



Embodied learning via a *knowledge concert*: An exploratory intervention study

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Abstract

Background: Music listening can improve acquisition of new knowledge.

Purpose: The purpose of the study was to evaluate the emotional and cognitive effects of a *knowledge concert* on the attending audience.

Methodology: The audience was asked to complete a Visual Analogue Scale (10 cm) before and after listening to the concert, along five variables: Arousal, Degree of happiness, Degree of worry, Daily worries and Benevolence. Follow-up qualitative interviews gathered narratives from the participants.

Findings: 228 concert attendees took part in the study by completing the questionnaires (51 percent of the whole audience). Statistically significant changes were observed in the outcome measures for: Arousal ($p=0.002$), Daily worries ($p<0.001$) and Degree of happiness ($p=0.01$). Degree of worry interacted with age ($p<0.001$). No changes were found for Benevolence ($p=0.93$). Gender and previous music experiences did not make a difference to feelings evoked by the music. Age, however, was important since younger participants became more worried by the concert than older.

Originality: We discuss the potential role of future *knowledge concerts* that comprise qualities explored, such as mitigating a variety of embodied psychological capacities, including reflection and agency in audiences, facilitating learning about sensitive issues, and potentially also transformation towards prosocial mindsets and behavior.

Keywords

embodied knowledge, emotional regulation, knowledge concert, #metoo, performance evaluation, satellite seminars

Background

The concept of the *knowledge concert* was developed by researchers at the Royal College of Music and Karolinska Institute in Sweden as a way for the audience to harness the emotional, cognitive and intentional responses they experienced after listening to a live music concert. Live music concerts are complemented by a series of satellite seminars (i.e. follow-up small-group seminars in which the contents of the concert are discussed) that engage audiences in discussions on a variety of topics. The *knowledge concert* represents a working format for discussing and acquiring new knowledge about issues that can be sensitive or difficult to communicate when using more traditional cognitive forms and settings, providing a forum that is conducive to learning. We define a *knowledge concert* as: a live music concert experience in which the audience attains new knowledge. Through listening to music which stimulates the emergence of a variety of emotions and can simultaneously increase susceptibility, audiences can benefit from both heightened receptivity and an increased access to embodied capacities (including memories). This can lead to a more comprehensive, multimodally facilitated understanding to knowledge in linked discussions.

The overall intention with our research is to investigate the possible future role of *knowledge concerts* and to find spaces for conversations oriented to the development of a more prosocial society. Based upon our earlier experiences, *knowledge concerts* might contribute to learning through schools, colleges and universities. The purpose of this study is to evaluate the emotional and cognitive effects of a *knowledge concert* on the attending audience.

Emotions, music and learning

Emotions are an important part of learning (Immordino-Yang & Damasio, 2007), and the emotional evocativeness of music means that music could serve as a facilitator of knowledge acquisition. Musical emotions could benefit new learning paradigms (Juslin & Västfjäll, 2008). When we are moved by a piece of music, a set of interactions, both of emotional and non-emotional nature are activated along with a range of psychological operations (Koelsch et al, 2019; Lindquist et al., 2012). We can say that emotions are ‘embodied’ because they arise when we create meaning from the world through our senses (Feldman-Barrett, 2017), including the auditory sense. At the same time, we draw upon emotions embedded in knowledge from previous experiences to attribute meaning to novel stimuli (Lindquist et al., 2012). Learning depends on both emotions and cognitions, which are more or less intertwined, as well as on motivation and intention (Okon-Singer et al., 2015, 2017). Therefore, when we endeavor to learn about topics of a sensitive nature, the emotional implications have a bearing on the way in which we learn. There are challenges in learning/communication regarding sensitive topics, such as for example social justice and the issues of gender-based harassment and sexual violence. Such themes are raised in the recent #metoo campaign. In order to respond to the emotional demands of such topics, we suggest music and lyrics could be used and complement more traditional “cognitive” ways of teaching and learning (Fancourt et al., 2019; Salvador & Kelly-McHale, 2017), as a way of facilitating embodied learning. Although the relation between emotion and learning is an important topic in the wider literature (e.g. Schutz & Phye, 2007), it is rarely discussed in relation to music. Embodied learning means that:

the whole person is treated as a whole being, permitting the person to experience him or herself as a holistic and synthesized acting, feeling, thinking being-in-the-world, rather than as separate physical and mental qualities that bear no relation to each other (Stolz, 2015, p. 474).

It includes appraisal of where our own knowledge is shaped; by sensations in connection to our inner world; through practice of mirroring experiences, from i.e. a *knowledge concert* (Merleau-Ponty, 1945/62; Stolz, 2015; Gleason, 2018). It is also relational (Formenti, 2016), and encompasses the process of fostering empathy, where our awareness is expanded to incorporate others' lived experiences and knowledge and thereby enrich our learning and the learning environment (Hein et al., 2016).

There is a rich body of work that explores the relation between music and learning. Listening to music requires several cognitive functions including working memory, audio memory and selective attention. We begin this research with an assumption that engagement with a *knowledge concert* will also require these cognitive functions (Okon-Singer et al., 2015).

