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1 Running head: PERSONALITY AND MUSIC PREFERENCE USING SOCIAL-TAGGING

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5 Personality and musical preference using social-tagging in excerpt-selection

6

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Abstract

8
9 Music preference has been related to individual differences like social identity, cognitive style, and
10 personality, but quantifying music preference can be a challenge. Self-report measures may be too
11 presumptive of shared genre definitions between listeners, while listener ratings of expert-selected
12 music may fail to reflect typical listeners' genre-boundaries. The current study aims to address this
13 by using a social-tagging approach to select music for studying preference. 2407 tracks were
14 collected and subsampled from the Last.fm social-tagging service and the EchoNest platform based
15 on attributes such as genre, tempo, and danceability. The set was further subsampled according to
16 tempo estimates and metadata from EchoNest, resulting in 48 excerpts from 12 genres. Participants
17 ($n = 210$) heard and rated the excerpts, rated each genre using the Short Test of Music Preferences
18 (STOMP), and completed the Ten-Item Personality Index (TIPI), the Empathy Quotient (EQ) and
19 the Systemizing Quotient (SQ). Mean preference ratings correlated significantly with STOMP
20 scores, suggesting that social-tagging can provide a fairly reliable link between perception and
21 genre-labels. Principal Component Analysis (PCA) of the ratings revealed four musical
22 components: 'Danceable,' 'Jazzy,' 'Hard,' and 'Rebellious.' Component scores correlated modestly
23 but significantly with TIPI, EQ and SQ scores. These results support and expand previous findings
24 linking personality and music preference, and provide support for a novel method of using crowd-
25 tagging in the study of music preference.

26

27

28 We take it for granted that the music we like and listen to says something important about us and
29 make judgements about others based on their musical tastes (Boer et al., 2011; Rentfrow & Gosling,
30 2006; Rentfrow & Gosling, 2003). Rentfrow and Gosling (2006), for example, analyzed the
31 conversations of participants as they got acquainted, and found that participants discussed their
32 musical tastes more than any other topic. They furthermore found that participants could use
33 information about others' music preferences to make partly accurate guesses about their
34 personalities.

35 Research linking music preferences to personality is nearly as old as modern measures of
36 personality themselves; early pioneers of personality research suggested that participants' ratings
37 of heard music might even function as a kind of Rorschach test to reveal subconscious emotional
38 tendencies (Cattell & Anderson, 1953). Over the following decades, the development of a widely
39 validated five factor model (FFM) of personality led to greater comparability across personality
40 studies (Digman, 1990). The five traits are comprised of Openness, which is the tendency to
41 broadly enjoy arts, new ideas and experiences; Conscientiousness, which is the tendency to be
42 responsible, organized and self-disciplined; Extraversion, which is the tendency to seek and enjoy
43 social engagement and high energy activities; Agreeableness, which is the tendency to act
44 cooperatively and helpfully rather than competitively; and Neuroticism¹, which is a tendency to
45 experience negative emotions. These traits have been widely studied, for example in relation to job
46 performance, mental health, and brain function (e.g., Caprara, Barbaranelli, Borgogni, & Perugini,
47 1993; Caspi & Shiner, 2006; Digman, 1990; Haas, Constable, & Canli, 2008; Hurtz & Donovan,
48 2000; Soldz & Vaillant, 1999), and in relation to music preference (Dollinger, 1993; Rawlings &
49 Ciancarelli, 1997). However, it was not until Rentfrow and Gosling's (2003) seminal study that a
50 factor-based model for measuring music preferences was attempted, resulting in the widely used
51 Short Test of Music Preferences, or STOMP. Participants used a seven-point Likert scale to rate

¹ 'Neuroticism' can be perceived as a negative trait and therefore sometimes it is re-conceptualized as Emotional Stability (or Emotionality), such that a positive correlation with Emotional Stability is the same as a *negative* correlation with Neuroticism. For the sake of consistency, results are reported in terms of Neuroticism in the current paper.

52 how much they liked each of a series of 14 musical genres: Blues, Jazz, Classical, Folk, Rock,
53 Alternative, Heavy Metal, Country, Sound tracks, Religious, Pop, Rap/Hip-Hop, Soul/Funk,
54 Electronica/Dance. These were found to be organized into four higher order factors: Reflective and
55 Complex (Classica, Jazz, Blues and Folk), Intense and Rebellious (Alternative, Rock and Heavy
56 Metal), Upbeat and Conventional (Country, Pop Religious and Soundtracks) and Energetic and
57 Rhythmic (Rap/Hip-Hop, Soul/Funk, Electronica/Dance) (see Rentfrow and Gosling, Figure 6, p.
58 1245). Rentfrow and Gosling found that Openness was positively correlated with liking for
59 Reflective and Complex genres, and with liking for Intense and Rebellious genres. Meanwhile,
60 Extraversion, Conscientiousness and Agreeableness were all positively correlated with liking for
61 Upbeat and Conventional genres, while Neuroticism was negatively correlated with the same, and
62 negatively correlated with liking for Reflective and Complex genres. Extraversion was also
63 positively correlated with liking for Energetic and Rhythmic genres.

