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A Mathematically-Based Technique of Matching Music to Food to Affect the Culinary Experience

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Abstract

Musical Pairing® is a method of matching music to food using a simple mathematical formula. The pairing is accomplished by assigning a numerical value to the components of a meal and then finding a musical match of equal value. Music that is properly paired with food should enhance the enjoyment of a meal. In this study, 67 respondents of various ages and genders were evaluated to assess the influence of various types of music on the enjoyment of their meal. Statistically significant results at $p<.01$ showed that specific music selections increased the enjoyment of food and produced a difference in the perception of flavors.

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Introduction

It is well established that the different senses can affect the perception of taste. Historically, the focus of study in taste psychophysics [1] has been the relationship of the sense of taste with vision [2], smell [3], and touch [4]. More recently there has been interest in the interaction between taste and hearing [5-7].

Musical Pairing® is a method of matching music to food using a simple mathematical formula. When matched, the result is a heightened enjoyment of your meal. The concept was developed and first published in book form by Barbara Werner in 2013 [8, 9]. In the 2013 book Musical Pairing The Art of Harmonizing Music to Your Meal and Musical Pairing The Art of Harmonizing Music and Beverages With Your Meal, the full process of Musical Pairing is described. See Appendix A for details of the basics of finding the food pairing number in the musical pairing.

Musical pairing is based on three interrelated hypotheses. The first is that music can influence how food is perceived and appreciated. The second is that a simple mathematical formula can define this relationship (Musical Pairing®). The third is that this knowledge can be used to enhance (or detract from) the enjoyment of a meal.

The present study tests the validity of these hypotheses by observing if one can alter the dining experience by manipulating the music according to the Musical Pairing algorithms.

Musical Pairing is accomplished by using a mathematical technique of evaluating food by assigning a numerical "weight" (or "value") to the components of a meal and then finding a musical match of equal value. Music that is properly paired with food will enhance the enjoyment of a meal while music that does not match can be neutral or even detract from the dining experience.

Years of manufacturing and production requirements in the food industry have resulted in products that have inherently less sharpness of flavor [10]. The use of additives, such as salt and chemical seasonings, has gradually increased to compensate for this lack of flavor. Using this Musical Pairing technique, heightened enjoyment of a meal can be accomplished with music. This implies that one could potentially reduce the reliance on other additives or externalities.

In the iteration of Musical Pairing described in this paper, the selected foods are evaluated first, and assigned a food pairing number. Music, whose mathematical value has been identified and catalogued, is matched to the food.

Musical Pairing Algorithm

In the Musical Pairing algorithm a numerical value is assigned to both the food and the music based on four criteria to determine its 'weight'. Lighter foods are matched with lighter music and heavier foods with heavier music. In the study, all of the music was matched to the food prior to service of the meal. See Appendix B for details on the parameters used to find the Music Pairing Number (MPN).

"Weight" of Food

The entrée is weighted and assigned a food pairing number from 0 to 5 (FPN) for each of the following four components:

- Protein
  - The density of the primary protein. Denseness is defined as the approximate compactness of the muscle mass of meat or fish when cooked.
    0 = Flesh Fish, 1 = Shellfish, 2 = Chicken, 3 = Pork, 4 = Beef,
    5 = Lamb/Game
- Sauce
  - The content of dairy and flour of a sauce as defined by the five 'Mother Sauces' [11].
    0 = None/Citrus & Oil, 1 = Bechamel, 2 = Veloute, 3 = Espangole,
    4 = Hollandaise, 5 = Tomato based
- Cooking Method
  - The amount of fat that is added to a dish based on the method of cooking.
    0 = Raw,1 = Poached/Sous Vide, 2 = Grilled, 3 = Roasted/Baked,
    4 = Sauteed, 5 = Deep Fried
- Spice
  - The spice level, esp. the level of salt and capsaicin.
    0 = No Discernible spice or salt, 1 = Some salt noted, 2 = salt and spices noted, 3 = heat noted, 4 = very noticeable heat, 5 = heat, salt or spice overpowering other flavors

The food pairing number (FPN) is calculated by adding the numerical values of each of these components. We then find an equivalent number in music. Note that other parts of the meal i.e., the appetizer, dessert would be evaluated using different components.

'Weight' of Music

The Musical Pairing Number (MPN) can be found in every genre of music, so the desired genre should be selected first.

The weight value of the music is based on:

- Tempo as defined by beats per minute and beats per measure.
  - The quicker the tempo, the lower the musical pairing number.
    0 = > 300 bpm, 1 = 200 – 299, 2 = 100 - 199, 3 = 90 - 99 bpm, 4 = 80 – 89 bpm, 5 = <80 bpm
- Instrumentation.
  - In an instrumental piece the weight of the primary instrument is assigned a value based on pitch. Stringed instruments with a higher pitch would be assigned a lower numerical value then a piece that is primarily percussion or with a lower tone. As it has characteristics of both percussion and strings, the piano has its own numerical category.
    1 = Stringed Instruments, 2 = Woodwind, 3 = Piano, 4 = Brass, 5 = Percussion
- Vocal Component.
  - In music with a vocal component, the assignment is based on the frequency of the vocal range (i.e.: Soprano is a higher frequency and therefore would carry a lower number then a Baritone or Bass vocal) [12].
    0 = Soprano, 1 = Mezzo Soprano, 2 = Contralto/Countertenor, 3 = Tenor, 4 = Baritone, 5 = Bass

- Dynamics.