Emotion has emerged as an important element in the relationship between music and learning. We know that music has a particularly strong influence on the development of those parts of the brain that are important for emotional function, for instance the corpus callosum (de Manzano & Ullén, 2018). These parts also encompass the elements of the brain's reward system: the insula, orbitofrontal cortex, amygdala and hippocampus, i.e. those areas that are important for motivation, emotion regulation and social communication. These are also areas of the brain that are foundational to the processes involved in acquisition of knowledge. Recurring activation of these emotional centers can have an impact on personality traits such as "openness to experience", which have been found at higher levels among children who had taken music lessons, even if genes also play a role in making children more "open to experience" (Miendlarzewska & Trost, 2014, p. 9). Theorell (2016) suggests the amygdala system is part of the "emotional brain" and has an important role in the body response to music activities. The emotional brain processes auditory impulses from the thalamus very quickly: the route between the thalamus and amygdala is labeled the "faster" route and the route to the sensory brain cortex from the thalamus is the "upper slower" route (LeDoux, 1998; Garrido et al., 2012). Recent research has also illuminated several characteristics regarding music perception as an active process in itself, both in terms of proprioception (i.e. wanting to move) and interoception (i.e. feeling pleasure), comparable with language perception (Koelsch et al., 2019). The act of listening may establish a cognitive representation in which those sensorimotor predictions are involved, and could therefore also play a role in the process of learning. Fancourt and Finn (2019) describe how music generates both biological-physical and behavioral changes that can improve acquisition of new knowledge, processing and integrating such new knowledge and enhancing overall comprehension of difficult and complex information.

The satellite seminars, which are an integral part of the *knowledge concert*, each select and address an important societal issue concerning the social sustainability of the future. We claim that a socially sustainable future would be one guided by knowledge that promotes humanity, empathy, emotion, well-being and integrity. This is in accordance with Agenda 2030 (the agenda for sustainable development) and the Climate Framework, to which Swedish colleges and universities have signed up (UKÄ, 2017). In relation to Agenda 2030, all societies need to be prosocial, as understood within the framework of fulfillment of the United Nations 17 SDGs (sustainable development goals) which are referenced in Agenda 2030. Transformative learning is a prerequisite to be able to engage in discussion, debate and change, integral elements of a prosocial society (Formenti, 2016).

Using the strongly emotive experience that the performance of a musical work can provide, we explore the question: How does the *knowledge concert* described above influence the emotional responses of the audience and their understanding of the issues raised?

Method

In this paper, we present a detailed analysis of measurements taken before and after one *knowledge concert*: ‘*Blodhov*’. This allows us to focus on specific variables measured with the visual analogue scale and a benevolence scale.

This research has a mixed-method design using both Visual Analogue Scale (VAS) and interviews. The interviews with students, musicians and composers will be described more in detail in a forthcoming paper. Surveys were completed by participants before and after the *knowledge concert*. Through this method, we explored how audience members were affected by the *knowledge concerts*. Ultimately, therefore we explore the concept of *knowledge concert* itself, through evaluating how prior familiarity of audience members with such events might shape their emotional and cognitive responses to the music that these concerts present.

The knowledge concert ‘Blodhov’

The *knowledge concert* took place in February 2020 in connection with satellite seminars and associated panel discussions and interviews. The performance featured a monodrama for singer and ensemble based on a folk tale. Due to the nature of the story, the music is dramatic and highly emotive. The impact of the concert was powerful and highly relevant today in the context of the #metoo movement. The concert supports audiences to encounter and engage with emotionally charged and sensitive topics that are difficult to verbalize. The length of the concert was 1.5 hours, and the musicians were playing on a stage in their ordinary clothes. *Blodhov*: <https://www.youtube.com/watch?v=3r4Vt25eozg>

Participants

At the *knowledge concert*, 228 (out of 450) people among the audience members completed the study questionnaires at the Royal College of Music in Stockholm at the beginning of February 2020. A subgroup of the 228 survey respondents (37 adults) also took part in the interviews (which will be described in further detail in the forthcoming paper). There was no selection of participants for the satellite seminars; the participants self-selected which seminar to attend (see below). The participants (n=228) consisted of more women than men (60%), and a large proportion were elderly people (40% > 60 years). A majority of the audience had higher academic background (80%). See Table 1.

Knowledge concert audience

This was an open concert offered free of charge in which 450 participants attended voluntarily. The concert and the seminars were promoted on social media and via the website of the Royal College of Music in Stockholm. At the beginning of the concert, all members of the audience were asked to give their written consent to participate in the integrated research study with the explicit understanding that participation was totally voluntarily and that they could opt out from the study at any time without providing an explanation for doing so. They also filled in a questionnaire regarding age, gender, education, and experience of attending music concerts (see table 1). A total of 51 percent gave their written consent and participated in the study. The rest of the audience did not participate in the study but remained as audience. The participants were informed by the researchers at the beginning of the concert that they could contact them if they had any need for support, concerns, or questions about the concert.

Satellite seminars

The *knowledge concert* involved the following four different satellite seminars focusing on the theme #metoo:

1. Distress and Compassion
2. In touch with the invisible
3. Embodied knowledge and social touch
4. Fear of touch

Each of the seminars surrounded the ‘*Blodhov*’ concert and the participants were engaged in the theme of #metoo.

