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Original article

Differential associations of leisure music engagement with resilience: A network analysis

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ABSTRACT

Background/Objective: Several factors associated with resilience as the maintenance of mental health despite stress exposure can be strengthened through participation in leisure time activities. Since many people listen to or make music in their leisure time, the aim of the present study was to provide insights into the architecture of how resilience relates to passive and active music engagement.

Method: 511 participants regularly listening to and/or making music completed an online survey on resilient outcomes (i.e., mental health and stressor recovery ability), different resilience factors (e.g., optimism, social support), quantitative music engagement (i.e., time spent with music listening/making) and qualitative music engagement (i.e., use of music listening/making for mood regulation).

Results: Bivariate correlations showed that subjects spending more time with music making reported better stressor recovery ability and less mental health problems, while partial correlational network analysis revealed no unique associations for quantitative music engagement. Regarding qualitative music engagement, people using music-based mood regulation reported lower mental health, mindfulness, and optimism, but also higher social support. A more heterogeneous pattern emerged for single music-based mood regulation strategies.

Conclusions: Our findings highlight the importance of the individual (mal-)adaptive use of music, painting a more nuanced picture of music engagement and resilience.

Introduction

The everyday life of human beings consists of numerous challenges leading to experiences of acute and chronic stress. Thus, how individuals are able to cope with and recover from stressors largely determines the onset and progress of mental and physical health conditions (Slavich, 2016). However, many people show resilient responses to stress. Resilience as an outcome can be defined as stable good mental health or fast recovery during or after stress (Kalisch et al., 2017). Therefore, outcome-oriented approaches to resilience commonly assess proxies of resilient outcomes, that is, mental health (Galatzer-Levy, Huang & Bonanno, 2018) or self-reports of stressor recovery ability (SRA) (Chmitorz et al., 2018). Resilient outcomes are proposed to be linked with resilience factors via resilience mechanisms (Kalisch, Müller & Tüscher, 2015). Most research has focused on resilience factors encompassing (external and internal) psychological, biological, and social resources, such as traits (e.g., optimism) or beliefs (e.g., self-efficacy), which interact with each other in complex reciprocity (Chmitorz et al., 2018).

Resources of resilience: resilience factors

A well-established resilience factor is the extent to which people hold positive expectancies for the future, that is, **optimism** (e.g., Gallagher, Long & Phillips, 2020). Perceiving desirable outcomes as likely might lead to active problem-solving and productive coping strategies, and in turn to more resilient outcomes. Moreover, **self-efficacy**, that is, a person's belief in their own ability to perform a behavior or achieve goals (Bandura, 1997), is considered essential for resilience to handle everyday life demands through its self-regulatory function. Further, numerous studies emphasize **social support**, that is, perceived social resources, as a key resilience factor (e.g., Wang, Chung, Wang, Yu & Kenardy, 2021). Social support may foster well-being and mental health through providing emotional, practical, and informational help by other people and strengthening a sense of belonging (Gleason & Iida, 2015). **Emotion regulation** as another contributor to resilience refers to the processes by which individuals experience and express emotions (Gross, 1998), with different emotion regulation strategies (e.g., positive reappraisal, self-

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blame) showing divergent associations with resilient outcomes. Especially positive reappraisal processes seem to be essential for moderating and mediating beneficial resilience dynamics (Riepenhausen et al., 2022). Other potential resilience factors include mindfulness and self-compassion. **Mindfulness**, often defined as non-judgmental awareness of the present moment, may contribute to resilience through modulating attention regulation, body awareness, emotion regulation, and change in perspective on the self (Hölzel et al., 2011). **Self-compassion** is characterized by three components: self-kindness (treating oneself with kindness), common humanity (acknowledging a common human experience), and mindfulness (Neff, 2003). Self-compassion may thus primarily enhance individuals' well-being through modifying negative emotions and enhancing positive ones (Inwood & Ferrari, 2018). This depiction of resilience factors is by far complete, yet even this evidence-based shortlist of constructs shows strong empirical interrelations and conceptual overlaps. Network analysis may thus be a useful tool to estimate unique relationships among resilience factors and resilient outcomes without providing a-priori information on the underlying dimensional structure (Fritz, Fried, Goodyer, Wilkinson & van Harmelen, 2018; Williams & Rast, 2020).

Promoting resilience through leisure music engagement

Music-related contexts can evoke self-regulatory processes, including the modification of cognitions, emotions, and actions, which in turn may affect mental health (Dingle et al., 2021). A recent theoretical review proposed that music engagement may promote resilience through strengthening factors such as meaning making, social relatedness, and agency (Nijs & Nicolaou, 2021). Since many people engage with music in their leisure time, music engagement has the potential for fostering resilience factors, and in turn, resilient outcomes. Passive forms of music engagement encompass music listening, while active forms comprise music making. Extensive research on music listening has shown positive associations with mental health (e.g., Bradshaw, Ellison, Fang & Mueller, 2014). Yet, little is known on its link with resilience, while the few previous studies examined only single resilience factors, such as emotion regulation or self-efficacy (e.g., Saarikallio, Randall, & Baltazar, 2020). Regarding active music making, the few studies on hobby musicians showed positive associations with well-being through pathways such as fulfillment of basic psychological needs (Koehler & Neubauer, 2020) and flow experiences (Koehler, Warth, Ditzen & Neubauer, 2021). Overall, no study yet examined the association of passive and active leisure music engagement with a larger set of resilience factors and resilient outcomes.

