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ARTICLE

Musical Preferences Correlate Architectural Tastes: An Initial Investigation of the Correlations Between the Preferred Attributes

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ABSTRACT

Despite a large number of discussions on the analogical and technical interrelations between architecture and music, very few studies have looked at the interrelations between the appreciations of the attributes among them. This study investigates the correlations between the preferences of architectural and musical attributes to reflect how they generally interrelate with each other. The considered visual qualities related to architectural forms are symmetricity, complexity, rhythm, pattern, and stress; and the considered musical attributes are related to the main four categories of Genres, perceived psychological attributes, five factors of music, and 3-Factors (arousal, valence, and depth). To discover the correlations, at first, a survey was designed to gather individual appreciations of the attributes. The responses were then filtered to remove the invalid ones before Pearson's correlation coefficient analysis unveils the relationships between every single considered attribute. In total, 5,184 correlations have been thoroughly explored, and a number of strong correlations were discovered and discussed in a classified manner; for instance, rap-followers showed higher satisfaction to asymmetrical building façade. This study also confirms some musical attributes are stronger reflectors of architectural taste, like rap, jazz, sophisticated, poetic music. Lastly, this paper confirms the significant effects of demographic attributes on the discovered correlations.

Keywords: Architectural preferences; musical taste; preference correlations.

1 Introduction

The reciprocal impacts of architecture and music have a long background. It dates back to Ancient times when both architecture and music had a number-based structure (Bandur, 2001). After the translation of sound into geometry, influxes of pleasant proportions in architecture and harmonic proportion in music took place over the Renaissance (Imaah, 2004); the application of complex rhythm and excessive decorations happened during the Baroque period (Kilicaslan & Tezgel, 2012). Not only the interrelations are not limited to a special era, but the method and essence of interrelations by the emergence of electronic technology have reached to an advanced level. Therefore, many philosophers' and specialist's quotations in different ages reflect the robust interrelations between architecture and music, including Schopenhauer, Xenakis, Steven Holl, Le Corbusier, John Cage, Daniel Libeskind, Miles Davis, as well as Goethe who famously called architecture as 'frozen music'.

Music is an analogical inspiration source and even translatable art for architectural forms. The formal relationship can be as overt as the translation of musical images into architecture, like the architecture department at Hefey University of Technology in the form of a piano instrument, Bloch city, by Peter Cook representing music staffs (Fowler, 2017). The interrelations can be more covert, otherwise in-depth, like the analogical similarities between the structure of Miles Davis's jazz and warping system of Gehry, ribbons of Hadid, superimposed shaped of Eisenman, and parametric architecture of Schumacher, as Michael E.

Veal believed them as mirror image of each other (Veal, 2014). Similarly, Toronto Music Garden by Yo-Yo Ma and Messervey is a spatial translation of Bach's Cello Suit #1 in G Major (Brown, 2014), and adversely, the trace of the Japanese garden Ryoanji exists in the non-intentional compositions of John Cage (Whittington, 2013). There are many theoretical and discursive shared terms among them such as shape, form, modularity, rhythm, proportion, distance, height, balance, weight, interval, and proportion, which all can be a root for the interrelations. For instance, the architectural proportion of Florence Cathedral dome by Brunelleschi in the Nuper Rosarum Flores music piece by Guillaume Dufay (Trachtenberg, 2001), (Warren, 1973). More in-depth multilateral interrelations exist in the technical translation of music into architectural forms; Steven Holl formed Stretto House based on the Bartok's Music (Holl, 1996), (Holl, 2017) and Xenakis directly transformed Metastasis into hyperbolic parabola shapes of Polytope in the pavilion of Brusseil (Xenakis, 2008) (Fowler, 2011). Finally, many architectural theorists have advocated the use of structural elements from music (Barnstone, 2015), and great masters of architecture continue to make use of musical concepts in architectural composition.

Among the interrelations, some concepts in one discipline are being considered as peer attributes in another one either in discourse or practice, like musical interval and architectural proportion, as well as time in music and either space or span/distance in architecture (Xenakis, 2008) (Baker, 1996). Many attempts have been done to find the theoretical or technical interrelations, while no study discusses the psychological effects of the shared attributes. Does technical translation of satisfactory proportion in architecture results in pleasant musical harmonies? Despite the existence of rhythm in both architecture and music, is there any correlation between the individual preferences of apparent rhythm in architecture and satisfaction of rhythmic music? This study, as a pioneer investigation, concerns the correlation between the preferences of architectural and musical attributes, instead of more technical or analogical interrelations. It focuses on the in-common building features and musical attribute and aims to explore the correlations between the attribute preferences, to discover how they correlate each other, with regards to the individual's appreciation.

2 Methodology

A two-sectioned methodology explores the correlations between the preferences of the focused musical attributes of architectural features. At first, the focused attributes are defined and the individual preferences of the attribute as the raw data are gathered; then after purifying the data, Pearson's correlation coefficient analysis discloses the correlated attributes.

2.1 Defining attributes and gathering raw data

The considered architectural attributes and method of gathering data are fully based on the previous investigations. Tayyebi and Demir, after introducing a systematic method to extract visual attributes and analyzing more than 200 diverse building forms, reflects the most in-common visible attributes(Tayyebi & Demir, 2019). On its basis and as a limitation of this study, the main focused attribute categories are (i) *symmetricity* concerning the axial symmetricity in building facade, (ii) *complexity* reflecting the sophistication degree of the form, (iii) *rhythm* as the repetition of the architectural elements, (iv) *pattern* that exists in the building forms that structurally constitute by organized repeated elements, and (v) *stress* concerning the emphasized direction by the elements or structural lines in its formal structure.