Table 1 Age, gender, education, and experience of attending music concerts

Sample characteristics		Count	%
Age	0–20	3	1
	21–40	57	26
	41–60	74	33
	61–85	89	40
	Total	223	100
Gender	Female	128	60
	Male	85	40
	No answer	0	0
	Total	213	100
Education	Higher Academic	168	80
	Other	41	20
	No answer	0	0
	Total	209	100
Previous experience of attending music concerts	None	126	56
	Little	77	34
	Average	19	9
	Huge	2	1
	No answer	0	0
Total	224	100	

Assessments

To measure emotional changes in the participants during the concert, Visual Analogue Scales (VAS) were used. This tool has been found to be efficient and easy to use in various contexts. For example, the VAS tool is preferred in healthcare when patients’ or staff’s experiences in emergency situations need to be quickly evaluated, in before/after comparisons (Theorell & Bojner Horwitz, 2019a). The VAS methodology has been subjected to extensive psychometric testing (Yang et al., 1991). Visual Analogue Scales and similar paper-and-pencil tests have a strong tradition of use in psychometric practice, being widely used in pain measurement (Yang et al., 1991) and in assessments of physical effort (Wilson & Jones, 1989) and fatigue (Ericsson & Mannerkorpi, 2007).

The questionnaire methodology was selected and designed to be simple and quick to administer and easy to fill in immediately before and after the audience’s listening experiences. The selection of VAS parameters was also based on experiences made from previous measurements at performance evaluations at chamber music concerts (Theorell & Bojner Horwitz, 2019a; Theorell et al., 2019b). Previous data also show that the specific chosen

emotional dimensions on the VAS seem to be sensitive to listening experiences also in events when the music is recorded and of short duration (Theorell & Bojner Horwitz, 2019a).

The design of our survey was shaped by an understanding that people who are less familiar with psychological terms relating to emotions, prefer concepts and words that belong to everyday life (as seen in the circumplex affect model, Russel, 1980). Furthermore, in prior research we have observed a link between music listening and a decrease in experience of daily worries. Daily worries could have a cognitive blocking function and are therefore significant to a person's openness to learning, and therefore a variable added to this study (Theorell et al., 2019b).

The emotional assessment tool that we devised and tested had five dimensions, namely: Arousal, Degree of happiness, Degree of worry, Daily worries and Benevolence. Four 100 mm horizontal lines were used for the first four dimensions with the extremes tired (left) to alert (right); sad (left) to happy (right); worried (left) to calm (right), and daily worries – not at all (left) to very much (right), respectively. The score was based on where the mark was placed, i.e. the distance in mm from the left. The adjectives were chosen following the results of previously developed and validated pilot tests with a larger selection of words (Theorell & Bojner Horwitz, 2019a). The Benevolence scale consisted of one question: “*I feel that my actions affect other people around me in a positive way*” and a horizontal line was used with the numbers 1 to 5, where 1 = strongly disagree and 5 = strongly agree.

Interviews

After the ‘*Blodhov*’ concert and the satellite seminars, a random group of 23 students, all the musicians from the concert and the satellite seminar leaders (altogether 37 participants) were interviewed about their attitudes and emotions in taking part in the *knowledge concert*. The interviews were recorded, and texts were transcribed and analyzed in relation to the purpose of the study. A phenomenological hermeneutic method was used (Grape et al., 2017). A summary of the different themes from the Naïve Reading of the texts is presented in this paper. The remaining parts of the analyses from the interviews will be presented in more detail in our forthcoming paper.

Statistical methods

The VAS data were presented with descriptive statistics using frequency and percentage for categorical data; and median, minimum and maximum for continuous data due to the ordered categorical type of data in the endpoints. Changes in the outcome measures for arousal, degree of happiness, degree of worry, daily worries and benevolence, taken from before to after the concert, were analyzed with non-parametric statistics in terms of Wilcoxon matched pairs test and also by subgroups of age, gender, and prior experience listening to music. The Kruskal-Wallis non-parametric test was used to test for interaction effects between time (pre-post) and subgroup by all subgroups, where pre-post differences were ranked among subgroups and further analyzed as the difference between independent groups. Only observed data were presented and statistical analyses were only using complete pairs of data.

All tests were two-sided and $p < 0.05$ was regarded as statistically significant and all nominal p -values are presented for completeness. There was no adjustment made for multiplicity as this was an exploratory study (Bender & Lange, 2001). However, it is recognized that one test result in 20 could occur to be statistically significant ($p < 0.05$) by chance.

Table 2. Descriptive statistics for the variable Arousal, Degree of Happiness, Degree of worry, Daily worries and Benevolence, by subgroups of age, sex and experience of music listening.

