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Preference Tendencies for Musical Instrument Sounds

Andreau Rau†, Yukari Shirota♠

A musical instrument is one of the most significant universal communication tools, and the sound of such instruments could be a universal language. One of our areas of particular interest is capturing children's responses to different cultures. An interesting study would examine ways of teaching these differences at an early age by gauging young children's reactions to different musical cultures. Currently, we are trying to establish preference tendency analysis methods, which are essential for this research. Through these methods, we would like to investigate regional tendencies in preferences, if such tendencies could be found. For the analysis method, we have selected the conjoint analysis method. Thus, we conduct sound preference conjoint analysis using the sound model. In this paper, we will present our first conjoint analysis results of preference tendencies regarding musical instrument sounds.

1. Introduction

A musical instrument is one of the most significant universal communication tools, and the sound of such instruments could be a universal language. One of our areas of particular interest is capturing children's responses to different cultures. Many people from a Western culture are familiar with Western/European musical idioms and sounds but are not particularly familiar with Eastern/Asian idioms and sounds. On the other hand, many people from an Eastern/Asian culture are familiar with Eastern/Asian musical idioms and sounds, but are not particularly familiar with Western/European idioms and sounds. An interesting study would examine ways of teaching these differences at an early age by gauging young children's reactions to different musical cultures. A more ethnographic study might be conducted to determine how early in life musical cultures are embedded within a child's likes/dislikes. This is our ultimate research goal [1].

Currently, we are trying to establish preference tendency analysis methods, which are essential for this research. Through these methods, we would like to investigate regional tendencies in preferences, if such tendencies could be found.

This research requires an information model of musical instrument sounds and an analysis method for preferences. However, to the best of the authors' knowledge, no research has been reported in these areas. Thus, Shirota had to start making the information model from scratch [2, 3]. For the analysis method, we have selected the conjoint analysis method. Thus, we conduct sound preference conjoint analysis using the sound model. In this paper, we will present our first conjoint analysis results of preference tendencies regarding musical instrument sounds.

2. Information modelling of the sounds of musical instruments

In this section, we will briefly explain the sound information model.

As the basis of the information model, Shirota proposed using Gunji's Systematics [4]. In Gunji's Systematics, a musical instrument is described by the following seven attributes, which are physical phenomena of sound generation: (1) Form of Vibrating Body, (2) Material of Vibrating Body, (3) Source of Vibration, (4) Application of Vibration, (5) Conversion of Vibration, (6) Form of Converting Part and (7) Material of Converting part.

Shirota has selected the three most important attributes of these seven: (A) Form of Vibrating Body, (B) Source of Vibration and (C) Application of Vibration [3]. As shown in Figure 1, the attribute Form of Vibrating Body has six values, and Source of Vibration has four values. These attributes were selected for use in the conjoint analysis.

The attribute Application of Vibration has three values: 'direct', 'indirect' and 'mechanical'. The value 'direct' means that the player's body is in direct contact

† University of Mannheim, Department. of Business Administration
♠ Gakushuin University, Department of Management, Faculty of Economics

with the instrument. The value 'indirect' means tools are used to play the instrument. For example, drums are divided into two groups, a direct-application group played with the hands and an indirect-application played with sticks or so.

The value 'mechanical' means that the player's action is transmuted into another action by means of mechanical equipment. Most typical mechanical-application instruments are keyboard instruments, such as pianos. Although no mechanical-application type drum exists, in future they might be invented.

As the fourth attribute for conjoint analysis, we add the attribute Attenuation, which shows whether the sound wave amplitude would be attenuated or could keep the continuation status. Percussion and plucking instruments have the attenuation value YES. On the other hand, friction and air current ones have the attenuation value NO. We consider these four sound attributes have the most effect on preferences.

In the first trial experiment, we focused on the combination of (1) Application of Vibration and (2) Attenuation. This is because the attribute Attenuation would be the most significant attribute and we wanted to survey the correlations of the two attributes concerning preferences.

3. Experimental methods

In this section, we will explain our experimental methods. First, we will explain conjoint analysis. Then we will present the difficulty encountered when we conducted the conjoint analysis for sound information modelling and its solution.

Conjoint analysis is a multivariate technique developed specifically to understand how respondents develop preferences for any type of object (products, services or ideas) [5].

We can say that conjoint analysis is a widespread preference analysis method. When we establish a valid model of respondent judgments, a critical occurrence that frequently happens is a correlation among attributes, which are known as interattributes. The presence of correlated factors denotes a lack of conceptual independence among the factors [5]. We must remove these dependencies among the factors.

