Full Length Article

Personality predicts words in favorite songs

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ARTICLE INFO

ABSTRACT

Psychologists have long theorized that people actively create, select, or modify experiences and situations to fulfill their individual psychological needs. However, little is known about how people may use forms of art and entertainment such as music to enhance their experiences and shape their environments for need satisfaction. In this research, we measured participants' personality and the linguistic styles of their favorite songs, and observed significant associations between personality traits and linguistic cues in lyrics. These associations were stronger for participants who generally liked a song because of its lyrics rather than melody. Our study is the first to show how one's personality is related to linguistic cues in someone else's writings. It points to the possibility that people may like certain songs because the linguistic cues in the lyrics are congruent with their personality and hence can satisfy personal needs. This expands research on person-situation interaction and literature on personality and language use, and has important practical implications.

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1. Introduction

Music is an important part of people's everyday life (Rentfrow & Gosling, 2003; Rentfrow, 2012), and individuals spend approximately 14% of their waking time listening to music (Mehl & Pennebaker, 2003). While past research has found associations between personality and music preferences through the lens of genre (e.g., Delsing, ter Bogt, Engels, & Meeus, 2008; Fricke & Herzberg, 2017; Rentfrow, Goldberg, & Levitin, 2011; Rentfrow & Gosling, 2003) and acoustic features (e.g., loud, fast; Rentfrow et al., 2011; Rentfrow et al., 2012), it is unclear why these associations occur, or whether there are other pathways through which personality can influence musical selection. Based on the theoretical perspective that individuals actively create experiences and situations to fulfill their individual psychological needs (Allport, 1961; Murray, 1938; Snyder, 1983) and empirical evidence that melodic and lyrical information can be processed independently when people listen to songs (e.g., Besson, Faita, Peretz, Bonnel, & Requin, 1998; Bonnel, Faita, Peretz, & Besson, 2001), it is reasonable to speculate that people may like certain songs because their lyrics provide stimuli that match their personality-related needs. Therefore, in this study, we examined how linguistic cues in people's favorite songs are associated with their personality traits.

We collected and analyzed songs that participants actually listened to, rather than asking them to rate a list of pre-selected songs or genres as in previous studies (e.g., Rentfrow et al., 2011; Rentfrow & Gosling, 2003), to increase ecological validity and generate findings based on what people actually do in real life. Our study is the first to reveal how one's personality is related to linguistic cues in someone else's writing. It contributes to personality research by showing the possibility of people using linguistic cues as stimuli to create personality-compatible experiences, and shedding light on how people may use forms of art and entertainment such as music to enhance their experiences and shape their environments for need satisfaction. We also expand and refine theories of musical preferences by showing whether lyrics exert an effect independent of melodic attributes. Our findings could have important practical implications, as millions are listening to music online and consume language products such as books, online reviews, and narratives from personal assistants like Siri or Alexa. Understanding how personality influences preferences for linguistic cues can help service providers create personalized linguistic styles in language products to improve user experiences and satisfaction.

2. Background and research questions

2.1. Personality and situation selection

Psychologists have long theorized that people actively create or select experiences or situations to fulfill their individual needs, and

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thus the experiences or situations that they are in are often related to their personalities (Allport, 1961; Buss, 1987; Ickes, Snyder, & Garcia, 1997; Scarr & McCartney, 1983). Multiple lines of research have supported this theoretical premise. For example, according to Eysenck's arousal theory of extraversion (1967), extraverts have a generally lower resting level of arousal than introverts. To maintain an optimal level of arousal, extraverts often choose social activities to heighten stimulation. Therefore, extraverts have been found to be engaged in more high-arousal activities (e.g., social activities) compared to introverts (McCabe & Fleeson, 2012), chose higher levels of background noise when completing learning tasks (Geen, 1984), and prefer studying in noisy rather than quiet environments (Campbell & Hawley, 1982). These findings are consistent with the notion that stable personality traits influence the selection of situations and environments with a view to maximizing compatibility, in this case a higher level of external stimulation to compensate for a lower resting level of arousal. Besides extraversion, recent studies on personality-driven situation selection has shown that conscientiousness is associated with enhanced involvement in dutiful situations, while neuroticism is negatively associated with exposure to positive situations (Rauthmann, Sherman, Nave, & Funder, 2015).

Murray (1938) used the concept of *press* to describe the property of an environment that elicits certain psychological reactions, and suggested that people should know the *press* of specific situations or environments so that they can choose the ones that fit their needs. Given that extraversion is related to need for affiliation and exhibition (Costa & McCrae, 1988; Piedmont, McCrae, & Costa, 1992), it is likely that extroverts prefer and hence select environments that provide opportunities to socialize, while introverts are drawn to environments that do not necessitate social interaction. Consistent with this premise, Oishi, Talhelm, and Lee, (2015) demonstrated that extraverts generally like beaches while introverts tend to prefer mountains, presumably because of a perceived fit and compatibility with their personality. Consistent with this idea, the authors also explored the reasons for these preferences, finding that beaches are preferred when seeking opportunities for social interactions and attention, while mountains are preferred when seeking solitude. Together with the finding of geographical clustering in traits (e.g., Rentfrow, Gosling, & Potter, 2008), these studies suggest that people also choose geographical environments that fit and complement their personality characteristics.

Finally, the person-environment fit theory posits that people are more satisfied when they are in situations or environments that fit their values, needs, or skills (e.g., Pervin, 1968; Snyder, 1983). Supporting this theory, Diener, Larsen, and Emmons, (1984) found that compared to introverts, extraverts chose more recreational environments in their everyday lives and experience more positive affect when engaged in social and recreational activities in an experience sampling study. Emmons (1991) showed that people higher in the need for affiliation felt better on days where they had engaged in positive social activities, while people higher in the need for achievement felt better on days where they had experienced positive academic performance. Jokela, Rentfrow, Bleidorn, Lamb, and Gosling (2015) found that people high in openness to experience were happier if they lived in culturally diverse areas, while people high in agreeableness were more satisfied living in areas with low diversity. Drawing from the person-environment fit theory, it is reasonable to speculate that people are motivated to choose or create situations that fit their personality in order to enhance positive affect, well-being, and other aspects of positive psychological functioning.