Factor	Level	Baseline comparison	Time	Arousal			Degree of Happiness			Degree of worry			Daily worries			Benevolence			
				n	Median (min-max)	P-value	n	Median (min-max)	P-value	n	Median (min-max)	P-value	n	Median (min-max)	P-value	n	Median (min-max)	P-value	
Age Group	1-40	1-40 vs 41-60	x time	60	51 (10-100)	0.36 ②	60	71 (23-96)	0.10 ②	60	52.5 (15-95)	<0.001 ①	60	48 (0-100)	0.003 ①	49	4 (0-5)	0.235 ①	
			before	58	52.5 (4-100)	<0.001 ①	58	48 (0-100)	0.01 ①	58	71.5 (0-100)	<0.001 ①	58	29 (0-94)	<0.001 ①	45	4 (0-5)	0.28 ①	
	41-60	41-60 vs 61+	before	73	49 (0-100)	<0.001 ①	74	73.5 (0-100)	0.03 ①	74	73 (10-100)	0.07 ①	74	27 (0-97)	0.06 ①	59	4 (1-5)	0.90 ①	
			after	71	60 (0-98)	0.07 ③	69	59 (5-97)	0.07 ③	70	66 (15-98)	0.07 ③	72	9.5 (0-90)	0.07 ③	58	4 (1-5)	0.90 ①	
	61+		before	88	65 (4-100)	0	88	78 (0-100)	0	85	75 (0-100)	0	88	18 (0-97)	0	81	4 (1-5)	0	
			after	88	77 (0-100)	0.29 ②	83	74 (0-100)	0.74 ②	85	75 (0-100)	0.60 ②	86	8 (0-100)	0.35 ②	81	4 (1-5)	0	
Sex	Women	Women vs Men	x time	126	55.5 (0-100)	0.38 ①	126	75 (0-100)	0.06 ①	127	73 (10-100)	0.41 ①	126	28.5 (0-100)	0.76 ①	106	4 (1-5)	0.73 ①	
			before	126	67 (0-100)	0.38 ①	121	64 (0-100)	0.06 ①	122	71 (0-100)	0.41 ①	124	10 (0-91)	0.76 ①	102	4 (1-5)	0.73 ①	
	Men		before	84	59 (10-100)	0.55 ②	85	73 (10-100)	0.25 ②	85	71 (10-100)	0.25 ②	85	28 (0-97)	0.11 ②	73	4 (0-5)	0.43 ②	
			after	82	63.5 (0-100)	0.55 ②	80	61.5 (0-100)	0.25 ②	82	70.5 (0-100)	0.67 ②	83	12 (0-100)	0.11 ②	71	4 (1-5)	0.43 ②	
	Experience music listening	Mod-High	Mod-High vs Little	x time	21	53 (15-100)	0.57 ①	21	73 (27-95)	0.49 ①	21	80 (22-96)	0.61 ①	21	23 (0-78)	0.18 ①	20	4 (0-5)	0.54 ①
				before	20	69.5 (3-90)	0.78 ①	20	66.5 (24-96)	0.96 ①	20	68.5 (05-95)	0.10 ①	20	12 (1-85)	0.06 ①	18	4 (0-5)	0.61 ①
Little		Little vs None	before	77	65 (4-100)	0.77 ①	77	77 (0-100)	0.11 ①	76	73 (13-100)	0.08 ①	77	26 (0-100)	0.49 ①	58	4 (1-5)	0.81 ①	
			after	76	69 (0-100)	0.77 ①	73	69 (0-100)	0.11 ①	75	75 (0-100)	0.08 ①	75	10 (0-100)	0.49 ①	57	4 (1-5)	0.81 ①	
None			before	125	54 (10-100)	0.002 ④	126	74 (18-100)	<0.001 ④	126	70.5 (10-100)	<0.001 ④	126	30.5 (0-97)	<0.001 ④	111	4 (1-5)	<0.001 ④	
			after	122	62 (5-100)	0.002 ④	118	56 (0-100)	0.002 ④	121	65 (0-100)	0.08 ④	122	12 (0-91)	<0.001 ④	108	4 (1-5)	<0.001 ④	
All		before	223	56 (4-100)	0.002 ④	224	74.5 (0-100)	<0.001 ④	223	72 (10-100)	<0.001 ④	224	28 (0-100)	<0.001 ④	190	4 (1-5)	<0.001 ④		
		after	218	67 (0-100)	0.002 ④	211	64 (0-100)	0.08 ④	214	70 (0-100)	0.08 ④	217	12 (0-100)	<0.001 ④	183	4 (1-5)	<0.001 ④		

* Statistically significant p<0.05, ** Statistically significant p<0.01, *** Statistically significant p<0.001, n=number of subjects, ref=reference group
 ① Baseline differences (before music listening) between subgroups. P-values were calculated using Mann-Whitney U test.
 ② Interaction between age/sex/experience music listening x time. P-values for factor x time (before/after) interaction was calculated using the Kruskal-Wallis for the differences between groups regarding the change before/after intervention within subgroups change from before-after intervention.
 ③ Change from before-after intervention all subjects. P-values for the overall differences before-after intervention was calculated using the Wilcoxon signed rank test.
 ④ Change from before-after intervention all subjects. P-values for the overall differences before-after intervention was calculated using the Wilcoxon signed rank test.

Note. Values presented are median and minimum - maximum of assessments pre and post listening to the concert as well as the outcome of the Wilcoxon matched pairs non-parametric test for change post-pre. Observed cases of the total study population (n=228) are presented.

Ethical approval

Ethical approval was obtained for the study (Dnr 2017/1009-31/1) from the Swedish Ethical Review Authority.

Results

There were statistically significant changes from before to after listening to music in the outcome measures of arousal ($p=0.002$), daily worries ($p<0.001$), degree of happiness ($p<0.001$). Degree of worry ($p=0.01$) interacted with age. Thus, younger participants reacted with more worry than older participants. There was no change in the level of expressed benevolence ($p=0.93$). The effect was similar among subgroups of prior experience of music listening, but levels did vary slightly in the baseline measurement taken before music listening at the concert.

