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%). Analyses revealed that congruence values between the rotated loading matrix and the ideal loading matrix ranged between 0.88 and 0.96. Factor reliabilities of subscales (i.e., Musical Seeking, Emotion Evocation, Mood Regulation, Social Reward and Sensory-Motor) also ranged between 0.88 and 0.96. In addition, reliability of the overall factor score (i.e., Music reward) was 0.91. Finally, the internal consistency of the overall scale was 0.85. 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.

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Joe Saliba, MD[1], Urbano Lorenzo-Seva, PhD[2], Josep Marco-Pallares, PhD[3], Barbara Tillmann, PhD[4], Anthony Zeitouni, MD, FRSCS[1], Alexandre Lehmann, PhD[1,5]

Institutions:

1. Department of Otolaryngology-Head & Neck Surgery, McGill University, Montreal, Canada.
2. Research Center for Behavior Assessment, Universitat Rovira i Virgili, Tarragona, Spain
3. Department of Basic Psychology, University of Barcelona, Barcelona, Spain.
4. Lyon Neurosciences Research Center, University Lyon-1, Lyon, France
5. Center for Research on Brain, Language and Music; International Laboratory for Brain, Music and Sound Research, QC, Canada

Abstract

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Results. A total of 1027 participants completed the questionnaire. Most responses were obtained from France (89.4%). Analyses revealed that congruence values between the rotated loading matrix and the ideal loading matrix ranged between 0.88 and 0.96. Factor reliabilities of subscales (i.e., Musical Seeking, Emotion Evocation, Mood Regulation, Social Reward and Sensory-Motor) also ranged between 0.88 and 0.96. In addition, reliability of the overall factor score (i.e., Music reward) was 0.91. Finally, the internal consistency of the overall scale was 0.85. 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.

Corresponding author:

Dr Alexandre Lehmann, PhD
Faculty of Medicine, Department of Otolaryngology-Head & Neck Surgery
McGill University Health Center, Suite DO5.5713
1001 Decarie Boulevard
H4A3J1, Montréal, Qc

Introduction

The rewarding effects of music are highly dependent on cultural and personal preferences. As a result, large differences in the way individuals experience musical pleasure are observed (Blood and Zatorre, 2001; Chanda and Levitin, 2013). While music can induce positive effects on mood and affect in some individuals (Juslin & Västfjäll, 2008), others seek the social bonding capacity of music (Cross, 2001). Conversely, certain individuals cannot experience any pleasure from widely different stimuli, including music – a disorder termed anhedonia (Assogna et al., 2011). Traditionally, it has been hard to assess the sources of this inter-individual variability in music-induced reward. Previous groups have developed questionnaires – such as the BIS/BAS scales (Carver and White, 1994) or the Sensitivity to Reward/Sensitivity to Punishment Questionnaire (Torrubia, 2001) – that assess individual differences to overall sensitivity to reward experiences (Carver & White, 1994; Torrubia et al., 2001). However, music is considered as a higher-order pleasure and as such, might involve different processing mechanisms than basic rewards (Menon & Levitin, 2005). In addition, previous studies have supported a dissociation of music rewarding experience from other rewarding experiences related to other types of primary and secondary reinforcements, such as food, sex and money among others (Mas-Herrero et al., 2014).

In light of these findings, the Barcelona Music Reward Questionnaire (BMRQ) was developed by Mas-Herrero et al. (2013). This questionnaire is specifically geared towards assessing sensitivity to music reward and was a welcome addition to a limited choice of behavioral tools suitable for music reward studies. The BMRQ can serve as a valuable research tool in psychophysical studies addressing music reward in healthy individuals, hearing-impaired individuals or individuals affected with other conditions or pathologies. To date, only Spanish

and English versions of this questionnaire are available in the literature, limiting its application. With over 200 million speakers worldwide, French is one of the most common languages in the world. In countries with several official languages including French such as Canada, Morocco and Senegal, it is all the more important for research tools to be available in all official languages to adequately test the population. In that context, a French version of the BMRQ was required to meet the needs of the numerous researchers in the French-speaking areas of the world. In this paper, we sought to translate the Barcelona Music Reward Questionnaire into an international French and to assess its construct validity and reliability.

