French validation of the Barcelona music reward questionnaire

Joe Saliba, Urbano Lorenzo-Seva, Josep Marco-Pallares, Barbara Tillman, Anthony Zeitouni, Alexandre Lehmann

Background. The Barcelona Music Reward Questionnaire (BMRQ) questionnaire investigates the main facets of music experience that could explain the variance observed in how people experience reward associated with music. Currently, only English and Spanish versions of this questionnaire are available. The objective of this study is to validate a French version of the BMRQ. **Methods.** The original BMRQ was translated and adapted into an international French version. The questionnaire was then administered through an online survey aimed at adults aged over 18 years, fluent in French. Statistical analyses were performed and compared to the original English and Spanish version for validation purposes. **Results.** A total of 1027 participants completed the questionnaire. Most responses were obtained from France (89.4%). Analysis revealed that congruence values between the rotated loading matrix and the ideal loading matrix ranged between .88 and .96. Factor reliabilities of subscales (i.e., Musical Seeking, Emotion Evocation, Mood Regulation, Social Reward and Sensory-Motor) ranged between .88 and .96. In addition, reliability of the overall factor score (i.e., Music reward) was .91. Finally, the internal consistency for the overall scale was .85. The factorial structure obtained in the French translation was similar to that of the original Spanish and English samples. **Conclusion.** The French version of the BMRQ appears valid and reliable. Potential applications of the BMRQ include its use as a valuable tool in music reward and emotion research, whether in healthy individuals or in patients suffering from a wide variety of cognitive, neurologic and auditory disorders.

1   **French Validation of the Barcelona Music Reward Questionnaire**

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15

16   Abstract

17

18   **Background.** The Barcelona Music Reward Questionnaire (BMRQ) questionnaire investigates the main

19   facets of music experience that could explain the variance observed in how people experience reward

20   associated with music. Currently, only English and Spanish versions of this questionnaire are available.

21   The objective of this study is to validate a French version of the BMRQ.

22   **Methods.** The original BMRQ was translated and adapted into an international French version. The

23   questionnaire was then administered through an online survey aimed at adults aged over 18 years, fluent

24   in French. Statistical analyses were performed and compared to the original English and Spanish version

25   for validation purposes.

26   **Results.** A total of 1027 participants completed the questionnaire. Most responses were obtained from

27   France (89.4%). Analyses revealed that congruence values between the rotated loading matrix and the

28   ideal loading matrix ranged between .88 and .96. Factor reliabilities of subscales (i.e., Musical Seeking,

29   Emotion Evocation, Mood Regulation, Social Reward and Sensory-Motor) ranged between .88 and .96. In

30   addition, reliability of the overall factor score (i.e., Music reward) was .91. Finally, the internal

31   consistency of the overall scale was .85. The factorial structure obtained in the French translation was

32   similar to that of the original Spanish and English samples.

33   **Conclusion.** The French version of the BMRQ appears valid and reliable. Potential applications of the

34   BMRQ include its use as a valuable tool in music reward and emotion research, whether in healthy

35   individuals or in patients suffering from a wide variety of cognitive, neurologic and auditory disorders.

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54 **Introduction**

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56 The potential rewarding effects of music have been described in recent reports (Blood & Zatorre,

57 2001; Chanda & Levitin, 2013). For most people, music can have positive effects on mood,

58 social interactions and positive affect (Juslin & Västfjäll, 2008). A growing body of evidence

59 points towards the contribution of dopamine and opioids pathways in musically induced pleasure

60 (Blood & Zatorre, 2001; Brown, Martinez & Parsons, 2004; Menon & Levitin, 2005). Both

61 fMRI and PET studies have shown that the Nucleus Accumbens and other structures in the

62 mesocorticolimbic system are crucial to the musical reward experience (Jeffries, Fritz & Braun,

63 2003; Menon & Levitin, 2005). Previous reports have also revealed heightened sympathetic

64 nervous system activity during musical enjoyment, indicating an association between objective

65 measures of arousal and subjective feelings of pleasure (Salimpoor et al., 2009; Zatorre &

66 Salimpoor, 2013). Moreover, Goldstein (1980) has demonstrated that the physical responses

67 accompanying musical pleasure – shivers, thrills, chills – can be blocked by naloxone, a known

68 opioid antagonist (Goldstein, 1980).