Each architecture attribute category contains some values, reflecting formal qualities. Symmetricity covers three attributes: *symmetrical* (fully symmetrical buildings), *partially-symmetrical* (some symmetrical elements in an asymmetrical building forms), and *asymmetrical* buildings (apparent asymmetrical formal concept). Complexity as another category has three attributes within: *simple* (buildings with a limited number of elements and without any sophistication in its composition), *moderately-complicated* (building with some formal sophistication), and *complicated* (sophisticated building forms which mostly have a large number of constituents). Rhythm focuses on repetitive solid elements in building forms instead of tiny elements like

windows dividers; it contains two values: *rhythmic* (conspicuous repetitive elements in formal elements) and *partially-rhythmic* (having a trace of rhythm in smaller-size elements). Pattern focuses on formal structure and covers two modes of pattern: *regular* (existence of predictable order in organizing the constituent elements) and *irregular* (covering the buildings formed by randomly-organized elements). And finally, stress concerns the formal emphasis on *horizontal* or *vertical* directions. Every single building has its individual attributes among these five categories; samples of these attributes exist in Appendix 1, provided as a supplementary file. Please consider some attributes may not be fully identifiable in the illustrated smaller size images.

Higher number of participants in correlation-related studies increases the credibility of the investigation and validity of the acquired outcomes. Accordingly, to increase the number of participants, questionnaire is the main method of gathering the raw data. Various questioning methods could reveal the building attribute preferences like discursive based inquiry, image-based questions, or even extracting their opinion based on the attributes exists in building forms. A recent paper of the authors explored 8 different methods of extracting the personal preferences of building attributes; on its basis, extracting the attribute preferences can be acquired reliably by analyzing the rates of a set of building images. That is to say, participants only need to rate some building images, then the rates are assigned to all the visible attributes of the buildings; finally, the average of each attribute's rate is assumed as the satisfaction rate of the attribute. Accordingly, some building images are selected in a way to have each attribute questioned multiple times in different building forms. The utilized building images in the survey and their assigned attributes are presented appendix 1. Consequently, to extract the personal preferences, participants merely rate the building façade via a bi-polar Likert scale, with 7 values; building attribute preferences of the participants are analyzed accordingly.

Selecting the considered musical attributes has been done on the basis of the previous studies. Based on a review paper which expresses how musical taste has been generally investigated (Tayyebi, Demir, Nemutlu, & Karadoğan, 2020), there are four main determinant categories that reflect our musical tastes. (I) *Genre* as the first identifier of our musical taste exists in numerous preference-related studies (Buskirk, 2015; Lopes, 2018; Schäfer & Sedlmeier, 2009). Many theoreticians criticized genre by being an assigned label instead of concerning the actual musical attributes (Greasley & Lamont, 2006; Lippens, Martens, & De Mulder, 2004; McKay & Fujinaga, 2006) accordingly (II) The perceived musical attributes, also called as Perceived Psychological Attributes (PPA), emerged as a reflector of our music preferences like Greenberg and his colleagues who discussed about 38 attributes including happy, sad, intense, mellow, etc. (Greenberg et al., 2016). In addition, there are some classification attempts to reflect musical tastes, like four music groups Rentfrow and Gosling (Rentfrow & Gosling, 2003). The most widely used category in musical taste studies is the (III) *five-factor model* (FFM), reminding the big five models of personality. The FFM model, known as MUSIC called after their acronyms, divides the music pieces into five categories: Mellow (M-Type), Unpretentious (U-Type), Sophisticated (S-Type), Intense (I-Type), and Contemporary (C-Type) (Rentfrow, Goldberg, & Levitin, 2011). And lastly, there is another recently developed categorization based on the perceived attributes. After years of investigations on musical appreciation, Greenberg and his colleagues organized 38 psychological attributes of music into 3 dimensions, called here as (IV) *3-Factor*: Arousal (energy level of the music), Valence (sad to happy emotions in the music) Depth (the sophistication and emotional depth in the music) (Greenberg et al., 2016).

Accordingly, there are four main categories for the musical attributes: Genre, PPA, FFM, and 3-Factor. The correlations between individual preferences of genre and FFM categories are already investigated; accordingly, the individual taste on each FFM type can be discovered by the correlated genres (Rentfrow et al., 2011). Thus, for each attribute of the FFM category, 2 prevalent genres with the highest correlation rates are selected, to both be considered in the genre category and reflect the FFM attributes preferences, including M-type (soul/R&B, pop), U-type (country, rock, and roll), S-type (classic, jazz), I-type (heavy metal, rock), and C-type (rap, electronica). Consequently, in order to extract the personal preferences of the

genres and FFM attributes, the participants just rate the ten musical genres, then the FFM attribute preferences are analyzed accordingly.

Similarly, each attribute of the 3-factor class has 2 values: positive and negative, or high and low; in fact, there are 6 attributes in the 3-factor category. 3-factor is like the summary of PPA, and the correlations between each factor and the perceived attributes are already investigated by Greenberg and his colleagues (Greenberg et al., 2016). Based on their study, for each positive value 3 strongly-correlated perceived attribute, and for each negative value 2 correlated perceived attribute are focused. Finally, 15 PPA are selected to show both participants' opinion about the attributes and reflect their opinion about the 6 values in the 3-factor category. The 3-factor attributes, and focused correlated PPA are: positive arousal (intense, forceful, aggressive), negative arousal (mellow/gentle, calming), positive valence (happy, fun/joyful, lively), negative valence (depressing, sad), positive depth (sophisticated/complex, inspiring, poetic/deep), negative depth (party music, dance-ability). Finally, participants rate 15 psychological attributes via a five-based Likert-scale spectrum, then their opinion on the 3-Factor attributes will be extracted accordingly.