The above theories and associated studies altogether suggest that people choose and create experiences or situations to match their personality traits and fulfill their individual psychological

needs. Since people spend a significant amount of time listening to music (Mehl & Pennebaker, 2003), it is conceivable that they may use music to create listening experiences that are compatible with their personality. In particular, people may use linguistic cues in lyrics as stimuli to fulfill their individual psychological needs. For example, example, need for cognition (NFC) refers to an individual's tendency to favor and engage in effortful cognitive processing, and has been found to be positively related to conscientiousness and negatively related to neuroticism (Fleischhauer et al., 2009; Sadowski & Cogburn, 1997). Therefore, it is possible that individuals higher in conscientiousness would like lyrics with higher cognitive complexity, whereas people higher in neuroticism would favor lyrics with lower cognitive complexity.

2.2. Music preferences and personality

Previous studies have examined individual differences in music preferences through the lens of genre (e.g., Delsing et al., 2008; Fricke & Herzberg, 2017; Rentfrow et al., 2011; Rentfrow & Gosling, 2003). Rentfrow and Gosling (2003) identified four underlying factors based on participants' preferences for fourteen genres, and labeled them Reflective and Complex (including classical, jazz, blues, and folk), Intense and Rebellious (alternative, rock, and heavy metal), Upbeat and Conventional (country, pop, religious, and sound tracks), and Energetic and Rhythmic (rap/hip-hop, soul/funk, and electronica/dance). They found that openness to experience was positively related to the preference for Reflective and Complex and Intense and Rebellious music, while negatively related to Upbeat and Conventional music. Extraversion was related to the preference for Upbeat and Conventional and Energetic and Rhythmic type of music. These associations were replicated in a German sample (Langmeyer, Guglhör-Rudan, & Tarnai, 2012). Delsing et al. (2008) found a four-factor model based on eleven music genres in a Dutch sample, and labeled them Rock (including heavy metal/hardrock, punk/hardcore/grunge, and jazz), Elite (including jazz, classical music, and gospel), Urban (including hip-hop/rap and soul/R&B), and Pop/Dance (including trance/techno and top 40/charts). They found that openness was positively related to the preference for Elite and Rock type of music, similar to the relationship found by Rentfrow and Gosling (2003). Extraversion was related to the preference for Urban and Pop/Dance music. Agreeableness was related to the preference for Elite, Urban, and Pop/Dance music. Conscientiousness was negatively related to the preference for Rock music. Neuroticism was found to be negatively related to the preference for the Elite type. These associations remained relatively stable over a three year period. While the above studies found similar structures of preferences for genres, other studies showed different factor models and personality-genre relationships (e.g., George, Stickle, Rachid, & Wopnford, 2007; Schäfer & Sedlmeier, 2009; Dunn, de Ruyter, & Bouwhuis, 2012). These inconsistent findings are likely to have resulted from the limitations in the genre-related method of examination (Greenberg et al. (2016)). First, music genres are often fuzzily defined and exhibit substantial overlap with one another. Second, people of different ages and background may differ in their conceptualization of a given genre, and their preference for the genre may be influenced by their idiosyncratic mapping of particular songs to the genre. Thirdly, there is a lack of consensus on which genres should be studied, with more niche genres or sub-genres frequently being ignored or excluded.

To address the limitations in genre-based approaches, Rentfrow et al. (2011) measured participants' affective reactions to a variety of music excerpts and found five dimensions named MUSIC. It includes Mellow (including smooth and relaxing music), Unpretentious (sincere and rootsy music), Sophisticated (classical, operatic, world, and jazz music), Intense (loud, forceful, and energetic

music) and Contemporary (rhythmic and percussive music). These dimensions suggest that preferences for genres are likely driven by preferences for acoustic features and psychological attributes of music (Rentfrow et al., 2012). Greenberg et al. (2016) further identified three latent factors for psychological attributes of music, labeled Arousal (e.g., intense, forceful, abrasive, etc.), Valence (e.g., fun, happy, lively, etc.), and Depth (intelligent, sophisticated, complex, etc.). They found that neuroticism was negatively related to preferences for Valence in music, and conscientiousness was related to preferences for Depth in music. Fricke and Herzberg (2017) replicated the above three factors in a German sample, showing that extraversion, agreeableness, and openness were related to the Valence factor, while agreeableness, neuroticism, and openness were related to the Depth factor. While both studies identified similar factors, their associations with personality traits were not completely consistent.

While existing research has provided significant evidence of how personality is linked with music preferences, a recent meta-analysis shows that the correlations between Big Five personality traits and musical genre preferences are near zero, except that openness exhibits small correlations with preferences for mellow (r = 0.16), sophisticated (r = 0.21), and intense (r = 0.12) music (Schäfer & Mehlhorn, 2017). Therefore, researchers have proposed alternative explanations that focus on the functions of music to account for individual differences in music preferences. The functional approach to music listening posits that individuals' music preferences are developed based on why they use music in their lives (Chamorro-Premuzic, Fagan, & Furnham, 2010; Larson, 1995; Schäfer & Sedlmeier, 2009). Chamorro-Premuzic and Furnham (2007) found that people used music in three different ways. Emotional use of music involves using music to change or enhance moods. Cognitive use of music focuses on using music for intellectual stimulation and experiencing music in a rational way. Background use of music entails using music as a background to other activities, such as studying, driving, or working.

Personality traits have been found to be related to uses of music. For example, neuroticism was associated with emotional uses of music, and openness was related to cognitive uses of music (Chamorro-Premuzic & Furnham, 2007; Chamorro-Premuzic et al., 2010). In addition, evidence has indicated that use of music is related to musical preferences. For instance, cognitive use of music positively correlated with preferences for Intense and Rebellious and Reflective and Complex music, but negatively correlated with preferences for Energetic and Rhythmic and Upbeat and Conventional music (Getz, Marks, & Roy, 2014). Emotional use of music predicted preference for sad music, and background use of music predicted preference for social and happy music (Chamorro-Premuzic et al., 2010). Vella and Mills (2017) further found that cognitive uses of music partially mediated the relationship between openness to experience and reflective-complex music preference, while emotional uses of music partially mediated the relationship between openness to experience and intense/rhythmic music preference. These studies suggest that use of music play an important role in the relationship between personality and preferences for music styles.

2.3. Preferences for lyrics

Songs in non-instrumental genres contain both melodies and lyrics. In such genres, these two components are integrated together to complement and enhance each other (Serafine, Crowder, & Repp, 1984). Although they simultaneously inform the music listening experience, lyrics make important and independent contributions (Ali and Peynircioğlu, 2006; Anderson, Carnagey, & Eubanks, 2003). However, little is known about whether lyrics play a role in the relationship between personality and music preferences.