Although research supports the notion that music engagement is positively associated with mental health, most studies included quantitative predictors, such as frequency or duration (e.g., Bradshaw et al., 2014), neglecting qualitative factors, in particular the individual (mal-)adaptive use of music for mood regulation. For instance, the mood regulation strategies discharge and diversion (i.e., using music to express negative emotions, or to distract oneself) were associated with worse mental health (Thomson, Reece & Di Benedetto, 2014). Therefore, it may be promising to include quantitative and qualitative aspects of music engagement to examine differential associations with resilience (factors).

The present study

The goal of the present work was to explore the architecture of the interplay between resilience factors, resilient outcomes, and music engagement. Building on previous studies, we included those resilience factors which may be particularly promising for music engagement: optimism, social support, emotion regulation (i.e., acceptance and positive reappraisal), mindfulness, self-compassion, and self-efficacy. We aimed at mapping unique links of music engagement with both the network of resilience factors and networks additionally including proxies of resilient outcomes, that is, mental health problems and self-reported SRA.

Regarding quantitative indicators, we hypothesized that more time spent with listening to and making music would be associated with better mental health, higher SRA, and higher levels of resilience factors. Regarding qualitative aspects of music engagement concerning mood regulation, we assumed a more diverse picture. Based on previous research (Thomson et al., 2014), we expected the mood regulation strategies discharge and diversion to be negatively associated with mental health outcomes, while we examined the other strategies exploratively.

Methods

Participants and procedure

Participants were recruited through social media and contacting hobby and university orchestras, choirs, and other musical ensembles based in Germany, Switzerland, and Austria via email. After recruitment, on February 6, 2022, all participants provided informed consent and completed a 45-min online baseline questionnaire on trait-like measures (e.g., resilience factors) and mental health. For the following seven weeks on every Sunday, an email was sent to all participants containing a link to the weekly survey on state mental health outcomes. As an incentive, all participants received an educational video on resilience and 30 coupons of €50 were raffled. The study was approved by the Ethics Committee of the Institute of Psychology, Johannes Gutenberg University Mainz, Germany [2022-JGU-psychEK-S001]. As we were interested in associations of rather stable constructs (i.e., resilience factors, SRA), we used cross-sectional data from the baseline assessment, while the longitudinal part of the study was designed to examine the association of music engagement and spontaneous mood fluctuations (Koehler, Schäfer, Lieb, & Wessa, under review).

Measurements

Proxies of resilient outcomes

Mental health problems. The 12-item form of the General Health Questionnaire (GHQ; Goldberg & Williams, 1988) was used to measure mental burden. Participants rated their agreement to each statement on a 4-point Likert scale. Higher scores indicate worse than usual mental health in the last weeks. Internal consistencies were excellent in the current study, reflected in Cronbach's alpha (α) = 0.88, and McDonald's omega (ω) = 0.89.

Stressor recovery ability. The 6-item Brief Resilience Scale (BRS; Chmitorz et al., 2018; Kunzler et al., 2018) was used to measure self-reported SRA. Participants assessed their agreement with each statement on a 5-point Likert scale. Higher scores indicate higher SRA. Internal consistencies were excellent (α/ω = 0.86).

Resilience factors

Emotion regulation. The Cognitive Emotion Regulation Questionnaire (CERQ) was administered in a 27-item version (Jungmann, Loch, Hiller & Witthöft, 2015) to measure how people regulate their emotions after experiences of negative events assessing nine strategies: self-blame, other-blame, rumination, catastrophizing, putting into perspective, positive refocusing, positive reappraisal, acceptance, and refocusing on planning. On a 5-point Likert scale, participants evaluated how they usually react to negative experiences. Higher scores indicate a stronger use of the emotion regulation strategy. For the current analyses, we used the subscales positive reappraisal and acceptance as resilience factors. Internal consistencies were acceptable to excellent (positive reappraisal: α/ω = 0.80; acceptance: α = 0.77, ω = 0.78).

Mindfulness. The Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003) was administered to measure mindfulness in everyday

life via 15 items. On a 6-point Likert scale, participants evaluated the frequency of mindfulness experiences with higher scores reflecting higher mindfulness. The internal consistency was excellent, $\alpha/\omega = 0.87$.

Optimism. The Revised Life Orientation Test (LOT-R; Scheier, Carver & Bridges, 1994) was used to measure how optimistic people feel about the future. Participants evaluated their agreement to ten statements on a 5-point Likert scale. Higher scores indicate higher optimism. The internal consistency was acceptable, $\alpha/\omega = 0.67$.

Self-Compassion. To measure trait self-compassion, the Self Compassion Scale - Short Form (SCS-SF; Raes, Pommier, Neff & Van Gucht, 2011) was used consisting of 12 items with a 5-point Likert scale. The participants were asked how often they feel/ behave a certain way towards themselves. The total score was used with higher scores reflecting higher self-compassion. The internal consistency was excellent, $\alpha/\omega = 0.85$.

Self-Efficacy. Self-efficacy was measured by administering the 10-item General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995). On a 4-point scale, participants rated their agreement to each statement. Higher scores indicate stronger self-efficacy beliefs. The internal consistency was excellent, $\alpha/\omega = 0.89$.

Social support. Perceived social support was assessed using the Brief Form of Perceived Social Support Questionnaire (F-SozU K-6; Kliem et al., 2015). Six statements were rated on a 5-point Likert scale. Higher scores reflect higher levels of social support. The internal consistency was excellent, $\alpha/\omega = 0.87$.

Music engagement

Quantitative music engagement. We used single items to measure quantitative music engagement. Respondents were asked to indicate on how many days of a regular week they usually listen to or make music (frequency) and how much time they spend on listening to or making music each day (duration). We calculated overall minutes spent with music listening and music making in a regular day or week respectively.

