

Musical Genre Analysis Over Dynamic Success-based Networks

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Publicações: [Oliveira et al. 2020]

Abstract. *As the music industry becomes more complex, reaching a wider audience through collaboration is effective in maintaining the relevance of artists from distinct genres in the market. As genre is one of the most prominent high-level music descriptors, all music-related analyses may depend on it. In this study, we propose to analyze the relation between musicians teaming up on a hit song with its success under a genre perspective. Our methodology includes building success-based genre collaboration networks to detect collaboration profiles and studying their evolution over time. With this work, we aim to provide potential impact to both the research community and the music industry.*

Resumo. *À medida em que a indústria da música se torna mais complexa, a estratégia de alcançar maiores públicos pela colaboração tem se mostrado efetiva ao manter a relevância de artistas de diferentes gêneros no mercado. Como o gênero é uma das principais características de uma música, todas as análises nesse contexto podem ser dependentes dele. Neste estudo, propõe-se analisar a relação entre a colaboração entre artistas com o sucesso musical sob a perspectiva de gênero. Nossa metodologia inclui a construção de uma rede de gêneros musicais baseadas no sucesso para detectar perfis de colaboração e o estudo de sua evolução através do tempo. Com este trabalho, espera-se proporcionar um potencial impacto para a comunidade acadêmica e a indústria da música.*

1. Introduction

Music is not only one of the world's most important cultural industries, but also one of the most dynamic. Over the last few decades, the world has seen a dramatic change in the way people consume music, moving from physical records to streaming services. Few years ago, songs and their videos needed to be played on the radio and TV to be successful; but today, they can be easily accessed on digital platforms such as Spotify and YouTube. Since 2017, streaming services have become the main source of revenue within the global recorded music market, mainly due to the fans' engagement and adoption of these platforms. In fact, their revenues increased by 75.4% from then, reaching US\$ 11.4 billion by the end of 2019¹. As a result, artists are encouraged to reinvent strategies to maintain their presence in the market and reach new audiences.

As the music industry becomes more complex and competitive, artist collaboration has grown into one of the main strategies to promote new songs and acquire new audience. This widely adopted strategy is a strong force driving music nowadays, maintaining artists' relevance in the market. Such connections usually help artists bridge the gap between styles and genres, overlapping new fan bases and consequently increasing their numbers. In such a way, several studies approach the factors behind musical success, creating an emerging field within computer science called Hit Song Science (HSS). Collaboration-aware studies then become promising, as successful artists are more likely to have a high degree of collaboration in success-based networks [Silva et al. 2019]. In fact, there is strong evidence in the literature that factors leading to an ideal musical partnership can be understood by exploring collaboration patterns that directly impact its success [Bryan and Wang 2011].

The genre perspective is very important when analyzing the impact of collaborations in musical success, as each genre has a distinct audience that behaves in its own way. Figure 1 shows this phenomenon and highlights the growing trend in the number of collaborations within Billboard Hot 100 Charts. Although the general curve increases over time, genres such as *pop* and *R&B* present a collaboration rate higher than others (e.g., *rock*). This contrast can be explained by the intrinsic nature of each music genre. For instance, *pop* and *R&B* artists frequently collaborate with the *rap* community, mainly as featured artists. Also, partnerships involving *pop* music may take place not only through intra-genre collaborations but also through inter-genres, bringing an additional dimension to their songs. For example, in April 2019, the collaboration between the American pop singer Halsey and the k-pop group BTS in the song *Boy With Luv* became the most viewed YouTube music video in 24 hours and reached #8 on Billboard Hot 100 Chart. As this creative market changes, it becomes more unpredictable; and doing both predictive and diagnostic analyses in such a context remains challenging.

