



Music listening as distraction from everyday worries

Töres Theorell

Professor Emeritus, Karolinska Institutet

Töres Theorell is a physician. His research has been in stress medicine and psychosomatics. He was the director of the National Institute for Psychosocial Factors and Health 1995-2006 and at the same time Professor of Psychosocial Medicine at the Karolinska Institute. Theorell is now a research consultant at the Institute for Psychosocial Factors and Health and at the Royal College of Music.

Jan Kowalski

Doctor of Philosophy. Senior Consultant in biostatistics

Jan Kowalski is a biostatistician and was employed by Karolinska Institute as a teacher in statistics for PhD students from 1993 to 1998 where he was a statistical advisor for more than 200 PhD students/theses. Since 1999, he has acted as a senior consultant in biostatistics, and his work has included: experimental studies, pre-clinical studies, clinical trials, registry studies, medical devices, and epidemiological studies.

Eva Bojner Horwitz

Professor, Royal College of Music in Stockholm

Eva Bojner Horwitz, Professor of Music and Health at the Royal College of Music in Stockholm and researcher at the Department of Clinical Neuroscience Karolinska Institute (KI). She is specialized in psychosomatic medicine and the creative arts; co-founder of the Center for Social Sustainability (CSS), KI and anchored in interdisciplinary research, now focusing on performance evaluations with musicians.

eva.bojner-horwitz@kmh.se

Abstract

Background: Anecdote suggests that listening to music can help to distract from worries about ongoing life problems.

Purpose: In this study we examine the phenomenon and ask, to what extent does music listening alleviate worry, and under what circumstances? Our focus was on the immediate temporary effects.

Methodology: We performed four pilot experiments with audiences comprised of different ages and backgrounds of musical experience. As part of these experiments, we constructed a visual analogue scale (VAS) to assess “daily worry” together with the three other dimensions of tiredness-arousal, sadness-happy and anxiety-calmness. Participants were asked to listen to live classical music and to fill out the VAS before and after assessments. The experiments enabled us to examine the similarities and differences among audiences of different ages and music experience with regard to the capacity for music to distract them from their worries, what we term ‘worry distraction’.

Findings: In the different listening situations, the self-rating of daily worries decreases after listening to live, high-quality professional performances of classical music. In our experiments, previous experience of classical music does not have a significant effect on decreased worry while listening. University level education in general, however, is associated with an increased effect. This prompts a discussion regarding the role education plays as a determinant for health – including the relationship between experiences of music in relation to health.

Originality: It is striking that live classical music could affect daily worries of people across different age groups evaluated with our simple and easily distributed Visual Analogue Scale. This could therefore be recommended for evaluations in other contexts.

Keywords

arousal, daily worries, live music, music listening

Background

Our daily lives are permeated by worries that vary from passing concerns to those on which we ruminate for hours, and which begin to interfere with everyday tasks. Arbel, Shapiro, Timmons, Moss and Margolin (2017) recently reinstated ‘worry’ at the forefront of the research agenda, arguing that although it is a commonly experienced phenomenon that can be dismissed by others off-hand, it is in fact ‘a complex, multidimensional process involving cognition, affect, and biologically based stress responses’. As part of this argument, the authors point to further research in the field that indicates that although worry can in some ways be benign and play the role of motivating an individual to take action (see also Arbel et al., 2017), in others worry is connected to symptoms of ill health including fatigue, musculoskeletal pain, and gastrointestinal issues (Verkull, Brosschot, Gebhardt & Thayer, 2010), and chronic experiences of worry leading to exacerbated insomnia (McGowan, Behar & Luhmann, 2016; Morin, 1993).

