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The German Music@Home: Validation of a questionnaire measuring at home
musical exposure and interaction of young children

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Running head: The German Music@Home questionnaire

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28 **Abstract**

29 The present study introduces the German version of the original version of the Music@Home
30 questionnaire developed in the UK, which systematically evaluates musical engagement in the
31 home environment of young children. Two versions are available, an Infant version for children
32 aged three to 23 months and a Preschool version for children aged two to five and a half years.
33 For the present study, the original Music@Home questionnaire was translated from English into
34 German and 656 caregivers completed the questionnaire online. A confirmatory factor analysis
35 showed moderate to high fit indices for both versions, confirming the factor structure of the
36 original questionnaire. Also, the reliability coefficients for the subscales (Parental beliefs, Child
37 engagement with music, Parent initiation of singing, Parent initiation of music-making for the
38 Infant version and Parental beliefs, Child engagement with music, Parent initiation of music
39 behavior and Breadth of musical exposure for the Preschool version) ranged from moderate to
40 high fits. Furthermore, the test-retest analysis ($N= 392$) revealed high correlations for the general
41 factor and all subscales confirming their internal reliability. Additionally, we included language
42 questionnaires for children of two and three years of age. Results showed that higher scores on
43 the Music@Home questionnaire were moderately associated with better language skills in two-
44 year-olds ($N= 118$). In sum, the study presents the validated German Music@Home
45 questionnaire, which shows good psychometric properties. The two versions of the questionnaire
46 are available for use in order to assess home musical engagement of young children, which could
47 be of interest in many areas of developmental research.

48 Keywords: music, home environment, children, questionnaire

49

50 **Introduction**

51

52 Music has always been an integral part of human life and positive effects of musical training and
53 interventions on social, cognitive and health aspects have been reported in numerous research
54 studies (1-5). Research has also shown that across cultures, children are exposed to music from
55 an early age (6, 7) and the positive effects of music on children's development and performance
56 on different skills have been shown and critically discussed (8, 9).

57 Until now, most studies investigating the impact of music on children's development and
58 cognitive performance have concentrated on formal musical training. For example, cross-
59 sectional studies have shown that children with formal musical training exhibit better
60 performance in cognitive functions such as dual task performance and exhibit higher intelligence
61 scores (10-12) compared to children without musical training. Furthermore, intervention studies
62 have shown that linguistic functions such as phonological awareness, pitch discrimination and
63 speech segregation can be improved with short formal musical training programs (13-16). In
64 these research studies the amount of formal musical training has been the main measure and
65 children are often categorized as "musicians" (with formal musical training) and "non-musicians"
66 (no formal musical training) based on this variable (11, 12).

67 However, research has also shown that musical engagement of a child goes beyond musical
68 training, as music is often part of the home environment. Music is often embedded in daily
69 routines and is frequently used to interact with young children (17, 18). Furthermore, it has been
70 shown that music can play an important part in everyday activities of under-fives (19).

71 Recently, Kreutz and Feldhaus (20) examined the development of familial musical engagement
72 as well as other everyday activities, such as reading and shopping and how these are related to
73 children's personality. They revealed that the amount of musical activity declined in this age

74 range as children grew older (ages ranged from seven to 14 years), in contrast to other activities
75 which tended to remain stable over time. Furthermore, the results highlighted that musical
76 engagement (singing and playing musical instruments) was associated with the personality
77 factors Prosocial Behaviour, Intimacy and Admiration (i.e. appreciation). Overall, the study
78 showed that music activities in the family setting have an effect on family dynamics,
79 relationships and children's personality (20), emphasizing that musical engagement at home is an
80 important factor to consider when conducting studies with children.

81 In recent years a few questionnaires have been developed in order to evaluate musicality not only
82 as a reflection of individuals' formal musical training, but as a multifaceted and comprehensive
83 construct in adult populations such as the *Goldsmiths Musical Sophistication Index* (Gold-MSI,
84 21) and the *Music Use and Background Questionnaire* (MUSEBAQ, 22). These questionnaires
85 typically have a multi-dimensional structure with several subscales and an overall score. The
86 questionnaires have been well received by the music research community and musical
87 background/ expertise as measured by these questionnaires have been important covariates in
88 many studies (i.e. 23, 24-26). Moreover, several translations of musical background
89 questionnaires have been published (27-30), which enables international comparisons of research
90 results.