Qualitative music engagement. We administered the Brief Music in Mood Regulation Scale (B-MMR; Saarikallio, 2012) comprising 21 items that are rated on a 5-point Likert scale. The B-MMR assesses seven music-based mood regulation strategies: *entertainment* (i.e., using music to enhance positive mood), *revival* (i.e., using music for renewal), *strong sensation* (i.e., using music to induce intense emotions), *diversion* (i.e., using music to forget unwanted thoughts and feelings), *discharge* (i.e. using music to express negative emotions), *mental work* (i.e., using music for contemplation), and *solace* (i.e., using music for comfort when upset). Exemplary items are “I listen to music to perk up after a rough day” (*revival*), “When I’m distressed by something, music helps me to clarify my feelings” (*mental work*), or “When stressful thoughts keep going round and round in my head, I start to listen to music to get them off my mind” (*diversion*). We administered the 21-item B-MMR regarding music listening and an adapted 18-item version regarding music making (see Supplementary Material). For music listening, $\alpha/\omega = 0.91$, and music making, $\alpha = 0.92$, $\omega = 0.93$, internal consistency of the total scale was excellent, while the subscales showed acceptable to excellent internal consistencies (from $\alpha = 0.67/\omega = 0.71$ to $\alpha/\omega = 0.87$).

Factors for sensitivity analyses. For sensitivity analyses, we assessed the music genre participants most frequently used in making or listening to music, the time (in years) spent with music making, current participation in music lessons, and time spent with music lessons (in years).

Data analyses

All analyses were performed using RStudio version 2022.02.3 (RStudio Team, 2020).

Missing data. For data completely missing at random, we performed imputations using the R package VIM (Kowarik & Templ, 2016) at item level.

Partial correlational networks. Network analyses were performed using the R packages *bootnet* (Epskamp, Borsboom & Fried, 2018), *qgraph* (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012), and *mgn* (Haslbeck & Waldorp, 2020). We calculated cross-sectional partial correlational network models using a mixed graphical model (*mgn*) with mental health problems, resilience (factors) and music engagement as variables (i.e., *nodes*) of interest. Interrelations between nodes (i.e., *edges*) represent partial correlations. The *mgn* method was chosen as it allowed for the inclusion of categorical moderators and was found to provide specific, precise, robust, and replicable network estimates also in smaller samples (Isvoranu & Epskamp, 2021). The estimation uses the Least Absolute Shrinkage and Selection Operator method (LASSO; Tibshirani, 1996) to shrink small - and likely less relevant - edge weights to zero. To choose the final network model, we used Extended Bayesian Information Criterion (EBIC, hyperparameter = 0.25) and applied bootstrapping with 1000 draws to examine the robustness of edge weights based on 95% confidence intervals. We used correlation stability coefficients to examine centrality stability, and strength as centrality index describing how each node relates to other nodes. Exemplary analytic code can be found in the Supplementary Material, data is uploaded to the Open Science Framework (https://osf.io/8mcrn/?view_only=cea30eda716b4b12b39c3ed5477e53c0).

First, we calculated our reference models. One model solely comprised resilience factors (i.e., acceptance, mindfulness, optimism, positive reappraisal, self-compassion, self-efficacy, social support). In the following models, we included mental health problems, and separately SRA as we did not aim to control for the strong interrelation of resilient outcomes. Second, we included quantitative music engagement (i.e., time spent with music listening and music making) and qualitative music engagement (i.e., music-based mood regulation) in different models for music listening and music making. Again, we estimated separate models for music listening and music making as we did not aim to control for their overlap. In the reference models, we examined the moderating effect of age, gender, and education for edge weight estimates.

Sensitivity analyses. To acknowledge the fact that other music-related factors may impact the association of music engagement and resilience (factors), we examined the impact of musical genre (i.e., classical music vs. other genres), time spent with music making, current participation in music lessons and time spent with music lessons by means of moderator analyses (Haslbeck, 2022).

Results

Analysis sample

A total of 585 respondents participated in the baseline assessment. Of those, 39 were excluded as they missed at least one scale completely. Two respondents indicated to neither regularly listen to music nor to actively make music and were thus excluded from analyses. All participants identified their musical activity as (a) “earning one’s living exclusively or mainly by music making” (professional musicians), (b) “partially earning money by music making, but mainly employed elsewhere” (semi-professional musicians), or (c) “making music without intention to earn money” (hobby musicians). As we were specifically interested in hobby musicians and at most semi-professional musicians, 33 professional musicians were excluded from analyses. Of the remaining 511 respondents, 15.7% indicated to partially earning money by music making, but being mainly employed elsewhere, 72.6% reported to make music without intention to earn money, and 11.7% did not engage in music making and were thus excluded from all analyses involving music making. Another eight respondents indicated to not regularly

Table 1
Characteristics of the total study sample and subsamples.