This work aims to better understand the dynamics of the music industry, specifically the relation between artist collaboration and musical success under the genre perspective. Although building and studying success-based artist networks are already subject of our group recent research [Silva et al. 2019, Silva and Moro 2019], to the best of our knowledge, there are no studies considering how the artist's genre may influence the popularity of a song. For example, in the past few years the collaborations between *pop* and *reggaeton* artists have become more frequent and successful, mostly due to the stardom

¹IFPI Global Music Report 2019: <https://gmr.ifpi.org/>

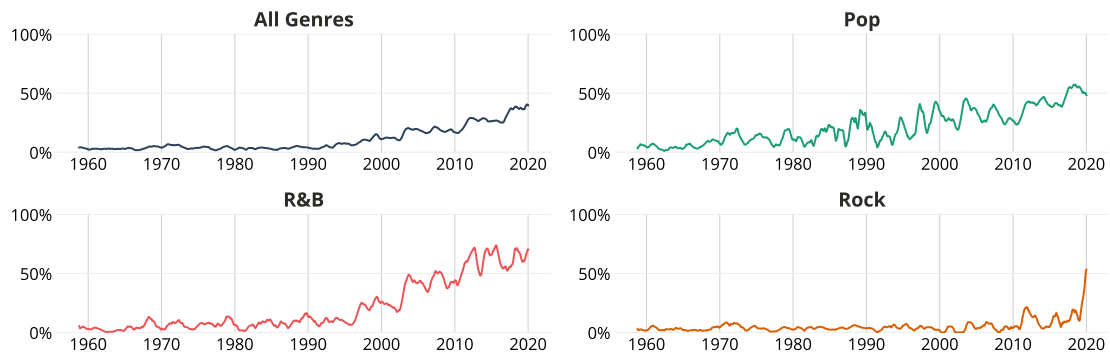


Figure 1. Historical frequency of collaborative hit songs for selected genres on Billboard Hot 100 Chart (1958 - 2020).

of the hit *Despacito* by Luis Fonsi and Daddy Yankee in 2017. This song gained a remix with the Canadian pop singer Justin Bieber, reaching the top of Billboard Hot 100² for 16 consecutive weeks.

Motivation and Relevance. Musicians teaming up is nothing new but has risen far beyond the norm. Remaining an industry of creative growth, it is only natural for music (i.e., all musical scene members) adapting to new conditions and redefining its layout. Not surprisingly, the Grammy³ categories were tightened (from 109 to 78, in 2012) as a result of music’s dynamic nature. That is, the notion of categories and genres are blurred as never before. Through cross-genre collaboration, artists are venturing into new domains and working outside of the category which they had originally been ascribed to. Such a collaboration phenomenon may be drastically reshaping music global environment, by challenging segments of certain genres to come up with something entirely new.

This novel and dynamic environment brings high volumes of data about songs, their characteristics, and the social interactions about them. The popularization of digital platforms allows people all over the world to have access and interact with content in real-time [Barbosa et al. 2013, Harb and Becker 2018], increasing the cultural connection between distinct parts of the globe, while each market maintains its unique characteristics. Therefore, this work provides relevant contributions to the Database field by collecting, aggregating, modeling, and analyzing data obtained from different sources on the Web, in addition to processing and enriching social data (e.g., the collaboration network between artists and genres). We also aim to organize and provide a unique dataset on musical success focusing on genre collaboration, with information from charts, songs, and artists.

Research Goals. As the collaboration phenomenon becomes stronger over the years, it is necessary to explore all factors that make it so relevant nowadays. Therefore, this work aims to analyze artist collaboration under a genre perspective to better understand how the genre connections impact musical success. Specifically, we plan to:

- RG1.** Build a proper musical success dataset with enhanced genre collaboration data;
- RG2.** Model a success-based genre collaboration network considering distinct regional markets, as well as the global aggregated scenario;

²The Billboard Hot 100 is the main weekly song chart within the United States. A song’s position in the chart is calculated by considering sales, radio plays and streaming count.

³Grammy Awards: https://en.wikipedia.org/wiki/Grammy_Award

- RG3.** Detect and evaluate the collaboration profiles within the genre network;
- RG4.** Evaluate the dynamics of both the network and the profiles over time, as well as their relation with musical success.

2. Related Work

Genre is fundamental within the musical scenario by aggregating songs that share common features. Hence, it is often used in the field of Music Information Retrieval (MIR), which aims to extract relevant information from music content. Indeed, several tasks are genre-dependent or directly related to them, such as automatic genre classification, which has been largely studied by the MIR community [Ghosal and Sarkar 2020]. Nonetheless, there are also genre-aware studies assessing genre modeling [Prockup et al. 2015], preferences [Bansal and Woolhouse 2015], disambiguation/translation [Hennequin et al. 2018, Epure et al. 2019], new datasets [Bogdanov et al. 2019], and ontologies [Schreiber 2016]. Network science, the core of our methodology, has also been used to model genres into influence networks [Bryan and Wang 2011] and song communities [Corrêa et al. 2011].