Worry has long been associated with anxiety and an individual’s response to perceived threat (Matthews, 1990). Borkovec, Ray and Stober (1998) established a tendency for ‘worriers’ to find it difficult to enter a restful, parasympathetic state. In their study of Generalised Anxiety Disorder (GAD), they assert that worry can therefore both contribute to a variety of physiological stressors and serve as a displacement of fear, or distraction ‘from the real problem’ (1998, p. 8) and result in avoidant behaviors. The picture is, of course, nuanced. For example, in their study of adolescents, Arbel et al. (2017) found that worry may also carry with it some protective health effects outside of at-risk groups, although in the long-term they assert that the effects of the cortisol awakening response that anxiety induces may lead to greater negative health consequences. Furthermore, distraction from worry itself has been thought not to be desirable in a straightforward sense, and may play a role in maintaining its impact ‘in the same way that avoidance slows the extinction of conditioned fear’ unless, however, the problems about which the individual concerns themselves are ‘insoluble’ (Matthews, 1990, p. 457).

Behaviorally, an association between worry and risk-taking behavior has also been tentatively found, for male but not female adolescents (Arbel et al., 2018). For those who had negative experiences of seeking support, the level of risk in their behaviors the following day were found to be elevated, which then generated further worries. For female adolescents, positive support-seeking experiences appeared to buffer this vicious circle of influence. This research suggests that it is important to more closely examine the effects of intervention for worry and anxiety. Research has begun to investigate the connection between music listening and stress response: Thoma et al. (2013) found that listening to music before exposure to a standardized stressor had an impact on the response of the autonomic nervous system, showing that relaxing music enabled the individual to recover more quickly. More generally too, music has been shown to affect stress-related physiology and cognition in a positive manner (Nyklicek, Thayer & Van Doornen, 1997; Khalfa et al., 2003). Studies on the effect of music on reducing cortisol levels during medical interventions have been mixed, with some studies showing a beneficial effect (Escher et al., 1993; Ventura, Gomes & Carreira, 2011) and others a more ambivalent connection (Yamamoto et al., 2007). However, there is good evidence that music can alleviate the symptoms of anxiety (Nilsson, 2008; Richards, Johnson, Sparks & Emerson, 2007) and reduce the impact of stressors on anxiety, systolic blood pressure and heart rate in men and women (Knight & Rickard, 2001).

In our study, we examine the capacity for music to distract individuals from their ‘everyday’ worries, defined on the basis of each person’s own perception of daily worries of problems and the impact of personal context on this effect. Our focus here is not on possible

long-term effects, but simply on the transitory effect that music listening may have on daily worrying. In doing this, we have allowed the participants themselves to define their worries – without detailed explanation. We furthermore examine possible modifying effects that age, prior music experience and general educational level may have. These are factors that have been largely overlooked in research.

Aim and research question

What is the “average magnitude” of worry distraction in different situations. How much dispersion is there? Do old and young people differ with regard to worry distraction while listening to classical music? Do people with prior knowledge of music differ from others in their worry distraction?

Material

In this study we used four different audiences for our experiments: two school audiences with little experience of listening to classical music, and two audiences with more experience.

Students from two different schools

1. Public school in Stockholm, grade 3 and grade 5.

There were 23 pupils in each class (N=46, mean age 10.4, SD 1.2, 21 girls and 25 boys). Students were invited to listen to a live concert played by a trio of advanced chamber musicians, consisted by one viola, one violin and one cello player. The performances were conducted separately in each of the classrooms. The viola player started with a solo performance, an excerpt of a partita by Johann Sebastian Bach. Thereafter, the ensemble first played a string trio by Beethoven in G-major, opus number 1, and a Serenade for string trio by Ernst Dochnanyi, opus number 10. Both the pieces from Beethoven and the Dochnanyi are interpreted by most people as being arousing in quality. The concert lasted a total of 30 minutes and the concert programs were identical in each of the two classrooms.

Among the listening participants, 24% reported no experience of classical music, 36% as having some, 31% reported an average level of experience and 9% a lot of previous experience of classical music.

2. A Waldorf school in Stockholm, grade 7 and grade 8.

There were 20 pupils in each class (N=40, mean age 13.6, SD 0.59, 12 girls and 28 boys) who were invited to listen to a live concert played by a string quartet of advanced chamber musicians, two violins, one viola and one cello-player. One violin player started with a partita by Johann Sebastian Bach. Thereafter the string quartet played Mozart’s string quartet number 15 (K no. 458 in B flat major). This last piece is a lively and joyful piece of music. The performances were conducted separately in each of the two classrooms and were identical. The duration was 30 minutes.