	Total sample (n=511)	Subsamples	
		Music listening (n=503)	Music making (n=450)
Age [M (SD), range]	43.77 (19.15) 16–88 years	43.50 (19.13) 16–88 years	45.16 (19.04) 16–85 years
Gender (n, %)			
Women	360 (70.5%)	353 (70.2%)	313 (69.4%)
Men	146 (28.6%)	145 (28.8%)	134 (29.7%)
Non-binary	2 (0.4%)	2 (0.4%)	2 (0.4%)
Not reported	3 (0.6%)	3 (0.6%)	2 (0.4%)
Educational level (n, %)			
University degree	283 (55.4%)	277 (55.1%)	257 (57.0%)
No degree (yet)	7 (1.4%)	7 (1.4%)	7 (1.6%)
9 years of school	5 (1.0%)	4 (0.8%)	5 (1.1%)
10 years of school	34 (6.7%)	33 (6.6%)	29 (6.4%)
11 years of school	24 (4.7%)	24 (4.8%)	23 (5.1%)
A level exam	158 (30.9%)	158 (31.4%)	130 (28.9%)
University degree	283 (55.4%)	277 (55.1%)	257 (57.1%)
Musical characteristics			
Minutes spent with music listening per day [M (SD)]	82.76 (75.97)	82.76 (75.97)	81.24 (72.95)
Minutes spent with music making per week [M (SD)]	67.24 (44.63)	67.28 (44.59)	67.24 (44.63)
Time spent with music making in years [M (SD)]	27.78 (18.53)	27.86 (18.86)	27.78 (18.53)
Music listening – most frequent musical genre (n, %)			
Classical	202 (39.5%)	197 (39.2%)	197 (43.7%)
Pop	102 (20.0%)	102 (20.3%)	82 (18.2%)
Indie	29 (5.7%)	29 (5.8%)	23 (5.1%)
Rock	24 (4.7%)	24 (4.8%)	18 (4.0%)
Jazz	14 (2.7%)	14 (2.9%)	14 (3.1%)
Hip Hop/ Rap	14 (2.7%)	14 (2.9%)	10 (2.2%)
Electronic music (e.g., House)	14 (2.7%)	14 (2.9%)	9 (2.0%)
Other (e.g., Punk, RnB)	112 (21.9%)	109 (21.7%)	97 (21.6%)
Music making – most frequent musical genre (n, %)			
Classical	257 (50.3%)	253 (50.3%)	257 (57.0%)
Sacred music	49 (9.6%)	47 (9.3%)	49 (10.9%)
Pop	38 (7.4%)	38 (7.6%)	38 (8.4%)
Folk music	12 (2.3%)	12 (2.4%)	12 (2.7%)
Rock	9 (1.8%)	7 (1.4%)	9 (2.0%)
Jazz	9 (1.8%)	9 (1.8%)	9 (2.0%)
Other (e.g., Punk, RnB)	77 (15.1%)	77 (15.3%)	76 (16.9%)
Music making – instrument (n, %)			
Singing	134 (26.2%)	130 (25.8%)	134 (29.8%)
String instrument	122 (23.9%)	121 (24.1%)	122 (27.1%)
Keyboard instrument	74 (14.5%)	72 (14.3%)	74 (16.4%)
Plucked instrument	35 (6.8%)	35 (7.0%)	35 (7.8%)
Brass instrument	28 (5.5%)	28 (5.6%)	28 (6.2%)
Percussion instrument	3 (0.6%)	3 (0.6%)	3 (0.7%)
Music making – context (n, %)			
Orchestra	164 (32.1%)	164 (32.6%)	164 (36.4%)
Choir	135 (26.4%)	135 (26.8%)	135 (30.0%)
Big band	1 (0.2%)	1 (0.2%)	1 (0.2%)
Ensemble	29 (5.7%)	29 (5.8%)	29 (6.4%)
Band	22 (4.3%)	22 (4.4%)	22 (4.9%)
Other social setting	33 (6.5%)	33 (6.7%)	33 (7.3%)
No group setting	68 (13.3%)	68 (13.5%)	68 (15.1%)
Current participation in music lessons (n, %)	146 (28.6%)	145 (27.8%)	146 (32.4%)
Duration of music lessons in years [M (SD)]	10.05 (8.53)	10.08 (8.53)	10.05 (8.53)

Note. In music making variables, absolute number of the total sample and the subsample of those who make music are the same, while percentage is divergent as more respondents were included in the total sample.

listen to music (but were at the same time actively making music) and were thus excluded from analyses on music listening. The total sample (n = 511) had an average age of 43.8 years (SD = 19.15) and 70.5% self-identified as women. Table 1 shows the sociodemographic characteristics and aspects of music engagement. Regression-based tests indicated that missing data (0.1%) was completely missing at random for all variables and could thus be handled by imputation at single-item level.

Descriptive statistics and bivariate correlations

Older age was associated with less time spent with music listening, $r = -0.10, p = .026$, and more time spent with music making, $r = 0.18, p < .001$. Moreover, older participants tended to engage less in music-based mood regulation; listening: $r = -0.42, p < .001$; making:

$r = -0.32, p < .001$. Higher education was related with less time spent with music listening, $r = -0.14, p = .001$, and lower engagement in music-based mood regulation; listening: $r = -0.16, p < .001$; making: $r = -0.12, p = .011$. Women and men spent a comparable amount of time with music listening, $t(394.18) = -0.70, p = .482$, while men spent more time with music making, $t(444) = 2.17, p = .030$. Engagement in music-based mood regulation was greater in women than in men; listening: $t(504) = -3.23, p = .001$; making: $t(440) = 3.70, p < .001$. Fig. 1 presents bivariate correlations of study variables. Time spent with music making was positively associated with SRA and negatively associated with mental health problems. While music-based mood regulation was negatively associated with mindfulness and optimism, positive associations were found for acceptance, positive reappraisal, and social support.