○ The dynamics are recorded as the number of sudden changes in tempo and amplitude. The less crescendos and changes in amplitude, the lower the numerical value.

0 = No Dynamics, 1 = Changes in amplitude alone. 2 = Dynamics noted in the chorus, 3 = Occasional dynamics in the melody, 4 = Shifts in tempo and amplitude throughout the piece, 5 = Sudden and constant changes in amplitude and pitch.

By adding the values of each of these components, we can find the Musical Pairing number (MPN). When the Food Pairing Number (FPN) is equal to the Musical Pairing Number (MPN) the result is a greater perception of flavor and an elevated dining experience.

MP Formula Weighting of the Food (FPN)

Protein	Density of the flesh of the meat
Sauce	Type of sauce (flour + dairy)
Cooking Method	Added fat during cooking
Salt/Spice	Level of Noticeable Capsaicin

After selecting preferred genre weighting of the Music (MPN)

Tempo	Beats per minute/measure
Primary Instrument	Pitch
Vocal	Frequency (soprano 1, bass 5)
Dynamics	Tempo changes + amplitude

Method

Twenty, five-course Musical Pairing dinners were conducted over the course of one year in four states. At each sitting, there was a minimum of twenty adult guests. One hundred surveys were sent to random participants of the dinner. Sixty-seven surveys were completed and returned. The participants in this study consisted of 31 men and 36 women of varying ages (from 21 to 75) with different economic and ethnic backgrounds.

Ten guests from the initial dinner were sent additional surveys at 3, 6 and 12 months after their initial experience, to gauge the length of the musical pairing effect.

During the dinner, each of the dishes was first sampled without musical accompaniment to establish a baseline and familiarize diners with the taste. Two different music samples were then introduced while diners tasted the same dish again. In one, the food pairing number and musical pairing number were equal. In the other, they differed by a minimum of three points. The sequence was reversed for the different courses. In all cases, the attendees did not know if the music and food were paired or were of unequal value ($\Delta \geq 3$).

To eliminate the influence of the power of suggestion, the host/proctor did not reveal the numerical values of either the music or the food and care was taken not to introduce the music as “ones that will match” or “ones that will not match”.

The delivery method of the music was through headphones, so that other noises and distractions were kept to a minimum. The headphones were of similar style, size and pre-set volume for each diner.

Controls

All dinners were held in chain steakhouses to provide consistency of ingredients, quality and grades of meat and fish, consistency of spice and spice level, equipment and cooking methods. All steaks were cooked to the same temperature (medium) which was kept constant by pre-set corporate standards.

Diners were served a pre-fixed menu that had been mathematically weighted. Music was also pre-selected.

Musical memory occurs when people have a strong association with past music inspired memories. To mitigate the influence of musical memory [13, 14] biases on guests, music of different genres were used during the dinner.

In order to eliminate short term music memory, diners were distracted with stories and comedic entertainment between courses as a mental palate cleanser. This was done between each course so that focus could be renewed for each dish.

All music was delivered via interconnected headphones. Each headphone was of similar quality and level of noise cancellation. There were two manufacturers used; "We Are Frends" and "Sol Republic." There was no noticeable difference between groups using either type of headphone.

Controls to limit the influence of other senses on the enjoyment of the meal were taken as follows:

Taste: No salt or other seasonings were made available on the tables. All meat dishes were cooked to medium temperature and kept consistent through the corporate controls set by the steakhouse management.

Sight: As the perception of flavors can be enhanced by intensifying colors [9], care was taken to ensure that dishes were uniform in appearance, with no exceedingly bright or vibrant colors on the plates and all serving dishes and dinner plates were solid white with no colored or embossed borders

Smell: To avoid conflicting aromas throughout the dinner, a ten minute waiting period was given between courses to allow any lingering odors from the previous dish to dissipate.

Touch: Dishes were selected which did not have vast differences in texture and the food was eaten with a knife and fork.

Hearing: Historically, research on the influence of hearing on taste has focused on the benefits it has on digestion or to categorize the effect of the sounds we make while eating [15]. To diminish the effect of 'eating sounds', dishes were selected that did not have extreme or noticeable crunch (i.e. raw carrots, etc.) which might distract the music selections.

Results

These tests show that music can impart both positive and negative effects on a diner's enjoyment of his or her meal.