Among these listening participants, 18% reported some, 68% average and 15% a lot of previous experience of classical music.

Experienced chamber music listeners

1. An inauguration concert with special guests in a small concert hall in Stockholm

The first concert was performed in a small concert room in the center of Stockholm. In the audience there were 25 participants with a mean age 43.1 (SD 15.7). There were 13 women

and 12 men. The concert was an inauguration of the Musethica program in Sweden. The performing trio was the same as the one played in the public school above. They played the string trio by Beethoven in G-major, opus number 1, and a Serenade for string trio by Ernst Dochnanyi opus number 10.

Among the listening participants, 4% reported no, 20% average and 76% a lot of previous experience of classical music. Sixty-four per cent had attended higher education after secondary school, 32 % had university-level education, and 4% had attended or were attending music college.

2. Nathan Milstein concert hall at the Royal College of Music in Stockholm

The second concert was held at the Royal College of Music in Stockholm in the Nathan Milstein concert hall as part of a series of concerts celebrating the opening of the new buildings for the College. There were 60 participants in the audience with a mean age of 58.4 (SD 17.9). There were 37 women and 23 men. The performing musicians were the same as above. They again played the string trio by Beethoven in G-major, opus number 1 and a Serenade for string trio by Ernst Dochnanyi opus number 10. Both concerts were free of charge.

Among the listening participants in this group, 23% reported no, 45% average, and 32% a lot of previous experience of classical music. Six percent had secondary school only, 44% higher education after secondary school, and 42% university-level education. Eight per cent had attended or were attending music college.

Overall, subjects were 31.3 (24.4) years old and 74 (47 %) were female. The listeners in the Musethica inauguration concert had the most previous experience of classical music. In the concert at the Royal College of Music, the subjects reported a medium experience of classical music. Both the adult audiences had, on average, a high level of education by national standards.

The VAS scales contained three different variables: arousal, joy and calmness (see below under methods), and a further question regarding daily worries. The listeners were instructed to mark a cross on the different VAS line continuum (a 1-dm horizontal line) before and after the listening situations and also to mark a cross to indicate the intensity of their experience of worry pre- and post-listening. This instruction was read out loud by the study leader to all the participants prior to the concerts, and questionnaires were distributed to all participants in the different audiences before the listening situations. The definition of worry was left entirely to the participants themselves.

Method

As presented in a previous study (Theorell & Bojner Horwitz, 2019), the emotional assessment tool has three dimensions: arousal, joy and calmness. The different dimensions are presented with a 1-dm horizontal line representing the following extremes: tired to alert (from left to right), sad to happy (from left to right) and worried to calm (from left to right), respectively. The daily worries was also marked on a VAS line. The different adjectives were chosen after pilot tests with different selections of words.

Validity test

Two different validity tests have been presented previously in which the VAS methodology has been used in music listening situations (Lingham & Theorell, 2009; Theorell, 2016). In those validity tests, evidence has been provided that the experimental subjects are able to discriminate between different feelings and that the VAS scales do reflect the chosen emotional states that were chosen for this study. In psychometric practices, the Visual Analogue Scales

have been commonly used in assessment of pain perception (Yang, Clark & Janal, 1991), fatigue (Ericsson & Mannerkorpi, 2007) and physical effort (Wilson & Jones, 1989).

Statistics

All data for the outcome variable of daily concern on the VAS score were presented using descriptive statistics, number of participants, mean, standard deviation, median, minimum and maximum. Individual scores for the changes from before and after listening to music were calculated and then the mean change of scores was used to test differences between subgroups of participants. The subgroups were: school unit, gender, education, and experience. The statistical method used to test for differences between subgroups was the ANCOVA model. In the first step, all subgroups variables were modeled separately in an ANCOVA with the subgroup factor as a fixed factor in the model, and with baseline values of VAS scores as a covariate in the model, i.e. univariate models. In the second step, a multivariate model was built with the factors of gender, education, and experience of classical music as fixed factors, and with baseline value as a covariate. Results of the ANCOVA models were presented using least square means (adjusted values) and standard error.

