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Datafication of Music Streaming Services

A qualitative investigation into the technological transformations of music consumption in the age of big data

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ABSTRACT

In the age of music streaming, the datafication of music listening is at the core of the contemporary configuration of music consumption. Every action taken by listeners to browse, search for, listen to, comment on, thumb up or skip each specific song can be traced, tracked and recorded as data, which is exploited to both personalise the listening experience and connect like-minded listeners. This technological variable brings about many unexplored transformations of individual musical habitus and everyday modes of music consumption.

In view of the pioneering position of NetEase Cloud Music in the realm of data-driven music streaming services in China, where a unique, domestic music consumption market is growing rapidly independent of other global players, this research looks into this particular music streaming platform's data-driven services and employs semi-structured in-depth interviews to investigate their impacts on the construction and evolvement of users' taste, behaviour and perceptions regarding music. Drawing on the sociology of music, the material differentiation of music consumption (Nowak, 2016), and the concept of music in everyday life (DeNora, 2000; Hesmondhalgh, 2002, 2008), this research uses thematic analysis to integrate empirical data with theoretical approaches to investigate the interconnection of the materiality of big data technologies, the structure of musical habitus, and modalities of music consumption.

The findings suggest that big data technologies intervene in the structuring of individuals' musical habitus through different usages and purposes and result in the reconfiguration of individuals' taste, behaviour and perceptions regarding music, which further organises individuals' music listening practices in the private and public spheres. The adoption of data analytics and data communication in music consumption extends the self-modulation and social networking functions of music and reconstructs the intricate mechanisms of the human-music-technology relation.

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1 INTRODUCTION

The music consumption market is a rising test field of big data bandwagon in recent years. The popularity of on-demand music streaming services has accelerated the adoption of data analytics in the music consumption market. Contemporary music streaming technologies allow a "data feedback loop" to be generated, collected and analysed in real time and make "all listening time" become "data generating time" (Prey, 2016).

Even though all music streaming platforms share the similar goal of upgrade the musical experience of users, the strategies and uses of big data vary on different platforms and relevant research needs to be situated in specific cultural and social contexts. China is a very unique and rapidly expanding music streaming market, where the penetration rate of music streaming services has hit 70% by 2018 and the whole music streaming market is dominated by three domestic digital giants, Tencent Music Entertainment (TEM), Alibaba Music Group and NetEase, which makes the local market relatively independent of other globally popular music streaming platforms (QuestMobile, 2018; Soundcharts, 2019). Compared with Tencent, the owner of China's most popular social media platform, and Alibaba, China's biggest online commerce company, NetEase Cloud Music has a relatively smaller business scale but earns a remarkable market share (11.1%) and approximately 116 million monthly active users (MAUs) to compete with the three music streaming platforms of TEM (75.6% market share in total) and Alibaba's Xiami (2.3% market share) (Soundcharts, 2019).

Big data technologies give NetEase Cloud Music an advantage over competitors, which enables the platform to differentiate itself in the market and expand its user base through the data-driven, AI-powered music recommendations, the personalised analysis reports of users' music listening practices, and the user-generated data of music comments and virtual

socialisation (Synced, 2018). NetEase Cloud Music develops a two-way big data strategy, combining the algorithmic harvesting of listening data and users' generation of information flows about music, with an attempt to extend the application of artificial intelligence in music distribution and consumption and unlock the social media functionality of music streaming services (IFPI, 2018; Soundcharts, 2019). The adoption of big data technologies supports NetEase Cloud Music to achieve the highest customer retention rate (46.7%) compared with all competitors (QuestMobile, 2017) and become the most significant paradigm of the "datafication of listening" in China's music streaming market (Prey, 2016).

In view of the absence of the global players in China's music streaming market and the pioneering position of NetEase Cloud Music in the realm of big data technologies that shaped the product philosophy of music streaming services in China, it is very meaningful to investigate the implications of the datafication of music listening in China, which should not be regarded as the "copy-cats of the western streaming apps" (Soundcharts, 2019: 7). However, recent academic research still witnesses a lack of attention to this technological transformation in the digital music landscape of this particular country and its domestic music streaming services that influence the music consumption experiences of hundreds of millions of listeners. Therefore, a case study focusing on the datafication of music streaming services in China's music consumption market can make valuable contributions to the exploration and understanding of the disruptions caused by big data and streaming technologies and the association between the materiality of music technologies and listeners' music consumption practices and preferences in the age of big data (Hesmondhalgh and Meier, 2018; Nowak, 2016).

Therefore, this study focuses on NetEase Cloud Music's data-driven algorithmic music recommendations, data-based personalised music listening reports, and user-generated music comments and virtual communities to explore the impacts of the datafication of listening on

listeners' music consumption behaviour and preferences in China. Based on the interviews with fifteen users of NetEase Cloud Music, this study employed a conceptual framework informed by Nowak's (2016) three uses of music technologies and DeNora (2000) and Hesmondhalgh's (2008) two dimensions of musical experience to locate the datafication of listening in the realm of everyday modes of music consumption and reevaluate and adapt the existing theories and concepts to the contemporary phenomena of music consumption through combining empirical observations of "micro-interactions of everyday life" with testable theoretical approaches (Hesmondhalgh, 2002: 119).

2 LITERATURE REVIEW

2.1 Musical Habitus

A great deal of research on the sociology of music draws on Pierre Bourdieu's concept of habitus, which provides a profound theoretical framework for "sociological examinations" of music taste and consumption (Prior, 2013). Bourdieu (1984: 18) argues that "nothing more clearly affirms one's 'class', nothing more infallibly classifies, than tastes in music". The model developed by Bourdieu (1984) provides an orthodox approach to explain the relationship between individuals' preferences and their social classes. According to Bourdieu's profound work, *Distinction*, the habitus of individuals is both "a structuring structure" and "a structured structure", which means that the habitus not only organises and signifies "practices and the perception of practices" but also develop and evolve as a consequence of individuals' "social belonging to a class" (Bourdieu, 1984: 170; Nowak, 2016: 109). The Bourdieusian notion of habitus emphasises the impacts of social stratification on the composition and constitution of individuals' habitus, "a set of preconscious dispositions", including preferences, perceptions and behaviour patterns, which symbolises social classes and reproduces social-cultural hierarchies (Nowak, 2016; Riley, 2017: 111).

However, Bourdieu's model of "elite-to-mass" social-cultural distinction is too exclusive to consider the evolution of music taste of individuals in various everyday contexts and the demographic, aesthetic and sociability dimensions of individual affective responses to music (Prior, 2013: 187; Lewis, 1992; Bennett, 2008; Nowak, 2016). Bourdieu's dichotomous model is also too obsolete to catch up with the rapid development of technologies in the digital age. The transformation of society has enhanced the impacts of other previously excluded factors, particularly the materiality of technological variables and the subsequent changing meaning and value assigned to music listening, and loosened the relationship between social classes and musical habitus, which is assumed to be tight and exclusive by Bourdieu's model (Dant, 2008). In recent decades, with the emergence and development of new music technologies, the relationship between the materiality of technologies and the modalities of musical consumption have been transformed and evolved within a "circuit of practices" (Magaudda, 2011; Bull, 2000). In retrospect, the introduction of recorded music reshaped "the ways in which music is written, recorded, produced, marketed and listened to" in the late 19th century (Nowak, 2016: 14). Nowadays, the contemporary music industry witnesses the rise of music streaming services and the exploitation of user data, which are nourishing the reconfiguration of music consumption, "from being based on ownership of music to being based on access", and fuel an advancement of "personalisation, mobility and connectivity" of music listening (Marshall, 2015: 179; Hesmondhalgh and Meier, 2018: 1566). The consequential implications of the materiality of music technologies possibly flatten social-cultural hierarchies and bring about more variation and complexity to the music taste and consumption, or reinforce existing musical tastes, habits, behaviour patterns and social links, rather than transform them (Tepper & Hargittai, 2009). Therefore, Bourdieu's theory of habitus provides a theoretical foundation for subsequent research on the structure of individual's everyday modes of music consumption but also has limitations in explaining "the longitudinal performative penetration" of music technologies in the transformation or maintenance of pre-existing musical habitus in the digital age (Nowak, 2016: 09). Alternative or supplementary approaches

are needed to examine multifarious properties of music and complex evolvement of individuals' preconscious dispositions of taste, behaviour and perceptions regarding music from new perspectives different from Bourdieu.

2.2 Material Modalities of Music Consumption

The materiality of music technologies has been overlooked for a long time in the field of the sociology of music, even though the age of digital music has witnessed the increasing multiplicity of individuals' interactions with music technologies, which reconfigure the complexity of modalities of music consumption and individual affective responses to music (Nowak, 2016). Recently, some research has been conducted, such as Michael Bull's study of iPod (2004, 2005, 2007), Dominique Bartmanski and Ian Woodward's work on the vinyl record (2013) and Mattias Östergren and Oskar Juhlin research on car stereos (2006), to focus on specific music technologies and their impacts on the modalities and meaning of music consumption.