One hundred surveys were given to guests. Of the 67 respondents, 62 (93%) reported a noticeable increase in the enjoyment of a dish when properly paired with music using the Musical Pairing algorithm. In contrast, 54 (81%) noted a decrease in the enjoyment and quality of the same dish when music with unequal values were introduced, although this latter effect was not statistically significant (Table 1).

There was a statistically significant difference in the flavors of a dish when certain music selections were introduced (93%). There were also a significant number of attendees who felt that music affected the dining experience for a period of time after attending a musical pairing dinner (93%). Although prior to attending the diner, a majority of participants felt that music could affect the dining experience, this percentage was not statistically significant (Table 1).

Table 1: Effects of Musical Pairing

Effects of Musical Pairing			
100 Surveys	Responses 67	Percent 67%	p-Value*
During the Musical Pairing Experience did you feel that certain music selections increased the enjoyment of a dish?			
Yes	62	93%	p<.01
No	5	7%	
Did you feel there was a difference in the flavors of a dish when certain music selections were introduced?			
Great difference	42	63%	p<.01
Noticeable difference	18	27%	
Slight difference	2	3%	
No difference	5	7%	
During the Musical Pairing Experience did you feel that certain music selections decreased the enjoyment or quality of a dish?			
Yes	54	81%	NS
No	5	7%	
Not sure	8	12%	
Before coming to the dinner, did you feel music can affect the dining experience?			
Yes	41	61%	NS
No	6	9%	
Never thought about it	20	30%	
After attending a musical pairing dinner, do you feel that music can affect the dining experience?			
Yes	62	93%	p<.01
No	3	4%	
Not sure	2	3%	
Has the music in a restaurant or bar ever made you leave or not return?			
Yes	60	90%	p<.05
No	7	10%	

Key to Statistics

1. P<.01. One tailed z-score z=2.66 testing that at least 80% of people felt music affected their culinary experience.

2. P<.05. One tailed z-score. Z=2.05 testing that at least 80% of people felt music affected their culinary experience.

3. NS = not statistically significant at p<.05

Discussion

Musical pairing is based on three interrelated hypotheses; that music can influence how food is perceived and appreciated, that a simple mathematical formula can define this relationship, and that this knowledge can be used to enhance (or detract from) the enjoyment of a meal. The present study supports the validity of these hypotheses by showing that one can alter the dining experience by manipulating the music according to the principles of Musical Pairing.

Using follow-up surveys at 3 month, 6 month and 12 month periods, the lingering 'musical pairing' effect appears to be most prominent immediately after the event, slowly dropping after 6 months. Since the musical memory displayed in our study can last up to a year, a person's future dining experiences can potentially be affected.

Five additional dinners (100 additional guests) were conducted at non-chain restaurants and another ten tests were held at outdoor events where the music was introduced over loudspeaker and public address systems. These meals were not included in the current study, but data collected at these events were consistent with the above results.

The focus of the present study has been on the entrée portion of the meal. In practice, the Musical Paring algorithm has been equally successfully when applied to appetizers and desserts. Confirmation of this will be the subject of a future study.

Although beyond the scope of this study, it is known that certain medical treatments can adversely affect the palate. Chemotherapy is one striking example, as this may produce both a biologic and psychologic (conditioned) response to food that can persist post-treatment. Proper pairing with music may aid these patients in obtaining sufficient nutrients and calories by counteracting the negative side effects of their medical treatment on their enjoyment of food. This could be an interesting area of further research.

This study shows that in everyday culinary experiences numerically paired music and food can increase the enjoyment of a meal. Other areas of study have been considered, such as an evaluation of the effects of musical pairing on the perception of saltiness. This might be useful for patients on restricted sodium diets.

If the association of positive effects of music on food is a learned behavior and taught at an early age, it may be possible to influence the eating habits of children with music selections rather than by using salt and chemical additives. Further, if music is introduced in a reward system, it may be a helpful technique to induce children to stay at the dining table longer and may even be able to influence their food choices.

Among the five guests who did not notice any discernible difference while listening to music at our dinners, there may be a commonality among them which warrants further study. Guests who are admittedly tone deaf seem to be immune to the influences of hearing on taste. Likewise, those who do not regularly pay attention to flavors in food (those who are self-described as "eating to live" rather than "living to eat") on our surveys and admittedly do not ordinarily take any special enjoyment from foods, did not appreciate the effect of Musical Pairing on their dining experience.

Interestingly, one of the male participants, a non-responder, related that he was also not susceptible to hypnosis as measured in the Stanford Hypnotic Susceptibility Scale. This is another area of possible research.

Conclusion

This study shows that one can manipulate the sense of taste and perception of flavor with music. Using the numerical values of the Musical Paring algorithm, this manipulation can be used to either add or detract from the enjoyment of one's food.

While the initial intent of the Musical Pairing technique was simply to enhance the enjoyment of a meal, the potential applications extend well beyond this limited use. The investigation of the psychological and neurological underpinnings of these results would be one important area to pursue.

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Disclosure: The investigators hold equity interest in Musical Pairing, Inc.

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