Research has considered lyrics as cultural products that reflect societal values. Studies have shown that popular song lyrics in China are more likely to depict love being embedded in a larger context or relationship (Rothbaum & Tsang, 1998), and express more positive giving back to parents (Rothbaum & Xu, 1995), than those in the U.S. This manifests cross-cultural differences in self-construal and interdependence (Markus & Kitayama, 1991). Changes in lyrical content of popular songs in the U.S. have also been shown to reflect the increasing individualism of American society (DeWall, Pond, Campbell, & Twenge, 2011; McAuslan & Waung, 2016). These studies highlight that lyrics convey important social and psychological meanings.

Individuals are drawn to the social and cultural meanings in music that match their personal characteristics and concerns (Colley, 2008; Delsing et al., 2008; George et al., 2007; Rentfrow & Gosling, 2003; Rentfrow & McDonald, 2010; Schäfer & Sedlmeier, 2009). For example, teenagers who lack friends prefer music with themes related to loneliness and independence (Burke & Grinder, 1966). Adolescents preferring heavy music (e.g., rock, heavy medal, and rap) tend to have developmental issues such as rejection of authority, conflict with parents over independence, and uncaring attitudes towards others (Schwartz & Fouts, 2003). Their characteristics match common themes in heavy music advocating rebellion against the establishment, hyperindividualism, and antisocial behavior (Arnett, 1991; Hansen & Hansen, 1990; Klein et al., 1993). In contrast, adolescents who prefer light music (e.g., pop, teen pop, and dance) are likely to be concerned with their sexuality, relationships with peers, and socially acceptable behavior (Schwartz & Fouts, 2003). Their concerns match the developmental themes often addressed in light music, such as identity, relationships, and sociability (Larson, 1995; Thompson, 1990). While these studies of music and identity show that individuals gravitate to particular themes and messages in lyrics because of their beliefs, values, and concerns, little is known about how personality traits are related to preferences for certain lyrical styles.

While past research on musical preference has generally not separated preference for melodies and lyrics because these two components exert simultaneous effects on the listener, lyrical information has been found to have unique effects beyond those exerted by melody. For example, Ali and Peynircioğlu (2006) measured participants' affective reactions to melodies with or without emotionally congruent lyrics, and found that lyrics reduced the positive emotion conveyed by happy and calm music while increasing the negative emotion conveyed by sad and angry music. Anderson et al. (2003) asked participants to listen to tense music with either violent or non-violent lyrics, and found that the content of lyrics, rather than the tense rhythm or distorted sound, resulted in aggressive thoughts and hostile feelings. Furthermore, studies in psychophysics and neuroscience have shown that the melodic and lyrical information are processed independently when people listen to music (e.g., Besson et al., 1998; Bonnel et al., 2001). Therefore, it is probable that individuals' preferences for lyrical features may not be entirely dependent on their preferences for melodic features and the overall music preferences are resulted from the interaction of preferences for lyrical styles and preferences for melodic styles.

2.4. Personality and linguistic styles

A number of studies have shown that personality traits are related to linguistic styles in a variety of writing samples (Pennebaker & King, 1999; Pennebaker, Mehl, & Niederhoffer, 2003), including personal essays (Mairesse, Walker, Mehl, &

Moore, 2007), text messages (Holtgraves, 2011), blogs (Yarkoni, 2010), and tweets (Qiu et al., 2017; Qiu, Lin, Ramsay, & Yang, 2012). For example, neuroticism has been found to be associated with the use of anxiety words (Golbeck, Robles, Edmondson, & Turner, 2011). Agreeableness is associated with the use of positive emotion words and first person plural pronouns (Yarkoni, 2010). Extraverts tend to use more social and positive emotional words than introverts (Pennebaker & King, 1999). The aforementioned studies all used a software program called Linguistic Inquiry and Word Count (LIWC; Tausczik & Pennebaker, 2010; Pennebaker et al., 2003) to identify linguistic cues associated with personality. LIWC counts word frequencies in around seventy pre-defined grammatical (e.g., articles) and psychologically meaningful (e.g., positive affect) word categories. LIWC categories have been validated by independent judges (Pennebaker, Booth, & Francis, 2007) and have been found to reliably measure emotion, thinking styles, and social processes from writing samples (Pennebaker et al., 2003; Tausczik & Pennebaker, 2010; Tov, Ng, Lin, & Qiu, 2013).

2.5. The present research

The present research aimed to explore the connection between personality and linguistic cues in favorite songs. We expected that lyrics in one's favorite songs would contain stimuli (i.e., linguistic cues) that can create personality-compatible experiences. We hypothesized that personality traits are associated with linguistic cues in favorite songs, and the associations between personality and lyrical cues remain after controlling for preferences for acoustic and psychological attributes of melody and use of music.

We further predicted that the strength of the relationship between personality and lyrics would vary in accordance with reasons for liking songs. This is because some people may choose songs more for their lyrics while others may choose songs more for their melodic features. When people tend to like songs particularly because of their lyrics, it is likely that these lyrics are more reflective of their personal characteristics. Therefore, we expected that the associations between personality and lyrical styles would be stronger for people who have a general tendency to like songs more for their lyrics than their melodies.

Due to the lack of theories and empirical evidence of how people use linguistic cues as stimuli to fulfill their needs, we did not test specific hypotheses regarding which linguistic cues are associated with personality traits. Instead, we conducted an exploratory study to analyze relationships among several personality traits and a large number of linguistic cues, aiming to provide descriptive insights of how linguistic cues in favorite songs are associated with personality traits.

3. Method

3.1. Participants and procedure

A power analysis suggested that at least 120 participants were needed to detect a medium effect size of $r = 0.25$ (this value was chosen because past studies have shown that the significant correlations between the Big Five traits and word usage were usually in the range of $r = 0.20–0.30$; e.g., Hirsh & Peterson, 2009; Qiu et al., 2017; Yee, Harris, Jabon, & Bailenson, 2011), with alpha levels set at 0.05 and a power of 0.80.

We recruited 130 participants from a large university in mainland China (females = 87, males = 43; age: mean = 22.29, $SD = 2.57$). Each participant received RMB15 (US\$2.17) for their participation. Participants completed an online survey including

demographic variables such as age and gender, and the measures described below.

3.2. Measures

Top 20 favorite songs and their lyrics Participants were asked to report their top 20 favorite Chinese songs contained in their most frequently used music player software/app. Compared to having participants listen to and rate pre-selected excerpts of songs as in previous studies (e.g., Rentfrow et al., 2011), our approach collected data that reflected participants' actual music preferences in real-life settings. In addition, asking participants to select songs from their music player ensured that participants actually listened to these songs and avoided the difficulty of retrieving a large number of songs from memory.