Consequently, a survey as the main method of gathering raw data is prepared by some demographical questions, 34 building images, 10 genres, and 15 PPA of music. The prepared survey is the designed and distributed online via Question-Pro platform. The participants are asked to cooperate the study voluntarily by filling the survey, while their responses were all anonymous and confidential.

2.2 Analyzing the data

The analysis is divided into three sections: (i) extracting the individual preferences of the architectural and musical attribute; (ii) applying some limitations to skim the reliable responses; (iii) analyzing the correlations between the preferences of architectural and musical attributes. Figure 1 shows the analysis procedure graphically to attain a more holistic understanding of the process. Concurrently following the procedure through the graph and explanation of the phases in the subsequent parts can facilitate its perception.

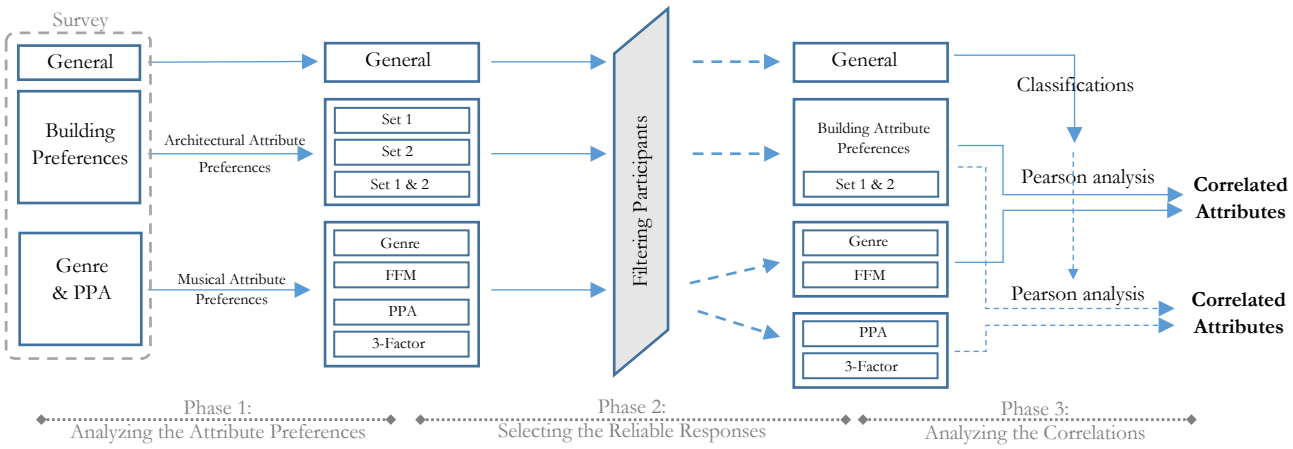

Figure 1: *Diagram of the analysis procedure*

Regarding the survey-based essence of this study, the split-in-half method examines the reliability of the answers and distinguishes the genuine answers; it means, preferences of each attribute are analyzed 2 times. Then, comparing the outcomes can distinguish sincere answers from the invalid responses. Thus, building images are prepared in two sets, as presented in appendix 1, and participants rate the buildings uninformed and randomly. In order to extract the building attribute preferences, as briefly discussed, the buildings' rates are assigned to their attributes, then the average of each attribute preferences considered as the final satisfactory rate of every single attribute. This method extracts the architectural attribute preferences from each set of architectural images. Since among the reliable responses concerning all images in the preference extraction analysis increases the accuracy of the results, for every participant, another set of attribute preference is also extracted based on the whole building images. Thus, as figure 1 shows, for each

participant, three sets of attribute preferences are obtained by the analysis of the first set of images, the second set of images, and all images. For the music part, 10 genres and 15 PPA do not need further analysis, as directly questioned, while the preferences of FFM and 3-factor attributes need to be extracted from the interrelated genre and PPA rates respectively. Thus, the satisfaction range of the attribute in FFM and 3-Factors are analyzed by averaging the correlated attributes, which are discussed earlier. Both architectural and musical attributes are extracted in Microsoft Excel via code writing in Excel Developer.

Section 2 aims to filter the participants based on their responses, to eliminate the inaccurate raw data and excerpt the reliable one. Whereas having a sincere answer takes more than 5 minutes, as the first selection criterion, the participants with the fewer completion time are eliminated. For the architecture part, comparing the outcome of the first and the second set of the building images – split-in-half method – is the main source of filtering the invalid responses. Those participants who their average distance between the outcomes of the first and the second set of images were more than 1.5 are erased; this initial but significant criterion skims most of the unreliable responses, and significantly increase the internal validity of the study. Besides, participants with an average discrepancy of less than 0.2 are also omitted; they were too good to be true. Verifying their answers shows that these people rate the buildings mostly similar; accordingly, the attributes' satisfaction ranges are eventually extracted similarly. The standard deviation (SD) of the discrepancy between the data can also reflect some other invalid responses, though the average of the differences was within the acceptable range; having high SD means the outcome were almost correct for some attributes and disparately wrong for others. Despite its covert essence, considering these people in the correlation analysis could affect the credibility of the study outcome. Thus, as another filtering criterion, participants with SD of the discrepancy more than 1.5 are also erased. Consequently, after skimming the reliable responses, the outcome of all images analysis is considered as the reference of the satisfaction rate of the attributes of the selected participants (Fig. 1).

Valid responses in architecture part do not suffice a reliable correlation analysis; respondents should also have answered the music part properly. As the first filtering criterion in music part, participants must have rated at least 5 out of 10 genres to be regarded as a valid respondent. Since considering the neutral participants could weaken the strength of the discovered correlations, participants with the range of preference less than 2 are neglected. For example, if a participant rated all the genres as 4 or 5 (preference range = 1), he/she would be eliminated from the valid respondents. Similarly, for the PPA part, a valid respondent must have rated at least 10 attributes with the preference range of 2 or more. Worth-noting, since the genre and PPA rates reflect the preferences of FFM and 3-factor attributes, there is no further filtering criterion; valid responses of genre and PPA means reliable preference rates for the FFM and 3-Factor attributes.

