

SUPPLEMENTARY INFORMATION

The Major-Minor Mode Dichotomy in Music Perception

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Search strings¹

We included two separate searches and screenings, after recommendations by a previous peer-review process.

Previous search: May 2018

(musical mode OR musical modes OR music mode OR music modes) AND (perception OR psychology OR behavior OR behaviour OR brain OR cerebral OR emotion OR emotions OR emotional OR happiness OR sadness OR depression OR cognition OR auditory perception OR chords OR electroencephalography OR neural correlates OR neural correlate OR mismatch negativity OR cortex OR cerebral cortex OR magnetoencephalography OR magnetic resonance imaging OR children OR child OR infant OR infants OR adult OR adults OR limbic system)

Current last search: August 2023

PubMed

("music"[MeSH Terms] OR "musician"[All Fields] OR "music"[All Fields] OR "music listening" [All Fields] OR "music production" [All Fields] OR "music performance" [All Fields] OR "music playing" [All Fields] OR "music composition" [All Fields] OR "music perception" [All Fields] OR "musical mode"[All Fields] OR "major mode"[All Fields] OR "minor mode"[All Fields] OR "musical training"[All Fields] OR "musical expertise"[All Fields]) AND ("emotions"[MeSH Terms] OR "valence"[All Fields] OR "arousal"[MeSH Terms] OR "happiness"[MeSH Terms] OR "sadness"[MeSH Terms] OR "mood disorders"[MeSH Terms] OR "depression"[MeSH Terms]) AND ("magnetic resonance imaging"[MeSH Terms] OR "electroencephalography"[MeSH Terms] OR "evoked potentials"[MeSH Terms] OR "magnetoencephalography"[MeSH Terms] OR "transcranial magnetic stimulation"[MeSH Terms] OR "electrocorticography "[MeSH Terms])

614

Scopus

(TITLE-ABS-KEY("music") OR TITLE-ABS-KEY("musician") OR TITLE-ABS-KEY("music listening") OR TITLE-ABS-KEY("music production") OR TITLE-ABS-KEY("music performance") OR TITLE-ABS-KEY("music playing") OR TITLE-ABS-KEY("music composition") OR TITLE-ABS-KEY("music perception") OR TITLE-ABS-KEY("musical mode") OR TITLE-ABS-KEY("major mode") OR TITLE-ABS-KEY("minor mode") OR TITLE-ABS-KEY("musical training") OR TITLE-ABS-KEY("musical expertise")) AND (TITLE-ABS-KEY("emotions") OR TITLE-ABS-KEY("valence") OR TITLE-ABS-KEY("arousal") OR TITLE-ABS-KEY("mood disorders") OR TITLE-ABS-KEY("depression")) AND (TITLE-ABS-KEY("magnetic resonance imaging") OR TITLE-ABS-KEY("electroencephalography") OR TITLE-ABS-KEY("evoked potentials") OR TITLE-ABS-KEY("magnetoencephalography") OR TITLE-ABS-KEY("transcranial magnetic stimulation") OR TITLE-ABS-KEY("electrocorticography"))

882

PsycInfo

(Music OR Musician OR Music listening OR Music production OR Music performance OR Music playing OR Music composition OR Music perception OR Musical mode OR Major mode OR Minor mode OR musical training OR Musical expertise) AND (Emotions OR Valence OR Arousal OR Mood disorders OR Depression) AND (Magnetic resonance imaging OR Electroencephalography OR Evoked potentials OR Magnetoencephalography OR Transcranial magnetic stimulation OR Electrocorticography)

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Figure S1

PRISMA Flowchart for Literature Search Process²

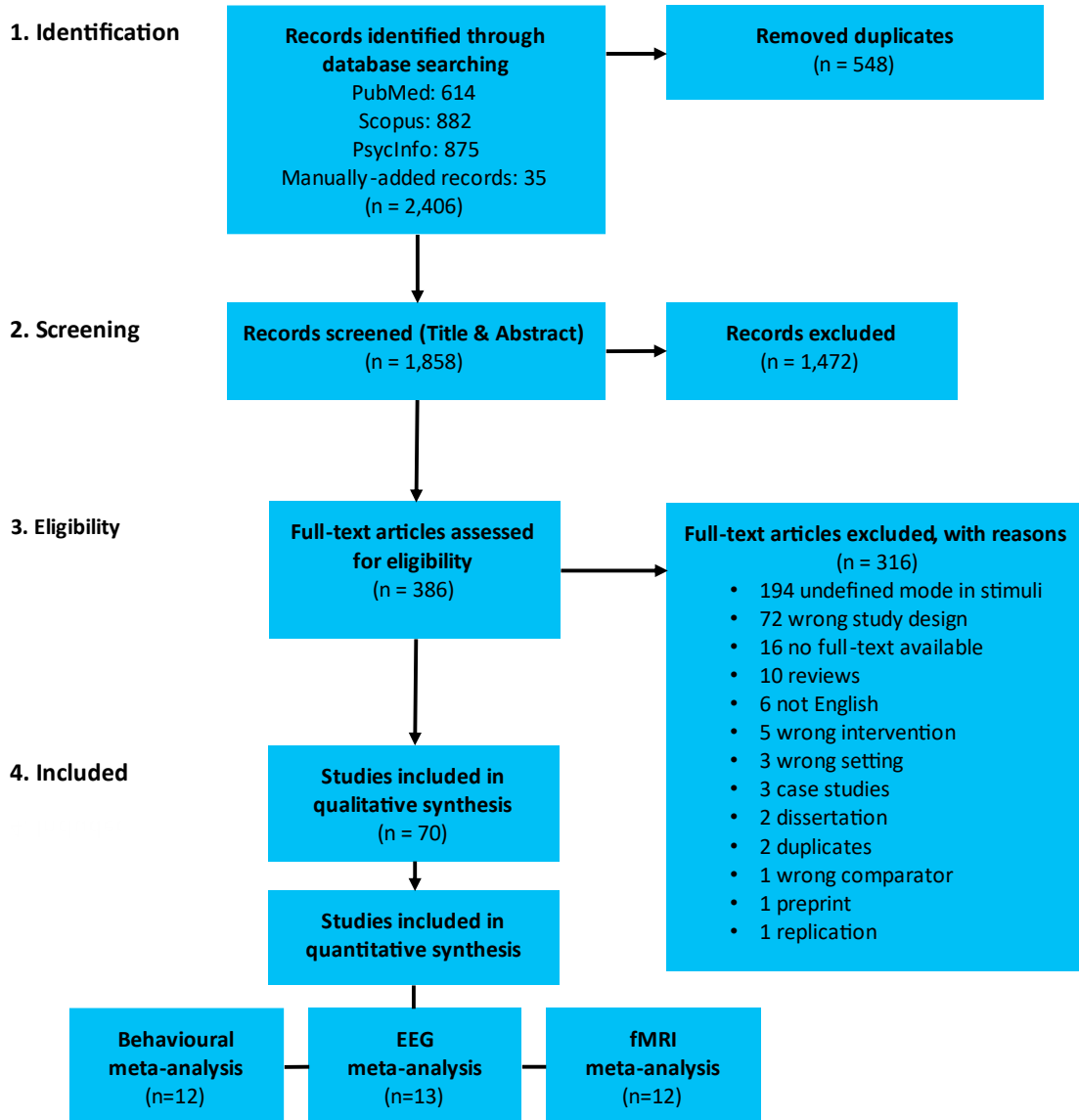


Table S1. Characteristics of included studies.

