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Musically Induced Emotions: Subjective Measures of Arousal and Valence

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Abstract

This study was designed to investigate whether US participants would experience the same emotions when listening to specific pieces of music as were labeled by participants in a previous study done in the Netherlands. It examined whether musical excerpts would fall into quadrants of serene, happy, agitated, and sad created by an interaction of the dimensions of arousal (calm-excited) and valence (unpleasant-pleasant) and whether the mean scores would fall within quadrant positions similar to those in the previous study. Participants heard 12 musical excerpts and responded by turning dials depicting different degrees of arousal and valence. After one of the pieces of music was reallocated to a different category, they experienced 3 of the 4 emotions as did earlier participants. Implications for the study of emotion in music and its use in music therapy and music medicine are discussed.

Keywords

music therapy, emotion, cross-cultural, responses to music

Emotions and emotional functioning are important in treatment aspects of music therapy and music medicine.[1,2] Music therapists and those who use music in treatment may benefit from research and discussions regarding theories of emotion and its impact in music selection. This may increase our ability to address clients' needs when selecting pertinent music and when analyzing or discussing clients' emotional responses to music. In addition, with increasing numbers of clients from different cultures, music therapists always need to consider how emotional responses may vary across cultures. This study addresses these areas by investigating a 2-dimensional model for understanding the emotional content of music and how specific selections of music may be experienced differently in 2 countries.

The meaning of the word ''emotion'' is not always clear in the literature. While most people intuitively know what an emotion is, it is difficult to define. Much of the confusion comes from the unclear use of related words in this area of research. In this article, the following definitions will be used:

> Emotion refers to a relatively brief episode of coordinated brain, autonomic, and behavioral changes that facilitate a response to an external or internal event of significance for the organism. Feelings are the subjective representation of emotions. Note that they can reflect any or all of the components that constitute emotion. Mood typically refers to a diffuse affective state that is often of lower intensity than emotion but considerably longer in duration. Moods are not usually associated with the patterned expressive signs that typically accompany emotion and sometimes occur without apparent cause.[3]

Emotions are understood[4-6] as a combination of physiological arousal and cognition. In theory, an emotional reaction includes arousal of the autonomic nervous system before, concurrently with, or following cognitive appraisal of the situation.

Some of the confusion in interpreting outcomes from research on emotions comes from the fact that varying instructions have been given to participants related to similar tasks in different studies. Some studies of music and emotion ask participants what emotion they think is conveyed by a piece of music, while others ask what emotion they experience when they hear the music. Juslin[7] points out that music psychologists often are concerned with whether music can evoke emotions and, if so, how it does this and what the components of the emotions are. He reports accumulating evidence on these questions in terms of ''emotion components, such as self-reported

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feeling, physiology, activation of brain regions similar to those of other emotions, emotional expression, action tendency and regulation'' (see Juslin[7] for sources of research on these components).

Emotions may be viewed as discrete or on a continuum. Some theories suggest that there are categories of emotional types that describe how people experience emotions. For example, Lundqvist, Carlsson, and Hilmersson[8] and Juslin[7] present evidence that some of the most predictable effects are whether the music is "happy" or "sad."

Other theories look at dimensions of emotion and suggest that all emotional states are located along a continuum of independent dimensions or qualities. Two general dimensions of affect are suggested by numerous ''analyses of facial and vocal emotional expressions, judged similarities among mood words, and semantic differential ratings of mood terms.''[9] An important contribution to the dimension theory of emotion is Russell's[10] circumplex model, a 2-dimensional circular structure with the dimensions of degree of arousal and pleasure-displeasure. In this model, emotions that are across the circle from each other correlate inversely. This model thus suggests that emotional responses are made up of 2 primary dimensions: arousal (ranging from calm to excited) and valence (ranging from unpleasant to pleasant).

The circumplex pattern has been confirmed using several different methods for characterizing emotion words.[10,11] In an application of the circumplex model to a medical situation, Sandstrom and Russo[12] investigated the effects of valence and arousal on physiological and subjective recovery from an acute stressor. They found music with a positive valence to be more effective at promoting both subjective and physiological arousal than music with a negative valence, with low-arousal music being more effective than high-arousal music. Some, though, have questioned whether the 2 dimensions suggested by Russell are the most accurate depiction and have suggested other dimensions and labels.[9,13]

Schubert's[14] research provides support for the reliability and validity of classifying emotion in music using a different 2-dimensional space. Based on this dimensional viewpoint, every music-evoked affective experience can be understood as an emotional state within a 2-dimensional matrix that depicts the intensity and direction of the experience. Thayer[15] also proposed a 2-dimensional structure for musical response, with the dimensions of pleasantness and activation.