64 A number of studies seeking to replicate and extend Rentfrow and Gosling's findings have
65 followed, with moderate success. Multiple studies have replicated the finding that Openness is
66 associated with liking for music in the Reflective and Complex domain (Brown, 2012; Delsing et
67 al., 2008; George, Stickle, Rachid, & Wopnford, 2007; Langmeyer, Guglhör-Rudan, & Tarnai,
68 2012; Zweigenhaft, 2008). Other studies have expanded to include types of individual difference
69 other than personality: Greenberg et al. (2015) found that trait Empathy was linked to preference for
70 mellow music such as R&B and Soft Rock, while participants who were less empathetic and more
71 systematic in their thinking preferred more intense music such as Punk, Metal and Hard Rock.
72 Similarly, Clark and Giacomantonio (2013) found that the STOMP factor Reflective and Complex
73 was positively related to empathy in males.

74 Inconsistencies have also emerged, however; George et al., (2007), for example, found
75 Openness and Conscientiousness, rather than Extraversion and Agreeableness, to be correlated
76 positively with liking for Dance/Electronica. Zweigenhaft (2008) did not find any personality

77 correlates for liking Intense and Rebellious music. Dunn, de Ruyter, and Bouwhuis (2012) provide
78 an overview of these inconsistencies (p. 4) and further point out that each study's factor analysis has
79 resulted in slightly different factor models of musical preference. They note that genres including
80 Rap, Dance, Blues Jazz and Classical have been grouped inconsistently and suggest that each group
81 of participants may have had somewhat different perceptions of these genres. George et al. (2007),
82 for example, ultimately chose to measure participants' preferences by genre rather than higher-order
83 factors after being unable to recreate the four factor model supplied by the STOMP. Others chose to
84 begin with a different set of genres than the STOMP, typically for cultural reasons. Brown (2012),
85 for example, who conducted a study using Japanese university students, excluded Country music
86 and including *Enka*, a popular genre specific to Japan. In this case, Brown related factors to the
87 STOMP conceptually rather than mathematically. Purhonen, Gronow, and Rahkonen, (2009)
88 employed PCA and found four similar factors to the STOMP when examining musical taste in a
89 Finnish population, but did not relate these preference factors to personality. Desling et al. (2008)
90 used a different questionnaire entirely, specific to their population of Dutch teenagers. Dunn et al.
91 (2012) used the original STOMP but failed to fully replicate the STOMP factor model due to Pop
92 not loading onto the Upbeat and Conventional dimension, and ultimately used Principal Component
93 Analysis (PCA) to determine five factors of their own. They found some positive correlations
94 between music listening behavior and stated preferences, but suggested that perceptual ambiguity of
95 some genres, such as Pop, may have contributed to lower correlations (Dunn et al., 2012).

96 These inconsistencies highlight musical genres as a problematic aspect in the quest for
97 consistent and accurate measurement of music preferences. The ambiguity of genre labels, and
98 differences between participants in their perception, is among the main difficulties in constructing a
99 widely applicable model (Dunn et al., 2012); what comes to mind for one participant as an example
100 of "Soft Rock" may be musically very different from another participant's conception. Indeed,
101 Patchet and Cazaly (2000) investigated several large commercial genre taxonomies and found very

102 little overlap between them; Amazon and iTunes, at least, do not define Soft Rock the same way.
103 Furthermore, a desire for broader appeal or to explore new creative ground can result in some artists
104 inconveniently employing musical tropes from multiple genres, or inventing new sounds altogether.
105 This, and the difficulty of conceptually separating very similar subgenres ultimately led Patchet and
106 Cazaly to abandon efforts to develop a cohesive genre taxonomy (Aucoeurier & Pachet, 2003).

107 One solution to this problem has been the creation of genre-free models of music preference.
108 Rentfrow, Goldberg, and Levitin (2011) sought to re-conceptualize music preference by focusing
109 on underlying musical features. The authors first developed preference factors based on
110 participants' ratings of heard stimuli and then had judges assign attributes to the excerpts including
111 musical and genre-based attributes. The five factors they defined were labeled Mellow,
112 Unpretentious, Sophisticated, Intense and Contemporary. Recently, Greenberg et al. (2016)
113 developed a three-factor solution using two familiar musical aspects—Arousal and Valence—and a
114 third called Depth, which seems to be related to complexity and intellectual engagement. Openness
115 positively correlated with a liking for Depth, and that some facets of Extraversion were correlated
116 with liking for higher Arousal in music.

117 Though such models are undoubtedly very useful to music researchers, discarding genre-
118 labels entirely within the measurement of preference may make the results less understandable and
119 relevant for the everyday music listener. While few people would likely describe their own musical
120 tastes in terms of arousal, valence and depth, genre is still common in average listeners' concepts of
121 musical style (Lamere, 2008). Rentfrow and Gosling (2003) assessed participants' familiarity with
122 70 genres and subgenres and found that the majority were familiar with broad genres but very few
123 were familiar with all subgenres, suggesting genres are indeed a useful unit of measurement in
124 preference. At the time, a new online phenomenon was only just becoming popular, and thus not yet
125 available to researchers as a possible solution to the genre problem: social tagging (Lamere, 2008;
126 Sordo, Celma, Blech, & Gaus, 2008).