	<i>Author (year)</i>	Country	N	Age (mean)	Age group	Males	Females	Years of education	Musical expertise	Years of musical training	Onset of musical training	Training time (hr/wk)	Method	Modality	Stimuli	Contextual/Isolated
1	<i>Abe et al. (2017)</i>	Japan	58	42	Adult	20	38	>9	U	-	-	-	Beh	-	Musical chords	Contextual
2	<i>Al'tmann et al. (2000)</i>	Russia	18	31.5	Adult	13	5	-	U	-	-	-	Beh	-	Musical excerpts	Contextual
3	<i>Bakker & Martin (2015)</i>	Australia	30	20	Adult	15	15	-	NM	-	-	-	Phys/Beh	EEG	Musical chords	Isolated
4	<i>Bonetti & Costa (2016)</i>	Italy	80	21.4	Adult	20	60	-	M/NM	8.57	-	-	Beh	-	Musical excerpts	Isolated
5	<i>Bonetti & Costa (2019)</i>	Italy	219	20.8	Adult/Toddler	121	98	-	M/NM	6.95	-	-	Beh	-	Musical chords	Isolated
6	<i>Bonetti et al. (2017)</i>	Denmark	88	28.4	Adult	40	48	-	M/NM	21	-	-	Phys	MEG/EEG	Musical excerpts	Isolated
7	<i>Brattico et al. (2009)</i>	Finland	20	26.4	Adult	6	14	-	M/NM	18.2	-	14	Phys/Beh	MEG	Musical chords	Isolated
8	<i>Brattico et al. (2011)</i>	Finland	15	23.9	Adult	9	6	-	M/NM	14	-	-	Phys/Beh	fMRI	Musical excerpts	Contextual
9	<i>Brattico et al. (2016)</i>	Denmark	29	23.9	Adult	14	15	-	M/NM	16.2	9.1	18.6	Phys/Beh	fMRI	Musical excerpts	Contextual
10	<i>Castro & Lima (2014)</i>	Portugal	80	23	Adult	40	40	-	M/NM	≥ 9	-	-	Beh	-	Musical excerpts	Contextual
11	<i>Chang et al. (2015)</i>	Taiwan	30	21.6	Adult	20	10	-	U	-	-	-	Phys/Beh	EEG	Musical excerpts	Contextual
12	<i>Chubb et al. (2013)</i>	USA	184	-	Adult	-	-	-	M/NM	-	-	-	Beh	-	Tone scrambles	Isolated
13	<i>Costa (2013)</i>	Italy	152	23.6	Adult	19	133	-	NM	-	-	-	Beh	-	Musical chords	Contextual/Isolated
14	<i>Costa et al. (2004)</i>	Italy	29	22.1	Adult	12	17	-	NM	-	-	-	Beh	-	Musical pieces	Contextual
15	<i>Dalla Bella et al. (2001)</i>	Canada	91	23	Adult/Preschool/Elementary school	42	49	-	NM	-	-	-	Beh	-	Musical excerpts	Contextual
16	<i>Dobrota & Ervegovic (2015)</i>	Croatia	323	21.7	Adult	89	234	-	U	-	-	-	Beh	-	Musical pieces	Contextual
17	<i>Eerola et al. (2013)</i>	Finland	46	30.2	Adult	25	20	-	M/NM	-	-	-	Beh	-	Musical excerpts	Contextual
18	<i>Ellison et al. (2015)</i>	Finland	24	24.6	Adult	9	15	-	NM	-	-	-	Phys/Beh	EEG	Musical chords	Contextual/Isolated
19	<i>Fang et al. (2017)</i>	China	70	21.4	Adult	25	45	14.7	NM	-	-	-	Beh	-	Musical excerpts	Contextual
20	<i>Franco et al. (2017)</i>	UK	112	22.2	Adult/Preschool	44	68	-	NM	-	-	-	Beh	-	Musical pieces	Contextual
21	<i>Gosselin et al. (2005)</i>	Canada	32	39.8	Adult	14	18	13	NM	-	-	-	Beh	-	Musical excerpts	Contextual
22	<i>Green et al. (2008)</i>	Denmark	21	27.3	Adult	-	-	-	NM	-	-	-	Phys/Beh	fMRI	Musical excerpts	Contextual
23	<i>Gregory et al. (1996)</i>	UK	96	-/3-8	Adult/Preschool/Elementary school	-	-	-	U	-	-	-	Beh	-	Musical pieces	Contextual
24	<i>Halpern (1984)</i>	USA	45	-	Adult	-	-	-	M/NM	≥ 5	-	-	Beh	-	Musical excerpts	Contextual
25	<i>Halpern et al. (1998)</i>	USA	103	18.8	Adult	-	-	-	M/NM	11.7/11.2	-	-	Beh	-	Musical excerpts	Contextual
26	<i>Halpern et al. (2008)</i>	USA	36	19-34	Adult	12	24	15.9	M/NM	11.3	-	-	Phys/Beh	EEG	Musical excerpts	Contextual
27	<i>Heaton et al. (1999)</i>	UK	42	10	Elementary school/Teenagers	NA	NA	NA	U	NA	NA	NA	Beh	-	Musical excerpts	Contextual

28	<i>Hevner (1935)</i>	USA	205	-	Adult	-	-	-	M/NM	-	-	-	Beh	-	Musical excerpts	Contextual
29	<i>Hoshino (1996)</i>	Japan	66	20.1	Adult	0	66	-	M/NM	14	-	-	Beh	-	Musical excerpts	
30	<i>Hunter et al. (2008)</i>	Canada	80	-	Adult	28	52	-	M/NM	4.6	-	-	Beh	-	Musical pieces	Contextual/Is
31	<i>Hunter et al. (2011)</i>	Canada	102	-	Adult	-	-	-	U	-	-	-	Beh	-	Musical pieces	Contextual
32	<i>Jenni et al. (2017)</i>	Switzerland	59	23.5	Adult	-	-	-	M/NM	16.2	6.5	-	Phys	EEG	Musical excerpts	Contextual
33	<i>Jeong et al. (2011)</i>	USA	15	22.8	Adult	5	10	-	NM	-	-	-	Phys/Beh	fMRI	Musical excerpts	Contextual
34	<i>Jomori et al. (2013)</i>	Japan	14	26.5	Adult	5	9	-	NM	-	-	-	Phys/Beh	MEG	Musical excerpts	Contextual
35	<i>Kastner & Crowder (1990)</i>	USA	38	3-12	Preschool/Elementary school	-	-	-	U	-	-	-	Beh	-	Musical excerpts	Isolated
36	<i>Khalfa et al. (2005)</i>	France	13	28	Adult	8	5	-	U	-	-	-	Phys/Beh	fMRI	Musical excerpts	Isolated
37	<i>Khalfa et al. (2008)</i>	France	86	31.5	Adult	40	46	12.5	M/NM	-	-	-	Beh	-	Musical excerpts	Isolated
38	<i>Ladinig & Schellenberg (2012)</i>	Ca-da	61	18.3	Adult	8	53	-	M/NM	1.8	-	-	Beh	-	Musical pieces	Isolated
39	<i>Leaver & Halpern (2004)</i>	USA	165	18.7	Adult	94	71	-	M/NM	9.8	-	-	Beh	-	Musical excerpts	Contextual
40	<i>Lee et al. (2011)</i>	USA	12	20.4	Adult	7	5	-	M/NM	5.7	-	-	Phys/Beh	fMRI	Musical excerpts	Contextual
41	<i>Lin et al. (2014)</i>	USA	24	24.6	Adult	14	10	-	NM	-	-	-	Phys	EEG	Musical pieces	Contextual
42	<i>Mao & Rau (2014)</i>	UK	12	23.1	Adult	7	5	-	U	-	-	-	Phys/Beh	EEG	Musical pieces	Contextual
43	<i>Maslennikova et al. (2013)</i>	Russia	15	24.5	Adult	1	14	-	NM	-	-	-	Phys/Beh	EEG	Musical chords	Isolated
44	<i>McConnel & Shore (2011)</i>	Canada	90	19.5	Adult	24	66	-	U	-	-	-	Beh	-	Musical pieces	Contextual
45	<i>Mednicoff et al. (2018)</i>	USA	73	-	Adult	-	-	-	M/NM	3.1	-	-	Beh	-	Tone scrambles	Isolated
46	<i>Mizuno & Sugishita (2007)</i>	Japan	18	23.1	Adult	10	8	-	M	12.4	-	-	Phys	fMRI	Musical chords	Contextual
47	<i>Nemoto et al. (2010)</i>	Japan	17	21	Adult	17	0	-	U	-	-	-	Phys	fMRI	Musical chords	Contextual/Is
48	<i>Nieminen et al. (2012)</i>	Finland	78	7.4	Elementary school	38	40	-	M/NM	-	-	-	Beh	-	Musical excerpts	Contextual
49	<i>Pallesen et al. (2003)</i>	Denmark	12	25	Adult	5	7	-	NM	-	-	-	Phys/Beh	fMRI	Musical chords	Isolated
50	<i>Pallesen et al. (2005)</i>	Denmark	21	26	Adult	12	14	-	M/NM	-	-	-	Phys/Beh	fMRI	Musical chords	Isolated
51	<i>Pallesen et al. (2015)</i>	Denmark	22	26.8	Adult	6	16	-	M/NM	18.2	-	14	Phys	MEG	Musical chords	Isolated
52	<i>Pilcher et al. (2014)</i>	UK	15	20s	Adult	5	10	-	NM	-	-	-	Beh	-	Musical pieces	Isolated
53	<i>Proverbio et al. (2020)</i>	Italy	16	22.3	Adult	8	8	-	U	-	-	-	Phys/Beh	EEG	Musical excerpts	Contextual
54	<i>Putkinen et al. (2014)</i>	Finland	133	7-13	Elementary school/Teenagers	-	-	-	M/NM	-	-	-	Phys	EEG	Musical chords	Isolated
55	<i>Schellenberg et al. (2008)</i>	Canada	108	-	Adult	-	-	-	M/NM	1.9	-	-	Beh	-	Musical excerpts	Contextual