From another perspective, Berlyne[16] stresses that a person's emotional response or arousal to music is an important part of a total musical response. He views arousal as an alerting signal indicating an interruption in physiological homeostasis and proposes that the main process underlying healthy central nervous system functioning involves seeking sensory input. For example, moderate increases in arousal, decreases from extremely high arousal, or temporary increases followed by immediate decreases are perceived as pleasurable and rewarding. Berlyne contends that arousal states are the physiological accompaniment of emotional states. He has shown that works of art, including music, contain stimulus patterns that have specific arousal-influencing potential and thus can induce affective experiences.

Support for the existence of a 2-dimensional structure in music comes from the research of Nyklicek, Thayer, and Van Doornen,[17] conducted in the Netherlands. They categorized excerpts of music as representing the following emotions: happy, serene, sad, and agitated, and also included a neutral stimulus. In their study, participants were asked to indicate how strongly each emotion was expressed in the music. They found clear differentiation of emotions using cardiorespiratory variables and suggested that a differentiation of lower-order discrete emotions takes place along a limited number of higher-order dimensions, such as arousal and valence. Sad excerpts fell in the low-arousal and low-valence quadrant; happy excerpts fell in the high-arousal and high-valence quadrant; agitated excerpts fell in the high-arousal and low-valence quadrant; and serene excerpts fell in the low-arousal and high-valence quadrant.

Across these studies, one of the issues in measuring emotional responses to music is that music changes over time so that what a person is experiencing emotionally at one moment is not necessarily the same as what is experienced at the next moment. Since emotional states can change over the course of a piece of music, Grewe, Nagel, Kopiez, and Altenműller[18] suggest using continuous measurement of psychological and physiological reactions to music. The continuous response digital interface (CRDI) device was developed to measure participants' continuous or discrete nonverbal responses. It consists of a dial that can be controlled by an individual and may be turned as the individual's perception of something changes. The dial can be moved to any point and has been used to assess a range of responses, including emotional responses to music.[19-22]

Another concern in these studies is varying interpretations of music across cultures. Music psychologists, ethnomusicologists, and others have found universal, or cross-cultural, responses to music. These have usually been in the uses of music across cultures.[23,24] Although these cross-cultural functions of music are recognized, there is little support for the idea that music might be heard or experienced similarly in all societies. The idea that there might be universal ways of experiencing music, though, received some validation from researchers who found that people from a native African population (Mafa) recognized some basic emotions in western music with which they were not familiar.[25]

Moreno[26] suggested a number of years ago that music therapists needed to be more aware of the music and customs of other cultures, particularly the shamanic aspects of healing throughout history. There is increasing awareness among music therapists and others of the differences among cultures and how this affects musical responses. For example, a special issue of *The Arts in Psychotherapy* covered aspects of multiculturalism, globalism, cultural identity, and ethics.[27] Stige,[28] a music therapist, says that music therapists should be ''more culture-centered in their work and thinking, not by labeling their work as such but by integrating cultural perspectives in

their thinking.'' Shapiro,[29] in a very practical article, describes a number of ways that he incorporates music of other cultures into his work with patients, but more particularly in training music therapists in their treatment of patients from many cultures. Dileo and Starr[30] emphasized the need for cultural sensitivity when working with people approaching the end of their lives. Wheeler and Baker[31] examined how the worldviews of music therapists from various countries influenced their clinical work and teaching of music therapy and found differences among those from various cultures. These are just a few examples of the increasing awareness of multicultural aspects of music among music therapists and others.

There is evidence that music therapists also see the need for increased awareness of cultural differences in responses to music. After a survey of 298 professional music therapists, Toppozada[32] suggested that it would be helpful for music therapy students to take more coursework in ethnomusicology, multicultural counseling, or ethnic studies. A survey by Darrow and Molloy[33] addressed the question, what are the multicultural experiences, practices, and concerns of music therapists in the major metropolitan areas of the United States? Of the 219 members of the (former) National Association for Music Therapy whose addresses indicated that they lived or practiced in a major metropolitan area, 62% believed that coursework in multicultural music was either ''very necessary'' or ''somewhat necessary.'' Only 13% believed that their university training adequately prepared them to incorporate multicultural music or practice with clients from other cultures. These surveys suggest that music therapists could benefit from greater awareness of the music of other cultures, which could include how people from different cultures respond to music.

