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"Hearing Music as . . .": Metaphors Evoked by the Sound of Classical Music

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Can we modify our experience of music by "hearing it as . . ."? It is thought that musical meaning partly arises through the use of cross-domain mappings, or metaphors. These metaphors allow the listener to conceptualize music differently, explaining one domain in terms of another, regardless of musical expertise. The aim of the present line of experiments was to produce a dimensional model of the different metaphors used in Western classical music for a population of musicians and nonmusicians. With a large pool of 540 participants and 3 successive studies based on participants' own musical experiences (Study 1) and on musical excerpts (Studies 2 and 3), we reduced an extensive list of metaphors collected at concerts to 5 final categories. The experimental setup was based on a combination of exploratory and confirmatory factor analyses to first extract a preliminary model of 5 factors and subsequently to confirm this model with a large number of participants. The resulting Geneva Musical Metaphors Scale comprises 5 metaphorical scales: Flow, Movement, Force, Interior, and Wandering. This model provides insight into how musicians and nonmusicians approach the use of metaphors when listening to Western classical music. This model might provide scientific grounds for music educators, musicians, and guided imagery and music practitioners to improve communication and teaching. It also creates a new way to label musical excerpts and classify them. Finally, this research offers a basis for investigating the understudied role of metaphors and visual imagery in classical music.

Keywords: music, metaphor, scale, classical, visual imagery

Supplemental materials: http://dx.doi.org/10.1037/pmu0000233.supp

For as long as modern human communities have existed, music has played an active part in historic and modern cultures around the world. The importance of music in culture is seen in how strongly it is associated with popular activities, from movies to concerts to invoking a sense of national pride during the mass singing of anthems. Music accompanies many human activities, especially in so-called preliterate cultures (Behne, 1997; Gregory, 1997). The prevalence and importance of music can be linked to its fulfillment of a number of social functions, from basic human interaction and collaboration to communication (Koelsch, 2014). This last function is underscored by the considerable overlap between the brain regions and cognitive mechanisms responsible for the production and perception of music and those responsible for language (Koelsch, 2012; Patel, 2003). Sophisticated music and language, both of which are unique to the human species, embody a coherent hierarchical structure from which meaning unfolds over time (Cooper & Meyer, 1960; Krumhansl, 1990; Levitin & Menon, 2003, 2005; Patel, 2003; Zbikowski, 2008).

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This work has been presented as a talk in two symposiums about visual imagery in two international conferences, namely, the Society for Music Perception and Cognition (SMPC2017) in July 2017 and the International Conference for Music Perception and Cognition 15/European Society for the Cognitive Sciences of Music 10 (ICMPC15/ESCOM10) in July 2018. This work has also been presented several times during the Annual Research Forum of the Swiss Center for Affective Sciences.

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However, for nonmusicians, such musical meaning sometimes seems unreachable because of their lack of expertise. The goal of this article is to verify the impact of such expertise by exploring how music can be "heard as. . ." in a large population of musicians and nonmusicians.

To begin with, meaning can be seen as an "emergent property," meaning that it results from the interactions of more local phenomena that add up to an unexpectedly greater whole than the sum of the individual parts (Larson, 2012). When listening to music, meaning emerges from many aspects of the musical piece, such as the context, perceived expressive intent, and inherent musical structure. Koelsch (2011) created two distinct categories of musical meaning: intramusical meaning and extramusical meaning (Koelsch, 2011). Although the former emerges from representations of the buildup of a structural model (e.g., harmonic structure), as well as its modification, stability, breach, and so forth, the latter emerges from the comparison between the musical information and the extramusical world. Extramusical meaning can also be referred to as designative meaning (Meyer, 2008). Based on semiotics, the study of signs, and the seminal work of Charles Peirce (Peirce, 1902), three subcategories of extramusical meaning can be defined on the basis of the (a) iconic, (b) indexical, and (c) symbolic qualities of music. Iconic meaning is recognized because of the resemblance between aspects of the icon and what it signifies. In the case of music, iconic meaning emerges from musical patterns or forms that may "sound like" objects, qualities of objects, or even abstract concepts. Examples include "this part sounds like a bird" and "this passage sounds sharp." Noteworthy is the fact that such associations can be formed through different mechanisms, ranging from iconic-onomatopoeic in the case of "sounds like a bird" to cross-modal and metaphorical in the case of "sounds sharp." Indexical meaning refers to the link between a sensory feature, A, that correlates with and thus implies B (e.g., smoke indicating fire). Indexical musical meaning emerges from sound patterns that show evidence of the presence of a particular psychological state of an individual, for example, an emotion or intention. An example would be "this music sounds happy." Finally, symbolic meaning emerges from a conventionally and arbitrary connection between the signifier and the signified. It is usually culturally learned. In music, symbolic meaning is represented by any explicit extramusical associations that are neither iconic nor indexical. Any national anthem falls into such a category, being a purely conventional and cultural association between a country and a musical piece (Nattiez, 1990). Culture plays an important role in shaping symbolic musical meaning and is in return shaped by it (Cross, 2009). All in all, musical meaning arises partly from cross-domain mappings when we "hear music as . . ." and is culturally affected (Larson, 2012).

One type of cross-domain mapping is of crucial importance for the understanding of a musical experience: metaphors (Scruton, 1999). Metaphors can be seen as conceptual processes in which we comprehend one concept (target domain) in terms of another concept (source domain), as described by the conceptual metaphor theory (M. Johnson, 1987; Lakoff & Johnson, 1980). Mappings between language and music rely on conceptual metaphors that are based on image-schematic structures common to the two domains (Zbikowski, 2008). The image schemas are mental structures grounded by listeners' bodily experiences. During childhood and later in the developmental process, bodily experiences can be transformed in the human mind. For example, a common feeling that people might have is to feel lighter when they are happy. This structure provides support for the creation of conceptual metaphor mappings, such as "Happy is up" (M. Johnson, 1987). Similarly, it has been proposed that musical meaning is grounded in embodied experiences (Aksnes, 2002; Borgo, 2004; Leman, 2008; Maes, Leman, Palmer, & Wanderley, 2014; Walker, 2000). In the conceptual metaphor theory, metaphors are recognized as a basic tool for cognition (Hofstadter & Sander, 2013). They provide us with the capacity to experience one kind of thing in terms of another (Lakoff & Johnson, 1980). From implicit knowledge of bodily experiences, such as feeling lighter when happy, we tend to comprehend an unknown target domain with the help of a source domain, which represents a well-known concept. This derives metaphors such as "My spirits rose" and "Thinking about her always gives me a lift." Another common example relates to the metaphor "Mind is a machine." The target domain "mind" is pictured as a "machine" for which the mechanisms and parts can be more easily represented. The use of a metaphor as a way to understand an unknown concept motivates an interactive and creative act of imagination, influencing our understanding of both domains (Jensen, 2001). Following this conceptual metaphor theory, music theorists have intensively used cross-domain mappings as a basis for theoretical models of musical structure and musical analysis (Brower, 2000; Larson, 1997; Saslaw, 1996; Spitzer, 2004; Zbikowski, 1997, 2002). Listeners seem to conceptualize the musical structure through metaphorical nonverbal mappings between the music and so-called image schemas grounded in bodily experience (Bonde, 2007; Lakoff & Johnson, 1980). Even children predominantly use metaphors to describe music, with mappings usually associated with image schemas related to the visual–spatial modality (Antovic, 2009). Lee Rothfarb (2002) even showed that writers have advantageously used metaphors to describe music for centuries (Rothfarb, 2002). Because of such prevalence, conceptual metaphors are seen as central to music: They join together the physiological and cultural aspects of the musical experience (Mac Cormac, 1987; Zbikowski, 2008).

Although arbitrarily created, many metaphors, such as space, time, and movement, including physical gesture, have been mentioned in the literature (Bonde, 2007; Epstein, 1995; Giacco, 2011; M. L. Johnson & Larson, 2003; Osborne, 1981; Spampinato, 2008, 2015). Other concepts such as heat, light, weight, force, container, path, and tension have been reported as well (Adlington, 2003; Antović, 2014; Saslaw, 1996). Music has also been described in terms of shapes because it is an easy-to-use, flexible concept that involves changes in both quantity and intensity and can be applied to any aspect of sound (Küssner, 2014; Leech-Wilkinson, 2017; Prior, 2010). Changes in musical parameters can therefore be translated into shapes and curves analogous to motion contours and used as analytic tools and as guidelines for performers (Repp, 1993; Truslit, 1938). In general, however, some metaphors have had a more consistent role in describing music. Three have especially been highlighted by music theory and music psychology: *music as motion*, *music as landscape*, and *music as a moving force*. Noteworthy is the fact that these metaphors are linked to simple experiential bases: A musician needs both movement and force to produce a tone (whether when using an instrument or singing); a change of tone can be seen as a change in distance or "height" (whether in the instrument itself if, e.g., comparing the distance between two notes on a piano, or in raising the larynx); and when playing a scale on any instrument, the successive distance between the notes seems like moving along a path in successive steps (Antović, 2014).