Hit Song Science (HSS) tackles the problem of predicting the popularity of a given song, and is also an emerging field within MIR. Thus, different studies analyze the impact of acoustic and social features in musical success. In the early years of HSS, only acoustic features (i.e., the internal technical aspects of a song, such as timbre, mode and key) were assessed by researchers [Dhanaraj and Logan 2005]. Nonetheless, as the Web became popular and widely adopted, social interactions were included as features in prediction models. For instance, Cosimato et al. [2019] predict an album success through users' interactions on social networks such as Twitter, Instagram and YouTube. Other studies include genre information in their models [Zangerle et al. 2019], although its impact on success is not deeply evaluated.

Moreover, Silva et al. [2019] address collaboration as a key factor in success, using topological properties to detect relevant profiles in artist networks. In a later study, the causality between collaboration and success is addressed [Silva and Moro 2019], increasing the knowledge and reinforcing the relevance of the collaboration phenomenon in the musical scenario. In fact, such an approach is novel and promising in HSS, but it is restricted to the artist and song levels. In addition, these and most of the aforementioned studies regarding musical success only consider data from American charts, mainly Billboard Hot 100. This may be due to the ease of obtaining data but it may not reflect the whole global scenario, as each country has its own distinct behavior when consuming music, which includes preferred artists and genres.

Contributions. Studying collaboration from a genre perspective may reveal important information on how artists from different communities team up to make a new hit song. To the best of our knowledge, we are the first to build a success-based genre network, investigating its evolution over time and the collaboration profiles within it, going deeper into the potential intrinsic factors that make up a successful collaboration. Likewise, the approach considering regional markets makes this work more realistic, as local engagement shapes the global environment. We combine a precise heterogeneous data collection with proper modeling to enhance further data analysis by scientists and record labels CEOs. Therefore, this work sheds light on the science behind the collaboration phenomenon, providing potential impact to both the Databases community and the music industry.

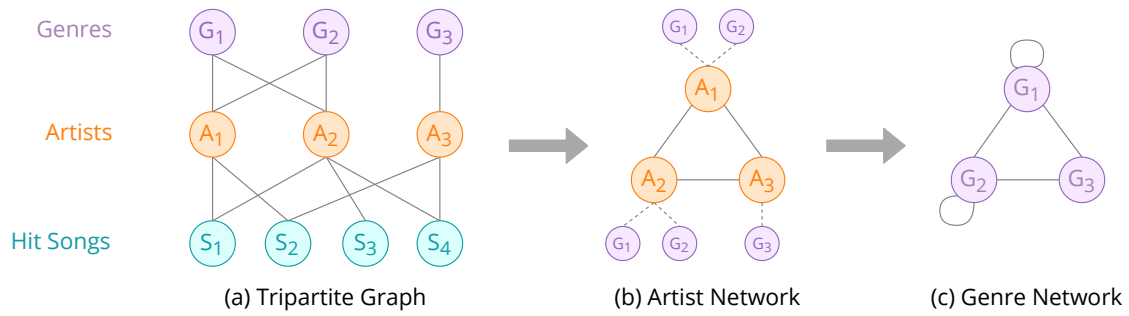


Figure 2. Reduction from the tripartite (a) to the one-mode Genre Collaboration Network (c). The intermediate step is an Artist Network with genre information (b). Artists and genres are linked when hit songs involve both nodes.

3. Methodology

In this section, we focus on the main steps of the proposed methodology to assess our research goals. These steps include data collection, the collaboration network modeling, plus the metrics and techniques that can be used in our experiments and evaluation.

Data Collection and Processing. Since 2017, streaming services have become the main source of revenue within the global recorded music market, with an increase in their revenues of 75.4% from then. Thus, we obtain our data from Spotify, the most popular global audio streaming service, with more than 286 million users across 79 markets⁴. It provides a weekly chart of the 200 most streamed songs in all its markets, and an aggregated global chart. We collect global and regional charts as from 2017, considering eight of the top 10 music markets⁵ according to IFPI: United States, Japan, United Kingdom, Germany, France, Canada, Australia, and Brazil. We also use Spotify API to gather information about the hit songs and artists within the charts, such as all collaborating artists within a song (since the charts only provide the main ones) and their respective genres, which is the core of this work.