Furthermore, Raphaël Nowak (2016) suggests a technological and material framework to provide a more comprehensive picture of the modalities of music consumption in the digital age by concluding three types of uses attributed to music technologies. First, the technological innovation in the music industry brings more convenience to music listening in the utilitarian aspect of music technologies. The term, convenience, means not only the affordance of particular music technologies to get access to desired music content but also the ability of individuals empowered by technologies to structure, manage and mediate their music taste and listening practices. Mary Madden (2009) also argues that there are five reasons behind the popularity of digital music technologies, including costs, portability, mobility, choice and remixability, all account for the levels of convenience of music technologies. Second, people also choose and use music technologies for the aesthetic meaning of music listening. Streaming

music services not only make music content immaterial and permeable between different devices but also reshape individuals' aesthetic experience of music listening by producing the contemporary form of "musicking", an extended range of activities related to music, and also bringing about the possibility of reducing the sound quality and fidelity of music that individuals can listen to or download (Nowak, 2016; Small, 1998). Individuals tend to use different music technologies to listen to different genres of music depending on their aesthetic potential, such as vinyl discs for electronic music, MP3 players for breakcore music, and streaming services for popular music (Bartmanski & Woodward, 2013; Whelan, 2008). The participation in the creation of listeners' aesthetic experience serves as a critical criterion for distinguishing and choosing different media and technologies for listening. Lastly, individuals also assign symbolic meanings to the chosen music technologies and modes of music consumption by regrading music as a symbolic projection of memories, ideas and sentiments (Nowak, 2016). Listeners tend to hoard material or immaterial forms of music content to claim ownership, keep track of music listening practices to construct memories, and use music to narrate life experiences (Van Dijck, 2007; Bahanovic & Collopy, 2009, 2013).

In the past ten years, the rise of the data-driven music recommendation technologies comes with the growing trend of music streaming, including the content-based recommendation technology, collaborative filtering recommendation technology and hybrid recommendation technology" (Lin, Xu, Liu, Wu, & Chen, 2016: 229; Yang & Wang, 2017). The popularisation of music streaming services and big data technologies enhances the convenience of music consumption by transforming the modes of browsing, discovering, getting access to, managing, sharing and interacting with and through music content, produces "new dynamics of personalisation and mobility" of listeners' aesthetic experience of music listening, and provides individuals new means of understanding their music collection and constructing their memories and life narratives through music (Hesmondhalgh and Meier, 2018: 1562). Nowak's (2016) notion of uses of music technologies allows for a deeper examination of the

meanings assigned to contemporary data-driven music streaming services to investigate whether and how the adoption of big data technologies redefine the ways individuals make meaning of their music listening practices and their interaction with music technologies.

2.3 Private and Public Spheres of Music Consumption

In order to study the sociology of music, it is important to investigate and analyse how individuals make "meanings" of music in everyday lives, instead of simply limiting it to a marker of "some hidden structural social force or distinction strategy" or a passive choice tightly subject to the materiality of technologies (Prior, 2013: 189). Tia DeNora (2000) argues that sociologists should not overlook the transformative powers of music, which is implicated in the self-programming and self-regulation in action and the construction of socio-cultural collective practices. Even though DeNora (2000) disregards music technologies as a minor factor in understanding music taste and consumption, which makes her arguments offer no explanation for the association between individuals' interaction with music technologies and their affective responses to the music they listen to, her approach to analysing two roles of music as "a technology of self" and as "a device of social ordering" makes an important contribution to the sociological analysis of music (DeNora, 2000; Nowak, 2016). Similarly, David Hesmondhalgh (2008: 329) suggests that there are "two contrasting but coexisting dimensions of musical experience", linking to "the private self" and providing the basis for "collective public experiences". He also takes technology innovation into account and examines the disruptions caused by the "digitalisation" of music and "networked mobile personalisation" of music consumption (Hesmondhalgh and Meier, 2018: 1555).

Music listening can provide resources for the "ongoing" construction and regulation of the private self, i.e. self-identity, of individuals and their "social psychological, physiological and emotional states" by structuring and mediating "memory, spiritual matters, sensorial matters,

mood change, mood enhancement and activities" (DeNora, 2000: 47; Sloboda, 1992). Individual music listening practices can be regarded as a type of "care of self", which means individuals consciously take advantage of the transformative power of music for their needs of "attaining, enhancing and maintaining desired states of feeling and bodily energy", and also a "device for the reflexive process" of building a repository for memories of life experiences, constructing self-identity and mediating future identity and practices (DeNora, 2000: 53). Individuals' choices of music for musical accompaniments in a given context are based on and mediated by a set of rational, aesthetic and emotional reflexivity of the appropriateness of chosen music for the contexts and the feelings, sentiments and actions of listeners, which unfolds various layers of individuals' meaning-making of music listening practices in the private sphere (Holmes, 2010; DeNora, 2000, 2006; Lash & Urry, 1993).

Music, with its embedded connotations and affections, is also entangled with various social practices and social bonds in the public sphere (Born, 2011; Brown & Sellen, 2006). Music can be used as a medium of social ordering and social resources for collective participation to enable people to structure the emotive dimension of their interaction with others and organise social activities for interpersonal relationships, which are often reinforced when emotional reflexivity and affective responses are shared or potentially shared with others through music (DeNora, 2000; Hesmondhalgh, 2007, 2008, 2013; Frith, 2002). On one hand, music can serve as an active, catalytic ingredient engaging in the construction and maintenance of interpersonal relationships by providing specific "settings" for different levels of intimacy or creating "environment" and "scenes" for different sorts of emotion-based interactions (DeNora, 2000: 111-123). On the other hand, messages can be conveyed via music as a medium from one side of a relation to another, which potentially either enhances or undermines "relationships between friends and intimates" (DeNora, 2000: 126-129). In these ways, music is not only a tool used by individuals to help them manage their interpersonal relationships but also an

indicator of the status of relationships, which affects how an individual chooses a specific piece of music and use it in a specific way for a specific relationship.

Therefore, music can be viewed as "a meeting point of the private and public realms" (Hesmondhalgh, 2008: 2). It is reasonable to combine the approaches of DeNora (2000) and Hesmondhalgh (2008) into an integrated model that splits individuals' music consumption experiences into private and public spheres and situate this model in the context of the penetration of big data and streaming technologies in everyday modes of music consumption. By doing so, this research aims to focus on "a specific sociology of people doing things with music", instead of a general sociological examination of music, to understand how individuals actively make meaning of listening and connect music to their "lives, experiences, needs and desires" (Prior, 2013: 189; Grossberg, 1992: 52).

2.4 The Power of "Networked Logjects"

Music consumption has been viewed as a "testing ground" for networked mobile technologies and data-based personalised services in recent research because of its accompanying role in various contexts of everyday life (Hesmondhalgh, 2018). In the last decades, the digitalisation of music has shifted the modes of music listening from domestic consumption of downloading music to mobile consumption of streaming music, which lays the foundation of the traceability of music listening practices and the feasibility of data mining in the field of music consumption (Turow, 2008; Prey, 2016). Mobile phones and the installed music streaming services serve as a paradigm of Dodge & Kitchin's (2009) notion of "networked logjects", which have the ability to trace, track and record their usage and analyse the recorded information to produce predictions and insights of the behaviour patterns and preferences of users. The predictive capabilities of data analytics involve an algorithmic process of sorting out, classifying and filtering the information or resources that can be received by individuals, which enhances the

personalisation of individuals' music consumption practices in both private and public realms (Beer, 2009, 2010; Hesmondhalgh, 2018). The participation of data as a technological component in the distribution and consumption of music not only decides what music can be listened to by individuals but also reconfigures individuals' habits of approaching music and constructing their soundworlds. As David Beer (2010: 480) argued, "the power of the algorithm" makes the music "find" its listeners and transforms the behaviour of discovering music to a "sedentary and inert process", through which people are passively connected to particular music and information, instead of actively finding the music they want. Scott Lash (2007) also defined this shift as an effect of algorithmic "post-hegemonic power" which becomes increasingly active and deeply embedded in everyday consumption practices.

Data-driven music recommendations and the digitalisation of the music-related activities facilitate "a move towards personalisation, mobility and connectivity" in music streaming experiences (Hesmondhalgh, 2018: 1566). However, existing research and literature in this realm mostly focus on the impacts on the discovery of new music and the accuracy of predictive analytics, leaving many blanks to be filled in about other aspects of music consumption, such as purposive choices of music, management and collection of music, and socialising potential of music, which reveal the possible reconfiguration of individuals' perceptions and preferences regarding the role and meaning of music in everyday lives. Further research is necessary for evaluating Marshall McLuhan's (1988) tetrad of effects of music technologies, by addressing the following questions: Does the adoption of big data and streaming music enhance or transform individuals' existing habits? What do these technologies make obsolete? Do these technologies recover certain musical experience which was previously lost? What would people do if these technologies can't satisfy their needs?

2.5 Conceptual Framework

The conceptual framework for this research is theoretically informed by the sociology of music and the media and cultural studies of the materiality of technologies and the modes of engagement and consumption. The sociology of music emphasises the significance of the interpretation and mediation of the meaning of music over "the course of everyday life", but has little consideration of the "technological and material variables" within the modes of music consumption (DeNora, 2000; Nowak, 2016: 7). In light of relevant literature on the mediations between music, everyday life and technologies, this research attaches importance to the materiality of technological structures and its roles in the changing dynamics of music consumption and the composition of preferences, with an aim to integrate the empirical observations of the materiality, affections and roles of music consumption with relevant theoretical approaches to the sociological analysis of music (Hesmondhalgh, 2008, 2018; Nowak, 2016).