Participants reported a total of 2600 songs as their favorite songs. Twenty-one songs were removed because they either did not contain lyrics or could not be found. After removing redundant songs, the lyrics of 1505 unique songs were downloaded from popular Chinese music websites (e.g., xiami.com). A widely used Chinese lexical analyzer ICTCLAS (Zhang, Liu, Cheng, Zhang, & Yu, 2003) was used to segment the lyrics into words, because Chinese texts do not contain word delimiters such as whitespaces. This resulted in a total number of 656,407 words. On average, each song contained 254.52 words ($SD = 29.47$). Then, we used the Simplified Chinese version of LIWC (Huang et al., 2012) to analyze the lyrics and generate word frequencies in 71 LIWC categories. The above text processing procedure was used by Qiu et al. (2017). For each participant, we averaged the word frequencies in each category. Out of the 71 categories, 25 categories had average frequencies lower than 1% and were removed from further analysis. The removal of low-frequency categories was to ensure the representativeness and reliability of results (Pennebaker & King, 1999; Qiu et al., 2017). The remaining 46 categories had frequencies comparable to those reported in other language samples (Pennebaker, Chung, Ireland, Gonzales, & Booth, 2007), and were used in the follow-up analysis.

Personality traits We used the Big Five Personality Inventory (BFI; John, Donahue, & Kentle, 1991) to measure participants' personality. The scale contained 44 statements and participants indicated their agreement with each statement on a 5-point scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*). Five personality traits were measured, including extraversion (*Cronbach's alpha* = 0.77), agreeableness (*Cronbach's alpha* = 0.74), neuroticism (*Cronbach's alpha* = 0.78), conscientiousness (*Cronbach's alpha* = 0.67), and openness to experience (*Cronbach's alpha* = 0.82).

Preferences for acoustic features We used 14 sound-related attributes (e.g., loud, fast) from Rentfrow et al. (2012) to measure preferences for acoustic features (see Table 1). Rentfrow et al. (2012) developed these attributes to code music excerpts. Participants rated their preferences for these attributes on a 5-point scale (1 = *not at all*, 5 = *definitely*). Following the procedure in Greenberg et al. (2016), we conducted a Principle Component Analysis (PCA) with varimax rotation to assess the underlying structure of preference for acoustic features. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.76, indicating that the data were suitable for PCA. Multiple criteria, including scree plot analysis and parallel analysis of random data, suggested four components should be retained. The four factors together accounted for 58.86% of the variance. We named them Loud and Heavy, Dense and Fast, Raspy and Yelling, and Electric. According to Hair, Black, Babin, Anderson, and Tatham, (2010), we selected 0.50 as the significant factor loading criteria given our sample size (see Table 1 for factor loadings). We averaged the item scores in each factor to obtain the composite scores.

Table 1
Four varimax-rotated principal components derived from 14 acoustic features.

Sound-related attributes	Factor 1 Loud and Heavy	Factor 2 Dense and Fast	Factor 3 Raspy and Yelling	Factor 4 Electric
Loud	0.69			
Heavy bass	0.65			
Brass	0.64			
Woodwind	0.61			
Dense		0.76		
Fast		0.76		
Percussive		0.60		
Raspy voice			0.73	
Piano			−0.68	
Distorted			0.64	
Yelling voice			0.57	
Instrumental			−0.52	
Synthesizer				0.79
Electric				0.75

Note. Only loadings above 0.50 are shown.

Preferences for psychological attributes of melody We used 36 psychological attributes of music from Rentfrow et al. (2012) to measure preferences for psychological aspects of melodies. Participants rated their preferences for these attributes about melodic styles on a 5-point scale (1 = *not at all*, 5 = *definitely*). Following Greenberg et al. (2016), we conducted PCA to measure the factor structure of preferences for psychological attributes of melody. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.82, indicating that the data were suitable for PCA. Multiple criteria, including parallel analysis of random data and analysis of the scree plot, suggested that four components should be retained. We selected 0.50 as the significant factor loading criteria according to Hair et al. (2010) and five attributes (complex, amusing, sensual, mellow, and calming) were removed because of their low loadings.

The four components together accounted for 54.01% of the variance. They were consistent with the four categories that Rentfrow et al. (2012) proposed for psychological attributes of music (i.e., Positive Affect, Negative Affect, Energy, and Cerebral), and therefore were labeled accordingly (see Table 2 for factor loadings).

Uses of music We used the 15-item Uses of Music Inventory (Chamorro-Premuzic & Furnham, 2007) to measure emotional (e.g., 'whenever I want to feel happy I listen to a happy song'), cognitive (e.g., 'I seldom like a song unless I admire the technique of the musicians'), and background (e.g., 'I enjoy listening to music in social events') uses of music. Each sub-scale contained five items. Participants rated their agreement with each item on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Table 2
Four varimax-rotated principal components derived from 36 psychological attributes of melody.

Psychological attributes	Factor 1 Positive Affect	Factor 2 Energy	Factor 3 Cerebral	Factor 4 Negative Affect
Joyful	0.82			
Merry	0.80			
Happy	0.78			
Animated	0.73			
Enthusiastic	0.73			
Romantic	0.71			
Fun	0.71			
Dreamy	0.68			
Warm	0.64			
Inspiring	0.60			
Mellow	0.57			
Relaxing	0.54			
Lively	0.54			
Forceful		0.84		
Strong		0.77		
Manic		0.72		
Danceable		0.66		
Aggressive		0.63		
Tense		0.58		
Thrilling		0.54		
Party music		0.53		
Intense		0.52		
Reflective			0.82	
Intelligent			0.80	
Thoughtful			0.77	
Deep			0.76	
Sophisticated			0.70	
Sad				0.72
Depressing				0.72
Abrasive				0.72
Angry				0.59

Note. Only loadings above 0.50 are shown.

Table 3
Descriptive statistics and variable intercorrelations (N = 130).