Genre Network Modeling. A Collaboration Network is usually modeled as a graph formed by nodes (vertices) that may be connected through edges. For analyzing the interactions between genres, we model music collaboration as a tripartite graph, in which nodes are divided into three sets: genres, artists, and hit songs. The building process of the genre network from the tripartite model is illustrated in Figure 2. Collaborative hit songs are sung by two or more artists, regardless of their participation (e.g., a *feat.* or a duet). We also equally consider all genres linked to an artist because they shape how such an artist is seen by fans and music industry. We then reduce the tripartite model into a one-mode network in which nodes are exclusively genres. However, such a reduction is only possible by executing an intermediate step: building the artist collaboration network, Figure 2(b). In such a network, two artists are connected when both collaborate in one or more hit songs. The genres are not lost, as they are linked directly to the artists. We may now build the final network by connecting the genres of artists who collaborate in the artist network. The edges are undirected and weighted by the number of hit songs involving artists from both genres, Figure 2(c). Also, self-loop edges are allowed, as there are hit songs from artists of the same genre.

⁴Spotify Company Info: <https://newsroom.spotify.com/company-info/>

⁵Data from South Korea and China was not available in Spotify.

Profiling and Evaluation. After building the success-based genre collaboration networks, it is necessary to characterize them considering each distinct market and their evolution over time. We do so by analyzing network science metrics such as degree and weighted degree, clustering coefficient, and density. Next, we plan to use a combined approach of network science metrics and clustering algorithms to detect collaboration profiles within music genres and then investigate their relation with musical success. Distinguishing cross-genre collaborations from intra-genre ones is fundamental for our analyses, as we believe that crossing genre frontiers may bring more success for a song, as it will join distinct but powerful audiences to leverage the song’s numbers. Finally, we intend to use the collaboration profiles and other genre features in more specific tasks such as collaboration prediction and recommendation.

4. Preliminary Results

The collaboration network characterization is the initial step of our evaluation, and we analyze global and each market separately. The global genre networks reveal the world is more open to new successful genres (number of nodes/genres growth). Also, the degree analysis indicates that low-degree emerging genres may become popular shortly, expanding their collaborations to other unexplored genres. For instance, *k-pop* connections double as it spreads worldwide, approaching genres such as *reggaeton* (e.g., the collaboration between J-Hope from BTS and Becky G in the song *Chicken Noodle Soup*, September 2019). For regional markets, we classify the countries into three groups, according to the similarities in networks’ evolution: (i) USA and Canada; (ii) Brazil, France, Germany and Japan; (iii) UK and Australia. Overall, considering regional markets individually becomes more important for producers and record labels, as they are delivering more global hits over time. Their distinct behavior emphasizes the strength of cultural aspects on determining how music is consumed and the success of a given genre or artist.

Next, for each country and year, we detect four distinct clusters within the genre networks and investigate the relation between these groups and musical success (i.e. hit songs present in Spotify charts, evaluated by their amount of streams). In short, the collaboration profiles discovered are: (i) *Solid*, composed of well-established collaborations between most popular genres (super-genres), which have been going on for decades; (ii) *Regular*, composed of the most common collaborations in all markets, which are very similar to solid collaborations but not as engaged; (iii) *Bridge*, composed of collaborations with high influence, representing bridge-like connectors between two regions of a network (mostly between divergent music styles); and (iv) *Emerging*, formed mainly of collaborations between regional genres. Such partnerships generally occur within the same genre. Hence, detecting such profiles is a powerful way to assess musical success by describing similar behaviors within collaborative songs from multiple angles.

These and other preliminary results are present in a paper recently accepted for publication in the 21st International Society for Music Information Retrieval Conference (ISMIR) [Oliveira et al. 2020]. As future work, we plan to continue investigating the evolution of genre collaborations, specifically the dynamics of the collaboration profiles. We also aim to address other open research issues regarding the science behind musical success (e.g., recommending collaborations) by using different data mining and machine learning techniques to extract meaningful knowledge about the music domain, such as mining frequent genre patterns within successful collaborations.

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