From 1100 participants, after applying all the filtering criteria, around 650 responses were valid enough for the final correlation analysis. Regarding the fact that there is no relation between genre and PPA in the analysis part, we had this opportunity not to apply both genre and PPA filtering concurrently. At first, we can filter general issue, architecture part, and genre to analyze the correlations between architectural attributes and either genre or FFM. Then, applying filters on general issues, architecture part, and PPA can excerpt the reliable responses to analyze the correlation between architectural attributes and both PPA and 3-factor attributes. In this case, the number of participants increases from 650 to 819 people for genre/FFM, and 728 people for PPA/3-factor correlation analysis. Consequently, as figure 2 presents, 2 sets of data attained for the correlation analysis, with 819, and 728 respondents. All the filtering criteria applied to the database via Microsoft Excel filtering command; afterward, 2 sets of participants' responses are prepared for the analysis phase.

After establishing clear sets of attribute preferences, in the third section, the correlations are then analyzed by Pearson's correlation coefficient analysis. It discovers the correlations between two sets of independent variables, without concerning the causality of the relations. Accordingly, regardless of the reasons, the

analysis shows the possible correlations between architectural and musical attribute preferences. Please consider, Pearson analysis has no unit. Having the values in a 5-based, 7-based, or even percentage grading system has no effects on the correlation outcome; as far as the proportions of the value sets are kept the same, the outcome of the Pearson analysis would be untouched. Thus, although participants rate musical instrument via a 5-based Likert scale and architectural image via a 7-based scale, the analysis reflects the correlation among the attributes flawlessly.

Apart from the whole participants, various classifications applied over the correlation analysis, to discover probable correlations among special categories. As figure 2 shows, the general demographical questions including gender and age are applied in the classification of the participants in the analysis section. Apart from the gender-based classes separating males and females, the participants' ages are divided into three categories: *young adults* including all participants under the age of 25, the *middle-aged adults* including 25-45 referred to as middle-aged, and the *mature adults* which cover all participants over 45, referred briefly here as mature. Finally, the correlations are analyzed in 12 categories: all, males, females, young, middle-aged, mature young male, middle-aged males, mature males, young females, middle-aged females, and mature females. The demographic of the two sets of participants in 12 categories are presented in table below.

Table 1: *Participant Demographics of the two studies across the 12 categories*

1st Study: Correlation between Architecture and Genre/FFM	All	Male	Female	Young	Middle aged	Mature
	819 (100%)	**230** (28%)	**589** (72%)	**139** (17%)	**393** (48%)	**287** (35%)
	Young Males	Middle aged Males	Mature Males	Young Females	Middle aged Females	Mature Females
	32 (4%)	**103** (13%)	**95** (12%)	**107** (13%)	**290** (35%)	**192** (23%)

2nd Study: Correlation between Architecture and PPA/3-factor	All	Male	Female	Young	Middle aged	Mature
	728 (100%)	**211** (29%)	517 (71%)	**120** (16%)	**356** (49%)	**252** (35%)
	Young Males	Middle aged Males	Mature Males	Young Females	Middle aged Females	Mature Females
	27 (4%)	**101** (14%)	**83** (11%)	**93** (13%)	**255** (35%)	**169** (23%)

Consequently, correlations between 12 architectural attributes, and 36 musical attributes within 12 different participant categories (altogether 5184 correlations) are analyzed in Microsoft Excel. VBA code writing in Microsoft Excel developer is the only analyzing tool, automatically done this huge amount of calculations. Although the correlations are analyzed in 2 different sets of the attribute, the analysis outcome is presented together.

3 Analysis Outcomes and Discussion

Pearson correlation coefficient analysis demonstrates the existence of correlations via p-value reflecting the statistical validity of the correlation and r-value reflecting the strength of the correlation. Regarding the fact that in the analysis, 0.05 is mostly considered as the p-value critical point, correlations with p-value > 0.05 are considered as statistically invalid. Then among the valid correlations (p-value < 0.05), higher r-value reflects the stronger correlation. In this study, p-value and r-value of every single correlation within 12 classifications are analyzed and the r-values of the statistically valid correlations are tabulated in appendix2, presented as a supplementary file attached to the manuscript. As an overview, figure 2 gives a general insight into the correlation between all the considered attributes. In the graph, background color of each cell reflects the number of statistically valid correlation; the darker greenish shows the higher number of

correlations with p-value < 0.05. The size of the midpoint dot shows the number of strong correlations (r-value > 0.25). In brief, the darker the background color and the bigger dot reflects stronger correlations between the attributes.