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Extraversion	3.01	0.62																			
2. Agreeableness	3.54	0.58	0.09																		
3. Conscientiousness	3.31	0.56	0.21*	-0.01																	
4. Neuroticism	3.01	0.56	-0.43**	-0.38**	-0.30*																
5. Openness	3.43	0.63	0.14	0.05	0.03	-0.06															
6. Gender	1.33	0.47	-0.10	0.00	0.05	-0.09	0.03														
7. Age	22.29	2.57	0.04	0.02	0.13	0.02	-0.05	0.08													
8. Reason for preferences	2.50	1.01	-0.05	-0.03	0.04	-0.04	0.09	0.17	-0.16												
Preferences for acoustic features																					
9. Loud and Heavy	3.15	0.66	0.13	0.08	-0.18*	0.06	0.24**	0.06	-0.12	-0.08											
10. Dense and Fast	2.77	0.79	0.02	0.03	-0.24**	0.12	0.21*	0.08	-0.02	-0.12	0.47**										
11. Raspy and Yelling	1.85	0.51	-0.02	-0.04	-0.08	0.03	0.01	0.23**	0.08	0.13	0.07	0.19*									
12. Electric	2.87	0.84	0.14	0.29**	-0.15	-0.10	0.09	0.25**	0.04	-0.21*	0.34**	0.43**	0.11								
Preferences for psychological attributes of melody																					
13. Positive Affect	4.06	0.49	0.04	0.11	0.02	-0.03	0.02	0.02	0.02	-0.20*	0.12	0.00	-0.28**	0.14							
14. Energy	2.85	0.72	0.11	0.04	-0.08	0.02	0.35**	0.08	0.08	0.02	0.50**	0.49**	0.35**	0.40**	0.15						
15. Cerebral	3.55	0.79	-0.16	-0.04	-0.06	0.27**	0.26**	0.01	-0.13	0.17	0.34**	0.13	0.06	0.05	0.03	0.31**					
16. Negative Affect	2.44	0.86	-0.06	-0.15	-0.07	0.17	0.12	0.10	-0.14	0.18*	0.29**	0.21*	0.27**	0.19*	-0.13	0.46**	0.42**				
Uses of music																					
17. Emotional uses of music	3.45	0.67	0.19*	0.02	-0.00	0.02	0.06	-0.09	-0.05	0.04	0.06	-0.01	0.04	-0.07	0.14	0.16	0.16	0.05			
18. Cognitive uses of music	2.23	0.71	0.05	-0.00	-0.01	0.07	0.20*	0.14	0.11	-0.00	0.30**	0.12	0.21*	0.09	-0.02	0.27**	0.36**	0.11	0.12		
19. Background uses of music	2.89	0.82	0.04	-0.03	-0.07	0.07	0.07	-0.01	-0.07	0.10	-0.10	0.06	0.07	-0.03	0.03	0.08	-0.01	0.01	0.30**	-0.03	

Note. Gender: 1 = Female, 2 = Male. Reasons for preferences: 1 = melody, 5 = lyrics.
* p < .05.
** p < .01, two tailed.

Internal consistencies for the subscales are in the moderate to high range (emotional uses: *Cronbach's alpha* = 0.39; cognitive uses: *Cronbach's alpha* = 0.69; background uses: *Cronbach's alpha* = 0.70), similar to those reported in previous studies (Vella & Mills, 2017). To improve the consistency for the emotional use subscale, we removed one item ('I am not very nostalgic when I listen to old songs I used to listen to'), and the internal consistency increased from 0.39 to 0.54. (The item was removed in the following analysis. However, results remained the same if the item was included).

Reason for preferences (lyrics vs. melody) We measured participants' general tendency of liking a song because of its lyrics or melody. Rentfrow and Gosling (2003) asked participants to rate a number of attributes regarding which aspect of the music they describe (i.e., lyrics, both the lyrics and music, music). We followed their approach and asked participants to indicate their general reason for liking a song on a five–point scale (1 = melody, 3 = both, 5 = lyrics).

4. Results

Table 3 presents the descriptive statistics and intercorrelations among the variables measured in our study. Individual differences were found in preferences for acoustic features and psychological attributes of melody. For example, conscientiousness was negatively correlated with preferences for Loud and Heavy, and Dense and Fast music, while agreeableness was associated with preferences for Electric music. Openness to experience was related to the preferences for melody that is energetic, cerebral, loud and heavy, and dense and fast. Males were more likely to prefer Raspy and Yelling and Electric music than females. Personality traits were also found to be related to uses of music. Openness to experience was correlated with cognitive use of music, and extraversion was correlated with emotional use of music, consistent with previous findings (Chamorro-Premuzic & Furnham, 2007; Chamorro-Premuzic et al., 2010).

4.1. Personality-related linguistic cues in lyrics

We first used a function in the 'multicon' R package developed by Sherman and Serfass (2015) to determine if there was an overall association between linguistic style (consisted of 46 LIWC categories) and personality (consisted of five traits). The function uses randomization tests to examine if two multivariate constructs are related to each other. Results showed an average absolute correlation of 0.0995 between linguistic style and personality (p = .0036), larger than the value expected by chance alone which is 0.0706 with a standard error of 0.0087. This suggests that the relationship between the two multivariate constructs, linguistic style and personality, is much greater than one would expect by chance alone. In other words, personality does seem to predict the words in favorite songs.

We then correlated LIWC word frequencies with participants' Big Five personality traits to reveal personality-related linguistic cues. Table 4 shows the word categories significantly correlated with at least one personality trait. A number of associations were consistent with previous findings. For example, extraversion was positively correlated with positive emotion words, suggesting that extraverts prefer lyrics expressing positive emotion. This supports past finding that extraverts tend to have higher level of positive emotion and subjective well-being than introverts (e.g., Anglim & Grant, 2016; Quevedo & Abella, 2011; Steel,

Table 4
Correlations between personality traits and LIWC word frequencies (N = 130).