127 Social tags may be defined as “free text labels that are applied to items such as artists, albums
128 and songs” (Lamere, 2008, pp 101). Music-listening platforms such as Last.fm allow users to apply
129 tags for purposes such as assisting in the retrieval of specific songs or groups of songs, organizing
130 libraries, and documenting categories and opinions for social use. Sixty-eight percent of such tags
131 of music are related to genre. Songs, artists, or albums may be tagged with multiple genres; thus, a
132 song combining elements of Folk, Rock and Jazz can be tagged as all three without conflict
133 (Lamere, 2008). Data from social tagging has been used, for example, in the development of
134 automatic music recommendation systems (Bu et al., 2010), in the automatic classification of music
135 according to mood and emotional content (Hu & Downie, 2010; Saari et al., 2013; Saari & Eerola,
136 2014), and in developing hierarchical genre taxonomies, sometimes called “folksonomies” (Sordo
137 et al., 2008). Song, Dixon, Pearce, and Fazekas (2013) successfully used social tags to select music
138 stimuli for a study on music and emotion, but, at the time of writing, the authors know of no studies
139 in which social tags have been used to select stimuli for the study of music preference.

140 The current study therefore aimed to replicate previous findings and address uncertainties in
141 the relationships between music preference and personality, by employing a data-driven approach to
142 stimuli selection using social tags to identify genres. The following hypotheses were tested:

143 H1) There will be a strong relationship between STOMP scores and the preference rating of
144 stimuli of the same genre as identified by social-tagging.

145 H2) Principal Component Analysis of music preference using social-tagging selected stimuli
146 will corroborate previous findings regarding factors of music preference.

147 H3) Previous findings regarding music preference and personality will be corroborated using
148 social-tagging selected stimuli.

149 **Methods**

150 **Participants**

151 Participants ($n = 210$) were recruited using University student and departmental e-mail lists
152 and social media to complete an online survey and listening experiment. They ranged in age from
153 19 to 68 years ($M = 29.4$, $SD = 10.3$) and were from 18 different countries. The most represented
154 countries were Finland (69%), the United States (7.6%), Germany (6.7%) and Canada (6.7%). The
155 majority were well educated, with 71% holding a Bachelor's or Master's degree. Forty-nine percent
156 of participants had received some musical training during their lifetimes. Participants were entered
157 into a lottery to win one of ten movie tickets (relevant to participants living in Finland only), and
158 were also given feedback about their music preferences and personality upon completing the
159 survey. Participants who completed the survey were also given the chance to sign up for a motion
160 capture experiment for which they would earn two free movie tickets.

161 **Stimuli**

162 As survey results were intended for use in a larger study involving music preference and
163 music-induced movement, one requirement for stimuli was that they were suitable for dancing. A
164 revised and updated version of the STOMP (the STOMP-R) is available online and was used as a
165 starting point for genre selection ("Short Test Of Music Preferences (STOMP) | Gosling," n.d.).
166 This version includes genres not found in the original STOMP such as Reggae and Gospel, thus
167 providing a broader initial pool of genres from which to choose. Genres that were not suitable for
168 dancing (e.g., Classical, Opera) were eliminated, as were genres that were not thought to be relevant
169 to a primarily Finnish population. Religious music was eliminated as European students have been
170 found to be significantly less religious than students in North America (Höllinger & Smith, 2002),
171 while World Music was, of the genres examined by Purhonen et al. (2009), the least likely to have
172 been heard by Finns at all. These eliminations resulted in the choice of 16 initial genres:
173 Alternative, Bluegrass, Blues, Country, Dance/Electronica, Folk, Funk, Heavy Metal, Jazz, Oldies,
174 Pop, Punk, Rap/Hip-Hop, Reggae, Rock, Soul/R&B.

175 Three online sources were accessed to collect the stimulus set: Last.fm, the Echo Nest API²
176 and 7digital API. The initial stimulus set, which was collected in Saari & Eerola (2014), consisted
177 of approximately 1,300,000 tracks, which were associated with 924,000 unique Last.fm tags. As
178 identifying stimuli appropriate for a motion capture experiment was a principal aim of the process,
179 a set of tags assumed to relate to danceability of a track were identified from the unique tags. For
180 the identification, those tags that included "danceable", "dancing", "head banging", or
181 "headbanging" as a separate phrase were considered. Consequently, tracks associated with any of
182 these tags were retained in the set. Tracks strongly associated with genre tags were also retained. In
183 order to obtain distinct genre subsets, tracks strongly associated to more than one of the genre tags
184 were discarded. Next, the stimulus set was balanced in terms of genres by retaining no more than
185 200 tracks for each genre tag, which led to a set of 2407 tracks.

186 In the next stage of the stimulus selection, the Echo Nest and 7digital APIs were accessed.
187 First, tracks were matched against the Echo Nest and 7digital catalogues based on the artist names
188 and track titles, and tracks found in both of the catalogues were retained. Tracks without an audio
189 preview available from 7digital were discarded. The danceability of the tracks was validated by
190 retaining only those tracks having non-zero danceability according Echo Nest, a measure based on
191 computational extraction of the acoustic features of each track. Moreover, uniformity of the
192 stimulus set in terms of tempo was ensured by including only tracks having tempo between 118 and
193 132 BPM (beats per minute) as estimated by the Echo Nest; that is, ± 12 BPM of preferred
194 spontaneous tempo (Repp & Su, 2013). To further narrow down the set, one track per artist was
195 randomly selected, resulting in a set of 489 tracks from unique artists. Finally, four tracks were
196 randomly subsampled from each genre, and genres having less than four tracks were excluded. This
197 resulted in a set of 56 tracks from 14 genres.