69 While the neurochemistry of musical reward has been the subject of numerous papers in recent

70 years, little is known about the inter-individual variability in music-induced reward. Previous

71 groups have developed questionnaires – such as the BIS/BAS scales (Carver and White, 1994) or

72 the Sensitivity to Reward/Sensitivity to Punishment Questionnaire (Torrubia, 2001) – that assess

73 individual differences to overall sensitivity to reward experiences (Carver & White, 1994;

74 Torrubia et al., 2001). However, music is considered as a higher-order pleasure and as such,

75 might involve different processing mechanisms than basic rewards (Menon & Levitin, 2005). In

76 addition, previous studies have supported a dissociation of music rewarding experience from

77   other rewarding experiences related to other types of primary and secondary reinforcements,

78   such as food, sex and money among others (Mas-Herrero et al., 2014). In light of these findings,

79   the Barcelona Music Reward Questionnaire (BMRQ) was developed by Mas-Herrero et al.

80   (2013). This questionnaire is specifically geared towards assessing sensitivity to music reward

81   and was a welcome addition to a limited choice of behavioral tools suitable for music reward

82   studies. The BMRQ can serve as a valuable research tool in psychophysical studies addressing

83   music reward in healthy individuals, hearing-impaired individuals or individuals affected with

84   other conditions or pathologies. To date, only Spanish and English versions of this questionnaire

85   are available in the literature, limiting its application. With over 200 million speakers worldwide,

86   French is one of the most common languages in the world. It is the official language of 29

87   countries, and the second-most widely learned foreign language in the world after English

88   (L'observatoire de la langue française, 2014). French also has a role to play in global

89   communication: international French media channels reach over 100 million people weekly

90   (L'observatoire de la langue française, 2014). In countries with several official languages

91   including French such as Canada, Morocco and Senegal, it is all the more important for research

92   tools to be available in all official languages to adequately test the population. In that context, a

93   French version of the BMRQ was required to meet the needs of the numerous researchers in the

94   French-speaking areas of the world. In this paper, we sought to translate the Barcelona Music

95   Reward Questionnaire into an international French and to assess its construct validity and

96   reliability.

97

98   **Materials and Methods**

99

100   The Barcelona Music Reward Questionnaire

101

102   The BMRQ examines five main facets that characterize musical reward experience in

103   individuals: musical seeking, emotion evocation, mood regulation, social reward and sensory-

104   motor. The questionnaire contains 20 statements equally divided among these five facets.

105   Participants indicate the level of agreement with each statement by using a five-point scale

106   ranging from ''fully disagree'' (1) to ''fully agree'' (5). The contribution of each facet to the

107   overall music reward experience is quantified by a numerical value obtained upon completion of

108   the survey. A score for global sensitivity to music reward is also provided, computed with a raw

109   addition of all 20-item participants' responses (reverting the scores in items 2 and 5). The mean

110   value of each factor is 50, and the standard deviation is 10. Standard values are therefore located

111   between 40 and 60. Punctuations below 40 indicate low values in this particular facet, whereas

112   values above 60 indicate high values (the same applies to the global sensitivity to music reward)

113   (Mas-Herrero et al., 2013).

114

115   The BMRQ was created in three steps (Mas-Herrero et al., 2013). The first consisted in

116   developing of a short psychometric instrument in Spanish that included various facets of music

117   and reward experiences. This initial instrument included 112 items addressing a variety of

118   activities and situations associated with music reward and pleasure experiences, and was

119   administered to 804 Spanish participants. From the initial pool of 112 items, only 20 were

120   retained for the final version, equally divided among five facets of music reward (music seeking

121   activities, mood regulation, emotion evocation, sensory-motor behavior and social reward).

122   Selection was based on loading values and content and adequacy of the items. The second step

123   involved exploratory and confirmatory factorial analysis of the Spanish BMRQ. The

124   questionnaire with the selected 20 items was administered to a new sample of 605 students in an

125   effort to replicate the previous findings. Analyses revealed a reliable factorial structure for the

126   Spanish BMRQ and an acceptable fit for the hypothesized five facets of music reward. The final

127   step in the development of the BMRQ was its translation and adaptation into English. The

128   translated version was completed by 252 English-speaking participants, and confirmatory

129   factorial analysis was performed to verify the replicability of the factor structure obtained in the

130   Spanish version. The original BMRQ has been shown to be valid with acceptable reliability

131   estimates of factor scores (i.e., a reliability value of .93 for the overall scale, and values between

132   .73 and .93 for the five subscales). The aim of the present study was to replicate this validation

133   for a French adaptation of the BMRQ.