56	Smit et al. (2022)	Australia	249	27.4	Adult	103	146	-	M/NM/U	<5	-	-	Beh	-	Musical chords/Musical excerpts	Contextual
57	Steinbeis & Koelsch (2011)	Germany	40	22.7	Adult	20	20	-	M/NM	12.32	-	-	Phys/Beh	EEG	Musical chords	Contextual
58	Suda et al. (2008)	Japan	10	25-35	Adult	5	5	-	U	-	-	-	Phys/Beh	OT	Musical pieces	Contextual
59	Suzuki et al. (2008)	Japan	13	20-26	Adult	13	0	-	M/NM	3.3	-	-	Phys/Beh	PET	Musical chords	Contextual
60	Tabei (2015)	Japan	17	21	Adult	7	10	-	M	-	-	-	Phys/Beh	fMRI	Musical excerpts	Contextual
61	Thompson & Opfer (2014)	USA	240	19.7/7.9	Adult/Preschool/Elementary school	131	109	-	U	-	-	-	Beh	-	Musical excerpts	Contextual
62	Trochidis & Bigand (2013)	Canada	16	16	Adult	8	8	-	NM	-	-	-	Phys/Beh	EEG	Musical pieces	Contextual
63	Tsang et al. (2001)	Canada	55	-	Adult	-	-	-	U	-	-	-	Phys/Beh	EEG	Musical excerpts	Contextual
64	van der Zwaag et al. (2011)	Netherlands	20	22	Adult	5	15	-	NM	-	-	-	Phys/Beh	ECG and respiration	Musical pieces	Contextual
65	Virtala et al. (2011)	Finland	16	28	Adult	6	10	-	NM	-	-	-	Phys	EEG	Musical chords	Isolated
66	Virtala et al. (2012)	Finland	24	13	Teenager	11	13	7	M/NM	-	-	-	Phys	EEG	Musical chords	Isolated
67	Virtala et al. (2013)	Finland	19	<1	Infant	-	-	-	NM	-	-	-	Phys	EEG	Musical chords	Isolated
68	Virtala et al. (2014)	Finland	30	24	Adult	13	17	-	M/NM	-	-	-	Phys/Beh	EEG	Musical chords	Isolated
69	Wang et al. (2018)	China	47	51	Adult	23	24	-	U	-	-	-	Phys	EEG	Musical pieces	Contextual
70	Zhou et al. (2019)	UK	32	24	Adult	10	22	17	NM	-	-	-	Phys/Beh	EEG	Musical chords	Isolated
Beh, behavioural study; B, both; EEG, electroencephalography; ERP, event-related potential; MEG, magnetometry of participants; OT, optical topography; PET, positron emission tomography; Phys, physiological study; U, un																

Table S2

PRISMA Checklist²

SI = Supplementary Information

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			

Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7-8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8-9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8-9
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	9-10-11

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	13

Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	15
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	13
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	15-16-17-18
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	15
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	19
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	42
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	46
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	NA

Table S3*Main Results of Included Studies*

	Author (year)	Title	Main results
1	<i>Abe et al. (2017)</i>	Music-evoked emotions in schizophrenia	Patients diagnosed with schizophrenia significantly failed to recognize minor mode chords as sad compared to healthy controls.
2	<i>Al'tmann et al. (2000)</i>	Estimation of short musical fragments in normal subjects and patients with chronic depression	Compositions in a minor key determined emotional estimate instability (expressed as high standard deviations) in patients with retarded depression.
3	<i>Bakker & Martin (2015)</i>	Musical chords and emotion: Major and minor triads are processed for emotion	N2 amplitudes were significantly lower for congruent (major mode–happy faces and minor mode–sad faces) than for incongruent pairings. No significant effects of chord congruence were observed for the P1.
4	<i>Bonetti & Costa (2016)</i>	Intelligence and musical mode preference	Preference for minor mode is significantly associated with fluid intelligence.
5	<i>Bonetti & Costa (2019)</i>	Musical mode and visual- spatial cross-modal associations in infants and adult	Children develop the association minor mode/sadness later than major mode/happiness. Warm-cold colours were associated with happy-sad stimuli in adults but not in children.
6	<i>Bonetti et al. (2017)</i>	Risk of depression enhances auditory Pitch discrimination in the brain as indexed by the mismatch negativity	Results showed higher MMN amplitudes to mistuned pitches within a major context compared to MMN to pitch changes in a minor context, suggesting a higher responsivity to sound frequency changes also in a subclinical condition of depression.
7	<i>Brattico et al. (2009)</i>	Neural discrimination of nonprototypical chords in music experts and laymen: An MEG study	MMN measures indicated an enhanced reactivity of the auditory cortex to unpleasant chords in musicians, but no difference was found in MMN to minor chords between musicians and non-musicians.
8	<i>Brattico et al. (2011)</i>	A functional MRI study of happy and sad emotions in music with and without lyrics	Sad music (in minor mode) induced activity within the right caudate head and the left thalamus, whereas instrumental happy music (in major mode) significantly activated structures of the limbic system and the right pars opercularis of the inferior frontal gyrus, with the involvement of auditory regions only to happy music with lyrics.
9	<i>Brattico et al. (2016)</i>	It's sad but I like it: The neural dissociation between musical emotions and liking in experts and laypersons	Well-trained musicians consider music in minor mode as beautiful and pleasant compared to non-musicians.
10	<i>Castro & Lima (2014)</i>	Age and musical expertise influence emotion recognition in music	Music training is associated with a more accurate categorization of musical emotions in response to sad/happy musical excerpts.

