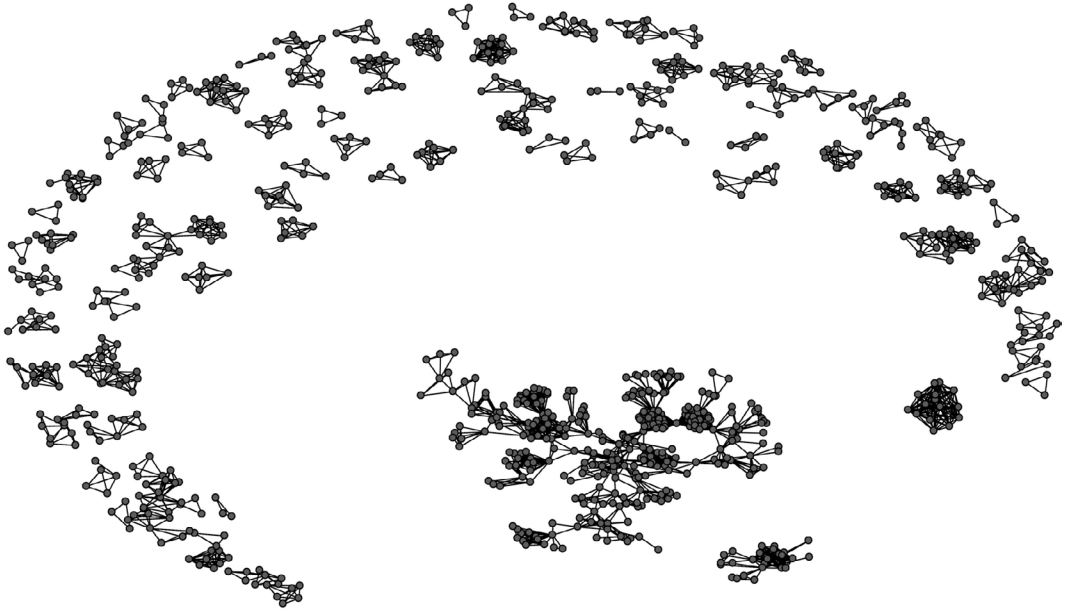


Figure 4: Riot grrrl-associated musician-by-musician affiliation network.

short-term collaborators or playing a guest slot with one another whilst on tour. Additionally, they take with them their activist ideologies, spreading the message and building further critical mass for the movement by connecting with other bands and scene participants. By examining the individual level, it becomes possible to understand the connections between riot grrrl-associated bands from across the world and it is possible to recognize its global reach. It is also feasible to conceptualize a more global network in a theoretical sense too, by detecting points of critical mass for the network based around the idea of scenes and translocal patterns of collaboration. Although there are many other measures that could be used to make network connections between key actors, playing together is a strong tie that requires a high degree of value homophily to make those musical and political collaborations pay off.

MICRO-LEVEL NETWORK INTERACTIONS: FROM THE GLOBAL TO THE LOCAL

Central actors in networks tend to be more visible, tend to know more people and be known by more people. An examination of degree centrality for the one-mode network reveals some interesting results. Figure 4 highlights clusters of activity occurring within the network. The visual evidence suggests there are a number of cutpoints in the network that warrant further investigation. Wasserman and Faust suggest that an 'actor who is a cutpoint is critical [...] if that actor is removed from the network, the remaining network has a [number of] subsets of actors, between whom no communication can travel' (1994: 113). Figure 5 is a close-up of this cluster. Degree centrality scores are examined to see which actors might hold an advantage in the network because of the number of direct connections they have. This opportunity to access different resources may make them less dependent on other network members, but it may also create a weak point in the network structure. Those

