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A Circular-City Location Model Application: Music in Advertising

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Abstract Recent research has extended the circular city location model to incorporate a single-peaked distribution of consumers around the circle. The present paper presents an application of that model to music-emotion theory. Psychology research has shown that human emotions can be characterized as points around a circle, and that a listener's emotional reaction to music depends on its structural characteristics. A firm could therefore choose advertisement music to strategically elicit an emotion in response to the music chosen by its competitors. We use results from the circular location model to describe how firms might do this to maximize sales.

Keywords Music theory, Music emotion, Location theory, Advertising

1. Introduction

In 2007, U.S. companies spent $149 billion on advertising [1]. Of this, 43% went towards television commercials and another 7% to radio. Both of these media incorporate music either in the background or as a major part of the message of their advertisements. The reason is well known – musiccan elicit desired emotions, make the product memorable, and attract consumers. In[2], it is also found that music in advertising is more effective if the mood induced by the music matches the nature of the product. For example, one might expect soft drink commercials to use "happy" music, whereas it may be more effective to use "tender" music in commercials soliciting donations for disaster relief.

While this research shows that a certain type of music-emotion may be most effective for marketing a particular product, some consumers may still respond more strongly to different emotions(perhaps because they view the nature of the product itself differently). If so, one might expect a variation in the musical styles used to advertisethe product. If a firm wishes to attract the maximum number of consumers with its music, therefore, it should consider not only the nature of the product, but also the heterogeneity among consumers and the types of music used by its competitors. To that end, the purpose of this research is to use a game-theoretical location model to examine the optimal placement of a company's advertisement within music/emotion space in order to maximize its market share and profits.

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In the field of music emotion, much research has been done to determine the emotional effects that music has upon its listeners. Experiments using listener response and physical reactions have shown that the effects of music tend to be the same for most people, irrespective of age, gender, or ethnicity. Furthermore, the emotional response can typically be explained by the structural elements of the music, such as mode, tempo, pitch, melody, rhythm, etc. For example, music played in a minor mode elicits feelings of sadness, whereas music played with a faster tempo creates feelings of happiness. Therefore, the emotional response that a listener has to a piece of music could realistically be predicted using the structural aspects of that piece of music. In sum, the research demonstrates that the effects of music arelargely predictable, measurable, and universal across listeners.

If the music in an advertisement can be chosen to elicit a desired emotion, and if emotions can be used to attract various consumers to products, then musically-induced emotion can be considered a strategic variable in a game. Furthermore, if emotions can be described as changing in a continuous fashion, then the problem can be addressed using a location model. The works of Hevner[3],[4] and Russell[5], among others, do just this. Hevner, through experimentation, maps music and musical characteristics to specific emotions, and represents these emotions in a circular diagram. Russell uses descriptions of subjects' emotional states to map emotions onto a set of axes. His result is that the range of human emotions can be described in a continuous circular diagram, called the "Circumplex Model of Affect". Starting from happy, for example, moving around the circle changes the emotion to satisfied, serene, sad, annoyed, angry, astonished, excited, and back to happy. When combining these results with Hevner's, we see that firms can theoretically locate at a point on the emotion circle by

choosing a combination of measurable musical elements.

With emotions mapped in a circular fashion, and with the ability to use music to elicit those emotions, we apply the model developed in[6] to analyze the firms' strategic behavior in choosing advertisement music. In that model consumers are distributed around a circle according to a symmetric, single-peaked distribution. Prices are fixed and equal, and an exogenously determined number of firms simultaneously choose a single location on the circle. Consumers purchase from the firm nearest their location. In the application of the model we assume competing products are homogeneous and have equal prices, but the advertisements for the products can vary in the style of music. Consumers are distributed around the circle according to their emotional preferences, and each purchases the product eliciting the "closest" musically-induced emotion. The distribution of consumers is single-peaked because a certain style of music may be better suited to market a particular product than others.

Application of the model describesthe optimal "music-emotion strategies" and potential equilibria. When ignoring entry deterrence strategies, it is optimal to choose the music that elicits the emotion attracting the greatest number of consumers. Equilibria can only exist with one or two firms, but perhaps more importantly, even when there is no equilibrium each firm's best response is always to choose a location equal to or right next to another firm's location, and to do so in such a way as to achieve the greatest market share. This will tend to result in agglomeration, and a balancing of clusters such that market shares are equal.

