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Abstract: Discusses the puzzle of music being both abstract and emotionally powerful. Experimental psychology offers an understanding of 3 processes that may resolve this puzzle: (a) People automatically attribute emotions to themselves that explain arousal; (b) perceptual processing of a serial stimulus involves attentional oscillations between accessing internal knowledge and recording external input, which causes neurophysiological arousal; and (c) intuitive aesthetic evaluation involves accessing abstract representations of the same type as problem solving and results in excitement. It is argued that in the absence of a clear basis for the arousal, listeners unconsciously select one of their own emotions as the cause. In this way, the mental processing of music as a complex object unlocks the private emotions listeners already have. (PsycINFO Database Record (c) 2013 APA, all rights reserved)

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A COGNITIVE THEORY OF EMOTION AND AESTHETICS IN MUSIC

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Acknowledgement:

In this paper, I consider music from the standpoint of an experimental psychologist, a point of view which emphasizes music as an experience rather than as a formal structure.

Outside the conservatory, music presents some interesting behavioral puzzles. First, it can elicit strong emotions, even though during a music performance, few symbols and no explicit events occur, Nobody is falling in love, being murdered, or dying of consumption. A second puzzle is that music can elicit emotions repeatedly. Indeed are recording can elicit a strong emotion on the hundredth hearing. And, most remarkably, it can elicit a *different* emotion at different times. The third puzzle about music concerns its aesthetic basis. Music is not merely emotionally powerful, it is also aesthetically attractive: it can be beautiful. This is curious because, unlike the other arts, it does not have reference points in natural events which might explain its aesthetic quality as a function of allusion. Visual art can refer to the real visual world, literature can refer to the work of events, and so on. But music has no clear reference of this kind.

To deal with these problems from the standpoint of a psychologist, as opposed to a structural analyst of music, we need to think about the nature of perception, the nature of emotion, and the nature of aesthetic experience. I will sketch a general overview of what a psychological theory might look like in each of these areas and how it might explain some aspects of the experience of music.

There are several occasional hypotheses about how music works and why it has emotional and aesthetic impact. I mention three of them in order to dismiss them. The first is the Referential Theory: on this view, music forms do have set meanings. For example, a march of a certain tempo has one sort of a meaning and of another tempo another sort of meaning; tone poems exaggerate some aspect of music form so

listeners can unambiguously perceive them. The National Anthem evokes certain kinds of association, as do well-known Christmas carols. Such music allusions are used by composers as reference points sometimes, but the basic fact about music remains; the well-known reference points are sparse and by no means account for the strength and quality of emotions that are felt. And, referential points cannot account for the fact that a given piece of music can elicit different emotions in different listeners, and have a different sort of emotion ascribed to it at different times by a single listener. So much for the Referential Theory.

There is a somewhat more frequently evoked theory of music experience, which is a special case of an aesthetic theory derived from Wilhelm Wundt (Woodworth, 1938). On this view, there is an optimally pleasurable level of arousal, As the intensity of a stimulus increases, there are two main functions that contribute to overall arousal. One is the intensity of the positive elements, the other is the intensity of negative elements. The hypothesis is that the positive arousal increases at lower levels of intensity than the negative arousal curve. This defines an intermediate range of stimuli, which are optimally arousing. Arousal occurs when an event is unexpected, a fact which is at the heart of a number of theories of music aesthetics. On this view, listening to music is a continual process of making predictions about what one is about to hear, at each note, these predictions are to some extent satisfied and to some extent not satisfied. The balance between expectation and satisfaction controls the amount of arousal. An aesthetically pleasing piece uses the tension between expectation and fulfillment to stimulate an optimal arousal level.

The major formal problem with this view is in the definition and quantification of expectation. To solve this, Meyer (1967) invoked information theory from mathematics, which quantifies the extent to which a note is expected; this also quantifies how unexpected it is at that point, and therefore how arousing it is. The difficulty with this formulation in practice is related to the second puzzle about music: one can perform or listen to the same piece of music many times, have it literally memorized, and nonetheless, continue to enjoy it. It cannot be the case for a piece that one has memorized, that the ebb and flow of partially fulfilled expectations control one's enjoyment of it: every note is exactly what is expected. There must be some computational mechanism at issue other than mere statistical predictability.