² Since the data collection, the Echo Nest API has been taken down, but similar functionality exists in the Spotify Web API (<https://developer.spotify.com/web-api/>)

198 Excerpts were listened through by the authors to check for tempo and consistency of style.
199 Excerpts representing Alternative and Folk were judged to be less suitable for dancing, due to
200 inconsistent beat clarity and tactus levels, and were eliminated from the final stimuli set. The
201 remaining 48 stimuli were used in the online listening experiment.

202 **Personality Measures**

203 FFM traits were measured using the Ten-Item Personality Inventory (TIPI), developed and
204 validated by Gosling, Rentfrow and Swann (2003) and further validated by Ehrhart et al. (2009).
205 This short test was chosen over longer versions in order to keep the total length of the survey within
206 reason. In addition to personality, trait empathy and trait systemizing were also measured, as these
207 traits have recently been shown to have some relationships with music preference (e.g., Greenberg et
208 al., 2015). Empathy is a complex psychological process involving observation, memory, knowledge
209 and reasoning, which allow for the understanding of others' emotions and perceptions (Decety &
210 Jackson, 2004; Zahavi, 2010). It comprises both cognitive and affective processes (Harari, Shamay-
211 Tsoory, Ravid, & Levkovitz, 2010; Shamay-Tsoory, Tomer, Goldsher, Berger, & Aharon-Peretz,
212 2004). The Empathy Quotient (EQ), developed by Baron-Cohen and Wheelwright (2004), measures
213 trait empathy as a whole, including both cognitive and affective aspects. Trait systemizing,
214 measured by the Systemizing Quotient (SQ) can be defined as a drive or tendency to think
215 analytically and in terms of systems; that is, in terms of predictable input, operation and output
216 (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). Although trait systemizing
217 and trait empathy vary independently of each other (rather than representing two opposite poles of a
218 single trait), more than half of normal adults have been found to be stronger in one trait than the
219 other (Lawson, Baron-Cohen, & Wheelwright, 2004). For the current study, trait empathizing and
220 systemizing were measured using short-form versions of the EQ and SQ, developed and validated
221 by Wakabayashi et al. (2006).

222 **Procedure**

223 The survey was administered using Survey Gizmo (www.surveygizmo.eu). Participants were
 224 informed via an introduction page that their data would be kept private and used anonymously.
 225 They were also informed that they would be listening to musical excerpts, and it was suggested that
 226 they complete the survey in a quiet place using headphones. The TIPI, ES and SQ were filled out
 227 prior to the listening experiment.

228 For the listening experiment, 30-second clips, including a one second fade-in and one second
 229 fade-out, were presented to participants in a randomized order. Participants rated their liking for the
 230 heard stimuli on a seven-point Likert scale. Participants could listen to an excerpt more than once.
 231 After rating all 48 excerpts, participants then completed a version of the STOMP-R including only
 232 the 12 genres used in the experiment. Data analysis was carried out using MATLAB and SPSS.

233 Results

234 As a first step, independent sample *t*-tests were used to determine whether there were
 235 differences in personality between participants with and without musical training, since previous
 236 research has shown that high levels of Openness predict involvement in music and the arts
 237 (Rawlings & Ciancarelli, 1997). Results showed no significant differences in personality, trait
 238 empathy or trait systemizing between participants with and without musical training (*p* ranged from
 239 .07 to .91). However, *t*-tests revealed some differences between participants with and without
 240 musical training in STOMP-R scores, shown in Table 1. Results suggested musicians liked Jazz,
 241 Blues and Funk more than non-musicians while non-musically trained participants liked Metal
 242 more than those with musical training.

243 *Table 1: Significant T-test results for STOMP-R (DF = 208)*

Genre	Musicians	Non-Musicians	<i>T</i> -statistic	<i>p</i> -value
Jazz	(M = 5.14, SD = 1.47)	(M = 4.46, SD = 1.80)	-2.98	< .01
Blues	(M = 5.12, SD = 1.28)	(M = 4.62, SD = 1.57)	-2.51	<.05
Funk	(M = 4.60, SD = 1.47)	(M = 4.19, SD = 1.52)	-2.01,	<.05

Metal (M = 3.48, SD = 2.16) (M = 4.14, SD = 2.29) 2.13, < .05

244

245 The results of the excerpt rating task indicated that, although there was a tendency towards
 246 this same pattern of differences between musicians and non-musicians as in the STOMP-R, the only
 247 difference that remained significant was that musically trained participants (M = 4.46, SD = 1.40)
 248 rated the Jazz excerpts higher than non-musically trained participants (M = 3.39, SD = 1.44), $t(208)$
 249 = -2.92, $p < .01$.