The paper is organized as follows: Section 2discusses the music-emotion literature and sets the groundwork necessary to link it to the location model. Section 3provides an overview of the circular location model from[6], and applies the results to the music-emotion context. Section 4concludes with a summary some avenues for further research.

2. The Circular Nature of Music-Emotion

Psychologists have found a number of ways to measure and compare musically-induced emotions relatively accurately. The obvious method of determining what a person is feeling is to have him or her express it. Subjects have been asked to do this in many ways, including writing descriptions as in[7], choosing from a list of words as in[3] and[4], rating their level of various emotions on scales as in[8], and choosing from pictures representing different emotions as in[9].

An alternative method of measuring emotional affect is to circumvent the subject's conscious reaction and measure the body's response to the music. Many physical reactions have been measured, including heart rate, pulse transmission time, pulse amplitude, respiration cycle time, respiration depth, various measures of blood pressure, skin conductance level, and skin temperature[10], for example, compared these reactions to their subjects' stated emotions in order to derive which physical reactions corresponded with which emotions.

In analyzing the effects of music on emotion, music psychologists have sought to determine if the effect of a piece of music is universal among all listeners.To answer this question, various studies have been done comparing how people in different groups responded to the same musical stimulus. Groupings that have been compared include age and educational level[7], nationality[9], level of music experience[3], and even people who have experienced traumatic brain injuries[8]. These and other studiesfind that the emotions invoked by a given piece of music are similar among all humans.

Research has also shown that music can have significant effects when used in advertising. Not only does music have the power to invoke certain emotions in the listener, but it can also lead them to purchase a product.[2] questioned how a customer's purchase intent was affected by music used in commercials by testing the effects of different types of music on the purchasesof greeting cards. In their findings they state, "When invoked mood is congruent with the mood of the purchase occasion, buying intention is higher than when the buyer and the occasion moods are inconsistent." For example, happy music is better suited for advertising a birthday card, whereas a "get well soon" card sells best to sad music.[1]

Applying location theory to the area of music-invoked emotions requires a method to quantify the emotions being analyzed. While the emotions could be directly measured, as described above, it is difficult in such subjective experimentation to achieve the non-biased environment required for accurate results. Ideally, one would like to skip the human testing stage and gather information directly from the music itself about which emotions it would elicit. One such method is to analyze the structural aspects of a given piece of music. Structural aspects, according to[11], are "factors in the composed musical structure represented in the musical notation." Examples of these factors include tempo, loudness, pitch, mode, melody, rhythm, and harmony. Each of these factors can be measured and compared merely by looking at a piece of sheet music for a song, thus cutting out the need for human-based experiments.

The key to this strategy, however, is demonstrating that different levels of these structural aspects result in different emotions. Various studies have been carried out analyzing this question for many of the structural aspects listed above. In the case of mode, for example,[12] showed some of the earliest evidence that major chords produce happy emotions while minor chords produce sad ones. These findings have since been supported by[3],[13], and many others. Studies have also been done analyzing the effects of adjusting multiple factors simultaneously. However, "The best known

[1] In another study[14] looked at music's effect on a customer's wish to be affiliated with an organization. They altered the background music being played while potential customers visited a bank. The authors found that background music may have a systematic effect on the desire of a customer to affiliate with an organization.

investigations with systematic manipulations of various factors in real music," according to Gabrielsson and Lindström's review on this subject ([11], p. 230) are those done by Hevner[3],[4]. Her studiesof mode, melodic direction (ascending vs. descending), harmony, rhythm, tempo, and pitch level were the earliest and are still some of the best known in this field.

2.1. Hevner's Circular Model

Hevner created a method of representing emotional responses by arranging a large number of emotional terms into eight "clusters." Each cluster represented one basic emotion, and the terms within were all close in meaning. She then organized these clusters around a circle so that clusters adjacent to each other were similar in meaning; those farther around the circle were decreasingly similar, and clusters directly opposite each other expressed completely opposing emotions. Her adjective circle is represented in Figure 1.