11	<i>Chang et al. (2015)</i>	Experiencing affective music in eyes-closed and eyes-open states: an electroencephalography study	When listening to musical pieces with different emotional content (i.e., positive music in major mode and negative music in minor mode), participants in eyes-open condition tend to rate music as more positive-valenced compared to eyes-closed condition. Also, the theta power in the frontal area significantly increased while listening to emotional-positive music compared to emotional-negative music under the eyes-closed condition.
12	<i>Chubb et al. (2013)</i>	Bimodal distribution of performance in discriminating major/minor modes	When asked to classify single tone-scrambles as major or minor, approximately 70% of listeners performed near chance, whereas the other 30% performed nearly perfectly.
13	<i>Costa (2013)</i>	Effects of mode, consonance, and register in visual and word-evaluation affective priming experiments	Mode can automatically influence non-musical cognitive tasks such as word and picture evaluation. When presented with an effectively congruent chord as prime, target words or pictures are evaluated faster and more correctly.
14	<i>Costa et al. (2004)</i>	Interval distributions, mode, and tonal strength of melodies as predictors of perceived emotion	The attribution of happiness and serenity is associated with the major mode.
15	<i>Dalla Bella et al. (2001)</i>	A developmental study of the affective value of tempo and mode in music	5-year-olds children can discriminate happy and sad musical excerpts, but they only used information about tempo, whereas starting from 6-8 years old they utilized both tempo and mode, like adults.
16	<i>Dobrota & Ervegovac (2015)</i>	The relationship between music preferences of different mode and tempo and personality traits-implications for music pedagogy	Emotional stability and optimism are significant predictors of preferences towards music in major mode.
17	<i>Eerola et al. (2013)</i>	Emotional expression in music: Contribution, linearity, and additivity of primary musical cues	When listeners judged the perceived emotional characters of 200 musical examples, mode was the most important cue.
18	<i>Ellison et al. (2015)</i>	Affective versus cognitive responses to musical chords: An ERP and behavioral study	In an ERP study, participants classified major and minor chords as happy and sad, respectively. Moreover, sad-rated, and minor chords were followed by negative ERPs at 300 ms postonset.
19	<i>Fang et al. (2017)</i>	Perception of Western musical modes: A Chinese study	Results show that major mode music among Chinese people induces greater pleasure, arousal, and liking ratings than minor-mode music, which instead induces greater tension.
20	<i>Franco et al. (2017)</i>	Preschoolers' attribution of affect to music: A comparison between vocal and instrumental performance	The results showed that even the youngest children were able to correctly identify the intended emotion in music, though the recognition of happy music appeared facilitated in the instrumental condition.
21	<i>Gosselin et al. (2005)</i>	Impaired recognition of scary music following unilateral temporal lobe excision	Recognition of happy (major mode) and sad (minor mode) musical excerpts was not impaired in patients with unilateral medial temporal lobe excision.
22	<i>Green et al. (2008)</i>	Music in minor activates limbic structures: a relationship with dissonance?	Minor melodies caused increased activity in limbic structures, namely left parahippocampal gyrus, bilateral ventral anterior cingulate, and in left medial prefrontal cortex compared to major melodies. Minor mode music was rated as sadder than major mode, whereas no significant difference was found in liking ratings.
23	<i>Gregory et al. (1996)</i>	The development of emotional responses to music in young children	7 to 8-year-olds children (like adults) showed significant differential responses to major and minor mode, but 3 to 4-year-olds children showed almost no difference, suggesting that the emotional response related to musical mode develops between the ages of 4 and 7 years.

24	<i>Halpern (1984)</i>	Perception of structure in novel music	When asked to discriminate between tunes in major and minor mode, non-musicians perform worse than musicians.
25	<i>Halpern et al. (1998)</i>	Perception of mode, rhythm, and contour in unfamiliar melodies: Effects of age and experience.	The discrimination of major from minor tunes is difficult for everyone, even for musicians.
26	<i>Halpern et al. (2008)</i>	An ERP study of major- minor classification in melodies	When asked to judge each melody as major/minor and happy/sad, musicians showed a late P3 to the critical note only for minor melodies in both tasks. Moreover, non-musicians who did not have affective labels available were unable to do this classification, and non-musicians who either were told about affective labels, showed moderately good performance.
27	<i>Heaton et al. (1999)</i>	Can children with autistic spectrum disorders perceive affect in music? An experimental investigation	No significant difference arose between children with autism and matched controls in identifying the affective connotations of major and minor mode music.
28	<i>Hevner (1935)</i>	The affective character of the major and minor modes in music	Major mode was associated with “happy” adjectives whilst the participants selected more “sad” adjectives when the music was played in minor mode.
29	<i>Hoshino (1996)</i>	The feeling of musical mode and its emotional character in a melody	Even non-western listeners associate the major mode with positive emotions and the minor mode with negative emotions.
30	<i>Hunter et al. (2008)</i>	Mixed affective responses to music with conflicting cues	Listeners tend to find music they rate as happy (major key) also as pleasant, whereas music rated as sad is perceived as unpleasant.
31	<i>Hunter et al. (2011)</i>	Misery loves company: Mood-congruent emotional responding to music	After inducing sad mood, the typical preference for major mode reduced and ambiguous stimuli are perceived as sadder.
32	<i>Jenni et al. (2017)</i>	Impact of major and minor mode on EEG frequency range activities of music processing as a function of expertise	Minor and major compositions distinctively modulated synchronisation of neuronal activities in high-frequency ranges (beta and gamma) in frontal regions, with increased activity in response to minor compositions especially in musicians and in experts. High-frequency electroencephalographic (EEG) activities carry information about musical mode.
33	<i>Jeong et al. (2011)</i>	Congruence of happy and sad emotion in music and faces modifies cortical audiovisual activation	The activation of superior temporal gyrus (STG) when happy music (major mode) was presented with happy faces was greater than the activation seen when sad music (minor mode) was presented with sad faces. In contrast, incongruent stimuli diminished the BOLD response in STG and elicited greater signal change in bilateral FG. When presented with happy music, happy faces were rated as happier, and sad faces were rated as less sad. When presented with sad music, happy faces were rated as less happy, and sad faces were rated as sadder.
34	<i>Jomori et al. (2013)</i>	Effects of emotional music on visual processes in inferior temporal area	A relatively larger M170 response during visual stimulation in the inferior temporal area was induced during negative (minor mode) compared to positive (major mode) music.
35	<i>Kastner & Crowder (1990)</i>	Perception of the major/minor distinction: IV. Emotional connotations in young children	Children aged 3 and 12 years, showed both a reliable positive/major negative/minor association.
36	<i>Khalifa et al. (2005)</i>	Brain regions involved in the recognition of happiness and sadness in music	Results of the minor versus major mode contrast showed a larger activity in the posterior cingulate cortex, and in the left orbital and mid-dorsolateral frontal cortex.