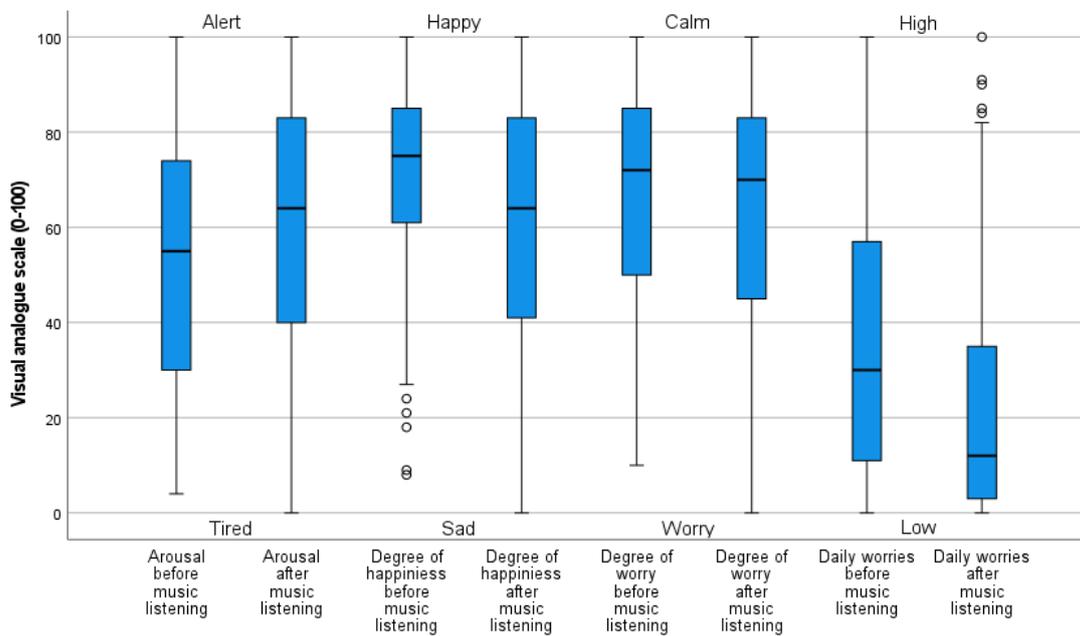


Figure 1

Boxplots for outcome measures from Visual Analogue Scale ratings for the variables Arousal, Degree of happiness, Degree of worry and Daily worries before and after the knowledge concert.

Note. Boxplots illustrate median, first and third quartiles defines the box, and whiskers (non-outlier minimum-maximum). Outlier is defined as a value which is more than 1.5 x box height. The small circle represents the outlier.

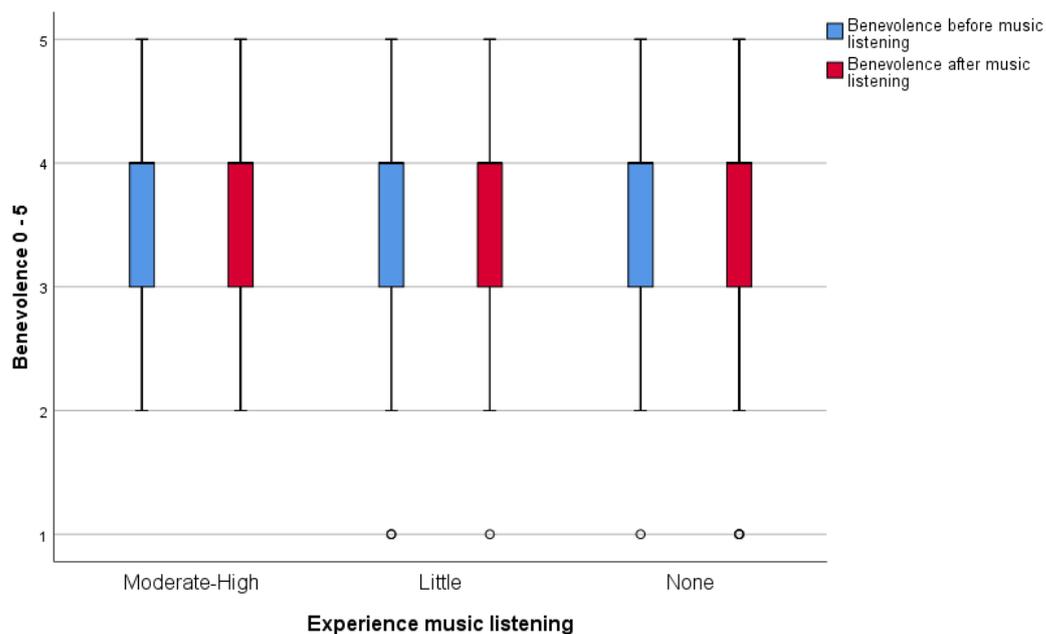


Figure 2

Benevolence ratings (strongly disagree to strongly agree) before and after listening to the knowledge concert.

Note. There was no change in their reported experience of benevolence before and after listening to the concert. Boxplots illustrate median, first and third quartiles define the box, and whiskers (non-outlier minimum-maximum). Outlier is defined as a value which is more than 1.5 x box height.