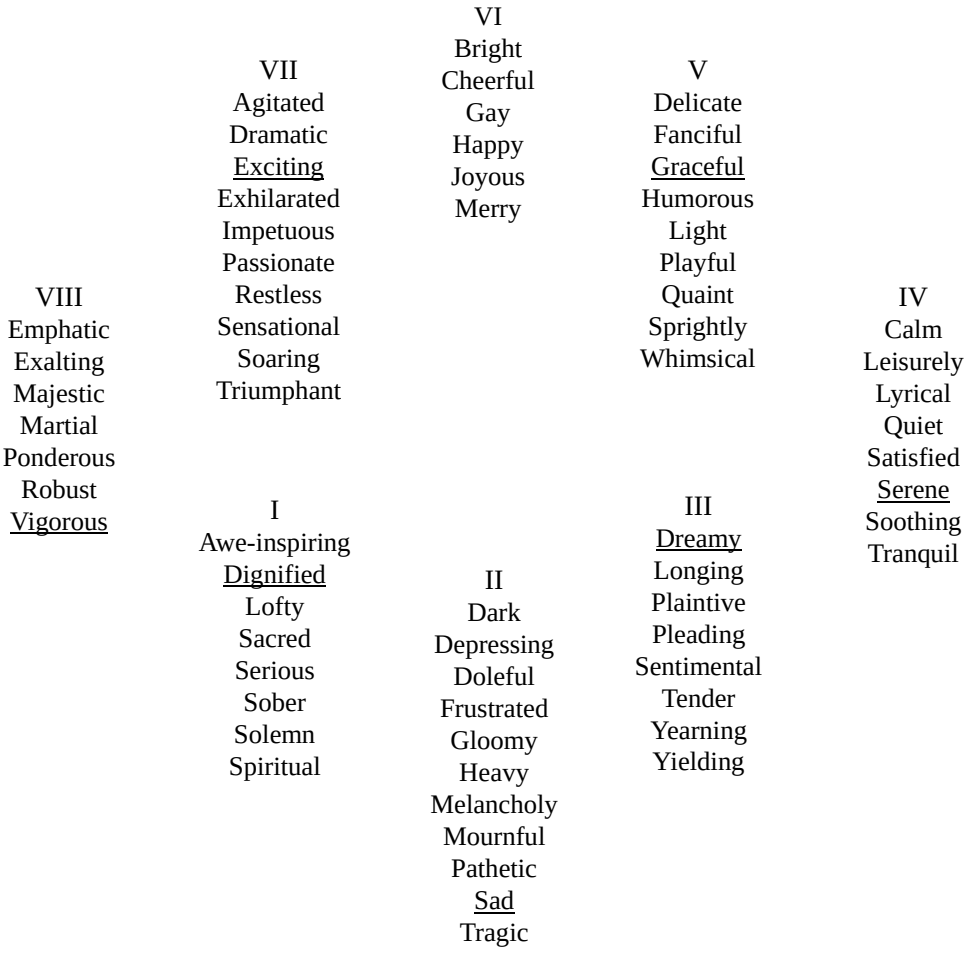

Figure 1. Hevner's Emotion Clusters ([11], p. 231)

Hevner conducted six experiments, each varying one structural aspect of music while holding the others constant.[2] She used pieces of existing classical music, rewriting them so that she had two versions of each piece for each experiment. During the experiments subjects listened to a variety of different pieces, and for each piece chose the cluster of adjectives best representing their emotions. Hevner interpreted her results by laying them out in circular diagrams based on the clusters. Figure 2 illustrates the results she found for tempo and pitch:

[2] The six structural aspects are tempo, mode, pitch, rhythm, harmony, and melody.