When we use the metaphor music as motion, we describe a representation of music as an object capable of moving through space. Music consequently can make leaps, proceed by steps, ascend, and so forth. Virtually, any quality of movement can be attributed to music. The notion of music as a continuous, unidirectional, forward movement across space is abundant in musical writings (Cumming, 2000). For millennia, music has been described in terms of motions (Rothfarb, 2002). Consequently, the experience of music as motion has been seen as pertinent to musical understanding (Scruton, 1999). It is also proposed to be a powerful drive for musical emotion by aestheticians (Hanslick, 1891; Kivy, 1981; Langer, 1953), semioticians (Lidov, 1999) and music theorists (Kurth & Ernst, 1991; Spitzer, 2003; Zbikowski, 2002). Johnson and Larson (2003) further claimed that our understanding of musical motion is entirely metaphoric and grounded in basic bodily experiences of physical motion (M. L. Johnson & Larson, 2003). Children, for example, well before being able to verbally map music to motion, express music–motion association through movement. It has been shown that children at a very young age are capable of expressing their understanding of tempo and dynamics through locomotive movements such as walking and running (McDonald & Simons, 1989; Moog, 1976; Sims, 1988). Furthermore, children and adults apply similar one-to-many mappings between acoustic and motion features, expressing a single auditory parameter with multiple dimensions of motion (e.g., loudness changes with motion in the vertical plane, distance, speed, and energy; Eitan & Timmers, 2010).

Another perspective on the physical motion associated with music comes with the metaphor *music as landscape*. In this context, we focus on the spatial aspect of the motion. One can consequently see it as movement unfolding along a path through a musical landscape that defines a particular work. Two points of view can be described in this metaphor: the observer and the participant (M. L. Johnson & Larson, 2003). The observer point of view refers to our basic experience of seeing an object being moved. From this perspective, we observe a passage from a distant standpoint as it unfolds. This perspective is present in descriptions such as “The first passage rises before leaping down to the second movement.” The participant point of view taps into our embodied experience of being moved. The participant is metaphorically in the piece, moving over the musical landscape. The listener follows the path through the musical landscape. This is referred to in examples such as “We’re coming to the coda.” In addition, sonic features (e.g., intervals and pitch) are often conceptualized in terms of space (Cox, 1999; Parkinson, Kohler, Sievers, & Wheatley, 2012; Spitzer, 2003) and motion through space, for example, height, depth, ascent, and descent (Rigas & Alty, 2005). Time and space have even been defined as “the essence” of music (Clifton, 1983).

Finally, music can be heard as a force capable of moving, pushing, and pulling the listener from one state location to another in the metaphoric space (music as a moving force). Based on causation and our experiences of being moved around by large natural forces, such as water or wind, a force (the music) applied to an object (the listener) creates movement from one location (state) to another (different state; M. L. Johnson & Larson, 2003). In his book, Larson (2012) proposed that music perception and composition are dominated by three major forces: gravitation, magnetism, and inertia (Larson, 2012). They are described as follows:

> Melodic gravity is the tendency of a note heard as above a reference platform to descend, melodic magnetism is the tendency of an unstable note to move to the nearest stable pitch (a tendency that grows stronger the closer we get to a goal), and musical inertia is the tendency of a pattern of pitches or durations, or both, to continue in the same fashion (where what is meant by “same” depends upon what that musical pattern is “heard as”). (p. 88)

Forces such as friction and elasticity have also been highlighted to emphasize aspects of musical communication related to the body and to movement (De Poli, Mion, & Rodà, 2009).

It is important to note that the perception of musical structures in terms of conceptual metaphors requires imagination from listeners, is associated with high interindividual variability, and is culture-dependent (Krantz, 1987). The perception and conceptualization of pitch across the world is a perfect example of the influence of culture context on metaphors. In Western culture, pitch is usually considered in terms of height (“high” vs. “low”). Across the world, it can instead be described as “light” versus “heavy” (Kpelle people in Liberia; Stone, 1981), “sharp” versus “heavy” (ancient Greek music theory), “small” versus “large” (used in Bali and Java as well as among Kpelle and Jabo in Liberia; Stone, 1981), “young” versus “old” (Suya people of the Amazon basin; Zbikowski, 1997), or “weak” versus “strong” (the Bashi people of central Africa; Merriam & Merriam, 1964).

Metaphors are sometimes seen merely as a stylistic device used in literature and philosophy, but they provide an essential tool for communication for both thoughts and actions (Hofstadter & Sander, 2013; Lakoff & Johnson, 1980; Ortony, 1975). Metaphors in music play a crucial role at the inter- and intrapersonal levels (Pannese, Rappaz, & Grandjean, 2016). On the one hand, at the interpersonal level, metaphors contribute to communicating musical and affective meaning across individuals, for example, a composer asking the musician to play a certain piece as though “he was a raging storm.” This provides an interface for shared understanding between different people (e.g., composers, performers, and audience) involved in or listening to musical performances. On the other hand, at the intrapersonal level, metaphors may help an individual by creating the link between emotions perceived and emotions induced.

Although the use of metaphors in a musical context often seems to be associated with a certain expertise (usually used by musicians or musical theorists), with this series of studies and a wide pool of musician and nonmusician participants, we aimed to develop a model to describe and categorize which metaphors are most relevant to Western classical music and how they are organized. Such classification is difficult to create for two reasons. First, there is an immense range, and probably an infinite number, of possible metaphors. Second, there are many important individual differences with regard to music preference, exposure, and expertise (Hansen & Hansen, 1991; McCown, Keiser, Mulhearn, & Williamson, 1997). This has the potential to affect the diversity of the induced metaphors during music listening. In this study, we tried to build a dimensional model for metaphors by using a method successfully used in the creation of the Geneva Emotional Music Scale (GEMS; Zentner, Grandjean, & Scherer, 2008) and further validated in different studies (Juslin & Sloboda, 2011; Zentner & Eerola, 2010), including attempts to characterize participants' sensitivity to the GEMS (Trost, Ethofer, Zentner, & Vuilleumier, 2012) and the amount of movement associated with it (Irrgang & Egermann, 2016). Therefore, we aimed to use a similar method to create a dimensional model from a list of terms containing metaphors and visual representations. This model can later be used as a research and pedagogical tool.

Study 1

To create a dimensional model for musical metaphors, we required a list of frequently used metaphors. The goal of the first study was to create a comprehensive list of terms or expressions that characterized these metaphors. The list was to be trimmed to only the most relevant terms that described participants' general musical experience.

Materials and Method

Participants. Ninety-two students (79 women, $M = 21.3$ years old, $SD = 3.2$) from the Department of Psychology and Educational Sciences of the University of Geneva took part in this study in partial fulfillment of course requirements. This set of studies was approved by the ethics commission of the department.

Materials. A list of 666 terms was initially derived from a list of over 2,000 words used. The initial list was gathered at multiple concerts, where we asked the audience to write on a sheet of paper all the metaphors that came to their mind while listening to the music (Spampinato, 2008). The sheets were collected and summarized, and a list of unique terms was extracted. With the help of music experts and their knowledge of musical literature, this list was then cut down to a smaller number by excluding exotic terms. We ignored inflections (e.g., past-tense endings such as "fly flew") and included just one item for the entire derivational paradigm (e.g., "flight" became "fly"). This list of 666 terms was presented in a unique random order to each participant. Qualtrics Ryan Smith, Seattle, U.S., www.qualtrics.com, a Web application to create, share, and manage surveys, was used to create the study questionnaires.

Procedure. The study took place in a computer room at the University of Geneva. Participants were seated in front of a computer. All participants filled out an online consent form as stated by the ethics protocol. Participants then answered a few questions about their musical habits ("Do you play an instrument?", "How many hours a week do you play?", and so on). After the questions were completed, participants were asked to rate on a Likert scale (from 0 to 8) how relevant each particular term was to their overall musical experience. They were instructed that there was no right or wrong answer. We played no music during this experiment. Rating of all terms took around an hour.

Results and Discussion

From the responses on the Musical Habits Questionnaire, we estimated that 35 participants were musicians (38%) by using the following criteria: play an instrument professionally or as a hobby at least frequently and have more than 4 years of practice. Overall, terms were rated relatively low ($Mdn = 2$, $SD = 1.40$) on the scale from 0 to 8. The difference between musicians ($Mdn = 3$, $SD = 2.666$) and nonmusicians ($Mdn = 2$, $SD = 2.664$) for every term was nonsignificant with nonparametric permutation testing ($z = 0.56$, $p = .45$).[1] Similarly, no significant difference was observed between men and women (online supplemental material 1). Furthermore, the top 100 terms remained more or less the same when we compared ratings from musicians and nonmusicians. Therefore, we used the data set as a whole.