250 Table 2 shows the distribution of STOMP-R scores. Correlation was run to examine the
 251 relationship between STOMP-R scores and excerpt ratings. As shown in Table 1, all STOMP
 252 genres correlated significantly and positively with mean excerpt ratings for each genre, with the
 253 highest correlation being between Metal scores ($r = .84$) and the lowest being between Funk scores
 254 ($r = .37$), suggesting that the chosen excerpts did indeed reflect the intended genres.

255 *Table 2. Correlation between STOMP scores and mean excerpt ratings for each genre.*

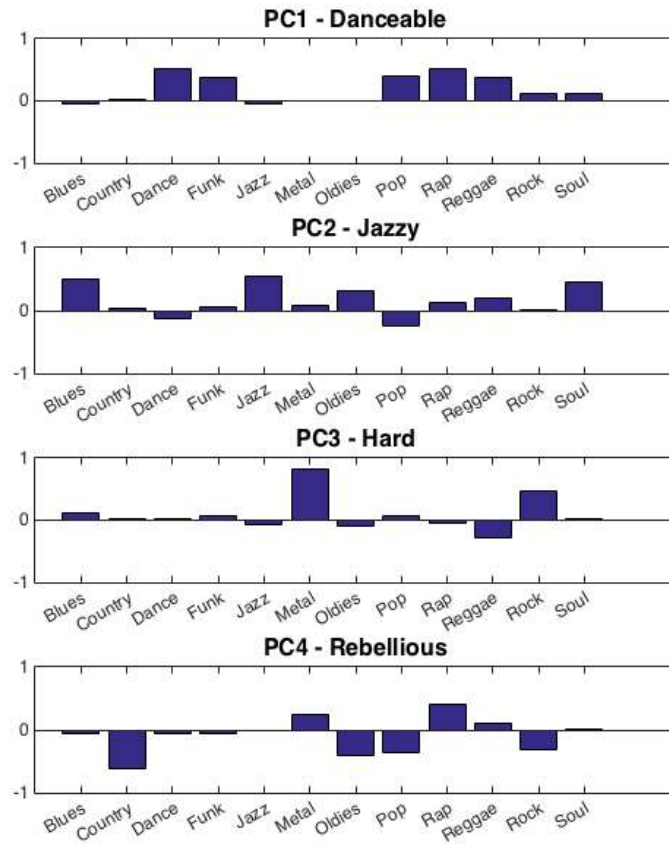
Genre	Pearson's r (DF = 208)	p -value
Blues	.61	<.001
Country	.69	<.001
Electronica/Dance	.53	<.001
Funk	.37	<.001
Jazz	.71	<.001
Metal	.84	<.001
Oldies	.53	<.001
Pop	.55	<.001
Rap	.70	<.001
Reggae	.60	<.001
Rock	.38	<.001
Soul	.48	<.001

256

257 To assess the relationships between genre preferences and to reduce the number of variables
 258 prior to further analysis, Principal Component Analysis (PCA) was run on the mean excerpt ratings.

259 To simplify the interpretation, components were then rotated to align with coordinates using
 260 varimax rotation, the results of which can be seen in Figure 1.

261 <<<Insert Figure 1 about here>>>



262

263 *Figure 1: Principal Component Analysis, Varimax Rotation Results*

264 Four components that collectively accounted for 75.5% of the total variance were retained for
 265 further analysis. The first component accounted for 39.9% of the variance and included high
 266 positive loadings on Pop, Dance and Funk; this component was therefore labeled Danceable. The
 267 second component accounted for an additional 16% of the variance and included high positive
 268 loadings on Blues, Jazz and Soul; this component was labeled Jazzy. The third component
 269 accounted for 10.6% of the variance and included a very high positive loading on Metal and a
 270 moderately high loading on Rock; this component was therefore labeled Hard. The fourth

271 component accounted for 8.96% of the variance and included a high positive loading for Rap/Hip-
272 Hop and high negative loadings for Country and Oldies and a moderate negative loading for Pop;
273 this component was therefore described as Rebellious.

274 TIPI, EQ and SQ scores were correlated with component scores to assess relationships
275 between personality and music preference. Liking for Danceable music was weakly positively
276 correlated with Neuroticism ($r = .14, p < .05$). Liking for Jazzy music was positively correlated with
277 Openness ($r = .20, p < .01$) and negatively correlated with Conscientiousness ($r = -.17, p < .05$).
278 Liking for Hard music was negatively correlated with EQ score ($r = -.17, p < .05$), negatively
279 correlated with Openness ($r = -.21, p < .01$) and negatively correlated with Extraversion ($r = -.16, p$
280 $< .05$). Liking for Rebellious music was positively correlated with SQ score ($r = .16, p < .05$) and
281 negatively correlated with Agreeableness ($r = -.21, p < .01$).

282 As very little previous research has been done exploring relationships between trait empathy,
283 trait systemizing and music preference, correlations between EQ and SQ scores and STOMP-R
284 scores were also carried out to assess possible relationships in further detail. EQ score was
285 positively correlated with liking for Blues ($r = .19, p < .01$), liking for Funk ($r = .25, p < .001$) and
286 Soul ($r = .25, p < .001$). There were no significant correlations between SQ scores and STOMP-R
287 ratings.