Materials and Methods

The Barcelona Music Reward Questionnaire

The BMRQ examines five main facets that characterize musical reward experience in individuals: musical seeking, emotion evocation, mood regulation, social reward and sensory-motor. Musical seeking refers to the way individuals pursue music-related activities (attending concerts, playing an instrument) or seek additional information about music they listen to (performers, composers). The emotion evocation aspect of music reward is related to the emotional impact of music on individuals. In contrast, the ability of listeners to use music to modulate their emotions (to relieve stress, to release emotions, to comfort) is referred to as mood regulation. The social reward facet examines the social bonding effect of music on individuals. Lastly, the sensory-motor facet addresses the capacity of music to intuitively induce body movements synchronized to a rhythm's beat in certain individuals (head nodding, even dancing).

100 The questionnaire contains 20 statements equally divided among these five facets. Participants
101 indicate the level of agreement with each statement by using a five-point scale ranging from
102 ‘‘fully disagree’’ (1) to ‘‘fully agree’’ (5). The contribution of each facet to the overall music
103 reward experience is quantified by a numerical value obtained upon completion of the survey. A
104 score for global sensitivity to music reward is also provided, which was obtained as the weighted
105 sum of participants’ scores (i.e factor score). The mean value of each factor is 50, and the
106 standard deviation is 10. Standard values are therefore located between 40 and 60. Punctuations
107 below 40 indicate low values in this particular facet, whereas values above 60 indicate high
108 values (the same applies to the global sensitivity to music reward) (Mas-Herrero et al., 2013).
109
110 The BMRQ was created in three steps (Mas-Herrero et al., 2013). The first consisted in
111 developing of a short psychometric instrument in Spanish that included various facets of music
112 and reward experiences. This initial instrument included 112 items addressing a variety of
113 activities and situations associated with music reward and pleasure experiences, and was
114 administered to 804 Spanish participants. From the initial pool of 112 items, only 20 were
115 retained for the final version, equally divided among five facets of music reward (music seeking
116 activities, mood regulation, emotion evocation, sensory-motor behavior and social reward).
117 Selection was based on loading values and content and adequacy of the items. The second step
118 involved exploratory and confirmatory factorial analysis of the Spanish BMRQ. The
119 questionnaire with the selected 20 items was administered to a new sample of 605 students in an
120 effort to replicate the previous findings. Analyses revealed a reliable factorial structure for the
121 Spanish BMRQ and an acceptable fit for the hypothesized five facets of music reward. The final
122 step in the development of the BMRQ was its translation and adaptation into English. The

translated version was completed by 252 English-speaking participants, and confirmatory factorial analysis was performed to verify the replicability of the factor structure obtained in the Spanish version. The original BMRQ has been shown to be valid with acceptable reliability estimates of factor scores (i.e., a reliability value of 0.93 for the overall scale, and values between 0.73 and 0.93 for the five subscales). The aim of the present study was to replicate this validation for a French adaptation of the BMRQ.

Questionnaire translation

The French adaptation of the BMRQ was obtained by forward and backward translation. Each item in the original English version of the questionnaire was independently translated by two groups two of bilingual (French and English) researchers – in Montreal, Canada and in Lyon, France – whose first language was French. Both groups also had knowledge of the subject matter. The groups were purposely chosen in different geographic areas in order to account for the regional differences in spoken French and hence create an internationally comprehensible French translation. The Spanish questionnaire was used as a reference for disambiguating some wordings. The emphasis was placed on the translation of meaning rather than a literal one. A consensus between the two translator groups was obtained to produce the final French version of the questionnaire. Finally, a third bilingual researcher (French and Spanish) conducted a back translation into Spanish. This researcher was not involved in the initial translation process. This last step ensured the meaning of the adapted French version was concordant with the meaning of the original Spanish questionnaire. The comparison between the source items and the French translation is shown in Appendix 1. The content of the French translation of the BMRQ is

reproduced in Appendix 2, along with the complete set of instructions, thus allowing readers for a direct use of this questionnaire tool.