In sum, all four of the VAS estimates show that the *knowledge concert* had a significant impact on the entire group. The experience for the variable 'arousal' had an 11 mm change in medians from tired to alert. The perception of 'degree of happiness' decreased in all groups from happy to sad, the decrease in medians was 9.5 mm; and the variable 'degree of worry' increased from calm to worry by -2 mm. The significant change along these scales may be due to the concert's particularly emotional subject matter.

Our findings have shown that the immediate experience of music, in the way in which we have assessed it, is not significantly affected by age, gender and academic background. The 'daily worries' variable has been shown to decrease significantly in all groups. The variable 'benevolence' was the same after the concert as before.

Themes from the follow-up interview data

The following three different themes were found in the interviews, which took place after the *knowledge concert*:

1. Increased susceptibility (the emotionality of the concert evoked a strong embodied memory which persisted and affected the susceptibility to the content of the seminar).
2. Increased memory (the strong emotions evoked from the 'Blodhov' concert helped the participants to remember the content of the linked seminar).
3. Increased verbalization ability (the #metoo theme was easier to talk about because of the linked concert content).

Discussion

In this study of the *knowledge concert* as a new concept, we found that the audience reported significant changes of increase in arousal, decrease in degree of happiness, increase in degree of worry and decrease in daily worries. The variable benevolence was not changed after the concert. The observed decrease in happiness was particularly distinct in this setup and corresponds to a more pronounced sadness reaction than we have seen in previous studies (Theorell & Bojner Horwitz, 2019a), likely due to the differences in themes between the concerts.

The study results did not appear to vary according to differences in age, gender, previous musical experiences or level of education except for the variable worry (where young participants increased their worry, and the two other older groups decreased their worry). An interesting finding of the study is that this *knowledge concert* seems to have equally affected people with no and a lot of previous experience of concert listening and/or classical music: this means that varying levels of prior experience of music listening to this genre of music has no significant importance for emotional reactions to this particular music.

The experience of daily worries decreased significantly after the concert. This result shows that the impact of the music led to reduced negative emotions in relation to individual circumstances, which is in line with our previous study (Theorell & Bojner Horwitz, 2019a; Theorell et al., 2019b). The VAS estimates show differentiation in the emotional variables in the variable degree of happiness i.e., decreases from happy to sad (more sadness as a reaction to the concert), while, for example, the variable arousal increases, from tired to alert. The dramatic emotional arc and subject matter of the concert (associated with the issues of the #metoo movement) seems to have been reflected in the VAS scores, even though there was no significant effect observed for the benevolence factor. One can speculate as to whether the benevolence scales' five elective steps from 1 to 5, affected the outcome, in comparison with the VAS scales' options. It is also interesting that, after the concert, the negative emotion of sadness did not change the perceptions of likelihood to undertake benevolent acts toward others. We asked whether “*I feel that my actions affect other people around me in a positive way*”. Even when participants answered that they had been saddened by the music, it did not negatively affect their response to the benevolence question, instead it remained stable. Moreover, changes in the emotional variables (from happy to sad, and from less worried to more worried) did not appear to disrupt individuals' capacity to process daily worries. The opposite was found; reported daily worries did decrease after the concert. This could be explained by the fact that people were thinking of others and bigger issues than their everyday worries. Although such a change is temporary, it may illustrate the “power of music” in a given moment.

Those who have less experience of music listening report more decrease in worries than those who are more experienced. The younger listeners were more capable of reacting with strong emotions than the older participants in the audience. It is also interesting that those with little experience felt more worries before the concert. This could be explained by the fact that they were worried about the concert itself because it was new to them.

The findings support the idea that taking part in music experiences such as the *knowledge concert* could be a productive part of learning about emotional regulation, since this type of experience can lead to enhanced arousal, have a beneficial impact on lessening daily worries, and can elicit emotional sensitivity in listeners. This could contribute to an increased appreciation of emotions within oneself and others. The strong emotional arc of the *knowledge concert* studied suggests that dramatic forms of music could cultivate rich emotional spaces to facilitate knowledge acquisition. As seen in other studies, links between

empathy and musical sound responses have been reported (Wallmark et al., 2018; Bojner Horwitz, 2018). A randomized control study of the effects of an extensive art intervention on managers showed that there were subsequent secondary effects on subordinates whose health improved significantly (Romanowska et al., 2010). In the present study the concert helped stimulate emotional activity among listeners and increase their receptivity to being reflective, as is also observed in our interview analyses after the satellite seminars.

From the data, it seems that *'Blodhov'* could evoke extremely strong emotional responses, perhaps in part because the singer screams and uses a guttural voice accompanied by gestures. *'Blodhov'* also incorporates scenes of sexual violence that are dramatic and shocking. These are topics that are rarely engaged with in ordinary music performance repertoires, which likely increased the degree of sadness that emerges among listeners of the concert. From the three themes: *increased susceptibility, memory* and *verbalization ability*, music can be interpreted to facilitate improvement of cognitive skills and maybe also emotional intelligence, which are key antecedents of learning.