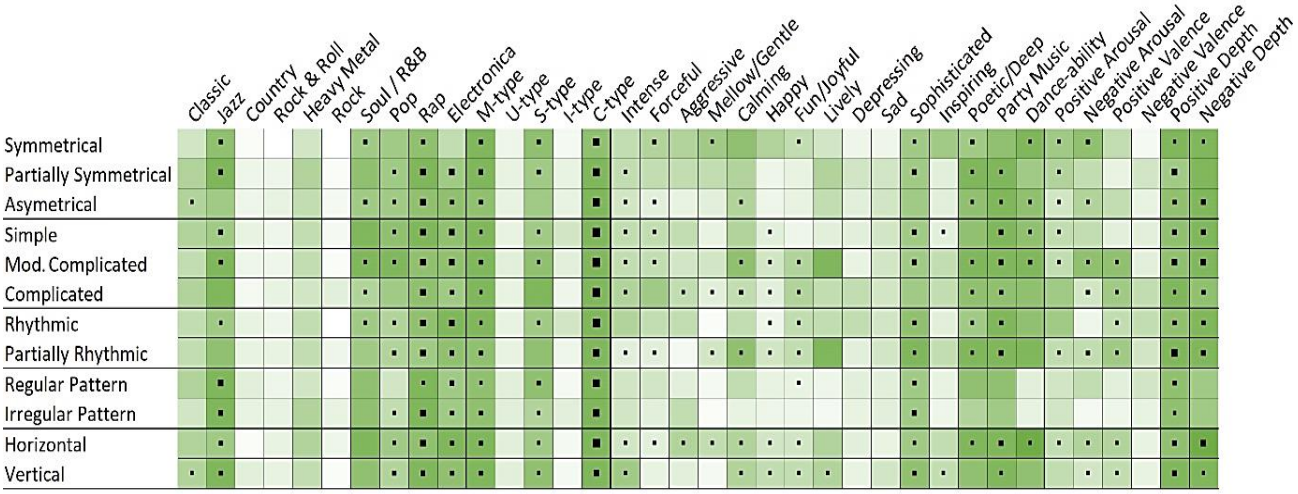

Figure 2: *Overview on the Correlations between the Attributes; darker color = higher number of valid correlations among the 12 categories (p-value < 0.05); bigger dot-size = higher number of significant correlations (r-value > 0.25).*

As figure 2 shows, some musical attributes are more correlated with the architectural attributes, and they are like a better distinguisher of architectural attribute preferences. For example, jazz, rap, electronica among the genre category, M-type and C-type among the FFM, sophisticated, poetic, and party music among the PPA, and positive and negative depth among 3-Factor attributes demonstrate higher number of correlations; they are more likely to provide a better reflector of architectural tastes. Otherwise, the architectural attributes generally reflect almost similar number of correlations with musical taste. Consequently, in contrast to architectural attributes, preferences of some musical attributes are better reflector of individual architectural taste.

The subsequent parts discuss the stronger correlations between the attributes in a classified manner. The discovered correlations are organized in 4 sections based on architectural attribute categories, and the correlation between the architectural attribute and all musical attribute categories are discussed accordingly. Please consider correlation indicates to a reciprocal relationship between the attribute preferences; to prevent tedious repetitive discussions, the correlations are mostly explained concisely in one way. Furthermore, to reflect the correlations more succinctly, a slash sign separates the attributes having similar correlation trends.

3.1 Symmetricity

Figure 3 shows the significant correlations (r-value>0.3) between architectural symmetricity and four categories of musical attributes, Genre and FFM on the left, and PPA and 3-Factor on the right. Among the M-type of music and its interrelated genres including soul/R&B and pop, there are positive correlations between the soul/R&B/M-type music and symmetrical buildings for young females, and asymmetrical buildings for the middle-aged females. It reflects that among the fan of soul music, young females would be more satisfied with symmetrical architectural forms, and middle-aged females would be more interested in asymmetrical forms. In addition, the negative correlation between pop/M-type and partially symmetrical buildings reflect that it is more likely to find a young male fan of pop music less interested in partially symmetrical forms.

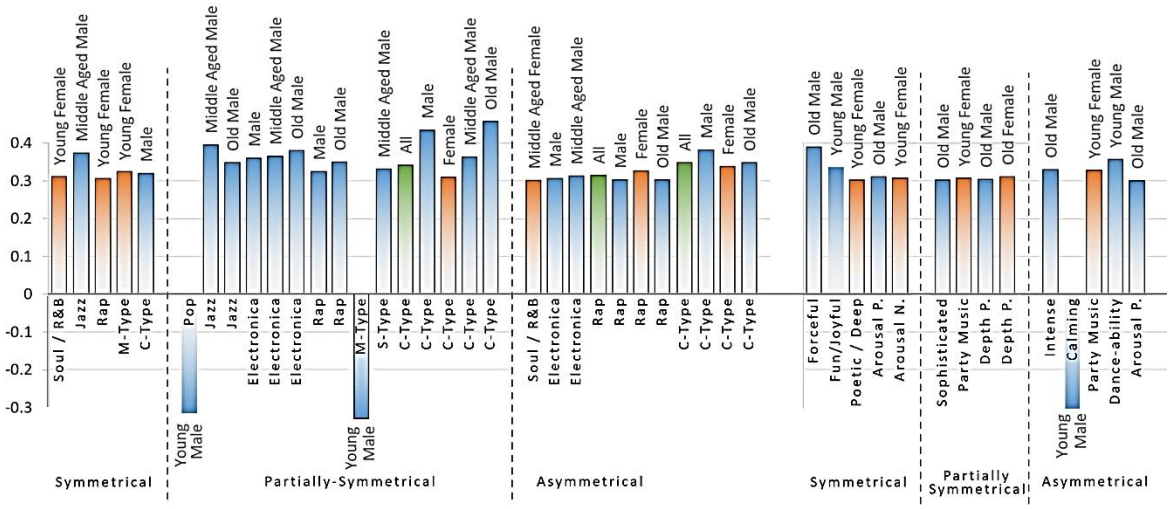

Figure 3: *Preference Correlations between Architectural Symmetricity and Musical Attributes (r-value > 0.3)*

S-type, classic, and jazz music are more correlated with partially and fully symmetrical buildings. Among the middle-aged males, there are positive correlations between the preferences of jazz and symmetrical/partially-symmetrical, as well as S-type and partially-symmetrical buildings. In addition, there is a positive correlation between the preferences of jazz and partially symmetrical forms between mature males. It shows that higher preferences of more sophisticated music among the middle-aged or mature males may reflect higher satisfactions for the symmetrical/partially-symmetrical building forms.