Data collection and participants

The questionnaire was administered via an Internet platform (LimeSurvey, McGill University servers) to any participant aged over 18 years and fluent in French. A written electronic consent was obtained for each participant. The survey was made publicly accessible from November 2014 to April 2015 and distributed electronically through various academic and healthcare institutions mainly in Europe, North America and Africa, but also in other areas of the world. In order to avoid sampling bias effect, the music focus of the study was not explicitly stated in the test instructions when administered to participants. Prior to completing the survey, participants were also asked to fill out a general demographic and linguistic background questionnaire. This study was approved by the McGill University's Faculty of Medicine Institutional Review Board (#A11-E88-14B).

Evaluation of the Psychometric Properties of the Translated Version

In order to assess the structure validity of the test, we used an approach similar to that employed by Mas-Herrero and colleagues in the development of the original questionnaire, as described above (Mas-Herrero et al., 2013). An exploratory factor analysis was carried out using MATLAB, and, for scale analyses, SPSS 22 was used. The polychoric correlation matrix was computed for the 20 items of the translated questionnaire. To control the variance due to this

response style factor, we applied the procedure proposed by Lorenzo-Seva and Rodriguez-Fornells (2006) developed for the specific case of non-perfectly balanced scales (see Lorenzo-Seva & Ferrando, 2009). As five content factors were expected, we retained this number of factors using Minimum Rank Factor Analysis (MRFA, Ten Berge & Kiers, 1991). Observed variables in MRFA consist of common parts and unique parts, each satisfying certain requirements: the covariance matrices for common and unique parts are positive semidefinite, and the unique-parts covariance matrix is diagonal. An oblique semi-specified Procrustean rotation (Browne, 1972) was performed in order to establish the loading factors associated with each of the five content factors. For the purposes of this analysis, the specified values were the loadings on each item that we expected to be zero. The procedure reported by Ten Berge et al. (Ten Berge et al., 1999) was then employed to calculate factor scores. The mean and standardized deviation of items, and the factor weights required to compute these factor scores are available for the use of researchers (in the supplementary materials and on the online test page).

We computed the reliability estimates for the five scales and the total scale on the basis of the factor scores based on the factor scores reliability (for example, see Mellenbergh, 1994; formula 22 on page 231). To assess internal consistency, we computed Cronbach's alpha for the overall scale.

Results

A total of 1027 participants voluntarily completed the entire translated questionnaire (Mean age: 22.3 (SD 7.8) years, females: 64.7%). While participants were mostly from France (89.4%) and

Canada (5.1%), 4% of our sample was obtained from 25 other countries such as Cameroun, Senegal and Egypt. Table 1 resumes the demographic statistics of the sample. The majority of our respondents were non-musicians (77.5%). While the questionnaire was primarily advertised in academic institutions, approximately a quarter of our participants did not complete a university degree. Overall, our French sample was similar to the Spanish and English samples in terms of age, gender and music training.

Table 2 shows the means and standard deviations of items of the French and the Spanish version of the test. As can be observed, the differences observed between the mean items in both cultures were not significant.

Once the polychoric correlation matrix was available, the observed Kaiser-Meyer-Olkin (KMO, Kaiser, 1970) index was computed: the 0.855 value obtained suggested that the correlation matrix was well suited for factor analysis (see Kaiser & Rice, 1974). The congruence values (Tucker, 1951) between the rotated loading matrix and the *ideal* loading matrix ranged from 0.88 to 0.96. As the coefficients were all above the threshold of 0.85, the factor similarity between the rotated loading matrix and the ideal loading matrix was fair (Lorenzo-Seva & Ten Berge, 2006). Table 3 shows not only the loading values after rotation, but also the loadings of items on the control scale (i.e., the acquiescence, AC). The procedure used to obtain a control scale was previously proposed by Lorenzo-Seva & Ferrando, 2009 Lorenzo-Seva & Ferrando, 2009). The method is based on the idea that in a scale where some items are worded in the opposite direction to the other items, it is possible to identify acquiescent response style. In such a balanced scale, the centroid helps to estimate the overall tendency of individuals to use systematically a particular value