A third view of the way music works and why it is emotionally powerful has been related to the different functioning of the right and left hemispheres of the human brain. It is a common view that the left hemisphere is the rational and computational hemisphere, while the right hemisphere is intuitive, artistic, and emotional. On this view, music must be processed primarily in the right hemisphere. This hypothesis was supported by the experimentally demonstrated fact that melodies are less-well recognized when played to the right ear than when played to the left ear (Kimura, 1964). (The left ear is more strongly connected to the right hemisphere and the right ear more directly to the left hemisphere.) However, there is no simple relation between music processing and the right hemisphere. The experiments on melody recognition characteristically used nonmusicians as subjects. Nonmusicians indeed perform a melody recognition task better in the left ear than in the right ear. But in musicians, one finds the opposites pattern by "musician" I mean "amateur" musician (Bever & Chiarello, 1974; Johnson, 1977; Gaede,

Parsons, & Bentera, 1978; Gordon, 1975, 1978). There are other studies showing that these ear differences reflect hemispheric differences. For example, in musicians the electrical activity above the left hemisphere in response to melodies shows a pattern of an active processing hemisphere, while in nonmusicians the corresponding pattern occurs above the right hemisphere (Gaede et al., 1978).

Why are melodies processed in different hemispheres by musicians and nonmusicians? To understand this, we must consider a general view of the difference between the hemispheres in all people. On this view, there is a difference in capacity between the hemispheres; the left hemisphere is computationally the more powerful hemisphere, as opposed to being specialized for certain tasks (Bever, 1980). Those tasks which are themselves computationally demanding end up being processed better in the left hemisphere. Thus, language, an extremely complex activity, is almost always represented in the left hemisphere. When an amateur musician learns about music intuitively, it becomes a complex activity like language and is processed in the left hemisphere. Of course, the complexity hypothesis on the basic difference between the hemispheres is still controversial, However it turns out, the musicians' asymmetry in favor of the left hemisphere disqualifies the view that the reason that music is so intimately connected to emotions is that it is processed in the right hemisphere. We cannot make that theory work unless we say that musicians are not emotional about music, which is palpably incorrect.

I have disposed of three occasional theories of the behavioral basis for music. We must understand music in the context of the interaction of several psychological processing mechanisms. This requires an initial review of what kind of stimulus music is—in particular, Western art music. What comes to mind first is that it is sequential, segmented into units; the structural stuff of which the music is made is inevitably bound up with the relations between the units, One can formulate this in the Shenkerian mode and argue that every unit in a given piece is distillable to the same essential elemental theme, which is the *signature* of that piece. Or, one may simply note that sections of a piece of music have an organizable relation to other sections, which may be characteristic of the piece—the characteristic of the piece may be the relationship between the different components. But, whatever the correct structural analysis of music may be, the commonly accepted view is that a piece is organized into structurally defined units and the relationship between each unit and the others.

Three areas of investigation within scientific psychology have some contributions to make to our understanding of music structure as an experience. These theories concern the source of specific emotions, the perceptual organization of segmented structures, and constraints on aesthetic experiences. What I will argue is that the cognitive activity of processing music structure automatically elicits physiological and aesthetic activities: these cognitively-elicited activities release inner emotions, which accounts for the emotional force of music.

Consider first the source of emotions. Obviously, emotions in the real world are often driven by events or facts, eliciting shock, excitement, surprise, fear, or joy. There are numerous things in the world that we would like to have happen—when they do, we are happy; there are numerous things in the world that we would like not to happen—when they do, we are not happy. The world transparently provides us with a lot

of information about how aroused we should be and what we ought to feel. But, art music characteristically does not give us much detail about how we should feel. To understand the emotional power of music we must examine how emotions occur when it is hard to recognize the source of arousal. A classical theory of emotion, "attribution theory" (James, 1884) suggests that we respond reflexively to the world and then attribute an emotion that is appropriate for what we are doing. A paradigm example is: I see a tiger, the body turns around and runs, the mind says, "I'm running, therefore I must be scared"; and then one "feels" fear. Such a theory is obviously limited, at best, simply because there are many complex feelings we have that are the result of cultural knowledge and accumulated beliefs about the world; these surely are not based on reflexes but rather on elaborately cognitive and deeply philosophical sources. But, attribution theory may be an appropriate explanation for certain emotional experiences, in particular those in which we do *not* recognize any obvious source for our feeling. This problem has been investigated in a way that is of particular relevance to understanding how music elicits emotion. For example, a classic experiment differentiates between the mechanism of arousal and the mechanism whereby one assigns an emotional interpretation to the fact that one is aroused (Schacter & Singer, 1962), An unsuspecting subject in an experiment is actually given some adrenaline, to ensure that his arousal level is physiologically increased. Another person and the subject fill out a questionnaire which assesses emotional mood. The other person is actually part of the study. He either acts overtly happy or unhappy. Some subjects actually receive adrenaline, and some receive only a placebo. The questionnaire results show that the other participant's exaggerated mood has very little affect on the adrenaline-free subject's mood; but when the subject is given adrenaline, his performance on the questionnaire is strongly influenced by the apparent mood of the other participant. Such a result separates two mechanisms that can contribute to the emotion that one feels. On the one hand, conventional meanings and events play a role in our emotional state. On the other hand, when convention does not specify what emotion to feel, local circumstances can determine one's emotional mood. If we arouse somebody and give him or her incidental information about the potential of the arousal, the person will then feel the appropriate emotion.