Differences in how people from varying cultures respond to emotional content in music, though, are in the early stages of being investigated. In an effort to add to an understanding of how people experience emotions in music, this study was designed to investigate whether US participants would experience the same emotions when listening to specific pieces of music as were labeled by the participants of Nyklicek et al,[17] in the Netherlands. In other words, would their experience of the excerpts fall into the 4 expected quadrants (serene, happy, agitated, and sad) created by an interaction of the 2 dimensions of arousal (calm-excited) and valence (unpleasant-pleasant), and would the mean scores fall within quadrant positions similar to Nyklicek et al's participants?

Methods

Participants

A total of 15 participants, 12 women and 3 men, were involved in the study. Their age range was from 19 to 49, with an average age of 24.2 (SD = 4.92). The sample included 12 Caucasians and 3 African Americans.

Participants were recruited through the contacts of one researcher at a large metropolitan university. Most participants were students in an introductory music education class for nonmajors, while a few were employees of the university or friends of other students. Only nonmusic majors and nonprofessional musicians were involved in the study.

Power calculations were done on valence data for a study that was conducted alongside the current study.[34] Results of power and sample size estimations showed that a sample size of 16 would be sufficient to detect a moderate effect (power 0.8, $\alpha = .05$) across all planned comparisons using dependent *t* test. The sample size of 15 for the current study was therefore considered large enough for the information that was sought.

Experimental Task

During the listening task, participants were seen individually and seated in a comfortable chair. They were told that they would hear 12 musical excerpts and asked to simultaneously respond to their feelings of arousal (calm-excited) and valence (unpleasant-pleasant) using 2 separate CRDI dials. That is, the participants were asked to identify their emotional responses, not what they believed the music was expressing. Each of the 12 excerpts represented an emotion associated with one of the 4 quadrants of the 2-dimensional structure, 3 for each of the emotions serene, happy, agitated, and sad. The dials were marked with simple figures of people showing different amounts of arousal and valence to remind participants of how to turn the dials to reflect what they were feeling. Two randomly ordered sequences of the excerpts were developed and then randomly presented to the participants. The excerpts ranged from 1' 18" to 3' 37", and the average interval between them was 4.125". They were presented in Dolby 5.1 surround sound via Apple iTunes.

Participants listened to the same 12 musical excerpts employed in the Nyklicek et al[17] study, previously demonstrated to elicit 1 of the 4 discrete emotions, serene, happy, agitated, and sad. Use of the excerpts employed by Nyklicek et al provided a previously tested set of music excerpts and allowed the present researchers to compare responses from US participants to those of another country, the Netherlands. The Nyklicek et al excerpts also were employed by other researchers,[12,35] further confirming their effective use in emotional discrimination tasks.

The excerpts were tested on a local sample of participants and, with one exception, were similarly categorized as the Nyklicek et al sample. The exception was *Death of Ase* from the Peer Gynt Suite, rated as serene by the pretest group but believed to be sad by Nyklicek et al's sample. Since only one piece was categorized differently, the music and categories from Nyklicek et al's study were used in this study. The excerpts, the emotions that they were expected to elicit (based on Nyklicek et al's study), the lengths, and the order of presentation are shown in Table 1. Additional information on the music used is listed in Appendix A.

Participants were instructed to simultaneously respond to feelings of arousal and valence using 2 separate CRDI dials. To assist the participants in identifying these dimensions of emotion, the dials were labeled with the nonverbal Self-Assessment Manikins scales (SAM),[36,37] depicting

Table 1. Music and Emotions Expected to be Elicited

Music Excerpt	Emotion	Length of Excerpt	Order 1 Sequence	Order 2 Sequence
Bizet–*Toreadors*	Happy	1 min 18 s	7	9
Codolban–*Nikitka*	Happy	2 min 15 s	9	8
Strauss–*Unter Donner und Blitz, Polka*	Happy	2 min 30 s	2	2
Chopin–*Sonata for Piano No. 2, Marche Funèbre*	Sad	3 min 16 s	8	3
Grieg–*Peer Gynt Suite, Death of Ase*[a]	Sad	2 min 25 s	11	5
Mozart–*Requiem, Lacrimosa*	Sad	3 min 30 s	12	6
Bizet–*Suite Arlesienne, Menuet*	Serene	1 min 33 s	5	10
Bizet–*Carmen Intermezzo*	Serene	2 min 55 s	6	11
Dvorak–*Largo*	Serene	1 min 53 s	10	7
Bartok–*Concerto for 2 Pianos*	Agitated	3 min 37 s	4	12
Shostakovich–*8th Symphony, Adagio*	Agitated	2 min 37 s	1	4
Stravinsky–*Rite of Spring*	Agitated	3 min 02 s	3	1

[a] *Death of Ase* was rated as serene by those who pilot tested these excerpts in the United States.

different degrees of both arousal and valence. The line-drawn, box-like figures for SAM ranged from an excited, wide-eyed figure to a relaxed, sleepy figure when representing the arousal dimension and from a smiling, happy figure to a frowning, unhappy figure for the valence dimension. When the dials were centered, they corresponded to an intermediate level of the given dimension of emotion. Turning the dials clockwise corresponded to varying degrees of an increase in the given dimension of emotion, while turning the dials counterclockwise corresponded to varying degrees of a decrease in the given dimension of emotion. The dials could be rotated from 0 to 256 degrees. All data were collected using CRDI software version 1.1.0 and saved to a personal computer for analysis. Each session lasted approximately 30 minutes.