Of the 666 terms, 256 were rated with a median value of $\geq$4. This value represented the middle of the rating scale that the participants used for this study ("neither relevant nor not relevant"). Among these 256 terms, only 157 were represented by an averaged value $>$4. To reduce the time necessary to complete the next experiment, we tried to limit this list to a maximum of 100 expressions. With the help of a music professor and specialists in the domain of emotions, we trimmed out expressions that were direct descriptions of emotional states (e.g., "loneliness" and "relief") while keeping some that could refer to emotional intensity with no identifiable associated emotion (e.g., "intense"). This step was important to be able to differentiate the metaphor scales from the GEMS (Zentner et al., 2008). On the basis of advice from the same music expert, we also picked six terms with a median value $<$4 (e.g., "jump," "large gesture," and "tortuous") that showed a direct link to conceptual metaphors of motion and space. Consequently, the selection of the final terms may seem arbitrary, but we remain confident that the main conceptual metaphors associated with Western classical music were present after this process. The final list consisted of 86 terms (online supplemental material 2).

Study 2

From the list of terms resulting from the first study, the second study aimed to retrieve the potential factors for categorizing musical metaphors. This process prepared the groundwork for the creation of the Geneva Musical Metaphors Scale (GEMMES). The goal was to compute factors that grouped together multiple terms and described major types of musical metaphors. We computed this classification from the ratings associated with Western classical musical excerpts (online supplemental material 3).

Materials and Method

Participants. A total of 160 undergraduate psychology students (135 women) from the University of Geneva took part in this study. Their participation fulfilled course requirements. The participants from Study 1 were excluded from participating in Study 2. The average age was 22.7 years ($SD = 5.84$).

Materials. For this study, we used the list of terms from Study 1 and presented it in four different pseudorandom counterbalanced orders across participants. We assembled a set of 36 classical

[1] Permutation testing is a nonparametric statistical significance test. It computes the distribution of possible values of test statistic under rearrangements of the labels on the observed data points. Confidence interval can be derived from the computed distribution. The observed data can be therefore compared with this distribution.

music excerpts that featured a variety of musical styles and emotional connotations, sufficient to control for the potential effect of these factors. Music experts from the Geneva School of Music handpicked these excerpts from a much larger set of musical excerpts tested and controlled in a set of previous studies, to represent a wide diversity of Western classical music (Eliard, 2017; Eliard, Labbé, & Grandjean, 2012). These excerpts included most of the characteristic styles of Western classical music, for example, baroque, classicism, romanticism, postromanticism, and modern (online supplemental material 3). The excerpts were also selected to represent all of GEMS subscales (Zentner et al., 2008). Specifically, from a series of previous studies and the musical qualities of each excerpt, four musical pieces were chosen by music experts for each of the nine GEMS subscales based on ratings acquired in previous studies (Eliard, 2017; Eliard et al., 2012; online supplemental material 3). The final music list consisted of 36 excerpts. The goal was to create a comprehensive and diverse list of musical excerpts that represented Western classical music rather than to elicit any particular emotion. The participants were never asked to focus on the emotions induced or to estimate the emotional content of the pieces presented.

We used Qualtrics to create the questionnaires and Intel computers to display them. The participants used individual Panasonic RP-DJ100 headphones (Kōnosuke Matsushita, Osaka, Japan, www.panasonic.com).

Procedure. Over 2 weeks, 160 students came to a computer room at the University of Geneva. All participants filled out an online consent form as stated by the ethics protocol. Participants completed a few demographic questions related to their musical habits (e.g., “Do you play an instrument?”, “Do you play as a professional?”, and “How many hours a week?”). Participants were then instructed to rate a list of terms that were based on the musical excerpts they heard during the session. The 36 excerpts were divided into four lists of 10 excerpts (one for each emotion of the GEMS and one supplementary common excerpt for all participants to control for the differences between groups). Sixteen different surveys were constructed by mixing the order of the four lists. Participants were asked to complete one survey only. Each survey was completed by 10 participants. For each questionnaire, participants had to rate each of the 86 terms in relation to the excerpts presented. They rated the terms on a Likert scale from 0 to 8 by using the following guideline: “Based on the musical excerpt you just listened to, please rate the relevance of the following expressions on a scale from 0 to 8.” The experiment lasted for an hour.

Results

From the ratings for each term on the common musical excerpt, no significant difference could be observed between the four different lists of musical excerpts with nonparametric permutation testing ($z = 0.10$, $p = .47$). Participants could be divided into two groups—musicians ($n = 77$) and nonmusicians ($n = 83$)—by their responses to the different questions linked to musical habits (“How often do you play an instrument?”, “How many years have you played an instrument?”, “Do you play professionally?”, and “Are you a music lover?”). The difference in ratings between musicians ($Mdn = 2$, $SD = 2.585$) and nonmusicians ($Mdn = 1$, $SD = 2.573$) for every term was on average nonsignificant with nonparametric permutation testing ($z = 2.05$, $p = .15$). Similarly, no significant difference was observed between men and women (online supplemental material 1). Consequently, we performed the rest of the analysis on the entire pool of participants as a whole. The median relevance rating across all excerpts and participants was 2 ($SD = 2.58$), ranging from mdn = 4 for “images in mind” to mdn = 0 for “swaying walk” (online supplemental material 4). The averaged interitem correlation reached $r = .27$ (minimum $= -0.42$, maximum $= 0.78$). The reliability of the ratings over the different music excerpts presented to each participant ranged from Cronbach’s $\alpha = 0.66$ for “party” to $\alpha = 0.89$ for “sensation” (online supplemental material 5).

We conducted an exploratory factor analysis (EFA) on the 86 terms to extract the underlying structure organizing these items. We computed the EFA by using an alpha factoring method of extraction and a promax rotation, maintaining a similar procedure to that for the creation of the GEMS (Zentner et al., 2008). The analysis extracted five factors from their eigenvalues and the amount of variance explained by each factor (Figure 1 and online supplemental material 6). Focusing on the lowest and highest loaded terms, the factors could be described as follows: (a) Factor 1: from “tortuous” and “turbulent” to “physical well-being” and “reassuring”; (b) Factor 2: from “calm” and “to come undone” to “fizzy” and “to move”; (c) Factor 3: from “calm” and “peaceful” to “empowerment” and “impressive”; (d) Factor 4: from “to gambol” and “party” to “to come undone” and “heartache”; and (e) Factor 5: from “intimate” and “heartache” to “to wander around” and “large spaces.” Loading correlations revealed a strong positive correlation between Factors 2 and 3 as well as moderate positive correlations between Factors 1 and 2, 1 and 4, and 3 and 4 (Table 1).

In addition, we extracted factor scores from the EFA for each response acquired for each participant. We computed a linear mixed model to estimate the factor values for each excerpt, using the participants as a random effect. The addition of a fixed effect comprising the interaction between the different excerpts presented and the different factors resulted in a better fitting model, when compared to a model comprising only the respective main effects, $\chi^2(140, N = 8{,}000) = 2620.2$, $p < .001$, $R^2_m = 0.23$, $R^2_c = 0.46$.[2] Such interaction highlighted that each excerpt was associated with different scores for each factor. Moreover, residues adopted a normal distribution. This analysis created musical ex-

[2] We report the effect sizes in accordance with the approach of Nakagawa and Schielzeth (2013), implemented in the “MuMIn” R package (Nakagawa & Schielzeth, 2013). The development of methods for the effect size calculation of multilevel regression models is an active field of research (P. C. D. Johnson, 2014; Nakagawa & Schielzeth, 2013; Orelien & Edwards, 2008; Xu, 2003). Whereas effect sizes (mainly R^2) are routinely reported for linear models and generalized linear models, the implication of random variables in linear mixed models and generalized linear mixed models causes theoretical problems (e.g., decreased or negative R^2 values in larger models) and/or practical difficulties (e.g., implementation) when using standard methods (Nakagawa & Schielzeth, 2013). Nakagawa and Schielzeth (2013) developed an approach based on two indicators, a marginal and a conditional R^2 (R^2_m and R^2_c, respectively), allowing comparability with standard methods, while taking into account the variance explained by the random effects. R^2_m is the variance explained by the fixed factors, whereas R^2_c is the variance explained by the entire model (both fixed and random effects). We calculated them for each effect in our statistical models.