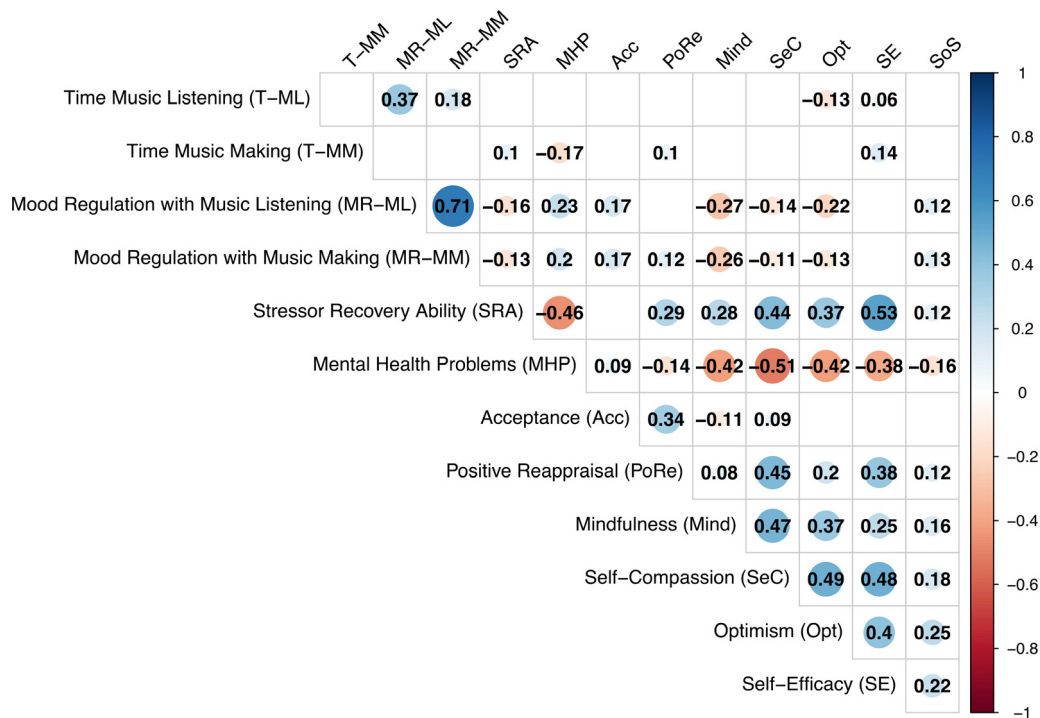


Fig. 1. Plot of bivariate correlations of all variables.

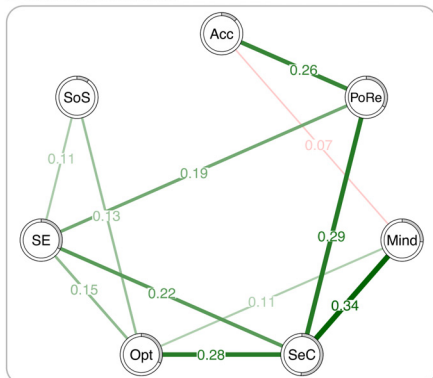
Note. Non-significant correlations ($p \geq .05$) are blanked. SoS = Social Support. See Supplementary Material for correlations at single strategy level.

Resilience factors and resilient outcomes

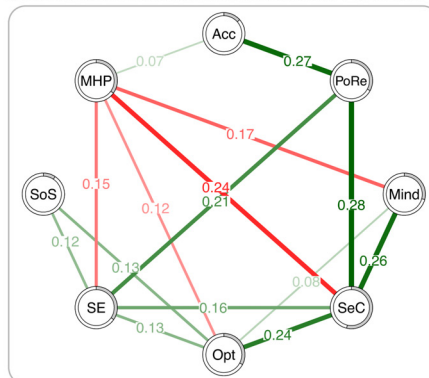
Fig. 2 shows network models solely comprising resilience factors and resilient outcomes that were used as reference models. In the resilience factor model, the strongest associations emerged for mindfulness and

self-compassion. In the model additionally including mental health problems, self-compassion, mindfulness, self-efficacy, and optimism were associated with better mental health, with 35% of its variance being accounted for by resilience factors. In the model including SRA, resilience factors accounted for 33% of its variance. We found no

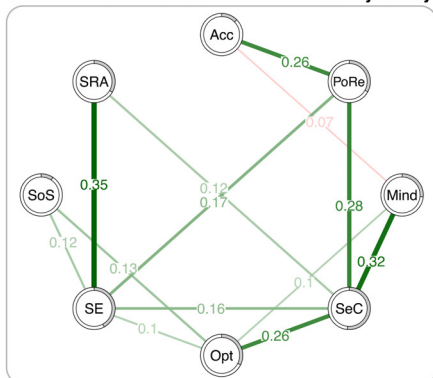
a. Resilience Factors



b. Resilience Factors and Mental Health Problems



c. Resilience Factors and Stressor Recovery Ability

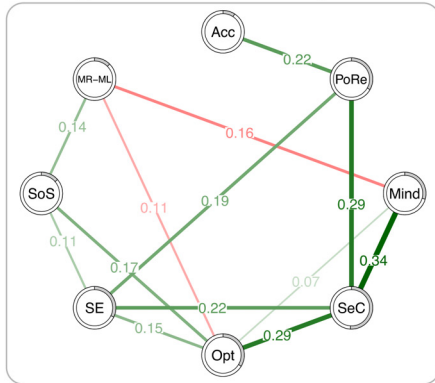


- Acc: Acceptance
- PoRe: Positive Reappraisal
- MHP: Mental Health Problems
- Mind: Mindfulness
- SeC: Self-Compassion
- Opt: Optimism
- SE: Self-Efficacy
- SoS: Social Support
- SRA: Stressor Recovery Ability

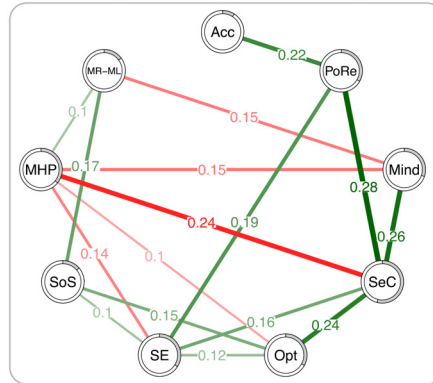
Fig. 2. Network models of resilience factors, mental health problems, and stressor recovery ability.

