

Title	ピアノ曲に対する情動分析を基にした音楽評価に関する研究
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Citation	
Issue Date	1997-03
Type	Thesis or Dissertation
Text version	author
URL	<a href="http://hdl.handle.net/10119/1065">http://hdl.handle.net/10119/1065</a>
Rights	
Description	Supervisor:堀口 進, 情報科学研究科, 修士

# Analysis of Music, based by Listening Impression to Piano Music

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February 14, 1997

**Keywords:** emotion, human performance, physical parameter in music, listening impression, adjective.

## 1 Introduction

In the last several decades we have made it possible to play the music by computer and it becomes easier than before. To add to it, audio-visual implements were in rapid progress, so that it became very popular to play the music automatically by computer. And researches to make music performance by computer close to human performance are carried out recently in information science. For example, a music performance system was made, which imitates performances of famous players, by analyzing data of the players performances and picking his/her characteristics up. For another example, by analyzing the structures of musical scores and tendencies of human performances, various rules of music are made and applied them to data of music scores to make emotional computer performance. These systems, however, have a lot of problems. The former needs data of each player and each performance, so that it may not be able to imitate lots of player's performances. And the latter will make a lot of rules and the number of rules will increase terribly. One of the reason why those systems need such a lot of data or rules is to find out rules for emotional computer performance depends on empirical knowledges, so we cannot know easily which rule is more effective.

These days some researchers carry out some works, in which they analyze the human's listening impressions and feelings with musics and try to make it clear what musical elements are very important. These researches will make it possible to select important and effective musical elements and rules without empirical knowledges. And in consequence the increase of data and rules will be prevented.

However, in those researches it didn't become clear yet what is the effective musical element, and the researcher were still using their empirical knowledge to explain their result of experiments.

In this study, we experimented on listening impression with "Semantical Difference Method", that is one of the methods for investigating our images to some targets by using "adjectives", and we also try to make the relation clear between musical elements and adjectives. And we also tried to analyze the results of our experiments by using multivariate analysis.

## **2 Experiments and Analyzing Listening Impression**

We call musical elements that we discussed in last section "physical parameter". We experimented with following way for investigating the relation between listening impression (i.e. adjectives) and physical parameter.

### **2.1 To estimate listening impression**

"Semantical Difference Method" is one of the methods for investigating our images by using pairs of "adjectives". In this method those pairs of adjectives are treated as measures in a psychological space. In experiments subjects evaluate some target by these measures. And to analyze the results of experiments, the measures of the psychological space will be arranged to a few measures by using multivariate analysis (e.g. factor analysis).

We adopted several adjectives not by pairs but as each adjective measure, for investigating properness of using pairs of adjectives.

### **2.2 To make musics for listening experiments**

In this study, we took up "local tempo(agogics)" and "velocity(dynamics)" as physical parameters and made several musics for experiments by changing values of these physical parameters. To put it concretely, we found meanings of each physical parameters and calculated differences between the meanings and each values of physical parameters. And we multiply the differences and some real numbers to make another differences.

### **2.3 Process of experiments**

We made musics by the procedure that we mentioned in the last section, and experimented with the musics. We make subjects to evaluate the musics by the measures of adjectives. The number of adjectives was 15 and each adjective had 5 levels. We treated each adjectives as each measures, because we consider that pairs of adjectives are not always pairs of opposite words.

## 2.4 Result of experiments

After the experiments we calculated averages of each musics by the value of all subjects. And we found that quickness, smoothness and naturalness are affected by “local tempo”, and heaviness has little relation to “local tempo”. We also found that smoothness and naturalness are also affected by “velocity” but quickness has little relation to “velocity”.

We investigated the properness of pairs of adjectives in previous article. We calculated correlation coefficients of those adjectives by average of each musics, and found that all pair of adjectives are not the pair of opposite words.

Next we tried to analyze the results by multivariate analysis for getting the images of psychological spaces. At first we used factor analysis for cutting down the number of measures. And we found that naturalness must affect the psychological spaces. Secondly we tried to express psychological space by multidimensional scaling, but we could not get meanings clearly.

We suppose that making musics by changing the values of physical parameters made some unnatural musics for subjects. The reason why those musics were listened unnatural by subjects is that almost all the subjects knew the music we used. We used “Fantasie-Impromptu cis moll Op.66” composed by Frédéric F. Chopin for the music of experiments. The result of questionnaire, only 3 percent of subjects answered they had never listened this music. And 61 percent of all the subjects answered that they often listened this music. This result means that they might listened the musics which we made stranger than ordinal performance.

## 3 Conclusion

In this study we tried to investigate the relation between listening impressions and physical parameters in musics. We made musics for experiments by changing values of physical parameters. We treated “local tempo” and “velocity” as physical parameters and experimented with them.

In this experiments, we could find that “local tempo” and “velocity” affect very much to listening impression. And we also saw that pairs of adjectives used in Semantical Difference Method are not always the pairs of opposite adjectives. We tried to express the psychological space by analyzing the values of musics, and we found that unnaturalness impression has influence to psychological space. From this result, we suggest that the well-known music is not suitable for experiment, because the music to which we added artificial changing let subjects feel strange. And the number of adjectives was not enough to investigate the listening impressions. But hence we cannot know the number of that and what adjective have to be selected, we’ll have to investigate space of adjectives. And to investigate by physiological side will be powerful explanation for this study.