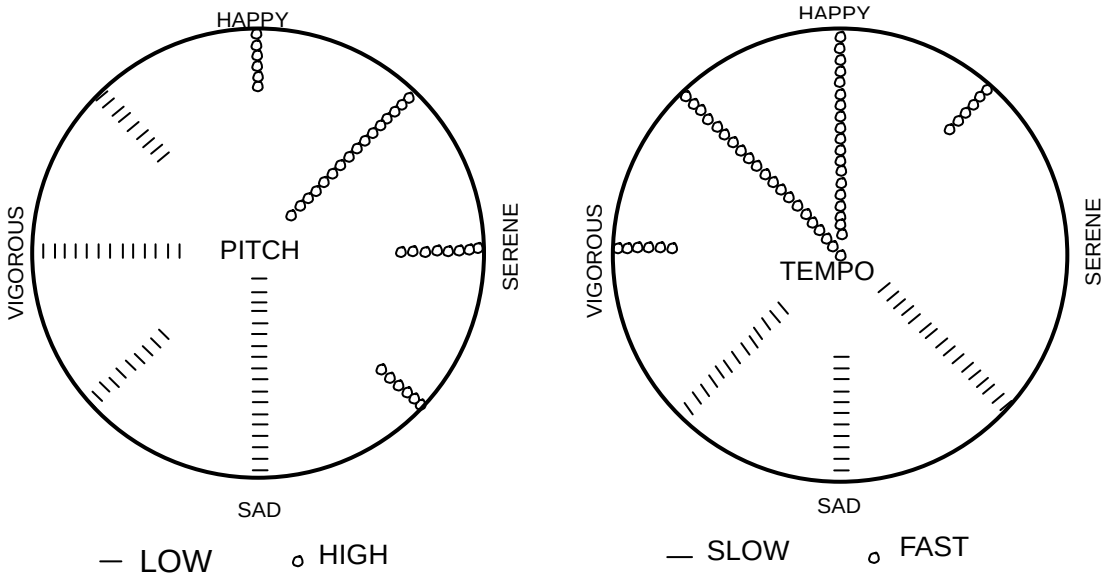

Figure 2. Hevner's Circle Representation of Results ([4] p. 624)

As is exhibited in these figures, Hevner's results showed marked divisions within the circle regarding where certain structural aspects had effects. For example, it is clear that a dividing line runs through the pitch circle from the upper left corner to the bottom right, representing the place where emotions switch from being represented by high pitch to low pitch.

2.2. The Circumplex Model of Emotion

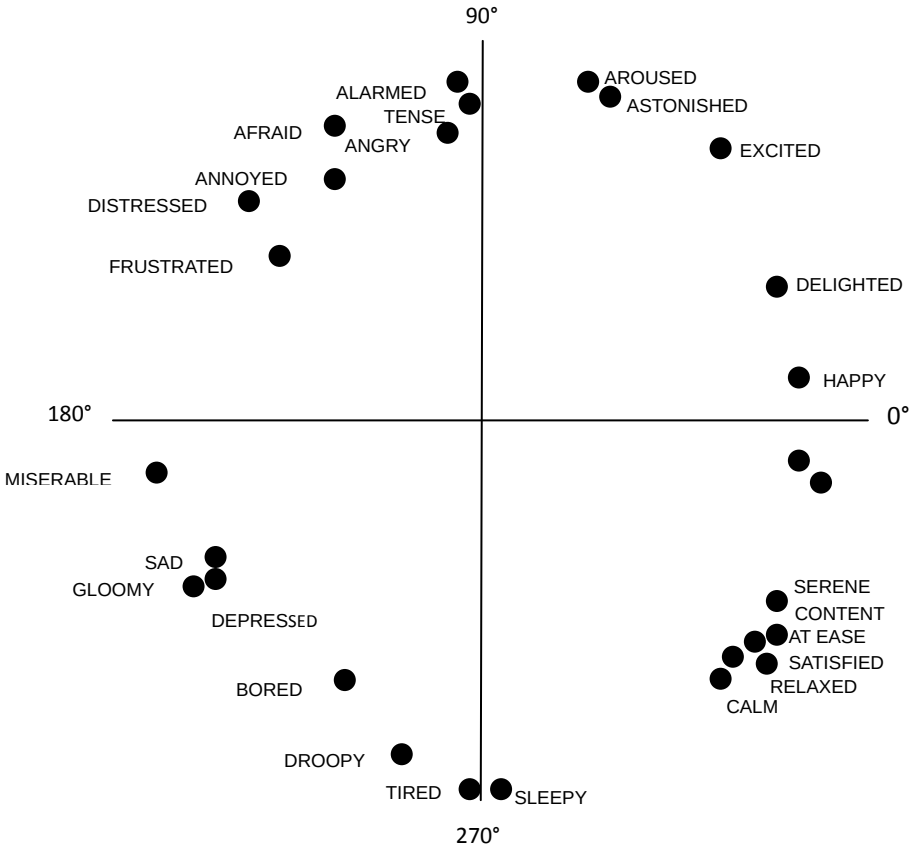

Figure 3. Russell's "Circumplex Model of Affect" ([5] p. 1167)

The idea of using a circular model to describe the range of human emotions was first introduced by[15], and has since been expanded by others. The main concept behind the model is the belief that emotion is best represented in two dimensions: as a combination of level of arousal (on the y-axis) and level of pleasure(on the x-axis).[5] demonstrated this result empirically by looking at how people conceptualized and described emotional states.