The C-type music and rap/electronica reflect higher number of correlations with architectural taste, especially in partially-systematical and asymmetrical attributes. Although it seems that among the males, preferences of C-type may reflect the satisfaction of symmetrical forms, participants in males, females, all, middle-aged males, and mature males' categories show a much stronger correlation between the preferences of C-type and partially-symmetrical/asymmetrical building forms. Correlation between the preferences of rap and asymmetrical forms among the all, males, females, and mature males, confirms that it is more likely to find a rap-follower interested in a-symmetricity in architectural forms. Generally, rap-followers seem to be more interested in asymmetrical building façade.

Concerning the positive arousal attributes and its related PPA, there are positive correlations between forceful/ positive arousal music and symmetrical buildings among mature males; in addition, they show a positive correlation between intense/positive arousal music and asymmetrical buildings. Thus, higher preferences of forceful/intense/positive arousal music for mature males may reflect higher satisfaction of either fully symmetrical or apparent asymmetrical forms. In similar trends, the negative correlation between the calming music and asymmetrical forms among the young males show that higher preferences of asymmetrical forms may reflect less satisfaction for calming music with negative arousal feature.

Among the valence-related attributes, although there is a positive correlation between the preferences of fun/joyful music and symmetrical architecture among the young males, they reflect a stronger correlation between the preferences of asymmetrical forms and dance-ability music. Similarly, among the young females, preferences of party-music shows reflect higher satisfaction for partially symmetrical and asymmetrical architectural forms. Thus, in general, preferences of party and dance-ability music may reflect higher preferences of asymmetrical and partially symmetrical building forms among the young people.

Lastly, among the depth-related attributes, the positive correlation between positive depth music and partially-symmetrical forms show that among the mature males and mature females, higher preferences of positive depth may reflect higher satisfaction for partially-symmetrical forms.

3.2 Complexity

Figure 4 illustrates the correlations between architectural complexity and Musical Attributes. Correlations between jazz and simple forms among the middle-aged males, and mature males, as well as S-type and simple/moderately complicated forms show that the preferences of jazz and s-type may reflect higher satisfaction for moderately complicated and especially simple building forms, among the middle-aged males; their architectural taste is more inclined toward simpler building forms.

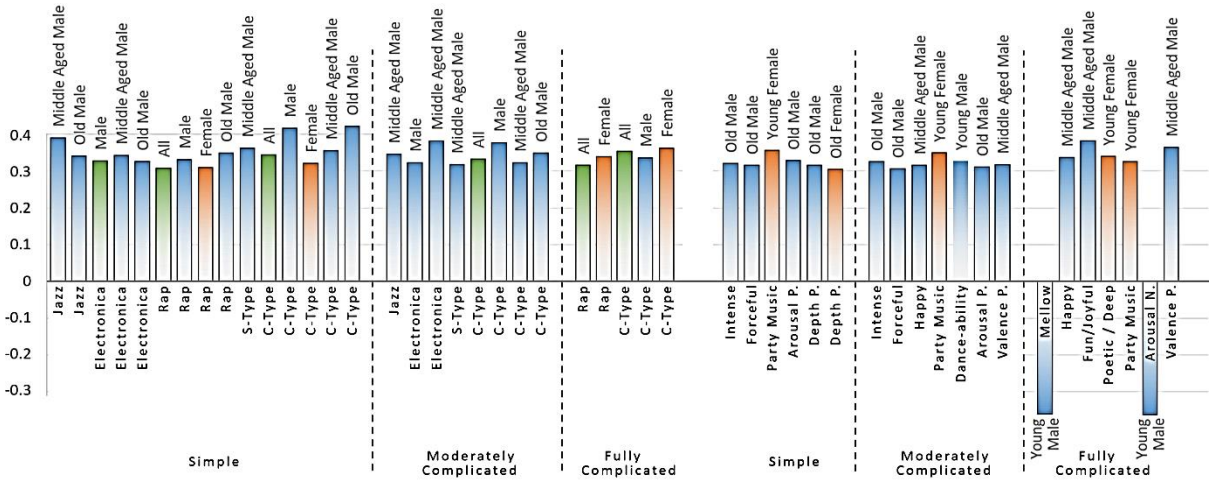

Figure 4: *Preference Correlations between Architectural Complexity and Musical Attributes*

High number of correlations between rap/electronica/C-type and all complexity levels shows that fans of the C-type music had a more positive opinion about building forms in general. Followers of electronica music especially among the male, middle-aged male, and mature male, are more likely to have a positive opinion about the simple and moderately complicated building forms; the male electronica followers tend simplicity in architectural forms. Otherwise, rap followers show higher satisfaction for both simple and fully complicated forms; males are more toward simple building forms, while females would be more satisfied with a highly complicated formal structure. All in all, among those who have a more positive opinion the c-type music in general, simple and fully complicated building forms seem to be more appreciated; males are more likely to be interested in simpler building forms, and females would be more satisfied with a fully complicated formal structure.

Among the arousal and interrelated attributes, as figure 6 shows, there are positive correlations between simple/moderately complicated buildings and intense/forceful/positive arousal music among the mature males; the more they like intense/forceful/positive arousal music, the more they would be interested in simpler buildings forms. In contrast, young males show negative correlation between mellow/negative arousal and fully complicated building forms; it means, not being interested in mellow music, may reflect higher preferences for highly complicated building forms, which seems to be an in-contrast with mature males who would be interested in simple buildings if they are interested in intense music.

As figure 4 shows, the existence of positive correlation between party music and all level of complexity shows that, in general, the younger females rated the party-music, the more they rated building forms; in another word, young females would rate buildings higher if they have more positive opinion about the party music in general. Otherwise, positive valence and fun-joyful music show a stronger correlation with the complicated building form among middle-aged males. The more they like party music, the more middle-aged males would be interested in a high level of complexity in building forms.