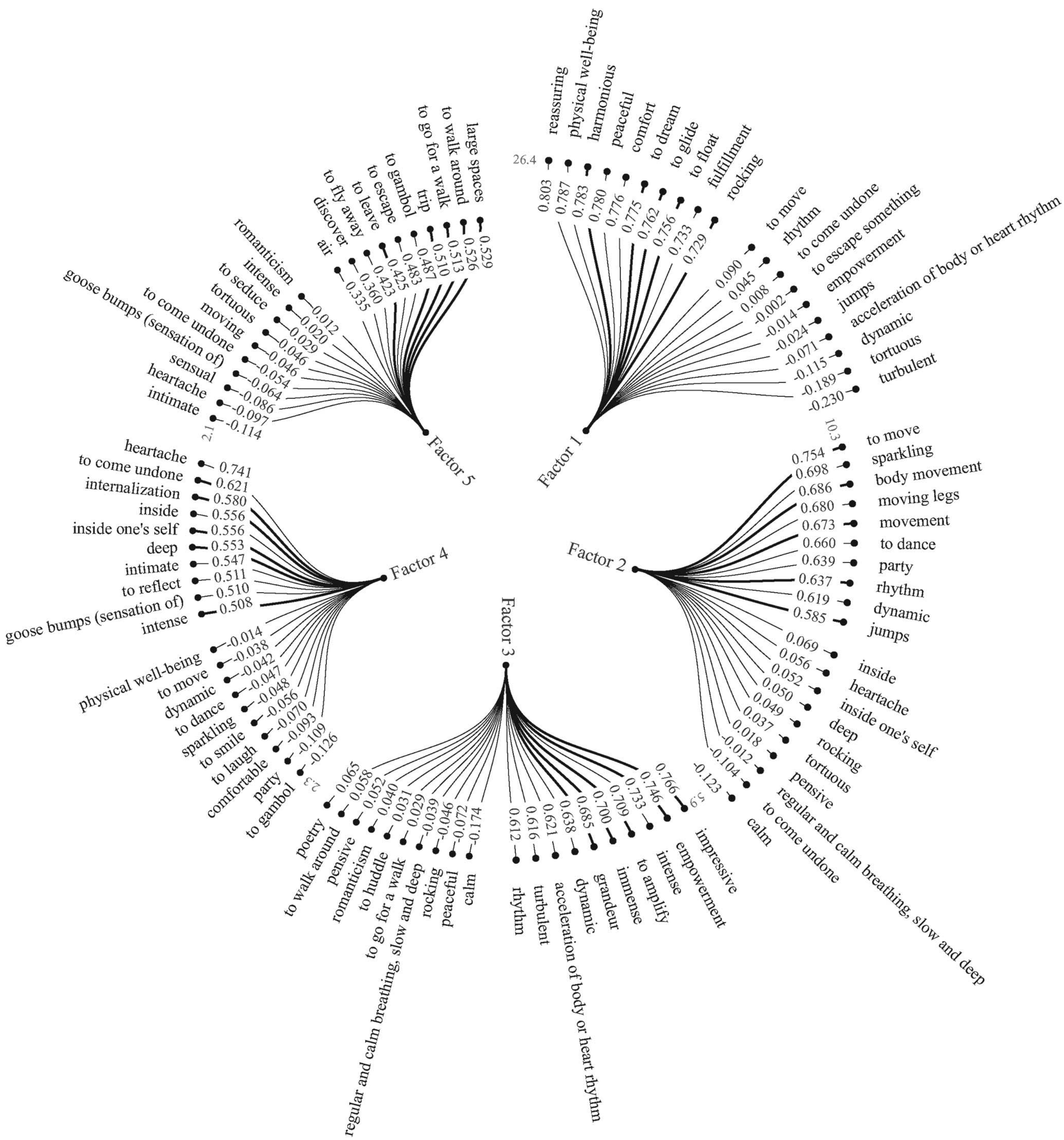

Figure 1. Results of the exploratory factorial analysis. The constituent terms are displayed for both ends of the spectrum for each factor with their corresponding loading factors. The bold line shows the selected terms for Study 3. The numbers next to the concentric circles represent the variance explained by each factor.

cerpt profiles that revealed which factors were relevant for describing each excerpt. We highlighted a few excerpts as typical examples of specific factors. For example, *Bach J.-S., Das Wohltemperierte Klavier, Book 1: Prelude in C Major, BWV 846* was described by Factor 1, whereas *Bach J.-S., Das Wohltemperierte Klavier, Book 1: Prelude in C minor, BWV 847* was better described by Factors 2 and 3 (Figure 2). To group excerpts together on the basis of factor values, we computed for each factor a cluster analysis by using Ward's method for the amalgamation rule and using city block (Manhattan) as a measure of distance. Following

Table 1
Correlations Between Factors From the Exploratory Factor Analysis

Factor	1	2	3	4	5
1	1				
2	.299	1			
3	.17	.457	1		
4	.277	−.013	.293	1	
5	.172	.235	.212	−.187	1

this cluster analysis, we observed that high loading terms for Factor 1 ("physical well-being" and "reassuring") were represented by musical excerpts such as *Bach J.-S., Das Wohltemperierte Klavier, Book 1: Fugue in D-Sharp Minor, BWV 853* and *Marais: La Rêveuse, Quatrième Livre*. High loading terms for Factor 2 ("fizzy" and "to move") were represented by musical excerpts such as *Stravinsky, Le Sacre du Printemps: VIIb. Dance of the Earth* and *György Ligeti, String Quartet No. 1 (Mètamorphoses nocturnes) for string quartet*. High loading terms for Factor 3 ("empowerment" and "impressive") were represented in the cluster analysis by musical excerpts such as *Chopin, 12 Etudes, Op. 25: No. 10 in B Minor* and once again by *Ligeti's Mètamorphoses nocturnes*. High loading terms for Factor 4 ("to come undone" and "heartache") were grouped in the cluster analysis and described musical excerpts such as *Liszt, Liebestraum No. 3 in A Flat, S. 541 No. 3: Notturno III: O Lieb, so lang du lieben kannst (Poco allegro, Con affetto)* and *Sofia Gubaidulina, Rejoice!, V. Heed Thyself*. High loading terms for Factor 5 ("to wander around" and "large spaces") were represented by musical excerpts such as *Bach J.-S., Goldberg Variations, BWV 988 (Aria With Divers Variations): Variation 13 a 2 Clav* and *Bach J.-S., The Well-Tempered Clavier, Book II: Prelude No. 3 in C Sharp Major, BWV 872*.

Discussion

We conducted this study to measure the relevance of specific metaphorical terms in the context of music listening. It led to the

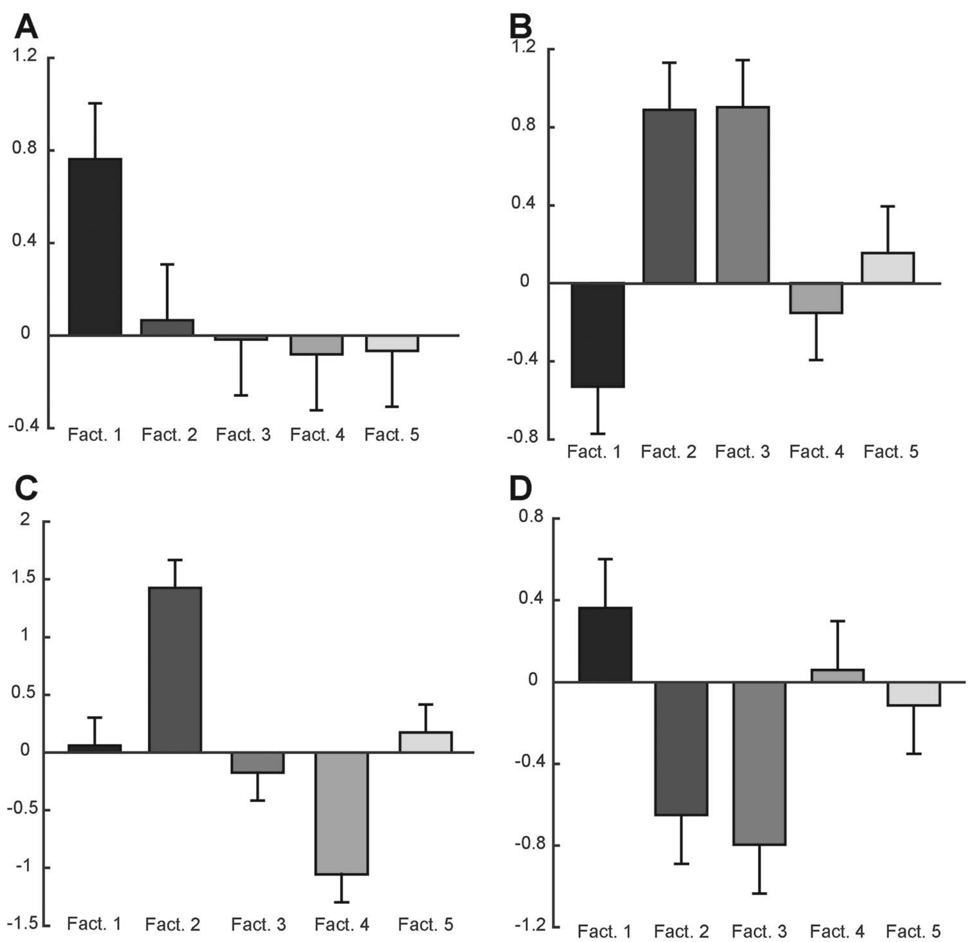

Figure 2. Examples of musical profiles with the factors computed in the exploratory factorial analysis as fixed effects for the linear mixed model. (A) Bach J.-S., Das Wohltemperierte Klavier, Book 1: Prelude in C Major, BWV 846. (B) Bach J.-S., Das Wohltemperierte Klavier, Book 1: Prelude in C Minor, BWV 847. (C) Dietrich Buxtehude, Sonata In G, BuxWV 271: Allegro. (D) Bach J.-S., Das Wohltemperierte Klavier, Book 1: Fugue in D-Sharp Minor, BWV 853. Fact. = factor.