A further aim of this study was to evaluate whether *knowledge concerts* could be helpful in facilitating a more equal and sustainable future through encouraging pro-sociality. By combining music concerts with seminars, a new kind of conversation and co-learning space could be created in academia. The Agenda 2030 needs to involve a transformative learning process (Wals & Benavot, 2017; Wahl, 2020), including the crucial challenges of bridging the value-action gap (Wamsler, 2020), where music is not yet presented as a tool for this transformation (Riley & White, 2019). For society to develop in a more sustainable direction, we should focus more on methods to create the change we want to see (Wamsler, 2021; Wamsler et al., IN PRESS). This is where the transformative process learning comes in, where music and *knowledge concerts* could play an important role.

How might the *knowledge concert* described above influence the emotional responses of the audience and their understanding of the issues raised? Our study helps us to understand that the *knowledge concert*, as a novel concept, has a potential function in facilitating emotions. The emotional response of the audience to the *knowledge concert* was considerable, and we observed increased sadness and increased degree of worry. However, the levels of perceived benevolence did not change after the concert.

Research strengths and limitation

One limitation with this study is that the population was not representative in terms of their educational background, i.e. a large proportion of the sample were elderly people (about 40% >60 years) with high academic training (80%). In addition, there were more women than men (just over 60%). Thus, our study sample simply does not represent the population at large. Despite this, we can make claims about the relevance of our findings regarding the impact of *knowledge concerts*. Such concerts may stimulate conversations aimed at the development of a prosocial society. Based on the findings, our tools may be used for evaluation. In this way, it may contribute to learning in schools, colleges, and universities.

Originality and value

The results show significant changes in several emotional variables, which are important for emotion regulation and behavioral change. The factor of 'benevolence' was stable and was not found to have changed for surveyed participants after the concert, which means that when participants answered that they had been saddened by the music, it did not increase

their malevolence. The study shows the potential role of a *knowledge concert* and how it can be used to stimulate emotional activity and reflection, especially related to difficult and sensitive topics, thus transformative learning.

Declaration of interest statement

The authors report no conflicts of interest.

References

- Bender, R. & Lange, S. (2001). Adjusting for multiple testing—when and how? *Journal of clinical epidemiology*, 54(4), 343-349. [https://doi.org/10.1016/S0895-4356\(00\)00314-0](https://doi.org/10.1016/S0895-4356(00)00314-0)
- Bojner Horwitz, E. (2018) Humanizing the working environment in health care through music and movement – The importance of embodied leadership, In L.O. Bonde and T. Theorell. (Eds.), *Music and Public Health – A Nordic Perspective*. Springer. ISBN: 978-3-319-76240-1
- de Manzano, Ö. & Ullén, F. (2018). Same Genes, Different Brains: Neuroanatomical Differences Between Monozygotic Twins Discordant for Musical Training. *Cerebral Cortex*, 28(1), 387-394. <https://doi:10.1093/cercor/bhx299>
- 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 Rehabilitation*, 29(22), 1665–1670. <https://doi:10.1080/09638280601055782>
- 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). <https://doi:10.1371/journal.pone.0211362>
- Fancourt, D. & Finn, S. (2019). What is the evidence on the role of the arts in improving health and well-being? A scoping review. *Health Evidence Network (HEN) synthesis report No. 67*. WHO Regional Office for Europe, Copenhagen. ISBN 978 92 890 5455 3.
- Feldman, L. B. (2017). The theory of constructed emotion: an active inference account of interceptions and categorization. *Social Cognitive and Affective Neuroscience*, 12(1), 1–23. <https://doi.10.1093/scan/nsx060>
- Formenti, L. (2016). Transformative learning and teaching in higher education. From evaluation to an embodied relational theory. *Adult Education, HAEA Special Issue*, 1, 4-11.
- Garrido, M. I., Barnes, G. R., Sahani, M. & Dolan, R. J. (2012). Functional evidence for a dual route to amygdala. *Current Biology*, 22(2), 129-134. <https://doi.10.1016/j.cub.2011.11.056>
- Gleason, M. 2018. Metaphor, Materiality, and Method: The Central Role of Embodiment in the History of Education. *Paedagogica Historica*, 54, 1–2, 4–19. <https://doi:10.1080/00309230.2017.1355328>
- Grape, C.V., Osika, W. & Bojner Horwitz, E. (2017). You can't feel healthier than your caregiver – the ripple effect of trust and empathy for patients and health care staff, cultivated through cultural activities. *Journal of Nursing and Care*, 6(5). <https://doi:10.4172/2167-1168.1000422>
- Hein, G., Engelmann, J. B., Vollberg, M. C. & Tobler, P. N. (2016). How learning shapes the empathic brain. *Proceedings of the National Academy of Sciences*, 113(1), 80-85. <https://doi.org/10.1073/pnas.151439112>
- Immordino-Yang, M.H. & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education*, 1(1), 3-10. <https://doi:10.1111/j.1751-228X.2007.00004>
- Juslin, P.N. & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences*, 31, 559-621. <https://doi:10.1017/S0140525X08005293>