Results

This study was designed to answer the question, do US participants experience the same emotions when listening to identical, specific pieces of music as did participants from the Netherlands in the Nyklicek et al[17] study? More specifically, 2 questions existed, did the excerpts fall into each of the 4 quadrants created by the intersection of the arousal (calm-excited) and valence (unpleasant-pleasant) dimensions, and were the mean placements of the excerpts within each quadrant similar to those of the Nyklicek et al participants?

Figure 1 shows the placement of the combined means of the arousal and valence dimensions across this group of participants for each of the music excerpts. The results of this study suggest that the current participants' experience of happy and agitated was similar to that of previous participants, as the music excerpts expected to be experienced as happy fell in the upper right quadrant identified as happy and those expected to be experienced as agitated in the lower right quadrant identified as agitated. Two of the 3 serene excerpts also were experienced similarly to the responses of previous listeners, being located in the upper left quadrant identified as serene. However, the excerpt from Bizet's *Carmen*, expected to be experienced as serene, was experienced as agitated. In addition, the sad pieces tended to fall near the bottom of the serene quadrant rather than in the lower left (sad) quadrant as expected.

Figure 2 shows the overall combined means for the 3 excerpts included in each emotion category for the arousal and valence dimensions. As discussed, the overall means for happy and agitated lay in the expected quadrants. However, the displayed mean rating for the assumed serene piece, Bizet's *Carmen* pulled the overall serene mean toward the agitated quadrant. The placement of the three excerpts that had been thought to be sad resulted in the overall mean for sad falling into the lower portion of the serene quadrant.

To help to understand more about the differences among the listeners' perceptions of emotion for each group of music excerpts, dependent t tests were conducted on the differences between the means for all possible pairs of emotions for both the arousal and the valence dimensions. Because multiple tests were conducted for each dimension, the modified Bonferroni method was employed and evaluated at a familywise α of .05.

Table 2 shows the analyses related to the arousal dimension, including the scores for *Carmen* within the mean for serene, although it fell into the agitated quadrant (see below for reallocation of this piece and discussion). Significant differences were expected in the 4 quadrants between sad and agitated and between serene and happy, as well as the diagonals sad-happy and serene-agitated. These were confirmed by the analysis.

Table 3 shows the analyses related to the valence dimension. Here, significant differences were expected between serene and sad and between happy and agitated, as well as between the diagonals sad-happy and serene-agitated. However, given the displacement of one serene excerpt and the sad excerpts, the only differences that were confirmed as expected were between happy and agitated, plus the 2 diagonals. An expected difference was not found between serene and sad, and unexpected differences were found between serene and happy and sad and agitated.

To further understand how people experienced each group of music excerpts within the arousal and the valence dimensions, several correlations were conducted. Only the correlations between happy and agitated in the arousal dimension ($r = .57$, $p = .031$) and between sad and serene in the valence