215 of the response scales independently of the worded direction of the items (i.e., to show an
216 acquiescent response style). In an initial step, the first centroid is computed, and it is taken as an
217 estimate of the loading values of items on an underlying acquiescent factor. If the scale is partially
218 balanced, a subset of balanced items is used to compute the first centroid, and then the unbalanced
219 set of items is projected on the first centroid. The variance explained by the first centroid is then
220 removed from the correlation matrix, and the residual correlation matrix is factor analyzed in order
221 to estimate the loading on the content factors. In addition, this first centroid can be understood as a
222 control scale: a scale that accounts for the variance due to the acquiescent response. Our results
223 show that some of the items properly loaded on the AC scale. This finding confirms the appropriate
224 use of a model in which AC response bias style was controlled. We were also able to validate that
225 the loadings of items on the content factors were free of AC using this model. Lastly, using the
226 loading values on the content factor, we demonstrated that the items in our adapted instrument were
227 well related with the corresponding expected scale
228
229
230 In addition, the inter-factor correlation values between content factors ranged between 0.22 and
231 0.32. While these inter-factor correlations are in general slightly lower than the original version of
232 the test by Mas-Herrero (0.22 to 0.46), our results demonstrated that the scales were also correlated
233 in the French adaptation.
234
235 Finally, the reliability estimates computed on the basis of the factor scores of the scales were 0.93,
236 0.96, 0.88, 0.91, and 0.93 for Musical Seeking, Emotion Evocation, Mood Regulation, Social
237 Reward and Sensory-Motor, respectively. None of the reliability estimates obtained in our

238 analyses were below the threshold of 0.80. In comparison, the corresponding reliability estimates
239 in the original pooled English and Spanish samples were 0.89, 0.88, 0.87, 0.78, and 0.93,
240 respectively (Mas-Herrero et al., 2013). Furthermore, the overall test (Music reward) in the
241 French translation showed an acceptable reliability (0.91), concordant with the reported value by
242 Mas-Herrero et al. (0.92). The distribution of the overall test scores (global sensitivity to music
243 reward) using the French translation was centered on a mean of 50, similar to that of the original
244 instrument (Figure 1). Likewise, the internal consistency for the overall French scale was 0.852,
245 with a 95% confidence interval [0.839, 0.865]. Globally, all our analyses demonstrated that the
246 fit obtained in the French translation was similar to that of the original English and Spanish
247 samples, indicating that the factorial structures are equivalent.
248
249 **Discussion**
250
251 Our study described the translation and adaptation of the BMRQ into French and provided
252 analyses of the psychometric properties of the translated scale. Our results demonstrated that the
253 translated BMRQ has acceptable construct validity while keeping the factorial structure of the
254 original English and Spanish questionnaires. In general, the results that we obtained were similar
255 to those reported by the developers of the original instrument (Mas-Herrero et al., 2013). This
256 suggests that our translation procedure was successful.

257 The geographic distribution of French speakers encompasses over 30 countries throughout all
258 five continents (L'observatoire de la langue française, 2014). With such a diverse speaker
259 population, significant regional differences in the spoken language currently exist. In that
260 context, an internationally acceptable French adaptation of the BMRQ was required to

accommodate researchers and clinicians across the French-speaking regions. This translated BMRQ is born from a collaborative work between two bilingual groups in North America (Montreal, Quebec) and Europe (Lyon, France). Efforts were made during the translation process to remove all regional French influences. Each group first independently translated the original English BMRQ into a locally acceptable French. Then, a consensus between the two translators was obtained to produce the final international French version of the questionnaire. We believe this collaboration was necessary to adapt the original BMRQ into a French that would be easily understood by speakers around the French-speaking world. This belief is echoed in our results: over 30 French-speaking countries are represented, and 5.5% of participants learned French in countries other than Canada (Quebec) or France. Finally, our association with the developers of the original Spanish instrument (UL) ensured the French adaptation remained faithful to the initial questionnaire.