288 **Discussion**

289 The current study examined relationships between music preferences and individual
290 differences in personality, empathy and systemizing, using a novel, data-driven approach to excerpt
291 selection. Previous music preference research involving listening tasks have employed industry
292 standards (Dunn et al., 2012) and expert suggestion (Delsing et al., 2008; Rentfrow, Goldberg, &
293 Levitin, 2011) to identify stimuli that are representative of desired musical genres, but this is, to the
294 knowledge of the authors, the first attempt to use social tagging to identify such stimuli. Analysis
295 showed correlations between participants' ratings of genres via the STOMP-R and their ratings of

296 the selected stimuli, suggesting that the stimuli were indeed representative of the desired genres.
297 Although not directly comparable, it is worth noting that the majority of these correlations were
298 noticeably higher than those found comparing STOMP-R ratings to participants' time spent
299 listening to expert-selected stimuli (Dunn et al., 2012, pp 12). That participants' overall ratings of
300 genres were higher than their rating of the excerpts indicates some room for improvement in the
301 current method. However, it is unlikely that any small set of excerpts can adequately account for all
302 ambiguity and differences in genre perception. The heard excerpts may simply not have reflected all
303 participants' preferences within their preferred genres in general or in relation to a specific element
304 of the excerpt, such as the lyrics or specific artist.

305 As the current data were collected in the context of a larger dance experiment, the included
306 genres were limited to those that one could easily dance to and thus not directly comparable to
307 previous works examining underlying factors of music preference. However, PCA did reveal
308 similarities between the current data and previous findings, as well as some unique insights. The
309 component labeled Jazzy is virtually identical to the component found by Dunn et al. (2012),
310 labeled Rhythm 'n' Blues. The component labeled Hard is similar to a component Dunn et al.
311 named Hard Rock, and also somewhat similar to Rentfrow and Gosling's (2003) Intense and
312 Rebellious factor. The Danceable component includes some of the same elements and Rentfrow and
313 Gosling's Energetic and Rhythmic factor, namely Funk and Electronica/Dance, but for both
314 Rentfrow and Gosling as well as Dunn et al., Pop loaded onto a different component from these,
315 suggesting that the Danceable component describes a broader range. Dunn et al. found Pop to be
316 grouped with Soundtracks in a Soft Rock component; Rentfrow and Gosling found it to be grouped
317 with Country and Folk in the Upbeat and Conventional. These differences may also reflect that
318 participants do not perceive clear boundaries for Pop, or that their conceptions of what constitutes
319 Pop may be quite broad. It is also possible, since the current dataset did not include genres like
320 Folk, Religious or Soundtracks, that the musical features Pop shares with Funk and Dance, such as

321 tempo and instrumentation, were more prominent for participants in determining similarity than
322 were extra-musical social factors such as social significance.

323 Social significance could, however, be important in the final component identified in the
324 current paper: Rebellious. This component included a positive loading on Rap/Hip-Hop along with
325 notably negative loadings on Country and Oldies, and a moderately negative loading for Pop, all of
326 which are classified under ‘Upbeat and Conventional’ according to the latest version of the
327 STOMP-R (“Short Test Of Music Preferences (STOMP) | Gosling,” n.d.). Although it would be
328 foolish to suggest that no individual could enjoy both Rap and Country music, it is interesting to
329 consider that dimensions of music preference might simultaneously include likes and dislikes.
330 Dislikes have been implied by previous research in that preference components are treated as
331 bipolar (i.e. a negative correlation between Conscientiousness and liking for Jazz interpreted as
332 conscientious people *disliking* Jazz), but disliking has not been as thoroughly researched as liking.
333 It is possible that in the current study’s Rebellious component, strong dislike of particular genres
334 (e.g., Country) may have sociological bases that overshadow simple hedonic reactions to acoustic
335 signals (Bryson, 1996). Both Rap/Hip-Hop and Country are often associated with mainstream
336 American culture and complex historical and socioeconomic extra-musical factors therein (Mann,
337 2008; Shevy, 2008; Sullivan, 2001; Watkins, 2001), and while cannot assume the same associations
338 for a Finnish population, Tervo (2014) suggests Rap/Hip-Hop has been adapted by Finnish culture
339 and maintains themes of marginalization and oppression (albeit sometimes humorously). Purhonen
340 et al. (2009), however, found socioeconomic variables like education and income explained very
341 little variance in liking for Hip-Hop and Electronic music, but that there were significant negative
342 correlations between education and liking for their music dimension Popular Folk (similar in many
343 ways to Rentfrow and Gosling’s Upbeat and Conventional; see Purhonen et al., Table 2, pp 43 for
344 details), as well as positive correlations between liking for this dimension and living in ‘Village’ or

345 'Country' areas, suggestive of socio-cultural influences at least for the negative loadings on the
346 current Rebellious factor.

347 The relationships between personality and music preferences somewhat supports previous
348 work. The positive correlation between Openness and liking for Jazzy music replicates previous
349 findings linking Openness to preference for more complex music (Brown, 2012; Dunn et al., 2012;
350 George et al., 2007; Greenberg et al., 2016; Langmeyer et al., 2012; Rentfrow & Gosling, 2003)
351 corroborating evidence of this relationship being relatively stable across different samples. Dunn et
352 al. (2012), also found a negative relationship between Conscientiousness and liking for Jazz,
353 suggesting that this relationship, while not as strongly supported as the former, may not be spurious.