Word Categories	Examples	Mean (SD)	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Age	Gender
Total function words	或许 (maybe), 那些(those)	48.80 (4.24)	0.14	0.01	0.25**	−0.24**	−0.07	0.05	0.11
Total pronouns	你(you), 他们(they)	11.64 (1.83)	0.13	0.04	0.18*	−0.17	−0.03	0.04	0.13
Personal pronouns	他(he), 在下(I)	8.80 (1.81)	0.16	0.05	0.18*	−0.15	−0.04	0.07	0.12
First person singular	本人(I), 我(I)	4.44 (1.10)	0.15	0.06	0.13	−0.13	−0.04	0.08	0.14
Second person singular	你(you),您(you)	3.70 (0.86)	0.08	0.04	0.21*	−0.14	−0.05	0.10	0.05
Impersonal pronouns	它(it), 那些(those)	2.90 (0.52)	−0.10	−0.03	−0.03	−0.07	0.02	−0.09	0.05
Common verbs	走(walk),去(go)	14.59 (1.94)	0.15	0.04	0.25**	−0.19*	−0.04	0.17	0.13
Auxiliary verbs	可能(may), 应该(should)	3.50 (0.80)	0.13	0.03	0.16	−0.14	−0.02	0.16	0.09
Adverbs	曾经(once),非常(very)	9.28 (1.56)	0.10	0.04	0.14	−0.27**	0.02	−0.02	−0.01
Prepositions	到(to),与(with)	6.04 (0.73)	0.18*	0.16	0.26**	−0.34**	0.05	0.01	0.10
Conjunctions	和(and),但是(but)	4.40 (0.76)	0.02	0.09	0.07	−0.26**	0.02	−0.15	−0.09
Negations	不(no), 未必(not)	1.57 (0.39)	−0.07	−0.13	0.04	0.01	−0.06	0.00	−0.04
Quantifiers	一些(some), 所有(all)	1.91 (0.38)	−0.01	−0.17	0.11	0.01	0.01	0.04	−0.04
Numbers	一(one),百(hundred)	1.52 (0.48)	−0.23**	−0.05	−0.16	0.26**	−0.07	−0.11	−0.14
Preposition end	之中(end), 以上(above)	2.05 (0.44)	−0.04	−0.06	−0.08	0.02	−0.11	−0.08	−0.06
Special Articles	本, 该	1.30 (0.31)	0.02	−0.09	0.03	−0.03	−0.19*	−0.05	−0.14
Quantity unit	条, 头	2.77 (0.53)	−0.10	−0.01	−0.06	0.16	−0.26**	0.01	−0.13
Interjunction	呢, 吗	8.39 (1.38)	0.15	−0.02	0.19*	−0.12	−0.01	0.11	0.13
Multifunction words	的, 有	8.32 (1.37)	0.16	0.05	0.26**	−0.19*	−0.04	0.19*	0.18*
Tense Markers	已经(already), 之前 (before)	3.78 (0.62)	0.07	−0.12	0.01	0.00	−0.06	−0.03	−0.02
Progress markers	了(already), 至今 (until now)	1.39 (0.44)	0.09	−0.06	0.00	−0.03	−0.01	0.07	0.00
Social processes	谈话(talk),接纳(accept)	8.31 (1.46)	0.13	0.04	0.20*	−0.16	−0.05	0.14	0.07
Affective processes	气愤(angry),感恩(gratitude)	8.42 (1.29)	0.26**	0.06	0.30**	−0.30**	−0.02	0.11	0.11
Positive emotion	高兴(happy),满足(satisfied)	4.19 (0.91)	0.20*	0.08	0.27**	−0.27**	−0.02	0.18*	0.13
Negative emotion	担忧(worried), 糟糕(terrible)	2.74 (0.48)	0.12	−0.04	0.17	−0.09	−0.08	−0.02	0.04
Sadness	失望 (disappointed),沮丧 (upset)	1.14 (0.29)	0.02	−0.12	0.17	−0.08	−0.15	0.16	0.00
Cognitive processes	理解(understand),选择(choose)	18.62 (2.47)	0.15	0.01	0.21*	−0.27**	0.00	0.06	0.01
Insight	了解(understand),体会(realize)	3.28 (0.71)	0.12	−0.05	0.18*	−0.17*	−0.07	0.08	0.02
Causation	因为(because), 导致(effect)	1.21 (0.37)	0.03	0.13	0.24**	−0.26**	−0.03	0.06	0.17*
Discrepancy	欠缺(lack), 必须(must)	3.22 (0.76)	0.13	0.02	0.06	−0.12	−0.01	0.05	0.06
Tentative	大约(about),未定(unsure)	2.64 (0.56)	0.16	0.01	0.07	−0.19*	0.04	−0.15	−0.02
Certainty	总是(always), 从不(never)	1.37 (0.39)	0.10	0.02	0.29**	−0.28**	−0.07	0.21*	0.07
Inclusive	包括(include),附近(near)	4.16 (0.61)	0.12	0.03	0.13	−0.20*	−0.02	−0.05	−0.13
Exclusive	取消(cancel), 除外(exclude)	3.65 (0.67)	0.06	0.01	0.04	−0.15	0.08	0.03	−0.06
Perceptual processes	观察(observing),听见(heard)	3.85 (0.57)	0.06	0.18*	−0.05	−0.02	0.04	−0.07	0.06
Hear	听见 (hear), 谈话 (talk)	1.17 (0.37)	0.05	0.05	0.06	−0.07	−0.03	−0.01	0.11
Feel	平滑 (smooth), 触摸 (touch)	1.01 (0.26)	0.03	0.10	0.00	−0.06	−0.01	−0.05	0.12
Biological processes	头晕(dizzy), 流汗(sweat)	3.38 (0.50)	−0.01	0.06	−0.02	0.08	0.08	0.17	0.10
Body	脖子(neck),皮肤(skin)	1.27 (0.26)	−0.18*	−0.02	−0.15	0.21*	0.11	0.10	0.06
Sexual	情人 (valentine), 吻 (kiss)	1.30 (0.45)	0.10	0.12	0.10	−0.15	−0.04	0.22*	0.09
Relativity	以前(past), 相比(comparably)	13.90 (1.29)	0.04	0.00	0.13	−0.10	−0.02	0.05	−0.05
Motion	通过(through), 靠近(approach)	3.63 (0.50)	0.07	−0.04	0.14	0.00	−0.01	0.14	0.03
Space	里面(inside),街道(street)	6.55 (0.76)	−0.09	0.06	−0.01	0.01	−0.06	0.03	0.04
Time	期间(period),过去(past)	4.93 (0.69)	0.11	0.04	0.18*	−0.20*	−0.07	−0.01	−0.17*
Achievement	擅长(skilled),赢得(win)	1.06 (0.33)	0.00	0.02	0.22*	−0.14	−0.13	0.17	0.24**
Assent	可以 (can), 好 (ok)	3.67 (0.74)	0.14	−0.07	0.16	−0.06	0.06	0.07	−0.02

Note: Gender: 1 = Female, 2 = Male. Only categories with mean values higher than 1% are shown.
* $p < .05$.
** $p < .01$, two tailed.

Schmidt, & Shultz, 2008). Conscientiousness was positively correlated with achievement words, consistent with findings that individuals high in conscientiousness are likely to experience more dutiful situations (Rauthmann et al., 2015). Neuroticism was negatively correlated with positive emotion words, suggesting that individuals with a higher level of neuroticism favor songs expressing less positive emotion. This is consistent with previous finding that individuals higher in neuroticism experience fewer positive situations (Rauthmann et al., 2015). Cognitive process-related words was positively correlated with conscientiousness but negatively correlated with neuroticism, consistent with past findings that need for cognition is positively related to conscientiousness but negatively related to neuroticism (Fleischhauer et al., 2009; Sadowski & Cogburn, 1997).