91 In addition, a number of questionnaires were developed to assess musical exposure of children at
92 home. Already in 1985, the Home Musical Environment Scale (HOMES) was introduced which
93 is a parent self-report questionnaire that evaluates parent-child musical engagement of school-
94 aged children on four factors (i.e. parents' attitude towards music and musical involvement with
95 child, parental concert attendance, parent-child ownership and use of records/tapes, parent plays
96 musical instrument) (31). Comparable to the HOMES which was developed for music education
97 purposes, the Children's Music-Related Behavior Questionnaire (CMRBQ, 32) was developed in

98 order to evaluate musical behaviors and needs of under-fives in order to integrate these into
99 preschool education settings. The CMRBQ comprises eight factors of which seven focus on the
100 child's behaviour (Attention & Emotion, Vocalizations, Moving, Daily Routines, Requests,
101 Taking Turns, Creativity) and the eighth factor evaluates Parent Music Activities. Additionally,
102 in 2018 Cogo-Moreira and Lamont (33)(33)(33)(33)(33)(34) introduced the *Exposure to Music in*
103 *Childhood Inventory*, a questionnaire which was developed to be suitable for children and assess
104 their exposure to musical activities and behavior. The questionnaire comprises two factors: the
105 first factor covers personal musical experiences such as music listening, home musical
106 environment and the impact of television and the internet, whereas the second factor covers social
107 elements such as playing an instrument, active and public music activities and performing (33).
108 The questionnaire is suitable for children aged five to thirteen years and the authors emphasize
109 that the questionnaire evaluates the amount and type of musical activities, which go beyond
110 musical training and the dichotomous categorization into non-musicians and musicians.

111

112 The English Music@Home questionnaire

113 In 2018, Politimou and colleagues introduced the Music@Home questionnaire, a parent-report
114 instrument that evaluates musical engagement in the home environment focusing on infants and
115 young children. The Music@Home enriched the available range of questionnaires by
116 concentrating on an age group that had so far lacked a systematic measurement for the home
117 musical environment. Two different versions are available, one for infants (aged three to 23
118 months) and one for preschoolers (aged two to five and a half years). The Infant version includes
119 18 items, whereas the Preschool version comprises 17 items, and responses are given on a seven-
120 point Likert scale ranging from completely agree to completely disagree. For the two versions of
121 the Music@Home questionnaire a general factor can be calculated as well as scores on different

122 subscales. These are Parental beliefs, Child engagement with music, Parent initiation of singing,
123 and Parent initiation of music-making for the Infant version and Parental beliefs, Child
124 engagement with music, Parent initiation of musical behavior and Breadth of musical exposure
125 for the Preschool version. The confirmatory fit indices showed moderate to good fit for both
126 versions (CFI of .872 for the Preschool version and .963 for the Infant version) and the test-retest
127 analysis revealed high correlations (.65 to .87). Furthermore the study demonstrated that the
128 Music@Home scores showed moderate but significant correlations (.24 to .53) with the
129 Children's Music Behavior Inventory (32) highlighting convergent validity of the questionnaire.
130 Furthermore, the Music@Home showed significant associations with musical background of the
131 parents as assessed with the Musical Training and Active Engagement scales of the Goldsmiths
132 Musical Sophistication Index (21).

133

134 Aim of the present study

135 As no German questionnaire exists for the evaluation of the home musical environment of young
136 children, the primary purpose of the present study was to translate and adapt the Music@Home
137 into German following standard recommendations from the literature. A secondary aim was to
138 validate the questionnaire (Infant and Preschool version) by testing whether the factor structure of
139 the original English Music@Home questionnaire could be replicated with a German sample. In
140 addition, we tested the internal and test-retest reliability of the questionnaire. Finally, in order to
141 take a first step towards exploring the utility of the German Music@Home questionnaire in
142 general developmental research, the associations between the Music@Home scores with parents'
143 musical engagement and children's language development were investigated in a subset of the
144 sample.