First, when we tried to conduct conjoint analysis on attributes from Gunji's Systematics, we found some correlations among the attributes. Figure 1 shows the correlations between Form of Vibrating Body and Source of Vibration. This survey was conducted with the database of Gakkigaku Shiryôkan (Collection for Organology), Kunitachi College of Music in Tokyo.

The number in the table shows the number of musical instruments of each kind. Some cells are empty, indicating that no corresponding musical instrument exists; i.e. instruments with the specific value combination do not exist. For example, in an air current instrument, the vibrating body is a board shaped air only, and the other instruments can have any of the forms.

Consequently, because there are correlations between the Systematics attributes, we could not conduct conjoint analysis using the attributes of Form of Vibrating Body and Source of Vibration.

	Solid	Hollow solid	Stick	Board	String	Membrane
Percussion	4	39	13	74	18	75
Friction	0	5	6	3	63	0
Plucking	0	0	0	9	118	0
Air current	1	0	0	205	2	1

Figure 1. Correlations between Form of Vibrating Body and Source of Vibration (cited from [2]).

In conjoint analysis, the general solution to the interattribute problem is to create superattributes that combine the aspects of correlated attributes. In previous work, Shirota made superattributes for the selected four attributes. Thus, we focus on these two attributes in the analysis that follow (1) Application of Vibration and (2) Attenuation, we found no correlation.

From the two attributes of Application and Attenuation, six combinations (groups) were created (see Figure 2). We used a questionnaire to investigate preferences for these six combinations.

We will explain the questionnaire environment. The respondents were students on our campus. Since we wanted to investigate multicultural tendencies, we collected data as much as possible from foreign students on campus, although the respondents are mainly Japanese.

	Application	Attenuation	Samples
Group1	direct	YES	guitar(string), table(percussion), djembe(percussion)
Group2	indirect	YES	zither(string), wadaiko(percussion), talking drum(percussion)
Group3	mechanical	YES	celesta(percussion), grand piano(percussion)
Group4	direct	NO	alphorn, shakuhachi, nai (all air current)
Group5	indirect	NO	sarangi, hardingfele, lira (all string)
Group6	mechanical	NO	hurdy gurdy(string), bandoneon(air current), pipe organ(air current)

Figure 2. Six created conjoint groups (combinations) and selected representative musical instruments for the groups.

In general, it is difficult to select representative musical instruments for the groups. In addition, we must carefully select sound recordings so that the respondents can concentrate on and appreciate the sound itself. However, we cannot remove the influences of melodies, which affect the respondents' evaluation. The problem remains unsolved.

In this questionnaire, we used the CD titled 'Music and Instruments of the World' [6]. The CD offers the instrumental sounds of musical instruments from various cultures. The melodies are simple and the respondents listened to the sounds from HTML web pages. On the other hand, for celestas and grand pianos only, we used sound samples on Yamaha's web page (www2.yamaha.co.jp/u/naruhodo/index.html). These melodies are from masterpieces and are impressive.

Preferences were measured using only rank orders, not ratings (metric data). Respondents were asked to rank the six groups from one to six in terms of their preferences.

Because rank orders are used, Kendall's tau measure is calculated as the goodness-of-fit measure. The goodness-of-fit measure is used to evaluate the correlation between the actual preference orders and the predicted utility values.

4. Results

The conjoint analysis result for the entire data set was that the attribute Application has a higher importance level (61) than the attribute Attenuation (39). The first principal attribute was Application of Vibration. The part-worth estimates for the attributes were calculated as shown in Figures 3 and 4. A greater value of the part-worth estimate indicates a higher preference for the attribute value.

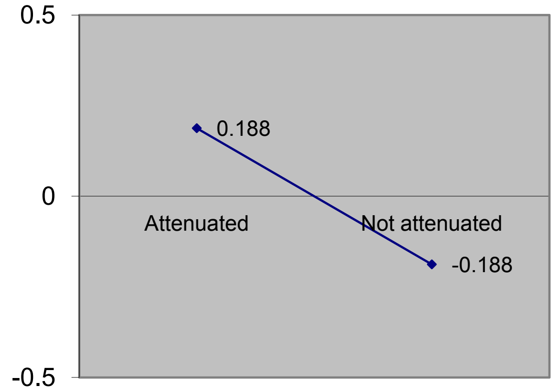

Figure 3. The part-worth estimates for Attenuation.