The correlations between changes from before and after listening to music with regard to various outcome variables, i.e. daily worry, arousal, joy and calmness, were estimated using the Pearson's correlation coefficient.

All statistical tests were two-tailed and $p < 0.05$ was considered as statistically significant.

Both means (with standard deviations) and medians (with maxima and minima) were calculated both before and after listening for all the emotional states. Significance of changes pre-post in reported emotional states was computed by means of two-tailed t-tests and other parametric tests. The rationale behind this was that the distributions were close to normal distributions. The questionnaire was designed to be simple to administer directly before and after listening experiences. It was designed to be easy for participants to fill in the sheets, thereby maintaining as close a connection as possible to the stimulus.

Finally, we examined whether the pre-music listening "daily worry" ratings differed systematically between the study groups or in relation to education, previous experience of classical music, age and gender.

Ethical approval

An ethical approval was obtained for the study (Dnr 2017/1009-31/1 Central Ethical Review Board in Stockholm, Sweden).

Results

Table 1. This table shows the means of pre and post listening for daily worries for all the four study samples as well as separately for men and women, subjects with and without university education and finally in subjects with more or less experience of classical music.

Daily Concern (VAS 0-10)			Number of Subjects	Mean	Standard Deviation	Median	Minimum	Maximum
Gender	Male	Pre	83	3,2	2,8	2,2	0,0	10,0
		Post	83	2,3	2,5	1,2	0,0	9,5
		Mean Change Post-Pre	83	-0,91	2,75	-0,75	-7,70	9,50
	Female	Pre	74	3,6	2,7	3,2	0,0	9,2
		Post	74	2,3	2,7	1,0	0,0	10,0
		Mean Change Post-Pre	74	-1,36	2,47	-0,80	-9,10	4,80
Education	Primary School	Pre	90	3,5	2,8	3,0	0,0	9,8
		Post	90	2,7	2,9	1,6	0,0	10,0
		Mean Change Post-Pre	90	-0,78	2,77	-0,60	-6,90	9,50
	University	Pre	70	3,1	2,7	2,0	0,0	10,0
		Post	70	1,6	1,9	0,9	0,0	7,1
		Mean Change Post-Pre	70	-1,55	2,34	-1,10	-9,10	4,60
Experience	No	Pre	11	4,7	3,8	4,0	0,1	9,8
		Post	11	2,7	3,4	1,1	0,0	10,0
		Mean Change Post-Pre	11	-1,99	2,59	-1,50	-6,80	1,00
	Little	Pre	36	3,4	3,1	2,2	0,0	10,0
		Post	36	2,9	3,2	1,0	0,0	9,5
		Mean Change Post-Pre	36	-0,52	2,88	-0,30	-7,70	9,50
	Moderate	Pre	70	3,0	2,4	2,1	0,0	7,7
		Post	70	2,0	2,2	1,2	0,0	9,1
		Mean Change Post-Pre	70	-1,02	2,05	-0,70	-6,60	6,90
	High	Pre	38	3,3	2,7	2,7	0,0	9,2
		Post	38	1,9	2,2	0,9	0,0	9,4
		Mean Change Post-Pre	38	-1,44	3,23	-1,70	-9,10	9,40
Unit	Musethica	Pre	22	3,6	2,8	4,7	0,0	10,0
		Post	22	1,4	1,5	1,1	0,0	6,0
		Mean Change Post-Pre	22	-2,14	2,19	-2,20	-7,70	1,40
	KMH	Pre	52	2,9	2,6	1,8	0,0	9,2
		Post	52	1,8	2,3	0,9	0,0	9,5
		Mean Change Post-Pre	52	-1,12	2,78	-0,90	-9,10	9,50
	Kristoffer-skolan	Pre	40	3,8	2,5	3,6	0,5	9,0
		Post	40	3,0	2,4	2,8	0,1	9,1
		Mean Change Post-Pre	40	-0,86	2,45	-0,60	-6,90	6,90
	Ulriksdals-skolan	Pre	46	3,3	3,1	2,1	0,0	9,8
		Post	46	2,5	3,2	0,7	0,0	10,0
		Mean Change Post-Pre	46	-0,83	2,71	-0,35	-6,80	9,40

The descriptive analyses are presented in Table 1.