Expanding and reevaluating Bourdieu's (1984) notion of habitus, this research defines the set of preconscious dispositions of individual taste, behaviour and perceptions regarding music as musical habitus and also borrows from Nowak (2016)'s research on technological transformations in music consumption to assume individuals' musical habitus is not only structured by the pre-existing social classes but also constantly evolving through and mediated by everyday modes of music consumption. This research is not ambitious to examine the validity of Bourdieu's theory of habitus, but aims to interrogate the engagement of the materiality of music technologies in the structuring and restructuring process of musical habitus and assess variations of music consumption that go beyond individuals' social and cultural origins.

In light of Bourdieu's (1984) argument that musical "habitus" is both "a structuring structure" and "a structured structure", this research conceptualises a model to incorporate the technological and material variables into the structure of musical habitus by assuming music technologies intervene the structuring of individuals' musical habitus, which is further mutually mediating and mediated by the modalities of music consumption in various everyday contexts. The assumed logical interconnection of the materiality of music technologies, musical habitus, and modalities of music consumption is illustrated in the following figure:

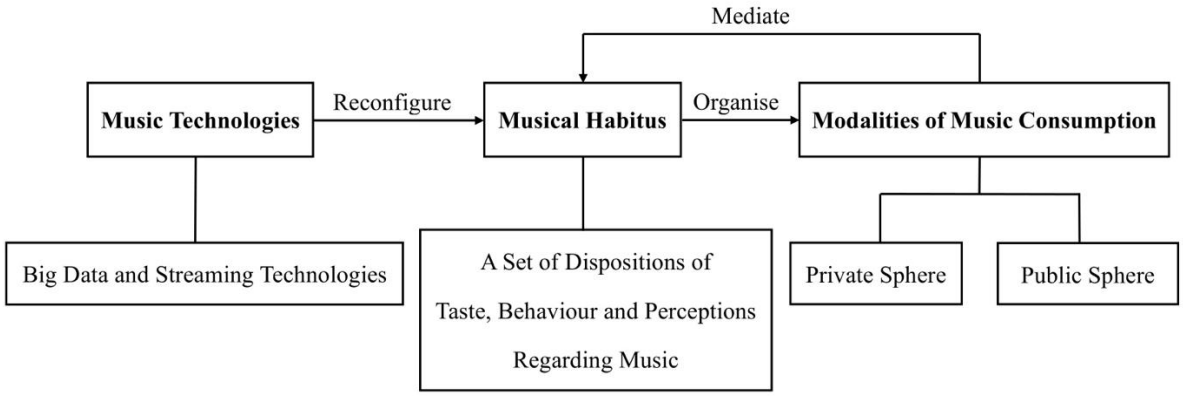

Figure 1: Visualising the interconnection of music technologies, musical habitus, and modalities of music consumption.

Considering the focus of this research on the rising adoption of big data in the realm of music streaming services, the big data and streaming technologies are defined as a paradigm of music technologies that this research aims to look into. On the basis of Nowak's (2016) notion of the three uses of music technologies, this research plans to scrutinise and interpret individuals' motivations of and responses to their various interactions with music technologies to examine whether empirical data can fit into or go beyond the established theoretical framework.

Furthermore, following the suggestions and approaches of DeNora (2000), Hesmondhalgh (2002, 2008) and Nowak (2016), this research situates the modalities of music consumption within "the structures of everyday life" and emphasises the importance of the concept of everyday life in the scrutiny of various "dimensions of human experience" (Nowak, 2016: 111; Hesmondhalgh, 2002: 121). Thus, in light of DeNora (2000) and Hesmondhalgh's (2002, 2008, 2013) theoretical approaches of locating music's roles and meanings in the private and public realms, the conceptual framework of this research understands music as both a resource for individuals' construction of the self and their inner world and a basis for individuals' social links and public collective practices. By distinguishing the two dimensions of musical experience, this research aims to investigate individuals' music consumption practices in their private and public lives respectively, especially through their interactions with the technological variables of big data and music streaming services.

2.6 Objectives of the Research

Through the theoretical lens of the conceptual framework, this research aims to answer the following research question:

> *How the musical habitus of individuals is structured by the materiality of music technologies, and also structuring the modalities of individual musical consumption in various everyday contexts in the digital age?*

Focusing on the particular case of data-based services provided the NetEase Cloud Music, this research plans to investigate the big data and streaming technologies (the materiality of music technologies) employed by this music streaming platform, and how its adoption of technologies reconfigures the structures of individuals' acquired dispositions of taste, behaviour and perceptions regarding music (musical habitus) and penetrates the

interconnection between music consumption and everyday life in the private and public spheres..

This research question can be divided into two parts. The first part focuses on how different uses of big data and streaming technologies have various impacts on individuals' musical habitus. The other part of the question looks into the modalities of music consumption in private and public spheres, and how these practices are organised by, and also mediating, the potential transformations of individual musical habitus with the intervention of big data and streaming technologies. Exploring the roles of big data and streaming technologies in the mechanism of music consumption on the foundation of existing research and theories, this research aims to grasp on the individual variations of music consumption, which go beyond pre-existing social-cultural distinction and get entangled with technological transformations, and contribute to the understanding of the effects of datafication of music listening on people's interactions with music.

3 METHODOLOGY

3.1 Rationale

The focus of this research is on the varying levels of the penetration of big data and streaming technologies into the configuration process of individuals' taste, behaviour and perceptions regarding music in the context of everyday music consumption. Thus, the research aims to address the "how" and "why" questions of individuals' personal experiences, attitudes and motivations of using particular music technologies, which can only be measured and interpreted through subjective narratives. Qualitative interviewing has the strengthen in enquiring individual life narratives and understanding the "meanings" people attribute to their music consumption experiences and private and public "life worlds" (Warren, 2002: 83;

Miller & Glassner, 2011: 133). The "authentic insight into people's experiences" can be extracted from the qualitative data of respondents' "points of view" to support this study to investigate how individuals construct meanings of their interactions with music technologies (Silverman, 2001: 87; Kvale, 2006: 481). Moreover, since this research plans to look deep into individuals' music consumption experiences in both private and public lives, the in-depth interviews are effective and necessary for this research to unfold individualistic, intimate attitudes and experiences regarding the self and social links.

Interviews and surveys are the two most common research methods employed by the former research on music consumption. However, surveys are more suitable for identifying behaviour patterns while motivations, feelings, meanings and relationships of experiences are difficult to be measured in quantitative terms (Matarasso, 1996; Rimmer, 2007). Moreover, the musical habitus of individuals, including individuals' dispositions of taste, behaviour and perceptions regarding music, are psychologically and socially complex and differentiated in various everyday contexts, which are not suitable for objective baselines and measurement but possible to be investigated through qualitative interviews (Gaskell, 2000). The pilot study concerning the same research topic provides support for the appropriateness of qualitative interviews for this study. The results of the pilot study indicate the variety and subjectivity of individuals' meaning-making of experiences and bring unexpected insights to the adjustment of the interview topic guide. Some segments of collected data also reveal respondents' "hidden feelings or attitudes and beliefs" that they were not conscious of (Berger, 1998: 55). Thus, the use of in-depth, semi-structured interviews brings flexibility to the research design and allows "the variety of meanings" and "unexpected information" emerging from the process of interviews (Warren, 2002: 87; Berger, 1998: 57).

Furthermore, the main context of this research is the rising use of big data and streaming technologies for music consumption. Even though some research projects on music

technologies have been conducted, most of them focus on either the devices for music listening or the technological mechanism of data analytics, and seldom address the meeting point between musical habitus and the datafication of music streaming services. Therefore, the qualitative interview method is useful in investigating the emerging topics that might not have been examined on the basis of the existing theoretical frameworks.

3.2 Sampling and Recruitment

Following "the four-point approach to qualitative sampling" suggested by Robinson (2013), firstly, the "sample universe" is defined as the users of NetEase Cloud Music in view of the focus of this study on this particular mobile music application. Secondly, to ensure a reasonable sample size, 38 potential participants who fit the criteria of the sample universe were contacted and finally 15 of them agreed to participate in this research. Thirdly, the purposive, stratified sampling strategy is adopted and based on the industrial report's findings on the age structure of the users of NetEase Cloud Music (Guest, Namey, & Mitchell, 2013). The recent report provided by QuestMobile (2017) reveals that, 14.6% of the app users are "post-00s" (born after 2000), 43.4% are "post-90s" (born between 1990 and 1999), 33.2% are "post-80s" (born between 1980 and 1989), and 6.6% are "post-70s" (born between 1970 and 1979). Therefore, the sample of this research was proportionally divided into these four age categories (Appendix 2). The sample is comprised of both male and female respondents across these four age ranges to ensure different age and gender groups are "represented in the final sample" (Robinson, 2013: 25-26).

During the last step of sourcing qualified respondents, in light of the pilot study, the combination of snowball sampling and site sampling is employed. The site sampling was used as the first step of snowball sampling procedure to counter the limitation of snowball sampling (Hendriks, Blanken, Adriaans, & Hartnoll, 1992). Instead of talking with acquaintances or

friends and "mov(ing) on to strangers", like what snowball sampling usually does, in this research, the first round of participants were located in both offline music-related events and online popular social media platforms where people share and discuss about music. They were asked for "recommendations of acquaintances who might qualify for participation, leading to referral chains" (Robinson, 2013: 37). In this way, this research made efforts to prevent biased sampling resulting from the constraint of the researcher's "own circle of acquaintances" (Flick, 2018: 166).