37	<i>Khalifa et al. (2008)</i>	Evidence of lateralized anteromedial temporal structures involvement in musical emotion processing	Both right and left temporal resections impaired sadness (minor mode music) recognition, whereas happiness (major mode) recognition was only reduced by the left-resections.
38	<i>Ladinig & Schellenberg (2012)</i>	Liking unfamiliar music: effects of felt emotion and individual differences	High scores on Agreeableness and Neuroticism dimensions are associated with stronger sad feelings in response to music. Sad music (in minor mode) tends to be more appreciated among listeners who scored high Introversion or low Extroversion levels, or high Openness to experience.
39	<i>Leaver & Halpern (2004)</i>	Effects of training and melodic features on mode perception	Non-musicians found mode discrimination to be harder than discrimination of other melodic features. Trained non-musicians and musicians showed a better performance but not to ceiling levels.
40	<i>Lee et al. (2011)</i>	Investigation of melodic contour processing in the brain using multivariate pattern-based fMRI	In a fMRI study, ascending and descending melodic sequences in major mode are perceived as happier than minor melodies irrespective of the contour. Searchlight analysis with respect to mode (major vs. minor) did not find any significant voxels.
41	<i>Lin et al. (2014)</i>	Revealing spatio-spectral electroencephalographic dynamics of musical mode and tempo perception by independent component analysis	Empirical results showed that music in major mode increases delta band activity over the right sensorimotor cortex, decreases theta activity over the superior parietal cortex and moderately suppresses beta activity over the medial frontal cortex compared to minor-mode music, where fast tempo music only engages significant alpha suppression over the right sensorimotor cortex.
42	<i>Mao & Rau (2014)</i>	EEG-based measurement of emotion induced by mode, rhythm, and MV of Chinese pop music	Among Chinese listeners, major mode was significantly more positive, and of higher arousal level than that induced by minor mode. Moreover, major mode is more likely to activate people and evoke feelings of vitality, happiness, and excitement
43	<i>Maslennikova et al. (2013)</i>	Evoked changes in EEG band power on perception of consonant and dissonant chords	Subjective evaluations of major and minor chords elicited no significant differences in terms of pleasantness/unpleasantness.
44	<i>McConnel & Shore (2011)</i>	Upbeat and happy: Arousal as an important factor in studying attention	Participants were in a more pleasant mood after listening to music written in major mode compared to music written in minor mode. Furthermore, musical mode influenced affective valence and arousal.
45	<i>Mednicoff et al. (2018)</i>	Many listeners cannot discriminate major vs minor tone-scrambles regardless of presentation rate	Listeners' performance in a major/minor classification task is not depending on the speed of presentation.
46	<i>Mizuno & Sugishita (2007)</i>	Neural correlates underlying perception of tonality-related emotional contents	No brain regions were found significantly related to listening to sequences in a major mode than those in a minor mode or vice versa. The data also suggest that the bilateral inferior gyri and thalamus are involved in sensing the mode.
47	<i>Nemoto et al. (2010)</i>	fMRI measurement of brain activities to major and minor chords and cadence sequences	Superior temporal gyrus and posterior and anterior cingulate are shown to be activated more strongly by minor chords than by major chords. In general, minor chords activated larger areas of brain regions than major chords.
48	<i>Nieminen et al. (2012)</i>	The development of the aesthetic Experience of music: Preference, emotions, and beauty	Children preferred the piece in major mode to the one in minor. But only 8-9-year-olds found the minor pieces sadder than the major pieces, and the major pieces more beautiful than the piece in minor.
49	<i>Pallesen et al. (2003)</i>	Emotional connotations of major and minor musical chords in musically untrained listeners	Untrained listeners are able to recognize the happy/sad emotional connotations of major/minor mode.

50	<i>Pallesen et al. (2005)</i>	Emotion processing of major, minor, and dissonant chords: a functional magnetic resonance imaging study	Minor and dissonant chords, compared with major chords, elicited enhanced responses in several brain areas, including the amygdala, retrosplenial cortex, brain stem, and cerebellum. Findings did not show any consistent difference between musicians and non-musicians when they listened to major, minor and dissonant isolated chords.
51	<i>Pallesen et al. (2015)</i>	Experience drives synchronization: the phase and amplitude dynamics of neural oscillations to musical chords are differentially modulated by musical expertise	Musicians reported a stronger gamma-band activity in response to non-prototypical chords in musicians, while beta-band activity was stronger in non-musicians when they listened to minor chords.
52	<i>Pilcher et al. (2014)</i>	Da capo: A musical technique to evoke narrative recall	In a memory evocation task, the major key evoked experiences of celebrations and ‘triumphs,’ and pieces in minor keys evoked experiences of exams, sadness, and disappointment.
53	<i>Proverbio et al. (2020)</i>	Multimodal recognition of emotions in music and facial expressions	Negative musical fragments (in minor mode) elicited greater auditory N400 than positive musical fragments (major mode), especially over the right hemisphere.
54	<i>Putkinen et al. (2014)</i>	Enhanced development of auditory change detection in musically trained school-aged children: A longitudinal event-related potential study	School-aged children showed MMNs to minor chords among major chords, with musical training and older age enhancing this effect.
55	<i>Schellenberg et al. (2008)</i>	Liking for happy- and sad- sounding music: Effects of exposure	After a long and complex task, the participants did not show the typical preference for happy over sad music.
56	<i>Smit et al. (2022)</i>	Emotional responses in Papua New Guinea show negligible evidence for a universal effect of major versus minor music	In a cross-cultural study, the typical major/happy and minor/sad association is strongly associated with exposure to Western or Western-like music.
57	<i>Steinbeis & Koelsch (2011)</i>	Affective priming effects of musical sounds on the processing of word meaning	Both musically trained and untrained participants evaluated emotional words more quickly when they were congruent to the affective connotation of a preceding chord (major-happy/minor-sad) as compared to words incongruent to the preceding chord. Moreover, a larger N400 for incongruous target words compared to congruous target words for both musically trained and musically untrained participants was found.
58	<i>Suda et al. (2008)</i>	Emotional responses to music: towards scientific perspective on music therapy	Salivary cortisol levels showed a significant decrease among major mode listeners. Moreover, in response to major mode music, haemoglobin increased.
59	<i>Suzuki et al. (2008)</i>	Discrete cortical regions associated with the musical beauty of major and minor chords	Minor chords perceived as beautiful, strongly activated the right striatum, whereas the “beautiful” major chords elicited significant left middle temporal gyrus activity.
60	<i>Tabei (2015)</i>	Inferior Frontal Gyrus Activation Underlies the Perception of Emotions, While Precuneus Activation Underlies the Feeling of Emotions during Music Listening.	Bilateral inferior frontal gyri and the precuneus are important areas for the perception of the emotional content of music and for the emotional response evoked in the listener
61	<i>Thompson & Opfer (2014)</i>	Affective constraints on acquisition of musical concepts: Children’s and adults’ development of the major–minor distinction	Adults, 10-year-olds, and 5-year-olds rated affective quality of excerpts that differed by mode, tempo, pitch, and excerpts type and then categorized the excerpts by mode. The assessment of category

			judgments indicated performance was accurately predicted by subjects' association of affective valence with musical properties.
62	<i>Trochidis & Bigand (2013)</i>	Investigation of the effect of mode and tempo on emotional responses to music using EEG power asymmetry	Musical modes influence the valence of emotion with major mode being evaluated happier and more serene than minor and Locrian mode. Furthermore, in EEG frontal activity, major mode was associated with an increased alpha activation in the left hemisphere compared to minor modes, which increased activation in the right hemisphere.
63	<i>Tsang et al., (2001)</i>	Frontal EEG responses as a function of affective musical features.	Change from minor to major (happier) induced increased left frontal activation while change from major to minor (sadder) decreased left frontal activation
64	<i>van der Zwaag et al. (2011)</i>	Emotional and Psychophysiological responses to tempo, mode, and percussiveness	Minor mode music evoked higher arousal ratings than major mode music.
65	<i>Virtala et al. (2011)</i>	The preattentive processing of major vs. minor chords in the human brain: An event-related potential study	Musically untrained individuals can neurally categorise chords even preattentively. Modes (minor, major) and degree of consonance (dissonance, consonance) can be preattentively encoded.
66	<i>Virtala et al. (2012)</i>	Musical training facilitates the neural discrimination of major versus minor chords in 13-year-old children	Only musically trained children demonstrated MMNs to the major- minor contrast.
67	<i>Virtala et al. (2013)</i>	Newborn infants' auditory system is sensitive to Western music chord categories	Newborn infants are sensitive to Western music categorizations since they showed statistically significant MMRs responses to dissonant and minor chords in a context of major chords.
68	<i>Virtala et al. (2014)</i>	Musicianship facilitates the processing of Western music chords—An ERP and behavioral study	Change-related mismatch negativity (MMN) was evoked to minor and inverted major chords in musicians only, and N1 amplitude was larger in musicians than non-musicians.
69	<i>Wang et al. (2018)</i>	Study on the impact of different music education on emotional regulation of adolescents based on EEG signals	Minor music can achieve better psychological regulation and relaxation compared to major music.
70	<i>Zhou et al. (2019)</i>	Impaired emotional processing of chords in congenital amusia: Electrophysiological and behavioral evidence	Participants without amusia (vs amusia) had faster reaction times and a larger N400 when judging the pleasantness of affectively congruous target images compared to affectively incongruous target images

Table S4.

