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Homophily of music listening in online social networks of China

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ABSTRACT

Homophily, ranging from demographics to sentiments, breeds connections in social networks, either offline or online. However, with the prosperous growth of music streaming services, whether homophily exists in online music listening remains unclear. In this study, two online social networks of the same group of active users who listened to complete songs over 1000 times and posted over 100 tweets are established, separately, in Netease Music and Weibo. Through presented multiple similarity measures, it is evidently demonstrated that homophily does exist in music listening for both online social networks. The unexpected listening similarity in Weibo also implies that knowledge from generic social networks can be confidently transferred to domain-oriented networks for context enrichment and algorithm enhancement. Comprehensive factors that might function in the formation of homophily are further probed, and many interesting patterns are profoundly revealed. It is found that female friends are more homogeneous in music listening and that positive and energetic songs significantly pull users close. Our methodology and findings shed light on realistic applications in online music services.

1. Introduction

One of the best-established findings in social networks is that people who are friends exhibit plenty of similarities in human behaviors (Mcpherson et al., 2001; De Klepper et al., 2010). Friendship relationships, either offline (Reagans, 2005) or online (Buote et al., 2009; Antheunis et al., 2012), in which individuals socially interact involve a need for shared mutual understandings. Tremendous efforts have been devoted to the homophily of social networks from many aspects, ranging from demographics (Chmiel et al., 2011) to mental states (Bollen et al., 2011; Fan et al., 2014). It is even revealed from a recent study that personality similarity exists among close relationships (Youyou et al., 2017). Particularly, with the flourishing of online social media, previous studies have extensively investigated the homophily of behaviors in online social networks (Brown et al., 2007; Mislove et al., 2010; Centola, 2010), and the friend similarity that exists in face-to-face offline networks is identically revealed. However, as a prominent element of daily life that possesses cultural universality (Blacking, 1995; North, 2004; Wright, 2013), music listening is rarely explored in the context of social networks, and little knowledge is established regarding the behavior referring to homophily, particularly in the circumstance of online social networks.

In fact, individuals embedded in social networks come across music of varying categories, including vast types of genre, language and mood, and continually judge whether they like the music (Frith, 2002). In addition, music is always shared with families, friends and other people socially around us (Håkansson et al., 2007; Voida et al., 2005). Before the era of the Internet, CDs and cassettes were the main media for recording music, and music communication was thus limited (Boström et al., 1999; Miell et al., 2005). However, in the last twenty years, with the prosperous development of the Internet, portable music players have exploded in popularity, essentially promoting music communication (Holmquist, 2005; Rondeau, 2005). Friends have been willing to exchange their iPods with each other, and now, music streaming platforms offer low-latency access to large-scale databases, such as Spotify (Kreitz and Niemela, 2010), Last.fm (Henning and Reichelt, 2008), QQ Music (Priest, 2006) and Netease Music (Fung, 2007). Since then, people have exchanged music with each other online and shared the amazing music they like, and music even creates interpersonal bonds between different individuals in turn (Boer et al., 2011). Although evidence of listening similarity in offline friendships has been demonstrated (Selfhout et al., 2009), the listening similarity of friends in online social networks has not been comprehensively explored and understood yet. Specifically, questions such as whether we enjoy the music with which online friends are enchanted, in other words, whether the homophily of music listening exists in online social

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networks, still deserve a systemic investigation.

Until recently, empirical research willing to answer the questions about music listening had to depend on interviews and surveys in controlled environments (Sloboda, 1999; Greenberg et al., 2016) with inevitable limitations in both data scale and granularity. However, the technological and societal evolutions that sustain the emergence of online music listening indeed provide unparalleled opportunities for human behavior understanding. Detailed footprints, including where, when and how numerous individuals listen to music, can be regarded as a big-data window through which the homophily in music listening can be collectively or individually probed and studied thoroughly. For instance, Netease Music, one of the most popular online music providers in China, provides a high-quality music streaming service to millions of users and accordingly accumulates the detailed behavior records of these users continuously. According to the official report of Netease Music in 2016 News (2016), it had over 200 million users. With music playlist creation being the core listening pattern, each day, users establish approximately 420 thousand playlists, and user-generated playlists total 800 million. In the first half of 2016, users played songs 1.82 billion times, and the duration amounted to 7.2 billion minutes, implying the impressive vitality of users in online music listening. Even more inspiring, Netease Music has developed one extraordinary trait of socializing its users. Specifically, it first provides a domain-specialized social network through which users engage in sharing music interests. Similar to generic online social networks, users can be networked by following others, not only ordinary users but also artists. Indeed, the social network sourced in music listening profoundly facilitates the acquiring and sharing of music interests, implying an ideal entanglement between social ties and music listening for the present study. Thus, anonymous digital traces of numerous users are collected to quantitatively support the investigation of homophily in music listening.