145

146 **Methods**

147

148 **Participants**

149 A total of 656 caregivers (616 mothers and 40 fathers; mothers and fathers were from different
150 families) participated in this online study between November 2018 and February 2019. Inclusion
151 criteria for the study were that participants had a child aged between 3 months and 5 ½ years and
152 spoke German sufficiently well to fill in the questionnaire. The sample was obtained through
153 convenience sampling and is therefore limited regarding its representativeness. As presented in
154 Table 1, the mean age of the caregivers filling out the questionnaire was 37.5 years ($SD = 4.5$
155 years) with a range from 25 to 51 years. The mean age of the child they filled out the
156 questionnaire for was 2.3 years ($SD = 1.3$ years; range: 3month to 5 ½ years). All participants
157 lived in Germany and 581 participants (88.6%) indicated that German was their native language
158 whereas the remaining 75 caregivers (11.4%) had another mother tongue but indicated that they
159 spoke German fluently. An overview of demographic details of the sample is presented in Table
160 1. From our overall sample of 656 caregivers, 326 (313 mothers and 13 fathers) filled in the
161 questionnaire for their child aged between 3 and 24 months and therefore filled in the Infant
162 version of the Music@Home questionnaire and 330 (303 mothers and 27 fathers) filled in the
163 Preschool version for their child aged between 2 and 5 ½ years.

164 For the test-retest analysis 392 caregivers (60% of the original sample) participated again in the
165 study. Two-hundred-one caregivers filled in the Infant questionnaire (62% from the original
166 sample) and 191 caregivers filled in the Preschool version (58% from the original sample). In 15
167 cases the caregivers did not fill in the same version of the questionnaire (i.e. as the child turned
168 two in between the two measurement time points) and were therefore excluded for the test-retest

169 analysis. The study was approved by the ethics committee of the Heinrich-Heine-University in
 170 Düsseldorf. Participants gave informed written consent.

171

172 **Table 1: Overview of relevant demographic details of the sample**

	M (SD)	n	%
Age	37.5 (4.5)		
Gender			
Female		616	93.9
Male		40	6.1
School Education (n=3 missing values)			
Did not complete school qualification		/	/
School Qualification with 14 years of age		6	1.0
First School Qualification (e.g. Realschulabschluss/GCSE)		44	6.7
Second school qualification (e.g. Abitur/ A-levels)		603	92.3
Level of monthly family income (n=55 missing values)			
< 1750 Euro		26	4.0
1750-3500 Euro		125	19.1
3500-5000		208	31.7
> 5000 Euro		242	36.9

173

174 **Materials**

175 Music@Home questionnaire

176 The self-report Music@Home questionnaire comprises two versions evaluating the home musical
 177 environment: the Infant version for children of three to 24 months, and the Preschool version,
 178 which should be used for children between two and five and a half years. The Infant version

179 contains 18 items and the Preschool version 17 items. For all items a 7-point agreement scale is
180 used, ranging from 1 = completely disagree to 7 = completely agree. For negatively worded items
181 reverse coding was used. The Infant version comprises four subscales, namely Parental beliefs (4
182 items), Child engagement with music (6 items), Parent initiation of singing (5 items) and Parent
183 initiation of music-making (3 items). The Preschool version also has a four-factor underlying
184 structure with the subscales Parental beliefs (5 items), Child engagement with music (4 items),
185 Parent initiation of musical behavior (4 items) and Breadth of musical exposure (4 items). The
186 factor structures of both Infant and Preschool versions showed moderate to good fit when the
187 questionnaires were administered to a UK sample (for more detailed information see 34).

188

189 Child Language questionnaire

190 In order to evaluate language skills, two versions of the *Sprachbeurteilung durch Eltern* (SBE;
191 language assessment through parents; 35) questionnaire were used, which are questionnaires that
192 are used at routine medical check-ups in Germany to evaluate language development. Two
193 different versions were used. The SBE-2 is applied at the medical U6 check-up when the child is
194 approximately two years old (20 to 26 months) and the SBE-3 is applied at the U7 check-up
195 when the child is around three years old (32 to 36 months) (Note: The “U” examinations are
196 compulsory check-ups every child in Germany needs to complete with caregiver at a pediatrician.
197 They start with the first examination (U1) at birth and end with the U9 when children are five
198 years old).