Quality Assessment of All included Studies³

	Author (year)	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total Score
1	Abe et al. (2017)	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
2	Al'tmann et al. (2000)	2	2	1	1	NA	NA	NA	2	1	1	1	1	2	2	0.73
3	Bakker & Martin (2015)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
4	Bonetti & Costa (2016)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
5	Bonetti & Costa (2019)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
6	Bonetti et al. (2017)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
7	Brattico et al. (2009)	2	2	2	2	NA	NA	NA	2	1	2	2	2	2	2	0.95
8	Brattico et al. (2011)	2	2	2	2	NA	NA	NA	2	1	2	2	2	2	2	0.95
9	Brattico et al. (2016)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
10	Castro & Lima (2014)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
11	Chang et al. (2015)	2	2	1	1	NA	NA	NA	1	2	2	2	1	2	2	0.82
12	Chubb et al. (2013)	2	2	1	1	NA	NA	NA	2	2	2	2	1	2	2	0.86
13	Costa (2013)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
14	Costa et al. (2004)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
15	Dalla Bella et al. (2001)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
16	Dobrota & Ervegovac (2015)	2	2	2	1	NA	NA	NA	2	2	2	2	1	2	2	0.91
17	Eerola et al. (2013)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
18	Ellison et al. (2015)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
19	Fang et al. (2017)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
20	Franco et al. (2017)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
21	Gosselin et al. (2005)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
22	Green et al (2008)	2	2	2	1	NA	NA	NA	2	2	2	2	1	2	2	0.91
23	Gregory et al. (1996)	2	2	1	1	NA	NA	NA	2	2	2	1	2	2	2	0.86
24	Halpern (1984)	2	2	2	2	NA	NA	NA	2	2	2	2	1	2	2	0.95
25	Halpern et al. (1998)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
26	Halpern et al. (2008)	2	2	2	2	NA	NA	NA	2	1	2	2	2	2	2	0.95

27	Heaton et al. (1999)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
28	Hevner (1935)	2	1	2	1	NA	NA	NA	2	2	1	1	1	1	2	0.73
29	Hoshino (1996)	2	2	1	2	NA	NA	NA	2	2	2	2	2	1	2	0.91
30	Hunter et al. (2008)	2	2	2	2	NA	NA	NA	2	2	2	2	2	1	2	0.95
31	Hunter et al. (2011)	2	2	1	1	NA	NA	NA	2	2	2	2	1	2	2	0.86
32	Jenni et al. (2017)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
33	Jeong et al. (2011)	2	2	2	2	NA	NA	NA	2	1	2	2	2	2	2	0.95
34	Jomori et al. (2013)	2	1	2	2	NA	NA	NA	1	1	2	2	1	2	2	0.82
35	Kastner & Crowder (1990)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
36	Khalifa et al. (2005)	2	2	2	1	NA	NA	NA	2	2	2	2	1	2	2	0.91
37	Khalifa et al. (2008)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
38	Ladinig & Schellenberg (2012)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
39	Leaver & Halpern (2004)	2	2	2	2	NA	NA	NA	2	1	2	2	2	2	2	0.95
40	Lee et al. (2011)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
41	Lin et al. (2014)	2	2	2	2	NA	NA	NA	2	2	2	2	1	2	2	0.95
42	Mao & Rau (2014)	2	2	2	1	NA	NA	NA	2	1	2	1	1	2	2	0.82
43	Maslennikova et al. (2013)	2	2	2	1	NA	NA	NA	2	1	2	2	1	1	2	0.82
44	McConnel & Shore (2011)	2	2	2	1	NA	NA	NA	2	2	2	2	1	2	2	0.91
45	Mednicoff et al. (2018)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
46	Mizuno & Sugishita (2007)	2	2	1	1	NA	NA	NA	1	2	1	1	1	1	1	0.64
47	Nemoto et al. (2010)	0	1	1	0	NA	NA	NA	1	1	1	0	0	1	1	0.32
48	Nieminen et al. (2012)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
49	Pallesen et al. (2003)	2	2	1	1	NA	NA	NA	2	1	2	1	1	1	2	0.73
50	Pallesen et al. (2005)	2	2	2	1	NA	NA	NA	2	2	1	1	1	1	2	0.77
51	Pallesen et al. (2015)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	1.00
52	Pilcher et al. (2014)	2	2	2	1	NA	NA	NA	2	1	2	1	1	2	2	0.82
53	Proverbio et al. (2020)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
54	Putkinen et al. (2014)	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
55	Schellenberg et al. (2008)	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
56	Smit et al. (2022)	2	2	2	1	NA	NA	NA	2	2	2	2	1	2	2	0.91
57	Steinbeis & Koelsch (2011)	2	2	2	2	NA	NA	NA	2	2	2	2	1	2	2	0.95

58	<i>Suda et al. (2008)</i>	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
59	<i>Suzuki et al. (2008)</i>	2	2	2	2	NA	NA	NA	2	2	2	2	1	1	2	0.91
60	<i>Tabei (2015)</i>	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
61	<i>Thompson & Opfer (2014)</i>	2	2	1	1	NA	NA	NA	2	1	2	2	1	2	2	0.82
62	<i>Trochidis & Bigand (2013)</i>	2	2	2	1	NA	NA	NA	2	1	2	1	1	2	2	0.82
63	<i>Tsang et al., (2001)</i>	2	2	0	1	NA	NA	NA	2	2	1	1	1	2	2	0.73
64	<i>van der Zwaag et al. (2011)</i>	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	0.86
65	<i>Virtala et al. (2011)</i>	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
66	<i>Virtala et al. (2012)</i>	2	2	2	1	NA	NA	NA	2	2	2	2	2	2	2	0.95
67	<i>Virtala et al. (2013)</i>	2	2	2	1	NA	NA	NA	2	1	2	1	1	2	2	0.82
68	<i>Virtala et al. (2014)</i>	2	2	2	1	NA	NA	NA	2	1	2	1	1	2	2	0.82
69	<i>Wang et al. (2018)</i>	2	1	1	1	NA	NA	NA	1	2	1	1	0	2	2	0.64
70	<i>Zhou et al. (2019)</i>	2	2	2	2	NA	NA	NA	1	1	2	2	2	2	2	0.91

A summary score was calculated for each paper by summing the total score obtained across relevant items and dividing by the total possible score (i.e.: 28 – (number of “n/a” x 2)). A score higher than 0.75 suggests high quality, between 0.55 and 0.75 suggests moderate quality, and lower than 0.55 suggests low quality in the study. Since no qualitative studies were included in this review, only the checklist for assessing the quality of quantitative studies was used. The review only included observational studies, so items 5, 6, and 7 were scored as not applicable (NA). The total scores for each study ranged from 0.32 to 1.0 with a mean of 0.9 ± 0.12.