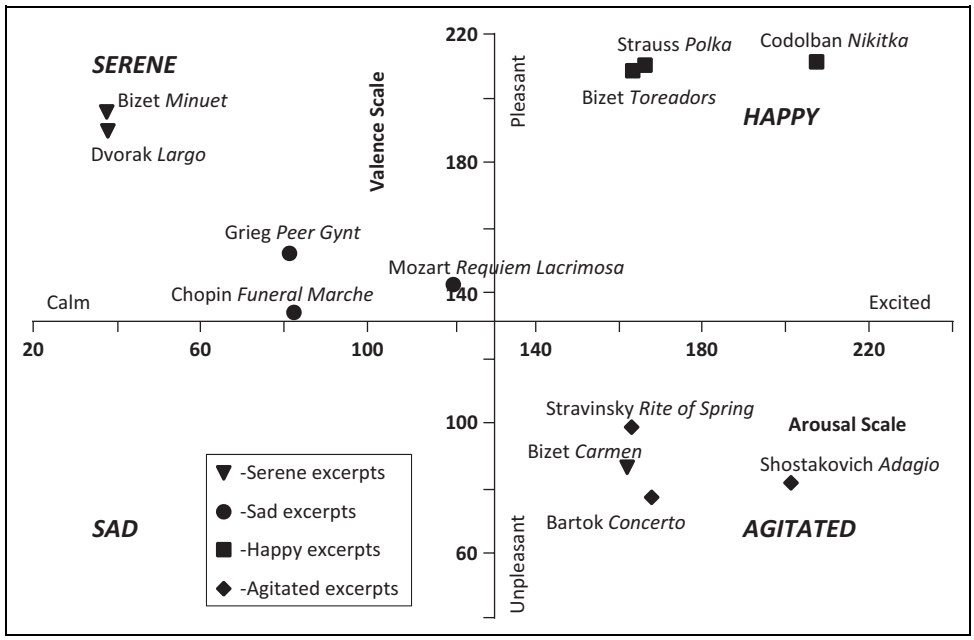

Figure 1. Arousal and valence ratings for 12 music excerpts.

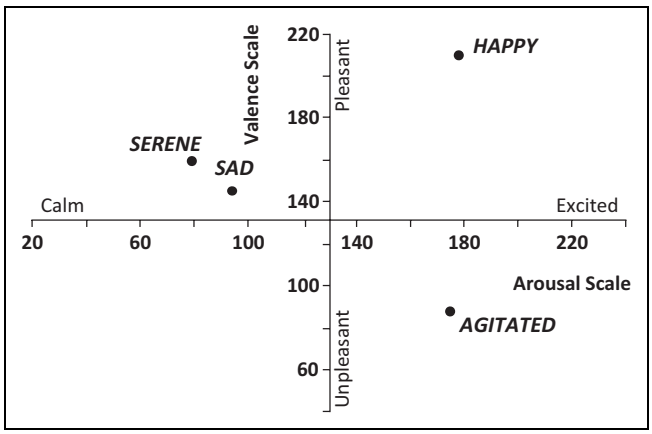

Figure 2. Combined arousal-valence means for each emotion category.

dimension ($r = .67$, $p = .009$) were significant. These relationships indicate that people found the sad and serene music excerpts to be similar in their pleasantness (an unexpected relationship) and the happy and agitated music excerpts to be similar in their level of arousal (an expected relationship).

As mentioned earlier, the excerpt from *Carmen* did not fit where expected. The excerpt had been identified as serene but fell into the agitated quadrant when it was plotted. Results were therefore recalculated, allocating this excerpt to the agitated category, and all analyses were recalculated using the new position for the *Carmen* excerpt. Figure 3 shows a plot of the combined means with this recalculation. The mean point for serene moved farther into the corner of the serene quadrant and the mean point for agitated moved only very slightly to the left.

Tables 4 and 5 show dependent *t* test results using the recalculated means, with *Carmen* averaged into the agitated category and only 2 excerpts averaged for serene. As observed

Table 2. *t* Tests for Arousal by Music Category

Emotion Pairs	Mean Difference	*t*	*df*	*P*	95% CI
Sad–serene	15.48	1.07	13	.302	(−15.67, 46.64)
Sad–happy	−84.04	−5.30	13	.000[a]	(−118.27, −49.81)
Sad–agitated	−82.51	−6.08	13	.000[a]	(−111.80, −53.23)
Serene–happy	−99.53	−9.28	13	.000[a]	(−122.69, −76.37)
Serene–agitated	−98.00	−11.51	13	.000[a]	(−16.39, −79.62)
Happy–agitated	1.52	.20	13	.842	(−14.66, 17.71)

[a] Significant at familywise $\alpha = .05$.

in Table 4, the only change for the arousal dimension was that the difference between sad and serene is now significant. This difference occurs because the mean for the 2 serene excerpts now exists as expected to the far left on the arousal dimension, and the mean for the sad excerpts falls more toward the middle of the arousal dimension.

The analyses shown in Table 5 for valence, with *Carmen* reallocated, show 2 changes, both as expected: a significant difference exists between serene and sad, and no significant difference occurs between serene and happy.

Discussion

Although the participants from the Netherlands were asked to indicate the emotional content of the music, while the US participants were asked to label their experience of the emotion, the results of this study with the mean from *Carmen* reallocated suggest that, for the most part, the experience of the US participants was similar to that of the participants from

Table 3. *t* Tests for Valence by Music Category

Emotion Pairs	Mean Difference	*t*	*df*	*P*	95% CI
Sad–serene	−14.05	−1.80	13	.094	(−30.84, 2.74)
Sad–happy	−65.80	−6.11	13	.000[a]	(−89.04, −42.57)
Sad–agitated	57.03	5.05	13	.000[a]	(32.66, 81.42)
Serene–happy	−51.75	−5.13	13	.000[a]	(−73.54, −29.97)
Serene–agitated	71.09	6.39	13	.000[a]	(47.09, 95.09)
Happy–agitated	122.84	14.22	13	.000[a]	(104.18, 141.50)

[a] Significant at familywise $\alpha = .05$.