Note. Absolute values of partial correlations. Green lines indicate positive relationships, red lines negative relationships. Wider lines represent stronger associations.

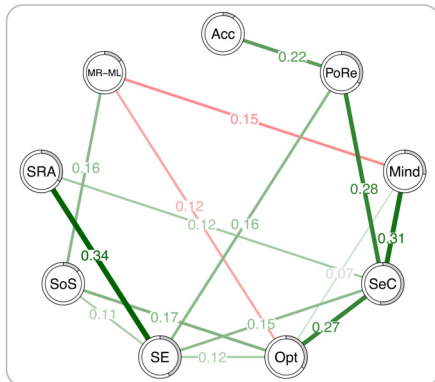
a. Resilience Factors and Mood Regulation with Music Listening



b. Resilience Factors, Mental Health Problems and Mood Regulation with Music Listening



c. Resilience Factors, Stressor Recovery Ability and Mood Regulation with Music Listening



Acc:	Acceptance
PoRe:	Positive Reappraisal
MHP:	Mental Health Problems
Mind:	Mindfulness
SeC:	Self-Compassion
Opt:	Optimism
SE:	Self-Efficacy
SoS:	Social Support
SRA:	Stressor Recovery Ability
MR-ML:	Mood Regulation with Music Listening

Fig. 3. Network models including mood regulation with music listening.
 Note. Absolute values of partial correlations. Green lines indicate positive relationships, red lines negative relationships. Wider lines represent stronger associations.

evidence for a moderation of edge weights by age, gender, or education, which thus were not considered in the following models.

Quantitative music engagement: time spent with music

When including time spent with music listening or music making in these models, neither time spent with music listening nor music making showed unique associations with other variables (see Supplementary Material).

Qualitative music engagement: music-based mood regulation

Mood regulation with music listening

In the model comprising **resilience factors**, greater engagement in mood regulation was associated with higher social support, and lower mindfulness and optimism (see Fig. 3). Regarding specific strategies (Table 2), mood regulation for entertainment and solace was associated with higher social support. Mood regulation for discharge, mental work and solace was related to lower mindfulness and optimism. In the model including **mental health**, greater engagement in mood regulation was related to worse mental health, lower mindfulness, and higher social support. At single strategy level, mood regulation for solace was related to higher social support. Greater engagement in mood regulation for diversion, discharge, mental work, and solace was associated with lower mindfulness. In the model including **SRA**, greater engagement in mood regulation was associated with higher social support, and lower mindfulness and optimism. For single strategies, the engagement in mood regulation for entertainment and solace was associated with higher social support, while mood regulation for diversion and discharge was related to lower mindfulness. Greater engagement in mood regulation for mental work and solace was associated with more positive reappraisal.

Mood regulation with music making

In the **resilience factors** model, greater engagement in mood regulation was associated with higher social support and lower mindfulness (see Fig. 4). At single strategy level (Table 3), mood regulation for diversion, discharge, mental work, and solace was linked with lower mindfulness. Greater engagement in mood regulation for mental work was also associated with more positive reappraisal and social support. In the **mental health** model, greater engagement in mood regulation was related to higher social support and lower mindfulness. For single strategies, greater engagement in mood regulation for diversion, discharge, mental work, and solace was associated with lower mindfulness. Mood regulation for diversion was also related to worse mental health, while mood regulation for mental work was also associated with more positive reappraisal and social support. In the **SRA** model, greater engagement in mood regulation was linked with higher social support and lower mindfulness. At single strategy level, mood regulation for diversion, discharge, mental work and solace was related to lower mindfulness, with mood regulation for solace also being associated with higher social support and mood regulation for mental work also being related to more positive reappraisal and social support.

Sensitivity analyses

For none of the network models on quantitative and qualitative music engagement we found evidence for an impact of musical genre (classical music vs. others), time spent with music making in life, the current participation in music lessons, and time spent with music lessons on the associations of music engagement and resilience (factors).

Discussion

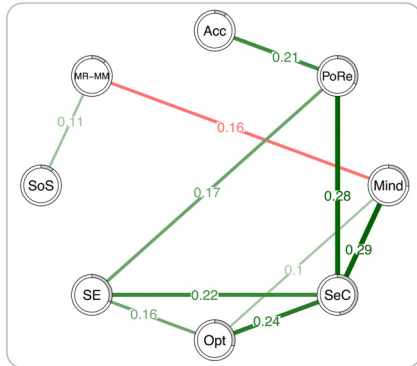
The present work aimed to provide new insights into the architecture of the interplay between resilience and music engagement. While we

Table 2
Associations of mood regulation strategies related to music listening.

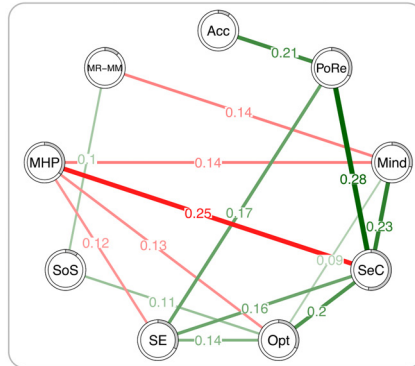
1. Resilience Factors Only	Entertainment	Revival	Strong Sensations	Diversion	Discharge	Mental Work	Solace
Acceptance						↑.09	
Positive Reappraisal							
Mindfulness				↓.11	↓.13	↓.14	↓.14
Self-Compassion							
Optimism					↓.11	↓.14	↓.08
Self-Efficacy							
Social Support	↑.10						↑.16
2. Including Mental Health Problems							
Acceptance							
Positive Reappraisal							
Mindfulness				↓.09	↓.13	↓.08	↓.12
Self-Compassion							
Optimism					↓.09		
Self-Efficacy							
Social Support	↑.08						↑.16
Mental Health Problems							
3. Including Stressor Recovery Ability							
Acceptance							
Positive Reappraisal						↑.10	↑.09
Mindfulness				↓.10	↓.13	↓.12	↓.13
Self-Compassion							
Optimism					↓.10	↓.12	
Self-Efficacy							
Social Support	↑.10						↑.16
Stressor Recovery Ability							↓.13

Note. Absolute values of partial correlations. The table displays all edges that were *not* set to zero based on the LASSO method for variable selection, while empty cells represent edges set to zero. Each column represents one network model per outcome. Red arrows indicate negative associations, green arrows positive links. Empty cells indicate that this edge was set to zero.