3.3 Design of Research Tools

The interview topic guide, information sheet, consent form and thematic coding framework were developed based on relevant literature regarding the research topic, the chosen methodology and also the results of the pilot study.

The interview topic guide was revised after the pilot study by reorganising topics and removing over-detailed questions to ensure the guide is semi-structured and more open-ended for unexpected information and a natural flow of conversations. The interview guide outlines six main topics, with "suggested questions" for each topic and warm-up questions in the beginning (Kvale, 1996: 129). The six topics are designed based on the established conceptual framework and informed by relevant theoretical literature. The questions start from respondents' everyday habits of music listening, and then enquire their experiences and preferences of using certain data-based, music-related services, and move on to respondents' music listening experiences in the private and public spheres respectively, and end with questions about respondents' choices of mobile music applications. Interviews were conducted in an open manner with follow-up and probing questions to pursue further elaborations and implications and allow unexpected issues to emerge through the "positive interaction" between respondents and the researcher (Kvale, 1996: 129-135; Warren, 2002).

Eleven of the fifteen individual interviews were conducted via WeChat calls, and the rest are face-to-face interviews, according to the geographic distance between the respondents and the researcher. As mobile music application, the users of NetEase Cloud Music are mainly distributed throughout China. The combination of face-to-face interviews and remote interviews via WeChat calls enables the researcher to interview respondents who use NetEase Cloud Music in different cities of China and also overseas, which ensures the variation of the sample.

3.4 Coding and Analysis

All interviews were audio-recorded and thematic analysis was employed to code and analyse the transcribed interview transcripts. Themes and patterns were identified within the data in a way of combining both inductive and deductive analysis on the basis of "the theoretical interests guiding the research questions" and "the salient issues that arise in the text itself" (Braun & Clarke, 2006; Attride-Stirling, 2001: 390). Thus, the main themes were deduced from relevant literature and the conceptual framework while sub-themes were mainly induced from the interview data, which was segmented and grouped into categories through "the reading and re-reading of data" in light of the research question and relevant theoretical concepts (Braun & Clarke, 2006: 87). In this way, four sub-themes of respondents' interactions with data-driven music-related services were identified through reexamining Nowak's (2016) three uses of music technologies, and six other sub-themes are induced from the data and categorised into two main themes regarding the private and public dimensions of music listening experiences through the lens of DeNora's (2000) and Hesmondhalgh's (2008) findings.

3.5 Ethical Considerations, Reflexivity of Researcher and Potential Limitations

First of all, the nature of the interview method brings about a few limitations to the research. Conducting interviews is a time-consuming process, which makes it difficult to recruit a large sample, so the results cannot be generalised for the large population of music listeners (Kvale, 1996). Moreover, the method is "person-dependent" and based on subject narratives of respondents, who may adjust responses "according to what they consider is appropriate" for the researcher (Hayes, 2000: 115). The common cultural background shared by the researcher and respondents may also have an influence on the respondents' expression and behaviour. In order to tackle the power asymmetries that may emerge during interviews and the potential biases and preconceptions of respondents, all respondents were informed of the objective of the research, the voluntary nature of participation and the right to anonymity before each interview, so respondents were aware of their rights and responsibilities of free expression and authentic narratives and participated in the research with informed consent (Flick, 2018). The interview questions were also carefully designed as neutral as possible to prevent the power imbalance between respondents and the researcher.

Each interview lasts 60 minutes approximately and all were conducted in Chinese, the first language of respondents, so respondents can "freely present their life situations in their own words" (Kvale, 2006: 481). The time, locations and methods of interviews were chosen by respondents for their convenience to make conversations as comfortable as possible. Furthermore, conducting interviews requires respondents' trust on researcher and voluntary participation, which may lead to the self-selection bias, because people tend to have different levels of willingness of self-disclosure. Even though the self-selection bias is "not possible to be circumvented in the interview-based research", the possibilities of bias and consequences have been taken into account throughout the sampling process (Robinson, 2013: 35-36).

4 RESULTS & ANALYSIS

This section presents and interprets the ten sub-themes identified from the interview data and categorised into the three main themes, uses of music technologies, the private self, and social links, through the lens of the conceptual framework based on theoretical literature and the thematic coding framework devised from interview transcripts.

4.1 Uses of Music Technologies

4.1.1 Possibilities of Music Discovery

One of the most prevailing uses of data for music streaming services is personalised music recommendations, which is based on the predictive analytics of the data of users' music listening practices and the algorithmic construction of playlists. All respondents shared their experiences of using music recommendation services of NetEase Cloud Music to find the music they like, which affirm the efficiency of the data-driven music recommendation and the increasing convenience of discovering music. Interviewee 15 (1996, postgraduate student) narrated her experience of using "Daily Recommendation", one music recommendation service of NetEase Cloud Music, to get access to new music efficiently:

> *There was a time period, just so-called "Ge Huang" (Lack of songs), I would use the Daily Recommendation, I think it really suits my taste, because the recommended songs are all relatively similar to the songs I listened to on a loop in recent days, so I don't need to listen to those songs all the time, and I don't need to find songs by myself, its match is, I think it is really effective. (Interviewee 15)*

Data-driven recommendations algorithmically connect users' music taste with recommended music that individuals might wish to consume, which enables users to easily get access to the music matching their tastes by only clicking into the recommended playlists and fosters the expansion of personal music libraries. The following quote by Interviewee 2 (1997, postgraduate student) reveals this:

> *[...] For example, there was a time when I listened to a lot of English songs, and the proportion of English songs within its Daily Recommendation also increased. Its Daily Recommendation recommended around 20 songs, and more than half of them were English songs. It makes me discover more English songs. [...] This Daily Recommendation really helps me expand my music library. (Interviewee 2)*

Furthermore, algorithmic music recommendations not only provide more music content but also bring more possibilities to the discovery of music by potentially transforming people's perception of the diversity of music and making listeners more open to new music styles. Interviewee 9 (1995, postgraduate student) and Interviewee 11 (1984, high school teacher) described how the convenience of algorithmic music recommendations changed their perceptions regarding music:

> *I think, for me, it is a type of expansion, which makes my vision or styles not only limited to the styles of Hip-Hop，R&B，Rap, and enables me to listen to some Blues, or some Rock & Roll, just some influence of different styles. It is a great expansion of the scope of the music styles I like, the styles I can appreciate or enjoy. (Interviewee 9)*

> *[...] And because of its convenience, and its, that is, it can quickly connect to other music. [...] It makes you more willing to be open, my attitude becomes more open to accept diverse, different music styles, instead of obstinately limiting myself to those I have had. You would unconsciously absorb something new, something younger, or something more different from your past styles. (Interviewee 11)*

However, Interviewee 8 (1985, cafe manager) also mentioned her concern about the potential constraints algorithmic recommendations place on the discovery of music:

> *I think, it seems like the range of my choices becomes wider, but also narrower. [...] In fact, it's true that when I open this app, NetEase Cloud Music, I'm likely to, I'm highly likely to find many songs, but in fact, since I don't know them, I would not search for them. It equivalently means this stuff is here but also not here, although it's true that I can find it, but I probably would never go to find it. (Interviewee 8)*

Therefore, algorithmic music recommendations exploit user data to bring music to users, in other words, to enable songs to find their listeners, which reshapes individuals' listening practices (Beer, 2010). On one hand, personalised music recommendations afford listeners a more convenient and efficient way to get access to more options of music content and satisfy listeners' needs for "variety, surprise, and the resolution of the unfamiliar", which can bring more "enjoyment and deep appreciation of music" to listeners (Tepper & Hargittai, 2009: 228). On the other hand, the predictive analytics of individuals' music taste intensified the correlation between the recommended music and the data of individuals' previous music listening activities, which shows a tendency to lead individuals to the limited music styles within the scope of their pre-existing music taste, instead of exploring new music styles they are not familiar with (Morris & Powers, 2015). The findings provide contrasting evidence for and against Tepper and Hargittai's (2009: 233-246) hypothesis that music technologies are more often employed by individuals to reinforce their "existing habits, interests and predilections", rather than "transform them". The contrast between the possibilities and constraints that are brought about by personalised music recommendations reveals the complexity of the utilitarian aspect of music technologies proposed by Nowak (2016) and acknowledge his statement that algorithmic recommendations pave a new way for music discovery by offering numerous, personalised choices of resources.