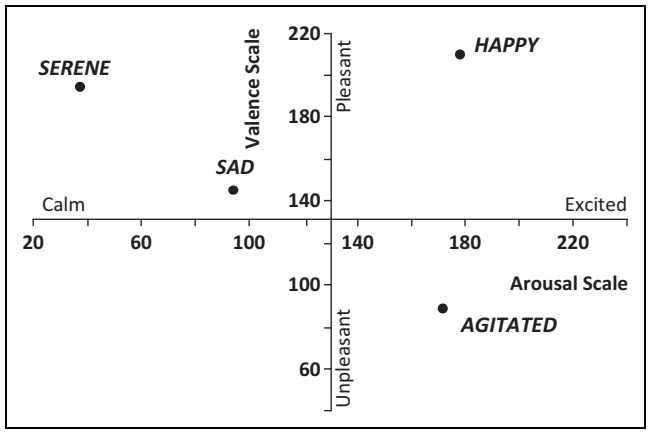

Figure 3. Combined arousal-valence means for each emotion category with *Carmen* reallocated from serene to agitated.

Table 4. *t* Tests for Arousal by Music Category With *Carmen* Reallocated

Emotion Pairs	Mean Difference	*t*	*df*	*P*	95% CI
Sad–serene	57.06	4.40	13	.001[a]	(29.04, 85.09)
Sad–happy	−84.04	−5.30	13	.000[a]	(−118.27, −49.81)
Sad–Agitated	−78.80	−5.33	13	.000[a]	(−110.72, −46.89)
Serene–Happy	−141.10	−10.95	13	.000[a]	(−168.95, −113.26)
Serene–agitated	−135.87	−13.12	13	.000[a]	(−158.24, −113.49)
Happy–agitated	5.24	.71	13	.488	(−10.61, 21.09)

[a] Significant at familywise $\alpha = .05$.

the Netherlands for 3 of the 4 emotions. See Figure 4 for a comparison of the current approximate means with the means from the previous study. The means for the excerpts fell into the expected quadrants for serene, happy, and agitated. However, while all US participants found similar low levels of arousal for the sad excerpts, Nyklicek et al's participants interpreted the music as much more unpleasant than was experienced by the US participants.

Table 5. *t* Tests for Valence by Music Category With *Carmen* Reallocated

Emotion Pairs	Mean Difference	*t*	*df*	*P*	95% CI
Sad–serene	−49.11	−6.43	13	.000[a]	(29.04, 85.09)
Sad–happy	−65.81	−6.12	13	.000[a]	(−118.27, −49.81)
Sad–agitated	56.80	5.35	13	.000[a]	(−110.72, −46.89)
Serene–happy	−16.70	−1.54	13	.148	(−168.95, −113.26)
Serene–agitated	105.90	8.89	13	.000[a]	(−158.24, −113.49)
Happy–agitated	122.60	14.23	13	.000[a]	(−10.61, 21.09)

[a] Significant at familywise $\alpha = .05$.

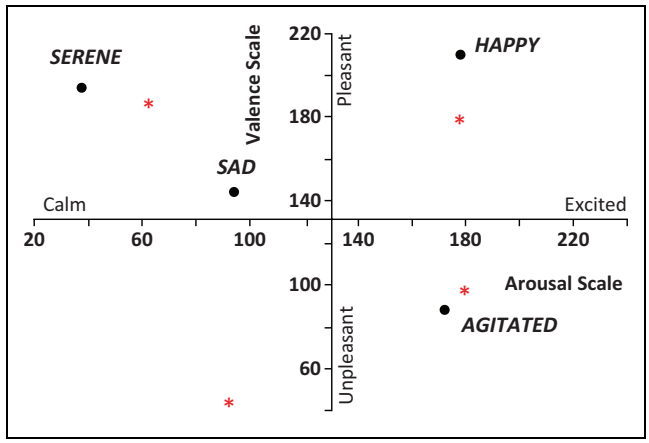

Figure 4. Comparison of combined arousal-valence means for current and Nyklicek et al[17] studies.
* indicates means for Nyklicek et al's participants.