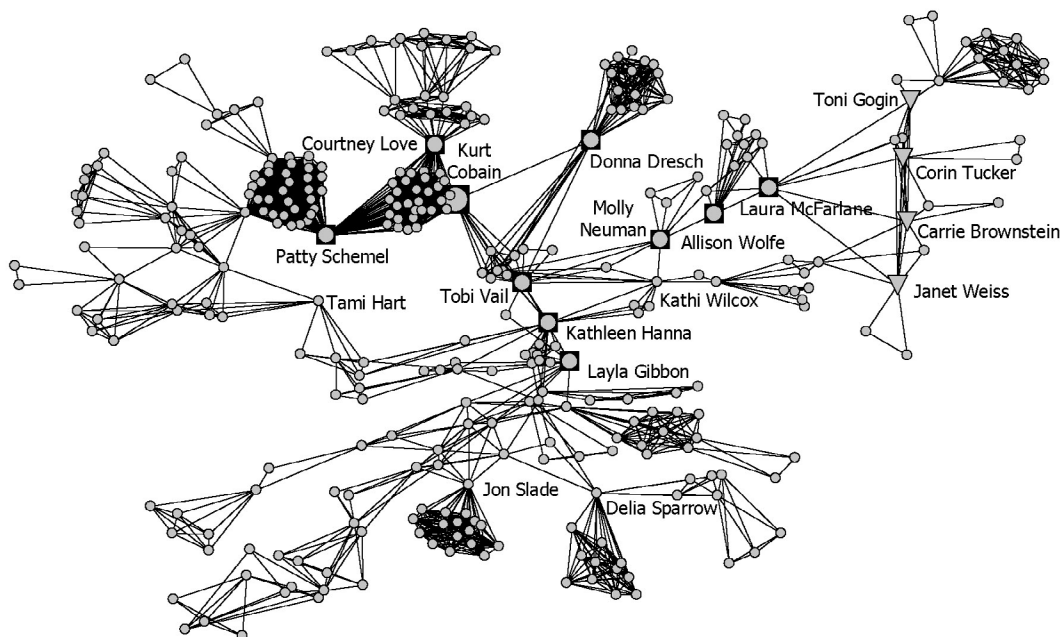


Figure 5: Core riot grrrl ego networks.

with the highest degree centrality scores are represented by a square with an embedded circle.

Patty Schemel (Hole, Lucid Nation) has the highest degree centrality with 67 direct contacts, and next is Courtney Love (Hole, Babes in Toyland, Pagan Babies, Sugar Babydoll) with 44. These actors were identified as cutpoints to investigate from Figure 4. Kurt Cobain (Nirvana) has a centrality score of 40 and Erin McCarley (Delta Dart, Lucid Nation, Shotgun Won) with 39. Kurt Cobain emerges as an important link between Love and the core riot grrrl activists as Cobain was close to Vail and made the initial introductions. Cobain also actively encouraged the participation of women in the grunge and punk scenes. In fact, if Cobain was removed from the network then the possibility of Love and Schemel being introduced to the core riot grrrl activists is greatly reduced. A network pathway still exists as Cobain and Vail are part of the same wider music scene but the route to making those connections becomes more circuitous. Hole are still an important band to acknowledge in the history of riot grrrl as their music was highly influential and frequently listed by those interested in the movement as being important. Schemel subsequently became involved with Girls Rock camps as have many of the core riot grrrl activists.

Corin Tucker (Cadallaca, Heartless Martin, Heavens to Betsy, Sleater-Kinney), Kathleen Hanna (Bikini Kill, the Fakes, the Julie Ruin [band/solo], Le Tigre, Suture, Viva Knieval), Allison Wolfe (Bratmobile, Cold Cold Hearts, Partyline, Sex Stains) and Tobi Vail (Bikini Kill, the Frumpies, gSp, the Go Team, Spider and the Webs) act as bridges in the network, as might be expected from what we already know about the riot grrrl movement. With these points in mind, perhaps it is not so surprising that there are few collaborative links between these two very distinct groups (Figure 5). In many ways, it is reflective of the division between riot grrrl activism and DIY feminist music making, represented by Wolfe, Tucker, Vail and Hanna, and more mainstream musical

success achieved by Love and perhaps Schemel. With the recent departure of Janet Weiss from Sleater-Kinney, it could be argued that Tucker and Brownstein are reducing their wider network involvement. The production power of St. Vincent ensures the band are moving towards a more commercial model of music-making. However, there is still evidence of a feminist mindset in their lyrics and in their infrequent audience addresses at shows. Statistically, Janet Weiss has an ego-betweenness of 42, higher than Tucker (33) and Brownstein (34), which might suggest she is better positioned within the wider riot grrrl movement so may have access to more music opportunities. This can also be theorized as a shift in value homophily for members of Sleater-Kinney as Weiss diverges, willfully or otherwise, from the creative core. However, it is Tucker and Brownstein that may be losing their 'cultural influence' in the network as they and Weiss 'share fewer cultural traits in common' with their supposed creative differences being insurmountable (Centola et al. 2007: 909).