In the experiment participants took categories of emotions and grouped them in a circular fashion such that words on opposite sides were opposite feelings and words near each other were similar. Russell's results were presented on a diagram reproduced in Figure 3. The length of the vector from the origin to each point represents the degree to which the test subjects agreed on that location for the emotion in question. A point located a distance of 1 away from the origin would mean that 100% of subjects located that emotion at that location. The values obtained in Russell's study ranged from .71 to .97, showing a high level of agreement among subjects.

The "circle" illustrated in Figure 3 is, theoretically, continuous. One can describe a unique emotion at every point of its circumference.[3] Furthermore, Hevner's work shows that a location on the circle can be induced by a specific musical structure. Because her musical adjectives line up well with the emotional adjectives used by Russell, matching each emotion with its related musical elements is straightforward. For example, the "sad" point on the circle, according to Hevner, could be achieved with music with a slow tempo and a low pitch. By conducting the same comparison with all of Hevner's circles, a specific list of characteristics could be found toelicit the emotion desired for the advertisement.[4]

3. The Circular Location Model

In this section we apply location theory to determine the optimal musical choices in firms' advertisements given three important claims of the previous sections:

1. Human emotions can be mapped in a continuous fashion around a circle.
2. Musical characteristics can be combined to evoke particular, targeted emotions.
3. Music in advertising is more effective if the mood induced by the music matches the nature of the product.

From claims 1 and 2 we assume that by selecting a musical style in its advertisement, a firm chooses a corresponding emotion on the circle. From claim 3 we assume that consumers are distributed around the circle according to a single-peaked distribution, with the point of highest density located at the emotion most suited to the product. (Variance around this point would depend on the heterogeneity of consumer preferences.) If prices are equal and low enough, consumers purchase the product whose music-emotion is closest to their own location. With these characteristics in mind, we utilize the model developed in[6]to analyze the firms' strategies.

In that model consumers are distributed around the perimeter of a circle according to a symmetrical, single-peaked distribution function. All firms are allowed only one location, which they choose simultaneously, and there is no entry.There are no fixed costs. Prices are fixed andequal(and greater than marginal cost), and the entire market is assumed to be covered. That is, consumers buy the product closest to their location, no matter how far away that might be. If firms choose the same location, they split evenly their total market share. Each firm's best response is always to choose the location that maximizes its market share.Results describe firm behavior in and out of equilibrium, and are summarized as follows:

1. Equilibrium can only exist with one or two firms.If there is one firm, any location constitutes an equilibrium.Equilibrium with two firms is characterized by both firms locating at the point of highest density.
2. Even if there are more than two firms, and therefore no possible equilibria, each firm's optimal location is always at, or right next to another firm's location.

While the first characteristic describes the only possible equilibrium outcomes, there is no reason there must be one or two firms in the market. The second characteristic is perhaps more usefulin that it describes any firm's optimizing behavior in the many instances no equilibrium exists. That is, to maximize its market share, and therefore its profits, a firm should never locate far from other firms. This implies that we should expect to see agglomeration.Also, because firmsalways wish to secure the greatest market share, their best responses would have them leapfrogging each other to corner(or perhaps share) the largest number of consumers. Disproportionally large open market shares should be exploited. While there is no equilibrium, firms following their best responses would agglomerate in such a way that market shares are equal, and this would necessarily mean the clusters are balanced around the point of highest density.

[3] We acknowledge that for emotions to truly form a circle, the "intensity" of the emotions must be fixed; otherwise it would be possible to locate within or outside of the circle. This is a simplifying assumption we choose to make, so that we may compare amongst emotions, and not amongst differing intensities of the same one. An extension to the model could examine differentiation through intensity, or through the dimensions of both intensity and the particular emotion.

[4] It is understood that the quality, or "likability", of the music is not accounted for here. We must assume that the firms use music of equal quality, which perhaps comes at a fixed cost. Interestingly, the HBR case, "Polyphonic HMI: Mixing Music and Math"[16] reports on the company Polyphonic HMI, which purports to be able to use its "Hit Song Science" technology to predict the popularity of music based on mathematical analysis of its characteristics. If so, then perhaps the likability of music could be modeled as well.