Checklist for assessing the quality of quantitative studies ³	
1	Question / objective sufficiently described?
2	Study design evident and appropriate?
3	Method of subject/comparison group selection <i>or</i> source of information/input variables described and appropriate?
4	Subject (and comparison group, if applicable) characteristics sufficiently described?
5	If interventional and random allocation was possible, was it described?
6	If interventional and blinding of investigators was possible, was it reported?
7	If interventional and blinding of subjects was possible, was it reported?
8	Outcome and (if applicable) exposure measure(s) well defined and robust to measurement/misclassification bias? Means of assessment reported?
9	Sample size appropriate?
10	Analytic methods described/justified and appropriate?
11	Some estimate of variance is reported for the main results?
12	Controlled for confounding?
13	Results reported in sufficient detail?
14	Conclusions supported by the results?

Table S5

fMRI Acquisition and Analysis

Author	Year	Teslas	MRI-system	MRI-model	Head-coil	Structural			Functional							Foci		
						T1 sequence	TR (ms)	TE (ms)	Voxel size (mm)	T2*sequence	TR (ms)	TE (ms)	Thickness (mm)	Acquisition Type	Analysis method		Analysis software	
1 Brattico	2011	3	General Electric	Signa	-	-	-	-	EPI	3	32	4	-	Interleaved	ANOVA	SPM8	Y	
2 Brattico	2016	3	General Electric	Signa	-	T1w	-	-	-	EPI	3	32	4	-	Interleaved	GLM	SPM8	Y
3 Green	2008	1.5	General Electric	Signa	-	T1w	-	-	-	EPI	2.7	40	5	-	-	GLM	SPM5	Y
4 Jeong	2011	3	General Electric	Signa	8-channel	SPGR	9.12	3.66	1x1x1	EPI	3	35	4	-	-	GLM	SPM8	Y
5 Khalfa	2005	3	Bruker	Medspec	-	T1w	-	-	1x0.75x1.22	STS	-	-	4	-	Interleaved	GLM	SPM99	Y
6 Lee	2011	3	Philips	Intera Achieva	-	MPRAGE	-	-	1z1z1	EPI	2	35	3	-	-	MVPA	SPM5	N
7 Mizuno	2007	1.5	General Electric	Signa	-	T1w	-	-	-	EPI	2	50	6.5	-	-	GLM	SPM99	Y
8 Nemoto	2010	1.5	Hitachi	Stratis-2	-	-	-	-	-	-	-	-	5	-	-	-	SPM8	N
9 Pallesen	2003	-	-	-	-	-	-	-	-	EPI	-	-	-	-	-	ANOVA	-	N
10 Pallesen	2005	1.5	Siemens	Sonata	-	-	-	-	-	-	-	-	-	-	-	-	FSL	N
11 Suzuki	2008	PET	-	-	-	-	-	-	-	-	-	-	-	-	-	T-stats	SPM2	Y
12 Tabei	2015	1.5	Siemens	Symphony	-	T1w	2.2	3.93	1x1x1	EPI	4	50	3	-	-	GLM	SPM5	N

Table S6*Functional Characterization of ROIs as Included on BrainMap Platform Resulted from ALE Meta-analyses*

1. Major - Minor	
1.1. STG-L BA22a	
Action	Execution, speech, imagination, observation
Cognition	Attention, language, phonology, semantics, speech, explicit memory, working memory, music, reasoning, somatic
Emotion	Negative, anger, fear, sadness, positive emotion, happiness
Interoception	Sexuality
Perception	Audition, pain
Paradigms	Cued explicit recall, encoding, face discrimination, film viewing, finger tapping/button pressing, flexion/extension, go/no-go, hand-eye coordination, lexical decision, music comprehension, music production, oddball discrimination, pain discrimination, passive listening, passive viewing, phonological discrimination, pitch discrimination, reading, reasoning/problem solving, recitation/repetition, semantic discrimination, sexual arousal, tone discrimination, visuospatial attention, word generation
1.2. MedFG BA6	
Action	Execution, speech, imagination, inhibition
Cognition	Attention, orthography, semantics, speech, working memory, music, reasoning, social cognition, somatic
Emotion	Embarrassment, fear, punishment, reward/gain
Interoception	Gastrointestinal/genitourinary, sexuality
Perception	Audition, olfaction, somesthesis, pain, vision, motion, shape
Paradigms	Affective pictures, chewing/swallowing, classical conditioning, competition/cooperation, counting/calculation, cued explicit recall, deception, delayed match to sample, emotion induction, film viewing, finger tapping/button pressing, flanker, flashing checkerboard, flexion/extension, gambling, go/no-go, grasping, imagined movement, isometric force lip pursing/tongue movement, micturition, music comprehension, music production, n-back, naming, oddball discrimination, orthographic discrimination, pain discrimination, passive listening, phonological discrimination, pitch discrimination, pursuit rotor/manual tracking, reading, recitation/repetition, reward, saccades, semantic discrimination, sequence recall/learning, sexual arousal, tone discrimination, transcranial magnetic stimulation, video games, visual object identification, visual pursuit/tracking, visuospatial attention, word generation
1.3. TTG-R BA41	
Action	Execution
Cognition	Attention, phonology, semantics, speech, syntax, working memory, music, reasoning, temporal
Emotion	Negative, positive, reward/gain
Interoception	-
Perception	Audition, somesthesis, pain, vision, motion, shape
Paradigms	Classical conditioning, driving, figurative language, finger tapping/button pressing, gambling, go/no-go, music comprehension, music production, orthographic discrimination, pain discrimination, passive listening, phonological discrimination, passive listening, pitch discrimination, reading, reasoning/problem solving, recitation/repetition, reward, semantic discrimination, syntactic discrimination, tactile discrimination, tone discrimination, transcranial magnetic stimulation, visual object identification, word generation
1.4. CG-R BA31	
Action	Execution, preparation
Cognition	Attention, semantics, speech, explicit memory, working memory, music, reasoning
Emotion	Anxiety, disgust, reward/gain
Interoception	Sexuality
Perception	Audition, shape
Paradigms	Affective pictures, cued explicit recall, deception, delay discounting, delayed match to sample, encoding, episodic recall, face discrimination, film viewing, finger tapping/button pressing, fixation, go/no-go, imagined objects, music comprehension, music production, reward, sexual arousal, Stroop, word generation
1.5. CAU-R	
Action	Execution, imagination, inhibition, observation, preparation
Cognition	Attention, phonology, semantics, syntax, explicit memory, working memory, music, reasoning, social cognition
Emotion	Negative, happiness, reward/gain
Interoception	Sexuality, thermoregulation
Perception	Audition, somesthesis, pain, vision, colour, shape
Paradigms	Counting/calculation, cued explicit recall, deception, delay discounting, encoding, episodic recall, face discrimination, film viewing, finger tapping/button pressing, flexion/extension, gambling, go/no-go, imagined movement, isometric

force, music comprehension, n-back, oddball discrimination, pain discrimination, passive listening, passive viewing, reward, sexual arousal, tactile discrimination, task switching, tone discrimination, visual object identification, visuospatial attention

Table S7

Meta-analytic Connectivity Modelling of ROIs Resulted from ALE Meta-analyses.