4.2. Control for age and gender

Past studies have shown age and gender differences in musical preferences (e.g., Bonneville-Roussy, Rentfrow, Xu, & Potter, 2013; McCown, Keiser, Mulhearn, & Williamson, 1997; North & Hargreaves, 2007). Our results showed that age and gender were associated with linguistic cues in lyrics. For example, males preferred lyrics with more causation words, and older individuals favored lyrics with more positive emotion words.

To examine if the observed associations between personality and lyrics were contingent on age and gender, we calculated partial correlations by controlling gender and age. Among the 42 previously found correlations, only three became marginally significant (conscientiousness and total pronoun, $r = 0.17$, $p = .06$;

conscientiousness and personal pronouns, $r = 0.17$, $p = .05$; conscientiousness and insight, $r = 0.17$, $p = .06$). This suggests that the relationships between lyrics and personality are likely to be independent of age and gender.

4.3. Control for preferences for acoustic features of melody

Since lyrical styles and melodic features may be related, and people's preferences for lyrical styles may be influenced by their preferences for acoustic features, we examined if the observed personality-lyrics relationship was contingent on preferences for acoustic features by calculating partial correlations, controlling for preferences for four acoustic factors (Loud and Heavy, Dense and Fast, Raspy and Yelling, and Electric). Five previously found correlations became marginally significant (conscientiousness and interjunction, $r = 0.16$, $p = .07$; conscientiousness and social processes, $r = 0.18$, $p = .05$; conscientiousness and insight, $r = 0.15$, $p = .09$; neuroticism and insight, $r = -0.16$, $p = .07$; neuroticism and inclusive, $r = -0.16$, $p = .07$), and two became non-significant (agreeableness and perceptual processes, $r = 0.13$, $p = .14$; conscientiousness and time, $r = 0.14$, $p = .13$). A total of 35 out of 42 (83.33%) correlations remained significant, suggesting that the majority of personality-word associations are independent of preferences for acoustic features.

4.4. Control for preferences for psychological attributes of melody

Since preferences for lyrics could also be contingent on preferences for psychological aspects of melody, we again calculated partial correlations between word categories and personality traits, this time controlling for preferences for psychological attributes of melodic styles (i.e., Positive Affect, Negative Affect, Energy, and Cerebral). Among the previously found correlations, 35 out of 42 (83.33%) remained significant. Seven correlations became marginally significant (extraversion and prepositions, $r = 0.17$, $p = .06$; extraversion and positive emotion, $r = 0.17$, $p = .06$; agreeableness and perceptual processes, $r = 0.16$, $p = .08$; conscientiousness and time, $r = . 17$, $p = .06$; neuroticism and common verbs, $r = -0.16$, $p = .07$; neuroticism and tentative, $r = -0.15$, $p = .09$; openness and special articles, $r = -0.16$, $p = .08$). This suggests that the majority of lyric-personality associations are independent of preferences for psychological attributes of melody.

4.5. Control for uses of music

Past research has shown that uses of music are associated with personality and music preferences (Chamorro-Premuzic & Furnham, 2007; Chamorro-Premuzic et al., 2010; Getz et al., 2014). To examine if the personality-word associations were contingent on uses of music, we calculated partial correlations. After controlling for uses of music, four correlations became marginally insignificant, including extraversion and body ($r = -0.16$, $p = .07$), conscientiousness and pronoun ($r = 0.17$, $p = .06$), conscientiousness and insight ($r = 0.17$, $p = .05$), neuroticism and insight ($r = -0.16$, $p = .07$). This suggests that the majority of personality-word associations are independent from uses of music.

4.6. Control for all covariates

We conducted partial correlations between word categories and personality traits after controlling for all covariates, including age, gender, preferences for acoustic features, preferences for psychological attributes of melody, and uses of music. Out of the observed 42 correlations, 27 remained significant. This suggests that many personality-word connections are independent from preferences for other musical attributes.

4.7. The moderation effect of reason for music preferences

We conducted an exploratory analysis to examine if the associations between personality and lyrics would be stronger in individuals who tend to like songs more because of their lyrics than their melodies. We performed a series of interaction analyses, focusing on three broad categories—social processes, affective processes, and cognitive processes. These broad categories contain words in narrow categories (e.g., affective processes category contains words in positive affect category, cognitive processes category contains words in insight category) and can indicate the overall association between linguistic styles and personality (Tausczik & Pennebaker, 2010). A total of 15 regression analyses were conducted, each with two predictors (one Big Five dimension and reason for music preferences), the resulting interaction term, and one of the three word categories as the dependent variable. Among the tested interactions, 6 out of 15 (40.00%) were statistically significant (see Appendix A), exceeding chance. Except the association between agreeableness and cognitive processes words, all other five interactions showed that word-personality associations only existed for individuals who tended to like a song for its lyrics (all $p < .05$), but not for those who liked a song for its melody (all $p > .05$). The associations found between social words and agreeableness, consciousness, and neuroticism (negatively), and between affective words and agreeableness have been reported in past studies (Gill & Oberlander, 2003; Golbeck, Robles, & Turner, 2011; Yarkoni, 2010). These results provide preliminary evidence of the moderation effect of reason for music preferences on the relationship between personality and lyrics.

5. Discussion

Music is an important aspect of everyday life for many people. It has great potential to create personality-compatible experiences and satisfy individuals needs. In this research, we examined how personality is related to linguistic cues in favorite songs. Our results revealed a number of associations between personality traits and word categories, and these associations remained significant after controlling for age, gender, preferences for acoustic and psychological attributes of melody, and uses of music. In addition, the associations between personality and word categories were stronger for participants who liked songs more because of their lyrics than melodies. While our study is exploratory, these results suggest that personality is associated with the lyrical content of favorite songs.