Results from the univariate models reveal that there is a statistically significant difference between subgroups of different educational levels – participants who had an education to university level decreased their levels of mean daily concern by -1.65 after listening to music compared to -0.71 for participants with education below university level (see Table 2). There is a tendency towards a statistically significant difference (P=0.07) among subgroups. Gender, age, and experience show less and non-significant relationship to change in daily worry.

As expected, (not shown) the level of worrying prior to listening to music is related to the degree of post-listening change. It explains 30% of the variance in change. This is the reason why pre-level is used as a confounder.

Results from the multivariate modeling in the next step (also Table 2) show that education is the factor that stands out. This variable shows a statistically significant correlation with decrease in daily concern, independently of gender, age and previous experience of classical music.

Table 2. This table shows the results of ANOVA for Change in Daily Worries after Listening to Music.

Variable	Mean Change	Standard Error	Univariate Model	Multivariate Model		P-value
			P-value	Mean Change	Standard Error	
Gender						
Male	-1,02	0,25	0,55	-1,27	0,29	0,94
Female	-1,24	0,26		-1,24	0,30	
Age (Regression Coefficient)						
	0,00		0,67			
Education						
Primary School	-0,71	0,23	0,01	-0,75	0,27	0,01
University	-1,65	0,26		-1,77	0,34	
Experience						
No	-1,27	0,68	0,27	-1,78	0,70	0,41
Little	-0,47	0,37		-0,68	0,38	
Moderate	-1,16	0,27		-1,27	0,27	
High	-1,45	0,36		-1,30	0,38	
Unit						
Musethica	-2,03	0,46	0,07			
KMH	-1,34	0,31				
Kristofferskolan	-0,62	0,35				
Ulriksdalsskolan	-0,85	0,32				

Analysis of the correlations between various outcome variables (see Table 3) shows that change in daily worry was statistically significantly correlated with change in arousal and change in calmness, whereas there was no such correlation with change in valence (change in joy). The strongest correlation was found with change in arousal – a decrease in arousal shares 12.6% (0.355 squared) of the variance with decrease in daily concern.

Table 3. This table shows the correlation Matrix between outcome variables.

Correlations		Change in Daily Worries	Change in Arousal	Change in Valence	Change in Calmness
Change in Daily Worries	Pearson Correlation		-.203**	-0,121	-.209**
	Sig. (2-tailed)		0,008	0,115	0,006
	N		171	171	171
Change in Arousal	Pearson Correlation			.269**	0,103
	Sig. (2-tailed)			0,000	0,178
	N			172	172
Change in Valence	Pearson Correlation				.355**
	Sig. (2-tailed)				0,000
	N				172
**. Correlation is significant at the 0.01 level (2-tailed).					

The pre-music listening “daily worry” ratings did not differ significantly between the study groups or in relation to education, previous experience of classical music, age and gender, neither in univariate nor in multivariate tests in this particular study.

Discussion

The main findings in this study, which are discussed below, are the following:

- A relatively uniform observation across the different listening situations is that the self-rating of daily concern decreases after listening to live high quality professional performance of classical music. The average decrease in daily concern rating is in the order of 1 cm on a 1-decimeter visual analogue scale with group mean change ranging from 0.6 (two teenaged groups) to 2.0 (a highly enthusiastic invited adult group). The standard deviation of the change for the total study group is 2.5, which means that while a substantial portion of the participants experience increased concern, a significant majority experiences a lowered level of concern for daily worries.
- There is no gender difference in reported change.
- Previous experience of classical music does not have a significant effect on score change after listening. University-level education, however, is associated independently of the other factors with an increased effect.
- Emotional change, especially decreased arousal, correlates with decreased daily concern, but this only explains 13% of the variance.