4.1.2 Management of Music Taste and Habits

The algorithmic music recommendation is not the only outcome of the harvesting of personal data which tracks users' music consumption practices. The predictive analysis of user data is not only performed in the back-end database but also presented to users in a form of "Annual Personal Music Listening Reports", which summarise users' yearlong music listening practices and predict users' music preferences. All respondents who have experiences of using this data-based service described it as a useful means of managing and reflecting on their music taste and habits, as the quote from Interviewee 4 (2000, undergraduate student) illustrates:

> *[...] It would let me know the amount of the songs I listened to in one year, let me know the details of my interaction with others, let me find what directions or fields of songs I focus on, and also the frequency and time periods of my music listening activities, and sometimes it is kind of, a type of reflection. (Interviewee 4)*

Some respondents attach great importance to the advantage of using this automatic data analysis service to help themselves manage their music taste and listening practices because they believe algorithms have better memory and management capabilities than humans. Interviewee 1 (1997, postgraduate student) explained how the "Annual Music Listening Reports" of NetEase Cloud Music helped him rediscover his forgotten favourites:

> *The data, the data it provides, because of it, you can know how the music styles you listened to have been changing over time, and you can reacquaint yourself with some music that you might just forget, but perhaps, you would still like. (Interviewee 1)*

This utilitarian use of data-based management of taste and habits has been embedded within individuals' "material interactions with music technologies", which is facilitated by and also facilitating the two-way data exchange between music listeners and service providers (Nowak, 2016: 31-40; Beer, 2010) The employment of data analytics highlights the increasing convenience and affordance for listeners to trace and track their music-related activities online and strengthens the bond between music listeners and music technologies, which cultivates

the habit of relying on the big data technologies and algorithms to structure individuals' understanding of and reflection on their own music taste and habits.

4.1.3 Redefinition of Aesthetic Meaning

The convenience of music streaming services and the permeability of digital music files are assumed to undermine the aesthetic experience of music listening and erode the emotional communication between listeners and music, which is regarded as one reason why some traditional modes of music listening, like CDs or vinyl discs, are "not fully conquered" in the age of digitalisation (Nowak, 2016: 36-38). However, the narratives of some respondents reveal a redefinition of aesthetic meaning that music listeners develop with music technologies. A salient topic emerging from respondents' narratives is "nostalgia", the admiration for or devotion to the old music and traditional modes of music listening, which can still be experienced with data-driven music recommendations and music streaming services, as Interviewee 4 and Interviewee 13 (1996, postgraduate student) described:

> *[...] Some very old works, the achievements are very preeminent, but as the time goes by, they are hard to avoid becoming out of fashion, and when you meet them again, either through the recommendations of others or when the music app suddenly recommends it to let you find this song, it is your nostalgia for the old, you would feel very touched, or feel like it catches your eyes. (Interviewee 4)*

> *What impressed me is, when playing music, NetEase Cloud Music has a vinyl record, a black disc (on the screen), it rotates just like a phonograph. [...] In this way, it makes me feel there is a sense of nostalgia within it, it's probably, it's already a very modern product, but I think its sense of nostalgia is very valuable. (Interviewee 13)*

The above quotes provide evidence for the new explanation of aesthetic uses of contemporary music technologies, particularly user data analytics and music streaming services, challenging

and supplementing Nowak (2016) argument, which only discusses the fidelity and sound quality of music without considering how digital music technologies can provide other forms of aesthetic experience and change people's definition of the aesthetic meaning of music consumption. Transforming the ways people consume music, the materiality of digital and data-based music technologies reshapes individuals' preconscious dispositions of their aesthetic judgements and taste regarding music listening.

4.1.4 Symbolic Meaning: Memory Construction

In the process of describing the experiences of using different data-driven services offered by NetEase Cloud Music, many respondents assigned the symbolic meaning to their music-related activities to explain why they liked specific services or technologies. The idea of "memories" are most frequently mentioned by respondents to illustrate how the data-based personalised "Annual Music Listening Reports" enable them to make meaning of their music listening practices and recall life experiences:

> *It makes me know about myself, know about something I probably would have not realise, in other words, after a year, it would remind me of my memories of certain days. [...] If it doesn't provide this stuff, I probably would have forgotten this thing, but it told me this, and then I started recalling. (Interviewee 10)*

Interviewee 6 (1989, civil servant) also provided a detailed example of how big data technologies helped him recall an emotional experience of having an unstable relationship by providing data analysis to remind him of his most-listened song during a particular period. This experience stimulated him to generate an unexpected feeling, which he described as "a feeling of strangeness" when the particular song symbolises his past relationship and experience:

> *[...] Through such a report generated from objective data, and then, I had a feeling of strangeness for those I used to be familiar with. [...] During a certain period, I listened to a song so many times, it is Teresa Teng's "Chang Huan" (Payback), this song is in Japanese. Actually it's consistent with the status of my relationship at that time. During that time period, my relationship status is very unstable. (Interviewee 6)*

These examples provide support for Nowak's (2016: 38) notion of the symbolic attachment to music technologies, more specifically, "the projection of an idea, a memory, or a personal feeling" assigned by individuals to music throughout their interactions with particular music technologies. According to the above quotes, the respondents attributed a symbolic meaning of reminding them of past memories and constructing life narratives to the data-based personalised annual music listening reports. In this way, music technologies not only impact the behaviour of music listening itself but also entangle a set of music-related emotions, memories and life narratives to connect individuals' music listening practices with their life experiences, relationships and environments through "mediated memories", the present recreation of memories of the past (Van Dijack, 2007). Thus, the employment of big data technologies in music listening practices reconfigures people's habits of mediating their memories, constructing their life narratives and understanding their emotional responses to music, which updates people's perceptions of music technologies by expanding the effects of music technologies from providing content and access to facilitating the meaning-making of music related activities.

4.2 The Private Self

4.2.1 Self-Regulation

When responding to the questions designed to enquire the experiences of consuming music alone, all respondents used examples to illustrate how they chose different types of music in different situations to psychologically and physiologically adapt their themselves to the things

they were doing in the meantime. For example, Interviewee 9, a sports enthusiast and hip-hop music lover, described how fast-paced music, recommended by NetEase Cloud Music, shifted his energy level and made him feel more energetic when he worked out in the gym:

> *[...] I think the music styles should be in line with the styles of the things you are doing. When my body is in a state of excitement, for example, when I'm doing exercises, I would listen to some fast-paced music, energetic music, to make me feel happier, and at the same time, my body can be full of energy. [...] NetEase Cloud Music often recommends me some relatively exciting music. For example, in recent days, it recommended me some playlists of training and sports music, like electronic music. [...] For the playlists, personally I think they're based on some analysis of my recent music listening experiences. (Interviewee 9)*

In the example above, Interviewee 9 related the music he likes to the performance and efficiency of his workout and acknowledged that listening to appropriate music plays a catalytic role in mediating physiological functions and achieving desired states of bodily energy throughout the courses of action.

Another use of music for attaining and maintaining desired states is structuring people's feelings and emotions within a predetermined framework and getting people in the mood by isolating people from other irrelevant or distracting factors. The set of mobile phones, streaming music applications and earphones allows individuals to block other sounds and build a virtual environment in any physical place to promote concentration on a given issue. The narratives of Interviewee 14 (1977, university administrator), who prefers to stream specific types of music she wants in particular situations, exemplifies the use of music for the self-regulation of moods:

> *[...] I need this type of pure music, very fast-paced, but it can enable me to concentrate in such a grandiose atmosphere, and make me calm down, and then increase my efficiency. (Interviewee 14)*

This example illustrates the use of music for producing the environment of working and formulating mental activities to establish focus. The respondent was aware of what types of music could calm her down and what could not, so she carefully chose music appropriate for the configuration of sonic environment and mental work.

In conclusion, choosing music for energy or mood mediation can be regarded as a purposive approach to self-regulation. During the process of pursuing self-regulation, respondents are very conscious of what kinds of physical and mental conditions they need to achieve and also how specific types of music can work for them. This intended use of music in private life functions as the action of "care of self" in people's everyday lives, which DeNora (2000: 53) explained as an engagement in "self-conscious articulation work, thinking ahead about the music that might 'work' for them". The participation of algorithmic music recommendations and streaming technologies in these self-regulation practices eases the process of finding "adequate music" for given situations and "dispelling random or idiosyncratic stimuli" outside the presupposed virtual environments (Nowak, 2016: 78-89; DeNora, 2000: 61).

4.2.2 Self-Identity

In addition to the use of music for self-regulation, the association between music and the construction of self-identity can be spotted in some narratives of respondents. Respondents not only attempt to locate their identities in their music tastes but also take advantage of data analytics as a tool to obtain the reflection on and projection of their identities and personalities, in other words, to learn and present to themselves who they are and what they love. For instance, the experience of Interviewee 13 illustrates how the annual music listening reports based on her yearlong music listening practices allowed her to have a deeper understanding of herself:

> *[...] You listened to music for a whole year, then you found out how many times you listen to some songs. And certain songs are actually your most-listened songs but you did not realise. That is, you would suddenly find that your understanding of yourself achieves a new level. (Interviewee 13)*

In addition, there can be some discrepancies between individuals' existing perspectives of themselves and the data-based presentation of their personalities and preferences derived from algorithmic analysis. Interviewee 6 described his feeling of this unexpected inconsistency:

> *The keyword it gave to me is different from the keyword I gave to myself, there are some inconsistencies. [...] I previously thought I was a spirited person, and the songs I listened to were also energetic, full of sunshine, the whole mental state was full of energy, very positive, but what it gave to me is, relatively artsy and melancholy, then probably, in fact, I'm kind of melancholy, but my mind keeps telling myself I'm a spirited person. (Interviewee 6)*

Interviewee 6 recognises that what the report said about him surprised him and gave him a second thought about his personality. The data-based personalised analysis of music listening practices facilitates the deconstruction and reconstruction of self-identity by allowing more encounters with the issue of self-identity and more means of "self-recognition" (Frith, 1996). Furthermore, expanding DeNora's notion of the role of music as a "building material of self-identity", data analytics technologies, as a third party, are entwined with the communication between music and individuals and intervene the process of "introjection" of self-identity, "a presentation of self to self" (DeNora, 2000: 62-63). Thus, with the increased opportunities for self-reflection and self-construction, people are changing their perceptions of music and attaching more importance to analysing and reflecting on their music consumption practices as a means of constructing and mediating their self-identity.