While we collected responses from over 1000 participants, the majority were obtained from France (89.4%). This is partly a reflection of the differences in the number of French speakers between the regions sampled: 6 million in Quebec compared to more than 77 million in the European Union (L'observatoire de la langue française, 2014). In an effort to reduce sampling bias effect, the music focus of the study was not explicitly stated in the test instructions when administered to participants. This can be seen in the number of non-musicians among our participants (77.5%), a proportion that is similar to what has been reported in the original version of the BMRQ. We therefore believe our sample is representative of the general French speaking population and that sampling bias was not significant.

283

284 Previous work by Ayotte (2002) and Peretz (2003) have established that approximately 4% of
285 the population suffers from congenital amusia, a disorder of music processing that hinders their
286 ability to perceive, produce and enjoy music (Ayotte, Peretz & Hyde, 2002; Peretz, Champod &
287 Hyde, 2003). In contrast, some individuals suffer from general anhedonia, a deficit in
288 experiencing pleasure from widely different stimuli, usually in the context of depressive
289 disorders or neurodegenerative diseases such as Parkinson's (Loas et al., 1994; Assogna et al.,
290 2011). Three case studies have also reported a form of acquired anhedonia specific to music that
291 resulted from strokes in limbic structures such as the amygdala, as well as areas of the temporo-
292 parietal cortex, inferior parietal cortex and insula (Mazzoni et al., 1993, Satoh et al., 2011,
293 Griffiths et al., 2004). In those neurologic and psychiatric patients, the use of a standardized tool
294 such as the BMRQ will help determine a loss in the capacity of feeling emotions through music.
295 However, the BMRQ can also be employed to explore music reward in healthy individuals. In
296 fact, a recent report by Mas-Herrero et al. (2014) was the first to identify a group of healthy
297 people for whom music is not rewarding (Mas-Herrero et al., 2014). The term coined - specific
298 musical anhedonia – refers to a unique subset of the population that draws no pleasure at all from
299 music despite being perfectly able to experience pleasure in other ways. Using a stepwise
300 regression analysis, Mas-Herrero et al. found the BMRQ score to be the only predictor of high-
301 pleasure or chill responses in all their participants (compared to other reward scales such as the
302 BIS/BAS). Their work has shown that the ability of music to induce pleasure may not be
303 universal, and that there may be individual differences in access to the reward system (Mas-
304 Herrero et al., 2014). To further understand the neural correlates behind musical pleasure and

reward processing, further studies in that population are required and the BMRQ could prove to be a very valuable tool.

Conclusion

The French version of the BMRQ appears valid and reliable. The addition of the French adaptation to the previously available English and Spanish versions significantly increases the reach of this scale. We believe it can not only serve as a valuable psychophysical tool in music reward and emotion research, but its use could also be extended to emotion and reward research in other domains and modalities, in which music can be used to test the specificity of a given deficit. Clinical applications of the BMRQ include the examination of musical pleasure experience in healthy individuals and in patients suffering from a wide variety of cognitive, neurologic and auditory disorders.

The French BMRQ test is available online at the following URL:
www.brainvitge.org/bmrq_french.php

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1

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

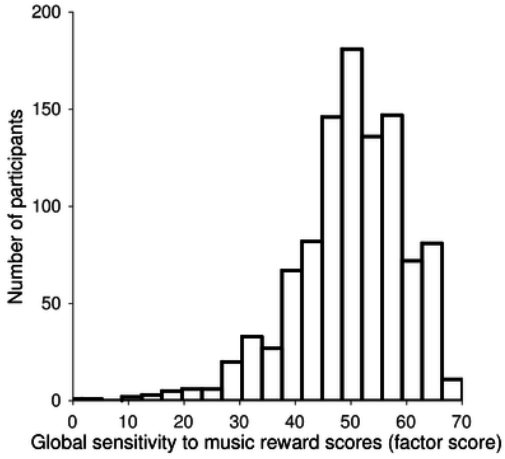

Table 1(on next page)