134

135   <u>Questionnaire translation</u>

136

137   The French adaptation of the BMRQ was obtained by double translation. Each item in the

138   original English version of the questionnaire was independently translated by two groups of

139   bilingual (French/English) researchers – in Montreal, Canada and in Lyon, France – whose first

140   language was French. Both groups also had knowledge of the subject matter. The groups were

141   purposely chosen in different geographic areas in order to account for the regional differences in

142   spoken French and hence create an internationally comprehensible French translation. The

143   Spanish questionnaire was used as a reference for disambiguating some wordings. The emphasis

144   was placed on the translation of meaning rather than a literal one. A consensus between the two

145   translator groups was obtained to produce the final French version of the questionnaire. Finally, a

146   third bilingual researcher (French/Spanish) conducted a back translation into Spanish. This

147   researcher was not involved in the initial translation process. This last step ensured the meaning

148   of the adapted French version was concordant with the meaning of the original Spanish

149   questionnaire. The comparison between the source items and the French translation is shown in

150   Appendix 1. The content of the French translation of the BMRQ is reproduced in Appendix 2,

151   along with the complete set of instructions, thus allowing readers for a direct use of this

152   questionnaire tool.

153

154   <u>Data collection and participants</u>

155

156   The questionnaire was administered via an Internet platform (LimeSurvey, McGill University

157   servers) to any participant aged over 18 years and fluent in French. A written electronic consent

158   was obtained for each participant. The survey was made publicly accessible from November

159   2014 to April 2015 and distributed electronically through various academic and healthcare

160   institutions mainly in Europe, North America and Africa, but also in other areas of the world. In

161   order to avoid sampling bias effect, the music focus of the study was not explicitly stated in the

162   test instructions when administered to participants. Prior to completing the survey, participants

163   were also asked to fill out a general demographic and linguistic background questionnaire. This

164   study was approved by the McGill University's Faculty of Medicine Institutional Review Board

165   (#A11-E88-14B).

166

167   <u>Evaluation of the Psychometric Properties of the Translated Version</u>

168

169   In order to assess the structure validity of the test, we used an approach similar to that employed

170   by Mas-Herrero and colleagues in the development of the original questionnaire, as described

171   above (Mas-Herrero et al., 2013). An exploratory factor analysis was carried out using

172   MATLAB, and, for scale analyses, SPSS 22 was used. The polychoric correlation matrix was

173   computed for the 20 items of the translated questionnaire. To control the variance due to this

174   response style factor, we applied the procedure proposed by Lorenzo-Seva and Rodriguez-

175   Fornells (2006) developed for the specific case of non-perfectly balanced scales (see Lorenzo-

176   Seva & Ferrando, 2009). As five content factors were expected, we retained this number of

177   factors using Minimum Rank Factor Analysis (MRFA, Ten Berge & Kiers, 1991). In MRFA, the

178   observed variables are decomposed into common parts and unique parts that satisfy the

179   following requirements: the covariance matrices for common and unique parts are positive

180   semidefinite, and the unique-parts covariance matrix is diagonal. To determine the loading

181   factors related to the five content factors, an oblique semi-specified Procrustean rotation

182   (Browne, 1972) was computed, where the specified values were the loadings on each item that

183   we expected to be zero. Factor scores were computed following the procedure proposed by Ten

184   Berge, Krijnen, Wansbeek and Shapiro (1999). The mean and standardized deviation of items, and

185   the factor weights required to compute these factor scores are available for the use of researchers (in

186   the supplementary materials and on the online test page).

187

188   We computed the reliability estimates for the five scales and the total scale on the basis of the factor

189   scores based on the factor scores reliability (for example, see Mellenbergh, 1994, formula 22 on

190   page 231). To assess internal consistency, we computed Cronbach's alpha for the overall scale.