4.2.3 Human-Technology Interaction

An emerging topic throughout respondents' narratives of their interactions with personalised music technologies in the private sphere is the humanisation of technologies. Some respondents paid attention to the humanised design of the data-driven music recommendation and music listening report services and even ascribed certain human traits to the technologies they used by using anthropomorphic rhetoric. In the following quotes, Interviewee 2 and Interviewee 4 thought these data-driven services were humanised and felt the music app "understood" and "cared" about them:

> *[...] Sometimes I feel this app really understands me, because the songs it recommends to me are exactly the styles I like, that is, I think it probably shows that nowadays products are becoming more and more humanised. [...] This makes people think it cares for you. (Interviewee 2)*

> *[…] It means I listened to music at midnight, it also reminded me to take care of myself everyday." (Interviewee 4)*

Interviewee 13 and Interviewee 11 also described their interactions with the annual music listening report, which analysed their music listening data, as an active, humanised dialogue between the mobile app and her:

> *[...] And you would, well, receive feedback from it about your personality. I think it is kind of a dialogue between this software and me. (Interviewee 13)*

> *[...] Its expression is very lovable, it would say "you must be very lonely during that day because you listened to this song many times", or something like "you must really love this song because you have listened to it for a long time". […] It would ask you, "what happened to you on that day?" (Interviewee 11)*

In the above examples, the data-based services are designed to perform some humanised behaviour, including understanding people's emotional needs, caring for people, using humanised dialogues to communicate with people, and tempting people to think about relatively private or emotional issues. In this way, human engagement with technologies can be deepened and reinforced by the practices of "thinking through the lens of the humanisation of technology" and the encounters between "technology and human consciousness" (Šimbelis, 2018: 39-40). The humanised design of technologies shifts the focus from technological qualities to human affection by embracing more humanistic values, including communication and engagement, which has the potential to transform people's perceptions and habits of human-technology interactions (Tanaka, 2006).

4.3 Social Links

4.3.1 Interpersonal Relationship

Sharing music is a common behaviour during respondents' music listening practices and music streaming technologies simplify the sharing process and allow it to be conducted in various everyday contexts. The sharing function of NetEase Cloud Music connects the music streaming platform with social media platforms, such as WeChat and Weibo, and digitalises the interpersonal communication about music. Through music sharing, respondents use music as a communication tool to convey messages among existing social links. Interviewee 3 (1996, postgraduate student) explained how messages and emotions could be embedded in music and shared to others:

> *[...] Sometimes through the songs you share people can know about your emotions. When you are in a bad mood, you share a dolorous song, people will know you are in a bad mood, and probably will message you or something. [...] Sometimes you don't know how to phrase your words when you want to post something on Moments (of WeChat), you can just use a song to symbolise your thoughts. (Interviewee 3)*

As the above example illustrates, in certain contexts, music can serve as a medium of information or symbols of emotions, the connotations of which can be interpreted by potential recipients. The responses to this type of music sharing behaviour are also significant for the maintenance of social links, as Interviewee 15 says:

> *[...] Because I'm busy recently and I haven't chatted with my friend for a long time, and she shared a song, and then I clicked 'Like' to give her a thumbs-up, which means "oh, I still care about you, I'm still thinking about you". (Interviewee 15)*

In addition to maintaining existing interpersonal relationships, finding and connecting with people with similar music taste is another function of music sharing. Sharing music to social media platforms enables people to present their music preferences to a relatively wider range of people, which makes the private music taste more public. Some respondents identify this as a way to enhance the previously weak social links or find new friends:

> *[...] I just posted this thing to Moments (of WeChat), and also shared Cheer Chen's song, and then I just found one person within my social circle is a fan of Cheer Chen for 14 years. [...] I think music can promote the relationship between people, because I was not very familiar with that person, we just met once, and then because we like the same singer and music, we have a lot to talk about. (Interviewee 2)*

> *[...] I think people usually would share this stuff to Moments (of WeChat), so another function of it is that everyone can comment on each other on Moments, saying "I also very often listen to the songs you like", something like this. [...] That enables you to find some friends with similar tastes. (Interviewee 15)*

However, some respondents show their doubts of the socialising function of music. For example, Interviewee 6, who said the importance of music in his life decreased with the increase of age, insisted that music was only a topic he could talk about with friends with limited effects on the attainment and maintenance of friendship:

> *Because, first of all, music listening is quite a private thing, that is, in fact, you are not sure whether other people would like the music you share. [...] The influence (of music) is not so great, it probably just offers an additional topic to chat about with friends who are not so close. (Interviewee 6)*

According to the analysis of collected interview data, all respondents participate in music sharing in different ways and varying degrees. Different people have various perceptions of the socialising potential of music and different levels of preferences for sharing music in their everyday lives. Respondents who acknowledge the social functions of music have more experiences and stronger intention of using networked technologies to share music and music-related ideas or feelings to others. This form of music-related, digitalised social networking facilitates the construction and maintenance of their interpersonal relations (Voida, Grinter, & Ducheneaut, 2006). This finding is in support of Hesmondhalgh's (2008) acknowledgement of music's role in intensifying sociality and Bassoli, Moore and Agamanolis' (2006) notion that emerging networked technologies provide more opportunities of establishing new social links and maintaining existing ones by enabling new forms of music sharing and more diversified social practices related to music. On the contrary, for those who assign less importance to music, they believe aesthetic judgements of music are private and subjective, which are hard to be shared with others. This perception of music and music taste is in consistence with Zangwill's (2012) argument that music listening is individualistic and the interpretations of music are subjective, which questions the possibility of joint listening. Thus, these contrasting accounts need to be united and further examined in more empirical cases.

4.3.2 Resonance and Community

Music and Music-related ideas can be shared not only in a direct, tangible way but also in a virtual, intangible way. In this way, joint listening can be performed even the listeners do not materially share music with each other or listen to music together in the same physical place. All respondents acknowledged that NetEase Cloud Music offers a virtual form of sharing and

communicating different from other traditional mediums or manners of music listening, and many of them ascribed the sociality and popularity of this music app to its unique, discrete comment areas for each song, where ideas and feelings about specific songs are digitalised as data and circulated among strangers publicly while songs are consumed by each individual privately. The quote of Interviewee 4 exemplifies how the comments made by strangers have resonance for her:

> *[...] More importantly, NetEase Cloud Music, as far as I'm concerned, probably in the process of communication, we regard it as not only a music app but also a tree hole, a communication app. [...] During the process of discussion, it has a resonance for me, I think there is someone else sharing the same culture with me, and it is communicated in the form of data. (Interviewee 4)*

Interviewee 7 (2005, junior high school student) even describes these strangers, who share common preferences with her, as "like-minded friends":

> *[…] You would see so many like-minded friends, some people who share the same preferences with you, probably they are all strangers. [...] But when you see these people, these one thousand comments all made by these people who support her, you feel very close to them. (Interviewee 7)*

In this way, the virtual and real forms of relationship start overlapping and new emotions and behaviour of music-related interactions are emerging (Bassoli et al., 2006). It is noticeable that some respondents show a tendency to constitute the social bonding with strangers by relating strangers' comments to their own experiences. Interviewee 3 uses the word "community" to describe this form of social networks:

> *[...] It really has resonance for me, because I'm also experiencing these things. [...] So it is kind of like a community, where you can find something you also want to say, but you just do not dare to write it out. (Interviewee 3)*

Similar to the narratives of Interviewee 3, several respondents frequently mentioned that the comments of strangers spoke out something they wanted to say but could not for various reasons. This form of virtual interactions among strangers is not merely a means of communication but a way to find self-identification and the sense of belonging. All of the references to resonance and community offer support for Bassoli, Moore and Agamanolis' (2006) and Larson (1995) argument that new technologies flourish the creation of social connections among strangers and also the trends of finding "the security of identification with other like-minded peers" (as cited in Bassoli et al., 2006: 152). The networked music listening practices also imply a new form of joint listening, which blurs the traditional boundary between music consumption in the private and public realms and allows individuals to concurrently suit their subjective aesthetic tastes in the physical private space and fulfil their socialising needs in the virtual public space.