However, domain-oriented social networks such as the one established by Netease Music cannot be a typical representation of online social networks, which generally result from comprehensive factors. Specifically, the Netease Music social network relies predominately on the musical interest, and its digital traces are insufficient to describe other individual traits. In the meantime, evidence of musical preferences being linked to individual traits, such as personalities (Greenberg et al., 2016), cognitive styles (Greenberg et al., 2015) and even socioeconomic statuses (Park et al., 2015), has been extensively demonstrated, implying the consideration of more generic online social networks. We argue that aiming at a systemic understanding, it is necessary to study listening practices based on other more typical social networks in which users are joined sophisticatedly but realistically by psychological traits, extensive interests or other individual characteristics. Considering the development of social media in recent decades, prosperous networks such as Twitter or its variant Weibo of China, which aggressively replicate offline social networks to online counterparts, can be ideal targets. These online social networks are natural, long-term and diverse, and thus, the objective footprints of massive individuals can be promising proxies for the present study. Nonetheless, it is still extremely difficult to correctly match each individual of the music social network to the identical one in networks such as Weibo, which is the essence of embedding music listening in a generic online social network. Very fortunately, users can log into Netease Music through their Weibo accounts, and along this line, we can obtain the digital traces of Weibo for these users. Therefore, it is possible to further study the similarity of music listening for friends who are linked in Weibo. In addition, demographics and tweets in Weibo are excellent supplements for enriching individual characteristics. We can even explore which key factors influence the similarity of music listening. Hence, we investigate the following research questions in this study:

- RQ1. Is there homophily of music listening behavior in online social networks of China?
- RQ2. Which factors influence the listening similarity of friends in online social networks of China?

Starting from the above motivations and assumptions, in this study, digital footprints of over seventy thousand individuals from both Netease Music and Weibo are thoroughly collected through a crawler. Then, 25,953 active users who listened to songs 1000 times and posted at least 100 tweets are sampled as the subjects for further exploration. Two online social networks, the Netease network and Weibo network, are constructed through user followings in Netease Music and Weibo, respectively. To examine whether music listening is homogeneous for users joined by online social networks, listening similarities from six perspectives are defined and measured, which can represent the strength of ties of music between online friends. To investigate the crucial factors influencing the music listening homophily, subjects are clustered into different categories from multiple perspectives such as social attributes and musical preferences.

Our results demonstrate that friends linked by each of online social networks (Weibo and Netease Music) indeed appreciate identical songs and possess similar music preferences. As for gender, patterns for music listening between female friends are closer than those between male friends, implying that women are more sensitive to emotional expression through music (Wells and Hakanen, 1991; Robazza et al., 1994). The listening practices of friends with common music preferences in the current culture are similar, particularly for music languages (Chinese) and genres (pop and folk). With regard to musical mood, the users who enjoy exciting, wild and happy music share more similarities in music listening. It is also difficult for users possessing high musical diversity to find friends with similar musical tastes. The present study confirms the existence of homophily in music listening of online social networks and elaborately clarifies the roles of human demographics and music traits in influencing the homophily. Our findings shed insight on music recommendations and friend suggestions in online applications. We merge different social circles of an individual and surprisingly reveal that generic social networks, such as Weibo, still significantly demonstrate the homophily that intuitively only exists in domain-oriented networks. This result indeed implies that rich information in general social media can be confidently introduced into the study of specialized social networks (Carmagnola and Cena, 2009).

Although most previous studies explored the homophily by questionnaires (Baym and Ledbetter, 2009; Hagen and Lüders, 2017), there have been some effective data-driven methods to investigate homophily of music listening in online social networks. Lambiotte and Ausloos analyzed correlations between online music groups of different genres in Last.fm and constructed a music genre cartography, with a tree representation (Lambiotte and Ausloos, 2006). Some researchers detected the communities from the social network and investigated whether the creation of these ties was influenced by the similarity of interest (Bisgin et al., 2010). Aiello et al. defined the topical similarity among users who were close to each other in the social network of three systems to study the presence of homophily that combined tagging (Aiello et al., 2012). However, they lacked connections between users in these different social networks. To the best of our knowledge, we are the first to build different social networks with the same group of active users from Netease Music and Weibo for probing six measures of homophily in music listening.

2. Dataset

2.1. Netease music dataset

Digital service providers began to amass large user bases, increasingly offering the primary sources of digital music streaming through the Internet. New innovations, including digitalization and the Internet, have transformed the existing landscape over the past decade and attracted new artists and listeners into the fields, and digital music

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