191

192   **Results**

193

194   A total of 1027 participants voluntarily completed the entire translated questionnaire (Mean age:

195   22.3 ± 7.8 years, females: 64.7%). While participants were mostly from France (89.4%) and

196   Canada (5.1%), 4% of our sample was obtained from 25 other countries such as Cameroun,

197   Senegal and Egypt. Table 1 resumes the demographic statistics of the sample. The majority of

198   our respondents were non-musicians (77.5%). While the questionnaire was primarily advertised

199   in academic institutions, approximately a quarter of our participants did not complete a

200   university degree. Overall, our French sample was similar to the Spanish and English samples in

201   terms of age, gender and music training.

202

203   Table 2 shows the means of items of the French and the Spanish version of the test, and the 95%

204   confidence interval. As can be observed, the differences observed between the mean items in

205   both cultures were not significant.

206

207   Once the polychoric correlation matrix was available, the observed Kaiser-Meyer-Olkin (KMO,

208   Kaiser, 1970) index was computed: the .855 value obtained suggested that the correlation matrix

209   was well suited for factor analysis (see Kaiser & Rice, 1974). The congruence values (Tucker,

210   1951) between the rotated loading matrix and the *ideal* loading matrix ranged from .88 to .96. As

211   the coefficients were all above the threshold of .85, the factor similarity between the rotated

212   loading matrix and the ideal loading matrix was fair (Lorenzo-Seva & Ten Berge, 2006). Table 3

213   shows not only the loading values after rotation, but also the loadings of items on the control scale

214   (i.e., the AC). As can be seen, some of the items loaded on the AC scale. These results reinforced

215   our choice of a model where AC response bias style was controlled. Using this model, we

216   confirmed the loadings of items on the content factors were free of AC. The loading values on the

217   content factor show that the items were well related with the corresponding expected scale.

218

219   In addition, the inter-factor correlation values between content factors ranged between .22 and .32.

220   While these inter-factor correlations are in general slightly lower than the original version of the test

221   by Mas-Herrero (0.22 – 0.46), our results demonstrated that the scales were also correlated in the

222   French adaptation.

223

224   Finally, the reliability estimates computed on the basis of the factor scores of the scales were .93,

225   .96, .88, .91, and .93 for Musical Seeking, Emotion Evocation, Mood Regulation, Social Reward

226   and Sensory-Motor, respectively. None of the reliability estimates obtained in our analyses were

227   below the threshold of .80. In comparison, the corresponding reliability estimates in the original

228   pooled English and Spanish samples were .89, .88, .87, .78, and .93, respectively (Mas-Herrero

229   et al., 2013). Furthermore, the overall test (Music reward) in the French translation showed an

230   acceptable reliability (0.91), concordant with the reported value by Mas-Herrero et al. (0.92).

231   The distribution of the overall test scores (global sensitivity to music reward) using the French

232   translation was centered on a mean of 50, similar to that of the original instrument (Figure 1).

233   Likewise, the internal consistency for the overall French scale was .852, with a 95% confidence

234   interval [.839, .865]. Globally, all our analyses demonstrated that the fit obtained in the French

235   translation was similar to that of the original English and Spanish samples, indicating that the

236   factorial structures are equivalent.

237

238 **Discussion**

239

240 Our study described the translation and adaptation of the BMRQ into French and provided

241 analyses of the psychometric properties of the translated scale. Our results demonstrated that the

242 translated BMRQ has acceptable construct validity while keeping the factorial structure of the

243 original English and Spanish questionnaires. In general, the results that we obtained were similar

244 to those reported by the developers of the original instrument (Mas-Herrero et al., 2013). This

245 suggests that our translation procedure was successful.

246 The geographic distribution of French speakers encompasses over 30 countries throughout all

247 five continents (L'observatoire de la langue française, 2014). With such a diverse speaker

248 population, significant regional differences in the spoken language currently exist. In that

249 context, an internationally acceptable French adaptation of the BMRQ was required to

250 accommodate researchers and clinicians across the French-speaking regions. This translated

251 BMRQ is born from a collaborative work between two bilingual groups in North America

252 (Montreal, Quebec) and Europe (Lyon, France). Efforts were made during the translation process

253 to remove all regional French influences. Each group first independently translated the original

254 English BMRQ into a locally acceptable French. Then, a consensus between the two translators

255 was obtained to produce the final international French version of the questionnaire. We believe

256 this collaboration was necessary to adapt the original BMRQ into a French that would be easily

257 understood by speakers around the French-speaking world. This belief is echoed in our results:

258 over 30 French-speaking countries are represented, and 5.5% of participants learned French in

259 countries other than Canada (Quebec) or France. Finally, our association with the developers of

260 the original Spanish instrument (UL) ensured the French adaptation remained faithful to the

261   initial questionnaire.