199 The SBE-2 and the SBE-3 were originally developed in order to identify developmental language
200 delays, but the validity for also evaluating language development and delay in research studies
201 has been shown (36-38). For the SBE-2 caregivers need to indicate which words their child can
202 already say from a list of 57 words and additionally there is one yes/no grammar question, which

203 asks whether the child uses two-word phrases. The SBE-3 for three years olds contains a word
204 list of 82 words and caregivers are asked to indicate which words their child speaks, in addition
205 to 15 grammatical items. All items concentrate on speech production. For scoring, one point is
206 given for every word the child is able to speak and for every grammar item the child uses
207 correctly. For the SBE-2 the maximum score is 58 (57 word items and 1 grammar item). For the
208 SBE-3 the number of correct grammar items (maximum 15) is multiplied by six and then the
209 number of word items (maximum 82) is added and therefore the maximum score here is 172 (35).

210

211 Socioeconomic status and parental musical engagement:

212 In order to evaluate the socioeconomic status of the caregiver who completed the questionnaire,
213 we included questions regarding the highest school and academic education, as well as
214 occupation and monthly household income.

215 Furthermore, in order to evaluate musical engagement of the caregiver, we included two
216 dimensions of the Goldsmiths Musical Sophistication Index (Gold-MSI, (21, 27), namely
217 Musical Training and Active Engagement. The Musical Training scale comprises seven items and
218 the dimension Active Engagement nine items. Each item is rated on a seven-point likert scale and
219 by adding all items belonging to the dimension respectively a sum score is generated. See
220 Müllensiefen et al. (21) and Schaal et al. (27) for more information.

221

222 **Translation process**

223 We translated the Music@Home questionnaires (Infant and Preschool version) following
224 recommendations from the literature and used the same procedure established by previous
225 scientific questionnaire translation studies (27, 30, 39, 40). First the English questionnaires were
226 translated into German from three independent persons who were all fluent in German and

227 English. Two of them were German native speakers with excellent English skills and one of them
228 had been brought up bilingually. Then, the three translations were compared with each other and
229 discrepancies were resolved by the first author in close correspondence with the four translators.
230 Next, the first German versions were developed and translated back into English by an English
231 native speaker, who is also fluent in German. The back translated English versions were then
232 compared to the original English Music@Home questionnaires and if required, the German items
233 were adjusted in order to ensure that the items had the same meaning in both versions. The two
234 versions of the German Music@Home questionnaire were then proofread by German colleagues,
235 who checked correct spelling and style. The aim of the translation process was to receive a
236 German version of the Music@Home questionnaires which are semantically, conceptually and
237 culturally equivalent to the English versions (41). The items of the two versions of the German
238 Music@Home questionnaire are attached as Supportive Information alongside the original
239 English items (S1 and S2).

240

241 **Procedure**

242 This online study was administered via the online platform www.soscisurvey.de. The link to the
243 questionnaire was sent to approximately 1200 parents with children between the age of three
244 months and five and a half years via email. The email addresses were taken from a database of
245 the Babylab at the Heinrich-Heine-University.

246 The parents were asked to fill in the questionnaire online on a home computer and to fill in the
247 survey for their youngest child. Informed written consent was obtained at the beginning of the
248 online questionnaire. Informed written consent was obtained by participants ticking a box “I have
249 read and understood the consent form and agree to take part in the online experiment” without
250 entering other personal information.