Demographics

1 **Table 1**. Demographics

2

Variable	Participants (n = 1027)
Age, years	
Mean (SD)	22.3 (7.8)
Minimun	18
Maximum	54
Gender, n (%)	
Male	363 (35.3)
Female	664 (64.7)
Education, n (%)	
University	788 (76.7)
College/Professional degree	218 (21.2)
High school	21 (2.0)
Country where French was learned, n (%)	
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, n (%)	
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

(SD, standard deviation)

Table 2. Item by item comparison between the original Spanish scale and the adapted French version (SD, Standard deviation)

Item	Original Mean (SD)	French Mean (SD)
Q1	3.85 (0.86)	4.00 (0.78)
Q2	1.70 (0.92)	1.77 (1.01)
Q3	4.30 (0.79)	4.32 (0.78)
Q4	4.17 (0.91)	4.32 (0.88)
Q5	1.65 (1.02)	2.11 (1.29)
Q6	3.74 (0.86)	3.63 (0.99)
Q7	3.89 (0.98)	3.72 (1.01)
Q8	4.53 (0.70)	4.49 (0.76)
Q9	4.26 (0.82)	4.33 (0.77)
Q10	3.96 (1.03)	3.61 (1.24)
Q11	3.46 (0.86)	3.49 (1.09)
Q12	3.55 (1.06)	3.50 (1.36)
Q13	3.28 (1.25)	3.12 (1.36)
Q14	4.35 (0.78)	4.29 (0.85)
Q15	4.29 (0.76)	4.21 (0.93)
Q16	3.82 (0.92)	3.69 (0.99)
Q17	2.29 (1.12)	2.17 (1.13)
Q18	3.94 (0.88)	4.08 (1.01)
Q19	4.11 (0.98)	4.12 (0.84)
Q20	4.00 (0.91)	4.21 (0.90)

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 0.4) in the content factors are printed in bold face.

Table 3. Factorial loading matrix for each item of the adapted French version of the questionnaire. Salient loading values (i.e., values larger than absolute 0.4) in the content factors are printed in bold face.

Item	Acquiescence	Music seeking	Emotion evocation	Mood regulation	Sensori-motor	Social
Q11	0.047	**0.790**	-0.060	0.108	0.108	-0.056
Q2	0.473	**-0.629**	0.019	-0.290	0.005	-0.037
Q7	0.557	**0.625**	0.005	0.087	-0.047	0.099
Q17	0.193	**0.605**	0.126	-0.173	-0.077	0.270
Q12	-0.039	0.004	**0.904**	-0.122	0.083	-0.080
Q8	0.057	0.056	**0.856**	0.021	-0.002	-0.001
Q18	0.098	0.031	**0.686**	0.093	-0.057	0.100
Q3	-0.055	-0.117	**0.634**	0.208	-0.041	0.059
Q14	-0.052	0.034	-0.042	**0.748**	0.066	0.134
Q9	0.007	0.218	0.101	**0.680**	0.057	-0.134
Q4	-0.185	0.056	0.072	**0.665**	0.032	-0.022
Q19	-0.023	0.131	0.241	**0.641**	0.046	-0.011
Q10	0.050	0.059	-0.020	-0.050	**0.975**	-0.106
Q5	0.236	-0.055	-0.005	0.253	**-0.933**	0.044
Q20	-0.013	-0.041	0.013	0.314	**0.527**	0.158
Q15	-0.005	-0.247	0.002	0.363	**0.443**	0.311
Q1	0.018	0.033	0.039	-0.044	-0.052	**0.705**
Q6	0.085	0.225	-0.121	0.014	0.020	**0.704**
Q13	0.082	-0.039	0.114	-0.013	0.144	**0.591**
Q16	0.091	0.124	0.138	-0.115	0.150	**0.526**