computation of five factors, with metaphors grouped together from our previously established list. Although we collected ratings on a scale from 0 to 8, we observed a low median value overall (*Mdn* = 2). This was driven by the high proportions of null values in our data set (36.84%). This suggests that participants favored a selection of specific terms for each excerpt, rating them with high values, while leaving the rest of the terms at zero. This might be due to the high number of terms available to rate (86) and the difficulty of keeping in mind all possible choices for comparison. More interestingly, it might underline the principle that one excerpt does not have the potential to elicit metaphors fitting all possible items provided. Each excerpt feeds the imagination of the participants in a certain way, which favors terms related to specific domains (Osborne, 1981). Another explanation could be the ineffability of music in general. Participants might have difficulty explaining in words how they conceptualize music in terms of metaphors. A final explanation could be that participants thought of metaphors other than those proposed. Despite the fact that the initial list by Spampinato was collected at concerts by using only free response, this method was not used in the rest of the experimental setup (Spampinato, 2008). All in all, this creates an adequate setup for factors to emerge from the data such as done in this study. Each metaphor was, however, consistently rated over the different musical excerpts presented to each participant. This highlighted the consensus between participants on how to apply metaphors to describe music. Not all expressions were associated with the same level of consistency; thus, not all metaphors were likely understood and applied in a similar fashion. Some metaphors might be easier to use than others. Similarly, in music teaching, the use of metaphors can be confusing when students struggle to understand a teacher's metaphorical language (Persson, 1996). The EFA emphasized the existence of a structure within the data, creating five distinct factors. These factors seem to point at separate domains. However, this preliminary exploratory result required further confirmation in order to be validated. The next study (Study 3) would thus allow us to formally test the structure of the GEMMES by using a confirmatory factor analysis (CFA). The emergence of such a structure prepares the ground for a potential new classification and labeling for all excerpts. As shown by the clustering analysis, the excerpts presented in Study 2 could be grouped together on the basis of the metaphors associated with them. Instead of being classified by style, instruments, or emotion, musical excerpts could be classified by using the GEMMES. Potentially, major music providers (such as Spotify, Deezer, Google Play Music, Apple Music, and so forth) could use such a classification to help people browse their enormous music libraries.

Study 3

We had two goals for Study 3. The first goal was to extend the results from Study 2 by using a larger sample of participants working from home in a more naturalistic environment. The second goal was to examine the structure and robustness of the factorial model computed in Study 2 and to check for emerging potential higher order factors within the GEMMES. To examine this question, we followed a CFA procedure.

Materials and Method

Participants. A total of 302 participants completed this study (152 women). They were native French speakers who came from Belgium, France, or Switzerland. To broaden the application of our research, we decided to select a large sample of the Western French-speaking population, mitigating the potential effect of nationality. We used social media to recruit participants. Their average age was 28 years (range = 18–73, $M = 28.13$, $SD = 10.52$).

Materials.

For this third study, we used the list of terms created with the EFA in the second study. From the 86 terms arranged in different factors, we extracted a list of 25 terms (online supplemental material 4). For each factor, among the terms with the highest loading values, we chose five with the help of music experts. We then created four different pseudorandomized presentation orders.

To reduce the duration of each questionnaire, we selected a subset of 18 excerpts from the 36 initially presented. We selected this subset with the help of music experts to best represent our previously defined set, maintaining the continuity of the type of music used. This process was double-blinded from the result of the factorial analysis. Consequently, we refrained from using only the highly discriminable excerpts, which would feed the CFA with biased information. We then divided the excerpts into two separate questionnaires. Each of these questionnaires contained a common soundtrack to assess the reliability of the results across participants. The surveys were created online with Qualtrics. We distributed the questionnaire over a social media network on the Web.

Procedure. All participants filled out an online consent form as stated by the ethics protocol. Participants could complete the survey at home at their leisure. They were instructed to use headphones or to isolate themselves so that they would not be disturbed by external sounds. They could test the volume level at the beginning of the test on a single excerpt that was not used in the following experimental part. By clicking on the given hyperlink, they were redirected automatically to one of the pseudorandomized lists of terms associated with one of the two uniquely randomized list of musical excerpts. Participants first had to sign a consent form and answer a few demographic questions, including questions about their musical habits (e.g., "Do you play an instrument?", "Do you play as a professional?", and "How many hours a week?"). Participants were then asked to rate a list of 25 terms on the same scale as that for Studies 1 and 2. The presentation order was consistent throughout the experiment for a specific individual. In this way, participants could easily remember the list of 25 metaphors to facilitate their evaluation. Participants were also asked if they knew the excerpt presented on a scale from 0 (*not at all*) to 8 (*very much*). At the end of the survey, participants had to send an e-mail with a code to complete the experiment and participate in a lottery for a chance to win Amazon gift cards.

Results

No significant difference could be observed between the two groups of participants assigned to either of the two questionnaires. This analysis was based on the common musical excerpt across both lists and used nonparametric permutation testing ($z = 0.70$, $p = .36$).

Our participant pool could be divided into musicians ($n = 148$) and nonmusicians ($n = 154$). The categorization was based on questions such as "Do you play an instrument professionally?" and "How long have you been playing an instrument?" The difference in ratings between musicians ($Mdn = 3$, $SD = 2.58$) and nonmusicians ($Mdn = 2$, $SD = 2.54$) for all 25 terms with nonparametric permutation testing was on average nonsignificant, despite being close ($z = 3.13$, $p = .056$). Similarly, no significant difference was observed between men and women (online supplemental material 1). Consequently, we used the data set as a whole.

Overall, participants did not know the excerpts presented ($Mdn_{know} \leq 2$). One exception stood out: the *Imperial March* (featured in the *Star Wars* franchise), with a median rating of 8 when asked how much participants knew about the excerpt played. Terms could be described across all excerpts and participants with a median below the middle of the rating scale (online supplemental material 7). We observed a median rating of 3 across all terms. "Intense," "harmonious," and "deep" were the best-rated items with a median rating of 4. "Jump" was the lowest rated item with a median value of 1, along with "come undone." Zeros and ones in ratings accounted for 37.4% of all answers. When comparing the same 25 terms with the two previous studies, we observed from nonparametric permutation testing (a) a significant difference on average from Study 1 ($Mdn_{Study\ 1} = 2$, $Mdn_{Study\ 3} = 3$, $z = 6.50$, $p = .038$) and (b) a trend toward a significant difference from Study 2 ($Mdn_{Study\ 2} = 2$, $Mdn_{Study\ 3} = 3$, $z = 5.12$, $p = .10$). The averaged interitem correlation reached $r = .20$ (minimum $= -0.29$, maximum $= 0.86$). We also estimated the reliability of the ratings in each factor selected from the EFA in the new data set. Each factor showed a relatively high reliability across excerpts, ranging from Cronbach's $\alpha = 0.51$ for "empowerment" to $\alpha = 0.75$ for "to internalize/internalization" (online supplemental material 8).

The principal aim of the current study was to examine the fit of the model created in Study 2. To achieve this, we computed CFAs by using M*plus* 4.0 (Muthen & Muthen, 2006). When evaluating model fit, researchers suggest relying on two different types of fit indices, using a method sometimes referred as the "two-index strategy." One of the indices, the standardized root-mean-square residual (SRMR), is sensitive to misspecified factor covariance, whereas the other, the root mean square error of approximation (RMSEA), is sensitive to misspecified factor loading (Fan & Sivo, 2005; Hu & Bentler, 1999). We reported both SRMR and RMSEA as measures of model fit, alongside χ^2 statistics, the Akaike information criterion (AIC), and the Bayesian information criterion (BIC; Table 2). Conventional guidelines for RMSEA suggest that values of .05 or less represent a very close fit in relation to degrees of freedom, and values of .08 or less represent a reasonable fit. For SRMR, a close fit is represented by values of .06 or less, and a reasonable fit is represented by values close to .09 (Hu & Bentler, 1999). The AIC and BIC both estimate the quality of a model while dealing with the trade-off between its complexity and goodness of fit. A lower score indicates a better fit.