251 The survey included demographic questions, the German Music@Home questionnaire, the items
252 of the two Gold-MSI dimensions and the items regarding the socio-economic status. The
253 participants received the appropriate version (Infant or Preschool) of the Music@Home
254 questionnaire depending on the age of their youngest child. Additionally, if the child for whom
255 the survey was filled out for was between 20 and 26 months of age ($N= 118$), the parents were
256 directed to the SBE-2 language questionnaire and if the child was between 32 and 36 months of
257 age ($N = 99$) the parents were asked to fill in the SBE-3 language questionnaire. At the end of the
258 questionnaire the participants were asked if they would be willing to fill in parts of the
259 questionnaire again in approximately two to four weeks, and if so, were requested to leave their
260 email address. They were instructed that, if they leave an email address, their data no longer
261 would be anonymous but would be saved with an identification code in order to link the data of
262 the first and second part together. Overall, completion of the survey took 15 to 20 minutes.
263 All participants who gave their email address received a link to the second survey approximately
264 2 weeks (range: 2-6 weeks, mean time lag of filling in the questionnaires: 17 days \pm 7 days) after
265 first completion with a personal ID in order to match the data of the first and second
266 measurement time point. The second survey only included the Music@Home questionnaire
267 (either Infant or Preschool version). All participants who also completed the second survey had
268 the chance to enter a prize draw to win one of five 20 Euro Amazon vouchers.

269

270 **Data analysis**

271 In order to explore whether the factor structure of the German Music@Home questionnaires was
272 similar to the factor structure of the original English versions, we applied the same analysis to the
273 German data as Politimou et al. (34) applied to the English sample.

274 We applied a confirmatory factor analysis (CFA) in order to establish factorial validity of the
275 Music@Home questionnaires using the R package lavaan (42). For both Infant and Preschool
276 versions, a bi-factor model was evaluated where the general factor impacted directly on all items
277 (i.e., all items loading directly on the general factor) while the sub-factors also impacted on the
278 items associated with them (i.e., individual items also loaded on their respective subfactor).
279 Furthermore, scores for each Music@Home dimension as well as for the general factors were
280 calculated by summing up the appropriate item scores. In order to calculate the internal reliability
281 of each subscale of the Music@Home questionnaires as well as of the general Music@Home
282 factors, we used three different measures (Cronbach's alpha, MacDonald's omega total, and
283 Guttman's lambda 6). For the test-retest reliability analysis Pearson correlations were calculated.
284 As a next step, we performed correlational analyses to assess convergent validity between the
285 Music@Home questionnaires and the two dimensions (Musical Training and Active
286 Engagement) of the Gold-MSI in order to test whether the Music@Home scores was associated
287 with musical characteristics of the parents. Furthermore, for the appropriate sub-samples
288 correlation analysis was performed between the Music@Home questionnaires and the two
289 language questionnaires. Regarding the scores of the SBE2 and possible associations with the
290 Music@Home scores, two sets of analysis had to be performed as approximately half ($N = 67$)
291 filled in the Infant version as their child was 20-23 months old and the other half ($N = 51$) filled in
292 the Preschool version as their child was 24-26 months old. Additionally, partial correlations were
293 calculated between Music@Home scores and language scores when controlling for parental
294 school education. We report the p-values of the correlations without correction of multiple
295 comparisons and state confidence intervals as it has been argued recently that effect sizes and
296 their confidence intervals are more meaningful for interpretation than p-values, even if corrected
297 for multiple testing (43).

298 The influence of SES variables was checked separately by performing Spearman correlations
 299 between parental school education and family income and general factors of the Infant and
 300 Preschool versions as well as the language questionnaires SBE2 and SBE3.

301

302 **Results**

303

304 The results of the confirmatory factor analyses for both versions are presented in Table 2. The
 305 Music@Home Infant and Preschool version show good fit indices, confirming the factor structure
 306 of the English version. The factor structure and item loadings are presented in Figure 1 for the
 307 Infant version and in Figure 2 for the Preschool version.

308

309 **Table 2: Confirmatory factor analysis for the Preschool and Infant version of the**
 310 **Music@Home questionnaire**

311

Models	χ^2	df	RMSEA	CFI	TLI	SRMR
M@H Infant	183.29	117	.042	.962	.951	.042
M@H Preschool	259.68	104	.067	.908	.880	.063

312

313

314 **Figure 1: Factor structure and item loadings of the Music@Home Infant questionnaire**

315 **Figure 2: Factor structure and item loadings of the Music@Home Preschool questionnaire**

316

317 Regarding reliability of the questionnaires, moderate to high coefficients were obtained for the
 318 general factors and subscales of both the Infant and Preschool versions (see Table 3). For the
 319 subscale Parent initiation of music-making of the Infant questionnaire, Cronbachs α was slightly
 320 lower with .529. The corresponding omega coefficient was at an acceptable level (.68).