It could be argued that the visual analogue scale (VAS) is a crudely insensitive method for recording level of worrying about daily problems. While this is possible, it should be pointed out that VAS has been used successfully in many contexts for the study of emotional and bodily change and that it correlates with physiological change (Yang, Clark & Janal, 1991; Wilson & Jones, 1989; Theorell & Bojner Horwitz, 2019). Together with the validity tests presented previously (Lingham & Theorell, 2009; Theorell, 2016) in which the VAS methodology was used in similar situations, evidence has been provided that the VAS scales did reflect the chosen emotional states which were the same as those chosen for this study.

It is interesting to relate to the issue of “distraction”, according to Fancourt et al.’s study (Fancourt, Garnett, Spiro, West & Mullensiefen, 2019), described as an emotion strategy in the context of engagement with music or other creative activities. We speculate that the dimension we are likely to capture with our brief VAS methodology corresponds to “distraction.” We argue that although this may be considered superficial, it still has a potential value for a listener since it may serve as an interruption in worried thinking – which may give the brain a possibility to recuperate.

Since there is a strong correlation between the level of worrying pre-listening and the change post-listening, we have used this variable as a confounder in the analyses. This should always be considered when the degree of change is interpreted. On the whole, the correlations between changes in the studied parameters should be interpreted with caution since product moment correlations of change scores are easily affected by outliers. Still it is of interest that the emotional change that correlates most strongly with decrease in worry is decrease in arousal.

The fact that the live music performed as part of this study was of high quality may also be an important factor. It is quite possible that lower quality performances may induce less change. This has not been studied, however.

Although classical chamber music may be perceived as complicated by audiences who are unaccustomed to this kind of music, it is interesting to note that even in the younger children, the exposure to this kind of music seemed to decrease worry to the same extent as it did for the general adult audience at the Royal College of Music. Furthermore, we observed that previous experience of classical music does not in itself seem to influence the degree of worrying significantly. In this study we did not measure the factor of alexithymia i.e. a personal construct when you have a difficulty in differentiating, identifying and verbalizing emotions (Söndergaard & Theorell, 2004). This factor would be interesting to include in future studies i.e. to examine if daily worries decrease when listening to classic chamber music regardless of alexithymia.

However, the general level of education does seem to be important to the change in participant scores. Subjects with a university education are more likely to react with decreased worry than others. This echoes other research findings that education plays an important role as a determinant for health and therefore could be better recognized as a factor also for the inequities of health (Hahn & Truman, 2015). If music and music education can play a role in reducing the inequities of health through easing daily worries, then this is something worthy of attention from the public health community in future. The causal relationship between listening to music, music education and health need to be better understood.

As seen in Arbel et al. (2017), anxiety and worry reduction may lead to better positive health consequences and if music listening can help create soundscapes of well-being, this is what we need to develop in our societies (schools, educational programs & health care institutions) in the future. Prior research supports the connection between music listening

in particular and a reduction in anxiety and stress (Nilsson, 2008; Nyklicek, 1997; Khalifa, Bella, Roy, Perets & Lupien, 2003; Richards, 2007) and so we need to better understand how this can be utilized in the most effective manner to target different groups.

The observation that university education was a variable that may amplify the lowering of daily worries in classical chamber music listening may illustrate one of many reasons why highly educated subjects in general have a better health than persons with a low level of education (Hahn & Truman, 2015). One interpretation could be that the highly educated subjects have a wider range of coping mechanisms available to them since they have been exposed to a wider range of cultural experiences that they can relate to throughout life. It remains to be seen what aspect of higher education leads to the positive effects observed in this study, but it may be that music education itself can produce beneficial effects in relation to stress reduction. If so, classical music listening and playing could be part of our education curricula to a greater extent – even in earlier stages i.e. primary schools. However, other music genres could also be effective: as seen in the Swedish study “We beat drums – not one another” where as a result of their musical intervention, researchers observed an increased percentage of students reaching high-school level with better school results, along with decreased destructive behaviors in the schools overall (Cruz, 2014).