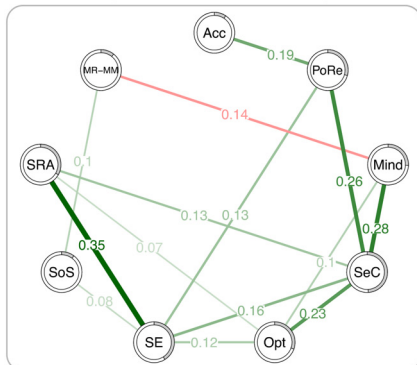
a. Resilience Factors and Mood Regulation with Music Making



b. Resilience Factors, Mental Health Problems and Mood Regulation with Music Making



c. Resilience Factors, Stressor Recovery Ability and Mood Regulation with Music Making



Acc: Acceptance
 PoRe: Positive Reappraisal
 MHP: Mental Health Problems
 Mind: Mindfulness
 SeC: Self-Compassion
 Opt: Optimism
 SE: Self-Efficacy
 SoS: Social Support
 SRA: Stressor Recovery Ability
 MR-MM: Mood Regulation with Music Making

Fig. 4. Network models including mood regulation with music making.

Note. Absolute values of partial correlations. Green lines indicate positive relationships, red lines negative relationships. Wider lines represent stronger associations.

Table 3
Associations of mood regulation strategies related to music making.

1. Resilience Factors Only	Revival	Strong Sensations	Diversion	Discharge	Mental Work	Solace
Acceptance						
Positive Reappraisal					↑.10	
Mindfulness			↓.10	↓.14	↓.17	↓.16
Self-Compassion						
Optimism					↓.14	
Self-Efficacy						
Social Support					↑.14	
<hr/>						
2. Including Mental Health Problems						
Acceptance						
Positive Reappraisal					↑.10	
Mindfulness			↓.08	↓.14	↓.16	↓.09
Self-Compassion						
Optimism						
Self-Efficacy						
Social Support					↑.15	
Mental Health Problems			↑.09			
<hr/>						
3. Including Stressor Recovery Ability						
Acceptance						
Positive Reappraisal					↑.11	
Mindfulness			↓.10	↓.14	↓.17	↓.15
Self-Compassion						
Optimism					↓.13	
Self-Efficacy						
Social Support					↑.15	↑.11
Stressor Recovery Ability						

Note. Absolute values of partial correlations. The table displays all edges that were *not* set to zero based on the LASSO method for variable selection, while empty cells represent edges set to zero. Each column represents one network model per outcome. Red arrows indicate negative associations, green arrows positive links. Empty cells indicate that this edge was set to zero.

hypothesized that quantitative music engagement would be related to higher levels of resilience factors and resilient outcomes, we expected a more diverse picture regarding qualitative music engagement.

Quantitative music engagement: time spent with music

As expected, bivariate analyses revealed that time spent with music making was positively related to resilient outcomes. However, time spent with music listening was only associated with higher self-efficacy and surprisingly with less optimism, which might be explained by inter-individual differences in the purpose of music listening. Indeed, music listening in unhealthy ways, such as getting stuck in bad memories, is associated with increased depression (Saarikallio, Gold & McFerran, 2015). It may further be interesting in future studies to include the musical genre in this context due to a high intraindividual variation of genres in music listening during different daily activities. The differences between music listening and making point to the importance of the active component which might support self-regulatory skills essential for mental health. However, against our hypotheses, neither time spent with music listening nor music making showed unique associations with any variable also when accounting for potentially confounding music-related factors. Corresponding to previous research (Thoma, Scholz, Ehlert & Nater, 2012), this finding highlights the notion that not (only) the amount of time spent with music, but also the quality of music engagement (i.e., why and how) plays an important role. Based on previous studies (e.g., Koehler et al., 2021), it may thus be promising in future research to include intrinsic and extrinsic components of motivation for music engagement during different musical activities.

Qualitative music engagement: mood regulation with music listening

Regarding qualitative music engagement, the overall use of music listening for mood regulation was associated with higher social support, but also with worse mental health, and lower mindfulness and optimism.

Corresponding to previous research (Thomson et al., 2014), diversion (i.e., using music to forget unwanted thoughts and feelings) and discharge (i.e., using music to express negative feelings) displayed only negative associations, suggesting a maladaptive quality perpetuating avoidance or rumination. However, mental work (i.e., using music for contemplation) and solace (i.e., using music for comfort) were also associated with more positive reappraisal indicating a facilitation of cognitive processing of emotions. The consistent negative associations with mindfulness suggest that people using music listening for mood regulation approach their emotions with a specific goal to interact with them instead of observing them non-judgmentally as would be the case in mindfulness. Further, the associations of entertainment (i.e., using music to enhance positive mood) and solace with higher social support point to the social setting of music listening or to music-elicited recall of social memories. One factor modulating the associations of music listening and mood regulation might be the concept of familiarity or repeated exposure in music which may operate in an inverted-U shape preference response (increasing pleasure for a certain period of time and ultimately inducing displeasure; Freitas et al., 2018). Thus, listening to certain music may or may not fulfill the musical expectations of an individual evoking a broad variety of emotions through different (rewarding or distressing) psychological response systems (Huron, 2006).