4.3.3 Competition

In addition to resonance, competition is another salient topic emerging from the narratives of the virtual social interaction in digital platforms. The effects of competition on further social interactions are two-sided. On one hand, the potential competition among commentators can elicit a feeling of being "defeated", which weakens individuals' intention of making comments, as Interviewee 7 illustrated:

> *Sometimes when you clicked into it, there were all excellent comments, so to speak, a bunch of comments. They are really great, and I just feel that I can't make comments as good as theirs, I can only write a little bit, or just write about some experiences, I feel like I'm defeated. (Interviewee 7)*

On the other hand, the connection between the users and the platform is established and consolidated on account of the desire to win the competition and the attention paid to those users whose comments are superior to those of others. Interviewee 11 recalled how much she

admired the users who made outstanding comments and cared about the number of replies to her comments, which links her with the music app more tightly:

> *[...] Sometimes there are some very awesome people, they write comments like poets. [...] Sometimes I would secretly check whether my comments got replies. Probably this commenting service also makes you more willing to use this platform, actually you feel that you have a connection with it. (Interviewee 11)*

Interviewee 4 also attempted to improve her comment skills in order to gain more attention:

> *After making comments for a long time, I thought making comments is very skilful, and then I started training my skills of making comments to get more attention from others. (Interviewee 4)*

The modes and conventions of the digitalised commenting and communication behaviour around music are similar with the social interactions in the real world. In other words, as Šimbelis (2018: 46) argues, it would be hard to distinguish the virtual world and the real world as the digital communication prevails in everyday lives and reproduces "the same social interactions" as those in the physical world. Moreover, individuals in the digital age are reconfiguring their behaviour patterns and social strategies to adapt themselves to new modalities of socialising and integrating this transformation into their pre-existing practices through circuits of practices (Magaudda, 2011).

4.4 Discussion

This section first identified and analysed the four uses of data-driven services in respondents' music streaming experiences: new possibilities of music discovery, management of music taste and habits based on data analytics, the redefined aesthetic use of music technologies, and the data-based memory construction and life narratives. These four uses supplement Nowak's

(2016) research on individuals' interactions with music technologies by situating his theory in the context of the datafication of music streaming. The findings reveal how big data and streaming technologies transform individuals' musical habitus through intervening the ways individuals structure their music taste, reconfiguring their music listening behaviour and reshaping individual perceptions of the meaning of music listening. Next, the analysis moved on to discuss how this transformed musical habitus reorganises the modalities of music consumption, from listening to music for the regulation, constitution and care of self in the private sphere to communicating through music for the construction of different levels of social links in the public sphere. The semi-structured interviews also allowed some unexpected topics to emerge, including the humanised design of human-technology interactions and the competition atmosphere within virtual social interactions, which are rarely addressed in existing literature on music consumption. These findings provide a new perspective for the study of music consumption and reveal the necessity of integrating the sociology of music with burgeoning theories regarding various technological innovations.

The results also provide evidence to evaluate McLuhan's (1988) tetrad of media effects of big data technologies in music streaming. The adoption of big data transforms individuals' approach to music, modes of music consumption and structures of music-related social networking, yet it also tends to enhance individuals' existing music taste and social links. Moreover, these technologies have the potential to drive out active music consumption because data analytics makes decisions for humans and replaces subjective behaviour with objective analysis while they can also retrieve old music content, lost memories and nostalgia for traditional modes and devices of music listening. These effects above are followed by people's concern about how these technologies would constrain their autonomy and choices. Although all respondents keep using these technologies, it is still unclear how music technologies would progress when contemporary big data and streaming technologies reach their limits. This study also notices the technological elements are not the only or most

influential factor of the construction of music habitus, which is also determined by individual personalities, cultural and social belongings, age, life experiences and other factors. Although the qualitative approach allowed the respondents to narrate personal experiences and reflect on the meaning of their preferences and behaviour, a larger sample of music listeners can produce the more comprehensive presentation and deeper analysis of the interconnections of technological materiality, social structures and cultural practices.

5 CONCLUSION

With the development of music technologies, the proliferation of big data in the music streaming industry is transforming the contemporary modes of music consumption and redefining the roles and meanings of music in listeners' everyday lives. The qualitative analysis in this research scrutinised how the materiality of big data technologies come into play in the structures of listeners' musical habitus and modes of music consumption. Through the narratives of users of data-based music streaming services and the conceptual lens of Nowak's (2016) three uses of music technologies and DeNora (2000) and Hesmondhalgh's (2008) two dimensions of musical experience, the analysis results highlight the variations of individual musical consumption practices and differentiation of the roles of music assigned by listeners in their everyday lives. Thus, this study categorised individuals' various interactions with big data and streaming technologies into four types of uses and interpret the meanings that individuals assign to each of uses: possibilities, management, aesthetic experience and memories. These new or renewed meanings of interactions with music technologies have transformed individual perceptions, preferences and behaviour regarding not only music but also the material means of musical experience. Moreover, this restructured music habitus further reorganises everyday modes of music consumption experiences in both private and public spheres and delineates how individuals use and assign meanings to music in different aspects of their everyday lives, which proves that music embodies various layers

of roles and multifarious types of resources for constructing and mediating the private self and social behaviour of each listener.

The adoption of big data technologies does not come out of thin air but occurs on the basis of established technological infrastructures, such as digital music files, mobile phones and music streaming services, and existing listening practices, including music discovery, musical accompaniments, music sharing, etc. The integration of data analytics and data communication into music consumption invades new territories of private and joint listening experiences through extending existing self-modulation and social networking functions of music and unfolding new aspects of the human-music-technology relation, such as humanised human-technology interactions and virtualised human-human interactions.

This study is grounded on individuals' narratives of their music-related experiences and their attitudes and motivations beneath these experiences through the lens of the sociology of music, which proves to be useful to investigate the intricate mechanisms of music consumption in various everyday contexts and distinguish the dichotomous roles of music that "group(s) people together" and "segregate(s) them" (Nowak, 2016: 153). However, this study has its limitations due to a lack of the quantitative and generalisable measurement of the correlation between big data technologies and individuals' music consumption patterns. A combination of the quantitative survey method and qualitative interview method would be effective to capture a more comprehensive picture of technological transformations of music consumption. Furthermore, the adoption of big data raises new technical and ethical questions concerning the accuracy of data analytics, quality of user-generated data, and protections for personal data, which need to be addressed by further research to understand how these factors influence individuals' preferences and behaviour and shape the future of big data technologies in the music industry.

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APPENDIX 1 - INTERVIEW TOPIC GUIDE

Warm-up Questions (Background Information):

- What's your name? What is your age? What do you do now?

- What do you think about the roles of music in your life? How do you think music listening can influence your daily life?

1. Devices and Mobile Applications for Music Listening

- What device(s)/mobile music application(s) do you usually use to listen to music? What do you think is the most important/attractive function(s) or feature(s) of these device/mobile application?

- When and where do you usually use NetEase Cloud Music to listen to music? Why do you prefer to listen to music in such particular situations?

- How do you think mobile phones and digital music influence your music listening experience, compared with other medium and modes of music listening?

2. Music Recommendation Functions

- Can you describe your experience of using any music recommendation service of NetEase Cloud Music to find new music ("Daily Recommendation", "People Like This Song Also Like", "Playlists That Contain This Song", etc.)? What do you think about these music recommendation services?

- Have you ever used the service of "Annual Music Listening Reports"? Can you describe the content of these reports? What do you think about this service?

3. The Origin and Evolvement of Interviewee's Music Taste

- Which music genre/artist do you like? Why? When and where do you usually listen to this type of music? Why?

- How do you think your music taste has changed or remained unchanged over time? What do you think makes your music taste change or remain unchanged (life experiences, technologies, etc.)?

- What type(s) of music does the app often recommend to you? How are these recommended songs related to your music taste and your past music listening practices? Do you prefer the app to recommend you music within or outside the scope of your existing music taste? Why?

4. The interviewee's music listening experiences in the private sphere

- What type(s) of music do you usually listen to when you are alone? Why?

- What do you usually do when you listen to music alone? Why?

- Do you prefer to listen to music alone or with other people? Why?

- What factors would affect your choice of music in everyday life? Why do you think these factors matter?

5. The interviewee's music-related social activities

- Can you describe a typical occasion when you used NetEase Cloud Music's sharing function to share music with others? How do you interact with others by using this music sharing function? How do you think this sharing function influences your friendship and interpersonal relations?

- What do you think about the user-generated comments in the comment area of each song? How do you interact with other app users in the comment areas? How do you think this commenting service influences your interaction with strangers?

6. The interviewee's choice of different music streaming services

- Do you also use other music apps? What do you think is the most important difference between these apps and NetEase Cloud Music?

- Why do you choose (or not choose) NetEase Cloud Music as your main music app? What do you think is the most important factor when you make a choice among different music apps?