Lastly, positive depth music is more correlated with simpler building forms among the people over 45 years old; higher satisfaction for deep music for mature people, either males or females, may reflect higher preferences of simple building forms.

3.3 Rhythm and Pattern

There are negative correlations between soul/R&B/M-type music and rhythmic architectural forms among the young males. It means young males who prefer mellow music pieces in the soul genre would be less satisfied by the existence of rhythm in architectural forms. Otherwise, middle-aged males Jazz-followers reflected higher preferences to rhythmic buildings forms as well as regular and irregular patterns in the formal structure of a building. The more they like jazz, it is more likely to find them satisfied with the existence of apparent rhythm as well as pattern in building forms.

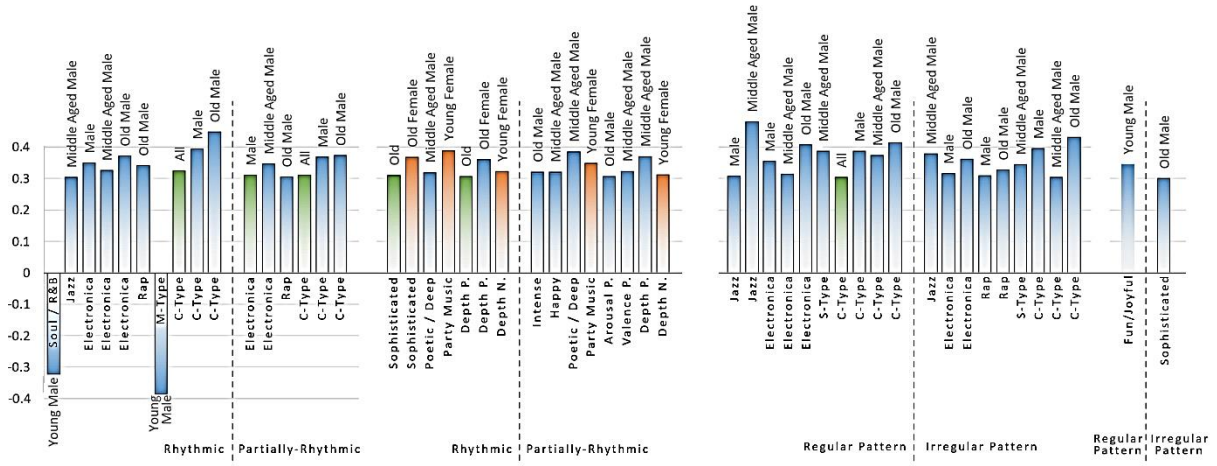

Figure 5: *Preference Correlations between both Rhythm and Pattern in Architecture and Musical Attributes*

Similarly, the large number of positive correlation between rap/electronica/C-type and both rhythm and pattern among the males especially over 25 years old confirms that the more males be interested in rap, electronica, and c-type music, it is highly probable to a strong tendency toward the existence of pattern and rhythm in architecture reflecting obvious repetition of elements; interestingly, it may be interpreted as the existence of the same trend of preference between the apparent audible beats in music and visible beats via formal elements in architecture.

The correlations between the attributes related to arousal and valence are very limited. There are just a few positive correlations between positive arousal / intense music and partially rhythmic buildings among the mature males. It means, if mature males are interested in a trace of rhythm in architecture, they can be more interested in intense and positive arousal music. The positive correlation between the positive valence and partially rhythmic architectural forms shows that the more middle-aged males, like positive happy music in general, the more they would be satisfied with the existence of rhythm in smaller formal structures. Besides, as the presented correlations show, preferences of party music for young females may reflect higher satisfaction for partially rhythmic architectural forms. They all show that partially rhythmic building forms may be a reflector for the higher satisfaction of happier and more energetic music pieces, among the middle-aged males, and mature males, and young females.

On the other hand, rhythm and pattern correlate more with the trace of depth and complication in music. Preferences of positive depth music show higher satisfaction for rhythmic buildings among the mature females; while for young females show a positive correlation between the preferences of negative depth and the existence of rhythm in architecture. Young females who are interested in negative depth music, with a low level of complexity, would be more satisfied with rhythmic architectural forms. Thus, mature females would be more interested in rhythm in architecture if they are interested in positive depth music,

while young females would be more satisfied with rhythm if they have a tendency toward the negative depth music pieces.

3.4 Stress

Figure 6 illustrates the correlations between formal stress as the last architectural attributes and all musical attributes. A glimpse over the graphs shows the strongest negative correlations exist between pop/M-type music and vertically stressed buildings among the young males. Young males who like pop music would dislike vertically stressed buildings.