321 Test-retest correlations were high for the general factors of the Infant and Preschool questionnaire
 322 respectively (.828 and .823, both p values $< .001$) confirming good test-retest reliability for both
 323 versions of the German Music@Home. The individual subscales also revealed high test-retest
 324 correlations (see Table 3).

325

326 **Table 3: Estimates of internal reliability (Cronbach's alpha, MacDonald's omega total, and**
 327 **Guttman's lambda 6) and test-retest correlations for the general factors and subscales of**
 328 **the Infant and Preschool version of the German Music@Home questionnaire**

329

	alpha	omega.tot	G6	test-retest
Music@Home Infant General Factor	.807	.827	.850	.828
Parental beliefs	.642	.724	.600	.700
Child's active engagement	.738	.758	.728	.703
Parent initiation of singing	.794	.817	.774	.797
Parent initiation of music-making	.529	.680	.566	.735
Music@Home Preschool General Factor	.822	.838	.863	.823
Parental beliefs	.714	.752	.691	.803
Child's active engagement	.657	.723	.614	.663
Parent initiation of musical behaviors	.785	.796	.801	.702
Breadth of musical exposure	.679	.690	.629	.745

330 Note: All test-retest correlations were significant with $p < .001$, uncorrected; $n = 194$ for the
 331 Infant version and $n = 183$ for the Preschool version

332

333

334 Regarding the associations between the Gold-MSI scores and the Music@Home questionnaires,

335 the data revealed, for the Infant version, significant small to moderate correlations between

336 Active Engagement of the Gold-MSI and all subscales and the general factor of the

337 Music@Home (r-scores between .173 and .395) and between Musical Training of the Gold-MSI

338 and all subscales, except Child's active engagement, and the general factor of the Music@Home

339 (r-scores between .188 and .316). Similarly, for the Preschool version, significant small to

340 moderate correlations between Active Engagement of the Gold-MSI and all subscales and the

341 overall score of the Music@Home (r-scores between .195 and .442) and between Musical

342 Training of the Gold-MSI and all subscales, except Breadth of musical exposure, and the general
 343 factor of the Music@Home (r-scores between .177 and .304) were shown.

344
 345 The subsample-analysis exploring associations between the Music@Home scores and language
 346 development showed moderate but significant correlations between the SBE-2 scores (children
 347 aged 20-26 months) and the general factor of both versions as well as between language
 348 development and most subscales of the Infant and Preschool version (see Table 4). In contrast,
 349 for children aged 32-36 months (N = 86) no associations were revealed between the SBE-3
 350 language scores and Music@Home scores (p-values > .156). When performing partial
 351 correlations between the Music@Home scores and language development and controlling for
 352 parental highest education levels, the correlations showed the same patterns (Table 4) by
 353 revealing significant correlations between SBE-2 scores and the Music@Home scores, whereas
 354 the associations between SBE-3 and Music@Home scores turned out non-significant.

355

356 **Table 4: Associations between the evaluated language skills of 20-26 month old children**
 357 **(SBE-2) and of 32-36 months old children (SBE-3) and the Music@Home scores (Infant and**
 358 **Preschool version).**

359

	Infant version					Preschool version				
	GF	PB	CAE	PIS	PIM	GF	PB	CAE	PIMB	BME
SBE -2	.391* [.158;.649]	.354* [.089;.519]	.113 [-.076;.375]	.342* [.153;.517]	.264* [.017;.433]	.364* [.163;.594]	-.046 [-.284;.249]	.335* [.109;.557]	.300* [.114;.522]	.432* [.046;.630]
	<i>.414*</i> [.247;.606]	<i>.368*</i> [.175;.551]	<i>.135</i> [-.049;.369]	<i>.348*</i> [.204;.533]	<i>.283*</i> [.072;.490]	<i>.363*</i> [.130;.604]	<i>-.044</i> [-.346;.242]	<i>.338*</i> [.050;.628]	<i>.299*</i> [.023;.540]	<i>.436*</i> [.143;.622]
SBE -3	/	/	/	/	/	.001 [-.206;.216]	-.156 [-.356;.029]	-.011 [-.224;.215]	-.004 [-.270;.288]	.151 [-.077;.439]
						<i>.012</i> [-.208;.316]	<i>-.132</i> [-.339;.099]	<i>-.017</i> [-.224;.220]	<i>-.001</i> [-.255;.297]	<i>.164</i> [-.110;.404]