What I am going to suggest is that the perceptual and cognitive processes involved in dealing with music as a complex stimulus act as arousal mechanisms. The individual emotional state that we feel can to some extent be shaped by conventional forms, as in the effect of a very slow piece versus a very fast piece; but the felt emotions are also shaped by salient feelings we have that day, or the emotion which we have previously assigned to the piece. Thus, the role of music is as an emotional trigger and amplifier. It arouses a listener through the rhythmicity of its cognitive demands. The particular emotion which is perceived is to a great extent contributed by the listener. This explains why the same piece of music can elicit widely different emotions. It also explains the power of such emotions—they flow directly in part from feelings which *the listener already has*. Hence, the cognitive activities unlock pre-existing personal feelings, which can be much more effective than any system of imposing emotions from the outside.

This is not to say that the music form and its performance does not guide which pre-existing emotions are selected. First, a set of partially synaesthetic conventions can play a role—harsh notes may elicit harsh emotions. Second, individual experience (or program notes) may permanently associate a work with an

emotion—one may consciously and, therefore, consistently *use* pieces of music to elicit particular emotions. Finally, different patterns of cognitively induced attentional fluctuations may correspond to the patterns faced in actual emotions. That is, as Langer (1967, 1986) suggests, different pieces of music may mimic some aspects of the physiological form of different emotions. Accordingly, particular pieces may have a specific set of emotions which can be selected from pre-existing emotions available in the listener.

I now turn to the cognitive mechanisms which arouse emotional states. The first has to do with the perceptual segmentation of the world. The second has to do with the aesthetic unification of the segmented analyses of the world. Language behavior offers useful case-studies in the segmentation of the world during perception. Language, like music, involves sequential behaviors that are both natural and exquisitely organized. The availability of independently motivated models of linguistic structure facilitates the study of the way in which listeners impose organization on sequentially structured stimuli. In a typical experiment, subjects judge whether two adjacent words were or were not in a two-clause sentence they just heard: the two words either occurred within the same clause or spanned the clause boundary. The theory is that if clausal segmentation is imposed while organizing and comprehending a sentence, then the difficulty of recognizing the two words should be greater for words that are in different clauses. This prediction has been confirmed in a large number of variations on this experimental paradigm (see Fodor et al., Chapters 2 and 6 for reviews). These results suggest that the organization of language is reflected in processes that occur as we hear the sentences: sequences of words and phrases are perceptually packaged in clauses—the minimal unit of semantic organization.

It is always slightly uncertain how each clause will end. Thus, certain comprehension activities cannot occur until just after the end of a clause. At the end of the clause, one is busy interpreting it in relation to other clauses in a discourse and in relation to our knowledge of the world. Such activities have a large impact on attentional capacities. The alternation between the two kinds of activities results in an alternation of the locus of attention between external information and internal processes. During a clause, we are busy listening to it; at the end of the clause, we are busy relating the clause itself to the other linguistic events and our internal knowledge. One can experimentally demonstrate that there is actually an oscillation of attention between the external stimulus and its internal organization. At the end of the clause, the detectability of other events is quite low compared with the beginning of a clause. For example, a brief click or tone is harder to hear when placed at the end of a clause than at the beginning (Bever & Hurtig, 1975). The oscillation of attention at the clause boundary is clearly a function of the processing that listeners apply to the linguistic sequence. It reduces attentional capacities to external stimuli for about a tenth of a second. This attentional oscillation has measurable electrophysiological effects. For example, evoked potentials are slower and less intense for clicks located in clause-final positions compared with clause-initial positions (Seitz, Weber, Jacobson, & Morehouse, 1980).

Consider now the perceptual segmentation of a music sequence. In an experiment similar to the linguistic word-probe, subjects listened to a short tonal melody about 18 notes long (Tan, Aiello, & Bever, 1981). They then reported if a four-note excerpt was in the melody or not. The melodies were designed so that

they had a natural phrasing structure dividing them into two tonal phrases. The four-note excerpt was either the four last notes from the first phrase, four initial notes from the second phrase, or the two last notes from the first and the two first notes from the second phrase. Interestingly, the nonmusicians performed better than the musicians for the case that is the awkward one from the musicological standpoint, namely the excerpt that bridges the phrase boundary. But the musicians do better on both cases where the music sequence is from within the phrase. Such results demonstrate that the ongoing perceptual segmentation of music is like that of language, especially for musically experienced listeners.