354 Liking for Hard music was negatively correlated with Openness, which contradicts previous
355 findings associating Openness with liking for genres such as Rock, Hard Rock, Alternative and etal
356 (Delsing et al., 2008; Dunn et al., 2012; Rentfrow & Gosling, 2003). One explanation, given the
357 relatively correlation between excerpt ratings (.38) with STOMP-R scores for Rock, may be that the
358 excerpts did not accurately reflect listeners' perceptions of the genre. However, the correlation
359 between STOMP-R and mean excerpt scores was the highest (.86) for Metal, which also had the
360 highest loading for this dimension and was probably the main driver of results. Previous research
361 has taken place in the United States, Holland and Japan, but current study is, to the authors'
362 knowledge, the first large study of music preference and personality to be conducted from Finland,
363 which supposedly boasts the largest number of metal bands per capita in the world ("A World Map
364 of Metal Bands Per Capita - The Atlantic," n.d.). Notably fewer people dislike Metal in Finland
365 than in the U.K. (Purhonen et al., 2009). Since previous research has found a relationship between
366 familiarity and liking (e.g., North & Hargreaves, 1995), the Finnish population may be predisposed
367 to enjoy Metal more than other populations due to exposure. It is probable that liking for Metal is
368 perceived as less unusual in Finland than in other parts of the world, as one would not need to be
369 particularly open to new experience in order to become familiar with the genre.

370 Liking for Rebellious music (which, as discussed above, can also be conceived of as a dislike
371 for conventional music such as Country and Oldies) was negatively correlated with Agreeableness.
372 This is in line with Rentfrow and Gosling's (2003) finding that Agreeableness was positively
373 correlated with liking for Upbeat and Conventional music, including Country and Oldies, although
374 contrary to their finding that Agreeableness was associated with liking for Energetic and Rhythmic
375 music, including Hip-Hop and Rap. This may have to do with the relationship of Rap/Hip-Hop and
376 Country within the current study's PCA components, but could also be due to differences between
377 Finland and the United States in terms of the perceived social significance and popularity of
378 Rap/Hip-Hop. Liking for Danceable music was slightly positively correlated with Neuroticism.
379 Both Brown (2012) and Langmeyer et al. (2012) found positive correlations between Neuroticism
380 and liking for Pop, which loaded strongly onto the Danceable component in the current research. As
381 Neuroticism is associated with a tendency to experience negative feelings (Haas et al., 2008;
382 Letzring & Adamecik, 2015; Mezquita et al., 2015), this association may reflect participants' use of
383 music in mood regulation (Koelsch, 2010; Saarikallio, 2011; Saarikallio & Erkkilä, 2007), although
384 the effect is small.

385 Although far less has previously been written regarding empathy, systemizing and music
386 preference, the current results do somewhat support previous findings. Empathy was associated
387 with decreased liking for Hard music, while liking for Rebellious music was positively correlated
388 with systemizing. Although not identical to Greenberg's (2015) finding that high empathizers
389 preferred Mellow music (e.g., Soft Rock, Jazz, Soul) while high systemizers preferred Intense music
390 (e.g., Rock, Metal), the current results do not conflict with these findings. One could suspect, for
391 example, that a person who dislikes harder music such as Metal may prefer mellower sounds, while
392 a person who enjoys understanding patterns and complex systems might be easily bored by
393 structurally simple music. Furthermore, analysis of STOMP-R results for individual genres revealed
394 that empathy was indeed positively correlated with liking for Blues, Funk and Soul, more directly

395 corroborating Greenberg's previous finding. Given the current study's tempo restrictions (all
396 excerpts were between 118 and 132 BPM), it is perhaps unsurprising that we were unable exactly
397 replicate Greenberg's work regarding Mellow music, as one character of this factor is slower
398 tempos, which were not available in the current stimuli set.

399 In general, the strengths of the correlations found in the current study were weak to moderate,
400 which is in line with virtually all previous work exploring the relationships between personality
401 traits and music preferences (Brown, 2012; Delsing et al., 2008; Dunn et al., 2012; Greenberg et al.,
402 2015, 2016; Langmeyer et al., 2012; Rentfrow & Gosling, 2003; Zweigenhaft, 2008). Nevertheless,
403 the replication of many of these findings seems to indicate that a genuine effect is there to be
404 detected. That the effect remains small, and that there are also many inconsistencies to be found
405 between studies seems to indicate that there are other significant factors beyond personality which
406 have an effect on music preferences. Some, such as the truly unique experiences of individuals
407 which help to shape their tastes, are likely impossible to quantify and may be best studied
408 qualitatively. Still, as the current results suggest, cultural and social contexts may influence the
409 relationships of traits to preferences. Schäfer and Sedlmeier (2009) have suggested that the
410 functionality of music to an individual may play an important role in determining music preference,
411 including social functionality. Rentfrow and Gosling's (2006; 2007) findings suggest that music
412 preference can be used in social signaling. Understanding and accounting for such influences in
413 future research may result in a clearer and more consistent picture of the effects of personality and
414 other individual differences on music preferences.