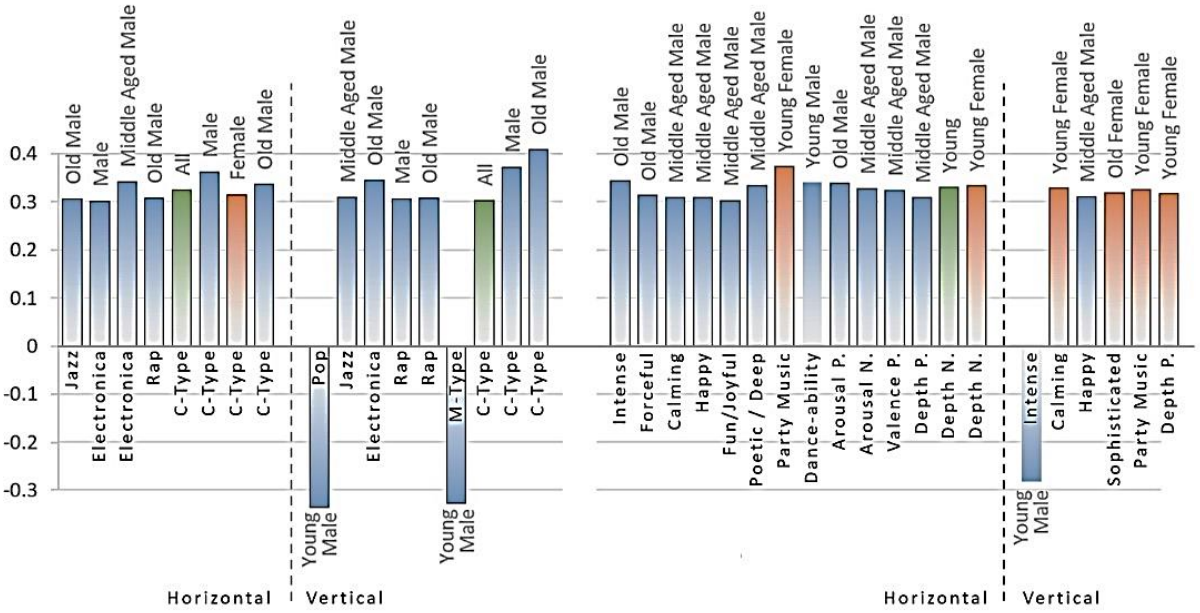

Figure 6: *Preference Correlations between Building Stress and Musical Attributes*

There are positive correlations between jazz and horizontal among the mature males, and jazz and vertical among the middle-aged males. The preferences of jazz may reflect higher satisfaction for horizontally-stressed building forms among the mature males and vertically-stressed building forms among the middle-aged males.

There are positive correlations between rap/electronica/C-type music and both types of stress in architectural forms among all participants especially males. It may reflect that higher preferences of the mentioned music attributes, can reflect the satisfaction probability for the existence of stress in architectural forms, in contrast to neutral architectural forms. Otherwise, males, especially mature males, show a tendency toward the verticality, and females show a tendency toward the horizontality in building forms if they are interested in rap/electronica/C-type music pieces.

Among the perceived attributes, there are positive correlations between horizontally-stressed buildings and intense/forceful/positive arousal music among the mature males. In addition, young males show a negative correlation between intense music and vertically stressed building forms. Thus, both for young and mature males, the more they like intense music, the more they would be interested in horizontally-stressed buildings. On the other hand, there are positive correlations between calming/negative arousal and horizontality in buildings among the middle-aged males; it means, those who like mellow and sedentary music, they would be more interested in horizontally stressed buildings, arising a sense of peace and stability. While young females who like calming/negative arousal music interested more in vertically stressed building forms.

There are positive correlations between fun/joyful/happy/positive arousal music and horizontality in building forms among the middle-aged males; it means while middle-aged males are satisfied with happy and fun music, they would be more interested in building forms possessing stress in horizontality.

Among the attributes related to music depth, preferences of poetic/deep/positive depth music may reflect higher satisfaction of horizontality in building forms among the middle-aged males. While mature females show higher satisfaction for vertically stressed buildings if they are interested in sophisticated music pieces. On the other hand, young females show some correlation between party / negative depth music and both horizontally and vertically stressed buildings. Higher rates of music pieces with a low level of depth for young females may reflect higher satisfaction for the existence of stress in building forms, either horizontally or vertically.

4 Conclusion

Consequently, analyzing more than 5000 correlations demonstrates the existence of various interrelations between the preferences of some architectural and musical attributes. As an overview, the number of valid correlations shows that the preferences of some musical attributes are stronger reflectors of architectural attribute tastes. For example, preferences of rap, jazz, M-type, C-type, sophisticated, poetic, and in-depth music can reflect better the preferences of some architectural attributes. Furthermore, different preference trends among the 12 considered categories confirm the substantial influence of the demographical attribute on the correlations. Not only the trace of age and gender apparently exists in the discovered correlations, in some cases, different demographical categories reflect in-contrast trends. Thus, for both preference correlation exploration and their application, concerning the demographic classes of the participants are a must. Finally, although all the discovered correlations, either statistically significant or insignificant, are indeed the outcome of the paper, a selected list of the stronger correlated attributes pertaining to architectural symmetry, complexity, rhythm, pattern, and stress can be summed up here. Across the correlations related to architectural symmetry, generally speaking, rap-followers are more interested in asymmetrical building façade. Among the fan of soul music, young females would be more satisfied with symmetrical architectural forms, and middle-aged females would be more interested in asymmetrical forms. The young males who like pop music are less interested in partially symmetrical forms. Across the correlations related to architectural complexity, preferences of jazz and s-type reflect higher satisfaction for moderately complicated and especially simple building forms, among the middle-aged males. Across the correlations related to architectural rhythm and pattern, the young males who prefer mellow music pieces, like soul music, are less satisfied by the rhythmic architectural forms. The middle-aged male jazz-followers reflected higher preferences to rhythmic buildings, as well as both regular and irregular patterns in the formal structure of a building. And lastly, across the correlations related to architectural stress, the preferences of jazz reflect higher satisfaction for horizontally-stressed building forms among the mature males and vertically-stressed building forms among the middle-aged males. Higher preferences of the rap/electronica/C-type music types reflect a higher satisfaction. Consequently, this initial investigation confirms the presence of a correlation between the preferences of some architectural and musical attributes. Thus, apart from the technical and analogical interrelations between architecture and music, the illustrated correlation between the preferences of the attributes can be the root of much more interrelated projects and further investigations in the future.

5 Appendices

Appendix 1 & 2 file is available at URL: https://journals.aijr.in/index.php/ajss/article/view/2665/342

6 Competing Interests

The authors declared that no conflict of interest exist in this work.

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