Above, I outlined a mechanism for the attribution of an internal emotion in the absence of an external explanation for it. I have just sketched some processes that occur when dealing with a serial stimulus, first in language and then in music: the evidence suggests that, as we segment a stimulus, there is an oscillation of attention; this oscillation itself is reflected in physiological phenomena. Thus, the stimulus, be it a sentence or a piece of music, has the listener physiologically under its attentional control It presents the listener with cognitively complex objects with structures which define the points at which the listener must integrate the structure, as opposed to attending directly to the sequence. A diligent listener of music will thus be in the position of the experimental subject who received adrenaline: he (or she) realizes that he is agitated, but does not have direct access to the mechanism actually causing the agitation: he intuitively attributes the agitation to a particular emotion, itself determined by both systematic and chance factors.

When we process the end of the clause we are organizing it in relation to other clauses and the world into higher units of *meaning*. A music sequence does not have meaning in the same sense, but it does have *beauty*. I suggest that the points of interphrase integration in music are the points at which it can be perceived as an aesthetic object. To understand how this might work, we must consider aesthetic experience in general. Like many before me, I suggest that aesthetic experience arises out of the application of high order cognitive judgement in ways that are typical of elementary perceptual processes (see e.g., Mandler, 1975 for some historical discussion and presentation of his own variant of this view). Consider first the pervasiveness in cognition and perception of the desire to create unities out of disparate events. An alternately flashing pair of red lights at a railroad crossing is actually perceived as one light in motion back and forth. This is a classic demonstration of the observer's contribution to percepts. A simple analysis of how it works is the following: the visual system perceives a light in one position and then an apparently identical light in another position. Suppose the light was actually a bee which zipped behind a rock and appeared on the other side. The natural interpretation for the visual system to have evolved to deal with events like this is to connect them; the attributed internal mechanism of connection is *motion*. So, the reason that the visual system automatically attributes motion to visual stimuli which alternate is that that is the only way it could have happened in nature. This is a very simple example of a system which takes disparate events and attributes an organizing structure to them which turns them into a single event It is striking because we perceive the two independent events and the motion relation between them as real (Rock, 1983, discusses many other examples of this kind).

There is a simple, already classic kind of experimental study which demonstrates the importance of

internal motion. The amount of time that it takes somebody to decide that pictures of two dimensional blocks are actually the same block, is itself proportional to the amount of time that it would take literally to rotate one of them into the other (Shepard & Metzlar, 1971; Shepard & Cooper, 1982), Some researchers have reported this not as the motion of the image, but the image of the motion: that is, the two images are related by an abstract process (Kubovy, 1983). This is a more elaborate example of the mental induction of an integrating relation between two distinct events.

How are such processes connected to aesthetics? My colleagues and I have argued elsewhere that the role of art objects in general is to stimulate distinct perceptual representations of an object and then to allow for their unification by some integrating relation (Lasher, Carroll, & Bever, 1983). We suggest that the activity of forming such integrating relations is itself pleasurable. due to the same kinds of mechanisms which make explicit problem solving pleasurable. Let me start with an example of that at a much higher level than the two examples I've just given, namely a child playing peek-a-boo, which is obviously an enjoyable activity. The child first sees the mother; then the mother disappears; this raises a question for the child, "Is there a mother or isn't there?". The next stage is to concoct for itself a representation of the mother, which is not the image of the mother but a representation which exists whether she's literally in the window of experience or not When the mother reappears, the child can now confirm the abstract representation of the mother with the image of what it is seeing. The recognition that there is a resolution between mother-present and mother-absent is in the representation of the mother. The child is playing with the concept of "mother permanence" and is understanding the relationship between the mother-present and mother-absent in terms of a representation of mother-constancy. In principle this is like understanding the relationship between two alternating blinks of light in terms of a single light in motion. The child is thinking of an abstract mother that sometimes is in its direct experience and sometimes is not. The representation of a constant mother is the resolution of the apparent conflict. It is interesting that like listening to a piece of music over and over again children like to play peek-a-boo over and over again. It is a mental game about the concept of the relationship between one's representations and one's sensations when the thing they represent is absent.