262

263   While we collected responses from over 1000 participants, the majority were obtained from

264   France (89.4%). This is partly a reflection of the differences in the number of French speakers

265   between the regions sampled: 6 million in Quebec compared to more than 77 million in the

266   European Union (L'observatoire de la langue française, 2014). In an effort to reduce sampling

267   bias effect, the music focus of the study was not explicitly stated in the test instructions when

268   administered to participants. This can be seen in the number of non-musicians among our

269   participants (77.5%), a proportion that is similar to what has been reported in the original version

270   of the BMRQ. We therefore believe our sample is representative of the general French speaking

271   population and that sampling bias was not significant.

272

273   Previous work by Ayotte (2002) and Peretz (2003) have established that approximately 4% of

274   the population suffers from congenital amusia, a disorder of music processing that hinders their

275   ability to perceive, produce and enjoy music (Ayotte, Peretz & Hyde, 2002; Peretz, Champod &

276   Hyde, 2003). In contrast, some individuals suffer from general anhedonia, a deficit in

277   experiencing pleasure from widely different stimuli, usually in the context of depressive

278   disorders or neurodegenerative diseases such as Parkinson's (Loas et al., 1994; Assogna et al.,

279   2011). Three case studies have also reported a form of acquired anhedonia specific to music that

280   resulted from strokes in limbic structures such as the amygdala, as well as areas of the temporo-

281   parietal cortex, inferior parietal cortex and insula (Mazzoni et al., 1993, Satoh et al., 2011,

282   Griffiths et al., 2004). In those neurologic and psychiatric patients, the use of a standardized tool

283 such as the BMRQ will help determine a loss in the capacity of feeling emotions through music.

284 However, the BMRQ can also be employed to explore music reward in healthy individuals. In

285 fact, a recent report by Mas-Herrero et al. (2014) was the first to identify a group of healthy

286 people for whom music is not rewarding (Mas-Herrero et al., 2014). The term coined - specific

287 musical anhedonia – refers to a unique subset of the population that draws no pleasure at all from

288 music despite being perfectly able to experience pleasure in other ways. Using a stepwise

289 regression analysis, Mas-Herrero et al. found the BMRQ score to be the only predictor of high-

290 pleasure or chill responses in all their participants (compared to other reward scales such as the

291 BIS/BAS). Their work has shown that the ability of music to induce pleasure may not be

292 universal, and that there may be individual differences in access to the reward system (Mas-

293 Herrero et al., 2014). To further understand the neural correlates behind musical pleasure and

294 reward processing, further studies in that population are required and the BMRQ could prove to

295 be a very valuable tool.

296

297 **<u>Conclusion</u>**

298

299 The French version of the BMRQ appears valid and reliable. The addition of the French

300 adaptation to the previously available English and Spanish versions significantly increases the

301 reach of this scale. We believe it can not only serve as a valuable psychophysical tool in music

302 reward and emotion research, but its use could also be extended to emotion and reward research

303 in other domains and modalities, in which music can be used to test the specificity of a given

304 deficit. Clinical applications of the BMRQ include the examination of musical pleasure

305 experience in healthy individuals and in patients suffering from a wide variety of cognitive,

306   neurologic and auditory disorders.

307

308   The French BMRQ test is available online at the following URL:

309   www.brainvitge.org/bmrq_french.php

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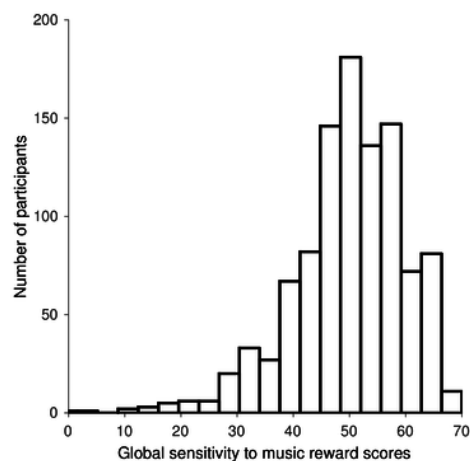386
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1