415 The information gained from social tagging of music, shown here to be an effective means of
416 identifying music stimuli that are representative of specific genres, could also be used to gain
417 further insight into music preference. Social tagging has been used, for example, to examine
418 perceived emotional content in music (Saari et al., 2013; Saari & Eerola, 2014), which could
419 provide important contextual information about preferences. Due to the unrestricted nature of most

420 tagging platforms, social tags can also include locations (e.g., “San Francisco” could indicate a band
421 local to or popular in that area), information about specific instrumentation (e.g., “Female vocals” or
422 “Erhu”), and popular opinions (e.g., “Amazing” or “Your Ears Will Bleed”), all of which could also
423 be used in further research into individual music preferences (Lamere, 2008).

424 The results of the current study should be replicated and expanded with fewer restrictions
425 regarding dancability and tempo, and with more control over potentially influential factors such as
426 the affective content of lyrics, and with different populations. Further study is also needed to gain
427 understanding into how individual traits beyond personality, such as empathy and systemizing are
428 related to the kinds of music we like best. As the current study demonstrates, there is plenty of room
429 for continued innovation in how we approach the study of this rich and complex topic.

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Appendix: Track list

Genre	Artist	Track	Excerpt
Blues	Tom Waits	Big, Black Mariah (Live)	0:30 - 1:00
Blues	The Paul Butterfield Blues Band	Mystery Train	0:24 - 0:54
Blues	Ray Charles	I Got A Woman (Live at Newport Jazz)	2:40 - 3:10
Blues	Keb' Mo'	She Just Wants to Dance	0:32 - 1:02
Country	Dixie Chicks	Goodbye Earl	0:30 - 1:00
Country	Faron Young	Goin' Steady	1:04 - 1:34
Country	Brooks & Dunn	My Maria	0:38 - 1:08
Country	Martina McBride	Independence Day	0:49 - 1:19
Dance/Electronica	Betty Boo	Doin' The Do (Radio Mix)	2:16 - 2:46
Dance/Electronica	ThouShaltNot	Come A Time	0:30 - 1:00
Dance/Electronica	M People	Sight For Sore Eyes (Dance Remix)	0:40 - 1:10
Dance/Electronica	Lady GaGa	LoveGame (The Gaga Bender Mix)	2:18 - 2:48
Funk	Dazz Band	Let It All Blow	0:30 - 1:00
Funk	Groove Collective	Everything Is Changing	0:30 - 1:00
Funk	Marcia Griffiths	Electric Boogie	0:44 - 1:14
Funk	The Bar-Keys	Freakshow on the Dance Floor	0:46 - 1:16
Jazz	Jimmie Lunceford	Lunceford Special	0:53 - 1:23
Jazz	Sidney Bechet	Muskrat Ramble	0:06 - 0:36
Jazz	The Jazz Crusaders	Tough Talk (2003 Remaster)	1:03 - 1:33
Jazz	Fatima Spar und die Freedom Fries	Egyptian Ella	1:30 - 2:00
Metal	Metallica	Until It Sleeps	0:30 - 1:00
Metal	Lamb of God	Redneck	1:16 - 1:46
Metal	My Fate	Sinking	0:28 - 0:58
Metal	White Zombie	Thunder Kiss	0:31 - 1:01
Oldies	The Archies	Sugar, Sugar	0:30 - 1:00
Oldies	Maurice Williams and The Zodiacs	Stay	0:31 - 1:01
Oldies	The Del-Vikings	Whispering Bells	0:38 - 1:08
Oldies	Anne-Margret	Slowly	0:50 - 1:20
Pop	Geri Halliwell	Bag It Up	1:25 - 1:55
Pop	Christina Aguilera	Come On Over	0:30 - 1:00
Pop	The Feeling	Love it When You Call	0:38 - 1:08
Pop	Duran Duran	Want You More!	0:48 - 1:18
Rap/Hip-Hop	Dizzee Rascal	Dance Wiv Me	1:38 - 2:08
Rap/Hip-Hop	Run-DMC, Jason Nevins	It's Like That	0:37 - 1:07
Rap/Hip-Hop	The Sugarhill Gang	8 th Wonder	2:07 - 2:37
Rap/Hip-Hop	DJ Laz	Move Shake Drop (Remix)	0:30 - 1:00

Reggae	Bob Marley	Jah Live	0:30 - 1:00
Reggae	Culcha Candela	Partybus	0:35 - 1:05
Reggae	Sean Paul	Temperature	0:32 - 1:02
Reggae	Shaggy	Oh Carolina	0:43 - 1:13
Rock	Supergrass	Mary	1:30 - 2:00
Rock	Sting	If You Love Somebody Set Them Free	1:38 - 2:08
Rock	Billy Idol	Don't You (Forget About Me)	0:15 - 0:45
Rock	The Cardigans	Godspell	0:30 - 1:00
Soul/R&B	Aretha Franklin	Eleanor Rigby	0:45 - 1:15
Soul/R&B	James Brown	Let Yourself Go	0:30 - 1:00
Soul/R&B	Wilson Pickett	In The Midnight Hour	0:40 - 1:10
Soul/R&B	Boyz II Men	Under Pressure	0:30 - 1:00

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Note: All tracks were accessed as audio previews from 7digital. For ease of editing, some tracks also purchased privately. Please contact the author to request exact copies of the stimuli.