Research strengths and limitation

A strength is that we have tested our scale with widely different audiences. It is useful that our VAS scale turns out to be easily applied in these widely different situations.

A limitation with the study is that the samples were not systematically recruited. However, we feel that for the purpose of testing the VAS scale, there was sufficient contrast between our audiences. Another weakness is that we limited listening to one genre, classical music. Although that limits generalizability, it is argued that it creates stimulus uniformity. Furthermore we are aware that worries are defined and experienced differently by young and old subjects, but these experiments were limited to self-definitions of worry. Similarly, our focus was on transitory effects that could be small and we therefore used sensitive methodology.

Originality and value

It is striking that live classical music could affect daily worries of people across different age groups evaluated with our simple and easily distributed Visual Analogue Scale. This could therefore be recommended for evaluations in other contexts. VAS could be used in other education situations after music performances, for example when evaluating changes of daily worries prior to exams or in other sensitive health care situations such as music therapy sessions. VAS is very easy to apply and repeat in before-after designs and it seems to be sensitive enough to record changes during brief periods of listening situations.

References

- Arbel, R., Perrone, L. & Margolin, G. (2018). Adolescents' daily worries and risky behaviors: the buffering role of support seeking. *Journal of Clinical Child & Adolescent Psychology*, 47(6), 900–911. DOI: <https://doi.org/10.1080/15374416.2016.1169536>.
- Arbel, R., Shapiro, L. S., Timmons, A. C., Moss, I. K. & Margolin, G. (2017). Adolescents' daily worry, morning cortisol, and health symptoms. *Journal of Adolescent Health*, 60(6), 667–673. DOI: <https://doi.org/10.1016/j.jadohealth.2017.01.007>.
- Borkovec, TD., Ray, WJ. & Stober, J. (1998). Worry: A cognitive phenomenon intimately linked to affective, physiological, and interpersonal behavioral processes. *Cognitive Therapy and Research*, 22(6), 561–76. DOI: <https://doi.org/10.1023/A:1018790003416>.
- Cruz Valois, D. (2014). *We beat drums – not one another*. Bachelor thesis at Karolinska Institutet, Institution of Public Health Science, Sweden.
- Ericsson, A. & Mannerkorpi, K. (2007). Assessment of fatigue in patients with fibromyalgia and chronic widespread pain. Reliability and validity of the Swedish version of the MFI-20. *Disability and Rehabilitation*, 29(22), 1665–1670. DOI: <https://doi.org/10.1080/09638280601055782>.
- Escher, J., Höhmann, U., Anthenien, L., Dayer, E., Bosshard, C. et al. (1993). Music during gastroscopy. *Schweizerische Medizinische Wochenschrift*, 123, 1354–1358. PMID:8393585.
- Fancourt, D., Garnett, C., Spiro, N., West, R. & Mullensiefen, D. (2019). How do artistic creative activities regulate our emotions? Validation of the Emotion Regulation Strategies for Artistic Creative Activities Scale (ERS-ACA). *PLoS ONE*: 14(2). DOI: <https://doi.org/10.1371/journal.pone.0211362>.
- Hahn, RA. & Truman, BI. (2015). Education Improves Public Health and Promotes Health Equity. *International Journal of Health Services*, 45(4), 657–78. DOI: <https://doi.org/10.1177/0020731415585986>.
- Khalifa, S., Bella, SD., Roy, M., Peretz, I. & Lupien, SJ. (2003). Effects of relaxing music on salivary cortisol level after psychological stress. *Annals of New York Academy of Sciences*, 999, 374–376. DOI: <https://doi.org/10.1196/annals.1284.045>.
- Knight, W. E. & Rickard, N. S. (2001). Relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure, and heart rate in healthy males and females. *Journal of Music Therapy*, 38(4), 254–272. DOI: <https://doi.org/10.1093/jmt/38.4.254>.
- Lingham, J. & Theorell, T. (2009). Self-selected “favorite” stimulative and sedative music listening – how does familiar and preferred music listening affect the body? *Nordic Journal of Music Therapy*, 18, 150–166. DOI: <https://doi.org/10.1080/08098130903062363>.
- Mathews, A. (1990). Why worry? The cognitive function of anxiety. *Behaviour Research and Therapy*, 28(6), 455–468. DOI: [https://doi.org/10.1016/0005-7967\(90\)90132-3](https://doi.org/10.1016/0005-7967(90)90132-3).
- McGowan, S. K., Behar, E. & Luhmann, M. (2016). Examining the relationship between worry and sleep: A daily process approach. *Behavior Therapy*, 47(4), 460–473. DOI: <https://doi.org/10.1016/j.beth.2015.12.003>.
- Morin, C. M. (1993). *Insomnia: Psychological assessment and management*. New York, NY: Guildford Press.
- Nilsson, U. (2008). The Anxiety- and Pain-Reducing Effects of Music Interventions: A Systematic Review. *ARON Journal*, 87, 780–807. DOI: <https://doi.org/10.1016/j.aorn.2007.09.013>.
- Nyklicek, I., Thayer, JF. & Van Doornen LJP. (1997). Cardiorespiratory differentiation of musically induced emotions. *Journal of Psychophysiology*, 11, 304–321. Available at: <https://psycnet.apa.org/record/1997-41450-002>.