Our study contributes to the extensive literature on person-situation interactions by pointing out the possibility that people may use lyrical content of songs to create experiences that match their personality traits. This is important, because while previous research has speculated that people create experiences to fit their personality, little is known about what means people use to create these experiences. Our findings suggest that conscientious individuals may use songs with achievement words to fulfill their need for accomplishment, while individuals high in neuroticism may use songs with few positive emotion words to match their low desire for positive emotion. In addition, conscientious individuals may use lyrics with high cognitive complexity to fulfill their high need for cognition, while individuals high in neuroticism may use lyrics with low cognitive complexity to match their low need for cognition. These findings shed light on how people may use forms of art and entertainment such as music to enhance their experiences or shape their environments for need satisfaction. While our results and the above speculations are consistent with past findings on personality-driven situation selection (Rauthmann et al., 2015) and the relationship between need for cognition and

personality traits (Fleischhauer et al., 2009; Sadowski & Cogburn, 1997), they do not provide direct evidence of the underlying mechanism of lyrical preferences. There could be alternative hypotheses such as mood regulation and attentional bias. For example, individuals high in neuroticism may like lyrics with few positive emotion and low cognitive complexity because such lyrics help to regulate their mood. On the other hand, it could be due to neurotic individuals' attentional bias towards negative stimuli so that they liked lyrics with little positive emotion. However, little research has shown the connection between neuroticism and mood regulation or attentional bias. The theory of processing fluency (Winkielman, Huber, Kavanagh, & Schwarz, 2012) may also explain our results. It is possible that neurotic individuals may like lyrics with low cognitive complexity because they can process them with ease, which could be due to their low need for cognition (Fleischhauer et al., 2009; Sadowski & Cogburn, 1997). Future research is needed to directly measure these psychological processes and examine if they can explain the relationship between personality and lyrics.

Our study expands the scope of research on personality and language use by showing how personality may be related to linguistic cues in other people's writings (i.e., lyrics). This is important, as past research has mainly focused on how personality predicts linguistic cues in one's own writings (Pennebaker et al., 2003). Based on our findings, we speculate that words in one's own writing samples reflects one's tendencies and needs, while words in preferred texts written by others are a method through which need satisfaction can be achieved. For example, extraversion has been found to be related to social process words in writing samples such as personal essays (Pennebaker & King, 1999), self-narratives (Hirsh & Peterson, 2009), and tweets (Qiu et al., 2012). However, the relationship was not found in our study. This could be because social process words in extraverts' writings reflect their high tendency to involving themselves in social activities and their desire for social engagement. However, extraverts may not like listening to songs with social processes words because listening to these words does not provide opportunities for social interactions with others. To test the above hypotheses, lab studies are needed to directly measure the underlying psychological processes of using certain words in one's own writing and reading or listening to words in other people's language products such as essays or speeches.

Our study also highlights the importance of lyrical information in understanding music preferences. Most of our personality-word associations remained significant after controlling for preferences for melodic attributes and uses of music. This suggests that people may be attracted to certain music because of the linguistic cues in its lyrics regardless of other musical attributes. In addition, a past meta-analysis on studies using genre-based approaches showed that conscientiousness and neuroticism had little connection with preferences for music styles (Schäfer & Mehlhorn, 2017). However, our study found that these two traits are related to many linguistic cues in lyrics. This suggests that the genre-based approach may mask the effects of lyrics due to the confounding effects of melody. Future research is needed to measure individuals' preferences for lyrics and melody separately, because the link between personality and music preferences maybe driven by preferences for lyrics, preferences for melody, and their interactions.

Our findings have important practical implications. First, as online music platforms become increasingly popular, millions of people listen to music and store their playlists online. Music platforms have tried to recommend music to their users based on their previous selections and listening habits of other users. Our results suggest that besides relying on information such as genres or sonic attributes, music providers should also consider the linguistic styles of lyrics when making suggestions. In addition, given the tremendous amount of personal music listening data available

online, future research may develop computer algorithms to automatically assess personality based on lyrics in preferred songs on a large scale. Second, besides lyrics, people nowadays consume many language products generated by others, including books, news articles, online reviews, and even conversations with personal assistants like Siri or Alexa. Our research opens new venues for researchers to explore how personality influences the preferences for language products and generate better personalized language products for users.

There are a number of limitations of our study. Firstly, it is important to note that our research is exploratory and our findings should not be interpreted as a definitive representation of how personality predicts linguistic cues in lyrics. In addition, given that our sample size is relatively small and only included Chinese participants, future studies with larger and more diverse samples are needed to assess the replicability and cross-cultural validity of our findings. For example, research in cultural psychology suggests that compared to East Asians, Westerners are more capable of selectively attending to salient information and ignoring contextual information (e.g., Masuda & Nisbett, 2001). It is possible that the associations between personality and lyrics may be stronger for Westerners (vs. East Asians) because they can better attend to lyrics independent from melody when listening to music.

Secondly, our study only examined the lyrical content of songs that the participants liked. This may present an incomplete picture as we did not examine the associations between personality and the lyrical content of songs that participants disliked. For example, people high in agreeableness may dislike songs with swear words. However, the negative association between agreeableness and swear words would not be discovered when people are asked to report their favorite songs, because people both high and low in agreeableness may not report songs with many swear words as their favorite songs. To address this issue, future studies are needed to ask participants to report the songs that they dislike, or measure their preferences towards a set of pre-selected songs on a liker scale from "dislike very much" to "like very much." These songs should differ in their linguistic styles but have similar acoustic features.

Thirdly, our study did not find the correlation between neuroticism and negative emotion words. This could be due to the implicit style of emotional expression in lyrics. For instance, lyrics such as "when will you come back?" can express negative emotions, but does not contain any word related to negative emotion. Future research is needed to develop specific methods or tools to analyze the more subtle semantic content of lyrics.

Finally, we collected songs that participants actually listened to on their music players to maximize the ecological validity of our study. While we have controlled for general preferences for acoustic and psychological characteristics of melody, our approach did not completely remove the influence of each song's melody. Future research may adopt an experimental approach to vary the lyrics of a song while maintaining the melody, and have participants rate their preferences for the songs to control for the influence of melody.

6. Conclusion

Music plays an important role in people's everyday life. In this research, we showed that people's personality traits predict linguistic cues present in their favorite songs. For example, extraverts tended to like songs expressing positive emotions and conscientious individuals tended to like songs that show cognitive complexity. Our results further indicate that these personality-lyrics associations are generally independent of preference for other

musical attributes such as acoustic and psychological attributes of melody. These findings suggest that individual differences in music preferences could be driven by preferences for lyrical style, and suggest the possibility that people use linguistic cues in lyrics as stimuli to fulfill their individual needs.

Open data access

Data used for this study can be found in the supplementary materials. We also include additional analyses and results in the supplementary materials.

Preregistration

This study was not preregistered prior to submission.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrp.2018.11.004.

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