The most preferable combination was 'mechanical application and attenuated sounds'. However, the goodness-of-correlation using Kendall's tau measure was calculated to be 0.6. We do not think that the results are that reliable. In a sense, however, this may be the right result because the respondents consist of people from many countries.

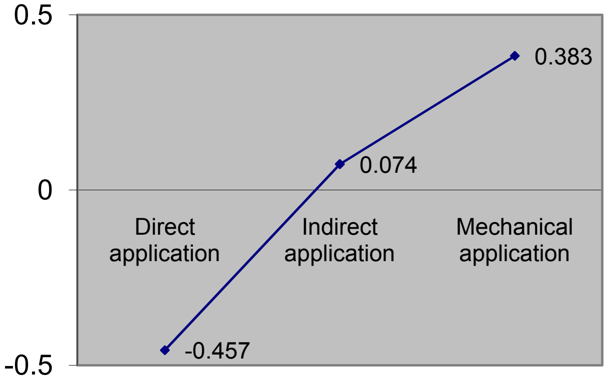

Figure 4. The part-worth estimates for Application of Vibration.

Next, let us examine the regional tendencies. Figure 5 shows the results of country-based analysis. We should not count on the results of countries with a small sample (less than four respondents). Among data from Japanese, Chinese and German students, the most preferable value of the application was mechanical, which agrees with the result for all the data.

Countries	Japanese	Chinese	Korean	Thai	German	English	French	Scottish	Total
number of respondents	33	4	2	1	4	1	1	1	47
attenuated	0.106	0.667	-0.167	0.5	0	1.5	-0.5	1.5	
not attenuated	-0.106	-0.667	0.167	-0.5	0	-1.5	0.5	-1.5	
direct appli.	-0.5	0	-0.5	-1	-1	0	1	0.5	
indirect appli.	-0.045	-0.25	1.75	0	0.5	0	0	0.5	
mechanical appli.	0.545	0.25	-1.25	1	0.625	0	-1	-1	

Figure 5. Country-based analysis results.

Years	19	20	21	22	23	24	25	26	28	much older	Total
number of respondents	3	13	11	4	3	1	4	2	3	1	45
attenuated	−0.389	0.141	0.076	0.167	0.722	−0.5	0.583	0.333	0.389	0.5	
not attenuated	0.389	−0.141	−0.076	−0.167	−0.722	0.5	−0.583	−0.333	−0.389	−0.5	
direct appli.	−1	−0.923	0.182	−1.125	−0.667	−1	−0.75	0.25	−0.167	1	
indirect appli.	1.333	0	−0.273	0.125	−0.667	−0.5	0.625	0.25	0.833	0	
mechanical appli.	−0.333	0.923	0.091	1.000	1.333	1.5	0.125	−0.5	−0.667	−1	

Figure 6. Age-based analysis results.

Finally, we present the age-based analysis results (Figure 6). The biggest two groups are the ages of 20 (13 students) and 21 (11 students). Ages 20 and 22 show that the most preferable application is mechanical. However, the result for age 21 does not show the same tendency; instead, the three values have similar low levels.

5. Conclusions

In the study, we presented experimental methods for analysis of musical sounds preferences. Using these methods, we examined regional tendencies of these preferences. The most preferable combination was ‘mechanical application and attenuated sounds’. However, the goodness-of-correlations using Kendall’s tau measure was calculated to be 0.6. We do not think that the results are that reliable. Among Japanese, Chinese and German data, the most preferable Application value was the mechanical one, which agrees with the result for all the data. The age-based analysis shows dispersion.

The conjoint analysis result for all the data was that the attribute Application has a higher importance level (61) than the attribute Attenuation (39).

Solely from this result, it is not possible to determine whether a general tendency exists and will require more examinations to do so. However, from this experiment we learned the following points for improvement. The most important point would be the selection of sound recordings. As a problem with this experiment, we noted a quality difference between the CD titled ‘Music and Instruments of the World’ [6] and Yamaha’s web page. The web page offers wonderful performances of great masterpieces of the grand piano and celesta. The respondents might be much more moved by these performances. On the other hand, the CD offers simple melodies only. Next time, we should select recordings of similarly impressive and wonderful performances.

Although we could not find satisfactory results from this experiment, the experimental precision will increase with repeated experiments. The preference analysis methods presented in this study could help to spark this type of sound preference research. We will also continue to investigate this topic.

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