Cluster Number	Volume (mm3)	MNI coordinates			ALE	P	Z	Label (Side Region BA)
		x	y	z				
1. Major – Minor								
1.1. STG-L BA22a: 946 foci, 53 experiments, 890 subjects (x=-52, y=-14, z=0)								
1	20272	60	-14	0	8E-02	4E-22	9.6	R Superior Temporal Gyrus BA22
2	20040	-52	-14	0	2E-01	0E+00	22.0	L Superior Temporal Gyrus BA22
3	1464	-12	-16	4	3E-02	9E-08	5.2	L Thalamus
4	1136	6	14	38	3E-02	2E-07	5.1	R Cingulate Gyrus BA32
1.2. MedFG-R BA6: 1520 foci, 67 experiments, 978 subjects (x=6, y=-4, z=60)								
1	45784	6	-2	60	3E-01	0E+00	23.1	R Medial Frontal Gyrus BA6
2	33048	14	-18	6	5E-02	4E-12	6.8	R Thalamus
3	1952	-30	-54	-26	4E-02	2E-07	5.1	L Cerebellum
4	1496	-32	24	0	4E-02	2E-07	5.1	L Insula BA13
5	1488	2	-60	-16	3E-02	8E-07	4.8	R Cerebellum
1.3. TTG-R BA41: 739 foci, 40 experiments, 599 subjects (x=46, y=-24, z=10)								
1	17000	46	-22	10	1E-01	0E+00	16.8	R Transverse Temporal Gyrus BA41
2	11168	-40	-30	14	5E-02	2E-14	7.6	L Superior Temporal Gyrus BA41
3	1648	56	-6	34	3E-02	2E-08	5.5	R Precentral Gyrus BA6
4	1536	-12	-18	0	3E-02	5E-08	5.3	L Thalamus
5	1280	16	-22	0	3E-02	5E-07	4.9	R Thalamus
1.4. CG-R BA31: 303 foci, 14 experiments, 212 subjects (x=8, y=-28, z=40)								
1	3432	6	-28	38	7E-02	4E-28	10.9	R Cingulate Gyrus BA31
1.5. CAU-R: 680 foci, 30 experiments, 511 subjects (x=20, y=-2, z=22)								
1	6960	20	-2	22	1E-01	0E+00	16.9	R Caudate
2	2296	2	10	54	3E-02	1E-07	5.2	L Superior Frontal Gyrus BA6
3	1872	-30	18	10	2E-02	7E-06	4.4	L Claustrum
2. Minor – Major								
2.1. STG-L BA22b: 763 foci, 48 experiments, 709 subjects (x=-60, y=-8, z=-6)								
1	17544	-60	-8	-6	2E-01	0E+00	20.6	L Superior Temporal Gyrus BA22
2	11904	64	-10	-2	5E-02	9E-16	8.0	R Superior Temporal Gyrus BA22
3	1056	-56	10	10	2E-02	2E-05	4.2	L Precentral Gyrus BA44
2.2. STG-R BA22: 1045 foci, 53 experiments, 776 subjects (x=60, y=-8, z=-2)								
1	18784	-56	-14	0	8E-02	2E-25	10.4	L Superior Temporal Gyrus BA22
2	16304	60	-8	-2	2E-01	0E+00	21.5	R Superior Temporal Gyrus BA22
3	2096	-2	0	64	3E-02	4E-06	4.5	L Medial Frontal Gyrus BA6
4	1456	-52	20	26	3E-02	9E-07	4.8	L Middle Frontal Gyrus BA9
5	1184	-36	22	0	3E-02	3E-07	5.0	L Insula BA13

ALE, anatomic likelihood estimation; M, musicians; NM, non-musicians; GM, gray matter; WM, white matter; BA, Brodmann area; ROIs, regions-of-interest; P, p-value; Z, peak z-value; R, right; L, left. **ROIs:** IFG, inferior frontal gyrus; IPL, inferior parietal lobule; IC, internal capsule; PostCG, postcentral gyrus (primary somatosensory cortex or S1); PreCG, precentral gyrus (primary motor cortex or M1); STG, superior temporal gyrus (primary auditory cortex). Music-related ROIs were created in Mango (<http://rii.uthscsa.edu/mango/userguide.html>) with a 5mm-radius sphere. Last search in Sleuth, 09.01.2023 (<http://www.brainmap.org/sleuth/>); NA, not enough available observations.

2. Minor – Major	
2.1. STG-L BA22b	
Action	Execution, speech, imagination, observation
Cognition	Attention, language, orthography, phonology, semantics, speech, syntax, explicit memory, working memory, music, reasoning, social cognition, somatic
Emotion	Fear, sadness, positive, happiness, reward/gain, valence
Interoception	Thermoregulation
Perception	Audition, pain, vision, motion, shape
Paradigms	Affective pictures, counting/calculation, divided auditory attention, emotion induction, face discrimination, figurative language, film viewing, finger tapping/button pressing, fixation, imagined objects, lexical decision, multi-tasking, music comprehension, n-back, naming, orthographic discrimination, pain discrimination, paired associate recall, passive listening, passive viewing, phonological discrimination, pitch discrimination, reading, reasoning/problem solving, reward, saccades, semantic discrimination, sequence recall, Stroop, syntactic discrimination, task switching, theory-of-mind, tone discrimination
2.2. STG-R BA22	
Action	Execution, speech, observation
Cognition	Attention, language, phonology, semantics, speech, syntax, working memory, music, reasoning
Emotion	Fear, happiness, reward/gain, valence
Interoception	Sexuality
Perception	Audition, gustation, somesthesia, vision
Paradigms	Affective pictures, counting/calculation, divided auditory attention, emotion induction, face discrimination, figurative language, film viewing, finger tapping/button pressing, fixation, imagined objects, lexical decision, multi-tasking, music comprehension, n-back, naming, orthographic discrimination, pain discrimination, paired associate recall, passive listening, passive viewing, phonological discrimination, pitch discrimination, reading, reasoning/problem solving, reward, saccades, semantic discrimination, sequence recall, Stroop, syntactic discrimination, task switching, theory-of-mind, tone discrimination

ALE, anatomic likelihood estimation; M, musicians; NM, non-musicians; GM, grey matter; WM, white matter; BA, Brodmann area; ROIs, regions-of-interest; P, p-value; Z, peak z-value; R, right; L, left. **ROIs:** IFG, inferior frontal gyrus; IPL, inferior parietal lobule; IC, internal capsule; PostCG, postcentral gyrus (primary somatosensory cortex or S1); PreCG, precentral gyrus (primary motor cortex or M1); STG, superior temporal gyrus (primary auditory cortex). Music-related ROIs were created in Mango (<http://rii.uthsca.edu/mango/userguide.html>) with a 5mm-radius sphere. Last search in Sleuth, 09.01.2023 (<http://www.brainmap.org/sleuth/>); NA, not enough available observations.

Table S8*FSN Robustness Assessment of ROIs Resulted from ALE Meta-analyses*

Cluster number	Volume (mm ³)	MNI coordinates			ALE	Label (Side, region)	FSN
		x	y	z			
1. Major – Minor: 65 foci, 7 experiments, 119 subjects, minimum FSN = 2							
1	1272	-52	-14	0	2E-02	L Superior Temporal Gyrus BA22	6
2	824	6	-4	60	2E-02	R Medial Frontal Gyrus BA6	4
3	808	46	-24	10	2E-02	R Transverse Temporal Gyrus BA41	2
4	768	8	-28	40	2E-02	R Cingulate Gyrus BA31	2
5	488	20	-2	22	2E-02	R Caudate	<2
2. Minor – Mayor: 33 foci, 8 experiments, 138 subjects, minimum FSN = 2							
1	1096	-60	-8	-6	2E-02	L Superior Temporal Gyrus BA22	4
2	1040	60	-8	-2	2E-02	R Superior Temporal Gyrus BA22	4

FSN, Fail-Safe N analysis; NA, not enough available observations.

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