Global sensitivity to music reward scores using the French version of the Barcelona
Music Reward Questionnaire

Table 1(on next page)

Demographics

1   **Table 1**. Demographics

2

Variable	Participants (n=1027)
Age (years)	
Mean	22.3 ± 7.8
Range	18 – 54
Gender	
Male	363 (35.3%)
Female	664 (64.7%)
Education	
University	788 (76.7%)
College/Professional degree	218 (21.2%)
High school	21 (2.0%)
Country where French was learned	
France	918 (89.4%)
Canada	52 (5.1%)
Algeria	10 (1.0%)
Madagascar	7 (0.7%)
Belgium	2 (0.2%)
Other (25 countries)	38 (3.7%)
Musician	
Yes	231 (22.5%)
No	796 (77.5%)

3

Table 2(on next page)

Item by item comparison between the original Spanish scale and the adapted French version

(CI, confidence interval)

1 **Table 2.** Item by item comparison between the original Spanish scale and the adapted French

2 version (CI, confidence interval)

3

Item	Original Mean ± 95% CI	French Mean ± 95% CI
Q1	3.85 ± 0.91	4.00 ± 0.78
Q2	1.7 ± 1.06	1.77 ± 1.01
Q3	4.3 ± 0.83	4.32 ± 0.78
Q4	4.17 ± 0.94	4.32 ± 0.88
Q5	1.65 ± 1.06	2.11 ± 1.29
Q6	3.74 ± 0.89	3.63 ± 0.98
Q7	3.89 ± 0.98	3.72 ± 1.01
Q8	4.53 ±0.69	4.49 ± 0.76
Q9	4.26 ± 0.81	4.33 ± 0.77
Q10	3.96 ± 1.06	3.61 ± 1.23
Q11	3.46 ± 1.09	3.49 ± 1.09
Q12	3.55 ± 1.28	3.50 ± 1.36
Q13	3.28 ± 1.30	3.12 ± 1.35
Q14	4.35 ± 0.80	4.29 ± 0.85
Q15	4.29 ± 0.99	4.21 ± 0.93
Q16	3.82 ± 0.95	3.69 ± 0.99
Q17	2.29 ± 1.13	2.17 ± 1.13
Q18	3.94 ± 0.97	4.08 ± 1.01
Q19	4.11 ± 0.86	4.12 ± 0.84
Q20	4.00 ± 0.99	4.21 ± 0.90

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Table 3(on next page)

Factorial loading matrix for each item of the adapted French version of the questionnaire.

Salient loading values (i.e., values larger than absolute .4) in the content factors are printed in bold face.

1   **Table 3**. Factorial loading matrix for each item of the adapted French version of the

2   questionnaire. Salient loading values (i.e., values larger than absolute .4) in the content factors

3   are printed in bold face.

Item	Acquiescence	Music seeking	Emotion evocation	Mood regulation	Sensori-motor	Social
Q11	.047	**.790**	-.060	.108	.108	-.056
Q2	.473	**-.629**	.019	-.290	.005	-.037
Q7	.557	**.625**	.005	.087	-.047	.099
Q17	.193	**.605**	.126	-.173	-.077	.270
Q12	-.039	.004	**.904**	-.122	.083	-.080
Q8	.057	.056	**.856**	.021	-.002	-.001
Q18	.098	.031	**.686**	.093	-.057	.100
Q3	-.055	-.117	**.634**	.208	-.041	.059
Q14	-.052	.034	-.042	**.748**	.066	.134
Q9	.007	.218	.101	**.680**	.057	-.134
Q4	-.185	.056	.072	**.665**	.032	-.022
Q19	-.023	.131	.241	**.641**	.046	-.011
Q10	.050	.059	-.020	-.050	**.975**	-.106
Q5	.236	-.055	-.005	.253	**-.933**	.044
Q20	-.013	-.041	.013	.314	**.527**	.158
Q15	-.005	-.247	.002	.363	**.443**	.311
Q1	.018	.033	.039	-.044	-.052	**.705**
Q6	.085	.225	-.121	.014	.020	**.704**
Q13	.082	-.039	.114	-.013	.144	**.591**
Q16	.091	.124	.138	-.115	.150	**.526**

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