We computed different models and compared them to keep only the model that best fit the data set (Table 2). The first model featured only one factor that comprised all expressions rated by the participants. The second model featured four factors, merging expressions from Factors 3 and 4 from the EFA, and the third model described the five originally computed factors from the EFA. As suggested by the

Table 2
Comparing Confirmatory Factorial Analysis Models

Model	Information criterion	χ^2 test	RMSEA and SRMR
One factor	AIC = 338076.5, BIC = 338527.5	$\chi^2(275, N = 3020) = 19908.08, p < .001$	RMSEA = .154, SRMR = .179
Four factors	AIC = 319328.7, BIC = 319833.7	$\chi^2(266, N = 3020) = 7056.47, p < .001$	RMSEA = .092, SRMR = .118
Five factors—original	AIC = 319157.1, BIC = 319668.1	$\chi^2(265, N = 3020) = 6986.88, p < .001$	*RMSEA* = 0.092, *SRMR* = .115
Five factors—model modification: intense	AIC = 317044.3, BIC = 317555.5	$\chi^2(265, N = 3020) = 5532.07, p < .001$	RMSEA = .081, SRMR = .097
Five factors—model modification: multiple	AIC = 313587.4, BIC = 314140.6	$\chi^2(258, N = 3020) = 3125.95, p < .001$	RMSEA = .061, SRMR = .086
Five factors—2nd level (Factor 1 + 5)	AIC = 315027.6, BIC = 315550.7	$\chi^2(263, N = 3020) = 4194.03, p < .001$	RMSEA = .07, SRMR = .106
Five factors—2nd level (Factor 1 + 5, Factor 2 + 3+4)	Did not converge	Did not converge	Did not converge

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; SRMR = standardized root-mean-square residual; RMSEA = root mean square error of approximation.

modification indices provided when computing models on M*plus*, the fourth model included the five factors with the expression "intense" paired with Factor 4 instead of Factor 3. From other modification indices provided when models were computed on M*plus*, we explicitly specified highly correlated terms, such as "amplify" and "power," "walking" and "wandering," "deep" and "impressive," "leave" and "fall down," "immense" and "greatness," "body movement" and "movement," and "float" and "glide." We implemented these modifications in the fifth model. Finally, we also computed a second-order factor, combining Factors 1 and 5 at the second level, as well as another model adding another combination of Factors 2, 3, and 4. This was similar to the procedure performed for the creation of the GEMS (Zentner et al., 2008). From the indices AIC, BIC, SRMR, and RMSEA, we observed that the fifth model was the best fitting. This confirmed the hypothesis that there was an inherent factorial structure in the data set and rejected the hypothesis of higher order factors. The final model was created from 25 metaphors and represented in five factors (Figure 3). With the help of music experts, we named these factors as follows: Flow, Movement, Force, Interior, and Wandering. As a side product of the model estimation, the CFA computed the estimated correlation matrix for the latent variables (Table 3). Most correlation values were low (between 0 and .3). The pairs Flow and Wandering, Flow and Interior, and Interior and Wandering stood out with values of .693, .683, and .413, respectively.

Discussion

This last study confirmed and refined the previously established model, the GEMMES. It was characterized by a large and diverse sample of participants. Half were musicians, and their musical training did not reveal differences in ratings compared with those of nonmusicians (further explored in the General Discussion).

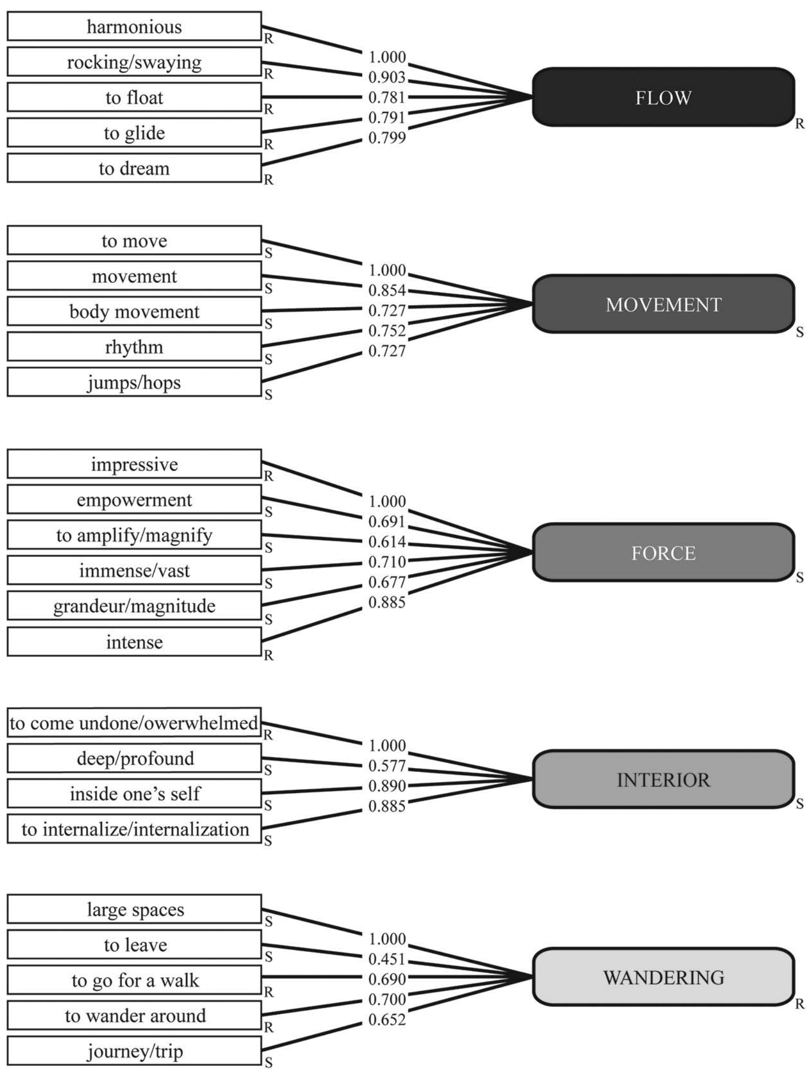

Figure 3. Confirmatory factor analysis on ratings of visual imagery expression in response to music. Boxes on the left are constituent terms. On the right are the first-order factors. Values on lines are the standardized parameter estimates. S and R symbolize metaphors that are considered "strongly schematic" and "more referential," respectively.

Table 3
Estimated Correlation Matrix for the Latent Variables of the Confirmatory Factor Analysis

Factor	Flow	Movement	Force	Interior	Wandering
Flow	1				
Movement	−.173	1			
Force	.239	−.028	1		
Interior	.683	−.211	.246	1	
Wandering	.693	.369	.192	.413	1

When we compared the results of the third study with those of the two previous studies, the number of items presented seemed to influence the ratings, resulting in fewer null responses. The median ratings for this last study were slightly higher than those of previous studies ($Mdn = 3$). The primary reason for this result is the number of terms presented. With the lowest number of terms of all studies (25), participants were less compelled to rate many terms with a null value (25.07%). There was a significant difference between the ratings obtained for the final 25 expressions in Study 1 and for those in Study 3. This could be partially explained by the presence of musical excerpts to listen to, which might have facilitated the use of a metaphor in this context because musical understanding is thought to be essentially metaphorical (Scruton, 1999). However, the resulting median across all answers was still low because, as stated in the second study, participants tended to rate specific groups of terms for each excerpt. No excerpts exhibited high ratings on all 25 terms. The absence of free responses and the general ineffability of music could also partly explain this result. Fortunately, this created a structure that could be extracted by our statistical models. The high reliability of ratings within factors highlighted the existence of an underlying construct, which links these expressions together, that is, the GEMMES.

The CFA highlighted a model with five factors on the basis of participants' ratings. We would like to draw attention to the process by which this model was constructed. It was computed on the ratings obtained on all 25 expressions and resulted from an iterative process of reducing two indices of fit. Semantics is notoriously difficult to approach experimentally, and our attempt to categorize metaphors into distinct factors is computationally driven rather than conceptually driven. The metaphors in this model were verbs, adjectives, or nouns, which were all selected for their evocative meaning in the context of music listening. The factor names were subjectively chosen by music experts to be as close as possible to the constituent terms. Our goal was to find generic terms that represented our specific metaphors and would be easily understandable by the general population. Nevertheless, we acknowledge that some metaphors might not have an evident direct link with the factor name. Finally, it is important to note that these scales are meant to be presented with their constituent metaphors. The factors can be described in the following manner.