Qualitative music engagement: mood regulation with music making

Regarding the use of music making for mood regulation, again, diversion and discharge were linked to reduced mindfulness and worse mental health, while mental work was also associated with higher positive reappraisal and social support. Solace also showed a positive link to social support suggesting that the social setting of music making (i.e., orchestras or choirs) might provide particularly beneficial conditions for feeling connected. Indeed, only 13.3% of participants reported regular music making in non-social contexts. In both music listening and making, the strategies revival (i.e., using music for renewal) and strong

sensations (i.e., using music to induce or enhance intense emotions) showed no unique associations. Due to high interindividual variability in the induction of music-related emotions or musical chills (Nusbaum & Silvia, 2011), using music for that purpose thus may not be as effective (on average). Therefore, similar to regulatory flexibility in general emotion regulation (Bonanno & Burton, 2013), flexibility in music-based mood regulation might be a promising construct in future research. However, so far, such a measure of flexibility is missing. Similar to music listening, it has been argued that musical expectancy may be a fundamental mechanism underlying the association between music engagement and emotions (Vuust & Frith, 2008). Especially in music making, individuals might actively deal with the structure of the music confronting their own musical expectations, which points to musical anticipation as a significant psychological process underlying the induction of emotions during music making.

In summary, the associations of music engagement with resilient outcomes were rarely direct, but rather indirect through links with resilience factors, which highlights the role of music-based mood regulation in resilience networks and encourages including assessments of resilience resources in further studies on music and mental health. Based on the differential findings of our analyses, future studies should explore potential moderators influencing the associations of music engagement with resilient outcomes, such as culture (e.g., religious rituals), the musical background (e.g., Wöllner, Ginsborg & Williamon, 2011), or collective exposure (e.g., background music in a supermarket or community music; Hallam & Creech, 2018; Nadon, Tillmann, Saj & Gosselin, 2021).

Limitations

Several limitations must be considered. First, the relatively small sample and the use of EBIC for *mgn* model selection may have reduced sensitivity of the analyses (Isvoranu & Epskamp, 2021), that is, edges might have been set to zero even if they are not zero in the “true” network. However, edges that survive the regularization are likely to reflect “true” links, which supports the relevance of the rather small associations for music-based variables. Future studies should examine the network structure in larger samples, which may also allow to discover associations for quantitative music engagement. This also holds for our sensitivity analyses that were performed to exploratively examine the impact of potentially confounding music-related factors on the association of music engagement and resilience (factors). Our analyses did not point to an important impact of these factors, yet it was not a priori powered for these analyses. Thus, future studies need to examine potential moderators in larger samples. Second, as our analyses focused on trait variables in cross-sectional data, we cannot draw conclusions about the existence or direction of causal links, which could be investigated in future experimental trials. Moreover, we assessed mental health and SRA as proxies of resilient outcomes, but we cannot confidentially say that all participants had been exposed to relevant stress, which is essential to measure resilience. However, our study took place when the COVID-19 pandemic, a major societal-level stressor, was still present in German-speaking countries. Future studies may use other operationalizations of resilient outcomes including assessments of individual stressor exposure and trajectory-based approaches (Schäfer, Kunzler, Kalisch, Tüscher & Lieb, 2022). Third, since our sample mainly consisted of Caucasian women with high education, our results cannot be transferred to other populations. Further, the sample mainly made and listened to classical music which may have limited generalizability regarding other musical genres. Although we measured their musical background via single items on years of music lessons and total music making, it might also be worthwhile in future studies to include more detailed questionnaires assessing self-reported musical abilities (e.g., Music Self-Perception Inventory; Morin, Scalas, Vispoel, Marsh & Wen, 2016) or even test batteries (e.g., Profile of Music Perception Skills; Law & Zentner, 2012). Additionally, it might be interesting to reproduce our findings in comparison to non-musicians or people engaging in other leisure time activities.

Conclusion

As the first study in this field, the present work generated novel insights into the architecture of the interplay between music engagement and resilience. While time spent with music listening or making was not uniquely associated with resilience factors or resilient outcomes, the use of music for mood regulation painted a more diverse picture. Music-based mood regulation was related to higher social support, but partially linked to worse mental health and lower mindfulness and optimism. The strategies diversion and discharge showed negative associations with resilience (factors), while entertainment, solace, and mental work also demonstrated positive links. These findings point to the importance of investigating divergent associations of quantitative and qualitative music engagement. Our results depart from the notion that music engagement and music-based mood regulation are strictly beneficial processes inspiring a more nuanced conversation on their relations with maintaining and regaining mental health in face of stress.

However, with this study we aimed to provide initial evidence on differential associations of music engagement with resilience factors and resilient outcomes, which involves limitations regarding a more detailed assessment of music engagement. Therefore, although our exploratory sensitivity analyses regarding several musical aspects did not yield significant results, further studies are necessary to examine the multifaceted nature of music engagement in greater depth, especially regarding intrinsic and extrinsic motivation for music engagement as well as different musical factors, such as the musical genre, familiarity, and anticipation. Additionally, future studies need to use the potential of experimental designs and should examine the role of flexibility in music-based mood regulation. Practical implications include the optimization of mental health interventions through improving education on (mal-)adaptive music-based mood regulation.

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Supplementary materials

Supplementary material associated with this article can be found in the online version, at [doi:10.1016/j.ijchp.2023.100377](https://doi.org/10.1016/j.ijchp.2023.100377).

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