The top ten ranked betweenness scores for the rest of the network, starting with the highest, are Tobi Vail; Kurt Cobain; Layla Gibbon (gSp, the Element of Crime, Petty Crime, Modern Reveries, Skinned Teen); Patty Schemel; Kathleen Hanna; Molly Neuman (Bratmobile, the Frumpies, the PeeChees); Stuart Mason (Phantom Pregnancies, Viva Knieval); Billy Karen (Bikini Kill, the Frumpies, the Go Team); Courtney Love; Laura MacFarlane (Cold Cold Hearts, Sleater-Kinney, Ninetynine). Interestingly, men are not absent from the riot grrrl network, and some men are particularly important to the movement like Cobain, Billy Karen and Jon Slade (Comet Gain, Huggy Bear). There is a heavy clustering of men around the ego networks of Love and Schemel who have significantly more connections with men than they do with women and these men are also unconnected, for the most part, to the rest of the network. With Schemel it is mostly through her links with Hole but also the experimental multimedia rock collective Lucid Nation, a band which arguably has had as many members through its ranks as the Fall. This is further evidence to support the theory about the division between idealized feminist music making with modest to poor commercial success and more mainstream success with an added interesting gender dynamic. It would appear that most of the men Love and Schemel are connected to are professional musicians, perhaps playing with them only on tour or on recordings and not as more permanent band members.

CONCLUSION

A strong case has been made for how a formal social network approach, with exploratory visualizations, can be used to transcend the prevalence of networks as a metaphor for collective action and DIY organizing in music worlds. Within the context of punk cultural studies, this methodology has revealed new insights into riot grrrl as a networked movement and has also confirmed previous qualitative theories with new empirical evidence. A significant theoretical contribution has been made to social movement discussions on meso-level processes and structures, which Staggenborg (2002) highlights as under-researched. The meso-level analysis reveals the relationships between bands and cities positioned within broadly defined feminist music worlds. It is at this level too where social movements develop their community identities and connections with other movements and groups and gather critical mass. The findings reveal clusters of band activity around particular cities (e.g. Olympia, Washington, DC, London, Newcastle), the strengths of ties

between bands represented by playing together and high betweenness scores revealing the positions held by bands in the network, such as Bratmobile and Huggy Bear, indicating they occupy a position of power and may control or facilitate the information flow. At the macro level, examining individual musicians' ties over time allows a global picture of collaborations across cities and countries to emerge. On a micro level, Patty Schemel, Courtney Love and Kurt Cobain unexpectedly have the highest degree centralities, meaning they are connected to more people in the network than everyone else. Closer inspection reveals an interesting gender dynamic.

Drawing on a substantial literature, an assumption was made that riot grrrl-associated bands and musicians have highly correlated value homophily in order to reconcile the dynamics of activism and musical collaboration. There is some evidence of value homophily in action in the discussion on Sleater-Kinney. Despite the obvious strengths of this approach, the study has limitations worth noting. Playing together, as the only direct ties between actors, leaves gaps in the network where actors do not share this strong tie and are unable to bridge groups. Opening up the measures of ties between members of the movement would be a useful strategy and something to consider for future research. If other measures were taken into account, then a valued network would increase the links between different cities, scenes and bands affiliated with riot grrrl. This might include bands being signed to the same label, for example Slampt, Mr. Lady Records, K Records, or playing in the same venues or DIY festivals like ladyfest. Several riot grrrl bands have released split-singles together or have gone on tour together by drawing on the goodwill and support of movement participants as well as musicians. This type of collaboration is something that continues today through transnational networks of musicians and fans interested in the legacy and feminist ideology of riot grrrl, and puts value homophily into action by helping bands get gigs and finding places to stay when touring in other countries. These additional connections could allow for a more forensic assessment of these trans-local collaborative networks. Additionally, the analysis is somewhat limited by the constraints of archival data collection and the lack of interview data that would allow for a more nuanced analysis of the network structure and the strength of ties between bands and musicians.

A formal social network approach has the ability to transcend the local context presenting a more globally diverse and connected community than is evidenced by qualitative data alone. Riot grrrl musicians that play in multiple bands together increase their opportunities for forming and developing networks in complimentary movements and increase their opportunities for music collaborations over time. Mixed-methods network analysis is an innovative methodology for investigating contemporary DIY and punk music scenes. Network visualizations help explore the underlying structural properties of networks to better understand the evolution of collaborative feminist music worlds.

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