While the quadrant in which serene, happy, and agitated fell was similar to the previous results, the comparative placements within the quadrants suggest differences between the US and Nyklicek et al's[17] participants. For the 2 serene excerpts, participants in the current study reported stronger arousal or intensity experiences but similar levels of pleasantness (valence). For the happy excerpts, the present group had a more pleasant (valence) experience that was equally intense (arousal). The 4 excerpts in the agitated category were perceived as just slightly more unpleasant (valence) and less intense (arousal).

These results also may assist in understanding emotional responses to music in general and nuances that may exist across different cultures. That the musical experience fell into 3 of the 4 quadrants as theoretically expected suggests that emotions expressed through music may be experienced along the dimensions of arousal and valence. The small differences found could be due to cultural differences, differences of context as will be discussed below, differences across samples of people, or a combination of the 3.

The 3 sad pieces, however, apparently were experienced quite differently by the US sample than by participants from the Netherlands. As seen in Figure 1, the means for all 3 sad

excerpts in the present study were fairly close to each other, suggesting that they were experienced similarly. The US participants, however, experienced the sad excerpts as less unpleasant but at the same level of arousal than the participants from the Netherlands. This may have been due to the pieces that were selected or that people do not experience sadness as strongly in the United States. It is also possible that the results for sad may reflect a defense mechanism whereby people do not want to feel sad and so do not allow themselves to experience this feeling.

Another explanation of the differences may be the different contexts or associations in which the music selections have been heard or experienced. For example, a piece of music may be familiar in one country as background for a particular movie or popular television series, while in another country it has different associations or none at all. So context is another consideration when taking into account how people from different cultures interpret or experience music.

The results further suggest that the examples selected for sad may not have been the most intense examples but instead were experienced as a blend of somewhat sad and somewhat serene. In fact, one of these pieces previously had been identified as serene by the US pretest group. The *Death of Ase* from the Peer Gynt Suite, which was felt to be sad by Nyklicek et al's[17] sample, was rated as serene by people categorizing music in a pilot testing of the music for the current study; but, because it had been classified as sad by the larger sample from the Netherlands, the excerpt had been left as representing sad. It does seem clear that the segment from *Carmen*, which needed to be reallocated from serene to agitated based on responses from the current participants, was not a good example of serene music.

Exploring where the music excerpts fell in the 2-dimensional space can contribute to understanding people's emotional reactions to music. The following points summarize expected and obtained differences in how participants experienced the emotions in musical excerpts:

- As expected, the intensity (arousal) of the emotion is what makes a person experience serene versus happy; for this study, pleasantness (valence) was not a factor in how these excerpts were experienced.
- Intensity (arousal) should be the only factor influencing whether people feel sad or agitated, but given where the sad excerpts fell, the data show that pleasantness (valence) also made a difference; the sad pieces were not felt as very unpleasant and some excerpts were heard as more serene.
- Pleasantness (valence) should have been the only contribution to the felt difference between serene and sad, but again, given where sad fell, valence was less influential and intensity (arousal) was somewhat influential.
- As expected, only pleasantness (valence) influenced whether people felt happy or agitated.
- Both intensity (arousal) and pleasantness (valence) assisted in differentiating whether people felt serene or agitated and happy or sad when listening to music.

These results further suggest that those who use music with the intent of evoking sad emotions need to be cautious when selecting music examples. This has implications for music therapists who, when music elicits sadness in clients, for instance, discuss or process feelings about a sad experience. The results also suggest that researchers of emotions in music should be aware that sad emotions may not be as easy to invoke or predict as some other emotions.

While this study lends support to the possibility that people experience similar emotions in music and that some of this experience can be predicted, researchers and music therapists also must remember that individual and cultural variations exist in emotional responses to music. As Sloboda[38] suggests, "A particularly acute problem presented by the study of emotion is its variability between individuals, and across time within individuals." He suggests that between-person variation may be due to cultural differences and biographical associations from particular pieces of music. He further proposes that within-person variations may be due to familiarity with the music as well as other factors, such as how the individual chooses to engage with the music or what she or he chooses to focus on when listening. In reviewing the literature, Hodges[39] concludes that "very limited work has been done on personal variables" in relation to psychophysiological responses to music. In fact, the slight differences between the US and the Netherlands samples for the placement of the serene, happy, and agitated excerpts could be due to cultural differences.

It is also important to realize that the precise request made of participants in the 2 countries was different. The Netherlands participants were asked to indicate how strongly each emotion was expressed by the music, while the US participants were asked to identify how they experienced the music. Thus, the Netherlands participants' responses were objective and involved a cognitive response, while the US participants' responses were subjective and involved their personal experience with the music. These different instructions may have influenced the responses and led to some of the differences.