APPENDIX 2 - DEMOGRAPHICS OF INTERVIEW PARTICIPANTS

Count	Name	Gender	Year of Birth	Position
1	[redacted]	M	1997	Postgraduate Student
2		F	1997	Postgraduate Student
3		F	1996	Postgraduate Student
4		F	2000	Undergraduate Student
5		F	1992	Public Institution Technician
6		M	1989	Civil Servant
7		F	2005	Junior High School Student
8		F	1985	Cafe Manager
9		M	1995	Postgraduate Student
10		M	1989	Postgraduate Student
11		F	1984	High School Teacher
12		F	1985	Project Manager
13		F	1996	Postgraduate Student
14		F	1977	University Administrator
15		F	1996	Postgraduate Student

APPENDIX 3 - SIMPLIFIED EXCERPT OF CODING FRAMEWORK

Deduced Themes	Induced Sub-themes	Codes	Example Quotes
Uses of Music Technologies	Possibilities of music discovery	Recommend songs and singers	"I remember there was a period of time, I was kind of obsessed with the Chinese-style songs, and then it recommended this type of songs to me, and most of them are niche singers, probably I had never heard about some of them, but, well, it successfully made me feel that, oh, the voice of this singer was pretty good, and then I further clicked on this singer, and listened to the music, listened to the Top 5 songs of his ranking list."
		Discover music	"It is influential, just like the electronic Chinese classical music, which I discovered on NetEase Cloud Music. Before that I never knew about there is such a kind of stuff in this world."
		Enrich personal music collections	"In most cases, it is an assistant tool, in fact, it is your music taste that is changing, and it serves as an assistant

			tool to help you enrich your, the content of the songs you listen to."
		Convenience	"It can be very convenient, especially today's software we use, like NetEase Cloud Music, QQ Music, well, the music libraries they provide are very complete, generally speaking, you can find anything you want to listen to."
		Constraints	"I think, it seems like the range of my choices becomes wider, but also narrower."
	Management of music taste and habits	Record music listening practices	"One day I listened to it over two hundred times, and it even recorded this. It also calculated, well, what period of time when I listened to songs for the longest time."
		Habits of music listening	"In this way, I can know my habits of music listening through the year, about which I actually had no idea, only after reading the report."
		Reflection on music listening practices	"In fact, to some extent, the music you listen to during a particular time period actually reflects your, either the whole mental and emotional states of you or the whole status of your life

			during that time period. It's a type of reflection on the whole status of you."
	Aesthetic meaning	Respects to classicism	"It pays respects to classicism. I think nowadays nobody uses discs any more, even CDs, nobody uses them any more, probably car stereos would use them sometimes."
		Nostalgia	"Either through the recommendations of others or when the music app suddenly recommends it to let you find this song, it is your nostalgia for the old."
	Symbolic meaning	Memories	"After half a year, I might have forgotten the existence of the specific day, forgotten such a thing, but suddenly there came a memory, a stuff about memories."
Private Self	Self-regulation	Physiological states	"For example, when I'm doing exercises, when I'm running, at this time, I listen to some songs that can make me more energetic, or some songs that I think have the similar rhythm with my running rhythm."

		Psychological states	"When I need to concentrate on writing something, or finishing a task within a short time, when I need to increase my efficiency in a short time, I need a very powerful stuff, something like symphonic music, which can push me to focus, concentrate."
	Self-identity	Understanding of self	"I previously thought I was a spirited person, and the songs I listened to were also energetic, full of sunshine, the whole mental state was full of energy, very positive, but what it gave to me is, relatively artsy and melancholy, then probably, in fact, I'm kind of melancholy, but my mind keeps telling myself I'm a spirited person."
		Mirror of self	"When I was young, I thought music is a type of, its covers a large proportion of the life, what it gives to me, my emotions, my feelings, it is a mirror."
	Human-technology interaction	Human-machine dialogue	"And you would, well, receive feedback from it about your personality. I think it is kind of a dialogue between this software and me."

		Humanised design	"It actually is, it gives you a direction, you may like this song so you may also like this singer, and then follow this vine to get this melon, you can find more songs you like, in fact, the design of this service is pretty humanised. "
Social Links	Interpersonal relationship	Common taste	"If a person, that is, our music tastes, the music we like, are very similar, I would get an additional good feeling about this person, only simply because of this."
		Convey messages	"For example, my friend broke up with her boyfriend, but we didn't know they broke up. She shared a song of Stefanie Sun, or someone else, I can't remember the name, but just I knew she broke up once I saw this."
		Enhance friendship	"I think it can enhance friendship, just let me, or let other people know more about me, just enhance the mutual understanding."
	Resonance and Community	Communication	"Sometimes I made dozens of comments and replies to others under a song, and this is also a way of communicating and connecting. And

			in this way, one point is that I can find the cultural resonance."
		Resonance	"Sometimes, some comments are really touching, and the things they talked about, their sentiments and thoughts of listening to this song speak out what I want to say but I did not."
		Like-minded people	"I'm very willing to find some thoughts similar to mine, because, well, I think there are like-minded people, even though we don't know each other, we are all strangers, but I think this is the function of music, which gives similar feelings to a lot of people, even if the feelings are different, it is also a very valuable experience."
		Community	"Sometimes I feel these comments, the whole cultural atmosphere is very vivacious. It is far more than my fantasy of a music app, it is more like a community."
	Competition	Reflection on commenting skills	"The comments that I made and got the highest numbers of thumbs-ups are often those with little meaning. And

			then it makes me think why, why some of my serious comments could not get many thumbs-ups of other people?"
		Unwilling to participate	"Sometimes I also thought there were already so many comments that had been bumped to the top, and my comments would just be overwhelmed by these comments. There is no need for mine, so sometimes I'm not very willing to make comments."

APPENDIX 4 - INFORMATION SHEET AND CONSENT FORM

Datafication of Music Streaming Services and Music Consumption

(Researcher Name)

Department of Media and Communications

London School of Economics and Political Science

Information for participants

Thank you for considering participating in this study which will take place from June to August 2019. This information sheet outlines the purpose of the study and provides a description of your involvement and rights as a participant, if you agree to take part.

1. What is the research about?

The research focuses on NetEase Cloud Music's data-driven music streaming service and its users' music listening experience and interaction with music technologies and aims to use qualitative interviewing to explore people's musical habitus and interaction with the datafication of music listening.

2. Do I have to take part?

It is up to you to decide whether or not to take part. You do not have to take part if you do not want to. If you do decide to take part, I will ask you to sign a consent form which you can sign and return in advance of the interview or sign at the meeting.

3. What will my involvement be?

You will be asked to take part in an interview about your experience of using NetEase Cloud Music for music listening. It should take approximately 50-60 minutes.

4. How do I withdraw from the study?

You can withdraw at any point of the study, without having to give a reason. If any questions during the interview make you feel uncomfortable, you do not have to answer them. Withdrawing from the study will have no effect on you. If you withdraw from the study we will not retain the information you have given thus far, unless you are happy for us to do so.

5. What will my information be used for?

I will use the collected information for a dissertation research project.

6. Will my taking part and my data be kept confidential? Will it be anonymised?

The records from this study will be kept as confidential as possible. Only myself and my supervisor will have access to the files and any audio tapes. Your data will be anonymised – your name will not be used in any reports or publications resulting from the study. All digital files, transcripts and

summaries will be given codes and stored separately from any names or other direct identification of participants. Any hard copies of research information will be kept in locked files at all times.

Limits to confidentiality: confidentiality will be maintained as far as it is possible, unless you tell us something which implies that you or someone you mention might be in significant danger of harm and unable to act for themselves; in this case, we may have to inform the relevant agencies of this, but we would discuss this with you first.

7. Data Protection Privacy Notice

The LSE Research Privacy Policy can be found at: https://info.lse.ac.uk/staff/divisions/Secretarys-Division/Assets/Documents/Information-Records-Management/Privacy-Notice-for-Research-v1.1.pdf

The legal basis used to process your personal data will be legitimate interests. The legal basis used to process special category personal data (e.g. data that reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, health, sex life or sexual orientation, genetic or biometric data) will be for scientific and historical research or statistical purposes.

To request a copy of the data held about you please contact: glpd.info.rights@lse.ac.uk

8. What if I have a question or complaint?

If you have any questions regarding this study please contact the researcher, (Researcher Name), on (Researcher Email).

If you have any concerns or complaints regarding the conduct of this research, please contact the LSE Research Governance Manager via research.ethics@lse.ac.uk.

If you are happy to take part in this study, please sign the consent sheet attached.

CONSENT FORM (Participants)

Datafication of Music Streaming Services and Music Consumption

Name of researcher: (Researcher Name)

PARTICIPATION IN THIS RESEARCH STUDY IS VOLUNTARY

I have read and understood the study information dated [__/__/__], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	YES / NO
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	YES / NO
I agree to the interview being audio recorded.	YES / NO
I understand that the information I provide will be used for the dissertation and that the information will be anonymised.	YES / NO
I agree that my information can be quoted in research outputs.	YES / NO
I understand that any personal information that can identify me – such as my name, address, will be kept confidential and not shared with anyone other than the researcher.	YES / NO
I give permission for the (anonymised) information I provide to be deposited in a data archive so that it may be used for future research.	YES / NO

Please retain a copy of this consent form.

Participant name:

Signature: _____ Date _____

Interviewer name:

Signature: _____ Date _____

For information please contact: (Researcher Name) (Researcher Email)

CONSENT FORM (Parents/Guardians)

Datafication of Music Streaming Services and Music Consumption

Name of researcher: (Researcher Name)

PARTICIPATION IN THIS RESEARCH STUDY IS VOLUNTARY

I have read and understood the study information dated [__/__/__], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	YES / NO
I consent voluntarily to permit my son/daughter to be a participant in this study and understand that my son/daughter can refuse to answer questions and he/she can withdraw from the study at any time, without having to give a reason.	YES / NO
I agree to the interview being audio recorded.	YES / NO
I understand that the information my son/daughter provide will be used for the dissertation and that the information will be anonymised.	YES / NO
I agree that the information provided by my son/daughter can be quoted in research outputs.	YES / NO
I understand that any personal information that can identify my son/daughter – such as his/her name, address, will be kept confidential and not shared with anyone other than the researcher.	YES / NO

I give permission for the (anonymised) information my son/daughter provide to be deposited in a data archive so that it may be used for future research.	YES / NO

Please retain a copy of this consent form.

Parent/Guardian name:

Signature: _____ Date _____

Interviewer name:

Signature: _____ Date _____

For information please contact: (Researcher Name) (Researcher Email)