"Flow" is composed of terms such as "harmonious," "float," "dream," "hover," and "rock/sway." Musical excerpts associated with the Flow factor are *Vivaldi, Concerto for Flute and Strings in D Major, Op. 10, No. 3, R. 428 - "Il gardellino": 2, Cantabile* and *Bach J.-S., Goldberg Variations, BWV 988 (Aria With Divers Variations): Variation 13 a 2 Clav*. Terms such as "float" or "hover" tend to describe situations related to air or water. They represent movements inside fluid environments. In another study, when participants were asked to describe their subjective experiences of listening to their favorite sad tracks, they similarly used metaphors related to "float" and "hover" (Peltola & Saresma, 2014). The researchers highlighted the use of conceptual metaphors, such as *feeling/music is a liquid*. Multiple instances were observed in the participants' descriptions, such as "swim in it." "Float above the earth" was also used as a prime example of visual imagery induced by music in Osborne's theory in 1981 (Osborne, 1981).

Movement is characterized by terms such as "move," "rhythm," "body movement," and "jump." In our experiment, musical excerpts such as *Stravinsky, Le Sacre du Printemps: VIIb. Dance of the Earth* and *John Williams, The Imperial March* were rated higher for terms related to the Movement factor. Terms such as "rhythm" and "body movement" are at the core of music and expressive performance. During early stages of development, movements and motion are associated with the production of sounds. Gestures and ancillary movements are also central to the practice of instrumental music and are therefore important in music perception. A large corpus of studies has consistently shown that listeners use their motor repertoire in music listening, such as moving hands to represent sound features (Caramiaux, Bevilacqua, & Schnell, 2010) or tapping to the beat (Snyder & Krumhansl, 2001). Because music perception often recruits the human motor system, this suggests that the musical mind is strongly embodied (Maes et al., 2014). In turn, embodiment might play a key role in the construction of concepts related to music and therefore one of the sources of the conceptual metaphors in music (Gibbs, 2008). Listeners tend to describe musical elements with a multifaceted description of motion (Eitan & Granot, 2006). For example, crescendo is seen as an approaching and accelerating motion. All in all, the Movement factor relates to the metaphor music as motion, which is ubiquitous in the musical world (M. L. Johnson & Larson, 2003; Spitzer, 2003; Zbikowski, 2002).

Force is represented by terms such as "impressive," "empowerment," "amplify," "immense," "grandeur," and "intense." Participants gave higher ratings for these terms for excerpts such as *Boulez, Messagequisse pour violoncelle solo et six violoncelles: Très lent* and *Bach J.-S., Brandenburg Concerto No.1 in F, BWV 1046: II. Adagio*. Terms such as "empowerment" or "amplify" could be related to previous experiences of bodily sensations encountered in daily life. In a desire to link to music is a moving force highlighted in Larson's book, we named this factor Force, with a crucial difference in mind. Here, we focus more on music's ability to move the listener to a different state location, rather than explaining the forces driving our understanding and the composition of music (e.g., gravitation, magnetism, and inertia; Larson, 2012). The force associated with music is seen here to be capable of "amplifying" a sensation, of "empowering" the listener, and of leading him/her to a conceptual space characterized by terms such as "grandeur" and superlative adjectives such as "impressive," "immense," or "intense." The metaphor of music as a physical force moving the listener has also been highlighted in participants' narratives when describing their own favorite sad songs (Peltola & Saresma, 2014). In their descriptions, participants presented music as having the ability to "make one stop," "pierce the shell," and "trigger" emotions.

"Interior" is composed of the terms "come undone," "deep," "inside one's self," and "internalization." The two musical excerpts showing higher ratings for these terms are *György Kurtág, 12 Microludes for String Quartet, Op. 13 "Hommage à András Mihály": V. Lontano, calmo, appena sentito* and *Marais: La Rêveuse, Quatrième Livre*. "Inside one's self" and "internalization" (and "deep" by extension) touch on the image schema of containment (Mandler & Cánovas, 2014). This refers to the conceptualization of the individual as a containment in which objects (in this case thoughts, sensations, feelings, and music) can be stored. The developmental view of this image schema, namely, the focus on motion in and out of a container, best fits our perception of music as compared with abstract generalizations such as "bounded region in space." This movement inward is also conceptualized in the ability of music to make people reflect on themselves. This inner exploration has been a central mechanism of music therapy for years—exploring traumas and helping patients cope with emotional, physical, or sexual abuse (Borling, 1992; Rinker, 1991; Tasney, 1993; Ventre, 1994).

Wandering is characterized by the terms "large spaces," "to leave," "to go for a walk," "to wander around," and "journey." They are associated with musical excerpts such as *Vivaldi, Concerto for Flute and Strings in D Major, Op. 10, No. 3, R. 428 - "Il gardellino": 2, Cantabile* and *Dietrich Buxtehude, Sonata In G, BuxWV 271: Allegro 2*. The terms representing this factor are linked to yet another important image schema derived from bodily experiences: the path. This corresponds to the act of moving through space, that is, navigating. It can also be associated with a source or a goal, giving the path a direction. In the context of music, this image schema is at the core of our musical representation. As mentioned earlier, the pitch is mainly represented in terms of "high" and "low" (Scruton, 1999). Therefore, the act of playing a scale is a perfect representation of such a path. People experience change of tone as a change in "height" and thus a change in distance. This distance can also be physically experienced on the instrument (distance between keys on a piano or in raising the larynx and spreading the lips while singing). Ultimately, playing scales requires musicians to produce the sound by applying some force while successively changing the distance, which could be seen as successive steps on a path that must be traveled (Antović, 2014). Moreover, musicology reviews describe music as a "continuous, unidirectional, forward movement across space" (Cumming, 2000). The movement in space is thus crucial to the conceptualization and understanding of music. Finally, the Wandering factor links to the metaphor music as a landscape, in which the listener either looks from a fixed standpoint as the music unfolds in the metaphorical space or moves along with it (M. L. Johnson & Larson, 2003).

Finally, unlike the GEMS (Zentner et al., 2008), our model does not contain second-order factors. This might be explained by the great diversity of terms presented. Our appreciation of which factors should be linked together is unfortunately influenced by the arbitrary names given to our factors. For example, one could believe that a second-order factor linking Wandering and Flow would have made sense, as they both conceptualize movement through space. Similarly, one could assume that the Force and Movement factors would be correlated because of the experiential basis of the use of force to produce a tone and therefore a movement (Antović, 2014). However, such models did not seem to improve the goodness of fit. In fact, in considering the constituent terms, we can observe why terms such as "grandeur" and "rhythm" should not be linked together. The names artificially created post hoc can bias our perception of the scales, and this is why it is essential to link to the original expressions. Expressions creating the Flow, Interior, and Wandering factors appear to be relatively correlated. Despite not being represented by a second-order factor, expressions such as "glide," "inside one's self," and "wander around" are all linked by the absence of excessive movement or force. This might explain why ratings for such terms appeared to be correlated.

General Discussion

This series of studies was performed with the goal of creating a dimensional model for metaphors used in the context of music-listening by both musicians and nonmusicians. To accomplish this, we conducted three successive rating experiments, welcomed 540 participants, and used both EFAs and CFAs. Throughout the three studies, no significant difference in ratings could be found between people who define themselves as musicians (by playing an instrument frequently or by having played for a long enough period) and nonmusicians. A difference in ratings could have been expected because musicians are usually more exposed to musical metaphors than are the rest of the population. Metaphors are a useful tool for interpersonal communication between musicians (Pannese et al., 2016). However, when a population of 700 Swedish were asked to rate which mechanism was the most prevalent to experience musical emotion, visual imagery, which comprises the use of metaphors, was reported to be rarely used (Juslin, Liljestrom, Laukka, Vastfjall, & Lundqvist, 2011). These facts could lead us to believe that musicians use different metaphors, or at least rate the presented metaphors differently than the nonmusicians do. However, no such difference was found in this series of studies. We conclude that because our pool of participants shares the same culture (Western), they share similar conceptual references and image schemas, allowing them to easily comprehend the presented metaphors regardless of their musical background or individuality. Consequently, this model, although associated with Western classical music, would be independent of the somewhat unapproachable world of musical writing and music theory. The results of this article are based on laypeople's ratings, and it establishes a common ground to describe how music is perceived in terms of metaphors. As a final result of our work, we extracted a factorial structure composed of five factors that we named Flow, Movement, Force, Interior, and Wandering. These factors are representations of groups of metaphors and must be associated with their constituent terms:

Flow: "harmonious," "rocking/swaying," "to float," "to glide," and "to dream"

Movement: "to move," "movement," "body movement," "rhythm," and "jumps/hops"

Force: "impressive," "empowerment," "amplify/magnify," "immense/vast," "grandeur/magnitude," and "intense"

Interior: "come undone/overwhelmed," "deep/profound," "inside one's self," and "internalize/internalization"

Wandering: "large spaces," "to leave," "to go for a walk," "to wander around," and "journey/trip"

We conceptualized the terms retained in our final model from simple image schemas and, by extension, image schema families (Hedblom, Kutz, & Neuhaus, 2015). Taking the example of the Movement factor, its constituent terms resolve around the image schema family of moving along a path and in loops. "To move" and "movement" are associated with *abstract movement*, whereas "body movement" depicts the *movement of an object*. "Jumps/hops" can be conceptualized as *movement along a path* (and by extension, *movement along a path toward a goal* if one considers higher elevation as a goal). A similar thought process can be applied to the other factors with more or less success. Finally, "rhythm" can refer to *movement in loops*. It must be noted that our final metaphors and categories can be divided into two classes, namely, "strongly schematic" and "more referential." Some metaphors such as "body movement," "jumps/hops," "inside one's self," and "amplify/magnify" are related to the former because they display clear links with embodied schemas, whereas metaphors such as "to float" and "to go for a walk" refer to more specific situations, farther away from the basic image schemas (Figure 3). Our category names can therefore be similarly subdivided as follows: Movement, Force, and Interior as "strongly schematic" and Flow and Wandering as "more referential." This classification allows for a deeper understanding of our metaphors and the conceptual basis associated with each of them. Note that adding such second-level factors, that is, Schematic and Referential, to our model did not improve the fit indices or they did not converge. The metaphors highlighted by this study find similarities with the description of sound as shapes. Metaphors such as "intense," "large space," "rhythm," "amplify" (as in growth), "movement," and "flow" have all been previously described as synonyms for "shape" (Prior, 2010). All in all, musical metaphors invite the listener to "hear music as . . ." mapping the domain of music to meaningful concepts. These mappings highlighted one major music property: its roots in metaphorical language. Multiple studies of Western classical music observed that the dynamics of musical structure and acoustic features are often conceptualized in terms of space (Parkinson et al., 2012; Spitzer, 2003), motion through space (Rigas & Alty, 2005), and forces (Larson, 2012). Scruton, for instance, wrote, "If we take away the metaphors of movement, of space, of chords as objects, of melodies as advancing and retreating, as moving up and down – if we take those metaphors away, nothing of music remains, but only sound" (p. 106; Scruton, 1983).

The importance of metaphors extends to many associated aspects of the musical experience. It is not surprising to find metaphors associated with musical emotions, because the main reason that people engage with music is its ability to evoke emotion (Juslin & Laukka, 2004). As one of the eight mechanisms eliciting emotions when listening to music (in the BRECVEMA model), visual imagery was described by Juslin as being similarly based on image schemas (Juslin, 2013; Juslin & Västfjäll, 2008). He proposed that people picture images or dynamic visual representation while listening to music. These representations are a direct cross-mapping between the metaphorical affordances of the music and image schemas grounded in bodily experiences (Juslin, 2011). These visual representations contribute to emotional reactions. Although visual images may come unbidden to the mind of the listeners, they are usually the result of a voluntary process in which listeners conjure images, play with them, and create their own story to enhance or modify their emotional experience. These images happen as the music plays, whereas musical metaphors can be used to describe post hoc the experience of music. Music stimuli are particularly effective in triggering visual imagery (Quittner, 1988). In turn, the experience of visual imagery effectively enhances emotions induced by music (Band, Quilter, & Miller, 2001; Västfjäll, 2001). Although visual imagery is based on metaphorical mappings, not all metaphors have a direct visual representation. To that extent, although image schemas can be represented visually for presentation purposes, they should not be equated to rich images (M. Johnson, 1987). Moreover, the acquisition of participants' responses about visual imagery can be tricky in an experimental setup because they result from a volatile process. Asking the participants for direct communication of the images that come to their mind disrupts the flow of such images. In the case of metaphors, such evaluation can be obtained after listening to a piece or even without listening to any music, which fits our experimental procedure. Therefore, despite the differences between visual images and metaphorical representation, the creation of the GEMMES brings insights into the categories of metaphors to be expected in both processes.

By inviting the use of metaphors understood through common embodied representations, the dimensional model proposed in this study offers the opportunity for listeners to create a richer understanding within a shared referential frame. This metaphorical communication also extends from the composer to the musicians as well as from musicians to musicians, creating a structured common space. It is to be hoped that this would eventually optimize musical performances themselves (Pannese et al., 2016). In addition, the metaphors explored in this study could find a place in music education, as some have suggested that the formalistic account of musical structures should be replaced by metaphorical language (M. A. Guck, 1981; Woody, 2002). Specifically, Guck concluded that metaphorical language could put students more directly in touch with those aspects of music on which traditional analytical techniques were focused and could add richness to their understanding of those aspects (M. A. Guck, 1994). In a practical way, Woody suggested that the use of a combination of aural modeling ("show and repeat"), technical musical terms, and mental imagery instantiated by metaphors was the key to success in musical learning. Finally, by pointing out the most commonly used metaphor dimensions and related terms, our model can also improve the guided imagery and music (GIM) methods. Music-guided imagery such as the Bonny method of GIM uses music and therapy as a way to help the patient explore his or her inner self. It has been reported to facilitate insight and cognitive reorganization (R. Blake & Bishop, 1994), and it increases the sense of meaning (Wrangsjö & Körlin, 1995). It has been successfully used to reduce stress and to help patients with multiple personality disorder (Pickett, 1991; Pickett & Sonnen, 1993) and posttraumatic stress disorder (R. L. Blake, 1994; R. Blake & Bishop, 1994) as well as people recovering from emotional, physical, or sexual abuse (Borling, 1992;

Rinker, 1991; Tasney, 1993; Ventre, 1994). Our results might lay more scientific groundwork for such musical therapy, eventually providing better treatment for patients with posttraumatic disorders or helping with mood and anxiety disorders or recovery from sexual and physical abuse (McKinney, Antoni, Kumar, Tims, & McCabe, 1997; Pickett & Sonnen, 1993; Wrangsjö & Körlin, 1995).

Limitations

The choice of using only classical excerpts can also be contested in terms of ecological validity. Juslin and colleagues have suggested using pop/rock music in research because it is the most prevalent genre of music listened to today (Juslin et al., 2011). However, classical music is mostly used in GIM methods and is known to evoke vivid images and metaphors (Band et al., 2001; McKinney et al., 1997). It is also the main genre of music explored by music theorists who use metaphors as a common tool in their work. We believed that, combined with the absence of lyrics, classical excerpts were the best candidate to explore the structure of metaphors in the context of music listening. Another drawback of our excerpt selection was the use of only a single set of excerpts for multiple studies. Currently, more than 30 million songs are available on streaming platforms. Because we could not base our study on all of them, we focused on a selection of the musical excerpts expertly handpicked from a previous study (Eliard et al., 2012). We aimed to cover a wide variety of the different styles and composers, reflecting Western classical music. The large number of participants and their varied background (musical expertise and country) contributes a certain robustness to our data. We are aware that varied playlists of different music genres must be tested in future studies to replicate the GEMMES structure and to generalize these results. Overall, one could see these scales as specific to a single population and a single musical genre. Although we agree that these scales should probably not be extrapolated to populations such as the Kpelle and Jabo tribes in Liberia or genres such as hardcore or metal, we argue that conceptual metaphors are associated with high interindividual variability and are culture dependent (Krantz, 1987). Such a model encompassing all populations and genres of music might unfortunately be too difficult to ever be computed. However, one could systematically investigate the building blocks of metaphors shared in different cultures and the specificities of each culture. It is likely that metaphors related to rhythms, for example, might be shared across different cultures, whereas others might be more specific.

Future Directions

Researchers in this domain might be interested in understanding the complex relationships between the GEMMES and emotions. This kind of research would create a better understanding of the connections between specific emotions and the five GEMMES factors found in this study, as hypothesized by previous research (Pannese et al., 2016). It would also be crucial to investigate the impact of the dynamic aspects of musical structure and acoustic features to test the correlations between these aspects, the GEMMES dimensions, and emotions. As an example, the temporal structure of the envelope of the sound might be correlated with the sense of space and force. Overall, this research opened up paths to explore the interaction between sounds, visual imagery, metaphors, and emotions. We hope that it will open new avenues of research for music education and help in understanding the impact of music on health with methods such as the GIM.

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