- Koelsch, S., Vuust, P. & Friston, K. (2019). Predictive processes and the peculiar case of music. *Trends in Cognitive Sciences*, 23(1), 63-77. <https://doi.org/10.1016/j.tics.2018.10.006>
- LeDoux, J. (1998). *The emotional brain: The mysterious underpinnings of emotional life*. Simon and Schuster.
- Lindquist, K.A., Wager, T.D., Kober, H., Bliss-Moreau, E. & Barret-Feldman, L. (2012). The brain basis of emotion: A meta-analytic review. *Behavioral and Brain Sciences*, 35, 121-202. <https://doi.org/10.1017/S0140525X11000446>
- Merleau-Ponty, M. (1945/62), *Phenomenology of Perception*, Colin Smith (trans.). Routledge & Kegan Paul.
- Miendlarzewska, E.A. & Trost, W.J. (2014). How musical training affects cognitive development: rhythm, reward and other modulating variables. *Frontiers in Neuroscience* 7(279), 1-18. <https://doi.org/10.3389/fnins.2013.00279>
- Okon-Singer, H., Hendler, T., Pessoa, L. & Shackman, J. (2015). The neurobiology of emotion – cognition interactions: fundamental questions and strategies for future research. *Frontiers in Human Neuroscience* 9(58). <https://doi.org/10.3389/fnhum.2015.00058>
- Okon-Singer, H., Stout, D.M., Stockbridge, M.D., Gamer, M., Fox, A.S. & Shackman, A.J. (2017). *The interplay of emotion and cognition*. In Fox, A. S., Lapate, R. C., Shackman, A. J. & Davidson, R. J. (Eds.). *The nature of emotion: Fundamental questions* (2nd edition). Oxford University Press.
- Riley, K. & White, P. (2019). ‘Attuning-with’, affect, and assemblages of relations in a transdisciplinary environmental education. *Australian Journal of Environmental Education*, 35(3), 262-272. <https://doi.org/10.1017/ae.2019.30>
- Romanowska, J., Larsson, G., Eriksson, M., Wikström, B.M., Westerlund, H. & Theorell, T. (2011). Health effects on leaders and co-workers of an art-based leadership development program. *Psychotherapy and Psychosomatics*, 80(2), 78-87. <https://doi.org/10.1159/000321557>
- Russel, A.J. (1980). The circumplex model of affect. *Journal of Personality and Social Psychology*, 38 (6), 1161-78. <https://doi.org/10.1017%2FS0954579405050340>
- Salvador, K. & Kelly-McHale, J. (2017). Music teacher educator perspectives on social justice. *Journal of Research in Music Education*. <https://doi.org/10.1177%2F0022429417690340>
- Schutz, P. A., Pekrun, R. & Phye, G. D. (2007). *Emotion in education* (Vol. 10). Academic Press. ISBN: 9780123725455
- Stolz, S. A. (2015). Embodied learning. *Educational philosophy and theory*, 47(5), 474-487. <https://doi.org/10.1080/00131857.2013.879694>
- Theorell, T. & Bojner Horwitz, E. (2019a). Emotional effects of live and recorded music in various audiences and listening situations. *Medicines*, 6(1), 16. <https://doi.org/10.3390/medicines6010016>
- Theorell, T., Kowalski, J. & Bojner Horwitz, E. (2019b). Music listening as distraction from everyday worries. *Nordic Journal of Arts, Culture and Health*, 1(01), 35–46. <https://doi.org/10.18261/issn.2535-7913-2019-01-04>
- Theorell, T. (2016). Psychophysiological links between cultural activities and public health. In S. Clift and P. M. Camic (Eds.), *Oxford Textbook of Creative Arts Health and Wellbeing: International perspectives on practice policy and research* (pp. 65-72), Oxford University Press. ISBN: 978-0-19-968807-4
- UKÄ (2017). Universitets och högskolors arbete med att främja en hållbar utveckling. En tematisk utvärdering, del 1. [The work of universities and colleges to promote sustainable development. A thematic evaluation, Part 1] Report 2017:12.
- Wallmark, Z., Deblieck, C. & Iacoboni, M. (2018). Neurophysiological Effects of Trait Empathy in Music Listening. *Frontiers in Behavioral Neuroscience*, 12, 66. <https://doi.org/10.3389/fnbeh.2018.00066>

- Wahl, K. (2020). *Defying Gravity: An Affective Photovoice Lens on Transformative Sustainability Learning* (Doctoral dissertation, School of Education, University of Wisconsin-Stevens Point).
- Wals, A. E., & Benavot, A. (2017). Can we meet the sustainability challenges? The role of education and lifelong learning. *European Journal of Education*, 52(4), 404-413. <https://doi.org/10.1111/ejed.12250>
- Wamsler, C. (2020). Education for sustainability: Fostering a more conscious society and transformation towards sustainability. *International Journal of Sustainability in Higher Education*, 21(1), 112-130. <https://doi.10.1108/IJSHE-04-2019-0152>
- Wamsler, C., Osberg, G., Osika, W., Hendersson, H. & Mundaca, L. (2021). Linking internal and external transformation for sustainability and climate action: Towards a new research and policy agenda. In Press.
- Wamsler, C. (13th March 2021). *What story do you want to live?* Medium. <https://christine-wamsler.medium.com/what-story-do-you-want-to-live-710ee8a91e29>
- 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(3), 277-282. <https://doi.10.1042/cs0760277>
- Yang, P. (2015). The impact on music on educational attainment. *Journal of Cultural Economics*, 39(4), 369-396. <https://doi.10.1007/s10824-015-9240-y>
- 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 Management*, 6(2), 58-64. [https://doi.org/10.1016/0885-3924\(91\)90519-A](https://doi.org/10.1016/0885-3924(91)90519-A)