360 Note: * indicates that non-corrected p-values are < .05, when correcting for multiple
 361 comparisons the p-values are non-significant; the italic values are the r-scores of the partial
 362 correlations when controlling for parental highest education; confidence intervals are presented in
 363 parentheses.

364 $n = 67$ for SBE2 and Infant correlation, $n = 51$ for the SBE2 and Preschool version and $n = 86$ for
365 the SBE3 and Preschool correlation
366 GF: general factor; PB: Parental beliefs; CAE: Child's active engagement; PIS: Parent initiation
367 of singing; PIM: parent initiation of music-making; PIMB: parent initiation of musical behaviour;
368 BME: breadth of musical exposure
369

370
371 The correlations between the SES variables and the Music@Home scores were non-significant:
372 no associations could be revealed between highest school qualification and the general factors of
373 the Infant and Preschool version ($p = .116$ and $.236$) nor between family income and the general
374 factors of both versions ($p = .323$ and $.120$).

375 Regarding associations between parental SES and the language scores, the correlations between
376 school education and family income and SBE2 as well as the correlation between family income
377 and SBE3 were non-significant, however the correlation between parental school education and
378 language scores of the SBE3 in three year olds was significant with $r = .224$, $p = .038$.

379

380

381 **Discussion**

382 The aim of the current study was to adapt the Infant and Preschool versions of the Music@Home
383 questionnaire into German and validate the translated versions with German samples. The results
384 revealed that both versions of the questionnaire (i.e., Infant and Preschool) showed acceptable to
385 good confirmatory fit to the data from the German convenience sample. Furthermore, the
386 Music@Home German questionnaires showed good internal and test-retest reliability. In sum, we
387 were able to confirm that the factor structure of the original English Music@Home
388 questionnaires can be reliably replicated with a German sample. Specifically, similarly to the
389 English version, the present results confirm an overall factor as well as four subscales for the

390 Infant and Preschool version respectively. However, the reliability analysis showed a divergence
391 between the coefficients alpha and omega in the Parent initiation dimension of the Infant version,
392 which warrants a comment here. This divergence can be explained by the fact that the different
393 items on this subscale have loadings that are considerably different from each other. Hence, in
394 practical application scenarios, it might be worth considering computing factor scores using
395 regression of the Bartlett method instead of simple sum scores or averages for the Parent
396 initiation subscale or all subscales of the Infant inventory because these alternative methods for
397 factor scoring do not make the assumption of equal item loadings. Cronbach's alpha is based on
398 the assumption that all item of a scale are equally important and hence have the same weight for
399 computing the coefficient. However, in practice this is rarely the case. In contrast, MacDonald's
400 omega allows differences in the importance of items and therefore item weights can differ in the
401 computation of the coefficient .

402 The present study revealed positive associations between the two subscales of the Gold-MSI
403 (Musical Training and Active Engagement) and the general factor and most subscales of the
404 Music@Home Infant and Preschool questionnaires. The results are in accordance with the results
405 by Politimou and colleagues (34) regarding the Infant version and only partly in accordance
406 regarding the Preschool version as in the English sample only Active Engagement but not
407 Musical Training correlated with the Music@Home scores. Overall, it seems that musical
408 engagement of the child is influenced by the general level of parents' musical activities and
409 involvement with music, which is in accordance with previous research (44).