Now to turn to the application of this sketch to aesthetics. One proposal is that an aesthetic stimulus evokes several representations which are themselves superficially incompatible but which afford an abstract representational integration. The application of these conflict forming and resolving principles to real art objects is complex, and even simple art works require considerable space to describe. I will limit myself to several examples of folk art, just as the descriptive linguist limits him or herself to naturally occurring languages. Folk aesthetic objects can reveal the operation of aesthetic constraints more directly than the fine arts just because the creative operation is the slow and redundant process of cultural selection, not the individually motivated act of genius. Though simpler perhaps, folk objects can reveal the aesthetic principle quite clearly.

Consider first the well-known rhythmic tattoo, "Shave and a haircut, two bits." This is an example of folk rhythm, common to quite a few cultures. What does it mean? It is an attention-getting noise, basically what it means is, "knock," "pay attention," "I'm here." How does it work on the representational conflict

analysis? Just as the mind integrates disparate experiences into single objects, it extracts an underlying metric from repeated noises or events. Yet the underlying rhythmic analysis of the folk tattoo is actually ambiguous between 2/4 and 3/4 until the last point. It is either, “Shave and a haircut two bits” (2/4) or “Shave and a massage two bits” (3/4). Some people hear it one way and others hear it the other way. *During* the sequence there are conflicting metrical representations which are resolved only at the last beat, which is why that is the place to stop. This heightens the focus on the sequence as basically a single, “knock,” which coordinates exactly with its cultural function.

Another folk example is the song “Happy Birthday.” The basic social function of Happy Birthday is as a song which says “Amen” to a person’s birthday. If you go to a birthday party, you cannot leave until Happy Birthday is sung. Another aspect of it is that the lyrics are really a question and answer. When you are a child the question is, “What terrible names are you going to call the other person?” As in: Happy birthday to you Happy birthday to you Happy birthday dear stinky-pants-in-his-underwear! Happy birthday to you!

The epithet is an answer for children, but adults, too, are often drawn into seeing whose birthday is occurring if they overhear a celebration (as at a restaurant). So, instead of being “Happy birthday to you,” the song really ought to be titled “Happy birthday to who?”. Happy birthday to who? Happy birthday to who? Happy birthday dear X. Happy birthday to you!

Just as the rhythmic ear automatically extracts an underlying metric from beats, the tonal ear automatically extracts a tonality from notes. From the tonal standpoint, Happy Birthday is a drawn-out modulation, wavering back and forth between the key implied by the extended final note of each phrase. Every note is consonant or dissonant with every key to some extent-stressed notes highly consonant with a key imply that as the underlying tonality. On this analysis, the song wavers back and forth between being perceived as in C and F(assuming the first note is C). That is, the song perceptually moves *from* C to F—harmonically the song is about the question of what key it is really in: Is this song sung in C? Is this song sung in F? Is it C, or F-major? This note makes it be F.

The resolution to F is definitive at the B flat (“This note”), because B flat is consonant in F, and not in C. But it is just after the point at which the celebrant’s name also occurs: hence, the music conflict is resolved at that critical point where the verbal question is answered. Finally, the abstract integrating structure is that the whole song perceptually inculcates a progression from the key of C to F, the B flat creating an extended form of “Amen.” This, in turn, is related to its social role as the song that says “amen” to a birthday. Happy Birthday as I’m sure many of you know, was not written to be a birthday song. It was written as a morning song for kindergarten, and did not enjoy popularity for that purpose: but once it was given the words “Happy Birthday,” it caught on like wildfire. On my analysis, this is because of the relationship between its social function and the music experience that it offers.

A folk song like Happy Birthday is not a sufficient example of art music, but it illustrates the basic aesthetic principles. Art music, of course, includes multiple layers of structures which afford overlapping examples of the aesthetic principles. The paradigmatic case of this is *theme and variation,* which can

often propel a listener to form and re-form an increasingly abstract representation of the theme. Thus a diligent performer and a diligent listener conspire to present and understand representational conflicts and their resolution. The abstract interrelation of superficially conflicting representations (e.g., a theme and its variant) will tend to occur at particular points—often at the boundaries of music phrases. This process is not only essential for the aesthetic appreciation; it also further enhances the attentional oscillation between relatively external processing and the accessing of internal, abstract schemata.

Conclusion

Music provides one of the most complex and rich experiences there is. It would be foolish to expect experimental and theoretical psychology to explain all the interactions of neurophysiology, emotional style, and fashion. But I have sketched some fundamental facts and processes which contribute to the experience of music. Listening to music includes computation of mental relations: these computations result in temporally controlled attentional oscillations, which elicit non-specific arousal: the arousal in turn is mentally organized as an emotion— *which* emotion is determined by a combination of musically synaesthetic devices, symbolic conventions, and the listener's currently salient emotional repertoire. The key to the emotional power of music is that it stimulates cognitive operations which unlock our private feelings.

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