Whether emotional responses to music are idiosyncratic or general will continue to be discussed by music therapists and others involved with music and medicine, and researchers. Despite laypeople's requests for music that can be used to elicit certain responses, most music therapists believe that music responses are individualized and cannot be predicted in any uniform sense. Some base this upon the view that responses to music are too complex to be predictable, while others hold that because key components of the music therapy process (such as personal agency and human relationships) are not subject to deterministic laws, there is no point in attempting to predict an individual's response to the music.[40]

The results of this study, that music may be interpreted within 2-dimensions, also suggest that it is important to understand the musical components of musical excerpts that are employed and the effects that the combined musical components have on emotional experiences. Being able to predict emotional responses to music has implications for music therapy. Thaut[2,41] encourages music therapists to develop a

view of stimulus processing where the perception of stimulus properties leads to transferable responses that can be meaningful determinants of nonmusical behavior. Toward this end, Thaut and Wheeler[2] suggest that "by developing a clear understanding of the neuropsychological processes and effects of music stimulus properties that underlie the influence of music on behavior, music therapy becomes an important and efficient treatment modality in which clinically significant emotional deficits are targeted for behavioral interventions." Developing an understanding of how music components interact will assist music therapists the understanding of how music can elicit responses that can be meaningfully interpreted.

Some limitations need to be considered when interpreting the results of this study. One limitation of this and any other study in which only a limited list of emotions is used is that emotional responses to music may have many emotional descriptors and nuances that vary from those selected for the study. Theories considering the influence of moods, which are considered longer lasting than emotions, and other models for categorizing emotions also were not included in the methodology of the study. In addition, the low number of participants also is a limitation, as only 15 participants participated. Since this was a fairly young population with a mean age of 24.2, the results could vary with older participants. How these results apply to other emotions, other models, and participants of varying ages remains to be investigated.

Despite these limitations, the study provides evidence that people's emotional experiences with music can be understood within the interaction of 2 dimensions, arousal and valence. For some music experiences, one of the dimensions may have a primary role in differentiating the emotional experience, while at other times both dimensions may be influential. Although further research is needed, researchers studying emotional responses to music can use this information to understand such responses, and music therapists can consider the arousal and valence of music when selecting examples for use in sessions or when responding to music improvised by clients.

Appendix A. Music Used

(a) Strauss J. *Unter Donner und Blitz, Polka Schnell*. Vienna Staatsopernchor & Vienna Philharmonic, Willy Boskovsky. DECCA 411 932-2. Digitally mastered compact disc (CD).
(b) Bizet G. Carmen, *Les Toreadors, Intermezzo*. London Symphony Orchestra, Neville Marriner. Philips 412 464-2PH. Digitally re-mastered from 9500 566(8/79). CD.
(c) Codolban, NE. *Nikitka* (traditional Russian folksong). Gregor Serban and his Roumanian Orchestra. CNR 100.240. CD.
(d) Mozart WA. *Requiem in D minor, KV 626, Nr. 8, Lacrimosa*. La Petite Bande & Nederlands Kamerkoor, Sigiswald Kuyken. Accent Acc 68645 D. CD.
(e) Grieg E. *Peer Gynt, The Death of Ase*. Ulster Orchestra, Richard Howarth. Chandos Records Ltd. SC 7040. CD.
(f) Chopin F. *Piano Sonate No. 2, Opus 35, Marche Funèbre*. Ignacy Jan Paderewski, Philips 456 9199-2. CD.
(g) Dvorak A. *9th Symphony in E minor, Largo*. Tajechisch Philhamonisch Orkest, Vaclav Neumann. SUPRAPHON 38C37-7002. CD.
(h) Bizet G. *L'Arlésienne, Menuet*. London Symphony Orchestra, Neville Marriner, Philips 412 464-2PH. Digitally re-mastered from 9500 566(8/79). CD.
(i) Bizet G. *Carmen, Intermezzo*. London Symphony Orchestra, Neville Marriner, Philips 412 464-2PH. Digitally re-mastered from 9500 566(8/79). CD.
(j) Stravinsky I. *The Rite of Spring*. Royal Philharmonic Orchestra, Yuri Temirkanov. BMG Classics/RCA Victor Red Seal RD87985. CD.
(k) Shostakovich D. *8th Symphony, Adagio*. Concertgebouw Orchestra, Bernard Haitink. Decca 411 616-2. CD.
(l) Bartok B. *Concerto for Two Pianos, Percussion and Orchestra, Assai Lento/Allegro Molto.* City of Birmingham Symphony Orchestra, Simon Rattle. EMI Records, Ltd. CDC 7 47446 2. CD.

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