410 In the present study, we also included two versions of a language development parent-report
411 questionnaire in order to examine relationships between home musical environment and language
412 development of the children. The results show that Music@Home scores are significantly
413 associated with language development scores in two-year-old children. However, no associations

414 were revealed when considering the language scores of the three year olds. The results of the two
415 years olds are interesting as they indicate that an enriched home musical environment can be
416 associated with more rapid language development in young toddlers. A positive link between
417 children's musical skills and/or formal musical training and language development has also been
418 reported in previous studies (15, 45, 46) and an association between higher frequency of musical
419 interactions and enriched musical exposure and development of complex language skills has been
420 reported in a study with 3- and 4-year-old children (47). However, it is important to note that the
421 results presented here need to be interpreted with caution. Even though the present data revealed
422 no correlations between parental SES variables and reported language scores on the SBE2 of two
423 year olds, many other confounding factors, which we have not controlled for, such as
424 environmental and genetic elements may influence language development (48, 49). Furthermore,
425 the fact that no associations were present between Music@Home scores and language
426 development in three year olds needs to be considered. There are several explanations for the
427 different findings in the two and three year olds: (i) we used two different versions of language
428 questionnaires for the assessment of language development in the two age groups, which lowers
429 the internal validity and strength of comparison of the two age groups (50), (ii) evaluating
430 language development in three year olds is more complex and therefore leads to higher variability
431 among participants (51), (iii) many other influencing factors may overshadow possible effects in
432 the three year olds such as language input of the parents and quality of child care (52) as children
433 of this age are more likely to be attending a range of activities outside the home. Furthermore, the
434 finding we present, that a higher parental school qualification is associated with better language
435 scores of the three years olds, but not two-year olds, may indicate that the influence of
436 socioeconomic factors on child development increases as children grow older (52). In this
437 respect, it is important to note that the parents, who participated in the current study, were mostly

438 middle class, since we used a convenience sample in the present study. For future research, it
439 would be important to try to recruit a more representative sample. The fact that our sample were
440 predominantly middle-class parents may lead to a potential bias in communication and
441 socialization strategies with their offspring (53). The association between SES and parental
442 education has been shown to be a strong predictor of early language development (54). However,
443 when separating SES/education from actual interaction variables, such as amount of daily verbal
444 interaction with their infants, robust research has shown that the developmental outcome is
445 predicted by the actual interaction variable rather than SES per se. For instance, Weisleder and
446 Fernald (55) investigated a lower-SES sample and showed that differences in the amount of
447 infant-directed verbal interactions mediated the infants' abilities to process language hence
448 predicted their expressive language at 24 months. Based on this perspective (56), we can
449 speculate that the moderate associations between parental musical sophistication measures, such
450 as formal training, and musical interactions with young children at home may well be mediated
451 by SES. However, parent-infant musical interactions will be associated to individual differences
452 independent of SES and the variations in the amount and quality of home music interactions that
453 would predict child developmental outcomes.

454 Another limitation is that we did not include a measure for general parental engagement. It may
455 be that parents who provide the two year old with a rich musical environment at home also
456 engage in other forms of activities with the child such as reading which could influence language
457 development. In future research, it would be desirable to also evaluate other home activities, next
458 to musical engagement, in order to disentangle whether an overall enriched home environment
459 leads to better language skills or whether language development is enhanced explicitly through
460 musical engagement. More research looking at the relationship between musical engagement at
461 home and language development is needed. It would be desirable to conduct a study with a larger

462 sample of two and three year olds and include the Music@Home questionnaire, a language
463 questionnaire such as the SBE-2 and SBE-3 and evaluate other forms of home activities in a
464 follow-up study. However, the results of the present study indicate that it could be useful to
465 assess home musical engagement in studies examining research questions on language
466 acquisition and possibly other developmental areas and we suggest that the Music@Home
467 questionnaire could be a useful tool for this.

468 In sum, this study presented the successful adaptation and validation of the German version of the
469 Music@Home questionnaire, which can be used to measure musical engagement in the home
470 beyond formal musical training in children under five. Both versions of the questionnaire
471 displayed good psychometric properties, allowing researchers to reliably assess the home musical
472 environment in two different age groups, and opening the way to novel research investigating the
473 influence of early home musical experiences on a range of developmental outcomes. The English
474 and German versions of the questionnaire are freely available for non-commercial research and
475 can be obtained from the authors upon request.

476
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487 **Competing interests**

488 None to declare.

489 **Author Contributions**

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