- Richards, T., Johnson, J., Sparks, A. & Emerson, H. (2007). The effect of music therapy on patients' perception and manifestation of pain, anxiety, and patient satisfaction. Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK73583/>.
- Söndergaard, HP. & Theorell, T. (2004). Alexithymia, emotions and PTSD; findings from a longitudinal study of refugees. *Nordic Journal of Psychiatry*, 58(3), 185–191. DOI: <https://doi.org/10.1080/08039480410006214>.
- Theorell, T. (2016). Arts, health and job stress. In Romanowska, J., Nyberg, A. & Theorell, T. (Eds.), *Developing Leadership and Employee Health Through the Arts*. London: Springer.
- Theorell, T. & Bojner Horwitz, E. (2019). Emotional effects of live and recorded music in various audiences and listening situations. *Medicines*, 6(1), 16. DOI: <https://doi.org/10.3390/medicines6010016>.
- Thoma, MV., La Marcia, R., Brönnigmann, R., Finkel, L., Eblert, U. & Nater, UM. (2013). The Effect of Music on the Human Stress Response. *PLoS One*, 8(8), e70156. DOI: <https://doi.org/10.1371/journal.pone.0070156>.
- Ventura, T., Gomes, MC. & Carreira, T. (2011). Cortisol and anxiety response to a relaxing intervention on pregnant women awaiting amniocentesis. *Psychoneuroendocrinology*, 37: 148–56. PubMed: 21705148. DOI: <https://doi.org/10.1016/j.psyneuen.2011.05.016>.
- Verkuil, B., Brosschot, JF., Gebhardt, WA. & Thayer JF. (2010). When worries make you sick: A review of perseverative cognition, the default stress response and somatic health. *Journal of Experimental Psychopathology*, 2010;1:87e118. DOI: <https://doi.org/10.5127/jep.009110>.
- Wilson, R.C. & Jones, P.W. (1989). A comparison of the visual analogue scale and modified Borg scale for the measurement of dyspnea during exercise. *Clinical Science*, 76, 277–282. DOI: <https://doi.org/10.1042/cs0760277>.
- Yamamoto, M., Naga, S. & Shimizu, J. (2007). Positive musical effects on two types of negative stressful conditions. *Psychol Music*, 35, 249–275. DOI: <https://doi.org/10.1177/0305735607070375>.
- Yang, J.C., Clark W.C. & Janal, M.N. (1991). Sensory decision theory and visual analogue scale indices predict status of chronic pain patients six months later. *Journal of Pain Symptom Manage*, 6(2), 58–64. DOI: [https://doi.org/10.1016/0885-3924\(91\)90519-A](https://doi.org/10.1016/0885-3924(91)90519-A).