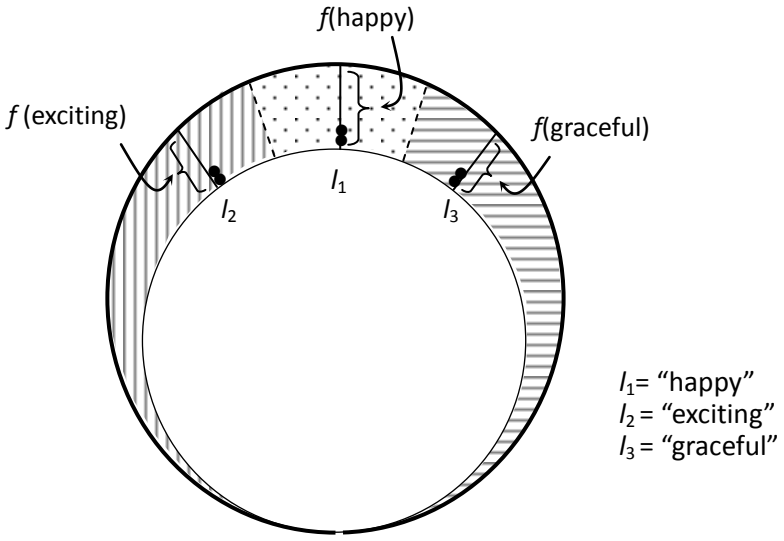

Figure 4. The Emotion Circle Distribution for a "Happy" Product

The direct implication in the present context is that for companies wishing to incorporate music into their advertising, they should target an emotion that corners the largest number of consumers. For example, in the market for candy, the most obvious choice may be to have "happy" music. However, if any firms already use happy music, it would best for some firms to migrate from that point and choose either more "exciting" or more "graceful" music. Additionally, it appears that firms will "balance" the market symmetrically around the type of music that is most effective. Thus, a cluster of firmswould wind up deviating as much as their competitors from the peak location, anddo not go disproportionately far on the opposite side of the circle. According to Figures 1 and 2, "exciting" and "graceful" are symmetrically located on both sides of "happy," whereas "vigorous" would be farther away.This balancing implies that firms should choose locations around the most effective emotion in such a way that demand is segmented evenly.

Figure 4 illustrates with an adaptation of a figure from[6]. Consumers are distributed around the inner circle according to a single-peaked distribution *f*, and a consumer's location depicts the musically-induced emotion that is ideal to attract that consumer to purchase this particular product.The distance from a point on the inner circle to the outer circle represents the density of consumers at that location. The peak density occurs at "happy", meaning that this is the emotion most closely associated with this product.

In this diagram there are six firms, with twoeach located at l_1, l_2, and l_3. (Because there are six firms this cannot be an equilibrium. It is snapshot to illustrate the optimal location of a seventh firm.) The firms at l_1 have chosen music to induce the emotion "happy", the firms at l_2 have chosen "exciting", and the firms at l_3 have chosen "graceful". Prices are equal, so consumers purchase the product from the "closest" firm. The firms at $l_1$therefore splitthe market share equal to the dotted area, the firms at l_2 split the area with vertical lines, and the firms at l_3 split the area with horizontal lines. Should another firm now choose its optimal location, it should first determine which of the three occupied locations has the greatest adjacent market share, and then locate just next to it to corner that share. For example, if the dotted area to the left of "happy" is the greatest of the market shares, the firm should choose "happy-inducing" music, but perhaps with a slightly faster tempo to marginally increase the level of arousal. That would locate the firm slightly to the left of l_1, thereby cornering the greatest possible market share.

4. Conclusions

The goal of this paper was to illustrate a novel and practical application of a circular-location model to music-emotion theory. Many firms use music in their advertisements to attract consumers, and evidence shows that the musical characteristics can be chosen to elicit specific emotions in listeners. It has also been shown that emotions can be mapped in a circular fashion, so by choosing a style of advertising music, a firm is effectively choosing a location on the emotion circle. This paper used a known circular-location model to describe firms' optimal locations around the circle. Findings were that firms following their best responses would likely cluster symmetrically at and around the emotion most suited to the product.

Additional research can be done to test the validity of the predictions made here and to consider extensions. It would be telling to study the patterns of music found in various industries' advertising to determine if there is a spectrum as described here. From there, one could examine which industries see the greatest overall success from their advertising and whether or not it is related to the pattern of music choices among competitors.Furthermore, the model could be adapted to include firms using more than one type of music, or entry by competing firms.

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